BUILDING THE RESILIENCE OF IRANIAN HOSPITALS TO EARTHQUAKE & FLOOD DISASTERS

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DEDICATION

I dedicate this piece of research to my mother, my brothers and my late father.

DECLARATION

This thesis is submitted under the University of Salford rules and regulations to award a PhD degree by research. While the research was in progress, some findings were published in refereed journals and conference papers prior to this submission (refer to Appendix A).

The researcher declares that no portion of the work referred to in this thesis has been submitted to support an application for another degree of qualification of this or any other university or institution of learning.

Seyed Payam Salamati Nia

ABSTRACT

For the last four decades, Iran has been experiencing an unprecedented series of disasters and has given rise to increased attention by policymakers to the country's arrangements for disaster management. A disaster event can be a severe disruption to the functioning of any community and organisation. During the last decades, the amount of disaster events has risen. The research of disaster management has been one of the main concerns of medical doctors, managers, policymakers, and scientists since the mid-twentieth century.

There is an urgent demand to improve our understanding of disaster management preparedness and mitigation measures to keep hospitals active in terms of hospitals' importance during and post-disaster events. Collapsed or damaged hospitals, resource shortcomings, absence of a command system, triage problems, treatment, and transportation have been challenged during previous disasters. This study researcher focuses on disaster mitigation and preparedness management associated with the events caused by natural disasters in Iranian Hospitals. The current study was conducted to evaluate various aspects of the current medical disaster management measures against disaster managers and hospitals to improve health services are provided during disaster events.

Accordingly, this research study evaluates mitigation and preparedness in some critical elements in disaster management measures implemented in the previous natural disasters. Implementing a comprehensive strategy would save lives and improve the effectiveness of using available resources for injured people. All skilled medical volunteers and the military’s medical teams must also be included in this plan. According to this research, challenges against disaster, managers identifies. The data was collected through a questionnaire survey and semi-structured interviews with some experts connected with hospital activities and disaster management in the Iranian context.

This research study aims to enhance the resiliency of the Iranian hospitals from earthquakes and floods by developing an appropriate mitigation and preparedness policy guideline.

This is done through conducting a questionnaire survey and interviewing some disaster management experts. In this research study, two different case studies were implemented to understand better the impact of natural disasters on hospitals and health services during and after disaster events. Furthermore, an expert interview was used to collect qualitative data through interviews with eight experts.

These experts were from both academia and industry, and they were selected based on their experiences and engagement case studies. The multiple-case holistic design was selected for conducting this research to provide credibility to the research outcome.

Two case studies were selected to better evaluate hospitals during earthquakes and floods. The questionnaire was distributed among 134 experts. In this research, the target population was professionals involved and experienced in disaster management and hospitals in two case studies.

The findings illustrate that disaster mitigation and preparedness management are critical stages in the disaster management cycle. Efficient and effective mitigation and preparedness will ultimately minimise the loss of life and damage to hospitals.

While there are some weaknesses and limited implementation of several elements of good practice in disaster mitigation and preparedness management in Iran's current disaster management practices, some strengths should be built upon. The final recommendations comprise and are based on the secondary and primary data findings.

Findings illustrate that there are variations among subordinate organisations within the health ministry with regard to different aspects of disaster management and outcomes, lack of training and disaster management knowledge, failure distribution of injured people, lack of accurate coordination and collaboration between various organisations, and lack of regular assessment of the hospital conditions. The sets of recommendations are developed to improve the healths services of hospitals to cope with disaster events. This study contributes to the scarce literature currently published on disaster mitigation and preparedness management connected with hospitals. Such studies' uniqueness could be attributed to the very limited attempts made in the past to explore disaster mitigation and preparedness management in Iranian hospitals. This study's practical contribution is the potential improvement of the current disaster mitigation and preparedness practices and disaster management systems in Iranian hospitals, which will ultimately minimise the loss of life and damage to property. The recommendations proposed in this study could improve the immediate mitigation and escalate the disaster management system's preparedness process for Iranian hospitals in future events.

Chapter 1

CHAPTER 1: RESEARCH BACKGROUND

1.1 Introduction

It is predicted that the frequency and extent of natural disasters are rising in the world (Warren, 2010). Disasters can be an unforeseen event, which could overwhelm the capacity of affected people and disrupt normal activities (Tomasini & Van Wassenhove, 2004). They are as old as human history, but the dramatic increase and damage caused in the recent past have become a cause of national and international concern (Palliyaguru, Amaratunga, & Haigh, 2013). Over the past decades, the number of natural and man-made disasters have climbed gradually. From 2004 to 2008, the reported disasters average was 428 per year, but from 2009 to 2013, this figure rose to an average of 707 disaster events per year, showing an increase of about 60 per cent over the previous years (WCDR, 2014).

Many people are periodically exposed to at least one natural disaster (Lin Moe Pathranarakul, 2006). There are almost thirty identified natural disasters across the world. Figure 1.1 shows the most natural disasters between 2004 and 2013. Drought and famine have proven to be the deadliest disasters globally, followed by Flood, technological disasters, earthquakes, windstorms, extreme temperature and others. Global economic loss related to disaster events averages at around $880 billion US dollars per year (Nateghi& Izadkhah, 2004).

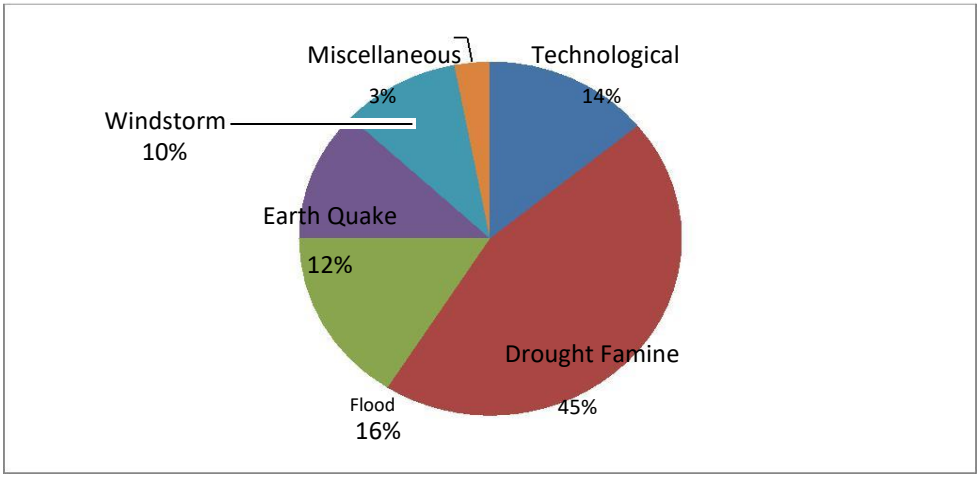

Figure 1. 1 World Scenario: Reported Deaths from all Disasters (2004-2013) (WCDR, 2014)

Hazards may be natural in origin, but societies have developed that causes them to become disasters (Gaillard, Liamzon, & Villanueva, 2007). Therefore, it can be argued that human activities condition disasters. Most disasters, or more correctly, hazards that lead to disasters, cannot be prevented. However, their effects can be minimised. Within this context, disaster management is highly significant.

As communities worldwide face an increasing frequency and variety of disasters, which can cause direct and indirect impacts, there is an urgent need to reduce the risks from disasters (Lin Moe & Pathranarakul, 2006). Furthermore, developing a resilient community capable of recovering from disasters is an increasing concern in many countries (Rotimi, Wilkinson, Zuo, & Myburgh, 2009). Disaster management aims to mitigate or avoid potential losses from hazards, assure prompt and appropriate assistance to victims of the disaster, and achieve rapid and effective recovery. The United Nations Office for Disaster Risk Reduction (UNISDR) defines disaster management as a systematic process of using administrative decisions, operational skills, organisation, and also capacities to implement policies, strategies, and coping capacities of the society and communities, to lessen the impacts of natural hazards and man-made disasters (Bosher & Chmutina, 2017).

According to the Red Cross and Red Crescent National society cited by (Thurairajah, Amaratunga, & Haigh, 2008), disaster management can act as one organisation in disaster events that can manage all resources and has some responsibilities for dealing with humanitarian and non-humanitarian aspects of an emergency. Ariyabandu (2005) stated that disaster management is a collective term encompassing all aspects of responses and planning disasters, including post and pre-disaster activities. Disastrous incidents can cause countless casualties and victims, and directly or indirectly, all of them are referred to hospitals to receive health care services. Thus, hospitals play a crucial role in response to disasters and a critical role in national and local responses to emergency events. Hospitals are complex facilities with an elevated occupancy level, including patients, staff, and visitors. Thus, this complexity makes them vulnerable to the impact of disasters.

1.2 Disaster concept

Disaster Definitions The term disaster has been defined differently by various scholars due to the system they are explained and based on their causes and consequences. The United Nations Office for Disaster Risk Reduction (UNISDR, 2009) confirms that disasters occur as a result of a combination of hazards, vulnerabilities, and a lack of measures, where using special measures for planning, coordinating and utilising appropriate resources will minimise the adverse impact of disasters (Alexander, 2003). Disasters are defined mainly as sudden unforeseen events with natural, technological or social causes that lead to destruction, loss and damage (Alexander, 2005b; Jorgustin, 2012; Iyer and Mastorakis, 2006; Parker, 1992; UNSDR, 2009). Cutter (2003) states that disasters usually are on a singular large scale and are high impact events. Some scholars have defined disasters as situations that overwhelm the local capacity to withstand, cope and recover; necessitating external assistance and involving various stakeholders (Guha-Sapir, Vos, Below, & Ponserre, 2014; Lighthouse Readiness Group, 2015; Moe, Gehbauer, Senitz, & Mueller, 2007; Coppola, 2015; Parker, 1992). Furthermore, definitions of a disaster vary based on time and space; for example, disasters are considered as events concentrated in time and space, in which a society or one of its subdivisions undergoes physical harm and social destruction, so that all or part of the essential functions of such a society are impaired (Wilson and Oyola-Yemaiel, 2001; Fritz, 1961; Lindell, 2013; UNSDR, 2009). Furthermore, disaster is defined as "a dynamic mechanism that begins with the activation of a hazard and flows through the system as a series of events, in a logical sequence to produce a loss to life, property and livelihood by negatively influencing the emergency systems (Iyer and Mastorakis, 2006; Biswas and Choudhuri, 2012). Baker and Refsgaard (2007, p. 332) concentrated on systems' breach claims that institutional systems charged with the responsibility to manage disaster situations face multiple challenges, including the need for the quick action and the accurate targeting of aid in an environment where information quality and quantity is highly unpredictable". Operationally, disasters exceed the capacity of normal, workday systems to cope with them effectively. Temporary systems of a different character must therefore be substituted. However, disregarding the number of studies on disasters and disaster management, it seems that there is no universal definition of disaster used by all scholars and institutions (Shaluf, Ahmadun, & Said, 2003). The differences in the definition of a disaster area due to various causes and consequences appear to be affected by the respective countries' geographic, economic, and political situation (Eshghi & Larson, 2008), making it practically impossible to summarise in brief (Alexander, 2005a).

1.3 Crisis Definitions

A crisis is "a disruption that physically affects a system and threatens its basic assumptions, subjective sense of self, and existential core" (Pauchant & Mitroff, 1992, p. 15). A crisis is an abnormal situation that presents a high business risk and may trigger rapid public policy changes since it draws public and media attention and threatens public trust (Sawalha, Jraisat, and Al-Qudah, 2013; Shaluf et al., 2003; Alexander, 2005b). Booth (1993), cited in Moe and Pathranarakul (2006, p. 402), indicate that “a crisis is a situation faced by an individual, group or organization which they are unable to cope with by the use of normal routine procedures and in which stress is created by sudden change”. Alexander (2005b) also argues that “the significance of crisis is its unexpectedness and uncontrollability which disrupts and impedes normal operations”. Further, Shaluf et al. (2003) agree with Robert and Lajtha (2002) and Darling's (1994) view that each crisis is unique and so managers adjust and respond differently to each situation. In addition, the same situation may be a crisis at one time but not at another (Darling, 1994). According to Lighthouse Readiness Group (2015), a crisis is a “time of intense difficulty, trouble, or danger and can be personal, or confined to a small population, like a family, or a company dealing with a severe problem”. Crises often have past origins, and diagnosing their source can help understand and manage a particular crisis or lead to an alternative state or condition (Farazmand, 2001). In an organisational context, crises are usually new situations to the organisation, often defined as unexpected, definitely unstructured and outside the typical operational framework of the organization (Beall, 2007). They are also characterized by an excessive amount of incomplete and conflicting information.

1.4 Emergency Definitions

An emergency is any natural or man-made situation that may substantially harm the population or damage to property (Shen & Shaw, 2004, p. 2110). An emergency can be defined as “an imminent or actual event that threatens people, property or the environment and requires a coordinated and rapid response. Emergencies are usually unanticipated, at least in terms of exactly what happens and when and where they occur. However, they can, and should, be planned for” (Alexander, 2005b, p. 159). Moreover, the emergency is defined as a state in which normal procedures are suspended, and extraordinary measures are taken to save lives, protect people, limit damage and return conditions to normal (Alexander, 2003; World Health Organization, 2002).

Conversely, Eshghi and Larson (2008, p. 63) state emergency is “an event that may be managed locally without the need for added response measures or changes to procedure”. Further, concentrating on immediate action, Jorgustin (2012) defines an emergency as “an unforeseen combination of circumstances or the resulting state that calls for immediate action; an urgent need for assistance or relief”. The Lighthouse Readiness Group (2015), while agreeing with Jorgustin (2012) that an emergency could lead to a disaster if left unchecked, also claim that an emergency precedes not all disasters. Alexander (2005b, p. 159) defines an emergency as “a broader term that includes disasters, catastrophes and smaller disruptive events”.

1.5 vulnerability

Disasters are often described as a result of/or the combination of the exposure to a hazard, the conditions of vulnerability that are present, and the insufficient capacity or measures to reduce or cope with the potential negative consequences. Disaster impacts may include loss of life, injury, disease, and other adverse effects on human physical, mental and social well-being, together with damage to property, destruction of assets, loss of services, social and economic disruption, and environmental degradation (UN/ISDR 2009).

The most common medical definition of a disaster is an event that results in the number of casualties that overwhelm the healthcare system in which the event occurs. A health disaster often is considered a medical disaster (WADEM 2003).

Vulnerability includes the characteristics and circumstances of a community or system that make it susceptible to damaging effects. It depends on various physical, social, economic and environmental factors of the involved community. The degree of vulnerability also depends upon the society's resilience at the time of the event (the following figure). Resilience is the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including the preservation and restoration of its essential basic structures and functions (UN/ISDR 2009). Resilience is comprised of three elements: (1) the absorbing capacity, (2) the buffering capacity and (3) the response to the event and recovery from the damage sustained.

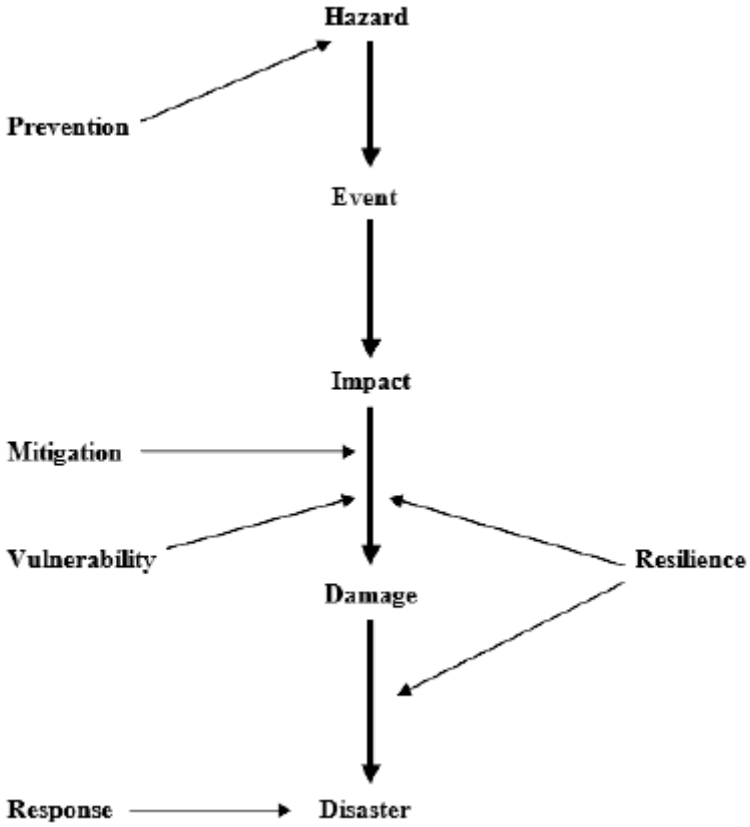

Figure 1. 2 Process from hazard to disaster Source: (Adapted from the Diagrammatic Process from Hazard to Disaster) (WADEM 2003)

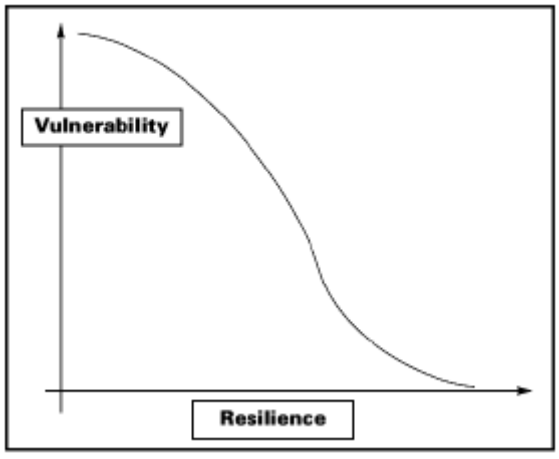

Figure 1. 3 Relationship between vulnerability and resilience

1.6 Hospital operation

Identifying and understanding a problem is an essential step toward better management. It also is essential in understanding the critical and essential tasks of the organization to efficiently and cost-effectively manage service outcomes.

Hospitals are large and complex workplaces that have large numbers of employees from different technical, medical, and professional fields. Healthcare staff includes management, maintenance, transportation staff, and employees from other supporting departments. They all work for hospitals to ensure successful and comprehensive healthcare services for patients. Moreover, besides the hospitals' core business function of providing medical care to patients, hospitals provide essential support services such as educating community members who assist people during disasters, injury and illness prevention, health examination, and disease notification (Sadleir, n.d.). Hospitals have differences in their classification, capability to perform tasks, characteristics, and management styles. Each facility has various levels of medical care they are prepared to provide to patients (Slepski, 2007).

For example, these differences are usually affected by the size and strategy of that facility because a large hospital can take in more patients, and the hospital's strategy can improve the hospital's achievements and services. Healthcare facilities are generally classified into three types, including community hospitals, medical centres, or speciality hospitals (Slepski, 2007). Nearly all substantial and urban communities have all three types of facilities (Slepski, 2007). Community hospitals provide primary short-term care for their patients, such as outpatient clinics and some minor surgeries. The emergency services are at a lower level compared to most medical centres (Slepski, 2007). A medical centre is more significant than a community hospital and provides more advanced healthcare services and treatments, such as cardiac, cancer, and brain surgeries.

It is open 24 hours has advanced emergency services and a full range of medical specialists, such as cardiac surgeons, neurosurgeons, and chemotherapists (American College of Surgeons: Committee on Trauma, 2010). Speciality hospitals usually provide specialized medical care, such as medical treatments for cancer patients, psychiatric therapy for mentally ill patients, inpatient counselling for drug addiction, various types of rehabilitation, or even short-term medical care (McGraw-Hill Concise Dictionary of Modern Medicine, 2002). This classification helps to serve the different care people need in the community. Because of the critical roles that hospitals play for people and communities in general and during disasters in particular, they need to be prepared structurally and functionally to respond effectively to people's needs.

According to the World Health Organization WHO), hospitals and healthcare facilities are one of the most critical areas that need to be protected from disasters. Over 500 hospitals have been destroyed by the flood-affected areas of Pakistan, including urban areas.

Also, many healthcare facilities were severely damaged in Haiti's earthquake (WHO, 2010). These recent examples and other events have stimulated WHO and other organizations to create and develop ideas and techniques for better emergency planning and preparedness (EPP) for safer and stronger hospitals, so hospitals will not be affected or destroyed easily during disasters, which will allow hospitals to continue to provide services for the community.

1.7 Importance of Hospitals in Disaster Events

In a disaster, it is vital to keep the hospitals safe and secure; thus, disaster management becomes even more significant, as the health sector has been particularly vulnerable to damages. During the last 20 years, more than 100 hospitals and 650 health centres were affected due to natural disasters globally; either hospital collapsed or was left in vulnerable conditions requiring evacuation (Bosher & Dainty, 2011). Health facilities, at all levels, deserve special attention in the case of disasters, as they are needed to continue the work of patient treatment and address persons injured by the event (Eybpoosh, Dikmen, & Talat Birgonul, 2011). Besides, the hospital building's construction plan and its equipment must also remain in service condition during a disaster. The hospital authorities recognise these facts, so many have drawn up plans to deal with disasters and design strategies to understand the risk and mitigate it using a specially designed construction plan (Kenny, 2012). Hospitals must serve as a secure environment during disasters, but many become unusable because of structural and non-structural damages. Therefore, appropriate disaster management is crucial to manage and mitigate natural disasters' adverse impact on hospitals (Benson & Rosseto, 2007).

For instance, providing security and preserving certain critical areas of the hospital, such as the emergency department, intensive care units, diagnostic facilities, operating rooms, pharmacy, food stores and medicines, and services registration, are significant for hospital disaster management. This indicates that hospital disaster management needs appropriate attention in a disaster. Hospitals play a critical role in national and local responses to emergencies and whose preparedness and offering on-time services play a vital role in reducing injuries and death. Disasters occurring in developed countries in the past decade have indicated the necessity of preparedness for handling them. In emergency cases, it is one of the critical cases in public opinion. The World Health Organization (WHO) presented the slogan of “health in disasters”. It made all its member countries committed to take a step in line with this slogan and conduct planning, management, coordination, training, and other necessary measures with a high emphasis on support, capacity building, and local management. Besides, according to the latest statistics reported by the Centre for Research on the Epidemiology of Disasters in 2015, from 2005 to 2015, about 1,040,074 individuals were affected by natural disasters. As the most critical treatment institutes, hospitals should enjoy necessary and sufficient preparedness before disasters to guarantee rapid responses to disasters (Daneshmandi, Nezamzade, & Zareeian, 2014). Therefore, the importance of managing hospitals in the event of a disaster is evident and should be the priority of disaster managers.

1.8 Research Rationale and Justification

Natural hazards have long been affecting human societies and have caused great physical harm and death to many human beings. Today, these disasters are rising in the world and have had a tremendous impact on human life and health, so far as their devastating and destructive impact have disrupted society's ability to meet its basic needs and caused injury, disability and death of many people. Disasters have also imposed economic costs to the government and nations by damaging the people's homes and properties. Over the past thirty years, disasters have doubled in the world, and the rate of damage and personal injuries has tripled, which shows the importance of taking actions to reduce the impact of disasters on human societies (Briceno, 2018) According to global reports in 2018, Iran is not among the ten most disaster-prone countries globally. Moreover, the trend of physical damage and deaths caused by disasters in Iran has decreased between 1995 and 2014 (Hamza, 2015). However, in recent years, an average of 253 hazards have occurred in Iran per year. Disasters, depending on the type, extent, frequency, and density of the population facing the hazards, lead to small and big catastrophes that are sometimes difficult to recover (Yavari, 2019). One of the main attributes of natural hazards is their unpredictability. Therefore, preparedness and mitigation are the only way to deal with this phenomenon, which can subsequently prevent or reduce the amount of damage caused by it. After emergencies and disasters, cross-regional services are necessary to respond and compensate the damages imposed, among which health and medical systems are the most basic units in providing services to the injured people (Pourvakhshoori, 2017). During the first 24 to 48 hours after a disaster, the greatest need for health care is felt, so that 85%–95% of the survivors need relief and health care during the first 24 h. Therefore, all hospitals should be well prepared to manage and provide services to promptly and efficiently provide timely health services to the injured patients to reduce mortality and increase the number of survivors (Daneshmandi, 2014). Thus, hospitals should be prepared to deal with disasters before they occur. In a study in Italy, which evaluated the preparedness level of hospitals against disasters using the WHO checklist, the preparedness of the hospitals is less than the level recommended by the WHO (Ingrassia, 2016). According WHO, Iranian hospitals, which evaluated the preparedness of 25 hospitals against disasters, the hospital preparedness in all areas was estimated to be between 20% and 47% (Djalali, 2014). The level of hospital preparedness was estimated in the 27 EU member states at 68%, which was at an acceptable level (Koka, 2018).

Regarding the probability of the occurrence of these hazards, especially in Iran, and the increasing occurrence rate of these disasters and their related consequences, the critical role of health services before, during and after disasters is more felt, and the proper preparation of service providers seems essential in all the hospitals.

So far, there has been no comprehensive study on the overall assessment of hospital mitigation and preparedness against disasters in Iran.

Thus, the present study aimed to evaluate the mitigation and preparedness of the Iranian hospitals against disasters to provide comprehensive information on the topic, through which one can take appropriate measures for improving the mitigation and preparedness level of the hospitals of the country against disasters.

1.8.1 Natural Disaster and Iranian hospitals

Evidence worldwide suggests that hospitals malfunctioning during a disaster has extensive impacts on inbound and outbound patients. Iran is in central Eurasia, with over 80 million, and it is exposed to a wide range of natural and man-made hazards. Iran is in a highly likely risk location regarding earthquakes and floods. Given an earthquakes' potential for devastation, hospitals are among the main critical facilities that should be active continuously to provide necessary emergency services. According to the Global Assessment Report on Disaster Reduction (UNISDR, 2009), Iran's risk class for natural hazards is 8 out of 10. Over the last four decades, these hazards have caused more than 109,000 deaths and 150,000 injuries (Ardalan et al., 2012). More than 31,000 were killed in Bam's Earthquake in 2003 and 600 in Zarand's Earthquake in 2005 (a neighbouring province of Hormozgan). The national and international responses were quick and considerable. Many field hospitals were created, and many patients were evacuated from their homes and transported to hospitals throughout Iran. Nearly 700 patients were transferred to Chamran hospital in Shiraz within 48 hours after the Earthquake (Emami et al., 2005). Almost all the hospital buildings were damaged, complete chaos (Ardalan et al., 2009b).

In the Zarand earthquake (South-East of Iran), there was chaos in the hospitals for hours due to non-structural damages and staff absence. Ardalan et al., 2014 mentioned that, in another case, most hospitals were destroyed in the East Azarbaijan earthquake, even newly constructed ones.

Furthermore, more significant numbers of patients were relocated from hospitals to shelters; meanwhile, medicines and medical equipment had to be moved to the shelters to provide a continuing health service for patients during the disaster (Djalali et al., 2012). Almost all public and private hospitals collapsed. Further examples of natural disasters in Iran include the Zarand earthquake of 2005, which led to the non-functionality of the district hospital for about six hours due to non-structural implications and staff absences (Ardalan, 2013). In the East Azarbaijan earthquake of 2012, the district hospitals almost collapsed, including one hospital that had only been opened for one year before the Earthquake. Additionally, a fire accident in the Arg mosque in Iran's capital (Tehran) in 2006 led to more than 100 burn injuries, which challenged Tehran's hospitals for their surge capacity and management of the burned cases. A similar problem was observed following a bomb explosion in Shiraz (2009) that left 202 injured when the hospital's role was essential. In recent November 2017, Iran's west providence was facing a high magnitude earthquake 7.3 Richter. The powerful earthquake struck the Iran-Iraq border region on Sunday night, shaking the Middle East as far as Turkey, but the worst devastation was borne in western Iran. Six hundred twelve people had been killed, and 6,700 people were injured, but the death toll was expected to rise as rescuers reached more remote parts of the mountainous Kermanshah province (IRNA, 2017).

At least nine people were killed in Iraq's Kurdish region, and more than 300 were reportedly taken to hospital with injuries. The quake caused damage that contaminated drinking water supplies and knocked out electricity, phone and gas services across a wide area of Kermanshah, most rural. Unfortunately, the newly constructed hospital in this region (Sar pol Zahab) was affected and destroyed totally while giving health service to injured people (Alef, 2017). Therefore, paying attention to the issues of health management in natural disasters in Iran and organising the information and communication situation for rescuing victims, as well as doing comprehensive research on disasters in Iran, resulting in preparedness and more appropriate mitigation in cases of occurrence of such events should be considered more.

1.8.2 Need for implementing appropriate Mitigation and Preparedness Measures to Iranian Hospitals

Mitigation means taking action to reduce the effects of a hazard before it occurs. The term mitigation applies to a wide range of activities and protection measures that might be instigated, from the physical, like constructing more substantial buildings, to the procedural, like standard techniques for incorporating hazard assessment in land-use planning (Coburn, Spence, & Pomonis, 1994). The mitigation phase aims to probe the organisation for signs of weakness before a determined adversary does so. This mitigation effort cannot be passive. It must be actively probed for weaknesses and potential problems (Pauchant & Mitroff, 1992).

With a high likelihood of natural disasters in Iran that happened in the past and recently increased, preparing hospitals in advance is critical. Preparedness includes developing emergency response plans, effective warning systems, maintenance of inventories, and workforce training (Gulyaeva & Arikan, 2016).

Many casualties and victims are referred to hospitals to receive healthcare services in disasters. The appropriate reaction to disasters necessitates hospital readiness for such conditions. Hence, each hospital should have a previously designed action plan for confronting the crises (Zaboli & Sajadi, 2014). Hence, hospitals should have a program for readiness against disaster events to act appropriately and enhance their performance in such situations.

Evidence in this respect shows that healthcare systems need to have the distinguishing features of flexibility, strategic resource allocation, as well as strengthened health structures to deal with crises and natural disasters because the quality of such accidents demands flexibility, preparedness, and planning because of its unpredictability (Khankeh, 2011). The healthcare sector has thus a special place among all the elements involved in the management of accidents and disasters since the first and the most important public demands and concerns are associated with healthcare services. Preparedness is among the elements of crisis management, and it simply requires planning, staff training, public education, practice, and assessment. This kind of preparation necessitates broadening knowledge and improving attitudes and essential skills at the individual level. At the local level, it stresses developing programs, providing resources, and determining local management structure; and at the national level, it dictates setting policies, instructions, and practical guidelines. Unprepared healthcare systems dealing with crises and natural disasters can accordingly initiate catastrophic consequences as those observed in the 2010 Haiti earthquake or the floods in Pakistan (De Ville de Goyet, 2018).

Here, preparedness refers to coordinating all healthcare elements and sectors as grouped by the World Health Organization (WHO), including service delivery, health personnel, health information, medical technologies, financing, and trusteeship (Manyazewal, 2017). In addition to the importance of comprehensive coordination of all the cases as mentioned above, healthcare systems must put much emphasis on three critical points of staff, infrastructure, and coordination in the human resources sector to appropriately act in response and also pay special attention to first-line personnel providing services (Blashki, 2017). In Iran's healthcare system, health workers' responsibility is to provide first-line services, so their crisis management skills and training should be highlighted more than ever. Moreover, a lack of straightforward mitigation and preparedness management strategies are needed.

1.8.3 Iranian Disaster Management policies in health facilities and hospitals

A look at the disaster management laws and regulations approved in Iranian hospitals and health facilities over the last four decades reveals that most of them are linked to seismic disasters that occurred in the country. Two events were significant and had considerable influence on the development of such regulations. The first was the Manjil Earthquake of 1990. After that event, shortcomings in emergency response and the impacts of the earthquake on weak structures were researched more particularly.

As a result, some rules and regulations were approved (such as the National Committee for Reduction of the Impacts of Natural Disasters) that gave special attention to improving emergency response activities in hospitals and health facilities.

In addition, the event led to the upgrading of the National Building Code (Standard no. 2800) based on lessons learned from that event (BHRC 1993). Some local codes were also prepared and applied at the municipal level to improve land use plans and the quality of construction (Bahrainy 1998).

However, as these rules were not prepared due to local conditions, they have not been well applied and thus have not had much impact on risk reduction in Iranian hospitals (JICA and TDMMO 2004). The second event that further focused attention on disaster risk management issues was the Bam earthquake of 2003. In that event, severe shortcomings were evident in the Iranian disaster management system, as discussed earlier. Those destructive earthquakes have resulted in gradual progress in hospitals' disaster management systems, and several policies and plans have been prepared, approved, and implemented. However, there are still some challenges that need to be resolved. Lack of appropriate executive guidelines to mandate and apply the plans and policies can be considered one of the most critical issues.

There is no sufficient enforcement on applying approved plans and policies. If some hospitals do not follow and implement the rules and regulations appropriately, there is no legal punishment anticipated for it.

In addition, most of the hospital personnel (particularly at local levels) do not have sufficient knowledge and experience to implement and execute the indicated laws and plans efficiently. This may cause the inappropriate implementation of risk mitigation and management projects without achieving the targets of plans. However, this can be resolved by organizing regular training for local hospital personnel and relevant staff.

Another issue is the insufficient attention of policymakers to local socioeconomic conditions while preparing the laws and regulations. Considering the complexities of different communities in Iran, uniform laws and plans cannot be applied successfully.

Therefore, such regulations should be revised and adapted to the local conditions. In addition, there is no appropriate attention toward promoting bottom-up approaches and community-based activities for improving preparedness at local levels. Experiences worldwide illustrate the importance of promoting public participation in risk reduction and disaster management activities (Dynes 1994; Victoria 2002; Wachtendorf 2001), but this subject has not been considered appropriate in the plans and policies of Iran and Iranian hospitals.

Unclear frameworks and mechanisms for managing, implementing, and controlling the activities of different organizations in risk reduction and disaster management fields is another challenge. Although, based on recent laws, the National disaster management department is responsible for coordinating and supervising all relevant disaster management affairs, most governmental and military forces still work individually without coordinating with or reporting to the NDMO (Amini-Hosseini 2009a). This problem should be resolved before the next potential disaster to minimize parallel activities of different organizations in charge of response and reconstruction (Zolfaghari 2003; Yazici 2003). By considering the above points when updating Iran's disaster management laws and regulations and among that Iranian hospitals, the legal framework for conducting risk reduction and disaster management activities will be improved, and implementation will be more successful. Similar approaches might also be proposed to other countries facing the same challenges.

1.8.4 Existing Gap of Knowledge in Iranian Hospitals Related to Disaster Management

The hospital emergency incident command system (HICS) is one of the most popular systems implemented in Iranian hospitals to make them efficient and confront hospitals when there is a disaster (Zaboli & Sajadi, 2014). Still, HICS has been implemented without coordination and collaboration between different organisations. Therefore, this system does not provide good consequences in disaster events (Najafi et al., 2017).

As Ardalan (2015) emphasises, multiple gaps and serious shortcomings have been revealed in disasters management of Iranian hospitals relating to mitigation and preparedness measures of non-structural elements such as building codes, land-use policies relocate building higher ground, insurance, and protection of existing natural barriers. According to Karimzadeh (2017), paying attention to non-structural disaster management elements has better collaboration between different organisations that may mitigate the risk of health management issues in Iranian hospitals.

Regarding preparedness for Iranian hospitals, including requirements for having a written disaster plan and participating in disaster drills, there is no validated, standardised method for assessing hospital disaster preparedness. To be prepared to care for an influx of victims, a hospital must have adequate supplies, equipment, and space and the appropriate medical and nonmedical staff (Tavakoli, Yarmohammadian, Safdari, & Keyvanara, 2016). There is a shortage of literature on disaster mitigation and preparedness management in Iranian hospitals. Most previous studies in the Iranian concept often involve response, and few have examined what is happening during mitigation and preparedness stages (Lakbala, 2016). Therefore, it is crucial to develop appropriate mitigation and adaptation methods for healthcare facilities in Iran, to withstand natural disasters such as earthquakes and floods, which are the most common natural disaster occurrences. A comprehensive disaster plan ensures a prompt disaster response and coordinated management of a multi-casualty incident (Lakbala, 2016).

1.9 Aim

This research study aims to build the resilience of Iranian hospitals against earthquakes and floods by recommending appropriate mitigation and preparedness measures.

1.10 Objectives

To achieve the research aim, the specific objectives are:

1) To critically review the operational management procedures in hospitals and identify the critical factors of successful hospital management.
2) To evaluate and synthesise the current status of Iranian public hospitals in the case of disaster events and examine the impact of floods and earthquakes on critical factors of successful hospital management.
3) To critically evaluate the weaknesses in the existing disaster mitigation and preparedness management in Iranian public hospitals.
4) To identify and critically evaluate the barriers and obstacles to the implementation of appropriate disaster mitigation and preparedness management in Iranian public hospitals.
5) To develop a set of recommendations for effective implementation of appropriate disaster mitigation and preparedness measures in Iranian hospitals.

1.11 Research Questions

The following research questions were formulated:

1) What are the statuses of disaster mitigation and preparedness management in Iranian public hospitals?

2) Why are the mitigation and preparedness phases considered two of the critical phases of the Disaster Management life cycle?

3) What are the weaknesses during disaster mitigation and preparedness management in Iranian public hospitals?

4) What are the good practices to evaluate the disaster mitigation and preparedness management stages critically?

5) Why are the evaluation of disaster mitigation and preparedness management critical to future hospitals' resiliency improvements?

1.12 Scope of This Study

This study is scoped to include disaster mitigation and preparedness management of public hospitals in natural disaster events, such as floods and earthquakes, the most popular natural disaster in Iran. The Disaster Management Organisation is a main administrative body responsible for the disaster management activity in Iran and coordinating disaster management strategies to different organisations like hospitals and health facilities. As such, this research focuses on the public hospitals in Iran to investigate the current disaster mitigation and preparedness practices and improve the resiliency of public hospitals.

1.13 Research Methodology

Based on the nature of the research questions and objectives, this research study is philosophically placed more towards subjectivism and interpretivism because the research deals with issues that are more subjective than objective. Further, from the understanding of axiology, the position of this research is closer to the value-laden stance. This research adopts a case study as the research approach. A multi-case studies design is taken.

The primary data was collected from experts involved in disaster mitigation and preparedness in public hospitals. To gather expert opinions regarding the phenomenon under consideration, semi-structured interviews and a questionnaire survey were used in this study and documents were reviewed to supplement the data collection techniques.

For the analysis of the semi-structured interviews and document analysis, content analysis was used, whilst descriptive statistics were used for the analysis of the questionnaire survey. The data analysis process was supported by using the computer aided software programmes NVivo and MS Excel. To increase the acceptability of the findings and make the study more robust, the findings were corroborated by triangulating the data sources. The primary and secondary data findings were validated by conducting expert interviews to increase the final guideline's robustness.

1.14 Contribution to The Knowledge

In terms of existing literature in disaster management and the impact of natural disasters on hospitals, minimal efforts were made to identify disaster mitigation management in response to natural disaster events. Though several studies have been conducted on disaster management, there is a concentrate on developed countries. In contrast, very limited research has been attempted to explore disaster mitigation and preparedness management of hospitals in developing countries.

This study has a vital contribution to the literature in terms of its primary and secondary data that do not likely exist anywhere else. The main contribution to knowledge is identifying the barriers and significant challenges against hospital disaster managers during or after natural disaster events. There are numerous types of barriers and challenges faced by hospital disaster managers. This study has also contributed to knowledge by recognising the weaknesses and strengths of the current framework used in the Iranian disaster management departments to develop the risk mitigation of natural disasters in hospitals. Identifying the best practice disaster mitigation and preparedness management factors helps determine the overall gaps during mitigation and preparedness management in Iranian hospitals and contribute to disaster management knowledge.

Besides, the weaknesses and strengths of the current disaster mitigation and preparedness are identified to make sets of recommendations to improve Iranian hospitals' disaster management process. Therefore, the proposed recommendations contribute to the sparse literature on Iranian hospitals, thereby enriching global disaster mitigation and preparedness management.

1.15 Structure of This Report

The researcher aims to reach a basic understanding of the adverse impact of natural disasters on hospitals, and in particular, the safety and continuity of health services during natural disaster events. In this report, the chapters are summarised as follows:

Chapter One: Introduction

Highlights the research background, research problem, aim, objectives, rationale and justification of this research. The chapter also outlined an overview of this research's scope, followed by this report's structure.

Chapter Two: A literature Review

This chapter presents an overview of literature considerations for this research that includes general areas of disaster management, specifically hospitals' importance and the impact of natural disasters on hospitals. The chapter also outlines disaster managers' challenges, weaknesses, and barriers to implementing a disaster management cycle's preparedness and mitigation stage.

Chapter Three: Research Methodology

It outlines the methodology adopted to achieve this research's aim and objectives. In addition, to meeting the requirements of the research questions. The methodological research design is provided in Chapter 3, and the research process followed during the study. The chapter delivers the research philosophy, approach, data collection, and analysis of the study's techniques.

Chapter Four: Quantitative Data Collection and Analysis

This chapter discusses the data collected from some experts connected with disaster management and hospitals by questionnaire. The following appropriate statistical test was implemented to evaluate and have a precise perspective of quantitative data.

Chapter Five: **Qualitative Data Collection and Analysis**

This chapter presents an overview of the interview design strategy and findings from semi-structured interviews. It implements NVivo data management in analysing the interview data.
Two case study backgrounds are provided.

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Chapter Six: Discussions

Presents and discusses the two case studies' key research findings based on the disaster management expert interviews, questionnaire survey, and literature review. It also presents the final sets of recommendations, after a validation process, to enhance the overall approach to mitigating the risk of natural disasters in hospitals effectively.

Chapter Seven: Conclusion and Recommendations

Concludes by linking the study's objectives with the primary and secondary data's overall research findings. Moreover, theoretical and practical implications are also provided, followed by the study's limitations and future research areas.

1.16 Summary & Link

This chapter has provided an overall view of the research subject under consideration by introducing the research background, justification of the research area, explanation of the research problem, and contribution to knowledge. The next chapter presents a literature review of this research.

Chapter 2

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

Disasters, such as earthquakes or floods, carry a substantial health burden for the affected people and compromise local health services' capacity to address priority health care demands. This chapter provides initial information and reviews current literature to establish the art's estate for this research. This section is designed to understand disasters, natural disasters, disaster management, and disaster management in hospitals. In this chapter, several domains will be reviewed from the existing literature as listed below:

- Definition of disaster and explanation of different types of disaster.
- Explanation of disaster management and the disaster management cycle.
- History of natural disasters and disaster management in Iran and comparison with other countries.
- The importance of hospitals and health facilities in disaster events.
- The impact of natural disasters on hospitals.
- Strategies to mitigate the adverse impacts of disasters for healthcare facilities.
- Barriers and drivers against disaster management in an Iranian hospital context.
- Challenges during mitigation and preparedness of disaster management.

2.2 Disaster Definition

People worldwide may face disaster events every day; the impact of these can be death, injuries, interruption of daily activities, and damages to personal belongings. These disruptions are categorised as disasters, emergencies, crises, accidents, catastrophes or calamities (McEntire, 2015). In terms of better understanding disaster, a definition is crucial. For instance, a disaster has been defined by the Oxford dictionary (2004), cited by (Stevenson, 2010, p. 498) as *"a sudden accident or natural catastrophe that causes great damage or loss of life*". Disasters are very stressful for all people and any organisation. Huder (2012) describes disaster events as pebble drops in a pond in terms of a disaster description.

As the pebble impacts the pond's surface and makes ripples throughout the community. The World Health Organisation (2006) defines a disaster as any occurrence that causes damage, ecological disruption, loss of human life, and /or deterioration of health and health services, on a scale enough to warrant an extraordinary response from outside the affected community or area. Many other researchers have also defined disasters; for example, it is identified by (Burnham, 2013) as an unforeseen and sudden overwhelming event. McEntire (2015) describes a catastrophe as a violent, deadly and disruptive incident when a hazard is connected with a human.

A disaster can happen abruptly and is classified as a dangerous and catastrophic incident, which overwhelms and disrupts infrastructures. It can be described from a different view, for instance, at the household scale, as a disaster can cause significant sickness and social calamity or an essential economic catastrophe. On the broader scale of community, it can appear as fire, floods, earthquakes, demolition of buildings and displacement through conflict. Once it happens, many populations can be affected, even in the district or cities (Vale & Campanella, 2005).

Furthermore, a disaster is described by The United Nations International Strategy for disaster reduction (UNISDR, 2009, p. 3) as *"A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources."* Regarding the International Federation of Red Cross and Red Crescent Society (2003), a disaster can be a catastrophic, sudden incident, which can seriously disrupt the functioning of a society or community and causes economic, human, and material or environmental losses that exceed the community's or society's ability to cope using its resources. Though often caused by nature, disasters can have human origins (Chen, 2011).

Additionally, according to WHO (2011), a disaster is identified as *"a serious disruption of* the *functioning of a community or society causing widespread human, material, economic or environmental losses, that exceed the ability of the affected community or society to cope using its own resources".* Compared to different definitions of disasters, it can be described as an incident or any condition that tramples local capacity and necessitates local, national or even international assistance. The following table, 2.1 are classified definitions of consensus on disasters according to different organisations, such as WHO or the Red Cross foundation, and other scholars.

Table 2. 1 Consensus of Disaster Definitions

Disaster	Reference
"a sudden accident or natural catastrophe that causes great damage or loss of life."	Oxford dictionary (2004) cited by (Stevenson, 2010, p. 498)
"pebble drops in a pond."	Huder (2012)
Any occurrence that causes damage, ecological disruption, loss of human life, deterioration of health and health services, on a scale sufficient to warrant an extraordinary response from Outside the affected community or area.	The World Health Organisation (2006)
An unforeseen event and sudden overwhelming event.	(Gilbert . Burnham, 2013)
A destructive, deadly and disruptive incident that happens when a hazard is in connection with a human.	McEntire (2015)
"A severe disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources."	The United Nations International Strategy for disaster reduction (UNISDR, 2009, p. 3)
A Calamitous, sudden incident which seriously can disrupt the functioning of a society or community, and causes economic, human, and material or environmental losses that exceed the Community's or society's ability to cope using its own resources.	International Federation of Red Cross and Red Crescent Society (2003)
"A severe disruption of the functioning of a community or society causing widespread human, material, economic or environmental losses that exceed the ability of the affected community or society to cope using its own resources."	WHO (2011)

Generally, there are two mutual points in all the definitions: time and location. It is clear from the above discussion that a disaster causes damage to human lives and constructed items (Rathore & Gosney, 2015). It is believed that there is a similarity in the definitions between other researchers on the topics of time, location, and damage. It is vital to find a solution for mitigating the impact of disasters on society with this knowledge.

2.3 Types of Disasters

Disasters are classified into three main types (Burnham, 2013). Sometimes different terminology may be mentioned for classifying disasters by various researchers, but most approve of this classification. The general view of disasters is summarised below in Figure 2.1.

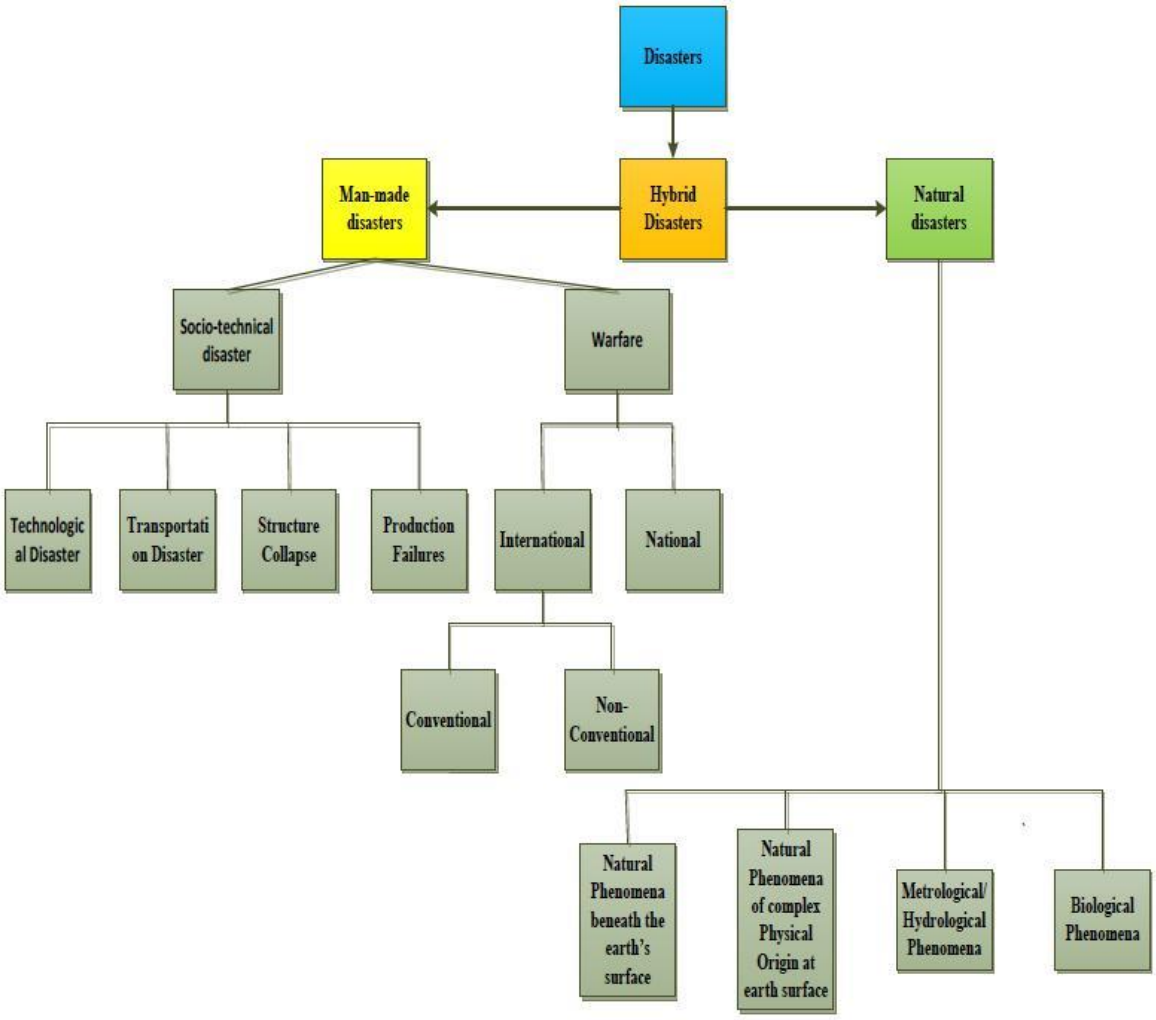

Figure 2. 1 Types of disasters (Shaluf, 2007, p. 705)

In some research, disorders are classified into two main groups: Natural disasters and man-made disasters or human-made disasters (Biswas & Choudhuri, 2012). On the other hand, some researchers such as Shaluf (2007) define the third group for catastrophe, which is labelled Hybrid disasters. In the following paragraphs is a description of each group.

2.3.1 Man-Made Disaster

This type of disaster stems from human decisions. The International Federation of the Red Cross and Red Crescent Societies defines man-made disasters as non-natural disaster events that can happen suddenly or longer (Societies, 2016). However, man-made disasters are categorised into two distinct types: warfare and socio-technological disasters. Indeed, a technological one is the consequence of any technical failure, such as transport failure or environmental disasters (Shaluf, 2007). Shaluf (2007) states that warfare disasters can be divided into national and international disasters. For instance, hazardous material emergencies include chemical spills and groundwater contamination. In addition, workplace fires are common and can cause considerable damage to property or loss of life.

On the other hand, some researchers such as Turner and Pidgeon (1997) agree with two individual causes of man-made disasters: warfare and accidents. In terms of this, man-made disasters caused by warfare are included with conventional warfare, such as sieges and blockades. And non-conventional caused man-made disasters are chemical, biological, and nuclear disasters. Furthermore, another type of man-made disaster is caused by accidents, such as fires, the collapse of buildings, and vehicular disasters (Turner & Pidgeon, 1997). Moreover, communities are also vulnerable to threats posed by extremist groups. Extreme groups are those that cause violence against both people and property. High-risk targets such as; civilian government facilities, military, airports, and high-profile landmarks. In table 2.2 below, examples of different man-made disasters are in more detail.

2.3.2 Hybrid Disasters

According to Shaluf (2007), hybrid disasters result from both human error and natural forces. The extensive clearing of jungles causing soil erosion and heavy rain causing landslides is considered one of many examples of hybrid disasters. Similarly, Hood and Jackson (1992), cited in Shaluf (2007), defined it as a compound of human decisions and volatile natural forces (e.g. floods ravage communities built on a known flood plain).

Table 2. 2 Types of disasters (Shaluf, 2007)

Disaster Type	Sub-disaster			Name of Disaster
Natural	Natural phenomena beneath the Earth's surface			Earthquakes Tsunamis Volcanic eruptions
	Topographical phenomena			Landslides Avalanches
	Meteorological/Hydrological phenomena			Windstorms (cyclones, typhoons, hurricanes) Tornadoes Hailstorms Floods Drought Heat waves/cold waves
	Biological phenomena			Infestations (locust swarms, mealy bug) Epidemics (cholera, dengue, ebola, malaria, measles, meningitis, yellow fever, HIV/AIDS, tuberculosis)
Man-made	Socio-technical	Technological disasters		Fire Explosions (munitions explosions, chemical explosions, nuclear explosions, mine explosions) Leakage Toxic release Pollutions (Pollution, acid rain, chemical Pollution, atmospheric pollution) Structural collapse of physical assets
		Transportation disasters		Air disasters Land disasters Sea disasters
		Stadia or other public places failures		Fire Structural collapse Crowd stampede
		Production failure		Computer system breakdown Distribution of defective products
	Warfare	National		Civil war between armed groups from the same country Civil strikes Civil disorder Bomb threats/terrorist attack
		International	Conventional war	War between two armies from different countries Sieges Blockades
			Non-conventional war	Nuclear Chemical Biological
Hybrid	Natural and man-made events			Flood ravage community built on known floodplain Location of residential premises, factories, etc., at the foot of an active volcano, or in an avalanche area Landslides

2.3.3 Natural Disasters

An effective term of interest for this research is that of natural disasters. It is significantly important to understand the concept of natural disasters before proceeding to the impact of disasters and especially natural disasters on hospitals. In terms of this, Biswas and Choudhuri (2012) define a natural disaster as an outcome when people are affected by natural hazards. They believe that with a lack of proper emergency management, human vulnerability can be increased, impacting the environment and financial resources (Biswas & Choudhuri, 2012).

Catastrophic and calamitous incidents that result from natural resources are classified in the natural disasters group, including tornadoes, eruptions, earthquakes, and volcanoes. Moreover, Shaluf (2007) states that natural disasters are often termed "Acts of God". There are several definitions of natural disasters, which all emphasise similar characteristics. For instance, Barkun (1986, p. 110) suggests that *"the idea of a defenceless society damaged by a powerful natural force is expressed in a definition, where a disaster is a severe, sudden and frequent disruption of normal structural arrangements within a social system, over which the social system has no control".*

Regarding the above scholars, Duarte (2012) believes natural disasters are such complicated incidents that humans face dangerous and risky situations in these events. There is a unique scenario for different disasters. And each single disaster event gives unusual challenges to the rescue and emergency teams and has a 'pronounced effect' on the potential victims (March, 2002). Additionally, Alexander (1993), cited in Turner and Pidgeon (1997), declares that the event is focused on space and time, which threatens society with many unexpected consequences such as disruption and collapse. Further adding that natural disasters appear as physical events that impact humans and their environment.

Natural disasters are classified into four categories: biological phenomena, metrological or hydrological phenomena, natural phenomena of complex physical origin at the earth's surface, and natural phenomena beneath the earth's surface, as shown in Table 2.2 above (Shaluf, 2007). In the following sections, the researcher will delve deeper into natural disasters and explore types of natural disasters that may occur more than other types. Moreover, the researcher attempts to assess these disasters' impact on hospitals and identify some barriers and challenges disaster managers face when keeping hospitals safe and secure during or after natural disasters.

2.3.3.1 Flood

Flooding usually results from a large amount of water beyond its regular measure, particularly in rainy conditions on dry land (OXFORD, 2014). A flood may result from an overflow or over raining on an expanse of water that submerges a field. Floods are generally due to the volume of water rising. This overflow can destroy constructions. In tough floods, the water may seep into houses or completely cover them, and if people are caught up in Flood, they might be washed away or drowned (Ardalan et al., 2009). Flood hazards are the most destructive and common among different types of natural disasters, especially in some regions such as the UK, Iran and East of Asia, including Malaysia, Bangladesh, and Sri Lanka, where the amount of rain in some parts has risen steadily annually.

Every year, flood disasters cause many economic disruptions and cause tremendous losses across the world. In recent years, the number of people affected by the Flood has increased. Floods may be caused by various factors, from natural to man-made (Ardalan et al., 2009). Some obvious causes of floods are melting ice or snow, heavy rain, and frequent storms within a brief time. For instance, floods are one of Iran's most common natural hazards. Usually happening during spring, due to the snow melting, and the possibility of flash flooding is very likely to occur during the summer season in some provinces close to the Caspian Sea. In early August 2001, excessively heavy rainfall took place over the Golestan Province in the North-East of Iran, resulting in one of the worst flooding cases Iran has seen in the last few decades. In this flooding event, almost 5000 km^2 of urban and rural regions were affected. According to the Red Cross Federation, Sharifi (2012), more than 200 people died, and about 175 people were reported missing (Sharifi, Samadi, & Wilson, 2012).

Figure 2. 2 Impact of Flood disaster in Golestan Province in August 2001

2.3.3.2 Earthquake

Sudden energy releases from inside the earth are conducted to the ground, causing an earthquake. Usually, earthquakes are measured by magnitudes, recorded with a seismometer (Grosse & Ohtsu, 2008). Generally, the magnitude of an earthquake is reported on the Richter scale. The magnitude has a scale of between 3 and 7 (Karimzadeh, 2017).

In terms of this number, different levels of destruction have occurred. The smaller earthquakes are often invisible, while a higher magnitude can severely destroy other communications and constructions (Guha-Sapir, Hargitt, & Hoyois, 2004). The Earthquake is one of the most dangerous types of natural disasters, with more than one million occurring every year, fortunately, most of them have a low magnitude. According to Montazeri et al. (2005), significant earthquakes happen on average three times per year. Some countries, such as Turkey and Iran, are located in the fault zone, where these tremors are highly likely.

As mentioned previously, Iran is located in central Eurasia, with about 75 million, and is a high seismicity area. During the last few decades, various country regions have experienced destructive earthquakes.

Most of them resulted in loss and severe property damage, particularly in the rural areas, where most old villages and community buildings were built with hazardous, traditional construction methods (Ambraseys & Melville, 2005). On the 26th of December 2003, an earthquake with a high magnitude of nearly 6.5 on the Richter scale devastated Bam, located in the south-East of Iran. Bam was almost destroyed, and approximately 43,000 people were killed, with more than 30,000 people injured. Even though the national and international responses were considerable, the Earthquake damaged everything.

Thus, after considering everything, it is clear that such earthquake incidents are especially devastating and can have different psycho-social, human, and physical impacts on humans and constructions (Emami et al., 2005). The following table (2.3) illustrates the most significant earthquake disasters between 1980 and 2009.

Table 2. 3 Countries with the most significant earthquake occurrence and consequences between 1980 and 2009 (Doocy, Daniels, Packer, Dick, & Kirsch, 2013)

Country	No. of Earthquake	No. Killed	No. Affected (Millions)	Economic Damage (Billions US$)
China	94	89,852	86.5	88.6
Indonesia	74	178,742	8.4	11.3
Iran	62	74,020	1.8	10.4
Turkey	34	20,495	5.9	22.8
Japan	31	5,753	0.8	145.7
Afghanistan	25	9,175	0.5	0.03
United states	23	145	0.1	38.6
Peru	22	1,095	1.3	0.9

2.4 Demographic and Natural Disaster in Iran

Iran is situated in the South-West, within the dry belt of Asia. It is the second-largest country in the Middle East, covering an area of1,648,000 square kilometres (Seyedin, 2008). In the last survey carried out in 2015, the estimated population was about 75 million people (Rezaei-Shouroki, Mostafaeipour, & Qolipour, 2017). It shares borders with seven other countries. Some of them are the most unstable countries in the world and are battlefields consisting of different groups seeking their interests; Iraq and Turkey to the west, Afghanistan and Pakistan to the east, Azerbaijan, Turkmenistan and Armenia, together with the Caspian Sea to the north and finally the Persian Gulf and Oman Sea to the south.

The Persian Gulf and the Straits of Hormuz are pathways for more than forty per cent of the world's crude oil transport. There are four different seasons, and temperature differences of over 40°C have been recorded between distinct parts of the country, giving it much climatic diversity. Its unique geographical position places it in the Middle East (at the crossroads of Asia and the Middle East) and along the Silk Road. It has free access to waterways, special climatic conditions, and rich natural reserves, including gas (second in the world) and oil (third), giving it an edge over other countries.

Although creating huge benefits and opportunities for Iran, these unique characteristics also make the country susceptible to more natural and man-made disasters that threaten Iranian communities (Seyedin, 2015). Furthermore, it is one of the sixth most disaster-prone countries globally, with an average of 4,000 people who have been killed and 55,000 affected annually by natural disasters in the last decade. It is in one of the most seismically active areas of the world besides severe losses due to hydro-meteorological hazards such as droughts, floods, and landslides. Drought has resulted in a shortage of drinking water in many urban and rural areas. Uncontrolled urbanisation has also increased vulnerability to disasters (UNDP, 2017)

The following table 2.4 outlines statistical data regarding the number of dead people affected by previous earthquakes in Iran. The table after (2.5) shows the number of citizens affected by drought, earthquakes, and floods between 1909 and 2016. While table 2.6 summarises the natural disasters that have occurred in Iran during these same periods. Demonstrating how they were affected and to what extent or the number of damages caused by these natural disasters.

Table 2. 4 Most terrific in order of deaths that occurred due to natural disasters (earthquakes) between 1909 and 2016 in Iran (Seyedin,2017)

Disaster Type	Date	Number of dead
Earthquake	21.6.1990	40,000
Earthquake	26.12.2003	26,796
Earthquake	16.9.1978	25,000
Earthquake	12.9.1962	12,000
Earthquake	31.8.1968	10,000
Earthquake	10.4.1972	5,057
Earthquake	23.1.1909	5,000
Earthquake	1.5.1929	3,300
Earthquake	13.12.1957	3,000
Earthquake	6.5.1930	2,500

Table 2. 5 Number affected by natural disasters between 1909 and 2016 (Seyedin,2017)

Disaster Type	Date	Number of Affected
Flood	10.8.2001	1,200,000
Drought	12.4.1999	3,700,000
Flood	July-1980	950,000
Drought	January-1964	625,000
Flood	3.2.1993	484,728
Earthquake	7.4.1977	400,000
Earthquake	21.6.1990	710,000
Earthquake	26.12.2003	267,628
Flood	10.8.2002	200,000

Table 2. 6 Summary of natural disasters in Iran between 1909 and 2016 and the outcomes (Seyedin, 2017)

	Events	Dead	Injured	Homeless	Affected	Total Affected	Damages US$
Drought	2	0	0	0	37,625,000	37,625,000	3,300,000
Earthquake	89	147,100	167,496	246,215	2,165,313	2,579,024	10,979,628
Epidemic	3	372	0	0	2,500	2,500	0
Extreme Temperature	1	158	0	0	0	0	0
Flood	64	7,262	583	212,370	3,335,701	3,548,654	3,748,720
Slides	4	116	44	0	100	144	0
Wild Fire	1	0	0	0	0	0	0
Wind Storm	10	308	85	5,500	14,200	19,785	28,540

From this data, it is possible to see how Iran has experienced different natural disasters with various incidences during the last century. Among the 40 known types of natural disasters globally, 31 were identified and have occurred in Iran (Interior Ministry of Iran, 2005). As illustrated in the previous table (2.4), earthquakes and flooding are the most likely natural disasters. The statistics demonstrate that these two types of natural disasters cause significant issues. Therefore, in this study, the researcher aims to study more on these two types and explore the negative impacts of earthquakes and flooding on essential organisations that are vital such as hospitals and health centres

2.5 Disaster Management

Extensive preparedness for managing man-made and natural disasters is needed as an appropriate plan and scheme. Whilst manmade disasters are avoidable, and natural disasters are inevitable to some extent, the impact may be mitigated considerably with proper management. Therefore with well-timed and appropriate preparedness, there is a possibility to reduce the adverse effects of man-made and natural disasters (Arora & Arora, 2013). Thus, disaster management is critical and efficient for managing man-made and natural disasters, which are crucial to mitigate casualties and save lives. The researcher's concentration and attention are more about disaster management analysis than disaster prevention (Masellis, 2014).

In the following section, some disaster management definitions will be reviewed. Gunn's Multilingual Disaster Dictionary has defined disaster management as follows: *"Disaster Management is concerned with all phases of planning, preparedness, training, response, relief, rehabilitation and reconstruction of a major emergency or disaster situation"* (Gunn, 2012, p. 27). It includes all activities connected with the whole procedure, such as administrative decisions, operational actions, and technological tools for mitigating the disaster's impact – both inbuilt and environmental (Lettieri, Masella, & Radaelli, 2009). Concerning Sabharwal and Swarup (2012, p. 43), disaster management is defined as all “activities taken by the organisation regarding unexpected incidents, which adversely affect people or resources and threaten the organisation's continued oper*ation.”*

Besides, March (2002) believes that every single disaster must be evaluated individually on previous incidents to understand the current situation's consequential and special features. Disaster managers should learn from past disaster events and implement the right and appropriate methodology for new disaster strikes. Above all, the definition of disaster management is a collective term encompassing all perspectives, including planning to mitigate the various adverse impacts and create more effective responses and recovery. Therefore, it is a systematic process to minimise disaster events' adverse effect or consequences.

2.6 Disaster Management Cycle

To better understand the importance of disaster management, it is vital to know disaster management procedures. In terms of this, a disaster management cycle is defined by Binashwan (2015) as an "*on-going process by which governments, businesses and society, plan for and reduce the impact of the disaster, by reacting immediately to the following disaster or during a disaster, and also take steps to recover after a disaster has happened"*. Thus, a disaster management cycle includes all activities, measurements, and planning obtained before, during or after a disaster occurs. The purpose of all these activities can be summarised as disaster risk mitigation, helping to avoid any catastrophe, respond and recover from its adverse impacts. There are four different stages of the disaster management cycle, illustrated by Iyer and Mastorakis (2006) as mitigation, readiness, recovery, and response. (See figure 2.4 below)

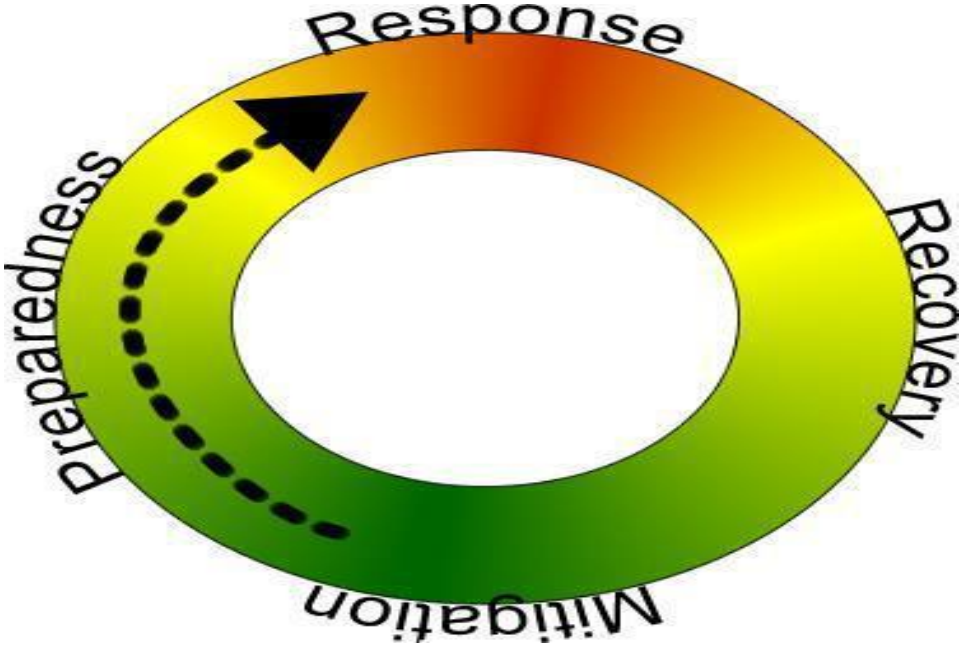

Figure 2. 3 Disaster management cycle (Iyer & Mastorakis, 2006)

According to Orlando, Danna, Giarratano, Prepas, and Johnson (2010), the disaster management process includes four main phases: mitigation, preparedness, response, and recovery, considered in a disaster event. The disaster management process may provide several challenges, which are overwhelming and complicated, where actions in each step are required to mitigate the disaster's impact (WHO & ICN, 2009). This process should be continued whilst applying previous experience to prepare for future events. Moreover, Warfield (2008) states that disaster management aims to mitigate the potential casualties of different hazards and give all disaster victims practical help by offering quick responses and recovery. In terms of the disaster management aim, a disaster management cycle demonstrates the ongoing process governments can hold, civil society or disaster management departments, to mitigate the adverse impacts, respond during and after, and recover. Proper operations in all steps of this cycle can reduce the adverse risks (H. Khan, Vasilescu, & Khan, 2008). The researcher attempts to explain more about each stage of the disaster management cycle in the following sections.

2.6.1 Preparedness

In the disaster management cycle, preparedness and mitigation are pre-disaster. During the disaster preparedness phase, measures are undertaken to manage and control disaster events' negative impact. Preparedness is defined by Hale and Moberg (2005) as a *"continuous cycle of planning, organising, training, equipping, exercising, evaluating, and taking corrective action to ensure effective coordination during incident response".* In other words, the main aim of the emergency preparedness stage is to get an appropriate level of preparation to respond to an emergency, such as a natural or man-made disaster, through specific advanced programs. Regarding Tambo, Fouad, and Khater (2017), preparedness can be described as the logistical preparation to deal with natural or man-made disasters. It may be enhanced by having procedures mechanisms and developing long-term or short-term strategies. Preparedness may be in the form of strategic reserves of equipment, water, food, medicine, and other necessaries in case of local or national disasters. Preparedness measures include some plans such as; training, exercises in emergencies, emergency communication systems and evacuation plans.

2.6.2 Mitigation

Mitigation is undertaken to reduce the possibility of hazards. Thus, mitigation seeks to reduce the negative impacts of disaster events. In other words, the mitigation phase relates to some activities that eliminate the probability of disaster occurrence and reduce hazard risks. In the mitigation phase of a disaster management cycle, all efforts are targets to prevent or minimise hazards from developing. Therefore, mitigation aims to make hazards less likely to happen or mitigate the adverse impacts of disaster events. Each hazard is unique in its effects on organisations, humans, the economy, and built environments.

In the same way, each hazard risk is uniquely altered by the different mitigation options. Thus, several mitigation alternatives might need to be considered and applied depending on the nature of the disasters. The mitigation phase differs from the other phases of a disaster management cycle, with the main concentration being on long-term measurements for eliminating or mitigating risk (Ardalan, 2012). Mitigation measurements are designated as non-structural or structural. Structural mitigation measures are related to those involved with some form of engineering, mechanical changes, construction, or improvement planned at mitigating risk likelihood. While, non-structural mitigation is generally engaged with mitigation in the possibility of risk through modifications in the natural process or human behaviour, where there is no engineered structure usage. In simple terms, a structured measurement uses technological solutions such as flood levees, and a non-structural measure includes land legislation and insurance.

The tactics mentioned above and measurements indicate that disaster mitigation is taken for pre-disaster strikes to reduce adverse risk. Mitigation means acting to mitigate the effects of a hazard before it occurs. The term mitigation applies to a wide range of activities and protection measures that might be instigated, from the physical, like constructing more substantial buildings, to the procedural, like standard techniques for incorporating hazard assessment in land-use planning (Coburn, Spence, & Pomonis, 1994). The prevention phase aims to probe the organisation for signs of weakness before a determined adversary does so.

This prevention effort cannot be passive. It must be actively probed for weaknesses and potential problems (Pauchant & Mitroff, 1992). Mitigation is making the facility less susceptible to damage from a disaster. Examples of mitigation include reinforcing the facility's structure, building a protective structure around it, or moving it to a different location if it is exceptionally essential or mobile. The mitigation of the likelihood or consequence of a hazard can be categorised into structural and non-structural types. (Haddow, Bullock, & Coppola, 2017). Structural mitigation is defined as risk reduction performed by altering the physical environment by applying engineered solutions. The mitigation measures involve or dictate the necessity for engineering, construction, or improvement to mitigate hazard risk likelihood. A unique set of structural mitigation may be applied to its risks through each hazard. For instance, the construction of community shelters, physical modification, resistant construction, building codes and regular measures can be some of the steps to mitigate hazard risk consequences or likelihood (Highfield, Brody, & Blessing, 2014). On the other hand, non-structural mitigation enhances measures and strategies to reduce risk by modifying human behaviour or natural processes without using engineered structures. Non-structural mitigation strategies are usually considered “mechanisms where man adapts to nature”. For example, some measures such as environment control, non-structural physical modifications, community awareness, education programs, and regular measurements can reduce the hazard risk likelihood or their consequences (Haddow et al., 2017).

2.6.3 Response

A response phase is defined by Balamir(2002), where all of the action will be taken and obtained by organisations and people against disaster. Generally, these actions start with the warning of an oncoming catastrophe. However, there can be no warning too. Usually, a response phase's primary goal in the disaster management cycle is to provide instant assistance to improve health and support the affected people's morale. These types of assistance might range from providing specific but limited service, such as temporary shelters and food, or establishing semi-permanent settlements in the closest location.

Regarding Bremer (2003), a response phase involves mobilising the first responders and necessary emergency services, such as ambulance crews, firefighters, and rescue teams. It is also likely to support many secondary emergency services, volunteer teams, and non-governmental organisations like the local Red Cross. In brief, the concentration in the disaster management cycle's response phase meets the basic requirements of victims until a more sustainable solution may be provided.

2.6.4 Recovery

Once the emergency has become relatively under control, the last step of a disaster management cycle should continue until the situation returns to normal. The main target of the recovery phase is to amend affected regions to their previous state. As the emergency is brought under control, the affected population can undertake many activities to restore their lives and the infrastructure that supports them (Seyedin, 2008).

There is no distinct point where immediate relief changes into recovery and long-term sustainable development. There will be many opportunities to enhance prevention and increase preparedness during the recovery period, reducing vulnerability. Ideally, there should be a smooth transition from recovery to ongoing development.

The recovery phase in a disaster management cycle is entirely different from the response phase. Generally, in the recovery stage, all efforts are dependent on problems and various decisions that must be taken after the disaster occurs. In the recovery phase, all steps involve immediate actions that involve rebuilding destroyed property, re-employment, and repairing essential infrastructure (Schwartz, 2006). To sum up, the views and definitions relating to a disaster management cycle are necessary to manage the four phases and eliminate the risk of hazards. The following table (2.7) illustrates the significant aspects of a disaster management cycle.

Table 2. 7 Summary of disaster management cycle phases

Preparedness	➢ Plans and any preparation to save lives ➢ Evacuation plans ➢ Pre-practice and simulation before a disaster occur.
Mitigation	➢ Includes any activities that prevent an emergency, reduce the chance of an emergency happening, or reduce the damaging effects of unavoidable Emergencies. ➢ Mitigation activities take place before and after emergencies.
Response	➢ Includes actions taken to save lives and prevent further Property damage in an emergency. Response is putting the preparedness plans into action. ➢ Response activities take place during an emergency. ➢ Seeking shelter from a tornado or turning off gas valves in an earthquake are both response activities.
Recovery	➢ Recovery activities take place after an emergency. ➢ Recovery includes getting financial assistance to help pay for the repairs. ➢ Includes actions taken to return to a normal or an even the safer situation following an emergency.

2.7 Disaster Management in Iran

As mentioned previously, Iran is in central Eurasia and the Middle East. The population of Iran is about 75 million, and it is exposed to a wide range of man-made and natural hazards. Regarding disaster hazards, humans in connection with disasters, and the impact on health services, the topic of disaster management is at the top of the agenda (Council, 1983).

The International Emergency Database EM-DAT has recorded more than 180 disasters in this country between 1900 and 2013, and in that period, about 160,000 deaths with about 45 thousand people affected. The most important natural hazards in this region are earthquakes, floods, and drought (Ardalan et al., 2014b).

In Iran, the Disaster Management Centre is under the control of the Deputy of Health. Planning, supervision, and coordination are the essential duties of an emergency management centre. In the Bam earthquake (2003), the functions of the Bam health system collapsed. In these terms, the Bam earthquake experienced rapid health assessments shaped by different regions, and training and regional emergency operation services were planned at a different level from provisions and districts. After the Bam earthquake, guidelines on disease surveillance in disasters were developed and applied to others (Ardalan, Mowafi, & Khoshsabeghe, 2013). Besides, the progress of disaster risk management was significantly accelerated, and many improvements were made. Despite valuable achievements, after the Bam earthquake in 2003 and other disaster events, where lessons have been learnt, there is room for improvement of disaster management systems in Iran and the health system.

This challenge has been approached in the last decades, with an improvement of the disaster health system and an upgrade of the centre for environmental health to an emergency management centre under the Deputy of Health Minister. The Iranian health system has been successfully dealing with health problems from the lowest to the highest level of the country's disaster management. Nevertheless, it is necessary to collaborate with different sectors (Babaie, Ardalan, Vatandoost, Goya, & Akbarisari, 2016).

2.8 Hospital management

The hospital management and its functions can be crucial in improving the quality of hospital care, and their managers need several competencies to perform these functions efficiently and effectively. Today, more attention should be paid to professional hospital managers, especially those educated in the field of Health Services Management.

Hospitals are essential organizations providing health services and have an essential role in maintaining and promoting public health (Mosadeghi, 2010) and consume a significant portion of health system resources (Rechel, 2009). Accordingly, the optimal management of hospital affairs requires new management and training of efficient managers (Dehbashi, 2005). The efficiency and effectiveness of the hospital depend to a large extent on the management and effective use of its resources. Managers do this through management functions such as planning, organizing, and directing (Tabibi, 2014), and they need several competencies to perform these functions efficiently and effectively.

These competencies are a set of knowledge, skills, behaviours, and attitudes that are effectively used in various managerial positions(Pillay, 2008). In addition to these competencies, managers' performance is influenced by organizational variables such as work environment, organizational culture, support of high-level managers, and their salaries and benefits (Mosadeghrad, 2018). Since the hospital is one of the important health care organizations that deals with human life and health, the position of management and its functions can be significant in improving the quality of hospital care (Mosadeghrad, 2018).

Effective management of hospitals can lead to the development of organizational culture (Tsai, 2011), empowerment and improvement of staff performance, improvement of quality (Mosadeghrad, 2013), and safety of services (Joshi, 2014), and promotion of efficiency and effectiveness (Tiemann, 2012) of hospitals. Effective process management will lead to better hospital management and resources and staff (Tabibi, 2014). One of the most important reasons for the problems in hospitals is the lack of robust and capable managers who can rely on the necessary knowledge and experience to have the best use of available facilities, satisfy the staff and the clients, and provide the best services in the shortest time (Sanai nasab, 2010). Poor managers' performance in hospitals can cause delays in timely treatment, disease progression, increased inpatient death, increased costs, and wasted human and financial resources (Parand, 2014). They should meet the rational needs of patients and make quality and safe diagnostic, treatment, and rehabilitation services available to the community at an affordable cost (Parand, 2014), and be equipped with relevant and appropriate skills to carry out their tasks and functions efficiently and effectively (Tabibi, 2014).

In developed countries, management in hospitals and healthcare organizations has received considerable attention, so that the Joint Commission on Accreditation of Healthcare Organizations considers the employment of graduates of Health Services Management in the United States and Canada to be essential in developing the mission and vision statements, as well as in accreditation programs for health care providers (Tabibi, 2014).

Graduates of this field are efficient and strategic forces in the health care system. They have an important role in increasing the system's efficiency and effectiveness, improving the quality and quantity of services. The optimal use of resources the these graduates can be used in management positions, the more successful the organization will be in achieving its goals and preventing the waste of resources. Thus, it seems that the use of educated managers in Health Services Management is necessary to improve the health system's performance. These managers today are considered experts and professional managers. Due to the expansion of health services in human societies, the need for experts in this field in all areas of health services management, especially hospital management, is vital to achieving maximum efficiency with minimum cost. Today, more attention should be paid to the education and training and the use of professional hospital managers because the future is full of challenges facing health care organizations in terms of competition for internal and external resources (Tabibi, 2014).

2.9 Vulnerability of Hospitals to disasters

Hospitals and health centres are extraordinarily complicated and are highly vulnerable to external and internal factors (Paul , 2006). Unfortunately, experience has revealed that health centres and the health system are vulnerable to disasters. For instance, in an earthquake measuring 6.6 on the Richter scale in Iran in 2003, all health centres were devastated, and half of the health personnel were killed (Kishore, 2004). In the 2005 earthquake in Pakistan (measuring 7.6 on the Richter scale), 68% of health centres in the earthquake-stricken areas were demolished and unable to provide the victims' services (Kishore , 2011). In 2007, Peru was struck by a major earthquake (measuring eight on the Richter scale), in which 60% of health centres reported various types of damage; however, 80% of services were uninterruptedly provided for the injured and affected people (Chapin , 2009).

In January 2015, a gas pipeline explosion at a maternity and children's hospital in Mexico City killed two infants and two adults and injured many people. It destroyed the entire building (Montejano-Castillo, 2018). According to the cases mentioned above, hospitals are considered one of the most crucial infrastructures of every society.

According to the World Health Organization (WHO) definition, a safe hospital can respond with its maximum power and capacity immediately after a disaster, is available, and is in full operational conditions (Cruz-Vega , 2018). During the 1990s (dedicated to disaster risk reduction), some disasters worldwide led to the publication of numerous articles on the effects of disasters on hospitals and their damage (Molavi-Taleghani , 2020). To prevent such problems, the United Nations launched the "Campaign for Safe Hospitals against Disasters" during the World Conference on Disaster Risk Reduction in 2005. The campaign was based on the commitment that the hospital must be safe to prevent the consequences of disasters and continue operating within three days after the disasters.

Thus, a safe hospital has three indicators: life protection, capital protection, and performance protection (Montejano-Castillo, 2018). Concerning the safety of hospitals, the Hyogo Framework for Action (HFA) and the Sendai Framework for Action (SFA) emphasized the importance of resilience of critical infrastructures such as hospitals by understanding the measures taken to reduce disaster risks. The Sendai framework has a direct impact on health. This framework promotes the safety of health and treatment facilities (*UNISDR, 2015).* There are currently few methods for measuring the safety and vulnerability of hospitals. The Safe Hospital Program Guide defines a safe hospital as a place where services are available and remain at their total capacity with the same existing infrastructures (Arboleda, 2006). The WHO has also developed a method for hospital managers to assess the level of structural, nonstructural, and functional safety by measuring weaknesses in different parts of the hospital; they then can take action to solve these problems (Morán-Rodríguez, 2018).

Owing to communities' limited resources, risk analysis is of great importance. Risk analysis can identify risk factors for hospitals and prioritize and reduce risks. In most risk and safety analysis methods, individual facilities are measured and analyzed mainly by focusing on structural aspects: 1 – risk analysis matrix, 2 – fragility curves, and 3 – structural, nonstructural, and functional indicators (Masi , 2014).

2.10 Hospital Disaster Risk mitigation Management

Disasters may impair people of any community throughout the world at any time. Disasters occur at high frequency and exert wide influence, typically causing property damage, injuries, and death (Hou,2018). In the past decade, sudden disasters have affected more than 1.5 billion people of the world's population (McDermott, 2017), enforced devastating effects on health and medical infrastructure, and posed significant challenges to health systems.

Hospitals may receive an early warning for some natural disasters, such as hurricanes and floods, and activate their response plans before an event. However, there is no preventive alert for other natural disasters, such as earthquakes. Some disasters affect a small number of people: therefore, there is a demand for health systems in a short time. Still, some others cause considerable casualties, followed by the massive demand for health systems.

As the cornerstone of any health system, hospitals play a crucial role in response to natural disasters. Hence, they must be prepared to respond to disaster and avoid it. Following disasters, necessity increases for health care in the affected areas.

In this regard, increasing the capabilities of local hospitals to manage such unusual situations enjoys the highest priority for disaster mitigation measures.

Hospital managers play crucial roles in effectively managing potential disasters. A disaster management program enables the hospital staff to respond adequately to disasters.

Although hospital preparedness has been emphasized in many reliable study sources, multiple studies have demonstrated that lack of preparedness and high vulnerability is a significant challenge for hospitals to deal effectively with disasters. For example, the hospitals providing relief to those injured in western Iran by the earthquake, which occurred in November 2017 in the Azgeleh-Sarpol-e-Zahab area of Kermanshah province, including many challenges for disaster response.

A review study examined 15 hospital preparedness surveys from 2007 to 2015. The results indicated that 80% of the studies estimated the hospitals' preparedness at a moderate level (40-60%) and 13% low. While hospitals are exposed to internal disasters, they also play an important role during the disaster response period. Frequent evaluation and monitoring to identify weaknesses and proper planning can improve the hospital safety level and ultimately improve the quality of hospital services. Health-care system managers must learn the information required in disaster management and make the necessary planning to have proper performance in disasters.

Maintenance of capability and performance of hospitals upon disasters is important to respond to a large number of patients who encountered the disaster when performing their ongoing tasks. Hospitals need to address disaster risk management. Disaster risk management aims to reduce underlying risk factors and prepare for an immediate response to the emergency consequences. Disaster risk management is a holistic approach to all hazards for the whole disaster cycle, including prevention and mitigation, preparedness, response, and recovery.

Lack of planning and organization to deal with disasters, hospital unpreparedness, and lack of staff training might affect irrecoverably the healthcare system. Disasters may functionally disrupt hospitals due to the high volume of referrals, over-hospitalization, inadequate training, nonstandard and insufficient education, communication system disorders, etc.

Disaster risk management reduces the adverse effects of internal and external events that detrimentally influence the organization's activity. Paying attention to risk management-based approaches will significantly improve hospital safety.

2.11 Importance of Hospitals in Disaster Events

A hospital has been defined by PAHO (2000) as a hotel, laboratory, office building and warehouse. A typical hospital depends on numerous factors, such as the continuity of its utility supplies, sufficiency and availability of normal and skilled staff, medical equipment supply, and easy accessibility for its daily operations. In fact, the failure of any of these factors can affect the continuity of medical services importance of hospitals and health centres is clear to everyone due to their critical services and facilities for giving health service to patients at any time. It is crucial that the hospitals remain safe and functional during and after a disaster. Health facilities at all levels deserve special attention in the case of a natural disaster; they must continue the work of patient treatment, staying in their facilities and addressing persons injured by the event (Eybpoosh et al., 2011). Hospitals at any time have a population of patients, staff visitors, and transient patients.

All patients and occupants' security and safety must be secured whilst continuing with ongoing treatments and support services. It is also vital that their promotion and prevention programs are not suspended, such as prenatal care and haemodialysis. To ensure the continuity of services in a natural disaster, the hospital must implement formal plans to deal with such harsh events. The construction plan of the building and its equipment must also remain in a condition of service. The hospital authorities recognise these facts, so they have drawn up plans for dealing with disasters and design strategies to understand and mitigate the risk using a specially designed construction plan (Kenny, 2012).

Though hospitals still need to incorporate prevention and mitigation in these plans, it is crucial to strengthen the committee's hospital disaster risk management system. Hence, the importance of formulating considerations in the design and construction of buildings is vital to provide security and preserve certain critical areas of the hospital, such as the emergency department, intensive care units, diagnostic facilities, operating rooms, pharmacies, food stores and medicines and services for registration and booking. Therefore, the architectural and structural designs should consider safety specifications in relation to aspects of natural physical phenomenon that can affect hospitals and the social, economic and human aspects when planning a hospital (Jaiswal & van Westen, 2013).

Health care factors are usually divided into two categories: social and physical. The physical category includes non-structural and structural parts, while the other type, social, includes administrative and staff functions (Achour, Miyajima, Kitaura, & Price, 2011). Medical facilities are of the utmost importance in any region. Significantly, the size and the priority of usage of health equipment in disaster events can be challenging.

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2.12 Hospital Disaster Management

Hospitals are powerful symbols of social progress. They are a prerequisite for stability and economic development and have symbolic social and political values which contribute to a community's sense of security and well-being(Ul-Haq et al., 2019). Hospitals are expected to play an essential role in reducing deaths and injuries. Hospital readiness may be defined as maintaining hospital operations effectively, sustaining a medically safe environment, and adequately addressing the affected population's increased and potentially unexpected medical needs (Barbera, Yeatts, & Macintyre, 2009). Hospital readiness requires a comprehensive disaster plan, which begins with a thorough risk and hazards vulnerability assessment to identify the most likely threats to a particular hospital. Enthusiasm continues to mitigate, prepare, respond, and recover phases (Kaji, Langford, & Lewis, 2008).

The goals of a comprehensive hospital disaster plan (HDP) are to enable the hospital to effectively manage a disaster, provide continuity of essential societal functions and minimise the following: physical damage to a hospital, loss of life, injury or illness of hospital personnel and human suffering of the persons affected (Olivieri et al., 2017). A comprehensive hospital disaster plan includes all hazards, disciplines/phases, and levels/related organisations in the disaster management process (Koenig & Schultz, 2010).

Nevertheless, one must not regard the plan as the entire essence of emergency preparedness but as one essential element in various activities (Adini et al., 2007). A disaster plan does not equal preparedness (Kaji & Lewis, 2006); however, a comprehensive disaster plan is considered the backbone of hospital preparedness. A critical aspect of a comprehensive disaster plan is an all-hazards approach, which considers any incident or event that could threaten human life, property or the environment (Olivieri et al., 2017). An all-hazards system does not mean being prepared for all hazards that might manifest themselves in a particular community, including the hospital. It means that everyday needs and responses are required in disasters, such as the need for treatment and triage of victims that can be addressed in a general plan. That plan can provide the basis for responders to prepare for unexpected events. It provides a basic framework for responding to various disasters, but planners typically address the kinds of disasters that might be expected to occur (Waugh Jr, 2005). Another aspect of a comprehensive disaster plan is to consider all phases of the disaster management cycle. An effective hospital disaster management plan must be constructed for four stages of emergency management: (1) mitigation, (2) preparedness, (3) response, and (4) recovery (Cyganik, 2003).

The mitigation phase should establish interim and long term actions to eliminate hazards that impact the entity or reduce the impact of those hazards that cannot be stopped. The hospital should develop and implement a strategy to eliminate risks or mitigate the effects of hazards that actions cannot eliminate, e.g. the use of applicable building construction standards; relocation, retrofitting, or removal of structures at risk; reduction or limitation of the amount or size of the hazard; establishment of hazard warning and communication procedures; redundancy or duplication of essential personnel, critical systems, equipment, supplies, pharmaceuticals, information systems, operations, or materials(Barbera et al., 2009). A necessary part of the mitigation plan is to monitor and assess the hazards and unsafe situations that may arise and develop measures to ensure personnel safety. Plans and procedures must ensure the safety of personnel, facilities and resources so that the system can operate effectively (A. Djalali et al., 2014).

The preparedness phase includes those actions taken before an incident to improve the hospital's capability and capacity to respond to a significant incident within or outside the hospital. Preparedness efforts include, but are not limited to, providing elements of surge capacity, developing and maintaining training programs for hospital employees, drill and exercise activities, maintaining cooperation with regional hospitals and community organisations regarding emergency preparedness activities (Cyganik, 2003).

The response phase is the most critical and vital part of the disaster management cycle; it includes those actions necessary to minimise an incident's adverse effects and lead to the recovery and restoration of essential hospital services. However, its success is an effect of the mitigation and preparedness plans. The response contains all processes to reduce morbidity and mortality, which is the medical part of a primary objective disaster plan. It includes but is not limited to command, control, communication, coordination, triage, treatment, surge capacity actions, etc. (Cyganik, 2003; Hick et al., 2008).

The Incident Command System (ICS) is the core of the response phase, not only the command-control system during hospital emergency responses. But it is also the organizing structure for hospital emergency management throughout the entire emergency management cycle, including the mitigation, preparedness, response, and recovery phases (Hick et al., 2008; Tsai et al., 2005).

The recovery phase is the last phase of disaster management. It refers to all activities to bring infrastructure and individuals back to pre-disaster conditions, including mitigation measures to facilitate short- and long-term recovery and rehabilitation. Also, it includes the elements of planning, finance and administration, documentation, and business continuity (Cyganik 2003; ASTM 2009).

The recovery plan should be developed using strategies based on the short- and long-term priorities, processes, vital resources, and adequate time frames for restoring services, facilities, programs, and infrastructure (Arab et al., 2019).

The third important aspect of a comprehensive hospital disaster plan is to be a part of the community disaster plan. Hospitals constitute only one part of the community. They do not function in isolation during a disaster; it is essential for hospital disaster plans to be integrated into the community disaster plan at all levels (Arab et al., 2019). Mutual aid agreements with relevant community organizations and other health care facilities should be included in hospital disaster plans. These agreements should have, but not be limited to, personnel, supplies, equipment, transportation and whatever else is determined to be needed if a disaster occurs.

A remarkable benefit of hospital cooperation with other hospitals and regional health centres is to address surge capacity and capabilities (Arab et al., 2019; Hick et al., 2008). Communications with these organizations should be established regularly to ensure an effective emergency response. This can be based on common terminology, codes, and processes to facilitate effective communication and coordination during an emergency. Some key organizations that a hospital should effectively interact with are (Arab et al., 2019):

•Other hospitals, healthcare organizations, clinics, poison control centres, and other speciality care centres,

•Emergency medical services (EMS) agencies,

•Emergency management agencies,

•Law enforcement agencies,

•Fire services,

•Media. The link between the hospital and the community disaster plan needs to be based on a common language and agreed upon between the hospital and all responsible organizations (Arab et al., 2019).

2.13 Iranian Hospitals in Natural Disaster Events

Nowadays, urban areas are threatened by several natural hazards such as floods, landslides and earthquakes. They can cause considerable damage to buildings and human beings, necessitating disaster mitigation and preparation. Within the context of Iran, hospital disaster management has attracted attention in the recent past. Iran is exposed to a wide range of natural and man-made hazards, especially earthquakes and floods. In the recent past decades, extensive loss and damages have been caused by natural disasters in Iran (Ardalan et al., 2014a). According to the EM-DAT, as cited in (Ardalan et al., 2009a), 181 disasters were recorded in Iran between 1900-2007, which caused 155,811 deaths, 168,217 injuries and affected 44,037,516. Earthquakes, droughts, and floods are the most considerable hazards in mortality, economic damage or people involved (Ardalan et al., 2009b).

The earthquakes of Bam (2003), Zarand (2005), Lorestan (2006), the Golestan floods (2001 and 2005), and Cyclone Gonu (2007), along with recurrent droughts, were the most significant disasters during the last 17 years, which has enabled health systems to learn from and apply the lessons learned. Existing regulations in the design and construction of health facilities in Iran should be reviewed towards disaster mitigation, with the ultimate goal being to protect the lives of patients, staff, and other occupants, ensuring that these facilities can continue functioning after a disaster occurs (Yarmohammadian, Atighechian, Shams, & Haghshenas, 2011).

To ensure continuity of services in natural disasters, the hospital must implement formal plans to deal with such events. Hospitals must have prevention and mitigation plans to reduce the risk of disasters and their impact on patients, buildings, staff, and medical equipment. Nevertheless, hospitals still need to incorporate prevention and mitigation in these plans, and it is equally important to strengthen the committee's hospital disaster risk management (Yarmohammadian et al., 2011). Hence the importance of formulating considerations in the design and construction of buildings to provide security and preserve certain critical areas of the hospital, such as the emergency department, intensive care units, diagnostic facilities, operating rooms, pharmacies, food and medicines stores and registration and booking services (HOJAT et al., 2008).

It is important to note that in Iran, proper designs according to the construction rules resistant to earthquakes, hurricanes, and floods should be considered (Nateghi, 2013). The challenges for hospitals have certainly changed since the Bam earthquake in 2003 as the disaster health management (previously mentioned) has been upgraded from a unit under the centre for environmental health to the emergency management centre under the Deputy of Health Minister, who directs a national emergency operation centre (Ardalan et al., 2014a). Consequently, health systems require strengthening inter-sectoral coordination and information management systems, collaboration, and the integration of disaster health management in all hospitals and health centres across the country (Ardalan et al., 2009b).

Additionally, hospitals' structures should be designed and structured to secure the patients and include health care teams and medical equipment used during disasters. It would require about two generations to replace the current stock of buildings in most communities and pay attention to the intervention structure of existing buildings and the design and construction of new buildings (HOJAT et al., 2008).

One of the most critical steps in disaster management is understanding the impacts and effects of disaster on urban facilities. Given that hospitals take care of vulnerable people, hospital buildings' reaction to an earthquake is vital. Iran is one of the world's most arid regions and suffers frequent droughts, floods, and landslides. Due to its position in the Alpine-Himalayan mountain system, Iran is also subject to numerous and often severe earthquakes. The adverse impacts of disasters on Iranian hospitals have been enormous. For example, in the Bam earthquake (2003), almost all public and private hospitals collapsed. The Zarand earthquake (2005) led to the non-functionality of the district hospital for about six hours due to non-structural damages and staff absence.

In the East Azarbaijan earthquake (2012), the district hospitals almost collapsed, including one hospital that had only opened one year before the earthquake. A fire in Tehran's Arg Mosque in 2006 led to more than 100 burn injuries and challenged Tehran's hospital surge capacity and its ability to manage burn victims. A similar problem was observed following a bomb explosion in Shiraz (2009) that left 202 injured. Even though the Bam earthquake significantly accelerated disaster risk management and hospitals' preparedness in disaster events, there is still room for improvement.

2.14 Surge capacity

Medical capacity is a term that is used to describe the number of persons that can be evaluated or treated within the health care system at any given time. Medical surge capacity is the maximum number of persons that the health care system can assess or treat on sudden demand (Stratton and Tyler 2006). In other words, surge capacity is the maximum potential delivery of required resources, either through augmentation or modification of resource management and allocation (Kelen and McCarthy 2006). Surge capacity is a critical component of hospital preparedness. Conceptually, an optimized, sustainable system for surge has the following components: comprehensive supplies and equipment, trained personnel, physical space, and management infrastructure, policies and procedures for escalation, which can respectively be referenced as "stuff, staff, structure, and systems" (Barbisch and Koenig 2006; Kaji, Koenig et al. 2006; Hick, Koenig et al. 2008).

Another concept related to surge capacity is surge capability, which refers to managing patients requiring unusual or very specialized medical evaluation and care. Surge requirements span the range of specialized medical services (expertise, information, procedures, equipment or personnel) that are generally not available at the location where they are needed. Surge capability also includes patient problems that require particular intervention to protect medical providers, other patients, and the health care organization (Barbera and Macintyre 2007). Hospitals are expected to manage surge capacity issues without external aid for up to 96 hours (Hick, Barbera et al., 2009; Kelen, McCarthy et al., 2009). However, other health care agencies and community emergency management organizations help the hospitals concerning surge capacity and capability (Schultz and Stratton 2007). Community infrastructure, including emergency medical services, communications infrastructure, government institutions (e.g. public safety agencies), and private infrastructure (supply chains, utilities, transportation assets), may have a significant impact on the ability of a hospital to maximize its surge capacity (Hick, Barbera et al. 2009).

2.15 Enhancing disaster management knowledge

Education and training are critical elements of disaster readiness. All medical staff should understand the nature and consequences of possible hazards and how they can contribute to disaster management activities. They should be familiar with all internationally used scientific terms (Ammar, 2008). It is recognized that the science of disaster medicine is evolving and currently lacks recognized not only mature theories but also rarely accessible and up-to-date evidence-based epidemiological studies. Both are considered essential to be developed parallel with the educational programs (Archer and Seynaeve 2007). However, international and national attempts have been made to establish standard educational curricula and materials for medical workers concerning disaster medicine (WADEM 2003; Archer and Seynaeve 2007; Collander, Green et al. 2008; Subbarao Lyznicki et al. 2008; Schultz, Koenig et al. 2012). In 2004, the World Association for Disaster and Emergency Medicine (WADEM) developed the International Standards and Guidelines on Education and Training in health and disaster medicine (Seynaeve G 2004). The guidelines emphasize that education and training programs should be multi-disciplinary and have a vocational focus, case or scenario-based, themed approach, core and electives, modular approach, supervised practical experience and a competency-based approach (Seynaeve G 2004). Enhancing disaster management knowledge can be three different concepts: developing a disaster education and training program, Level of proficiency, and Education program.

2.15.1 Developing a disaster education and training program

Terminology is the foundation for education and training efforts. Because disaster medicine is interdisciplinary by nature, establishing an integrated compendium of terms, acronyms, and definitions is an essential first step. The basic theory that supports the development of education and training programs is called Instructional System Design (ISD) (Clark 2010). It is also known as ADDIE (Analysis, Design, Development, Implement, and Evaluate) (Clark 2010) that involves five phases (Koeing and Schultz 2010):

- Analysis of training needs and identification of requirements for each target audience, including regulations, standards, and accepted practices
- Design of the education and training program and schedule, individual activities, and delivery methods
- Development of content and instructional resources
- Implementation of the education and training program
- Evaluation and improvement activities

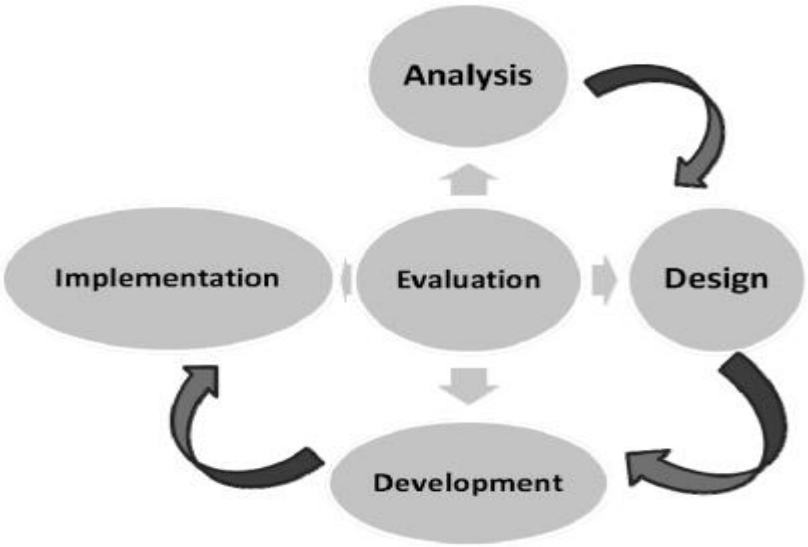

Figure 2. 4 The phases of Instructional System Design

2.15.2 Levels of proficiency

The use of "levels of proficiency" (awareness, operations and expert) is every day in education and training courses. Awareness-level proficiency involves having the necessary knowledge or understanding of the topics. Operations-level proficiency entails the knowledge, skills, and abilities to perform any tasks involved safely. Expert level proficiency in the operations-level, plus the knowledge, skills and abilities to apply expert judgment necessary to solve complex problems (Koeing and Schultz 2010).

2.15.3 Education programs

The frequency and scope of training should be sufficient to maintain knowledge levels in various hospital personnel types. This can be validated through a competency-based approach that allows healthcare workers to be evaluated during a scheduled drill/ exercise (ASTM 2009; Schultz, Koenig et al. 2012). Some crucial subjects need to be addressed in a disaster training program for healthcare systems, including hospitals, such as individual and family preparedness, safety, incident command system, organizational resiliency, surge capacity and capability, and cooperation with external systems (Koeing and Schultz 2010). A regulatory or certifying body may establish the minimum hours of hospital personnel training in emergency operations preparedness. Still, hospital employees are recommended to train two to ten hours per year, based on the employee's function and the hazard vulnerability assessment for his/her department (ASTM 2009). Training adequacy should also be measured by achieving educational objectives and demonstrating competency in the content (ASTM 2009).

2.16 Disaster Drills and Training

An exercise is a generic term for a range of activities that test emergency response readiness, evaluate an emergency response plan and assess the success of training and development programs, all of which are for improving a hospital disaster plan (School of Nursing 2006; ASTM 2009; Melissa Cheung 2010). Besides, drills and exercises can identify areas of the plan that have not been addressed, provide experience in the use of the plan, can be used to identify training that is required or has been conducted, evaluate personnel performance, meet requirements for community preparedness and maintain continuous learning on all-hazards preparedness (ASTM 2009).

In general terms of hospital context, a hospital preparedness exercise is the means for a hospital to test and evaluate its capacity and capabilities for preventing, preparing for, protecting from, responding to, and/or recovering from an event that may overwhelm a hospital's patient care or operating systems. Exercises are an essential component of an emergency management program and one of the most effective ways a hospital can test, evaluate and ultimately improve this program (Lynn, Gurr et al. 2006; Melissa Cheung 2010). There are five basic drills and exercises: orientation exercises, tabletop exercises, drills, functional exercises and full-scale exercises. The first two categories are primarily discussion-based, whereas the other three are action-oriented (School of Nursing 2006)

2.16.1 Discussion-based Exercises

- Orientation exercises that familiarize the personnel with the emergency response plan and/or new or changing information/procedures.
- Tabletop exercises stimulate in-depth discussions of a simulated situation and make decisions about it. In these exercises, the problem-solving methods will take longer than the actual emergency conditions where the decision making must be faster. Problem-solving is the primary purpose of this exercise (School of Nursing, 2006).

2.16.2 Operations-based Exercises

- Drills test personnel training, response time, interagency cooperation and resources, and equipment capabilities.
- Functional exercises that test and evaluate the capabilities of an emergency response system.
- Full-scale exercises are used to test and evaluate a significant portion of the emergency operations plan interactively over an extended period. These exercises typically involve more than one agency (School of Nursing, 2006).

Before developing and conducting an exercise and maximising these exercises' efficacy and efficiency, some key areas should be considered, such as training personnel, defining clear objectives and providing requirements (Dausey, Buehler et al. 2007; Melissa Cheung 2010). Participants must be trained in the emergency operations plan and their roles during an emergency; an exercise can only effectively test the participants' knowledge. An exercise should be small-scale, which requires less time and resources. It will effectively focus on the deficiencies of previous training and improve response practice. The exercise also needs clear and SMART (simple, measurable, achievable, realistic and task-oriented) objectives to be specifically tested.

Finally, it is important to use exercises that involve the entire community, including the EMS, police, fire and public health departments, because very few incidents affect a single entity (Dausey, Buehler et al. 2007; Melissa Cheung 2010). Generally, developing an exercise consists of five steps (Melissa Cheung 2010): foundation, design and development, conduct, evaluation, and improvement planning. These phases are meant to be a cycle, with the following exercise based on lessons learned and improvements made from previous exercises. Before a hospital can enter the exercise cycle, it is also necessary that it must have established an emergency management program (ASTM 2009; Melissa Cheung 2010).

The purpose of the evaluation of an exercise is to assess the performance of participants, and the emergency operations plan to determine the proficiency with which the hospital staff was able to carry out the tasks and demonstrate the desired capabilities and competencies, as well as the extent to which objectives were met. Evaluation of exercises is essential for identifying weaknesses and gaps, critical in improving and strengthening a health care organization's emergency management program. The exercise design and control team (Lynn, Gurr et al. 2006; ASTM 2009).

2.16.3 Performance measures

Performance is a measure of how well an activity is executed and measured in terms of structure, process or outcome (Moore 1999; Sobo, Andriese et al. 2001). Performance measurement analyzes the success of a workgroup, program or organization's efforts by comparing data on what actually happened to what was planned or intended (Lichiello and Bernard J. Turnock 2011).

Performance measurement is the selection and use of quantitative or qualitative measures of capacities, processes and outcomes to develop information about critical aspects of activities during education, training, exercise and real incidents (Gryth, Radestad et al. 2010; Lichiello and Bernard J. Turnock 2011).

Results of management groups' performance such as command, control and coordination activities by the hospital incident command system are one way of testing and evaluating disaster preparedness (Arnold, Paturas et al. 2005; Ruter, Nilsson et al. 2006). In this thesis decision making, the hospital incident command system's performance was measured, during tabletop exercises, using the job action sheets of the HICS as performance indicators (EMSA 2006).

2.17 Impact of Natural Disasters on Hospitals

Generally, hospitals and health care centres need special consideration to manage the impact of disasters. This is because of the need to continuously provide healthcare facilities for the patients currently in the hospitals and deal with accidental injuries (SPARC, 2016). As aforementioned, hospitals have a population of patients, staff, visitors, and transient patients. All patients and occupants' security and safety must be secured whilst continuing with ongoing treatments and support services. It cannot be doubted that hospitals and health facilities are the world's largest industry; in this case, hospitals and especially public hospitals need a vast bureaucratic structure to run and give good service to patients (Yarmohammadian, Atighechian, Haghshenas, & Shams, 2013).

According to (WHO, 2011), as cited by (Noralfishah, Thayaparan, Haidaliza, and Kulatunga, 2015), hospitals play a critical role in disaster events by providing communities with essential medical care. In terms of disasters and the disaster's nature, healthcare services' demand can rapidly increase and overwhelming functional capacity and safety.

There are different impacts associated with disaster events, such as the hospital's ability to function, the direct effect on the patients and health equipment, and physical damage to hospital buildings (Ardalan & Schnelle, 2016).

Moreover, the documentation of the options and medicine can be affected, and it is vital to keep these in the correct order. The supply of food and necessary treatment, especially in the early hours of a disaster, is crucial, considered by disaster managers (Nakhaei, Khankeh, Masoumi, Hosseini, & ParsaYekta, 2014). Consequently, proper disaster management is vital for hospitals and health centres. It may become necessary to evacuate non-ambulant and ambulant patients; therefore, the responses to a disaster, including evacuation procedures, should be well established.

As the initial source of medical care, a hospital's very nature and purpose demand that it remains fully operational in the aftermath of any major disaster (Schultz, Koenig et al. 2003). To consider the priorities for hospital disaster management activities, it is essential to know which of the health facility's services will be of greater or lesser importance in managing a disaster. , the importance of medical services can be rated as (1) dispensable, (2) preferable, (3) necessary, (4) very necessary and (5) indispensable in the event of a disaster (Table 2.8) (Arab et al., 2019).

Table 2. 8 Importance of typical hospital services in an emergency Source: Pan American Health Organization (Arab et al., 2019; Chand & Loosemore, 2015)

Clinical and support services	Importance rating
Trauma and orthopedic	5
Intensive care unit	5
Urology	5
Emergency care	5
Sterilization	5
Diagnostic imaging	5
Pharmacy	5
Nutrition	5
Transport	5
Recovery	5
Blood bank	5
Outpatient consultation/admission	4
Pediatric surgery	4
Pediatrics	4
Laboratory	4
Haemodialysis	4
Laundry services	4
Internal medicine	3
Gynecology and obstetrics	3
Administration	3
Neonatology	3
Respiratory medicine	2
Ophthalmology	2
Filing and case management	2
Dermatology	1
Psychiatry	1
Oncology	1
Otorhinolaryngology	1
Dental services	1
Therapy and rehabilitation	1

Negative natural phenomena affect health systems' operations directly and indirectly (Sever, Remuzzi, & Vanholder, 2018). An unexpected number of deaths and injuries, migrations from the affected area towards other areas where the health system capacity may be overwhelmed by the new arrivals, an increase in the potential risk of a critical outbreak of communicable diseases, etc., are indirect effects of disasters on health systems (WHO/PAHO 2004). Experience shows that hospital damage from natural disasters often occurs in the event of a disaster, and this is not limited to developing countries (Edelman, 2006; Schultz et al., 2012).

The most likely impact of an event on a hospital is damage leading to a functional collapse (WHO/PAHO 2004), which results in a complete or partial evacuation of the damaged hospital (Bagaria et al., 2009; Schultz et al., 2012; Sternberg, Lee, & Huard, 2004)

There is a consensus that knowledge of the potential impact to facilities on hospital operations is of major importance for the following reasons (WHO/PAHO 2000; Paul and Lin 2009):

1. Hospital facilities must maintain their normal functions and attend to the sudden surge of demand for medical treatment following a disaster,
2. Hospitals accommodate many patients, who, due to their disabilities, are unable to evacuate a building in the event of a disaster,
3. Hospitals have a complex network of electrical, mechanical, and sanitary facilities, as well as expensive equipment, all of which are essential for the routine operation of the hospital,
4. The ratio of the cost of non-structural elements to the total cost of the building is much higher for hospitals than other facilities (WHO/PAHO 2000; Paul and Lin 2009).

The terms "structural" or "structural components" refer to those parts of a building required for physical support. They include foundations, columns, supporting walls, beams and divisions. For instance, some elements such as floors and ceilings are designed to transmit horizontal forces occurring in an earthquake through beams and columns into the foundation. Both existing and planned health care establishments in areas exposed to seismic activity must comply with building codes for seismic resistance (Preparedness & Program, 2000). There are many measures to mitigate the risk of disasters on structural elements in hospitals. One of the most common measures is using building codes in hospitals.

A Building Code is defined by the Committee, Institute, and Standardization (2008) as *"a set of laws enacted by the state, county and city governments to determine the required design and construction standards for home construction. For example, building codes determine how electrical, plumbing and framing must be built."*

These building codes are intended to ensure the building's occupants' safety and, secondarily, to allow the facility to continue functioning during and after the event. Although completely earthquake-proof structures are financially unrealistic, seismic-resistance standards provide design criteria to avert collapse and assure functionality after any disaster.

2.18 Measures to Mitigate Risk of Non-Structural Elements in Hospitals

Building standards for health facilities are different from those of most other buildings, particularly health facilities under increased pressure to attend to medical emergencies in a disaster's aftermath. As a result, hospitals' mitigation measures must be oriented to avoid the loss of life of patients and staff, and secondly, to ensure that the hospital will function properly after the hazard's impact. Each component of the hospital must undergo a vulnerability analysis. A breakdown of standard non-structural mitigation techniques is presented below (Jabari, 2014).

2.18.1 Brace Exterior Elements

Eliminate or mitigate damages to exterior elements such as external facing, windows, doors, bracing, strengthening, reinforcing, or replacing components or connections to withstand earthquake forces. Mitigation measures include bracing parapets, anchoring or replacing cornices and architectural elements, bracing chimneys, securing wall panel anchors, bracing large windows, or replacing window glass (Ehteshami, 2005).

2.18.2 Anchor Interior Elements

Anchor interior non-structural elements (non-load bearing interior walls, partition walls, suspended ceilings, and raised computer floors) strengthen or reinforce components or connections to withstand earthquake forces and movements. Mitigation measures include securing un-braced suspended (drop) ceilings and overhead lighting fixtures, wires and struts, bracing of interior partitions, and anchoring raised computer floors at their pedestal supports (Sazegar, 2012).

2.18.3 Protect Building, Electrical, Mechanical, and Plumbing Systems

Anchor heavy building utility equipment and secure utility connections and supply lines protect them against earthquake forces and movements. Heavy building utility equipment can be anchored by protecting springs on vibration isolators, securing gas tanks with metal straps, and bracing and restraining elevator counterweights and rails. Utility connections and supply lines can be secured by bracing overhead utility pipes and HVAC ducts with metal brackets, installing flexible pipes or conduits at connections, and installing seismic shut-off gas lines (Ardalan, 2009).

2.18.4 Secure Building Contents

Secure medical equipment and other building contents to mitigate movement from earthquake-induced ground shaking. Desktop computers and equipment can be restrained with chains, cables, clips, or cords. Metal anchors can secure bookcases and large filing systems to floors, walls, or each other. Hazardous materials and other miscellaneous furnishings (tables, chairs, cubicle wall partitions, wall hangings, etc.) can be secured with straps, anchors, angle brackets, sturdy hooks (Shams, 2011). As can be seen from the information above, maintaining a high standard of structural and non-structural measures in hospitals should be a priority.

Non-structural elements in hospitals are those elements that are not physically involved with construction, therefore any measures that are not affecting physical structure which uses knowledge, practice or agreement to reduce disaster risks and impacts, in particular through policies and laws, public awareness-raising, training and education (ISDR, 2009). Non-structural mitigation in emergency management involves what people can do on a personal level that is not structurally or physically evident as a protective defence such as a surge wall or a storm shelter. Non- structural mitigation, in general, would involve things such as having flood insurance (WHO 2011). Standard non-structural measures include building codes, land use planning laws and their enforcement, research and assessment, information resources, and public awareness programmes (Karimzadeh, 2009). Structural measures are engineering works that aim to moderate the stream channels, while non-structural are non-engineering based measures mainly aim at loss sharing (e.g. disaster aid and insurance) and loss reduction methods (e.g. preparedness, forecast, warning and land use planning) (Smith & Ward, 1998).

2.19 Barriers Against Disaster Management in Hospitals

Regarding hospitals' importance in disaster events, there are some barriers against disaster managers to managing these events properly. According to Yarmohammadian et al. (2013), disaster managers must face internal and external barriers. Some internal barriers connected to hospitals include; a lack of motivation in the hospital staff and managers, a lack of common language, the high cost of implementation, a lack of competitive atmosphere for the excellence and progress involvement of administrative managers in daily activities, as well as a lack of feeling the need for crises management and a lack of knowledge in disaster managers (Milsten, 2000).

At the same time, there are also some external barriers that disaster managers are confronted with, such as; a lack of non-commitment and authoritarianism of managers, an absence of statutory requirements, different decision making authorities, a lack of administrative culture for managing crises, weak communication, and coordination of crises teams, as well as a lack of emergency incident command systems in a country with one of the highest levels (Yarmohammadian et al., 2011). In conclusion, the importance of hospitals in disaster events is clear. As a result, it is crucial to have proper disaster management to avoid and mitigate the risk of disasters in hospitals. In this study, the researcher has attempted to improve and find appropriate disaster management strategies to mitigate the impact of natural disasters in hospitals. In the following chapter, the methodology of this research will be explained.

2.19.1 Injury Management

When facing a disaster, the first issue for hospitals is managing the numbers and requirements of injured people. Examples include the Herris hospital (in North-West Iran, which was destroyed in the 2012 earthquake, and the Ahar hospital, which saw its first and ground floors destroyed. Although both hospitals had to be evacuated, no special instructions were prepared to deal with this eventuality. Moreover, as staff and patients had to be evacuated, some patients could move while others were left in the health centres. Later, with rising tensions between patients and increasing damage to the hospital structure, the evacuation was slowly. After this earthquake, all affected patients were moved to Tabriz, and only one hospital was fully evacuated. Besides, the patients' documents also needed to be incorporated into the evacuation and eventual relocation. Hence, the coordination of patients and their records needs attention during and after a disaster, particularly when undertaking evacuations (Pouraghaei et al., 2017).

2.19.2 Lack of Communications

When a natural disaster occurs, some communication tools will be suspended, such as Wi-Fi signals, mobile and local telephone networks, and internet signals; for example, following the Herris and Ahar earthquakes, local telephones failed, and there was also an issue with hospital phones in Tabriz. Furthermore, although the mobile signal was not cut off, the signal was weak in most areas due to a failure in the centre and a spike in call traffic. Nevertheless, after one day, the issue was resolved, demonstrating a rapid response to communication access (Ardalan, Mowafi, & Homa Yousefi, 2013).

2.19.3 Lack of Coordination

A further challenge following the earthquake was the lack of proper coordination of relief, which can be classified into two categories: intra coordination and inter-sectoral coordination. A lack of coordination affects all activities, and this, plus a shortage of equipment, are significant barriers to effective service delivery. In the case of the Bam earthquake, it impacted as follows: coordination problems with volunteers who came to assist; a lack of coordination among health centres and officials of different hospitals; a lack of hospital incident command systems and a failure to perform sufficiently frequent examinations of some of the injured; confusion between personnel and officials; a lack of coordination between prehospital emergency officials and hospitals; staff disregarding official orders; the intractable performance of tasks by the team; the absence of a command unity and unit commander fragmentation; unnecessary interventions of irrelevant people; the absence of official accountability; and disaster management interventions by county headquarters (Pouraghaei et al., 2017).

2.19.4 Lack of Preparedness

The lack of preparedness of disaster managers can significantly impact providing an effective service to hospital patients in a natural disaster event. With a lack of previous staff training, a lack of initial planning to address issues arising from disaster events, no attention to previous experience, no anticipation of demands, a failure to meet demands, and no attention to the preparedness plans, the impact of natural disasters can be increased (Shamsalinia, Ghaffari, Dehghan–Nayeri, & Poortaghi, 2017).

2.19.5 Logistics Deficiencies

Other challenges facing disaster managers in such events include logistic deficiencies, including a lack of funds for emergencies, challenges to security management, issues with donation management, inappropriate places to provide medical services, and difficulties with human resource management. Both hospitals in the North-West of Iran were destroyed after an earthquake happened; however, only one location was prepared in the hospital campuses to assign their health services, which was inadequate for the numbers of personnel and injured people. For instance, there were insufficient sanitation facilities and an issue with the cooling and heating systems.

Even when other health centres were not damaged, the same problems were experienced. Furthermore, there were not many donations to the hospital, and no funding was predicted for such urgent moments, which also caused issues for the disaster recovery of the hospital and its continued operations.

Although there were no security issues, people rushed to get first aid treatment and medicines. Staff members complained about the temporary settlements in the hospital campuses. There was fear about incoming injured people and the buildings' security due to a lack of sustainability in the temporary constructions (Shojaie, 2007). The following table summarises the most challenging impacts for disaster managers in Iran when keeping hospitals safe and secure in a natural disaster.

Table 2. 9 Summary of challenges faced by disaster managers in hospitals

Lack of preparedness No previous training of personnel and lack of training programs Lack of prior planning for disaster situations Failure to anticipate and meet needs Lack of attention to the experiences	**Communication and information management** Contact with the media Communication within the hospital Out-of-hospital communications Management of crucial people and visitors
Logistics challenges Inappropriate places for providing services to the injured Management of donations No emergency fund Security management Human resources management	**Technical challenges** Evacuation of hospitals Patient security Admission Entry and exit management and discharging of injured Triage and prioritization of patients
Lack of coordination Coordination problems with volunteers who were referred to help Lack of coordination among hospital officials Lack of coordination among the authorities in different hospitals Lack of coordination among the prehospital emergency and hospital authorities No Incident Command System and not running if there was any Disobeying the orders of officials by personnel Intractable performance of tasks by staff Absence of command unity and single commander Frequent examinations of some injured Bewilderment of personnel and officials Fragmentation and repetition Inappropriate interventions of unrelated individuals	

How hospitals respond to the demand for medical attention during and after a disaster event can be highly challenging. Natural disasters impact healthcare organisations and remind disaster managers to pay attention to their staff's safety, particularly their first responders and physicians (Francescutti, Sauve, & Prasad, 2017). Usually, disaster managers in hospitals are faced with a range of challenges in such events, which include; unexpected changes to newly injured or ongoing patient management, communication challenges, a lack of coordination, a lack of preparedness, and logistical deficiencies.

For example, in August 2012, an earthquake occurred close to Ahar and Varzeghan in the East-Azerbaijan province of North-West Iran. This earthquake caused over two million people to suffer and forced many to sleep outside for two nights. The earthquake killed 327 people, claimed more than 3000 injuries, and left more than 30,000 people homeless. Buildings in the stricken area experienced diverse levels of damage; however, most of the villages' adobe buildings had collapsed, and several masonries and framed buildings were damaged. Furthermore, some roads were damaged due to surface faulting and geotechnical instabilities (Razzaghi & Ghafory-Ashtiany, 2012).

Although some of the bridges suffered damage, they remained serviceable after the event. Nevertheless, many essential facilities, such as hospitals in the stricken areas, were damaged. After the earthquake, some industrial plants experienced economic losses due to the unsafe shutdown process. The hospitals' performance was not acceptable in that they were not operable after the disaster. One example of this was the Bagher-aloom Hospital in Ahar city, which suffered remarkable non-structural damages and was put out of commission after the earthquake. The collapse of the infill walls, false ceilings, and overturning medical equipment were significant failures in the hospital's non-structural components. Due to such damage, treatment was carried out in temporary hospitals set up in tents; as shown in Figure 2.8, rescue teams had to transfer injured people to the hospitals in nearby cities.

Furthermore, heavy traffic jams in Tabriz-Varzaghan, Tabriz-Ahar and along other main roads of the affected area caused significant trouble for the rescue teams, with the main reason being the substantial number of volunteers heading towards the affected areas to help the rescue teams. Notably, effective disaster planning could have mitigated some of the potential damage of this natural disaster and provided a better health service during and after the disaster to patients in the worst affected hospitals. Some specific challenges of disaster managers will be explained (Razzaghi & Ghafory-Ashtiany 2012).

Figure 2. 5 Herris Hospital and the Temporary Tents Outside Of Hospital Building (Razzaghi & Ghafory-Ashtiany, 2012)

2.20 Summary& Link

This chapter has presented a review of the literature in disaster management. The chapter began by introducing the concepts of disaster, disaster management elements and their definitions. Specifically, disaster management in Iran was reviewed, and the impacts of natural disasters on the hospital. Finally, disaster managers' main challenges when controlling and managing hospitals in a natural disaster event are mentioned. In the next chapter, an outline for the methodology is chosen and adopted to achieve this research's aim and objectives.

Chapter 3

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

A study can be defined as a particular process the researcher follows to achieve the aims and objectives. Thus, accomplishing the aim and objectives is similar to having a set of different activities to realize. These activities have to be completed within a certain time; otherwise, it can be pointless (Becker, 2008). The research methodology is defined by Sekaran and Bougie (2016) as *"an organised, systematic, data-based, critical, objective, scientific inquiry or investigation into a particular issue, undertaken to find a solution to it".* Research is an original contribution to the existing stock of knowledge making for its advancement. It is the pursuit of truth with the help of study, observation, comparison and systematic methods of finding solutions. The research methodology is a way to solve the research problem systematically. It may be understood as the science of studying how research is done scientifically (Kumar, 2014). Many dimensions and research methods constitute a part of the research methods. Thus when research methodology is discussed, it is not only of the research method, but also it considers the logic behind the methods being used in the context of the research study and explains why a particular technique or methodology is used and why the others are not used (Kumar, 2014).

Consequently, the research methodology is an approach that a study considers its philosophical or theoretical assumptions to develop strategies for collecting and analysing data. It differs from methods, which is only used to collect and analyse data; in other words, methods are part of the methodology, and methodological choices refer to the research design.

A systematic approach concerned with the generalization and the formulation of a theory is also research (Yin, 2009). According to Sanders (2011), research is a science concerned with the comprehensive, intellectual searching of facts and their significance or inference regarding the problem under study. It is considered more objective, systematic, a well-determined scientific process of investigation, and, finally, a frequent report form. It is always intended to invent or discover new knowledge and answers to the questions and solutions to problems.

Therefore, it is vital to follow proper research methodology from the beginning of any research. This is because it needs to be conducted accurately to achieve the aim and objectives at the end of the research. Moore (2006) states that methods are tools for the researcher's trade, and researchers need to know how and when to use them. It is defined by the Concise Oxford dictionary and has been quoted by Naoum (2012) as *"careful search or inquiry; endeavour to discover new or collate old facts"*. By this definition, the importance of research methodology is illustrated. Managing it is a complex task and changing field that demonstrates many non-interrelated and interrelated tendencies. An adequately designed research methodology should help address the research problems (Blessing & Chakrabarti, 2009).

Thus, research methodology brings different required information and guidelines that allow the researcher to make suitable decisions to solve research problems and conduct research through an appropriate path, ultimately achieving the aim and objectives.

In this chapter, the researcher attempts to describe the research and data collection methods. The research methodology adopted for the study will be discussed in the chapter to show how the study aims and objectives will be achieved. The researcher has defined research models and philosophy, approach and strategy, and research choice, and in the following section, each option is justified for this research.

3.2 Research Models

Considering the research definition, Kumar (2014) states that research is a process for collecting, analysing and interpreting information to answer questions. But to qualify as research, the process must have specific characteristics: it must, as far as possible, be controlled, rigorous, systematic, valid and verifiable, empirical, and critical. Furthermore, Rugg (2006) characterises research based on the nature of finding something new. 'New' may mean new to everyone (primary research), or it may merely mean new to the researcher (secondary) (Rugg, 2006).

Traditionally, scholars have identified three components that form the backbone of all research (a) Design, (b) Measurement, and (c) Analysis (Heppner, Wampold, Owen, Thompson, & Wang, 2015). Besides, there have been many attempts to explore and exploit research methodology for scientific disciplines and social sciences. This work of scholars and experts has resulted in the production of models, explaining the research nature and path stage amongst other criteria (Ritchie, Lewis, Lewis, Nicholls, & Ormston, 2013).

In terms of finding the best way to approach the objectives, choosing the correct research model is essential, and several models can be used to achieve this. The Nested model (Khan & Tzortzoplous, 2016) and the Onion model (Saunders, 2012) are very popular among different researchers.

The Nested model consists of three layers: research philosophy, research approach, and research strategies (Kagioglou, 1998). Whilst in the onion research approach model, six layers are included. In this research, the research onion approach of Saunders et al. (2015) is adopted because it provides a comprehensive understanding of the different aspects that need to be followed when structuring the research methodology.

From the outer layer to the inner layer are research philosophy, research approach, embodies, choice of the methodology, time horizon, and the final one is the collection and data analysis. The Nested research model is shown in Figure 3.1, and the Sanders research model is shown in Figure 3.2.

Figure 3. 1 Nested research model is adopted by Kagioglou (1998)

The ‘Research Onion’ (Figure 3.2), introduced by M. Saunders, Lewis, and Thornhill (2009), is selected for this research. Saunders’ model's main advantage is its detailed design of strategies and their sequences, which is drawn.

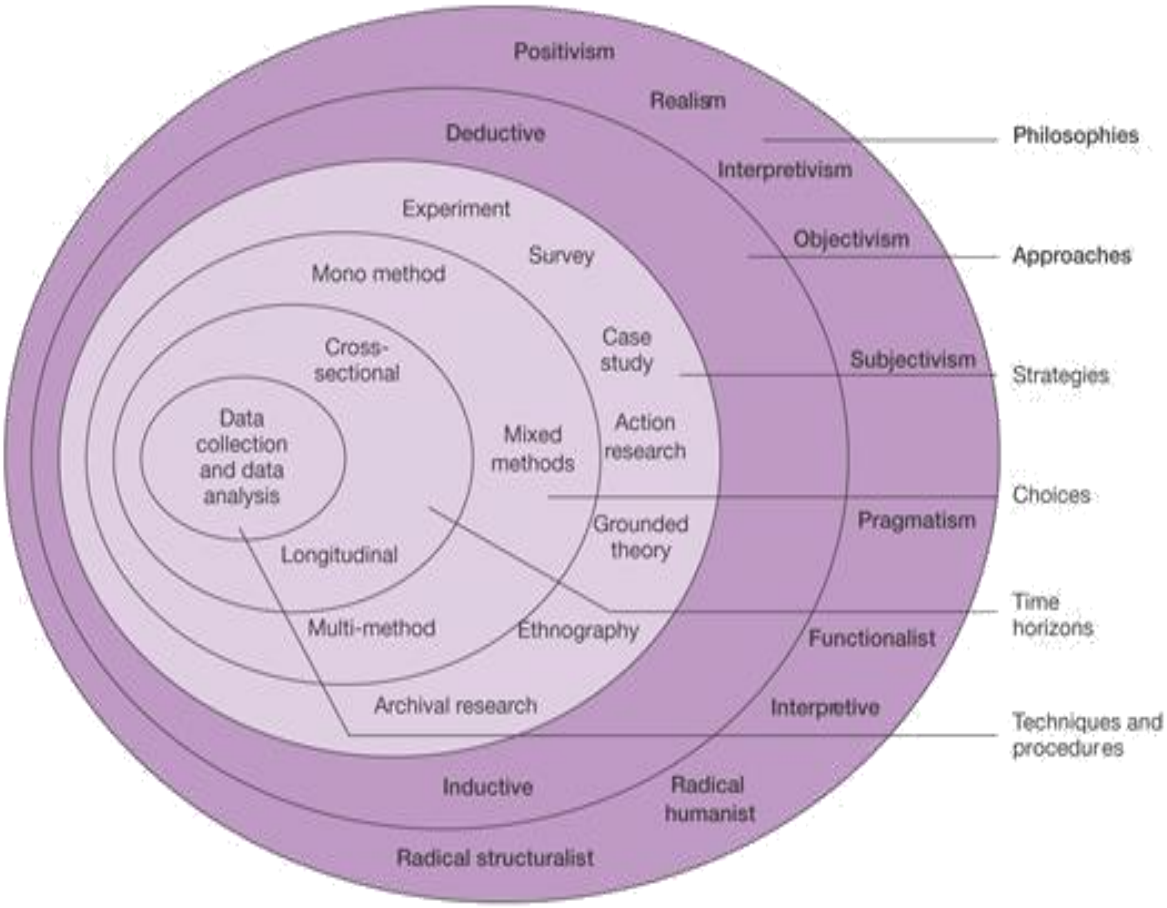

Figure 3. 2 The Research Onion, Source:(Saunders, 2012)

According to the research onion model, the research process should start from the outer layer and peel away different onion layers until it reaches the centre. It identifies the techniques that should be used to collect data to answer research questions. The first layer identifies the research philosophy that should be adopted for the research. The second layer considers the research approach that flows from research philosophy. The following three layers, methodological choice, research strategy or strategies, and choosing time horizon for the research, are concentrated on the research design process.

The third layer considers different methodological choices that could be used for the research and is influenced by the research philosophy and approach. The fourth layer considers the most appropriate research strategy. The fifth layer concentrates on the research's time horizon, which depends on the research questions. The last layer is about different data collection methods that could be used for the research. Choosing the best data collection methods is dependent on the previous layers and research questions.

3.3 Research's Types

Two essential elements of conducting research are identifying (a) the research type and (b) research design. Kumar (2014) classifies research into three perspectives (a) application, (b) objectives and (c) type of information sought. However, Kumar (2014) suggests that these three classifications are not mutually exclusive; that is, a research study can also be classified from the perspective of each of the above items. According to Kumar (2014), research endeavour can be classified as descriptive, explanatory, exploratory, and correlational when research is conducted from its objectives.

Exploratory research is from the viewpoint of the objectives of a study. This is carried out to investigate the possibilities of undertaking a research study. This study is also called a 'feasibility study' or a 'pilot study. Generally, research is conducted through this method when very little is known about the topic being investigated or the research context. Perhaps the topic has never been explored before or in that context. The methods used to conduct exploratory research need to be flexible but are not usually as rigorous as those used to pursue other purposes (Blaikie, 2009). This research could be conducted by interviewing 'experts' in the subject, a critical review of the literature and conducting focus group interviews. According to Collis and Hussey (2013), exploratory research is likely adopted for qualitative measures.

Kumar (2014) classifies a study as descriptive research, which attempts to systematically describe a situation, problem, phenomenon, service or program, or provides information about, say, the living conditions of a community or describes attitudes towards an issue. According to Andrew, Pedersen, and McEvoy (2011), descriptive research focuses on what is happening rather than why it happens.

It typically describes characteristics of a phenomenon using surveys, interviews or observations. Furthermore, statistical or quantitative techniques are adopted in descriptive research to collect and summarise the data. It aims to overview the various characteristics of a phenomenon and not necessarily why the phenomenon exists (De Vaus & de Vaus, 2001). On the other hand, explanatory research attempts to clarify why and how there is a relationship between two aspects of a situation or phenomenon (Kumar, 2014). Therefore, the descriptive study aims to assess causal relationships between variables, and it can be used to determine the accuracy of a theory (Andrew et al., 2011).

However, it is difficult to differentiate explanatory research from descriptive research as it seeks to answer the 'why' questions, and any explanation involves description. To clarify the difference, DeVaus (2001) states that the explanation is used to discover why the phenomenon exists to suggest solutions, whilst the description only gives an overview of a phenomenon. Explanatory research explains the relationships between variables in a situation or a problem.

In this study, the researcher focuses on natural disasters and the impact of natural disaster events on hospitals. As the statistics of previous natural disaster events show, hospitals are very likely to be affected and involved with the negative impact of these disasters.

This research aims to enhance the resilience of the health care facilities from floods and earthquakes in Iran by improving some failures in mitigation and the preparedness section of the disaster management cycle. It is expected this research will contribute to expanding the understanding and knowledge of individual disaster managers and different organisations relating to the health system to mitigate the risk of natural disasters in hospitals. Consequently, this research is potentially grouped under the descriptive type of research, which is descriptive. This research study attempts to systematically describe a situation, problem, phenomenon, service or program, or provides information about, say, the living conditions of a community or describes attitudes towards an issue; thus, the descriptive research type is the closest.

3.4 Research Philosophy

Researchers need to know and choose the right research philosophy from their initial point. Saunders et al. (2007) state that the research philosophy relates to the nature and development of knowledge. An appropriate research philosophy contributes to a better vision and gives several better assumptions about how researchers work with reality (Saunders, Lewis, & Thornhill, 2012).

Moreover, the term 'research philosophy' relates to the development and nature of knowledge (Collis and Hussey (2013). This principle is premised on the researcher's assumptions concerning how the world operates, how acceptable knowledge is defined, and the role values play. These perspectives have the power to direct and steer the researcher through the research process (Pasian, 2015). The choice of research philosophy underpins the choice of research design. Subsequently, there are three reasons as to why an understanding of the philosophical issues is very useful:

First, it can help to clarify the research design. This entails considering the type of evidence required and how it can be collected and interpreted. Second, knowledge of philosophy can help the researcher recognize which design works best. Finally, knowledge of philosophy can help the researcher identify and adapt research designs according to different subjects' constraints or knowledge structures (Wilson, 2010).

A research philosophy contributes towards a better foundation based upon research questions and the research objectives. According to Easterby-Smith, Thorpe & Jackson (2012), a research philosophy is crucial. Firstly, it helps researchers to clarify the research design. Secondly, it recognizes which research design is suitable for this research. Finally, it recognizes and makes designs that are possibly outside of the researcher's experience (Easterby-Smith, Thorpe, & Jackson, 2012). There are three core approaches to reflect on research philosophy: epistemology, ontology and axiology. Each approach contains significant differences, influencing how a researcher thinks about the research process (Collis & Hussey, 2013). Researchers must understand the three assumptions of ontology, epistemology, and axiology to understand better the research philosophy, explained in the following sections.

3.4.1 Ontological Assumptions

Ontology refers to the nature of reality. This raises questions of the assumptions researchers have about how the world operates and the committee held to a particular view (M. Saunders et al.). According to Carter and Killam (2013), beliefs about accurate or true determine what can be known about reality. Ontological questions include: what exists? What is true? How can the existing things be sorted? Straightforwardly, ontology is the assumption that describes the nature of reality. This is part of the assumption that researchers have about how the world operates.

In ontology, to produce valid knowledge, two aspects are considered; Objectivism and Subjectivism. Fellows (2015) considers objectivism as the reality that can be recorded objectively and analysed structurally. Whilst subjectivism is subjectively phenomenological and interpretative. Besides, objectivism stands for the existence of social entities, which is external to social factors. Meanwhile, subjectivism stands for the position that social phenomena are created out of perceptions. It is *"based upon the position that social phenomena are made out of consequent actions of those social actors concerned with their existence"* Mark Saunders (2007, p. 48).

This research attempts to develop a mitigation method to implement in the event of a disaster, particularly natural disasters. To achieve this mitigation method, different people, such as disaster managers and stakeholders, must understand the distinct aspects of natural disasters' negative impacts on hospitals. For this study, the **subjectivism** ontological stance is applicable, as the views of different respondents will be considered when developing the existing method to mitigate disasters' impacts on hospitals.

3.4.2 Epistemological Assumptions

Epistemology is studying the nature of knowledge within a field of study. It is also one of the core areas of philosophy. It is concerned with nature, methods, validity, scope, source and limits of knowledge. As the study of knowledge, epistemology is concerned with the following questions: What are the necessary and sufficient knowledge conditions? What are its sources? What is the structure? And what are its limits? (Ahsan, 2009). Epistemology is what constitutes adequate knowledge in a particular field of study (M. Saunders, 2012). There are two main positions for epistemology, which are positivism and interpretivism. Positivism lies in the social world that should exist externally and be measured through objective reasons instead of being inferred subjectively. While the idea of interpretivism is that objective or external factors do not determine reality, instead, it is socially constructed. This study takes an **interpretivism** stance regarding epistemology.

In this research, disaster managers' involvement and role are essential because the actors and their experiences, perceptions, and understanding of the disaster events are sources of knowledge. Therefore, an emphasis will be placed on their feelings, awareness and thoughts regarding disaster management regarding the risk mitigation of natural disasters on hospitals. Thus, the researcher needs to be part of what is observed and interact with participants. This will enable comprehension and the collection of relevant information to explain why and how the phenomenon exists.

3.4.3 Axiological Assumptions

An axiological assumption studies judgment about value systems and will answer the questions, “what is the role of values?” and “what researcher values go into it?” (Saunders *et al*., 2012). As the researcher plays a significant role in the entire research process, the analysis process and techniques that are adopted for research are highly affected by the researcher’s values. In other words, the researcher is biased by cultural experiences, world views and upbringing. Therefore, it can be concluded that this research's axiological philosophy will lean towards **Value Laden** (Saunders *et al.*, 2012). As this research is exploratory and experts' interpretation forms a major component of understanding reality, it is value-laden. Therefore, a social constructionist approach is most suitable. The philosophical stance of this research is shown below in Figure 3.3.

This research seeks to evaluate and explore the current disaster mitigation and preparedness management in Iranian hospitals. Furthermore, due to the involvement of different experts in this process and the fact that their "subjective" perceptions and decisions collectively "socially construct" what is seen as the response to disaster "phenomena", the research falls mainly within the ontological stance into the subjectivism continuum. In addition, the researcher adopted an interpretivistic epistemological position to gain an in-depth understanding of social reality by studying peoples' attitudes and behaviours to mitigate the risk of disaster events and have an appropriate preparedness. Moreover, as this research is exploratory and the interpretation of interviewees (experts) forms a significant component of understanding the reality, combined with the researcher's expertise in this particular field, it is value-laden since the value is added from both parties. Hence, a social constructionist approach is adopted. The philosophical stance pertaining to this study is illustrated in Figure 3.3. The following section will discuss research approaches of the study.

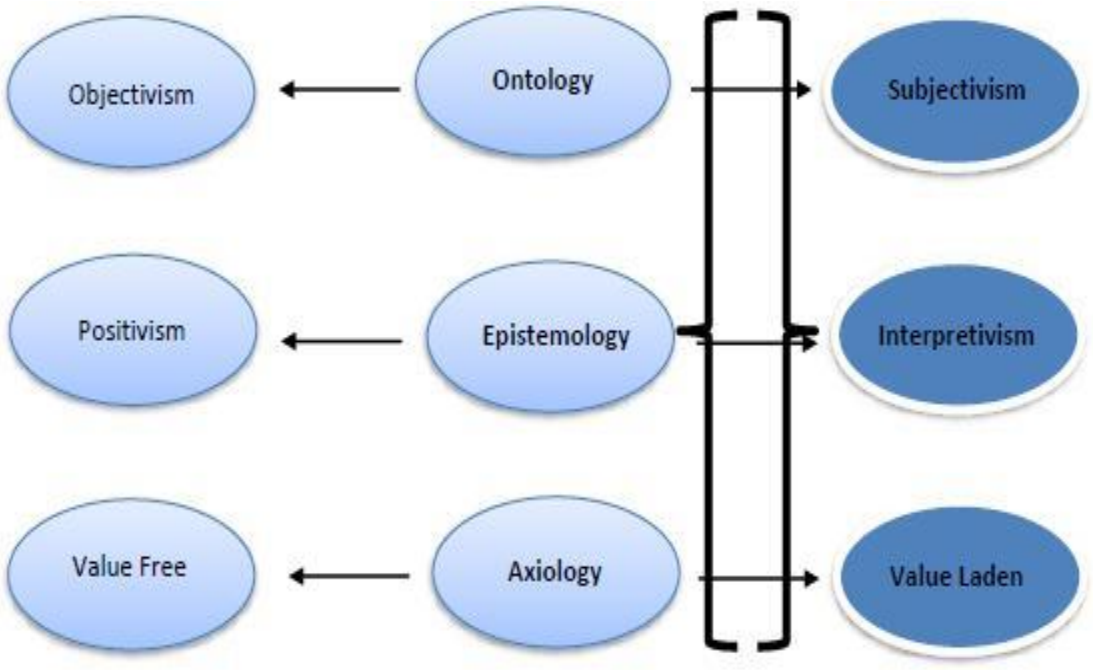

Figure 3. 3 Philosophical stances of this research

3.5 Research Approach

To meet the objectives mentioned earlier in the research (section 1.6), the research approach's role is critical (Creswell 2003). According to Saunders (2012), there are three main methodological approaches; deductive (testing theory), inductive (building theory) and abductive. The inductive research approach is developed from experimental observation, while the deductive one is theoretical, and a conceptual structure is designed and tested with empirical observation (Collis and Hussey, 2003).

The researcher, in the deductive approach, develops hypotheses or hypotheses. The hypotheses will be expressed in operational terms to explain the relationship between variables. The hypotheses will be tested prior to examining the specific outcomes, and, if necessary, the theory will be modified according to the findings. Conversely, there is no theory development in the inductive approach before data collection. Researchers in following interpretive approach, starting with the evidence and then building up a theory based upon it. Within the inductive approach, according to Pathirage, Amaratunga, and Haigh (2008), the theory would follow the data rather than vice versa as with deduction. The third approach is the combination of deduction and induction, called an abductive approach by Saunders et al. (2016).In addition to this, inductive reasoning usually leads to inductive methods of data collection through which the researcher (1) systematically observes the phenomena under investigation, (2) searches for patterns or themes in the observations, and (3) develops a generalization from the analysis of those themes (Lodico, Spaulding, & Voegtle, 2010). As the previously mentioned approaches are out of this research framework, this approach will not be applied to the research.

In contrast, deductive reasoning uses a top-down approach to knowledge. First, it is used by first making a general statement of prediction and then asking for evidence that would support or disconfirm the statement. There are models of deductive strategies that form a hypothesis tested against data, usually obtained from carefully planned experiments. The aim is not to prove the hypothesis but rather to attempt its ‘falsification’ and consider it ‘conditionally valid’ until falsified (Bodart & Evrard, 2011). The researcher used secondary data to review the significance of mitigation and preparedness management in hospitals. As such, the data collected are partly theory loaded. In addition, this research attempted to build a theory on improving mitigation and preparedness management in Iranian hospitals. Therefore, this research used a combination of deductive and inductive approaches. Based on the above discussion, in this study, abductive principles that combine deductive and inductive approaches are employed in theory building.

This is because the research requires an examination of complex interactions between people with different concepts and a complete picture of the real situation. Having discussed the research approaches, the following section looks into the research strategy.

3.6 Research Strategy

The third layer of the research onion model is a research strategy. These strategies include surveys, experiments, historical, archival, and case studies. The research strategy provides a complete and directed process by which the research is conducted (Remenyi, 2008). Saunders *et al.* (2012) define strategy as a plan and set of action(s) for achieving a goal; therefore, a research strategy could be described as a set of action(s) of how the researcher will answer the research question.

Denzin and Lincoln (2011) defined a research strategy as a methodological link that connects the research philosophy to its subsequent choice of collecting and analysing data. In contrast, Saunders *et al.* (2012) argue that a research strategy is guided by its research aim, objectives, approach, amount of time, access to potential participants, the extent of existing knowledge, and other data resources. Furthermore, Saunders *et al.* (2012) provide nine (9) different research strategies: Experiment, Survey, Archival Research, Case Study, Ethnography, Action Research, Grounded Theory and Narrative Inquiry. These strategies, with their characteristics, are presented in Table 3.2. Apart from each strategy's distinctive features, considerable overlaps among them (Zhou et al., 2014).

This research aims to enhance the resilience of health care facilities in Iran from floods and earthquakes by developing guidelines for hospital disaster management for the mitigation and preparedness phases of a disaster management cycle. Thus, it is greatly significant to understand the selected research methods considering this research's aim. To justify the criteria of research method selection, some of the methods will be discussed one by one, and the reason for selection or deselection will be explained.

Saunders et al. (2012) define ‘survey’ as a common research strategy in management and business research and is mainly used to answer ‘what’, ‘who’, ‘where’, ‘how much, and ‘how many questions. It is also used for descriptive and exploratory research. This strategy allows the researcher to easily compare the collected data from a sizeable population and control the research process.

This will enable the researcher to develop a model of relationships between variables and suggest possible reasons for those relationships. Regarding the time and cost, this strategy is more appropriate because the researcher is not required to collect the data for the whole population and only needs to use the sampling, which enables the researcher to generate findings representative of the whole population (Saunders et al., 2012). The survey strategy is mainly used for descriptive and exploratory research, whereas this research is descriptive and would be an advantage to implement a survey to get pure saturated data.

As mentioned in table 3.4, eight research strategies were introduced by Saunders *et al.* (2012). Some of which will be described and evaluated in more detail as follows. The first research strategy, experiment, is not suggested for this study because it requires the researcher's full control over the researched phenomenon.

Furthermore, an experimental strategy is primarily suitable for quantitative research design and undertaken in a highly controlled context (Saunders *et al.,* 2012). As the researcher does not have complete control over the phenomenon being studied and the qualitative research design, an experimental research strategy is inappropriate.

The second research strategy, archival research, uses administrative records and documents as the principal source of data (Saunders *et al.*, 2012). Bryman and Stephens (1996) discuss that the term 'Archival' has historical connotations and may be misleading, as it can refer to recent and historical documents. As this research attempts to understand the phenomenon of disaster management and the impact of natural disasters on hospitals in Iran, an archival strategy could be used to collect data like case studies that use document analysis as one of its data collection techniques.

The following research strategy is ethnography, which is used to study groups and is rooted in the inductive research approach (Saunders *et al.*, 2012). In this strategy, the researcher is required to be part of the group which is understudy to observe, talk and understand them, to be familiar with their behaviours, shared beliefs, interactions, and the events that have shaped their lives, enabling the researcher to produce detailed cultural accounts of the group (Saunders *et al.*, 2012). As an ethnography research strategy requires more time and is appropriate for long-term researchers, it is not suitable for this research for a certain time.

The sixth research strategy is action research, which promotes organisational learning to produce practical outcomes by identifying issues, planning, taking and evaluating action (Saunders *et al.*, 2012). According to Coghlan and Brannick (2010, p.4), this research strategy is about 'research in action rather than research about action'. Saunders *et al.* (2012) state that this type of strategy is best suited for researchers who have more time and can research their work. Besides, as the nature of the action research strategy is longitudinal, it is more appropriate for medium or long-term research projects than short-term. As a result, an action research strategy is inappropriate for this research. A grounded theory research methodology is another of the research strategies mentioned. It can be used to refer to a methodological approach, a method of inquiry and the result of a research process (Bryant and Charmaz, 2007; Saunders *et al.*, 2012).

A grounded theory strategy uses data collection techniques for collecting data and analytical procedures, which will lead to the development of a theory that explains social interactions and processes in a wide range of contexts (Saunders *et al.*, 2012).

The last research strategy is a narrative inquiry. Saunders *et al.* (2012) state that narrative inquiry allows the researcher to analyse the linkages, relationships and socially constructed explanations within narrative accounts to understand the complex processes people use to make sense of their organisational realities' (Musson, 2004, p.42).

Besides, the first two strategies are towards positivism. Therefore, the experiment research strategies are not appropriate for this study due to the subjectivism aspect of this study. The narrative inquiry and grounded theory research strategies require time-consuming, which limitation of completing this research cannot be suitable. As this research is short-term and the aim is not to develop grounded theory in the data, the grounded theory strategy is not suitable for this particular research.

The ethnography research strategy cannot be appropriate for this research for a long time. The ethnography research strategy is suitable for group study; thus, it is not ideal for this individual study. In this research, ethnography was not chosen because the scale of ethnographic studies is ordinarily small (e.g. a single setting) to facilitate an in-depth understanding (Hammersley & Atkinson, 2007). This research focuses on four different settings, which can be dealt with more appropriately in the form of a multiple case study. According to Yin (2009) stated that a case study approach should be used when questions such as "how" and "why" are being asked and that it is preferable to use this approach to answer questions about a contemporary set of events over which the researcher has no control. Yin (2009) identified three different types of case studies, namely exploratory, descriptive and explanatory.

Tellis (1997) stated that an exploratory case study allows a researcher to conduct fieldwork and data gathering before identifying the research questions and developing the hypothesis. Descriptive cases require a descriptive theory to be established before starting the project.

Saunders *et al.* (2012) define a *Case Study* as a research strategy exploring and investigating the phenomenon within its context or real-life contexts. Yin (2009) highlighted the importance of context, stating that the boundaries between phenomena (research topic) and the context within which the research topic is being studied are not always evident and distinguishable in real-life situations.

Besides, Easterby-Smith, Thorpe, and Jackson (2008) move forward this notion and stipulate that the case study is a flexible research strategy that allows researchers who support a single case and those who support multiple cases. It should be mentioned that the research philosophy of those who support a single point is interpretivism epistemology, and those who support various cases is positivist epistemology. Furthermore, a case study enables the researcher to deeply explore the research context and understand both the context and the processes being enacted (Eisenhardt and Graebner, 2007).

In other words, the researcher can deeply explore individuals or events, of one or a small number of organisations, over time (Easterby-Smith *et al.,* 2008) by adopting a case study strategy, which enables the answers to ‘why?’, ‘What?’ and ‘how?’ questions (Chetty, 1996; Yin, 2009). Furthermore, this strategy profoundly considers the details of the various impacts of both dependent and independent variables.

In the following table, the advantages of using each research strategy are illustrated.

Table 3. 1 Research Strategy Characteristics (Saunders et al., 2012)

Research Strategies	Characteristics
Experiment	Suitable for laboratory research rather than the field Unlikely to be related to the real world of organisation
Survey	Most frequently used to answer 'what', 'who', 'where', 'how much' and 'how many' questions Used for exploratory and descriptive research An easy to explain and to understand research strategy
Archival research	This strategy makes use of administrative records and documents as the principal source of data Allows research questions that focus upon past and changes over time to be answered
Case Study	It is suitable for research that wishes to gain rich understanding of the research context and processes Has considerable ability to generate answers to the question 'why', 'what', and 'how.' Not suitable for collecting data for generalisation
Ethnography	It is used to study groups It requires a longer-term field work-study
Action Research	Provides an in-depth understanding of specific phenomena, but the literature advises using it in the education context
Grounded Theory	It has been used by many academic research studies in the building environment field It has been criticised widely due to its confusing process and the time required to be completed Collecting data processes might require visiting the field several times
Narrative Inquiry	Suitable for small, purposive samples This strategy is intensive and time-consuming
Mixed methods	Allows answers to questions on what, how and why Adopted to describe, explain and explore a phenomenon Allows for diversity of views to aid interpretations Allows for generalisation of the study or its relative importance Allows for both qualitative and quantitative data to be employed in a single research Allows combination of inductive and deductive approaches within a single research

Consequently, a '**case study'** research strategy fits in with different research methods and techniques to collect and analyse data. It is also suitable for conducting research, which requires an in-depth investigation of understanding a phenomenon's perceptions.
In the following table research strategy implanted for each objective of this research study is demonstrated.

Table 3. 2 Research strategies implemendetd fted for each research objectives

Objectives	Research Strategies
To critically review the hospital operation management and the critical factors of successful hospital management.	**Questionnaire Survey**
To evaluate and synthesise the current status of Iranian public hospitals in disaster events and examine the impact of floods and earthquakes on critical factors of hospitals.	**Questionnaire Survey**
To critically evaluate the weaknesses in the disaster mitigation and preparedness management stage with reference to Iranian public hospitals.	**Case Study**
To critically evaluate barriers and obstacles to implement appropriate disaster mitigation and preparedness management in Iranian public hospitals.	**Case Study**
To develop guidelines for effective mitigation and preparedness measures for disaster managers to implement in Iranian hospitals.	**Triangulation of Quantitative & Qualitative Research**

He added that such an approach has the strength to assist researchers in investigating an elaborate phenomenon in a natural setting. Denscombe (2010) argued that the case study approach helps the researcher examine the studied phenomena or real-life situations. It also allows the researcher to gain an in-depth picture of the relationships and processes within the phenomenon. The 'case study research is adopted as a research strategy for this research, and it is briefly discussed in the following sections. According to the mentioned factors, research aim and objectives, a case study research strategy is more appropriate and suggested for conducting this research. The following sections further discuss case study design and case studies design protocol.

3.7 Methodological Choice

This choice could be a single (Mono) or multiple (Multi or Mixed) method research designs, presented in Table 3.2 below. Identifying the research design is a critical and complicated task because it determines collecting and analysing research data (Churchill, 1979). It also requires consideration and analysis of different resources to provide a reasonable link between theory and argument (Nachimas and Nachimas, 2008).

Table 3. 3 Methodological choices (Saunders et al., 2012)

Methodological choice	Research design	Example
Mono Method	The single data collection technique and analytical procedure	Questionnaire (Quantitative) In-depth interviews (Qualitative)
Multi-Method	Use of multiple data collection techniques and analytical procedures	Questionnaires and observations (Quantitative) in-depth interviews and dairy accounts (Qualitative)
Mixed-Method	Use of single and multiple data collection techniques and analytical procedures	Questionnaires and in-depth interviews(Quantitative and Qualitative)

Multiple methods use a multi-data collection technique, whereas a single method uses one data procedure and collection technique applied to address the research questions. Besides, Saunders et al. (2008) state that multiple methods have been included in two individual methods: multi-method research and mixed-methods. More than one form, either quantitative or qualitative, is used in the multi-method approach. Meanwhile, in the mixed-methods approach, the researcher uses quantitative and qualitative data collection in one research and analyses them accurately. In this research, a **Mixed-method** approach has been adopted.

A mixed-methods approach is used to improve the validity and reliability of the research. As such, the findings are based on semi-structured interviews and questionnaire surveys with executives responsible for disaster mitigation and preparedness of Iranian hospitals. The mixed-method approach used in this study privileges qualitative methods, with the quantitative element playing a secondary auxiliary role, ensuring that "all relevant voices are heard" (Howe, 2004, p.54) to obtain "deeper, more genuine expressions of beliefs and values to foster a more accurate description of views held" (Hesse-Biber and Nagy, 2010, p.64).

This research attempts to understand the negative impacts of natural disasters on hospitals and mitigate these risks in Iran. To achieve the objective, semi-structured interviews are suggested. Thus, a mixed qualitative and quantitative method approach has been used throughout the research. The researcher intends to set some semi-structured interviews with disaster managers and experts related to disaster management who have had experience with hospitals in natural disaster events in Iran. Moreover, this research questionnaire is distributed to some experts in connection with disaster management and hospitals in two case studies in Iran. As well as reviewing archived documents regarding the case study and disaster management in Iran. Qualitative refers to the attributes, entities, and processes, and it is not connected with the experimentally measured (Denzin & Lincoln, 2008). Table below is a comparative analysis of both quantitative and qualitative research.

Table 3. 4 Comparative Analysis of Qualitative vs Quantitative Research Saunders(2007)

Comparison dimension	Quantitative Research	Qualitative research
Objective	To qualify the data and generalise the result from sample to the population of interest	To gain an initial qualitative understanding of the underlying reasons and motives
Type of Research	Descriptive and/or casual	Exploratory
Flexibility of Research design	Low(one-way communication)	High (Two-way communication)
Sample Size	Large	Small
Choice of respondents	Representative Sample of the population	Persons with considerable knowledge of the problem
Data Analysis	Statistical Summary	Subjective, interpretative
Ability to Replicate with the same result	High	Low
Interviewer requirements	No special skills required	Special skills required
Time consumption during of the research	Design phase: high Analysis phase: low	Design skills required
Information per respondents	Low	High

3.8 Case study Design

There are different ways to approach case study design based on the researcher's epistemological standpoint (Crowe *et al.*, 2011). In other words, a case study can be designed to meet certain requirements of the research; therefore, it can be a single case or multiple cases. However, carefully identifying case study research design and details within a case will strengthen the case studies and provide tools for the researchers to study complex phenomena within their context (Baxter and Jack, 2008; Yin, 2009).

Yin (2014) discusses four case study designs based on the 2x2 matrix, including single and multiple case studies, reflecting distinctive design situations. Within these two variants, there can be unitary or various units of analysis. The four types of case study designs are single-case holistic designs (TYPE 1), single-case embedded designs (TYPE 2), multiple-case holistic designs (TYPE 3) and multiple-case embedded designs (TYPE 4). These classifications enable the researcher to select a case according to its nature before the research data collection (Zhou et al., 2014). According to Yin (2014), the first step in case study design is deciding, before collecting any data, on whether the researcher will use a single case or multiple cases. Selecting a single-case design requires careful and precise investigation of the potential case to maximise the access needed for collecting the case study evidence. Considering this, Yin (2014) states that a single-case study is an appropriate design and is greatly justifiable under several circumstances and five conditions: critical, unusual, common, revelatory, or longitudinal case. These rationales will be briefly explained.

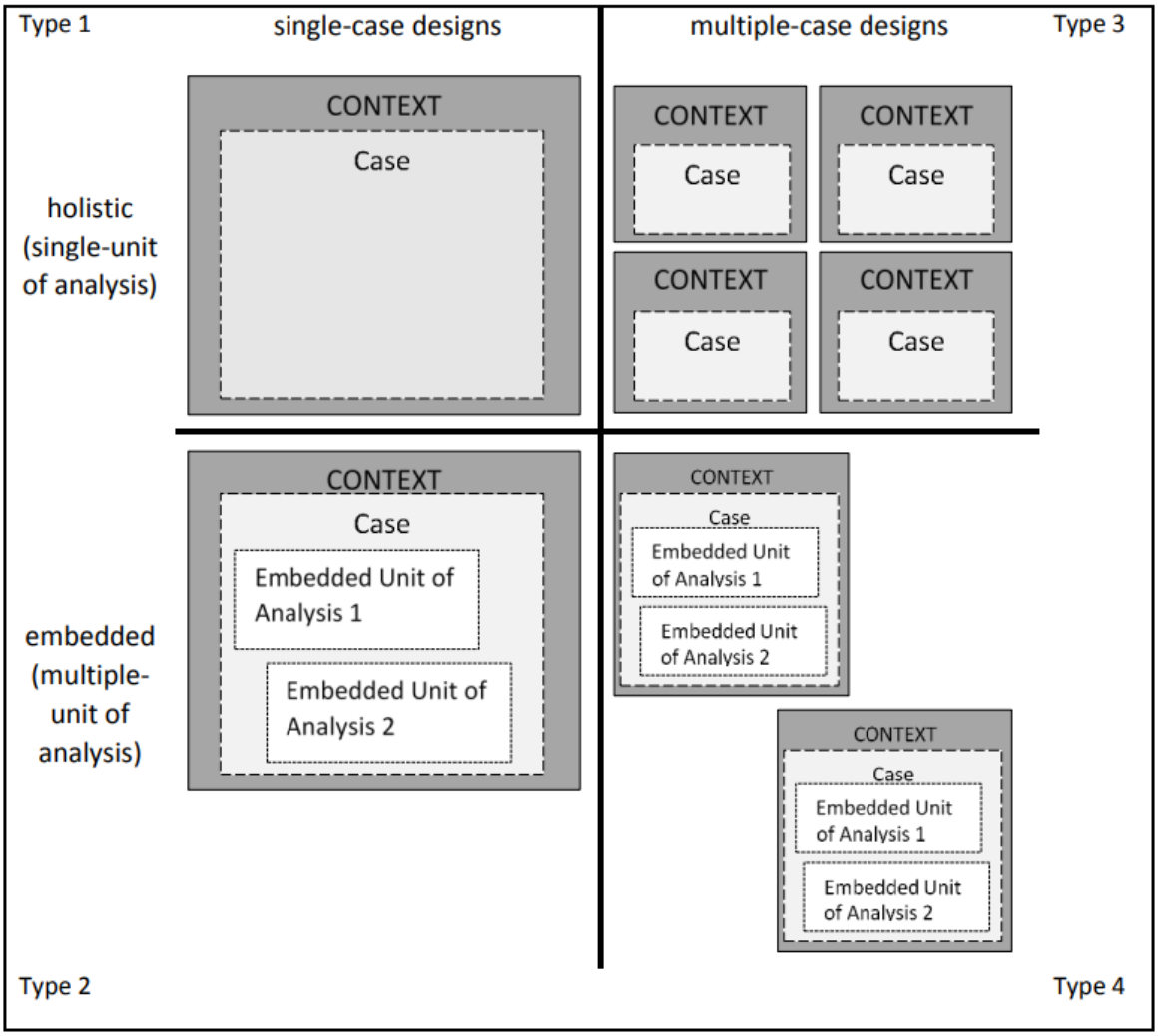

Figure 3. 4 Basic Types of Designs for case studies(Adapted from Yin, 2014)

The first rationale for a single-case study is selecting a critical case, where the case represents a crucial test of an existing situation. The second rationale for a single-case study is where the case presents an unusual or extreme circumstance, deviating from everyday occurrences. Therefore, a single case can be effectively utilised. Meanwhile, the third rationale for a single-case study is a common case, where the objective of the case is to capture the conditions and circumstances of an everyday situation. Simultaneously, the fourth rationale is a revelatory case, where the researcher has an opportunity to observe and analyse a phenomenon previously inaccessible to social science inquiry. Finally, a single-case study can be a longitudinal case, when the same single case is being studied at two or more different points in time.

Despite the mentioned conditions for selecting a single-case design, Yin (2014) states that the results are pretty hard to generalise for the benefit of a larger population because the study samples in the single-case format are often minimal. Therefore, a multiple-case studies design is suggested because the evidence and results from multiple cases are often more robust and generalised (Zhou et al., 2014). However, they have their advantages and disadvantages compared to single-case designs. In extreme cases, the critical and revelatory cases are associated with a single-case design, which cannot usually be satisfied by multiple cases. However, multiple-case studies considerably reduce the scepticism and criticism associated with case studies and provide credibility to research outcomes. Although conducting a multiple-case study design can require more time and resources (Yin, 2009). As mentioned in the previous paragraph, conducting multiple-case studies research decreases scepticism and criticism and produces a stronger effect on the research process and its outcomes. Therefore, researchers are advised by Yin (2014) to have at least two cases. The results of multiple cases are more robust when replicating pattern matching, and such replications will increase the robustness of the original findings (Amaratunga and Baldry, 2001). In light of this, two or more case-study selections would fall within direct replication logic (Zhou et al., 2014). However, each case in multiple-case studies must be carefully selected, either a literal replication (predicting comparable results) or a theoretical replication (prediction of contrasting results but for anticipated reasons). One of the main factors and strengths of using multiple-case studies is that it enables researchers to use various data, sources and research methods as part of the investigation (Zhou et al., 2014). For example, in multiple-case embedded design, each case may include collecting and analysing quantitative data, including surveys within each case study (Zhou et al., 2014). In other words, the researcher can gain access to various data from a broader spectrum through multiple-case studies. Therefore, the researcher can better explain the understanding of the phenomenon being studied.

A single-case study design is not suitable for this research because the phenomenon being studied does not represent a critical, unusual or extreme case situation. Moreover, the phenomenon under study is neither common, revelatory, nor a longitudinal case situation. Consequently, a multiple-case study design is the most suitable approach.

3.8.1 Justification of Multiple Case Study

In this study, researchers adopt multiple-case holistic designs (TYPE 3) to conduct this research and reach the aim and objectives. In natural disaster events, individual hospitals adopt different practices with different components. The reason implemented Type 3 instead of Type 4 was adopted for this research is that there is only one unit of analysis that needs to be studied. Therefore, considering a single case study cannot conduct by the researcher in proper finding, by choosing two case studies, the researcher must understand the different impacts of natural disasters on hospitals. Also, by choosing two case studies, the researcher can understand some weaknesses and some Iranian disaster management team's progress to manage hospitals in these two events. Therefore, a single case study cannot contribute to the researcher completing this study. Two natural disaster events that are the most popular in Iran have been chosen: the earthquake of the Kermanshah in 2017 and the flooding of Golestan in 2017. Thus, by selecting multi-case studies, a researcher can compare different impacts of these various natural disasters differently to Iran hospitals.

3.8.2 Case Study Selection

A critical factor that the researcher should consider during the design phase is selecting the case(s) to study. This is due to the cases' uniqueness rather than others' representative (Crowe et al., 2011). The first criterion that should be considered by the researcher when selecting a case is to maximise understanding and perception. (Stake, 1995). In light of this, the multiple-case design was adopted as the research approach after considering other case study design types. Case studies should be chosen considering the many ways of investigating and empirical descriptions of particular instances of a social phenomenon (Yin, 2009). To enrich the research process, two different case studies happened recently selected. Because of this, a multiple-case design was adopted as the research approach after consideration of other case study design types. Case studies should be considered rich, as they provide many ways of investigation and empirical descriptions of particular instances of a social phenomenon (Yin, 2009). Two natural disaster events were selected as case studies to enrich this research process. Study-specific criteria are expected to be set apart from the general conditions for case selection. As a result, the reasons behind selecting these two case studies and the rationale can include various natural disasters, progression improvement, and scale size of the events. As described in the following table below:

Table 3. 5 Case study selection criteria

Rational	Justification
progression improvement	Investigating the disaster management progress between these two natural Disasters.
size of the events	The significant consequence of the disaster during and after the event in hospitals to provide health care service to injured people in comparison with similar Events.
Variety of types of natural disasters	Choosing a variety of types of disasters to understand the vulnerability of hospitals in different types of natural Disasters scenarios.

Based on the above selection criteria, the following two natural disasters happened in Iran and significantly resulted in chosen hospitals. The Kermanshah earthquake and Golestan flooding were major catastrophic disasters in Iran, resulting in mass destruction and a very high toll on human health and lives. Table 3.6 below shows some statistics related to different flood and earthquake disasters and clearly shows Golestan and Kermanshah events had significant destructions.

Table 3. 6 A comparison of destruction results of some natural disasters in Iran in the last two

Events	Bam Earthquake	Haris Earthquake	Golestan Flood	Azarbayjan Flood	Kermanshah Earthquake
Date	2003	2012	2015	2017	2017
Number of dead people	30,000	300	200	5	612
Number of injured people	40,000	5000	1,150	380	6,700
Number of Houses destroyed	25,000	2,500	4,000	700	15,000
Number of hospital destroyed or affected	3	2	4	1	3
Number of Urban, rural, and health centres destroyed	119	31	47	12	85

3.8.3 Justification for the Selection of Kermanshah Earthquake and Golestan Flood

The disaster managers' challenges in these two recent natural disasters due to some failures and the number of injured people were higher than other natural disasters. To properly understand managing hospitals in natural disaster events, the researcher decided to select two typical natural disaster occurrences in Iran: flood and earthquake. In fact, by choosing these two distinct types of case studies, a better understanding of managing hospitals can be provided. Also, by selecting these two case studies, the researcher will attempt to understand the development of disaster management systems and their capability in different hospitals after natural disaster events.

Thus, by comparing the results of these two case studies, the researcher can compare the case study hospitals' vulnerability to comprehend better the recommendations needed to improve disaster management's effectiveness. The researcher will compare different natural disaster events in Iran in the last two decades with further probing.

3.9 Unit of Analysis

Miles and Huberman (1994) stated that the unit of analysis of a study is a “phenomenon of some sort of occurring in a bounded context”. Based on Collis and Hussey (2013) it is the focal point where the research problem, phenomena and the variables refer to and about which the data is collected and analysed. Due to its importance, Miles and Huberman (1994) considered the unit of analysis as the “heart” of the research. According to Yin (2014), there is a relation between the chosen unit of analysis and the research objectives. The unit of analysis might help in shaping the scope of data collection in the later phase. In this study, the unit of analysis is disaster mitigation and preparedness management in hospitals.

After identifying the unit of analysis, the next step was to define the boundary of the study. Deciding the boundary helps the researcher identify the study's scope, for instance, to determine the limits of the data collection (Yin,2003). As discussed previously, disaster management activities at the hospitals can take academic research, industrial research, or collaborative research between academia and industry. In this research study, collaborative research work is preferred. Thus, this research study is decided to consider this study's scope as collaborative disaster management between hospitals and academics. Therefore the unit of analysis was extended outwards to represent multiple hospitals and universities. The case can be individuals, groups, organisations, movements, events, or geographic units (Neuman, 2011). In this study, two cases choose the Kermanshah earthquake and the Central flood. The unit of analysis is mitigation and preparedness management in hospitals. The audience of this research will be Iranian disaster managers.

3.10 Data Collection Method

Data collection and their analysis procedures are related to research techniques. Walliman (2006) defines data as "the essential raw materials of any kind of research. They are how we can understand events and conditions worldwide". The data collected can fall into two categories: primary data and secondary data (Saunders et al., 2016; Walliman, 2006). When the data is collected from a researcher's research, it is called primary data, while secondary data is the data obtained from existing sources. Walliman (2006) argues that although data can be collected from virtually everywhere, it requires a plan of action that uses and identifies the most appropriate and effective data collection methods. As mentioned previously in the research methodology section, this research uses qualitative research methods to clarify the various aspects of a phenomenon. To reduce the number of critical reasonable alternative conclusions obtained from the findings and acquire verification. There are different data methods, among which the most important are secondary data, interviews and questionnaires. These methods will be discussed below in the context of this research. It should be mentioned that secondary data, including both qualitative and quantitative, are used most frequently in case study and survey research strategies (Saunders *et al.,* 2012). Three main sub-groups of secondary data are documentary data, compiled from multiple sources and survey-based data. According to Saunders *et al.* (2012), secondary data documentation includes written materials such as; minutes of meetings, diaries, notices, transcripts of speeches, reports to shareholders and administrative and public records. Furthermore, it also includes journals, newspapers, books and magazine articles. However, documentation of secondary data can also include non-written materials like; drawings, videos and voice recordings, films, pictures and television programmes, Organisations' databases, DVDs and CD-ROMs (Robson, 2002). These types of data can be analysed both quantitatively and qualitatively. The primary use of documenting secondary data is triangulating findings from other data collected through data collection tools like interviews or questionnaires. In this research, the documentation of secondary data is used to form background information and build the project by collecting data from books, journals and conference papers. This documentation will cover both the first and second objectives of the study.

3.10.1 Quantitative Method of Data Collection

One of the most common quantitative data collection techniques is a questionnaire. Saunders et al. (2012) state that a questionnaire is a general term to include all data collection techniques. The researcher distributes the same set of questions in a predetermined order to a sample group, expecting many respondents. It includes structured interviews, telephone, and online questionnaires. According to Collis and Hussey (2003), using a questionnaire saves time and costs while collecting a reasonable amount of data related to the study. It could be distributed via post, telephone, online and face to face. Still, the crucial factor should be considered in developing an excellent questionnaire to ensure that the collected data is precise to achieve the research objectives and answer the research question(s). Qualitative data refers to numeric data that must be processed, analysed, interpreted, and turned into valuable and meaningful information. Whilst, quantitative analysis techniques enable the researcher to explore, present, describe and examine relationships and trends within the data (Saunders *et al.*, 2012). These techniques vary from a simple table or diagram to complex statistical modelling, presenting statistical relationships between variables. Some techniques usually used to analyse quantitative data are the T-test, Chi-square test, and variance analysis. However, statistical analysis and advanced data management software packages are required for implementing these techniques, such as Minitab, SPSS, SAS and STATVIEW (Saunders *et al.*, 2012).

3.10.2 Qualitative Methods of Data Collection

According to Saunders *et al.* (2012) and Collis and Hussey (2003), a qualitative data collection method generates, obtains, records, or uses non-numerical data through in-depth semi-structured and grouped interviews direct observation. Although a qualitative data collection method provides in-depth data and information to be collected, it might be costly and consume more time than quantitative data collection methods (Collis and Hussey, 2003). Observation is the systematic process of observing, recording, describing, analysing and interpreting people's behaviour (Saunders et al., 2012).

There are two types of observation; Participant and Structured. Participant observation is qualitative and is used to discover "the meanings that people attach to their actions", whilst structured observation is quantitative. It is used to record "the frequency of those actions" (Saunders et al., 2012). An Interview is a purposeful discussion between two or more individuals in which one individual (the interviewer) asks questions and the others (interviewees) willingly answer the questions.

Qualitative data refers to non-numeric data or data that has not been quantified and can be a product of all research strategies (Saunders et al., 2012). According to Saunders et al. (2009) and Denscombe (2010), there are five different methods for analysing qualitative data: content analysis, thematic analysis, grounded analysis, discourse analysis and comparative analysis. These five methods are explained in more detail below.

The conversation or speech is analysed as performance rather than the state of mind. Finally, the comparative analysis compares data from different individuals until no new issues arise. This type of research is connected to the thematic analysis

Furthermore, interviews will enable the researcher to collect reliable and valid data relevant to the research question(s) and objectives. There are three classifications of interviews; structured, semi-structured and unstructured (Saunders et al., 2012). Structured interviews use questionnaires developed upon a predetermined and standardised set of questions. Hence, they are called 'interviewer-administered questionnaires' (Saunders et al., 2012). Furthermore, this type of interview is also referred to as 'quantitative research interviews' because structured interviews collect quantitative data. Semi-structured interviews are non-standardised interviews. Therefore, they are referred to as 'qualitative research interviews' (Saunders et al., 2012).

According to Saunders et al. (2016), in research, sampling is needed. Such requirements resulted from the limitation in obtaining information from the entire population. Sample selection is mainly relying on the research objectives. When deciding on sampling technique, the researcher should not ignore factors such as time limitations, financial, and accessibility to the resources. Two strategies can be used in sampling: random sampling/probability and nonrandom sampling / non-probability sampling. In random sampling, the chance of each element being selected from the population is usually equal, while non-random sampling doesn't give an equal chance to each element being selected. Kumar (2011) sheds light on the usage of sampling within quantitative research and qualitative research. The sampling in the qualitative research is not significant, whereas a sample represents the study population in quantitative research. The following figure illustrates some sampling methods under each of the basic strategies.

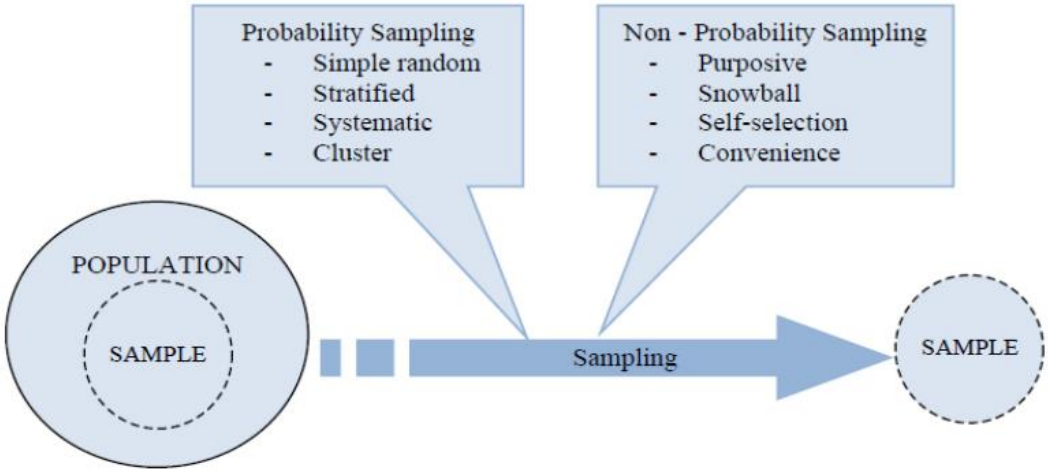

Figure 3. 5 Sampling methods (adapted from Saunders et al. (2016))

According to the nature of the research outlined in chapter 1, the quality of the sample is required rather than the quantity for this study. Each person included in the sample was studied in more detail and greater depth, and the researcher aimed to probe deeper with every person in the sample. Moreover, the researcher considers how informative the sample is rather than its size. Therefore, the researcher selected purposive sampling for this study to get enough information. Kumar (2011) and Saunders et al. (2016) stated that purposive sampling is a sub-set of non-probability sampling where a specific sample is selected non-random way to obtain rich and specialised data related to a study.

The reason for distributing the questionnaire is to explore the current disaster mitigation and preparedness management situation in Iran, particularly in hospitals.

In qualitative research, deciding on sample size is complex. Simultaneously, the sample size in qualitative research is not an essence, unlike in statistical research (Kumar, 2011). The researcher achieved an adequate size when reached the saturation point in data collection. This point is achieved when no new themes are discovered or new information is received (Kumar, 2011; Saunders et al., 2016). Saunders et al. (2016) recommended a non-random minimum sample size illustrated in the following table.

Table 3. 7 Minimum Size for Non-Probability Sample (Saunders et al., 2016)

Nature of Study	Minimum Sample Size
Semi-structure/in-depth Interviews	5-25
Ethnographic	35-36
Grounded Theory	20-35
Considering a homogenous population	4-12
Considering a heterogeneous population	12-30

In this type of interview, the researcher uses a list of themes and questions adapted in each interview based on the previous one's answers. Notably, unstructured interviews are informal and used to in-depth explore a general area of interest. As the interviewer only needs to have a clear idea about the topic of interest that needs to be explored, there is no need to have a predetermined list of questions, and the interviewees are free to talk about their beliefs in relation to the topic area (Saunders et al., 2012). To enhance better and more reliable and triangulated questions in the semi-structured interview about disaster management and mitigation risk of natural disaster on Iranian hospitals, reviewing the current information in archival documents and records will be implemented. Regarding Sanders et al. (2016) and Yin (2014), archival and existing documents as empirical research field data are important. In this particular research, some experts in this research area identified archival records and documents connected with disaster management. Some documents such as reports, studies, statistics have been gathered from organisations such as the Iranian health minister, disaster management department, and Iranian Red Cross. Such gathering has been conducted before and during the interviewing stage. Therefore, the semi-structured interview and document review are suggested to have a deep understanding and have set of opinions of some experts in connection with disaster management about impacts of natural disasters on hospitals and understanding challenges and some barriers in the face of disaster managers in natural disasters to control health centres accurately. To gain a unique perspective and better understand the relevant issues in this research, the researcher plans to conduct 8 interviews in each case, which was conducted as part of the data collection for this study. Purposive sampling will be used to select the most suitable interviewees from each individual case study. Purposive sampling is a technique in which the researcher relies on their judgment when choosing population members to participate in the study. Purposive sampling is a non-probability sampling method.

It occurs when “the researcher's judgment chooses elements selected for the sample. Researchers often believe that they can obtain a representative sample using a sound judgment, which will save time and money” (Black, 2009).

3.11 Data Analysis Method

Data Analysis depends on two types of data: either non-numeric or numeric. Moreover, there are two methods for analysing data; qualitative and quantitative. The qualitative data (words or text, or images) typically follows the path of aggregating the words or images into categories of information and presenting the diversity of ideas gathered during data collection (Creswell, 2003). Blaxter et al. (2006) reflect by saying that all research involves collecting and analysing data, whether through reading, observation, measurement, asking questions or a combination of these or other strategies. Data from the survey phase of the research was analysed using a standard statistical package such as the Statistical Package for the Social Sciences (SPSS) and Microsoft Excel. This was used to examine any cross-tabulation, associations, or grouping from the survey data through factor and coding analysis. A qualitative data analysis software package such as Nvivo was used to assist in coding, and derivation of themes, from the interview data. Descriptive statistics were used to describe the main features of data collection in quantitative terms. This involved the use of frequencies, percentages and means for presenting descriptive findings of the survey. These techniques were employed to analyse data related to the respondents' characteristics, organisations, and open-ended questions/comments. They are also used to analyse rating score data of the various research variables. Graphical techniques utilised to present the results from these analyses include pie charts, bar charts, and Tables. Detail statistical, the test used for quantitative data analysis is discussed in chapter four, whilst qualitative data analysis is presented in chapter five of this thesis.

3.12 Questionnaire Design and Strategy

Regarding collecting quantitative data, the implementation of electronic questionnaires or internet-based is the most suitable for better understanding once data is completed, especially in disaster management research communities because of simple and easy administration.

Thus, this study researcher adopts electronic methods in its questionnaire design, distribution, and consequent data collection processes.

This questionnaire consists of both closed and open-ended questions. Closed-ended questions are designed with multiple responses, and open-ended questions offer those responses the chance to give additional comments freely. This survey was intended Using **Google Forms; a web-based application implemented to make** an online questionnaire survey. By using this web-based application, the researcher captured and analysed responded data. In Appendix G, the screenshot copy of this questionnaire is illustrated.

Implementing an online questionnaire survey in disaster management research gives better confidence that online questionnaires might likely give fewer questions as non-response rates than traditional questionnaires. Using an online questionnaire survey offers some advantages: cost-efficiency, quick response time, faster delivery, ability to track, many design options, better addressing sensitive issues, and having the same strengths as postal survey or paper method(Wright, 2005).

However, some of them acknowledge web-based surveys' problems, including privacy issues, technical issues, and multiple submissions (Monkey, 2019).

Besides, it was pointed out that questionnaires that are administrated online might appear to produce fewer questions remain non-response, and rates where the problems are open-ended, making online surveys suitable for capturing text-based data.

3.12.1 Covering letter

The cover letter was designed and written to distribute the questionnaire's final version and be allocated on the questionnaire's first page. The cover letter was written to explain more about this questionnaire's purpose to get more participants' responses. Thus it encouraged more participants and have a high amount of response.

According to Harris and Brown (2010), the cover letter should demonstrate who the researcher is, what the researcher is doing, and give the research project's brief.

Thus, the cover letter must be succeeded in dominating any opposition or prejudice a respondent may have against this research survey. It is enormously crucial the cover letter has been written politely and that recipients' participation is desirable. A copy of the questionnaire and cover letter are attached in Appendix G and H.

3.12.2 Questioner overview

For this research study, the questionnaire consisted of three sections; In the initial section, the general information and professional background of participants, the second and third sections improve hospitals' efficiency in Natural disasters solicits.

Section one consists of five questions that provide background information about participants. Question one asks the respondents to identify their names. Question two seeks to classify positions and their responsibilities at the time of this research.

In the third question of this questionnaire, the researcher planned to classify participants' experience rates related to disaster management. Questions four and five in this section ask respondents to indicate their experience about the organizations and people are involved in disaster events in hospitals.

Section two consisted of four questions: respondents' opinions about hospitals' importance and evaluating critical factors in disaster events. These questions are designed as multiple-choice questions to have better comparisons and save respondents time. For instance, the first question was solicited to understand hospitals and health centres' importance during disaster events in this section. In the following section in question seven, the importance of some critical factors understood from the literature review in hospitals was asked to rate by respondents.

In this section's last two questions, the researcher asked about the importance of training and early preparations to mitigate natural disasters risk. In the final section of this questionnaire, the researcher examines the adverse impact of hospital disaster events. This section has got three questions. The first question was to get the participants' opinion about which groups of people are more in danger during hospital disaster events. In flowing in question 11 classifies which facilities and activities of hospitals can be involved during disaster events.

To conclude this questionnaire in question number 12, an opportunity was provided for responders to express more about their opinion regarding disaster management and the importance of hospitals during disaster events. This question allowed the participants to add any other challenge from their experience or knowledge that has not been captured in previous questions or literature reviews.

3.12.3 Piloting Questionnaire

After completing the questionnaire and designing all of the questions, it was initially evaluated by piloting this questionnaire before its final distribution to disaster management experts. In this case, the initial draft of this questionnaire was sent to five respondents related to disaster management and hospitals in both industry and academic parts for getting comments. All of those participants were recognised as disaster managers or disaster management researchers involved in past natural disaster events in Iran. Academic participants with the disaster management background were considered to have more accuracy of questions in terms of the latest disaster management measures

Comments and feedbacks were constructive to improve and shape the final version of this questionnaire. In terms of feedback and comments received from respondents who took part in the pilot, the survey improved the questionnaire's overall design in terms of structure and format. The style of questions and format of the survey was adjusted twice according to the pilot study's feedback before distributing the final version of the questionnaire. By doing this pilot study, the response rate for the definitive pilot study was 100%. Regarding review received from some respondents by email, they confirmed that questions were clear and relevant to the subject matter. Generally, filling out this questionnaire took between 10-15 minutes.

3.12.4 Selected sample and questionnaire distribution

The targeted sample was randomly selected from some expertise and personnel of hospitals in Iranian hospitals involved in the Kermanshah earthquake and Central flooding. In random sampling, the chance of each element being selected from the population is usually equal, while non-random sampling doesn’t give an equal chance to each element being selected. Kumar (2011) A web-based questionnaire with a cover letter was sent through those participants via email. Besides, to obtain these experts' email addresses in disaster management and personnel of hospitals were contacted by telephone and through some disaster management conferences and resilience seminars. During this research journey, the researcher attended different conferences and seminars to expand his networking and presented this research to get more feedback. Indeed, it was beneficial to meet some experts in the disaster management area. This questionnaire was sent to these experts.

Three weeks after the first request for this questionnaire, a reminder was sent through email to those who had not replied. This increased the response rate to better understand and outcome of this research. However, some of those experts did not reply to this request due to their circumstances, but 134 responses were received.

3.12.5 Likert Scale

The opinion and behavioural variables can be captured by using a Likert scale. Five scales of "importance" (not important, little important, moderately important, important, and extremely important) have been represented by the Likert scale to capture the level of importance. Further, other five scales of "frequency" (never, rarely, sometimes, very often, and always) have been used to capture the level of implementation. In addition, a column for "no opinion N/O" has been added for both scales. This addition is important as it would minimise the tendency for giving an inaccurate answer when the respondents lack knowledge or opinion for a specific question (Kulatunga, 2008).

The following table represents the values designated for the Likert scale.

Table 3. 8 Values Designated for the Likert Scale

Scale for importance	Unimportant	Of little importance	Moderately important	Important	Very important	No opinion N/O
Scale for implementation	Never	Rarely	Sometimes	Very often	Always	No opinion N/O
Value	1	2	3	4	5	999

3.12.5 Data collection

Data collected from the questionnaire were exported into excel, grouped, checked, and controlled for evidence of bias to ensure they were entirely done. Then the researcher started another process called "editing". The researcher checked all responses to provide all participants' answers thoroughly in this process. Doing this helped the researcher know maximum data was collected and reviewed the provided answers to ensure they met the expected and accurate results to avoid any "response set". Rennie (1982) states that " response set is the tendency of a person to respond to questions in a particular way inadequately of the content of the questions". The results were taken from the questionnaire were delivered to an excel sheet. After all that, all collected data was transferred from excel to the statistical package for social sciences software (Pallant) for analysing quantitative data. The result of the questionnaire's responses is demonstrated in the following table.

Table 3. 9 Analysis of questionnaire responses

	Hospital personals		Disaster management experts		Others(Researcher, construction, etc.)	
Item	Number	%	Number	%	Number	%
Number of questionnaires distributed	38	100%	68	100%	28	100%
Completed questionnaire	38	100%	68	100%	28	100%

Once data were imported into SPSS software, it was vital to examine that data was imported correctly. The simple way was to implement the summarize case command of the SPSS software (Pallant, 2013). The summarised cases result presented in the following Tables demonstrate that the total data was valid for statistical analysis. There was no missing data from the case statistics analysis; thus, no data were excluded from the data analysis circle.

Table 3. 10 case processing summary (SPSS 25)

	Valid		Missing		Total	
	N	Per cent	N	Per cent	N	Per cent
Name	134	100.0%	0	0.0%	134	100.0%
Main Role	134	100.0%	0	0.0%	134	100.0%
Rate of experience	134	100.0%	0	0.0%	134	100.0%
Responsible person	134	100.0%	0	0.0%	134	100.0%
Responsible Organisation	134	100.0%	0	0.0%	134	100.0%
Importance of hospitals	134	100.0%	0	0.0%	134	100.0%
Manging Medical equipment	134	100.0%	0	0.0%	134	100.0%
Controlling Medicine supply	134	100.0%	0	0.0%	134	100.0%
Providing continues energy	134	100.0%	0	0.0%	134	100.0%
Having Reserve Fuel	134	100.0%	0	0.0%	134	100.0%
Providing Sufficient water and food	134	100.0%	0	0.0%	134	100.0%
Sufficient equipment and supplies in the sterilization services	134	100.0%	0	0.0%	134	100.0%
Keeping communication system such as phone, internet, etc	134	100.0%	0	0.0%	134	100.0%
Keeping heating, ventilation	134	100.0%	0	0.0%	134	100.0%

Controlling the nuclear medicine and radiation therapy	134	100.0%	0	0.0%	134	100.0%
Managing radiology and imaging devices	134	100.0%	0	0.0%	134	100.0%
Mitigating physical damages to facilities	134	100.0%	0	0.0%	134	100.0%
Making patient's document safe and reachable	134	100.0%	0	0.0%	134	100.0%
Controlling human resources such as hospital's personnel and volunteers	134	100.0%	0	0.0%	134	100.0%
Keep operation theatres and recovery room safe and accessible	134	100.0%	0	0.0%	134	100.0%
Keeping hospitals accessible to everyone	134	100.0%	0	0.0%	134	100.0%

	Valid		**Missing**		**Total**	
	N	**Per cent**	**N**	**Per cent**	**N**	**Per cent**
Managing collaboration with other organisations in connection with disaster management	134	100.0%	0	0.0%	134	100.0%
Providing regular training for hospital's staff	134	100.0%	0	0.0%	134	100.0%
Early disaster management planning	134	100.0%	0	0.0%	134	100.0%

Rank of impact of disaster on Elder people	134	100.0%	0	0.0%	134	100.0%
Rank of impact of disaster on disabled people	134	100.0%	0	0.0%	134	100.0%
Rank of impact of disaster on Children	134	100.0%	0	0.0%	134	100.0%
Rank of impact of disaster on women	134	100.0%	0	0.0%	134	100.0%
Rank of impact of disasters on others	134	100.0%	0	0.0%	134	100.0%
Medical equipment	134	100.0%	0	0.0%	134	100.0%
Medicine storage and blood resources	134	100.0%	0	0.0%	134	100.0%
Patient's document	134	100.0%	0	0.0%	134	100.0%
Water and food resources	134	100.0%	0	0.0%	134	100.0%
Energy supply system	134	100.0%	0	0.0%	134	100.0%
Resource allocation for the hospital staff	134	100.0%	0	0.0%	134	100.0%
Accessibility to hospital	134	100.0%	0	0.0%	134	100.0%
Coordination and collaboration with others	134	100.0%	0	0.0%	134	100.0%
Resource allocation for volunteers	134	100.0%	0	0.0%	134	100.0%
Communication systems	134	100.0%	0	0.0%	134	100.0%

Table 3. 11 Case processing summary (SPSS 25)

Statistics		
N	Valid	134
	Missing	0

Table 3. 12 Case processing summary (SPSS25)

Main Role					
		Frequency	**Per cent**	**Valid Per cent**	**Cumulative Per cent**
Valid	Construction management	1	1.0	1.0	1.0
	Data Scientist	1	1.0	1.0	2.0
	Office manager	1	1.0	1.0	3.1
	Civil engineer	5	5.1	5.1	8.2
	Disaster manager	2	2.0	2.0	10.2
	Project manager	1	1.0	1.0	11.2
	Biomedical engineer	1	1.0	1.0	12.2
	Geomatics M.Sc.	1	1.0	1.0	13.3
	Supervisor	2	2.0	2.0	15.3
	Medical member at the hospital	1	1.0	1.0	16.3
	Disaster management Researcher	52	53.1	53.1	69.4
	Volunteer in disaster events	15	15.3	15.3	84.7
	resilience researcher	15	15.3	15.3	100.0
	Total	134	100.0	100.0	

3.13 Response rate

This questionnaire was distributed among disaster management experts and hospital personnel. The sample size for this research was randomly chosen, 140 for the questionnaire. The following table shows the percentage of overall participant responses to this questionnaire.

According to Baruch (1999), a usable response is identified as an appropriate response rate that illustrates the response percentage for the usable questionnaire. There might be some unusable responses in this research; as described in the overall response rate becomes 95.71%

With regard to Johnson and Wislar (2012), there is no universally accepted response rate for any research; hence, in general, 60% is implemented as the limit. This study's questionnaire response rate was 95.71%, which is considered adequate for related data analyses to rely on the received responses.

3.14 Method of Data Analysis

The raw data was collected from some disaster managers, researchers, and hospitals personnel, exported to Excel and edited. All of the respondents for this questionnaire survey were selected from Iranian public hospitals, and some disaster management researchers had been involved in connection with two case studies. Those participants were selected due to their disaster management background and involvement in Iranian hospitals in the past few years. Moreover, a good understanding of participants from the nature of Iranian hospitals and their currents status of them during disaster events would be great to have a better understanding. Also, data were collected from the questionnaire was converted to numerical values.

Trochim (2005) states that data analysis has three steps; data preparation, descriptive, and inferential statistics. Data preparation includes some measures such as; logging or checking data in, ensuring data accuracy, importing data into the computer, transforming data, and documenting and developing the database's structure. Naoum (2012) states that four different data types can be used in any research study: nominal, ordinal, interval, and ratio. Interval and ration were implemented for parametric analysis, whereas ordinal and nominal data were used in non-parametric forms.

The following figure illustrates all of the statical data analysis for this research study.

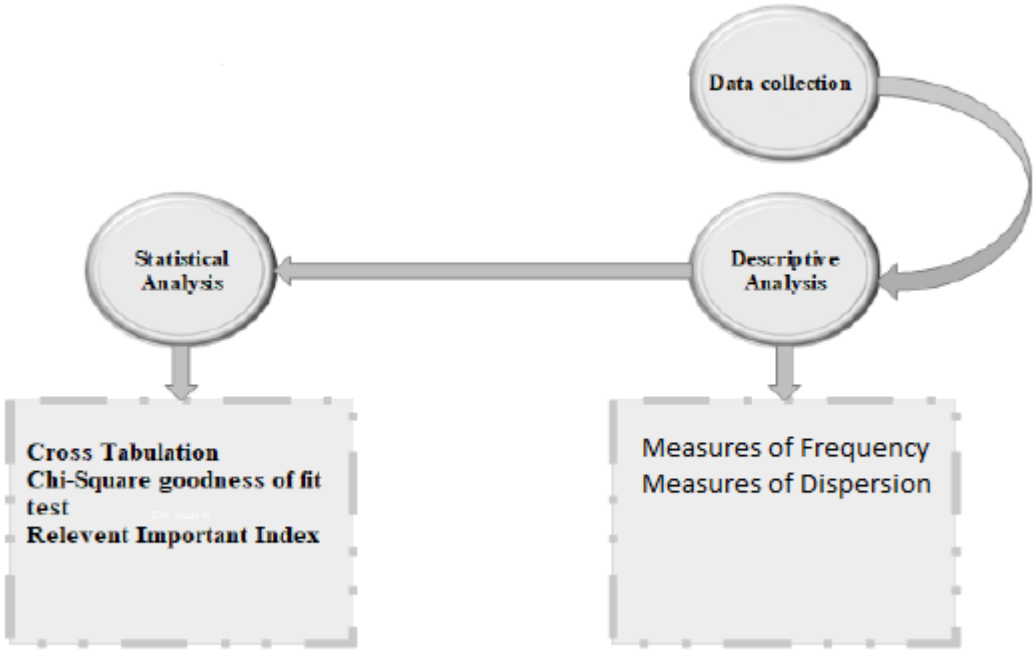

Figure 3. 6 Statistical data analysis process for this research study

Based on this research's foundation, the data obtained for this research to be accepted can be either ordinal or nominal (Kraska-Miller, 2013). Most responses were assigned a rating measured on the “five-point Likert Scale” in this questionnaire.

Thus this type of data cannot be categorized as parametric data. It is crucial to understand the nature of data that can be parametric or nonparametric when the statistical test will be implemented for the research. In terms of that, Garth (2008) recommended that it was crucial whether data is parametric or non-parametric not to make assumptions about the kind of data; when it was given a small sample, it was believed that it was sensible to alternative for the non-parametric way of data analysis to avoid making assumptions. Some methods, such as scores, ranking, or categorising, are usually classified as non-parametric data (Fellows & Liu, 2015).

Between scholars have argued many over ordinal scale data; in some cases, large ordinal scales have been verified as continuous variables measuring, thus enabling parametric testing (Orme & Buehler, 2001).

Parametric data are supposed to be generally distributed. Normal distribution means a data distribution with more data is close to the mean and symmetrically gradually less far away from the mean. In this study, the researcher believed it is essential to justify that data was generally distributed before implementing any parametric test. Otherwise, Garth (2008) asserts that if the data was not normally distributed, it might be better to suppose data as non-parametric.

Implementing a nonparametric test provides some advantages, such as having fewer assumptions and being much more relevant to cases with small sample size.

Generally, nonparametric methods are suitable for data measured on a nominal scale and able to analyze data that is basically in ranks as long as that numerical numbers have the strength of ranks.

As long as advantages for the nonparametric test, there are some disadvantages. For instance, these tests are based on information connected with numbers, asserting that those tests might be less robust. Besides, it has been stated that parametric tests might be more flexible and allow the researcher to have a better range of hypotheses tests than non-parametric tests (Legendre & Legendre, 2012).

The consequence of any research investigation can be analyzed by implanting some methods such as a descriptive analysis method, inferential statical analysis method, and exploratory data analysis (Naoum, 2012). In this type of research, exploratory analysis is regularly implemented for open-ended questions.

3.14.1 Descriptive Statistics

The major objective of descriptive statistics is to describe the fundamental characteristics of the data used in the investigation. It provides a concise summary of the study's sample. This style of analysis, when combined with visualisations, forms the basis for the majority of quantitative research studies. In a nutshell, Fellows and Liu (2015) state that descriptive statistics analysis enquires into the nature of the data.

The researcher gained an understanding of the data collected by the questionnaire through descriptive and statical tests. The type of question determines the nature of the test and the type of data collected. As a result, the researcher analysed these data using descriptive-analytic techniques such as median, standard deviation, and mean. The results of this investigation are illustrated using a variety of charts and histograms. The researcher selects the graphical presentation approach based on which demographic presentation is more precise.

The replies of all participants to this questionnaire were examined, and the raw data were summarised using frequency distribution. According to Naoum (2012), rather than summarising enormous amounts of raw data, it may be considerably more beneficial to categorise them.

To better grasp a group's central tendency, data utilises the mode, mean, and median. According to Fellows and Liu (2015), *"mean is the numerical figure that most accurately represents the series or distribution." The Median is the distribution's midpoint. The mode of a distribution is the value that appears the most frequently".*

The median is the value in the middle of a set of data. Simultaneously, data are ranked numerically from smallest to largest, with the median being the intermediate value. Otherwise, the mode is the value that occurs most frequently in the sets, i.e. the most frequent value (Holt, 1998). Additionally, the standard deviation quantifies the degree to which data are dispersed around the mean. The data should be normally distributed. When this occurs, the standard deviation provides an acceptable basis for probability interpretation of the data (Naoum, 2012). Caswell (1995) states that the standard deviation provides information about the spread of responses around the mean. The wider the data spread about the norm, the less probable that the population mean will be near the sample mean. Holt (1998) finds that the standard deviation is a more meaningful and widely used measure of dispersion because it offers information about the answers around the mean.

3.14.2 Inferential statistics

Inferential statistics provide an opportunity for the researcher to have the capability to draw results that develop based upon the primary data. Thus, implementing this statical test helps the researcher specify different connections between two, three or more groups. In a simple way, is there any connection between two or more variables (O'Leary, 2005). This type of statistics can be implemented to consider models, questions, and hypotheses.

3.14.3 Cross Tabulation and Chi-Square

The cross-tabulation analysis is a possibility analysis type and is frequently implemented to analyze nominal data. The cross-tabulation combines a few or more dimensional tables that account for the frequency of respondents' rate. Using cross-tabulation data analysis, the researcher can get an appropriate source of evidence about the connection of variables (Huddleston, 2019).

Thus cross-tabulation is known as the joint frequency distribution of cases based on categorical variables. To analyse this joint frequency distribution, the chi-square static can be implemented to specify if the variable statically is associated or statistically independent (Michael, 2001).

Naoum (2012) asserts that the measure of connection between different variables can be carried out using the chi-square test, which tests the association between two data groups. The Chi-square test is implemented while the data is either ordinal or nominal. In this type of test, three different analyses, such as goodness of fit, the test of independence, and the test for homogeneity, consist (Wildemuth, 2016).

If the sample under analysis was drawn from a population that has been determined distribution, the goodness of fit test could be implemented. Also, the test for homogeneity answers is appropriate if several people are homogeneous concerning some characteristic. Lastly, if the subjects' population is independent for testing the null hypothesis, the independence test's two classified criteria are implemented.

If they are not independent, there is an association between them at an acknowledged probability level. The results of interest are the levels of significance dependency with the chi-square. This value amount, which is the feasibility that the outcome was produced by random chance, might be between 0.00000 to 1.0000 (Denscombe, 2014).

3.15 Reliability Test

Before statistical analysis, the reliability of the collected data was checked to eliminate any potential error. Reliability is represented as a test of an instrument's consistency and reproducibility(Williams, 2003). The available testing methods for quantitative data reliability are factor analysis, test-retest reliability, parallel forms, split-half reliability, and Cronbach's alpha. However, Cronbach's alpha method is the most common and popular implemented because it benefits testing the reliability of the overall and subscales reliability of any questionnaires (Field, 2005). Cronbach's alpha is the most prevalent internal consistency test ("reliability"). It is most popular implemented when there are multiple Likert questions in questionnaires that form a scale and wish to define if the scale is reliable or not. Cronbach's alpha gives an overall reliability factor for a given set of variables. When implementing a Cronbach's alpha method for reliability testing, the outcome can be between 0 and 1; 0 defines a completely unreliable test, and 1 for a completely reliable test (Hilton et al., 2004). An alpha coefficient of .70 is the minimum acceptable level, while .80 is seen as a good value Field, 2005). Validity refers to how an instrument measures what it is supposed to be measuring (Polit and Hungler, 1985). This research validity of the survey instruments (Questionnaire) was tested through the pilot study using sample respondents. Based on their feedback, necessary revisions were made to the questionnaire before it was distributed. Whereas reliability is concerned with data measurement accuracy, it is free of random error when estimated (Cooper & Schindler, 2003; Zikmund et al., 2007; Pallant, 2013). As this questionnaire is designed with a Likert scale, it needs to determine the reliability of the plate. Using Coefficient alpha (referred to as Cronbach's alpha), reliability can be measured. This research follows the rules of thumb by George and Mallery (2003) that provide the Cronbach's alpha values for reliability test: "_>0.9=Excellent; _>0.8=Good; _>0.7=Acceptable; _>0.6=Questionable; _>0.5=Poor; _<0.5=Unacceptable". The summary of the reliability test for both data sets is presented in table 4.2, with all items in the questionnaire sections having high reliability. The Cronbach's Alpha is 0.918, and reliability for this questionnaire was high

3.16 Exploratory Pilot Interviews

Exploratory pilot research to build the technique's mood in practice was undertaken at the beginning of this PhD research journey. This pilot research was implemented as an examination run or possibility of this research in readiness for the main study. Thus, it was a great tool to collect primary data to help the literature review's suspected research gap (Van Teijlingen & Hundley, 2001).

The exploratory pilot research study interviewed four experts in resilience and disaster management. Each interview took about 20-25 minutes.

By doing those interviews, the researcher understood some crucial angels of this research. For instance, an interviewee pointed out that:

"*The role of disaster management in hospitals and health centres is very crucial; hospitals require some disaster managers, who can lead and manage hospitals in disaster events and champion the proper disaster management agenda*".

On the other hand, another interviewee mentioned that:

"In terms of coordination and collaboration in most disaster events, various non-skilled people made serious chaos. These people at different levels can make a problem. Thus, appropriate coordination should be done by disaster managers".

Accordingly, pilot interviews demonstrated that the original research was over-ambitious for this single research study. However, it pointed out that disaster management is a massive study, but the disaster management cycle's mitigation and preparedness parts can be considered. As a result of the above pilot study and some recommendations received during the school of Built Environment's internal evaluation, mitigation and preparedness in this study, the researcher concentrates on the mitigation and preparedness stage of disaster management in hospitals. Thus, this research was prompted by interviewees and recommendations from internal evaluation examiners that the mitigation and preparedness part of the disaster management cycle should be considered.

After implanting the pilot interviews, the research concentration was shifted from the wild research area, and it narrowed down to preparedness and mitigation stages. Consequently, this research study's aim and objectives were revised and modified to concentrate more on preparedness and mitigation stages instead of the rest, such as recovery and hospital responses.

3.17 Interview Design Strategy

For this research semi, a structured interview with open-ended questions was implemented for collecting qualitative data. Using semi-structured interviews, the researcher had opportunities to approach interviewees to have more conversations to get more in-depth information about the general theme. On the other hand, this semi-structured interview provides a chance to over-chatting to have more specific questions, get new ideas, and explore different research angles. It is crucial that the interviewer balance between free flow questions and queries during interview time (Lee, 1999).

These interviews were conducted with some disaster managers experts who had experience or were involved in the Kermanshah earthquake or flood (2019) in north and south of Iran to explore the research questions that have appeared from the identified gap in the literature review.

Therefore, this semi-structured interview designed in three different parts as follows:

- Introduction to get more information about interviewees and their backgrounds.
- To identify and evaluate hospitals' existing mitigation and preparedness measures and identify barriers and obstacles to implementing appropriate disaster management strategies.
- To identify barriers and obstacles to implementing appropriate disaster management strategies in hospitals. What were the most challenges faced in disaster management during hospitals' mitigation and preparedness stages?

3.18 Transcribing and Coding of interviews

In this research, all of the interviews were in Farsi Language and have been fully transcribed and translated. In the first stem interviews delivered in the Farsi language, all participants were originally from Iran and were suitable for the once all of the interviews are delivered, the transcribing and translating process implemented. In terms of transcribing and translating interviewer paid full attention to keeping the data as it was given. Also, all of the interviewees were permitted to verify the accuracy of the final transcripts. By doing this, the researcher and interviewees ensured the reliability and validity of interviews were kept as original. In terms of refining data, all of the collected data should be read and all of the text separated into different segments to better understand the general sense of collected data (Creswell & Creswell, 2017). In the following, all of the text segments were assigned to codes. In the next step, all codes were converted into themes. In the following figure, this process is illustrated.

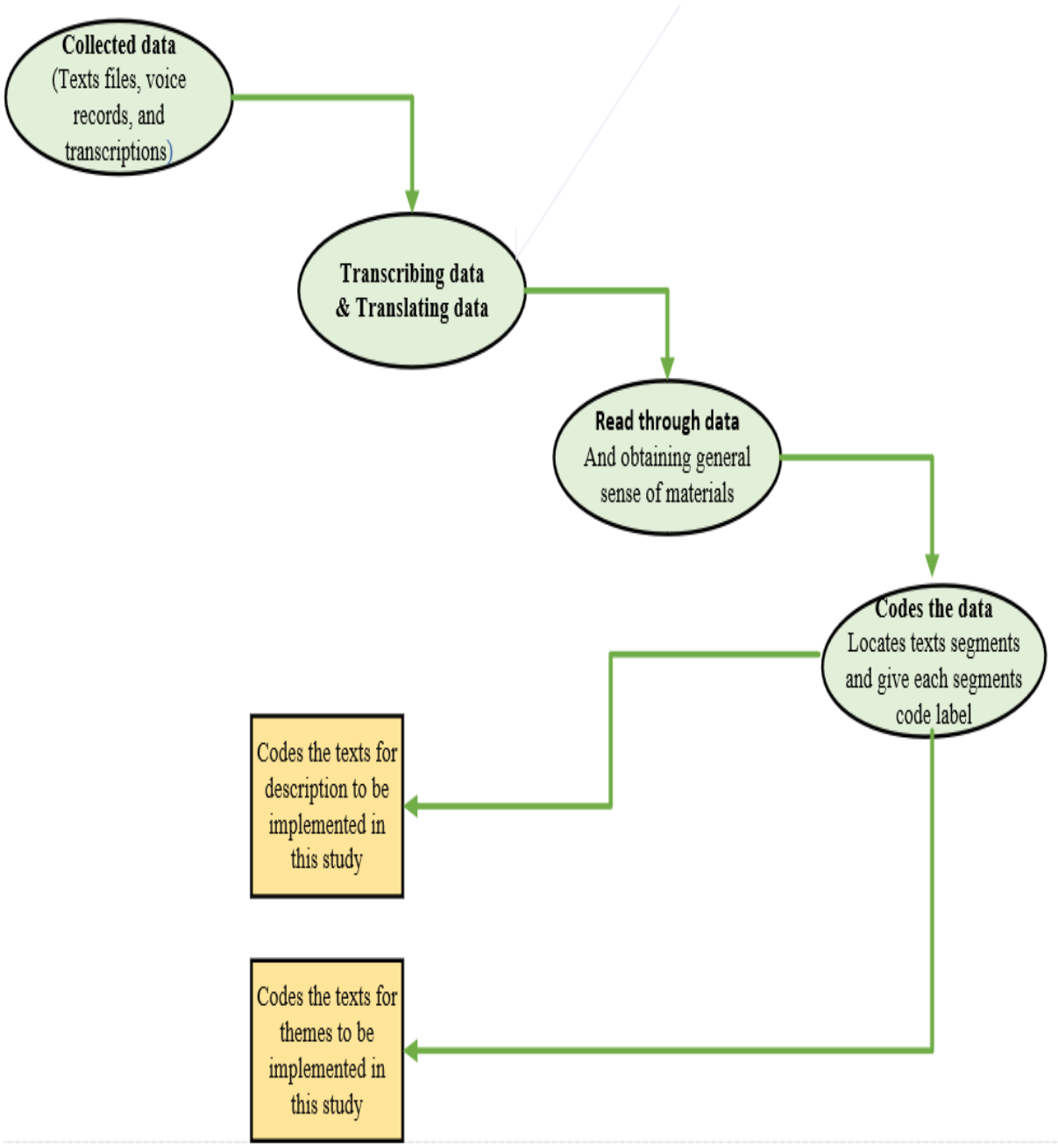

Figure 3. 7 Qualitative data process adapted from(Creswell & Creswell, 2017)

After preparing transcripts and identifying themes of this research, the interview data were coded. The coding process of interviews contributes to recovering answers from interviewees and classifying them in the identified themes and concepts (Rubin & Rubin, 2011). Thus, the coding process helps to scrutinise interview data better.

Version 12 of the NVIVO data management software was implemented to code all the themes from interviews into nodes. The coding process involved recording the number of responses associated with each interviewee for a question.

Semi-structured interviews were used to collect qualitative data. These interviews were digitally recorded with an average duration of 60 minutes. Easterby Smith et al. (2008) state that "full record of the interview should be compiled as soon as possible after it has taken place". This view is supported by (Saunders et al., 2012), who believe that there is a need to "create a full record of the interview soon after its occurrence to control bias and to produce reliable data for analysis". The important factor about qualitative data analysis is exploring the meaning through what is experienced and reported by the interviewees and what is observed by the interviewer. Analyzing qualitative data aims to identify pattern, concepts, themes, and meanings. Bogdan and Biklen (2003) describe qualitative data analysis as "working with the data, organising them, breaking them into manageable units, coding them, synthesising them and searching for patterns". Qualitative data analysis begins with transcribing interviews followed by open coding of the data, which is the categorisation of data to identify patterns, themes, and meanings that emerge from the data.

In this process, the whole data is initially explored, and then the researcher reconstructs it again in a more meaningful way. This categorisation enables the researcher to compare and contrast patterns and deeply reflect on certain patterns of the data to understand them. According to Richards (1999), a content analysis software package such as NVivo could synthesise and manage themes from a large amount of qualitative data by organising data into manageable nodes (themes). The semi-structured interviews are analysed using the content analysis method to organise data into general themes. To make sense of the data, open coding of the data is used, which is the process of recording the number of responses that a particular interviewee gives to a question. Then thematic content coding of the interview transcripts is used to analyse responses. Initially, each transcript is individually analysed for identifying key themes. In the next stage, common themes shared between interviewees are identified.

3.19 Main Study-interviews

The primary purpose of conducting interviews was to obtain the disaster management expert's views on the barrier and challenges of implementing disaster management mitigation and preparedness strategies. Thus, interviews designed to obtain normal life data might assist in extending to have a better understanding of the research in connection with the disaster management of hospitals in disaster events.

The discussion with disaster managers and some researchers in connection with disaster management was to identify the most substantial drivers, their understanding of disaster management, the disaster management strategies they are engaged in, disaster manager roles, and challenges against them in their attempt to implement disaster management strategies in hospitals to mitigate the risk of disaster.

The primary purpose of the interviews was to supply an in-depth conception of disaster management strategy angles and identify some challenges and barriers against disaster managers to eliminate the risk of disasters in hospitals. Due to the aforementioned argument and because this research contains an in-depth study on the current practices related to disaster management, a semi-structured interview will let the interviewees be more flexible in giving their response from various viewpoints with the consistency coming from a similar set of questions. Interview questions are designed into three individual sections as follows:

Section 1: Introduction and understanding more about the interviewee's experience and background.

Section 2: To identify and evaluate the existing global mitigation and preparedness measures in hospitals. To identify barriers and obstacles to implementing appropriate disaster management strategies in hospitals.

Section 3: To identify barriers and obstacles to implementing appropriate disaster management strategies in hospitals.

In the first section, the interviewer gets more background information about the interviewees, and in the following section, the researcher attempts to address 3rd and 4th objectives deeply.

3.20 Interview Samples

The interview sample was chosen from hospital personnel such as nurses, the medics team, and disaster managers from the Iranian disaster management department. Moreover, hospitals were involved in the Kermanshah earthquake and the 2019 flood north and south of Iran. Semi-structured interviews were carried out with eight disaster managers and hospital personnel in Iran. Those participants charged with promoting disaster management practices in delivery hospitals and health facilities were interviewed in this research study. An initially purposeful sample of this interview was developed by contacting more than 30 consultants, medicines and hospital personnel who experienced the Kermanshah earthquake and the 2019 flood in central Iran. Doing this made the researcher more convenient that interview participants who cover a wide range of disaster management aspects and manage hospitals in disaster events. A useful sample is not common or generic. It is typically used for exploratory research where the interview participants are hard to touch (Bradley, Curry, & Devers, 2007) or in special circumstances where a detailed investigation is required of the specific issue (Choy, 2014). This research distributed standard invitation emails to disaster managers and hospital personnel. The researcher contacted them with a telephone call, and eight agreed to take part.

Even though there are variations in the interviewees' job titles, all were responsible for driving forward the agenda relating to disaster management practice and giving health service to injured people in hospitals in disaster. All participants were held recorded with interviews permissions and were confidentiality. The interviews lasted between 40 and 60 minutes. To ensure the interviewees' anonymity, the research adopts representative descriptors to represent each interviewee. The five disaster managers and hospital personnel interviewed were involved in the Kermanshah earthquake event. Other talks were engaged with the central flood that happened in 2019 in Iran. All interviewees were represented using letters 'A' to 'H'. Appendix D, E, and F, Interview guidelines, semi-structured interview questions and interview transcripts are presented.

Despite the variation in job titles, all the above intra-organizational leaders interviewed have responsibilities within their respective organizations to promote disaster management practices in delivering disaster events. Analysis of the interview data using NVivo data management software is discussed in the following of this chapter.

3.21 Data Analysis Technique and Using NVivo 12

Because of semi-structured interviews, the free-flowing text was obtained as qualitative data. To analyse such data within this study, content analysis has been utilised. This section will explain its use of it. In qualitative research, content analysis is widely used. This method extracts significant desired raw information such as implicit or explicit data from texts or images. Before making interpretation and valid inferences, such 100 information will be organised into a systematic concept (Busch et al., 1994-2012; Krippendorff, 2012; Kulatunga, Amaratunga, & Haigh, 2007; Smith, 2000). The content analysis tool can also quantify qualitative data (Kulatunga et al., 2007; Vaismoradi, Turunen, & Bondas, 2013). Based on Kulatunga et al. (2007), four approaches to content analysis have been presented in qualitative research. Firstly, word count, by counting the frequency of identified words, the importance of the words can be shown by using the assumptions of the most frequent word. Secondly, the conceptual content analysis focuses on identifying the occurrence and presence of an identified concept and themes is examined in text or sets of text (Busch et al., 1994- 2012). The predetermination of concepts or themes could be through the literature review or appear from the information itself. Thirdly, the relational analysis considers the relation between concepts inside the text is analysed by this approach (Busch et al., 1994-2012). Fourthly, referential content analysis focus on the underlying meaning of the text is examined, and text interpretation is based on the researcher's judgement. The researcher sought to explore the interviewee's thoughts about the current disaster response practices in this study.

Once the key themes were classified from the interview data, they were coded into the node and implemented NVIVO. The following table shows the codes and references of themes and subthemes. Organising the interview data into themes contributes to extracting insight from the data in terms of their contextual nature and, at the same time, identifies any interdependency of the research questions investigated.

The following table presents the key research themes, sources, and references identified in the content analysis.

Table 3. 13 Coded main themes, sub-themes, sources, and number of references

Main themes	Sub Themes (Question areas)	Sources	References
Strategies	Understanding disaster management in hospitals	10	22
	Strength and weaknesses of strategies	9	34
	Improvement after implementation	10	31
	Rehearsal strategies	10	27
Challenges	Disaster Management roles	9	26
	Barriers against disaster management teams	10	30
	Impact on hospitals and health services	10	19
	Organisations and person obligations	8	21

3.22 Data Validity and Reliability

Validity refers to whether the findings are really about what they appear to be about, whilst Reliability is about how the data collection techniques or analysis procedures have yielded consistent findings (Saunders et al., 2009). Validity produces accurate results and measures what is supposed to measure; its ability to attain is one of the basic social research principles. On the other hand, reliability describes a research instrument's ability to produce the same results whenever generated; it's all about consistency in results (Sarantakos, 1998). Assessing the validity of mixed research findings is incredibly complex because it combines the complementary strengths and non-overlapping quantitative and qualitative research (Onwuegbuzie and Johnson, 2006). Bazeley (2004) argued that mixed methods are essentially neither more nor less valid than specific approaches to study. Still, mixed methods enrich the understanding of an experience by confirming conclusions, an extension of knowledge, or new ways of thinking about the research subject.

The questionnaire was also designed to ensure that the questionnaire measuring the presence of constructs(Construct Validity) is intended to measure using Cronbach's Alpha reliability test for the questionnaire's relevant questions.

Sarantakos (1998) argued that there was a general belief that qualitative research does not provide a high level of reliability than quantitative analysis. Validity and reliability are interrelated, and a valid instrument is expected to be reliable, even though a dedicated instrument is not necessarily valid. The research findings' validity and reliability could be achieved by ensuring that the interviewees' transcripts are 1e-checked. All information from the study should be reported if it had not been in line with major findings (Creswell, 2003). To achieve validity, questionnaires and interviews were designed to ensure that respondents understood all questions to achieve internal validity. An extensive literature review has been undertaken to ensure that the questionnaire adequately covers the research's aim and objectives. Finally, qualitative and quantitative data collection, data analysis, and results interpretation were undertaken only by the researcher to eliminate observer error (errors made by the researchers scoring the measure). Saunders et al. (2012) indicate that validity and reliability are two important factors in assessing the quality of research. Gibbs (2007) states validity in qualitative research as “the verification process of the findings employed by the researcher”.

On the other hand, reliability refers to the consistency of findings if the same data collection and analysis techniques are applied by a different researcher or repeated on another occasion (Saunders et al., 2012). Yin (2014) highlighted that reliability aims to minimise the biases and errors in a study. Therefore, the case study tactics and procedures recommended by Yin (2014) are adopted to maximise the validity and reliability of this research.

3.23 Triangulation

Triangulation refers to using more than one approach to investigating a research question to enhance confidence in the ensuing findings. Patton (1987) describes the basic triangulation types as; data, methodological, theory and investigator triangulation. Data triangulation involves data collection through several sampling strategies, whilst Methodological triangulation refers to using more than one method for collecting research data (Patton, 1987; Bryman, 2007). Theory triangulation involves using more than one theoretical method to underpin and interpret a researched phenomenon. However, multiple researchers in a single investigation are known as investigator triangulation (Patton, 1987).

The use of mixed method research allows the consideration of a wide range of data and provides triangulation opportunities, including reviewing and analysing evidence from multiple sources (Creswell, 2003). A mixed-method strategy can provide better opportunities to answer a research question and assess how findings may be trusted and conclusions made. A qualitative research approach produces rich data to help develop quantitative research questions for further investigations (Hussein, 2009). Triangulation in research is used when the quantitative and qualitative research method are combined to provide a more comprehensive set of findings. It is a device for increasing the credibility and persuasiveness of a research result. The triangulation of research methods or data helps evaluate and analyse evidence from various sources to check the qualitative results with the quantitative results (Creswell and Plano Clark, 2007). Using a semi-structured interview, a qualitative data collection approach may be a valuable way of triangulating quantitative data collected by other means such as a questionnaire. Using different data collection techniques within one study helps ensure that the data provides the researcher with a better reflection of what the study should deliver to understand the results (Saunders et al., 2009). A qualitative research method is used to generate rich data. A quantitative research method is employed in data collection and analysis to archive a broader and more comprehensive view of the explored phenomenon. Triangulation is an excellent way to reap the benefits of both qualitative and quantitative methods(Hussein,2009). Data triangulation is an excellent way to validate qualitative results by quantitative studies. Triangulation helps nullify one method's weaknesses and strengthen the other's benefits to increase the data's validity and reliability. As it has been explained in this chapter this study is a mixed-methods study. Therefore methodological triangulation has been partly used for validation of findings.

3.24 Time Horizon

Dawood & Underwood (2010) state that a time horizon is necessary for research. It is also believed that all researchers should determine the time to complete their research. Sanders et al. (2012) state that the time horizon is identified as longitudinal or cross-sectional. In this research, the researcher will use a cross-sectional time horizon due to concentrating on a phenomenon and event at a specific time.

3.25 Ethical Considerations

Several key ethical issues were considered, including voluntary participation, informed consent, privacy and confidentiality. Participants were also given the freedom to withdraw at any time without penalty. The researcher provided the interview participants' letters before the interview process began. The interview letter explained the research's aim and objectives and how data from the interview will be protected and used. This research involved no deception, and participation in both the interview and the questionnaire was voluntary. Ethical consideration was consistently shown in managing the questionnaire and interviews. Informed consent is an important issue and concerns identifying and protecting the human subject from the potential risk of physical or psychological harm. Before starting the interview, the researcher informed the participants of all the vital information, and participants completed consent forms confirming their approval to participate in the interview. A copy of the interview participants' consent form is shown in appendixes C and D. Ethical approval was received from the University of Salford's Research Ethics Panel (REP) prior to any data collection. An email confirmation of ethical approval is shown in Appendix B. All data from the interviews and questionnaires were kept confidential by keeping them locked and Secure. Data in electronic form were encrypted to ensure the confidentiality and anonymity of research participants. The research ethics for data collection, storage and analysis were followed for this research. The names of interviewees will remain anonymous. The data collected will be stored in a password-protected system.

3.26 Summary & Link

In this chapter, the research methodology has been presented and justified by discussing how the research philosophy, approaches, and techniques were designed to address the study's research problem. The chapter that follows describes the preliminary finding of the interviews and documents in greater detail. In the following two figures, the methodology for this research is adopted from Saunder’s research onion and research methodological road map.

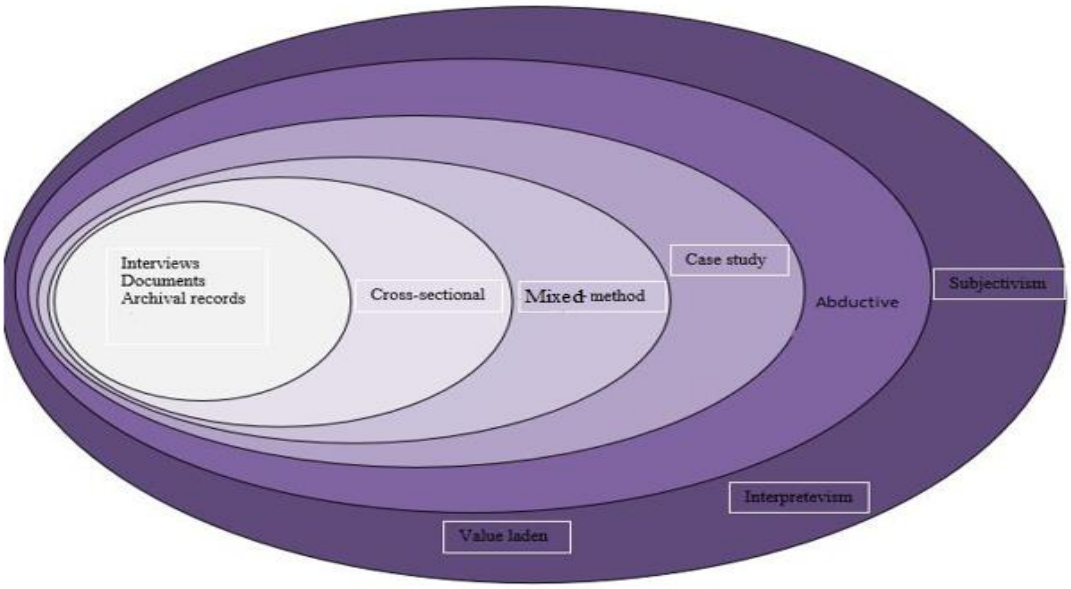

Figure 3. 8 Methodology for this research adopted from Saunder's research onion

To achieve the research aim and address the research objectives, the selected sources of evidence were tailored carefully by constructing a robust research design. Both Bryman (2012) and Creswell (2009) argue that the research design is the researcher's framework to collect the data and analyse them. Further, the researcher should clearly address the scope of the examination. This chapter discussed and justified the research methodology adopted for this study. Therefore, to summarise the procedures used, this section shows the research methodological framework of the study as a flow chart, identifying the three main stages as expressed previously to articulate the logical steps taken throughout this study.

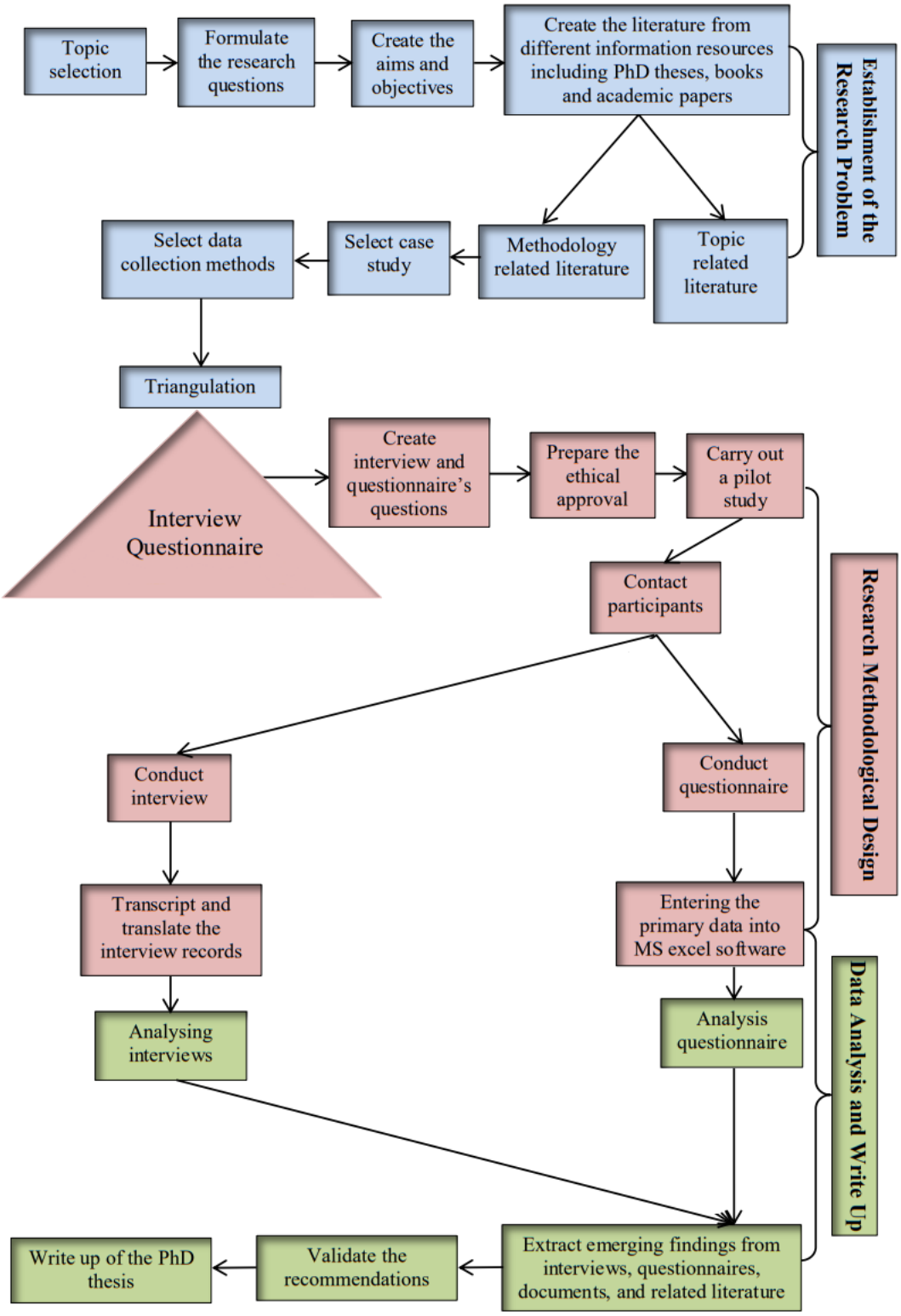

Figure 3. 9 Research methodological road map for this research

Chapter 4

CHAPTER 4: QUANTITATIVE DATA COLLECTION AND ANALYSIS

4.1 Introduction

This section illustrates the findings of this research's quantitative data collection stage. This chapter discusses the data collection process, the sample size, and the main results. This study employed a questionnaire survey to collect data on hospitals' importance in disaster events, examine the impact of disasters on hospitals' critical factors, and evaluate hospital preparation management and critical elements of successful hospitals. The implementation of this questionnaire survey complements research findings and gives a broader perspective of hospitals' crucial role in disaster events. The analysis and result of the questionnaire survey are discussed and written under the following sub-headings;

- Questionnaire design and strategy
- Method of Data Analysis
- Reliability Test
- Analysis of questionnaire
- Statistical Test

4.2 Analysis of Questionnaire

The data analysis was accomplished to respond to the research questions appointed in the first chapter. All of the statical analysis detail of each question of this questionnaire are stated in the following. A copy of questionnaire screenshots and questionnaire cover letter is attached in appendix G and H.

4.2.1 Section One Professional background

In the first section of this questionnaire, the professional background of respondents is primarily concerned. These questions were asked to get more information about respondents' rate and their disaster management experience background; therefore, it confidence researcher that the questionnaire's data would be appropriate and fit this research project. The third question was about the rate of disaster management experience of participants. In questions four and five in the first section, the researcher purposed to get more responses about the participant's general knowledge of disaster management and responsible person or any organisation in charge of disaster events in hospitals.

Question 1: Name?

To collect identifying information of any sort, one must demonstrate to an Institutional Review Board that this information is required. The research has established procedures for protecting the participant's identity. In the first question of this questionnaire, respondents were asked to give their essence to classify them in the future. Therefore, in the first question, the researcher collected all participants' names and modified them to protect participants' privacy.

Question 2: Main role?

In question two, participants were asked about the primary role and status of employability. This question was to describe their current job title to establish if they have a disaster management role or any connection with disaster management or hospitals. The survey results demonstrate that 8.95% of respondents are in disaster management, and more than 64.92% of participants as hospital personnel, 18.65%. 18.65% of them had been involved in those disaster events as volunteers, and just 7.46% of them with an academic background who researched disaster manmagement and had experience with those events.

Despite the differences in job roles of participants, they all have disaster management experience. This illustrates that the level of diversity in occupation roles to have a different opinion can be collected with this survey.

Statically tests were carried out to show any issues in responses in different groups involved in this questionnaire survey. The analysis of these questions examined the differences between the disaster managers' responses and those involved in hospitals' disaster events and personnel.

Table 4. 1 Statistical representation of participants

Main Role

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Disaster management	12	8.95	8.95	8.95
	Disaster management researcher	10	7.46	7.46	16.41
	Hospital personnel	87	64.92	64.92	81.33
	Volunteers in disaster events	25	18.65	18.65	100.00
	Total	134	100.0	100.0	

Question 3: How would you rate your experience with disaster management?

The respondents for this survey were asked to rank their experience with disaster management. The detailed statistical consequences are demonstrated in Table 4.5; the graphical of this outcome is shown in Figure 4.3. The respondents have been categorised into six main parts, namely N/A, less than one year, 1-3 years, 3-5 years, 5-10 years and more than ten years of experience in disaster management. The respondents ranked from N/A to very high experience rates in disaster events and disaster management. However, most respondents had a high experience rate in disaster management. The participants' high experience rate was 51 out of 134, which equated to almost 38.1% of overall respondents. The consequence shows that 14 participants had very high disaster management experience, which is about 10.4% of overall respondents. Otherwise, this survey shows that just 1 participant did not have any experience in disaster management, and 25 participants had low or very low experience. The result demonstrates that more than 70.6% (108 participants) respondents have average and more experience rates in disaster management and have been involved in different disaster events in the past. As the respondents were randomly chosen from people who work in hospitals, disaster management department in Iran, and some researchers with disaster management backgrounds, this outcome can reflect participants' variety of opinions. Thus, such a respondent profile strengthens this questionnaire survey's consequence in terms of participants' reliability.

Table 4. 2 participant's experience in disaster management

Rate of experience

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	N/A	1	.7	.7	.7
	Very Low < 1 Year	11	8.2	8.2	9.0
	Low 1-3 years	14	10.4	10.4	19.4
	Average 3-5 years	43	32.1	32.1	51.5
	High 5-10 year	51	38.1	38.1	89.6
	Very High >10 Years	14	10.4	10.4	100.0
	Total	134	100.0	100.0	

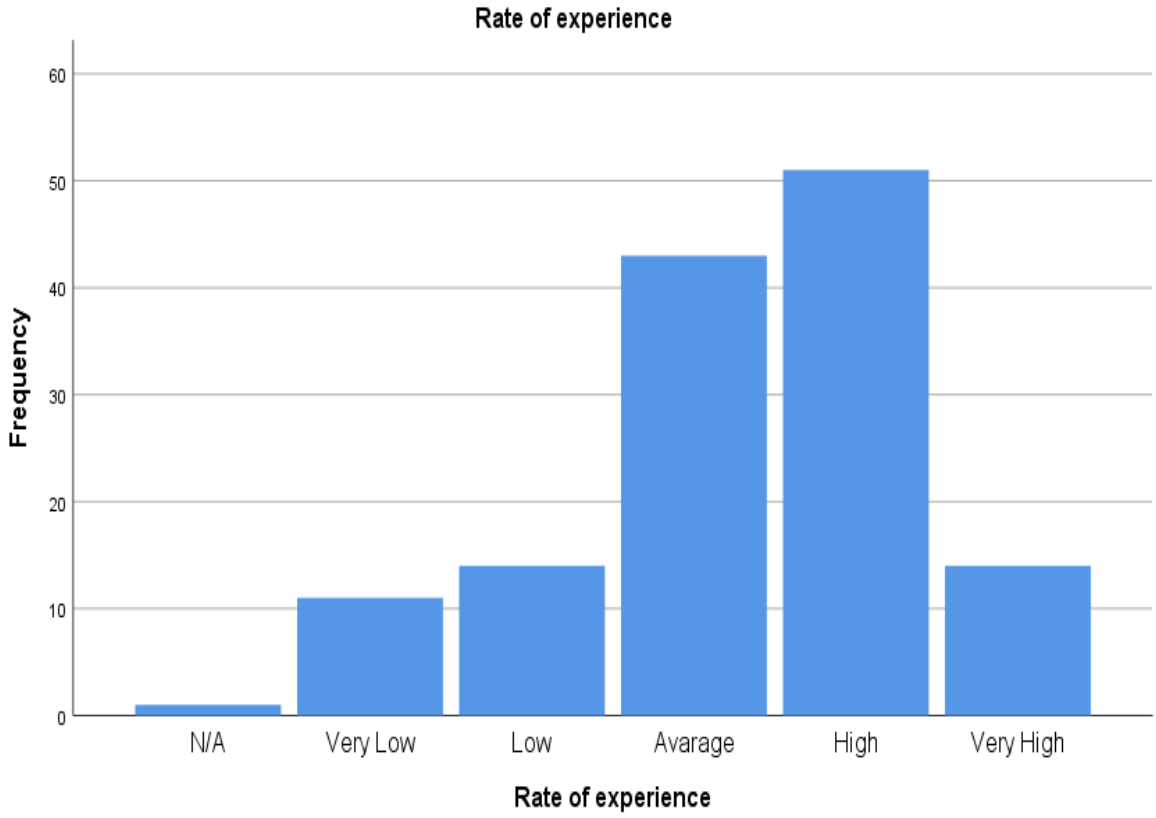

Figure 4. 1 participant's experience in disaster management

Question 4: Is someone in the hospital responsible for disaster management?

This questionnaire's background profile was designed to identify the general information about the entire group of participants for this survey. The survey respondents were asked whether anyone in the hospital is allocated to manage disaster events and have this obligation. The reason behind this question was to understandeness of different people. However, this question examines participants' level of disaster management knowledge about hospitals. It was noted that 26 participants out of 134 did not know whether or not any person is allocated in hospitals to manage disaster events. However, as much as 19.4% of respondents did not know. Still, in managing disaster events, nearly 30 per cent of participants considered as no one is responsible in hospital for disaster management purposes. Out of 134 respondents, 74 participants (58.2%) considered a person or a team to manage hospital disaster events.

Table 4. 3 Responsible people at hospitals in disaster events

Responsible Person

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Yes	76	56.7	56.7	56.7
	No	32	23.9	23.9	80.6
	I do not know	26	19.4	19.4	100.0
	Total	134	100.0	100.0	

Question 5: If the answer to the previous question is "yes", does this person interact with any of the following?

The survey respondents were asked to share their disaster management knowledge to understand better the most popular organisation with disaster management at hospitals in disaster events in leading hospitals and health facilities usable for injured people. This question was to understand better how different organisations might be involved in disaster events.

In this part of the questionnaire, five typical organisations were named, and for those participants who have had interactions with another organisation, the other option was provided. Participants had an equal response to the Ministry of Health and the National disaster management organisation. Each of these organisations was chosen 36 out of 134, equivalent to 26.9%. However, it was noted that only 6% of the participants of this survey chose the United Nations. Still, 26 out of 134 participants were selected, about 21% of respondents. Despites with differences in the other organisation can be involved with the disaster management team in hospitals. Most of the respondents to this survey agreed about the role of the ministry of health and National disaster management organisation as essential and critical organisations to interact with during and after disaster events.

Besides the above organisations, some other organisations, such as the Red Cross, Hilal Ahmar, and some Charites, provide volunteers for these events. This survey results show that different organisations can be involved in disaster events to manage hospitals and keep health services ongoing for injured people. Some of those have more interaction due to their objectives, such as the Ministry of Health and the National disaster management department. Some of them, such as the United Nations, can be involved due to the size of the disaster and the amount of region distraction.

This survey also shows the most popular organisations after the Ministry of Health and National disaster management organisation. Some organisations, such as NGOs with almost 21% and Civil protection with 19.4%, can be the other organisation with more interaction in terms of demand and size of disaster events. In the following table, this question's result is illustrated, and the following figure demonstrates the variety of organisations' percentages.

Table 4. 4 Responsibility organisations interacting with the disaster management team in hospitals

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Ministry of Health	36	26.9	26.9	26.9
	Civil Protection	26	19.4	19.4	46.3
	National Disaster Management	36	26.9	26.9	73.1
	United Nation	8	6.0	6.0	79.1
	NGOs	28	20.9	20.9	100.0
	Total	134	100.0	100.0	

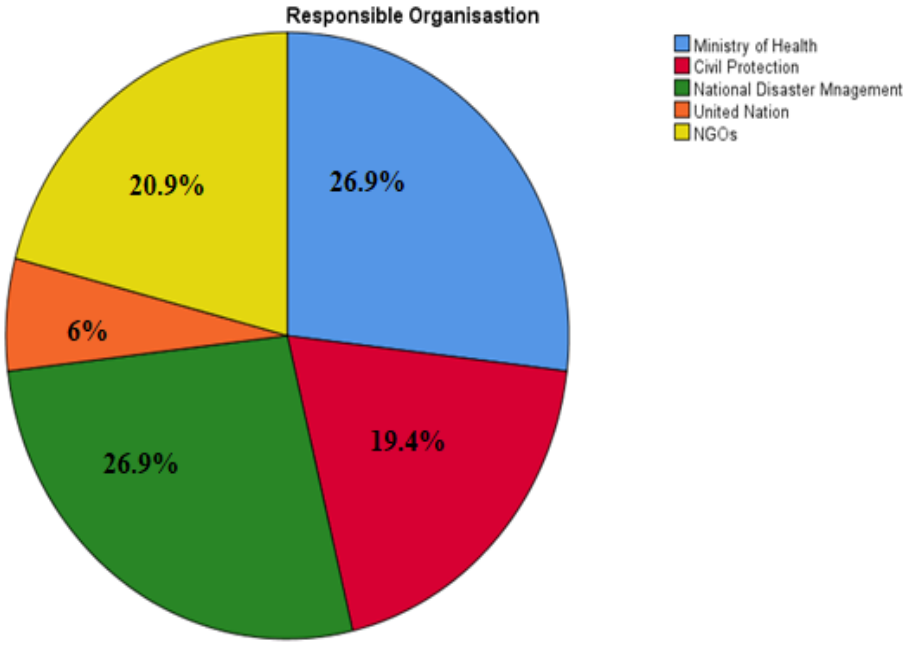

Figure 4. 2 Responsibility organisations interacting with the disaster management team in hospitals

4.2.2 Section Two Importance of Hospitals and Evaluating Some Critical Factors of it in Disaster Events:

In the second section of this questionnaire, the researcher attempts to identify participants' experiences connected with hospitals and their importance to in-disaster events. Besides, hospitals' critical factors during disaster events were better asked to understand each critical factor's significance. Following this section, the importance of rehearsal and mitigation and preparedness planning were asked.

Question 6: Based on experience from past disasters, how would you rate the importance of hospitals during disasters?

This question establishes the participant's understanding of hospitals' importance rate during disaster events; thus, respondents for this survey were asked to rate hospitals' importance in four categories: not important, little Important, important, very important, and extremely important. The importance of hospitals as a critical place during disaster events that can give essential health services to the injured people was asked of participants. The detailed statistical results are demonstrated in the following table.

The respondents ranged from not important to extremely important of hospitals in disaster events. However, most of the participants were situated in extremely important, having 65 out of 134. This is equated to almost 48.5% of the respondents. The result also shows that nearly 28% of participants agreed that hospitals' role is critical.

However, about 89.6% equate to 120 participants who agreed that hospitals' role is important, but 2.98% of participants agreed to not crucial for hospitals during disasters. As the respondents were randomly selected from different backgrounds and organisations in terms of turnover, the true reflection of the variety of opinion responses can be seen. Such a respondent profile provides strength to the outcome of this questionnaire in terms of its reliability. The researcher understood that more than 89% of participants believed hospitals and health facilities' importance during disaster events to manage injured people and provide health service to demands by asking this question.

Table 4. 5 Importance of hospitals in disaster events

Importance of hospitals

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Not important	4	2.98	2.98	2.98
	Little Important	29	21.6	21.6	24.58
	Important	26	19.4	19.4	43.98
	Very Important	10	7.64	7.64	51.62
	Extremely important	65	48.5	48.5	100.0
	Total	134	100.0	100.0	

Question 7: How would you rate the impact of natural disasters on the following critical factors?

In this question, the researcher attempts to rate the impact of natural disasters on some critical factors that might keep hospitals active during disaster events. These factors have been found in the literature review, and were asked participants of this questionnaire survey to rank their importance in their experience. In the following, each aspect is interpreted.

Manging Medical Equipment:

The survey respondents were asked to rank the impact of natural disasters on managing medical equipment during and after disaster events in hospitals and health centres. This factor was selected with an equal percentage of 26.1% as a high and extremely high impact. Besides, 18 out of 134 participants chose medium impact, equivalent to about 13.4%. However, 88 participants agreed to this as a medium, high, and extremely high, and just about 46 participants, equal to 26.1%, chose never and little impact of natural disasters on this factor. For instance, 35 out of 134 participants chose little, and 11 participants believed natural disasters do not impact on managing medical equipments. The result of the participants' answers is demonstrated in the following table.

Table 4. 6 Impact of natural disasters on medical equipments

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	11	8.2	8.2	8.2
	Little Impact	35	26.1	26.1	34.3
	Medium Impact	18	13.4	13.4	47.8
	High Impact	35	26.1	26.1	73.9
	Extremely high Impact	35	26.1	26.1	100.0
	Total	134	100.0	100.0	

Controlling Medicine Supply:

In this research, another factor that was vital in disaster events was medicine supply and control during and after disaster events, and the impact of natural disasters on this factor was asked. Therefore, the researcher asked this factor to participants of this questionnaire survey to rank the impact during disaster events at hospitals. Regarding participants respondents, the amount of answers for little impact and medium impact is equal with 23.9% in each equivalent to 32 participants out of 134. In a comparison of participants, respondents just 4.5% selected this factor as never, in the opposite 27, which is equivalent to 20.1%, chose extremely high, and most participants chose high with 27.6%. In the following table, the results of participants' respondents are demonstrated.

Table 4. 7 Impact of natural disasters on controlling medicine supply in disaster events at hospitals

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	6	4.5	4.5	4.5
	Little Impact	32	23.9	23.9	28.4
	Meduim Impact	32	23.9	23.9	52.2
	High Impact	37	27.6	27.6	79.9
	Extremely high Impact	27	20.1	20.1	100.0
	Total	134	100.0	100.0	

Providing continuous energy:

Distributing energy to the hospital that might be devastated during disaster events was carried out. This can cause some difficulties in having appropriate health services during and after disaster events while high-demand patients are at hospitals. Therefore, in this questionnaire researcher asked about the impact of natural disasters on this factor during these events. It was noticed that 6 participants, equivalent to 4.5%, selected never. On the other hand, 46 participants (34.3%) chose this extremely high impact factor. Though the number of participants who chose extremely high impact was high, 35 of the respondents chose little impact, equivalent to 26.1%. Likewise, 24 selected medium impact and 23 chose high impact on providing continuous energy to the hospital during and after disaster events. In the following table, the result of the participant's respondents is demonstrated.

Table 4. 8 Impact of natural disasters on providing energy supply for hospitals during disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	6	4.5	4.5	4.5
	Little impact	35	26.1	26.1	30.6
	Meduim Impact	24	17.9	17.9	48.5
	High Impact	23	17.2	17.2	65.7
	Extremely High Impact	46	34.3	34.3	100.0
	Total	134	100.0	100.0	

Having Reserve Fuel:

Another factor might be devastated and cause some problems for hospitals lack of reserve or shortage of fuel. Thus, the researcher raises this factor for participants of this questionnaire survey to better understand the impact of natural disasters on this factor. Comparing all participants' results, the researcher understood that just six respondents out of the total amount chose never. On the other hand, 27 out of 134 chose extremely high impact. Whereas 36 of the participants, equivalent to 26.9%, chose little impact to have an alternative or reserve fuel during disaster events for hospitals, but 32 and 33 of respondents chose high and meduim impact on having reserve fuel during the events of the disaster. The participant's respondents' result for this factor is demonstrated in the following table.

Table 4. 9 Impact of natural disasters on having reserve fuel for hospitals during disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	6	4.5	4.5	4.5
	Little impact	36	26.9	26.9	31.3
	Meduim Impact	33	24.6	24.6	56.0
	High Impact	32	23.9	23.9	79.9
	Extremely Impact	27	20.1	20.1	100.0
	Total	134	100.0	100.0	

Providing Enough water and food:

The impact of natural disasters on providing enough food and water during disaster events was asked participants of this questionnaire to rate. The detailed statistical result of these respondents is shown in the following table. In comparing respondents of participants, there was a slight difference in the number of respondents who answered providing enough water and food for hospitals. About 20% of participants chose as never whilst slightly more, with 20.9% chose high impact, and 26.1% selected as extremely high impact. There were various respondents in different impact rates for providing food and water for hospitals during disaster events, but just 4 out of 134 participants were selected as never.

Table 4. 10 Impact of natural disatsers on providing enough food and water for hospitals during disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	4	3.0	3.0	3.0
	Little impact	26	19.4	19.4	22.4
	Meduim Impact	41	30.6	30.6	53.0
	High Impact	28	20.9	20.9	73.9
	Extremely High Impact	35	26.1	26.1	100.0
	Total	134	100.0	100.0	

Enough equipment and supplies in the sterilization services:

Enough equipment and supplies in the sterilization services might be devastated because of the disaster event at hospitals. This factor was questioned to participants, and in response, the amount was chosen for never, medium impact, high impact, and extremely high impact were close together. However, this factor was selected as extremely high impact with 32 participants. It was high impact with 30 participants, that were equivalent to 22.4%, but 32 of the participants chose as a little impact, and just 5.2% chose as never. Most participants chose this factor as medium impact, with 33 out of 134, close to 25%. Also, the total result of the participant for this factor is shown in the following table.

Table 4. 11 Impact of natural disasters on Enough equipment and supplies in the sterilization services in disaster events at hospitals

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	7	5.2	5.2	5.2
	Little impact	32	23.9	23.9	29.1
	Meduim Impact	33	24.6	24.6	53.7
	High Impact	30	22.4	22.4	76.1
	Extremely high Impact	32	23.9	23.9	100.0
	Total	134	100.0	100.0	

Keeping communication system such as phone, internet, etc.:

Medical facilities may struggle to maintain effective communications during a major disaster. Natural and man-made disasters threaten connectivity by degrading or crippling Internet, cellular/mobile, and landline telephone services across wide areas. Communication among staff, between facilities, and resources outside the disaster area may be lost for an extended time. Moss and Townsend (2005) state that *"…the failure of telecommunications infrastructure [during a disaster] leads to preventable loss of life and damage to property… Yet despite the increasing reliability and resiliency of modern telecommunications networks… the risk associated with communications failures remains serious because of growing dependence upon these tools in emergency operations."* Thus, the researcher asked this question in this questionnaire to better understand this factor's impact rate in disaster events at hospitals. Participants' number of chose little impact and high impact were in the same number as a 30 for each equivalent of 22.4%. Otherwise, most participants chose medium impact, with more than 31%. Despite more than 72% selecting the different rate of impact of natural disasters on keeping communication systems such as phone, internet, etc., slightly more than 5% chose as a never for this factor during disaster events at hospitals to provide appropriate health service for injured people. In the following table, the total result of participants for this question is demonstrated.

Table 4. 12 Impact of natural disasters on Keeping communication system such as phone, internet, etc. in disaster events at hospitals

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	7	5.2	5.2	5.2
	Little Impact	30	22.4	22.4	27.6
	Meduim Impact	42	31.3	31.3	59.0
	High Impact	30	22.4	22.4	81.3
	Extremely High Impact	25	18.7	18.7	100.0
	Total	134	100.0	100.0	

Keeping Heating, Ventilation:

Depending on the region's location and condition, providing an appropriate temperature might be another challenge for disaster managers in disaster events. This can make giving health services to demanded difficult if anything goes wrong. The researcher asked about the impact's rate of this factor to have less impact on hospitals during disaster events. In terms of participant's respondents, 41 out of 134 respondents chose as medium impact, and in contrast, the number of participants chose as high impact and extremely high impact was slightly less.

For instance, 24 participants, who were equivalent to 17.9%, chose as extremely high impact, and 31participants (23.1%) chose to keep heating and ventilation systems for hospitals during and after disaster events. However, more than 96 participants agreed that this system's high impact during disaster events, but 36 respondents received a little impact, equivalent to 26.9%. Just 2 participants stated as never for this factor for hospitals during disaster events. All of the respondents' results are demonstrated in the following table.

Table 4. 13 Impact of natural disasters on keeping heating, ventilation system during disaster events at hospitals

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	2	1.5	1.5	1.5
	Little impact	36	26.9	26.9	28.4
	Meduim Impact	41	30.6	30.6	59.0
	High Impact	31	23.1	23.1	82.1
	Extremely high Impact	24	17.9	17.9	100.0
	Total	134	100.0	100.0	

Controlling Nuclear Medicine and Radiation Therapy:

The preparedness of emergency medical staff and health care units against any incident that causes a problem for controlling nuclear medicine and radiation therapy is nowadays a global concern (Davari, F., & Zahed, A. (2015).

Implementation of appropriate treatment protocols for nuclear accident casualties and research to find more effective treatment protocols, the right and accurate understanding of radiation mechanisms and other issues related to nuclear casualties require training of an expert workforce or team making (Berger et al., 2016). In terms of implementing Nuclear Medicine and Radiation Therapy in hospitals, this questionnaire survey asked about the impact of natural disasters on controlling this facility during disaster events.

The participants' comparison shows that 36 participants selected it as medium impact, equivalent to 26.9%. However, the number that chose this facility as extremely high impact was 35 and as a high impact 24 out of 134, but 30 participants chose it as a little impact. A comparison of participant's respondents shows that more than 87.6% agreed about the high impact of this facility and should be controlled during disaster events with a different rank of impact. Still, just 9 participants, equivalent to 6.7%, chose it as never. The participant's results are demonstrated in the following table.

Table 4. 14 Impact of Natural disasters on controlling nuclear medicine and radiation therapy in disaster events at hospitals

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	9	6.7	6.7	6.7
	Little impact	30	22.4	22.4	29.1
	Meduim Imapct	36	26.9	26.9	56.0
	High Impact	24	17.9	17.9	73.9
	Extremely high Imapct	35	26.1	26.1	100.0
	Total	134	100.0	100.0	

Managing Radiology and Imaging Devices:

Over recent decades, imaging has increasingly been used to evaluate critically ill patients. It can also be used to increase the accuracy of triaging mass casualty incidents victims since over triage (falsely higher triage category) and under triage (falsely lower triage category) can severely impact resource availability and mortality rates, respectively (Berger et al., 2016). Thus, the impact's rate of natural disasters on managing radiology and imaging devices was asked participants in this questionnaire to give rate. The results gathered from the participants understood the number of participants who agreed with the important of managing these facilities are equal with those who agree as little impact with 31 out of 134 participants.

This is equivalent to 23.1% for each group of participants. However, just 2 participants did not agree that managing these facilities can be impacted during disaster events, but 43 participants chose medium impact, equivalent to 32.1%. Besides, 27 participants selected extremely high impact for managing radiology and imaging devices during the disaster and after that in hospitals. In the following table, the result of the participant is demonstrated.

Table 4. 15 Impact of natural disasters on managing radiology and imaging devices in disaster events at hospitals

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	2	1.5	1.5	1.5
	Little impact	31	23.1	23.1	24.6
	Meduim Imapct	43	32.1	32.1	56.7
	High Imapct	31	23.1	23.1	79.9
	Extremely high Impact	27	20.1	20.1	100.0
	Total	134	100.0	100.0	

Mitigating Physical Damages to Facilities:

Health sector damage can cause devastating secondary disasters. Hospitals and health facilities are about much more than bricks and mortar. They are home to critical health services such as public health laboratories, blood banks, rehabilitation facilities or pharmacies. They are the setting in which health workers work tirelessly to ensure the highest level of service. Their importance extends far beyond their role in saving lives and safeguarding public health in the aftermath of disasters. Health facilities have a symbolic social and political value and contribute to a community's security and wellbeing. They must be protected from the avoidable consequences of disasters, emergencies and other crises.

Regarding the importance of hospitals and buildings in this part, the researcher asked participants about the impact of natural disasters on mitigating physical damages to facilities. In terms of participants' results, 44 out of 134 chose this mitigation should be considered high impact; 27.6% (37 participants) selected this mitigation as medium.

Even though most participants chose this mitigation as high impact and medium impact, and extremely high impact with 10.4%, the number selected as little impact was significant. The little impact was chosen with 35 participants, equivalent to almost 26.1%. Besides, those 4 participants chose this mitigation as a never, equivalent to 3%. The result of the participants demonstrated in the following table.

Table 4. 16 Impact of natural disasters on mitigating physical damages to facilities of hospitals in disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	4	3.0	3.0	3.0
	Little impact	35	26.1	26.1	29.1
	Meduim Imacpt	37	27.6	27.6	56.7
	High Imapct	44	32.8	32.8	89.6
	Extremely High Imapct	14	10.4	10.4	100.0
	Total	134	100.0	100.0	

Making Patients Document Safe and Reachable:

How hospitals respond to the demand for medical attention during and after a disaster event can be extremely challenging. One of the challenging factors during a disaster might be damage and cause issues with different parts of the hospital to have proper health service during disaster events. By recording those documents, the medical team can better understand the injured people. Thus, this factor was asked participants of this questionnaire survey better to understand the importance of this factor in disaster events and rating the impact of natural disasters on hospitals during disasters events. Regarding the participant's result, just 2 out of 134 chose it as never. On the opposite, 59 chose it as a medium impact equivalent to 44% of keeping patients' records safe and secure to help the medical team have better health service to injured people. Despite 32 (23.9%), participants chose this factor as high impact, and 10 (7.5%) selected it as an extremely high impact during disaster events, 31 participants, which is exact 23.1%, agreed with little impact of this factor during disaster events at hospitals. In the following table, the total result of participants is demonstrated.

Table 4. 17 Impact of natural disasters on making patients document safe and reachable during disaster events at hospitals

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	2	1.5	1.5	1.5
	Little impact	31	23.1	23.1	24.6
	Meduim Impact	59	44.0	44.0	68.7
	High Impact	32	23.9	23.9	92.5
	Extremely high Impact	10	7.5	7.5	100.0
	Total	134	100.0	100.0	

Controlling Human Resources Such as Hospital's Personnel and Volunteers:

The shortage of specialized healthcare volunteers is a major challenge during disasters, and one solution could be pre-identified healthcare volunteers. According to the WHO, the health system refers to all organizations, people, and actions in which its primary goal is to promote, restore or maintain health (Organization, 2007), and play a crucial role in responding to disasters.

Disasters could adversely affect health systems through the destruction of healthcare facilities and the shortage of personnel. Damages to the health facilities during disasters and shortage of human health resources in response to disasters can lead to irreparable consequences and increase morbidity and mortality (Ardalan, Mowafi, & Homa Yousefi, 2013). The impact of natural disasters on controlling human resources such as hospital's personnel and volunteers were asked

in this part of the questionnaire survey. In terms of participants' results, 34 out of 134 participants chose this factor as extremely high impact on having a good health service during disaster events. Also, 37 of the participants, equivalent to 27.6%, chose it as medium impact. Despite 7.5% being selected as never, 16.4% selected it as high impact for hospitals in disaster events.

In contrast to participants' respondents, the high impact of controlling human resources such as hospital personnel and volunteers was selected more than 76.9% with the different rank of impacts such as medium, high, and extremely high impact. Still, the number chosen as a little impact was significant and was selected with 31 participants. This number is about 23% of the total participants for this questionnaire survey. The full results of participants for this factor are demonstrated in the following table.

Table 4. 18 Impact of natural disasters on controlling human resources such as hospital's personnel and volunteers in disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	10	7.5	7.5	7.5
	Little impact	31	23.1	23.1	30.6
	Meduim Impact	37	27.6	27.6	58.2
	High Impact	22	16.4	16.4	74.6
	Extremely high Impact	34	25.4	25.4	100.0
	Total	134	100.0	100.0	

Keep Operation Theatres and Recovery Room Safe and Accessible:

Disaster can cause issues for any person, organisation, and hospital. One of the critical zones for hospitals is operation rooms and recovery rooms after surgery. In disaster events, these rooms should be kept in the appropriate condition. Due to rapid evolution and technological advancements, medical personnel now require special training to manage these operation rooms suitable under challenging situations. In this part of the questionnaire survey, the researcher asked the participants about keeping operation theatres and recovery rooms safe and accessible and the impact of natural disasters on this factor. Regarding respondents of this questionnaire survey, just 1 participant chose it as never. In opposite, 39 out of 134 chose it a high impact. This is nearly 30% of participants, and 26.9% selected it as medium impact. Even though 17.2% agreed this facility is an extremely high impact, 26.1% of participants had opposite opinions and selected this factor as a little impact during hospitals' disaster events. The total result of participants is illustrated in the following table.

Table 4. 19 Impact of natural disasters on keeping operation theatres and recovery room safe and accessible for hospitals in disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	1	.7	.7	.7
	Little Impact	35	26.1	26.1	26.9
	Meduim Impact	36	26.9	26.9	53.7
	High Imapct	39	29.1	29.1	82.8
	Extremely High Imapct	23	17.2	17.2	100.0
	Total	134	100.0	100.0	

Keeping Hospitals Accessible to Everyone:

When disasters strike, aid agencies, communities, the media, and governments focus immediately on the victims. But if our concentrates on victims have real meaning, we must prioritize a deeper understanding and support of medical care. Those injured need urgent medical attention, but those who escape injury have not escaped the long-term need for medical care and public health after the disaster is forgotten. When health services and hospitals fail due to disaster, people die and suffer needlessly during the disaster and long into the future. Health sector damage can cause devastating secondary disasters.

Accessing hospitals can be affected by disaster events. In the early hours that disaster occurred, there should be some chaos in hospitals. Hospitals ' access to the roads can be interrupted during or after the disaster occurs. Thus, in this part of the questionnaire survey, the impact of natural disasters on keeping hospitals accessible to everyone in the early hours after the disaster occurred was asked. Regarding participants, just 5 out of 134 selected this as never, equivalent to only 3.7%. In contrast, 42 participants chose it as a high impact on managing disaster events. This is equal to 31.3% of participants. However, 24 participants chose this factor as a little impact during disaster events, but 26 of the participants chose it extremely high impact. The medium-impact was another highest number of participants selected by participants of this questionnaire survey, 37 and equivalent to 27.6% of total participants.

In the following table, the result of participants illustrated.

Table 4. 20 Impact of natural disasters on keeping hospitals accessible to everyone during disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	5	3.7	3.7	3.7
	Little impact	24	17.9	17.9	21.6
	Meduim Impact	37	27.6	27.6	49.3
	High Impact	42	31.3	31.3	80.6
	Extremely High Impact	26	19.4	19.4	100.0
	Total	134	100.0	100.0	

Managing Collaboration with Other Organisations in Connection with Disaster Management:

A further challenge following the earthquake might be the lack of proper collaboration of relief between different organisations and hospitals during and after disaster events. Lack of appropriate implication of good cooperation can interrupt health service during disaster events. In this part of this questionnaire, the impact of natural disasters on managing collaboration with other organisations connected with disaster management at the hospital was asked.

It was noticed that just only one participant selected this factor as never for the hospital. In contrast to the rest of the participant's respondents, 49 out of 134 (36.6%) chose it as a high impact on this factor. Besides, 37 participants, equivalent to almost 28%, were selected as a medium impact on this factor.

However, 12.7% of participants chose the collaboration between hospitals and other organisations as an extremely high impact, but 30 participants (22.4%) chose it as a little impact. In contrast to all questionnaire survey participants, more than 76.9% chose it as a high impact with a different rank of impacts. The total result of participants for this factor is illustrated in the following table.

Table 4. 21 Impact of natural disasters on managing collaboration with other organisations in connection with disaster management

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	1	.7	.7	.7
	Little impact	30	22.4	22.4	23.1
	Meduim Impact	37	27.6	27.6	50.7
	High Impact	49	36.6	36.6	87.3
	Extremely High Impact	17	12.7	12.7	100.0
	Total	134	100.0	100.0	

Question 8: How do you rate the importance of training and disaster rehearsal for mitigating the risk of natural disasters in hospitals?

The question allowed respondents to understand the importance of rehearsal and training sessions for hospital staff to better understand during disaster events. Respondents were asked to choose from Not important, little important, moderately important, important, and extremely important role of regular training sessions to manage better disaster events in hospitals.

It is hard to believe that the importance of training and rehearsal sessions for improving hospitals' personnel are not necessary, but as shown in the following figure. That 106 participants out of 134 agreed to the importance of training and rehearsal sessions to improve hospital personnel's knowledge and ability to manage and control crises and disaster events. However, 4 participants have chosen not to have regular training for the hospital’s staff, which is just 3% of the total participants, but about 21% choose extremely important. Besides, nearly 30% choose as important, and 28.4% as moderately important. It is vital to confirm whether the respondents are actively involved in disaster management and health service within their professions. Still, most respondents deal with the importance of regular training to improve staff's ability to control and manage disaster events better. The researcher met the research requirements in acquiring feedback from the appropriate respondents to generalise the findings. In the following table and figure, the result of this question is demonstrated.

Table 4. 22 Providing regular training for the hospital's staff

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Not Important	4	3.0	3.0	3.0
	Little Important	24	17.9	17.9	20.9
	Moderately Important	38	28.4	28.4	49.3
	Important	40	29.9	29.9	79.1
	Extremely Important	28	20.9	20.9	100.0
	Total	134	100.0	100.0	

Figure 4. 3 Providing regular training for the hospital's staff

Question 9: Does the mitigation disaster management planning reduce the risk of negative impacts on health services?

Once again, this question allowed respondents to discover how early disaster management planning activities eliminate or mitigate disaster risk by giving appropriate health services during disaster events.

This survey result shows that 83 out of 134 participants, equivalent to almost 62%, agreed to the importance of making advance planning for mitigating the impact of disasters on hospitals and health services. Although this high number of participants agreed with planning for hospitals in advance, 20 out of 134, equivalent to about 15%, did not believe in the importance of planning and early disaster management planning for the hospital to mitigate the risk of disaster events.

A further 23%. One of the participants cited that as “Maybe”, they doubted this planning's impact due to various circumstances. It was also interesting to note that the number of participants who chose yes and maybe total was more than 92%. In the following table and figure, the result of this question is demonstrated.

Table 4. 23 Early disaster management planning

Early disaster management planning

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Yes	83	61.9	61.9	61.9
	No	20	14.9	14.9	76.9
	Maybe	31	23.1	23.1	100.0
	Total	134	100.0	100.0	

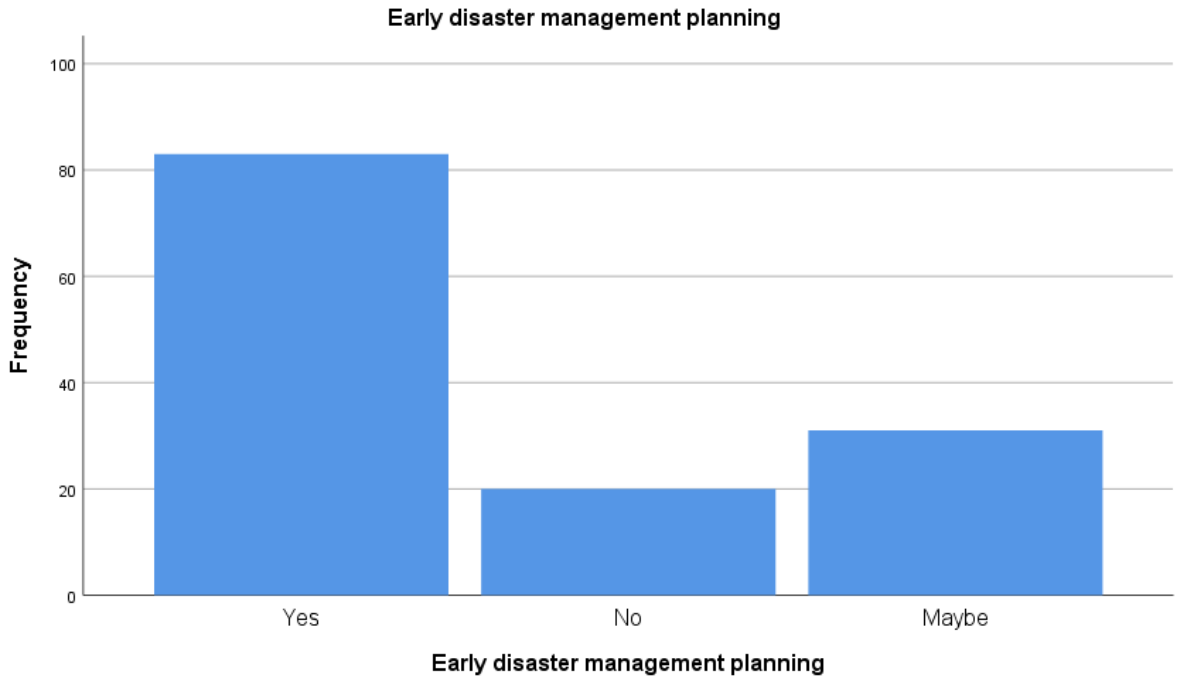

Figure 4. 4 Early disaster management planning

4.2.3 Section Three Examining Adverse Impact of Disaster Events on Hospitals:

In the third section of this questionnaire, the survey researcher attempts to identify the adverse impact of disasters on hospitals. The researcher also tries to verify the rank of some adverse effects of disasters on hospitals' different facilities. Following this section, the researcher asked participants about some challenges in managing hospitals during disaster events.

Question 10: Based on your observation, rank the impact of disasters on the groups below? (1= Never, 2=Little impact, 3= Medium Impact, 4= High Impact, 5= Extremely High Impact)

The question establishes respondents' understanding of the rank of the adverse impact of disasters on different groups that can be interacted during or after the disaster at the hospitals. The researcher in this survey question named four different groups: elder people, disabled people, children, and women. Besides, for some participants, the other option has been provided. In the following, each of this section, each of this group will be interpreted.

Elderly people:

This question researcher attempts to understand the impact of natural disasters on elderly people in hospitals during disasters, as demonstrated in the following table. Most of the participants agreed older adults are exposed to the adverse impact of disaster events. Participants responded that 46.3% as high impact, and 21.6% agreed elderly people are as medium impact in disaster events. However, more than 91 out of 134 participants agreed about the impact of natural disasters on elderly people as medium or high impact. Still, about 23.1% of them decided as little impact and less than 1.49%, equivalent to 2 participants, believed that elderly people are never impacted in those events.

Table 4. 24 The rank of the impact of the disaster on Elder people

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	2	1.49	1.49	1.49
	Little Impact	31	23.1	23.1	24.59
	Meduim Impact	29	21.6	21.6	46.19
	High Impact	62	46.3	46.3	92.49
	Extremely High Impact	10	7.46	7.46	100.00
	Total	134	100.0	100.0	

Disabled People:

The second group researcher attempts to get a good understanding is disabled people. In disaster events, the feasibility of an adverse impact on disabled people can cause significant problems. More than 73% of participants agreed on medium impact and high impact of natural disasters on elderly people (High impact = 47.8%, and medium impact 25.4%).

However, about two-thirds of the total participants believed disabled people as medium impact and high impact group. Still, nearly 17% of participants agreed to this group as little impact and exacted 2.98% as never. The following table demonstrates the variety of importance rates of disabled people that might be imposed on hospitals' adverse impact on disaster events.

Table 4. 25 The rank of the impact of the disaster on disabled people

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	4	2.98	2.98	2.98
	Little Impact	22	16.4	16.4	19.38
	Meduim Impact	34	25.4	25.4	44.78
	High Impact	64	47.8	47.8	92.58
	Extremely High Impact	10	7.46	7.46	100.00
	Total	134	100.0	100.0	

Children and infants:

The third group was asked children and infants, which are feasible to get hurt by disaster events. Regarding respondents' statistics, which is demonstrated in the following table, nearly 100 respondents out of 134 agreed about meduim impact and high impact of these groups in hospitals' disaster events. For instance, 66 participants, equivalent to 49.3%, are selected high impact for children and infants in these events. Whereas more than 70.9% of participants believed about the impacts of this group, nearly 1.34% picked never, and 34 out of 134 participants, who were equivalent to 25.4%, chose little impact for this population.

Table 4. 26 The rank of the impact of a disaster on Children and infant

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	1	1.34	1.34	1.34
	Little Impact	34	25.4	25.4	26.74
	Meduim Impact	29	21.6	21.6	48.34
	High Impact	66	49.3	49.3	97.64
	Extremely High Impact	4	2.98	2.98	100.00
	Total	134	100.0	100.0	

Women:

In this part of the questionnaire, the final group was asked about the impact of the disaster on women at hospitals. Therefore, one of the groups that might be affected during or after disaster events is women. 88 respondents out of 134 agreed as medium impact or high impact of natural disasters on this group during disaster events at hospitals. This illustrates that about 61.9% are agreed on the impact of this group that can be imposed with the adverse impact of disasters. Although more than 60% believed that women's impacts on natural disaster events at hospitals during disaster events, 32.1% stated that women have as little impact and just 2.23% as never or not likely to impose any adverse impact on hospitals' disaster.

Table 4. 27 The rank of the impact of the disaster on women

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Never	3	2.23	2.23	2.23
	Little Impact	43	32.1	32.1	34.33
	Meduim Impact	50	37.3	37.3	71.63
	High Impact	33	24.6	24.6	96.23
	Extremely High Impact	5	3.73	3.73	100.00
	Total	134	100.0	100.0	

Others:

The researcher provided alternatives for respondents to give some of the other groups that might be imposed any adverse impact of disaster events at hospitals. Regarding participants of this survey, personnel of hospitals such as the Medical team, staff, and nurses might be affected by disasters' adverse impact; besides, the above groups were asked before.

Question 11:

How do you rank the importance of following facilities and activities on hospitals during disaster events? (1=less, 5=highest)

Once again, the researcher offered respondents the opportunity to add other factors that respondents consider affected by disaster events and rate the importance of those factors. The researcher was asked to rank the importance of following facilities and activities at hospitals during disaster events regarding this question. An interesting variety of respondents came across the questionnaires that helped the researcher better understand the most feasible facilities and activities during a disaster that can be interrupted. In the following, each of these factors and activities will be interpreted.

Medical Equipment:

The question sought to establish whether hospitals' significant facility and activity during disaster events can be medical equipment. Thus, the researcher attempts to understand that better and asked respondents of this questionnaire survey to get importance ranking during hospitals' disaster events. Respondents scored the importance of medical equipment in the hospital into five different categories. 34 respondents out of 134 chose medical equipment as extremely important, which is equivalent to 25.4%. The otherwise same number of participants agreed and chose medical equipment as important during disaster events.

Regarding 15 participants, that is equivalent to 11.2% believed medical equipment is not important, or 27 out of 134 participants chose little important for medical equipment, but 24 of respondents agreed as moderately important (17.9%). Totally 92 participants out of 134 decided that medical equipment has a significant role in hospitals' disaster events to give better health service to high-demand injured people. The participant’s response rate has been illustrated in the following table and figure.

Table 4. 28 The rank of the impact of disasters on medical equipment

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Not important	15	11.2	11.2	11.2
	Little important	27	20.1	20.1	31.3
	Moderately Important	24	17.9	17.9	49.3
	Important	34	25.4	25.4	74.6
	Extremely Important	34	25.4	25.4	100.0
	Total	134	100.0	100.0	

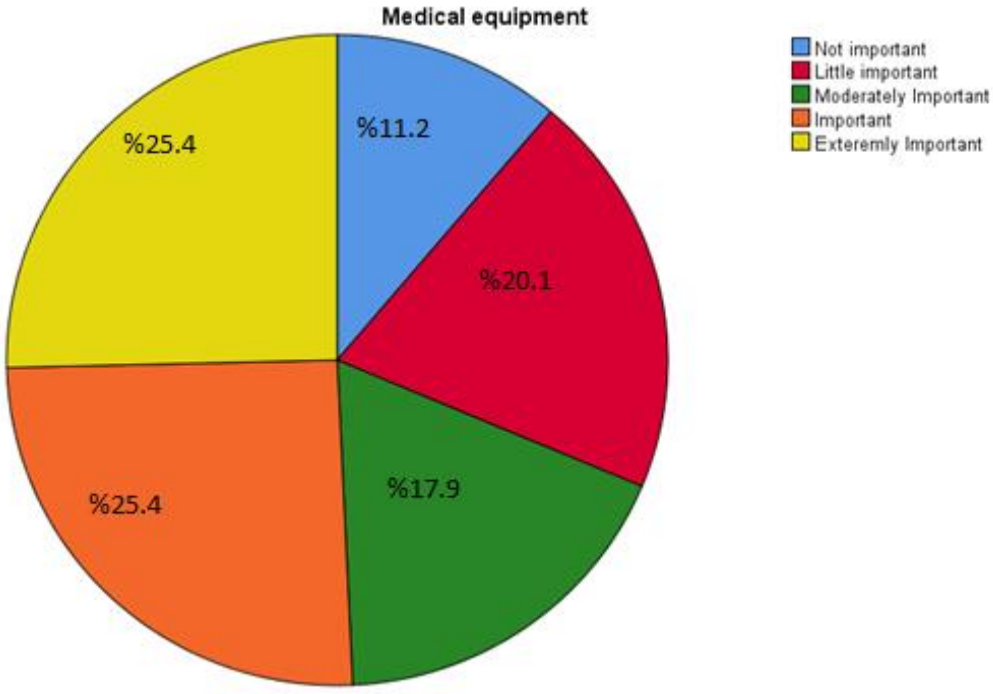

Figure 4. 5 The rank of the impact of disasters on medical equipment

Medicine Storage and Blood Resources:

Another facility that can be affected and disrupted during or after disaster events at hospitals is medicine storage and blood resources. It is frankly for the researcher that this facility is vital at the hospital during a disaster and after events, but various responses were received from participants. More than 105 participants agreed with the important role of medicine storage and blood resources at the hospitals regarding participants' responses. In particular, 33 out of 134 participants chose moderately important, 28 participants who were equivalent with 20.9% selected important, and nearly 33% of participants picked extremely important. Although more than 79.3% of participants believed the importance of medicine storage and blood resources at the hospital during disaster events, 29 participants, equivalent to nearly 20.7%, had different opinions. About 14.2% chose little, and 7.5% selected not important. Concerning the variety of respondents received from participants, as is demonstrated in the following table and figure, more than nearly 80% of total participants for this survey agreed on the vital role of medicine storage and blood resources.

Table 4. 29 Medicine storage and blood resources

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Not important	10	7.5	7.5	7.5
	Little important	19	14.2	14.2	21.6
	Moderately Important	33	24.6	24.6	46.3
	Important	28	20.9	20.9	67.2
	Extremely Important	44	32.8	32.8	100.0
	Total	134	100.0	100.0	

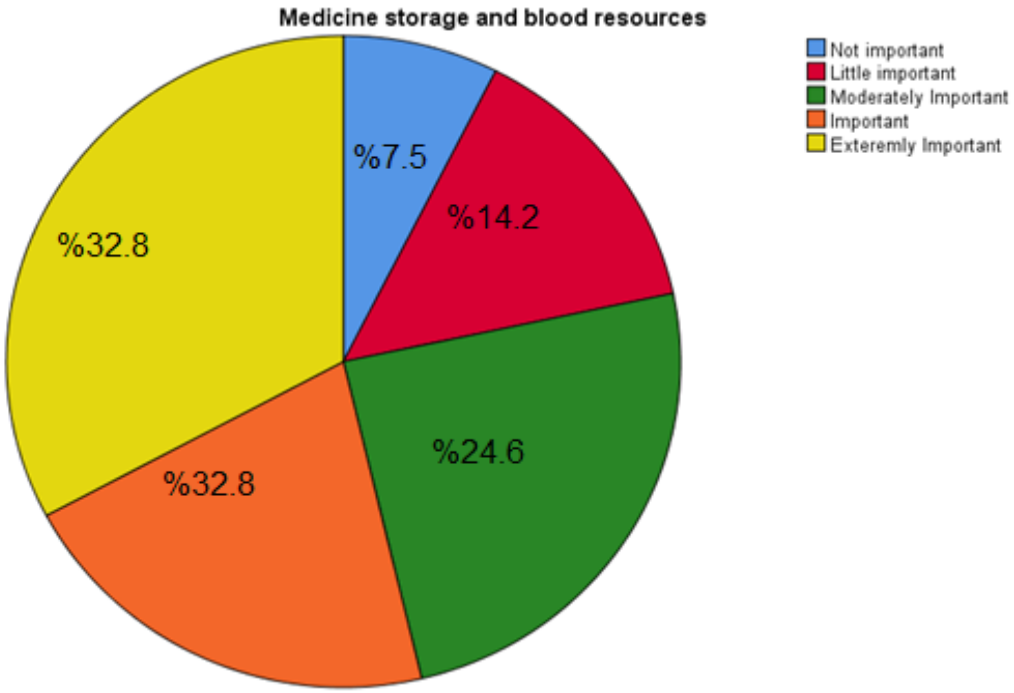

Figure 4. 6 Medicine storage and blood resources

Patient's Document:

In general health history of a patient is significant to have a better and continued treatment. Due to some chaos that occurred by a disaster in hospitals, patients' documents might be lost or disappear. Thus, the researcher aimed to get participants' opinions about this factor. So, a researcher was asked about the importance of a patient's document, and in response, a variety of answers were collected.

For instance, despite more than 53.7% of participants agreeing about the importance of that as moderate, important, and extremely important, just 7 participants, equivalent to 5.2%, chose extremely important and most participants that agreed patent's document moderately important with 35.8%. In contrast, 40 participants out of 134, nearly 30% decided as little important, and less than 17% agreed with not important of patent's document during disaster events at hospitals. All of the respondent's statics are demonstrated in the following table and figure.

Table 4. 30 Importance of patient's document at a hospital in a disaster event

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not important	22	16.4	16.4	16.4
	Little important	40	29.9	29.9	46.3
	Moderately Important	48	35.8	35.8	82.1
	Important	17	12.7	12.7	94.8
	Extremely Important	7	5.2	5.2	100.0
	Total	134	100.0	100.0	

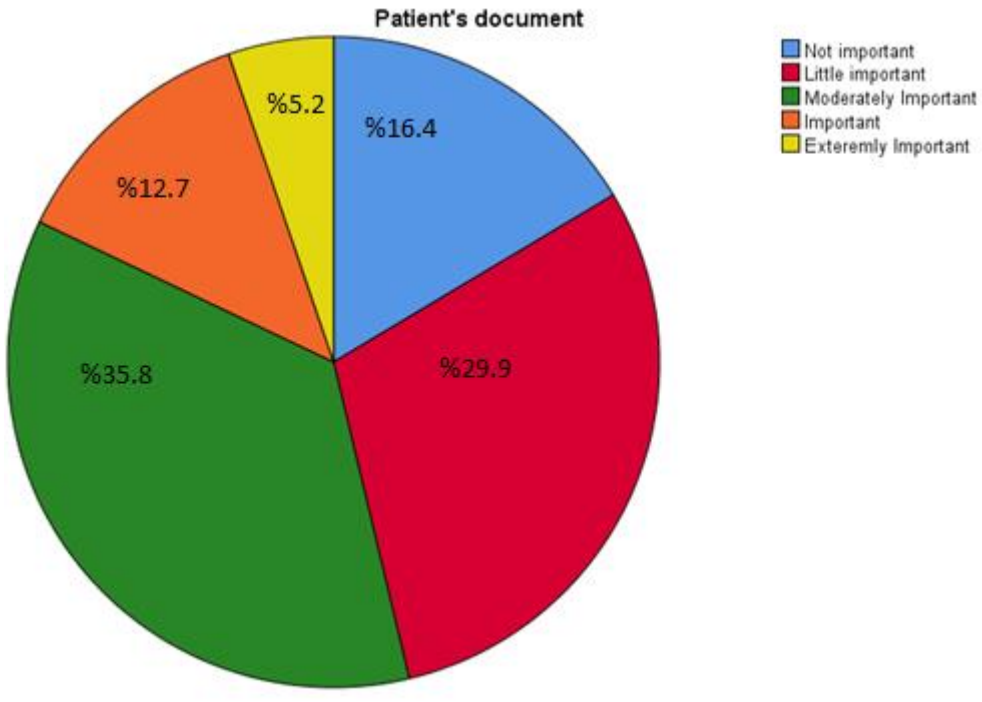

Figure 4. 7 Importance of a patent's document at a hospital in disaster events

Water and Food Resources:

Disaster can affect different facilities and resources of hospitals. During a disaster, food banks and water storage can be affected and might cause hospitals to have a good health service. Therefore, the researcher in this question asked about the importance of water and food resources during disaster events.

In response, less than 19% agreed as little and not important, 4.5%. Although about 31 participants did not choose this resource as important, more than 28.4% (38 participants) chose it as moderately important, 44 participants (32.8%).

21 out of 134 participants, equivalent to 15.7%, chose extremely important water and food resources to make a better condition for hospitals to provide better health service during and after disaster events. In the following table and figure, all participants' responses are illustrated.

Table 4. 31 Importance of water and food resources at a hospital in disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Not important	6	4.5	4.5	4.5
	Little important	25	18.7	18.7	23.1
	Moderately Important	38	28.4	28.4	51.5
	Important	44	32.8	32.8	84.3
	Extremely Important	21	15.7	15.7	100.0
	Total	134	100.0	100.0	

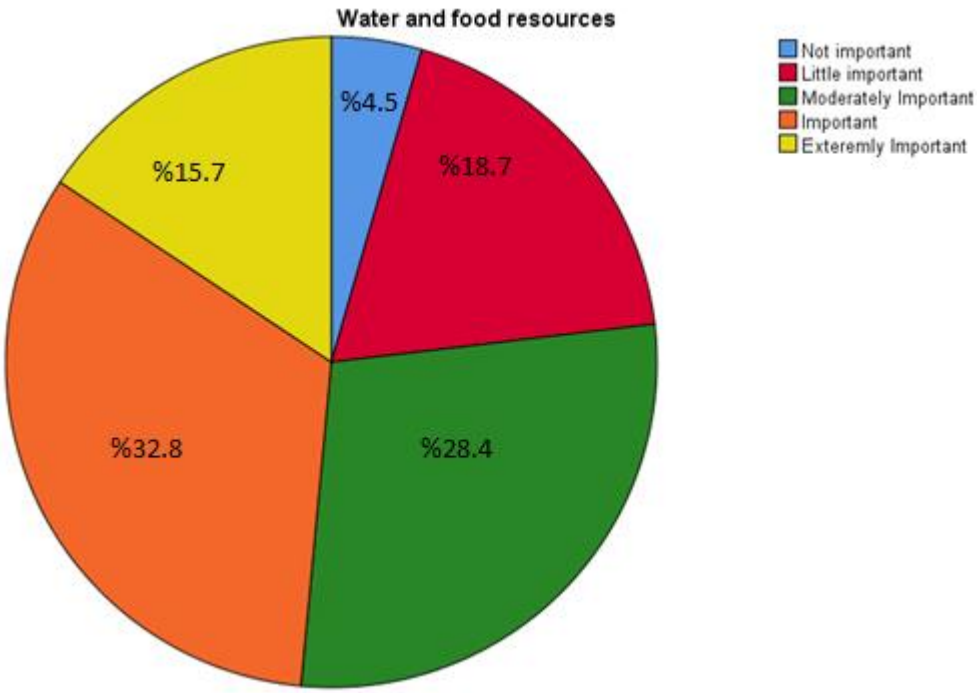

Figure 4. 8 Importance of water and food resources at a hospital in disaster events

Energy Supply System:

Supplying energy and keeping the hospital active during disaster events was asked to participants of this questionnaire survey. Participants gave various respondents not important to extremely important of this facility during disaster events at hospitals. For instance, less than 12% is equivalent to 16 participants out of 134 who did not agree to this facility as important; participants, which is less than 20%, believed as it was

However, about 31.3% of participants did not choose this facility as important. Still, the rest of the participants, who were equivalent to 68.7%, believed this facility could be important for hospitals during and after disaster events.

For example, 33out of 134 participants chose moderately important (24.4%), 30 of the participant chose important, and the rest of that, which is 29 participants, were selected as extremely important. The result of participants respondents is demonstrated in the following table and figure.

Table 4. 32 Importance of energy supply system at a hospital in disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Not important	16	11.9	11.9	11.9
	Little important	26	19.4	19.4	31.3
	Moderately Important	33	24.6	24.6	56.0
	Important	30	22.4	22.4	78.4
	Extremely Important	29	21.6	21.6	100.0
	Total	134	100.0	100.0	

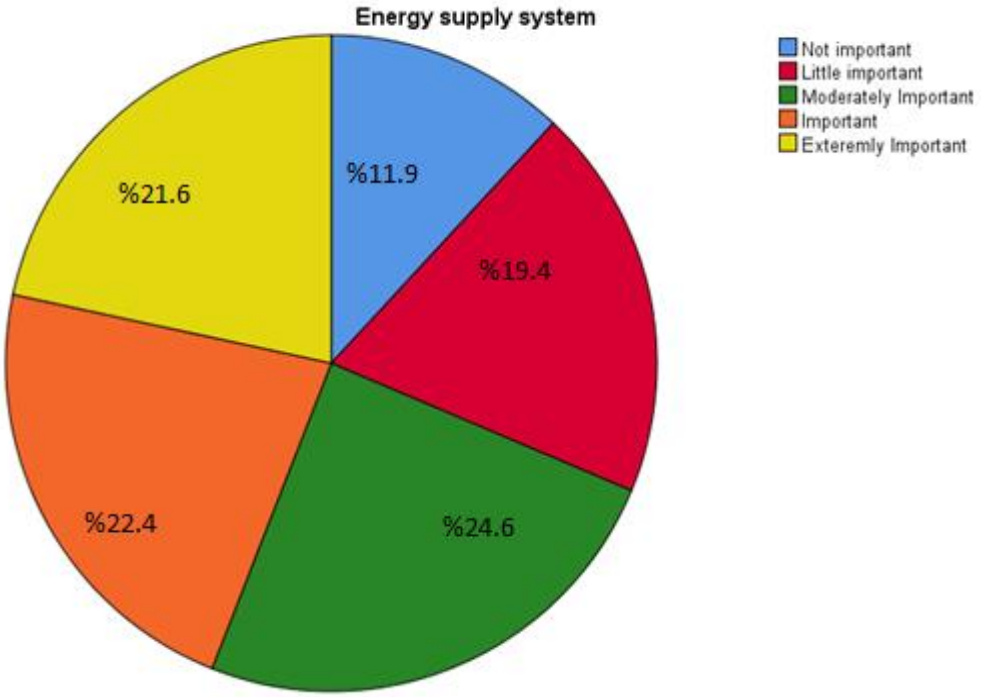

Figure 4. 9 Importance of energy supply system at a hospital in disaster events

Resource Allocation for the hospital staff:

In any disaster, keeping a hospital safe and secure to have ongoing health service to people's high demand is a matter of proper allocation of hospital personnel. The researcher asked about the importance of resources allocation in this questionnaire survey. As a result, a variety of responses was gathered from participants. In terms of participant's responses, about 5.2% (7 participants) chose not important, and on the opposite, 19 participants decided to allocate resources as extremely important to manage hospitals during disaster events.

However, 43 participants chose as little important for allocating resources in hospitals during disaster events, equivalent to 32.1% of total participants, but 27.6% and 20.9% chose Moderately important and important to allocate resources in hospitals during disaster events. In the following, the result of the participant's respondents is illustrated.

Table 4. 33 Importance of Resource allocation for the hospital staff at a hospital in disaster events

		Frequency	Per cent	Valid Percent	Cumulative Percent
Valid	Not important	7	5.2	5.2	5.2
	Little important	43	32.1	32.1	37.3
	Moderately Important	37	27.6	27.6	64.9
	Important	28	20.9	20.9	85.8
	Extremely Important	19	14.2	14.2	100.0
	Total	134	100.0	100.0	

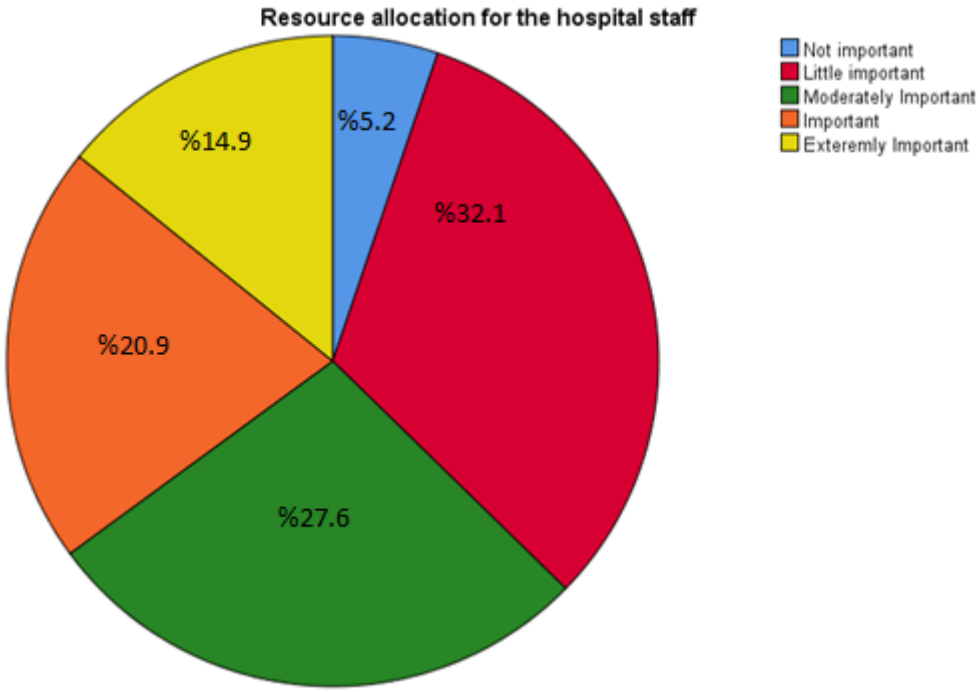

Figure 4. 10 Importance of Resource allocation for the hospital staff at a hospital in disaster events

Accessibility to Hospitals:

Accessibly to any building can be vital, and hospitals can be more important. During disasters and after this, importance gets more important. This questionnaire researcher provided the opportunity for respondents to rank the importance of accessibility to hospitals during and after disaster events. In terms of that, just less than 6.7% chose not important for accessibility to hospitals. In opposite, 32 participants, nearly 24%, chose this factor as extremely important for hospitals to have more efficient health services during disaster events.

As 31 participants agreed with a little importance of accessibility to hospitals during disasters, which is equivalent to 31%, more than 65% believed that managing accessibility to hospitals during this event. For instance, 24.6% chose moderately important, and nearly 22% selected this factor as important for managing hospitals during or after disaster events. Regarding accessibility to hospitals during disaster events, all participants' results are demonstrated in the following table and figure.

Table 4. 34 Importance of accessibility to hospitals at a hospital in disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Not important	9	6.7	6.7	6.7
	Little important	31	23.1	23.1	29.9
	Moderately Important	33	24.6	24.6	54.5
	Important	29	21.6	21.6	76.1
	Extremely Important	32	23.9	23.9	100.0
	Total	134	100.0	100.0	

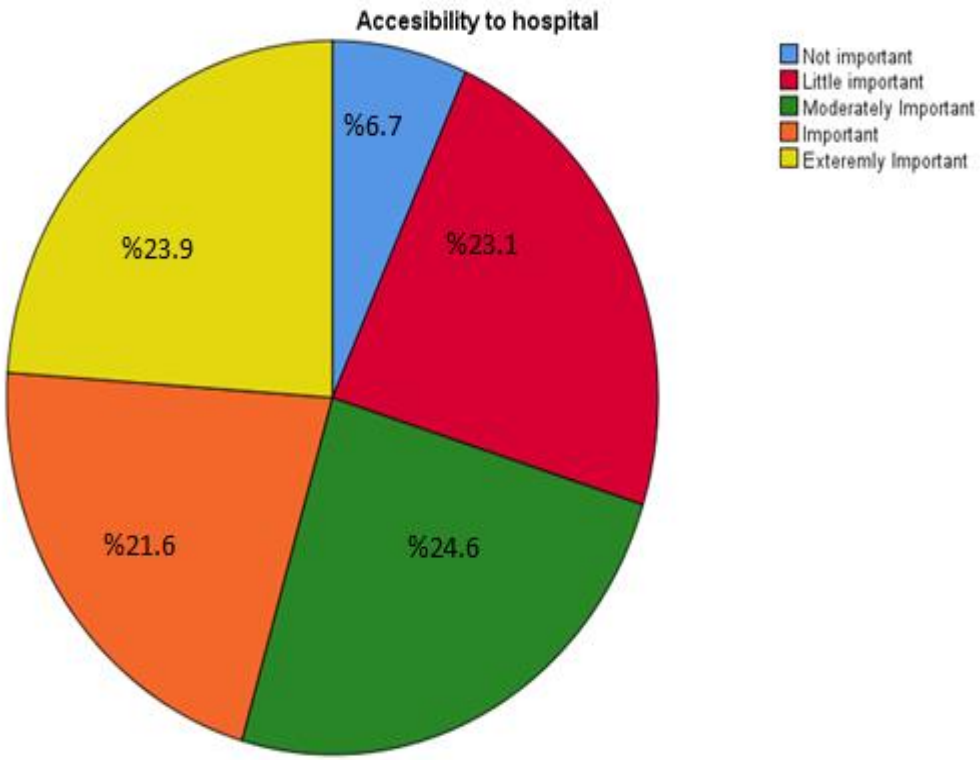

Figure 4. 11Importance of accessibility to hospitals at a hospital in disaster events

Coordination and Collaboration with Others:

Appropriate coordination and collaboration between hospitals and different organisations can help have better health service to high demanded people during disaster events. Regarding coordination and cooperation of other organisations with the hospital during disaster events, this question was asked in this questionnaire survey. Regarding respondents, just about 5.2% did not believe that coordination and collaboration between an organisation can be vital. However, a few participants declined the importance of coordination and cooperation with others, but 103 out of 134 participants chose this factor moderately important and extremely important. For instance, 35.8% (48 participants) selected moderately important, and also 36 out of 134 respondents were received for important, and just 19 participants equivalent to extremely important as 14.2%. Illustration of participants results in the importance of coordination and collaboration with others in hospitals during disaster events, as demonstrated in the following table and figure.

Table 4. 35 Importance of coordination and collaboration with others during disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Not important	7	5.2	5.2	5.2
	Little important	24	17.9	17.9	23.1
	Moderately Important	48	35.8	35.8	59.0
	Important	36	26.9	26.9	85.8
	Extremely Important	19	14.2	14.2	100.0
	Total	134	100.0	100.0	

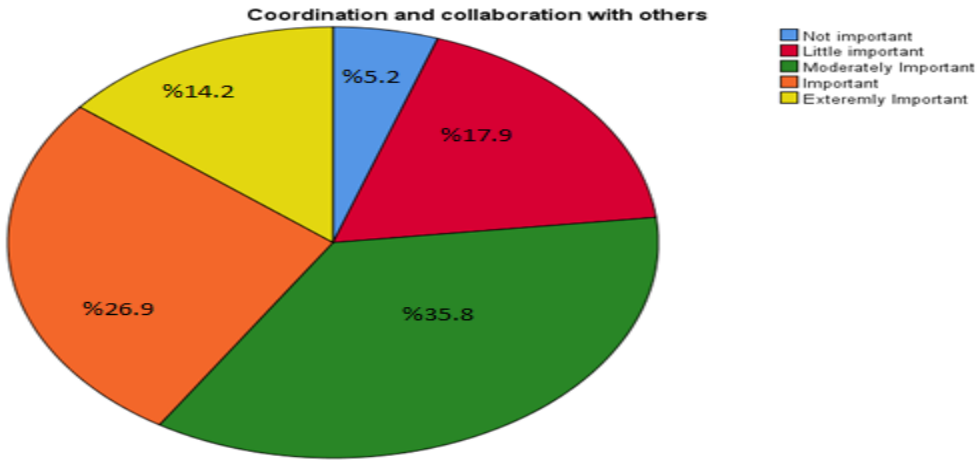

Figure 4. 12 Importance of coordination and collaboration with others during disaster events

Resource Allocation for volunteers:

The question provided respondents with an opportunity to rank the importance rate of resource allocation of volunteers in disaster events such as volunteer groups or NGOs from different backgrounds to help injured people. Those areas were damaged. Therefore, managing and allocating this amount of human power should be considered. The researcher asked a participant to rank the importance of allocating volunteers in disaster events in this questionnaire. In response, it was noted that just 11 out of 134 participants chose an allocation of volunteers that were not important. In comparing that, 93 participants agreed about the importance of different ranks such as moderately, important, and extremely important. Moderately important was chosen as the highest number for this questionnaire survey with 38.8% (52 out of 134), and the amount of little important was slightly more than an important amount. However, slightly more than 22% of participants chose little importance, but 9.7% of selected volunteer allocation is extremely important. The result of the participant's answer to this questionnaire is provided in the following table and figure.

Table 4. 36 The importance of resource allocation volunteers at hospitals in disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Not important	11	8.2	8.2	8.2
	Little important	30	22.4	22.4	30.6
	Moderately Important	52	38.8	38.8	69.4
	Important	28	20.9	20.9	90.3
	Extremely Important	13	9.7	9.7	100.0
	Total	134	100.0	100.0	

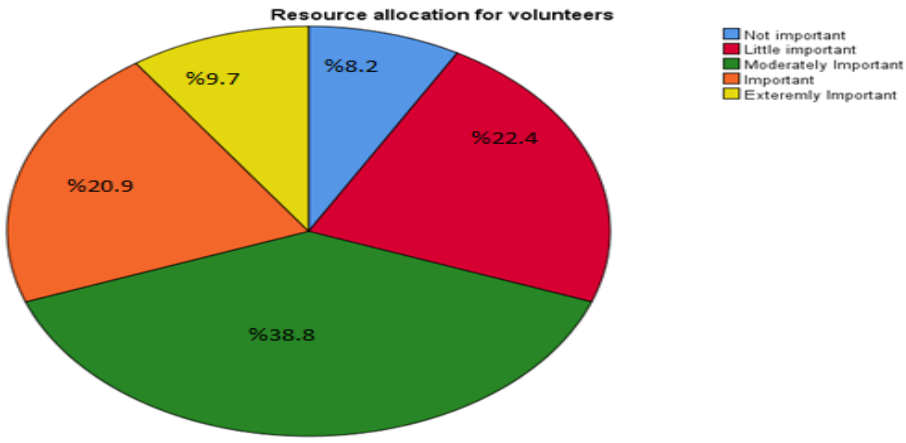

Figure 4. 13 The importance of resource allocation volunteers at hospitals in disaster events

Communication System:

Regarding the type of disaster events and the scale size, updating information for other people, family members, and relatives of injured people might be difficult and stressful. Although in most disaster events, some hospitals' requests should be made with various types of the communication system. The failure of this system may cause some difficulties to manage hospitals during disaster events. In this part of the questionnaire, the researcher attempted to get participant opinions regarding the importance of the communication system and keeping hospitals more productive.

Despite different responses to this question, but mostly agreed with the importance of hospitals' communication systems in disaster events with various scales. For example, important was selected with 41 participants (30.6%). While moderately important was chosen with 31 participants (23.1%), and extremely important was selected with 29 participants out of 134 (21.6%), the amount of little important is nearly close to extremely important with 20.1% (27 participants). The demonstration result of participants' responses is shown in the following table and figure.

Table 4. 37 The importance of communication system at hospitals in disaster events

		Frequency	Per cent	Valid Per cent	Cumulative Per cent
Valid	Not important	6	4.5	4.5	4.5
	Little important	27	20.1	20.1	24.6
	Moderately Important	31	23.1	23.1	47.8
	Important	41	30.6	30.6	78.4
	Extremely Important	29	21.6	21.6	100.0
	Total	134	100.0	100.0	

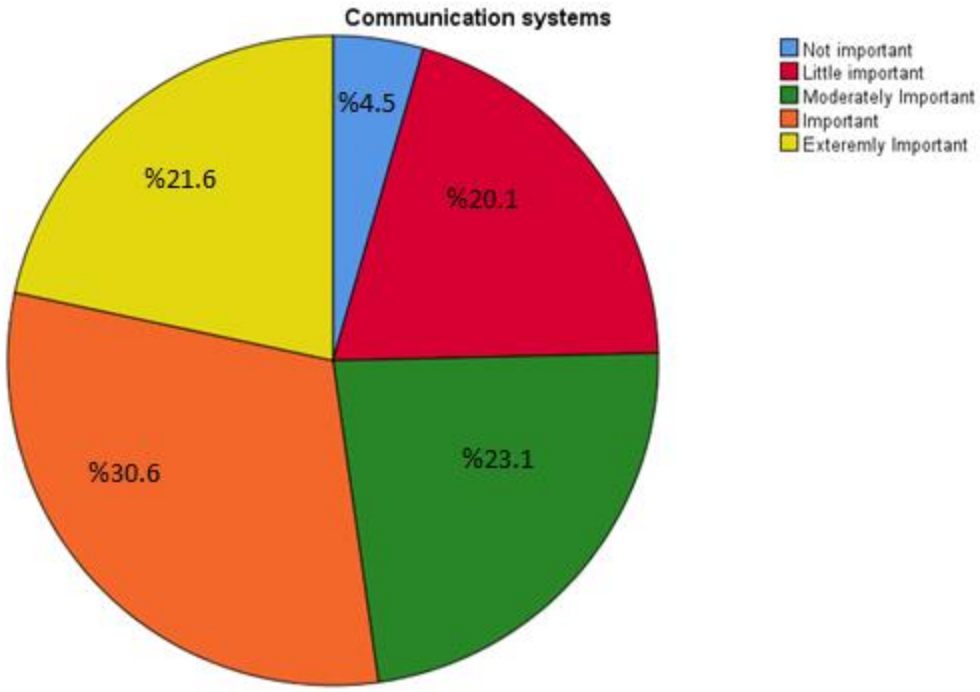

Figure 4. 14 The importance of communication system at hospitals in disaster events

Question 12: From the experience, you had the most challenging aspect of keeping the hospital safe and secure during a disaster?

In this part of the questionnaire, the researcher provided participants with an opportunity to add any other significant challenges to promoting hospitals during disaster events—some of the other significant challenges cited by respondents.

4.3 Statistical Test

Further analyses were accomplished by implementing inferential statistical tests to conclude the wider population. The main target for this section of this research is to identify and investigate whether the respondents' differences from different experiences and backgrounds in disaster management were statistically significant and better understand the impact of natural disasters on hospitals' critical factors. Thus, implementing appropriate statistical tests can demonstrate if a relationship is meaningful. This means that the connection has not occurred just by chance. A wide range of statistical testss may be implemented depending on existing data. Inferential statistical analysis on the data was accomplished by implementing the Cross Tabulation test, Chi-Square test, and Relative importance index.

4.3.1 Cross Tabulation

Cross tabulation tests were implemented in this research to investigate if there was any significant relationship or association among variables (experience, Importance of hospitals, and regular training for hospital staff).

Thus, to better understand the result, cross Tabulation analysis was accomplished to contrast the connection among two variables in this questionnaire once; in this case, the respondent’s experience and hospitals' importance during disaster events.

Rate of participants' experience with disaster management and the Importance of hospitals in disaster events (Statistical association/relationship):

The statistical analysis of the respondent's experience in disaster management and hospitals' importance in disaster events is illustrated in the following table. The main purpose of this test is to better understand different participants with different experiences in disaster management, how they rate the importance of hospitals during disaster events, and how this can be valid with different years of experience.

Participants' experiences are divided into six different groups, as illustrated in the following table:

Table 4. 38 Participants' experiences 's rate

Years of Experience in disaster management	Rate of experience
0	N/A
0-1	Very low
1-3	Low
3-5	Avarage
5-8	High
More than 8 Years	Very High

Table 4. 39 Cross-tabulation of respondents' experience and the importance of hospitals in disaster events

			Importance of hospitals				
			Not important	Important	Very Important	Extremely important	Total
Rate of experience	N/A	Count	0	0	0	1	1
		% within Rate of experience	0.0%	0.0%	0.0%	100.0%	100.0%
		% within Importance of hospitals	0.0%	0.0%	0.0%	1.5%	0.7%
		% of Total	0.0%	0.0%	0.0%	0.7%	0.7%
	Very Low	Count	2	2	2	5	11
		% within Rate of experience	18.2%	18.2%	18.2%	45.5%	100.0%
		% within Importance of hospitals	14.3%	6.9%	7.7%	7.7%	8.2%
		% of Total	1.5%	1.5%	1.5%	3.7%	8.2%
	Low	Count	4	6	2	2	14
		% within Rate of experience	28.6%	42.9%	14.3%	14.3%	100.0%
		% within Importance of hospitals	28.6%	20.7%	7.7%	3.1%	10.4%
		% of Total	3.0%	4.5%	1.5%	1.5%	10.4%
	Average	Count	4	10	12	17	43
		% within Rate of experience	9.3%	23.3%	27.9%	39.5%	100.0%
		% within Importance of hospitals	28.6%	34.5%	46.2%	26.2%	32.1%
		% of Total	3.0%	7.5%	9.0%	12.7%	32.1%
	High	Count	2	9	9	31	51
		% within Rate of experience	3.9%	17.6%	17.6%	60.8%	100.0%

		% within Importance of hospitals	14.3%	31.0%	34.6%	47.7%	38.1%
		% of Total	1.5%	6.7%	6.7%	23.1%	38.1%
	Very High	Count	2	2	1	9	14
		% within Rate of experience	14.3%	14.3%	7.1%	64.3%	100.0%
		% within Importance of hospitals	14.3%	6.9%	3.8%	13.8%	10.4%
		% of Total	1.5%	1.5%	0.7%	6.7%	10.4%
Total		Count	14	29	26	65	134
		% within Rate of experience	10.4%	21.6%	19.4%	48.5%	100.0%
		% within Importance of hospitals	100.0%	100.0%	100.0%	100.0%	100.0%
		% of Total	10.4%	21.6%	19.4%	48.5%	100.0%

The detailed cross-tabulation analysis comparing the experience's level of participants in disaster management and understanding each group with the importance of hospitals in disaster events shows that respondents of this questionnaire had a different understanding of hospitals' reputation in disaster events experiences in disaster management. For instance, 45.5% selected hospitals as extremely important while for very important, important and not important this group chose an equal percentage of 18.2%. However, respondents with high experience chose hospitals as important and very important, with 17.6%. Still, the percentage of extremely high was the highest amount in the group of average, high, and very high experience in disaster management. For instance, the group with average experience chose hospitals with 39.5%, 60.8% in the high experience group, and 64.3% in a very high experience group. The importance of hospitals was frankly for all participants with different experiences. Despite the extremely important hospitals in a disaster event was 48.5%, and the amount of important and very important groups was very close together with 21.6%, and 19.4% in order, but the 10.4% of total chose hospitals as not important in disaster events.

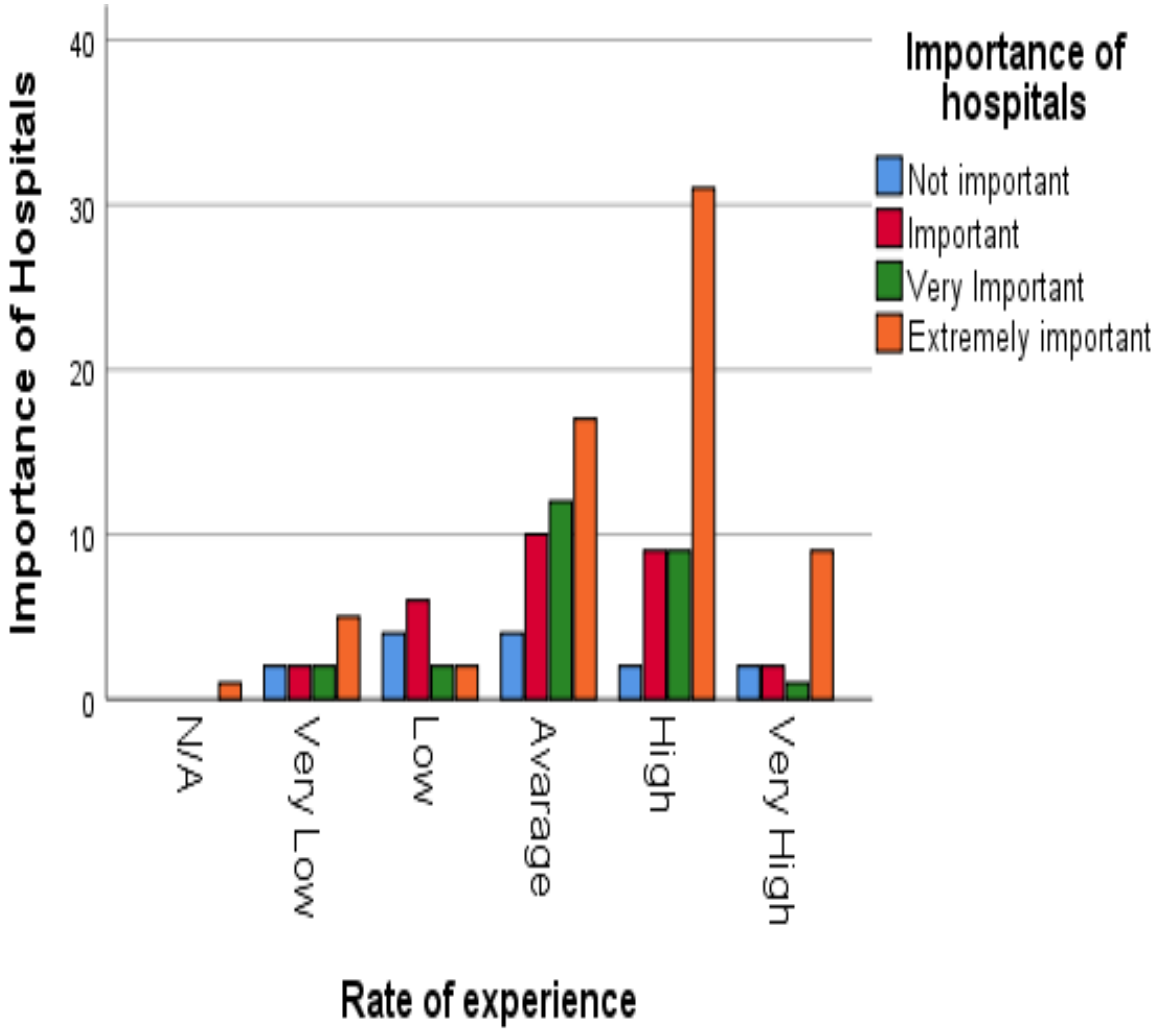

Figure 4. 15 Cross-tabulation of respondents' experience and the importance of hospitals in disaster events

Rate of participants' experience with disaster management and the importance of training for hospital's staff (Statistical association/relationship)

Rate of experience and providing regular training for hospital's staff Crosstabulation

The statistical analysis of the respondent's experience in disaster management and the importance of training for the hospital's staff in disaster events is illustrated in the following table. This test's main purpose is better to understand different participants with different experiences in disaster management. How did they rate the importance of providing regular disaster training, and how this can be valid with different years of experience.

Table 4. 40 Cross-tabulation of respondents' experience and the importance of training for the hospital's staff

			Providing regular training for the hospital's staff					
			Not Important	Little Important	Moderately Important	Important	Extremely Important	Total
Rate of experience	N/A	Count	0	0	0	0	1	1
		% within Rate of experience	0.0%	0.0%	0.0%	0.0%	100.0%	100.0%
		% within Providing regular training for hospital's staff	0.0%	0.0%	0.0%	0.0%	3.6%	0.7%
		% of Total	0.0%	0.0%	0.0%	0.0%	0.7%	0.7%
	Very Low	Count	1	1	2	5	2	11
		% within Rate of experience	9.1%	9.1%	18.2%	45.5%	18.2%	100.0%
		% within Providing regular training for hospital's staff	25.0%	4.2%	5.3%	12.5%	7.1%	8.2%
		% of Total	0.7%	0.7%	1.5%	3.7%	1.5%	8.2%
	Low	Count	0	3	5	4	2	14

		% within Rate of experience	0.0%	21.4%	35.7%	28.6%	14.3%	100.0 %
		% within Providing regular training for hospital's staff	0.0%	12.5%	13.2%	10.0%	7.1%	10.4%
		% of Total	0.0%	2.2%	3.7%	3.0%	1.5%	10.4%
	Average	Count	2	12	12	9	8	43
		% within Rate of experience	4.7%	27.9%	27.9%	20.9%	18.6%	100.0 %
		% within Providing regular training for hospital's staff	50.0%	50.0%	31.6%	22.5%	28.6%	32.1%
		% of Total	1.5%	9.0%	9.0%	6.7%	6.0%	32.1%
	High	Count	1	8	11	20	11	51
		% within Rate of experience	2.0%	15.7%	21.6%	39.2%	21.6%	100.0 %
		% within Providing regular training for hospital's staff	25.0%	33.3%	28.9%	50.0%	39.3%	38.1%
		% of Total	0.7%	6.0%	8.2%	14.9%	8.2%	38.1%
	Very High	Count	0	0	8	2	4	14
		% within Rate of experience	0.0%	0.0%	57.1%	14.3%	28.6%	100.0 %
		% within Providing regular training for hospital's staff	0.0%	0.0%	21.1%	5.0%	14.3%	10.4%
		% of Total	0.0%	0.0%	6.0%	1.5%	3.0%	10.4%
Total		Count	4	24	38	40	28	134
		% within Rate of experience	3.0%	17.9%	28.4%	29.9%	20.9%	100.0 %

	% within Providing regular training for hospital's staff	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
	% of Total	3.0%	17.9%	28.4%	29.9%	20.9%	100.0%

A detailed cross-tabulation analysis compares respondents of the experience level of participants in disaster management and the understanding of the importance of providing regular training for hospital staff. Comparing these two groups can be understood that participants of this questionnaire survey had different perspectives on the importance of providing regular training for hospital staff with varying experiences in disaster management.

For instance, in this questionnaire, 43 out of 134 participants had average experience in disaster management and 51 participants in the high experience. The importance of providing regular training was classified with 29.9% of total participants that 20 out of 134 of them that is equivalent to 14.9%, as a high experience in disaster management. However, the amount of high and average experiences participants was significant, but participants with a low and very low level of disaster management experience had very similar opinions. Participants with low and shallow levels chose to provide regular training as important with 3% and 3.7% of low-level experience in disaster management. Alternatively, 38 out of 134 participants agreed to the importance of providing these regular staff training, that 9% of them had average disaster management skills and nearly 8.2% with high skills. The Cross tabulation table illustrates that 28 participants chose regular training as extremely important, equivalent to 20.9% of total participants. Extremely important was selected with eight average and 11 high experience participants. Despite the number of participants who chose the importance of providing training for staff more than moderately important, it was 110 out of 134, but 24 believed that providing regular training has little importance to mitigate the risk of disaster on providing health service disaster events. This is equivalent to 17.9% of the total. Also, just 4 participants chose as unimportant, equivalent to an exact 3% of the total. In the group of little importance of providing regular staff training, most participants were from average disaster management skills with 9% of total participants.

Besides, the number of participants that chose a little important and moderately important with average skill experience was equal in 12 (9%), and the number of participants who decided moderately important and extremely important with high-level experience in disaster management was equal in 8.2% (11 out of 134). The following figure shows the association of the importance of providing regular training for staff in hospitals and experience levels in participants' disaster management.

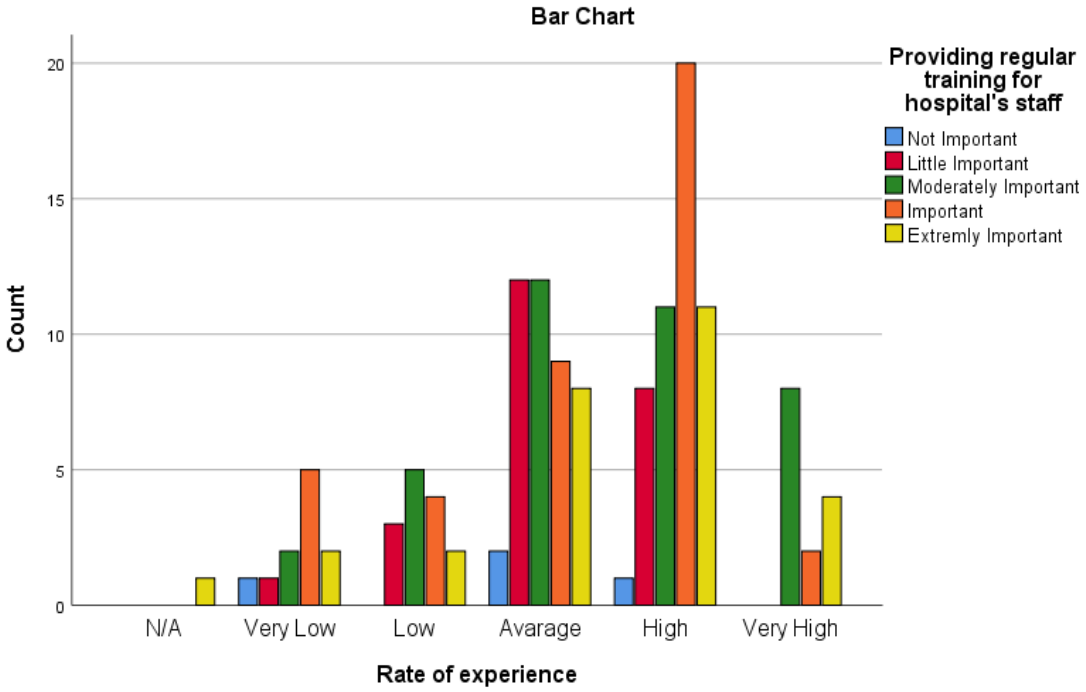

Figure 4. 16 Cross-tabulation of respondents' experience and the importance of providing regular training for staffs in hospitals

4.3.2 Chi-Square goodness of fit test

The chi-squared test is a widely implemented statistical data analysis method represented by χ^2. Implementing this test is more appropriate for the data set variables at both types of ordinal and level of measurement. This can be implemented when data is categorical. The Chi-squared test is implemented to illustrate whether the observed frequencies significantly differ from the frequencies from a set of expected frequencies. Only, it helps to contrast observed data with data the researcher would expect to collect based on a specific hypothesis. The chi-squared test can be implemented in both bivariate and univariate levels (Saha & John, 2016).

In bivariate analysis, the analysis of two variables combined is called the chi-squared test of independence. On the other hand, univariate analysis analyses a single variable associated with "goodness of fit", called the chi-squared one sample test. This attempts to determine whether a single categorical variable fits a theoretical distribution or not.

Moreover, the results enable the researcher to assess whether the frequencies across the variables are likely to distribute according to random variation or something more meaningful.

Therefore, to examine the questions of 3, 6, 8 in this questionnaire survey, the chi-squared goodness of fit test was implemented to assess whether observed frequencies differ from expected frequencies. Before implementing the chi-square goodness of fit test, the hypothesis was designed. Thus, the null- and alternative hypotheses were created for each question.

A. Null hypothesis: In the Chi-Square goodness of fit test, the null hypothesis assumes no significant difference between the observed and the expected value.

B. Alternative hypothesis: In the Chi-Square goodness of fit test, the alternative hypothesis assumes a significant difference between the observed and the expected value (Shankar, 2019).

Compute the value of the Chi-Square goodness of fit test using the following formula:

$$\chi^2 = \left[\frac{(O-E)^2}{E}\right]$$

χ^2 = Chi-Square goodness of fit test O= observed value

E= expected value

In the first stage, the chi-square goodness fit was implemented with equal values to illustrate any significant difference at < 0.05 in the respondent's perceptions of agreeing with the statements. The second stage was conducted with two sets of hypotheses; in this stage, different values were based on the respondent's answerers. If the p-value is greater than 0.05, the null hypotheses are accepted, and the alternative hypotheses will be rejected. By doing this chi-square test, the researcher understood that this sample size represents the whole population of this research.

4.3.2.1 Rate of experience with disaster management

The following table demonstrates the chi-square goodness-of-fit test results for the rate of experience with disaster management have equal values for the respondent's perceptions. This chi-square goodness-of-fit test indicates that all the statements got 0.000 as a p-value, and it is less than 0.05, which is test statistics are statically significant. Therefore, the null hypothesis has rejected the experience rate with disaster management. Thus, it can be concluded that there's a statistically significantly different in the respondent's perceptions in agreeing with the statement.

Table 4. 41 The chi-squared test 1 for the rate of experience with disaster management

Test 1				
Rate of experience with disaster management		**Chis squared test**		**Result on Hypothesis**
Null Hypothesis (H0)	Alternative Hypothesis (Ha)	Estimate	P-Value (0.05)	
There is an equal preference on respondent's perceptions in the rate of experience with disaster management	There is not an equal preference on respondent's perceptions in the rate of experience with disaster management	0.000	<0.05	H0 rejected

To conduct test 2 researcher formulated another two hypotheses with different values in the respondent's opinions, and it is demonstrated in the following table. For the rate of experience with disaster management, comparisons of opinions between none experienced participants and high experienced participants in the disaster management null hypothesis has been accepted as its p-value 0.640 is statistically not significant enough as it is higher than the significant level of 0.05. Thus, it indicates that 38.1% of the participants are high skill in disaster management. By this result, the null hypothesis cannot be rejected. Moreover, the rate of experience for participants was different N/A (0.7%), very low (8.2%), low (10.4%), average (8.2%), and very high (10.4%).

Table 4. 42 The chi-squared test 2 for the rate of experience with disaster management

Test 2				
Rate of experience with disaster management		**Chis squared test**		**Result on Hypothesis**
Null Hypothesis (H0)	Alternative Hypothesis (Ha)	Estimate	P-Value (0.05)	
38.1% have high experience, and 0.7% N/A experience in disaster management	38.1% do not have high experience, and 0.7% N/A experience in disaster management	0.640	>0.05	Retain the null hypothesis

4.3.2.2 The importance of hospitals during disaster events

The following table illustrates the chi-square goodness-of-fit test results for hospitals' importance during disaster events with equal values for respondents' perceptions. The results indicate that the statement got 0.000 as a p-value, and it is less than 0.05, which is statically significant test statistics. Therefore, the null hypothesis has rejected the importance of hospitals during disaster events; it can be concluded that there's a statistically significantly different in the respondent's perceptions in agreeing with the importance of hospitals during disaster events.

Table 4. 43 The chi-squared test 1 for the rate of the importance of hospitals during disaster events

Test 1				
Rate of the importance of hospitals during disaster events		**Chis squared test**		**Result on Hypothesis**
Null Hypothesis (H0)	Alternative Hypothesis (Ha)	Estimate	P-Value (0.05)	
There is an equal preference on respondent's perceptions in the rate of importance of hospitals in disaster events	There is not an equal preference on respondent's perceptions in the rate of importance of hospitals in disaster events	0.000	<0.05	H0 rejected

To conduct test 2 researcher formulated another two hypotheses with different values in the respondent's opinions for each statement, as demonstrated in the following table. For the importance of hospitals during disaster events, comparisons opinions of (not important and extremely important) null hypothesis has retained as its p-value 0.896, which is statistically not significant as it is greater than the significant level of 0.05, which indicates that 48.5% of the disaster management have a critical opinion about the importance of hospitals in disaster events. In comparison, 6.7% believe hospitals as not crucial in disaster events. Therefore, the null hypothesis cannot be rejected. Moreover, participants with important perceptions (24.6%) were very important (20.9%).

Table 4. 44 The chi-squared test 2 for the rate of the importance of hospitals during disaster events

Test 2				
Rate of the importance of hospitals during disaster events		**Chis squared test**		**Result on Hypothesis**
Null Hypothesis (H0)	Alternative Hypothesis (Ha)	Estimate	P-Value (0.05)	
48.5% critical opinion about the importance of hospitals in a disaster even, and 6.7% not important	48.5% do not have an extremely important opinion about the importance of hospitals in a disaster even, and 6.7% not important	0.896	>0.05	Retain the null hypothesis

4.3.2.3 Critical factors for keeping hospitals safe and secure during the disaster

The following table demonstrates the chi-square goodness-of-fit test results for the importance of critical factors for keeping hospitals safe and secure during disaster events with equal values for the respondent's perceptions.

The results indicate that all the statements got 0.000, and some got 0.001(Q7A, Q7F, Q7J, Q7N), as the p-value is less than 0.005 that tests statistics are statically significant. Therefore, the null hypothesis has been rejected. Thus, it can be concluded that there's a statistically significant difference in the respondent's perceptions in agreeing with the statement.

Table 4. 45 The chi-squared test 1 for the rate of critical factors for keeping hospitals safe and secure

Test 1					
Rate of the importance of critical factors to keep hospitals safe and secure			**Chis squared test**		**Result on Hypothesis**
Code	Null Hypothesis (H0)	Alternative Hypothesis (Ha)	Estimate	P-Value (0.05)	
Q7A	There is an equal preference on respondent's perceptions in the rate of managing medical equipment.	There is not an equal preference on respondent's perceptions in the rate of importance of managing medical equipment.	0.001	<0.05	H0 rejected
Q7B	There is an equal preference on respondent's perceptions in the rate of controlling medicine supply.	There is not an equal preference on respondent's perceptions in the rate of importance of controlling medicine supply.	0.000	<0.05	H0 rejected
Q7C	There is an equal preference on respondent's perceptions in the rate of providing continues energy.	There is not an equal preference on respondent's perceptions in the rate of providing continues energy.	0.000	<0.05	H0 rejected
Q7D	There is an equal preference on respondent's perceptions in the rate of having reserve fuel.	There is not an equal preference on respondent's perceptions in the rate of having reserve fuel.	0.000	<0.05	H0 rejected

Q7E	There is an equal preference on respondent's perceptions in the rate of providing Sufficient water and food.	There is not an equal preference on respondent's perceptions in the rate of providing Sufficient water and food.	0.000	<0.05	H0 rejected
Q7F	There is an equal preference on respondents' perceptions of the rate of enough equipment and supplies in the sterilization services.	There is no equal preference for respondents' perceptions of the rate of enough equipment and supplies in sterilization services.	0.001	<0.05	H0 rejected
Q7G	There is an equal preference on respondent's perceptions in the rate of keeping communication system such as phone, internet, etc	There is no equal preference on respondent's perceptions in the rate of keeping a communication system such as phone, internet, etc.	0.000	<0.05	H0 rejected
Q7H	There is an equal preference on respondent's perceptions in the rate of keeping heating, ventilation.	There is not an equal preference on respondent's perceptions in the rate of keeping heating, ventilation.	0.000	<0.05	H0 rejected
Q7J	There is an equal preference on respondent's perceptions in the rate	There is not an equal preference on respondent's perceptions in the	0.001	<0.05	H0 rejected

	of Controlling nuclear medicine and radiation therapy.	rate of Controlling nuclear medicine and radiation therapy.			
Q7K	There is an equal preference on respondent's perceptions in the rate of managing radiology and imaging devices.	There is not an equal preference on respondent's perceptions in the rate of Managing radiology and imaging devices.	0.000	<0.05	H0 rejected
Q7L	There is an equal preference on respondent's perceptions in the rate of mitigating physical damages to facilities.	There is not an equal preference on respondent's perceptions in the rate of mitigating physical damages to facilities.	0.000	<0.05	H0 rejected
Q7M	There is an equal preference on respondents' perceptions about making patient's document safe and reachable.	There is no equal preference on respondent's perceptions in making patient's document safe and reachable.	0.000	<0.05	H0 rejected
Q7N	There is an equal preference on respondents' perceptions of controlling human resources such as hospital's personnel and volunteers.	There is not an equal preference on respondent's perceptions in the rate of controlling human resources such as hospital's	0.001	<0.05	H0 rejected

		personnel and volunteers.			
Q7P	There is an equal preference on the respondent's perceptions of keeping the operation theatres and recovery room safe and accessible.	There is no equal preference for the respondent's perceptions of keeping the operation theatres and recovery room safe and accessible.	0.000	<0.05	H0 rejected
Q7Q	There is an equal preference on respondent's perceptions in the rate of keeping hospitals accessible to everyone.	There is not an equal preference on respondent's perceptions in the rate of keeping hospitals accessible to everyone.	0.000	<0.05	H0 rejected
Q7R	There is an equal preference on respondent's perceptions in the rate of managing collaboration with other organisations in connection with disaster management.	There is no equal preference on respondent's perceptions in the rate of managing collaboration with other organisations in connection with disaster management.	0.000	<0.05	H0 rejected

To conduct test 2 in this part of the questionnaire, the researcher formulated another two hypotheses with different values in the respondent's opinions for each statement, as demonstrated in the following table.

For Q7A, comparisons of opinions (Not important and extremely important) null hypothesis has been accepted as its p-value 0.789, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 26.1% of the participants have a critical opinion. In comparison, 8.2% have no important opinion with the statement Q7A. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have little, moderately important, and important perceptions of the statement.

For Q7B, comparisons of opinions (Not important and important) null hypothesis has accepted as its p-value 0.869, which is statistically not significant as it is larger than the significant level of 0.05, indicating that 27.6% of the participants have important opinions. In comparison, 4.5% have no important opinion with the statement Q7B. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, moderately important, extremely important with the statement.

For Q7C, comparisons of opinions (Not important and extremely important) null hypothesis has been accepted as its p-value 0.659, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 34.3% of the participants have a critical opinion. In comparison, 4.5% have no important opinion with the statement Q7C. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have little, moderately important, and important perceptions of the statement.

For Q7D, comparisons of opinions (Not important and Little important) null hypothesis has accepted as its p-value 0.671 which is statistically not significant as it is greater than the significant level of 0.05 which indicates that 26.9% of the participants have little important opinion while 4.5% have not important opinion with the statement Q7D. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions of moderately important, important, and extremely important with the statement. For Q7E, comparisons of opinions (Not important and Moderately important) null hypothesis has been accepted as its p-value 0.249, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 30.6% of the participants have a moderately important opinion. In comparison, 3% have no important opinion with the statement Q7E.

Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, important, and extremely important with the statement.

For Q7F, comparisons of opinions (Not important and Moderately important) null hypothesis has been accepted as its p-value 0.455, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 24.6% of the participants have a moderately important opinion. In comparison, 5.2% have no important opinion with the statement Q7F. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, important, and extremely important with the statement.

For Q7G, comparisons of opinions (Not important and Moderately important) null hypothesis has accepted as its p-value 0.640, which is statistically not significant. It is greater than the significant level of 0.05, which indicates that 31.3% of the participants have a moderately important opinion. In comparison, 5.2% have no important opinion with the statement Q7G. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, important, and extremely important with the statement.

For Q7H, comparisons of opinions (Not important and Moderately important) null hypothesis has been accepted as its p-value 0.896, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 30.6% of the participants have a moderately important opinion. In comparison, 1.5% have no important opinion with the statement Q7H. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, important, and extremely important with the statement.

For Q7J, comparisons of opinions (Not important and Moderately important) null hypothesis has been accepted as its p-value 0.789, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 26.9% of the participants have a moderately important opinion. In comparison, 6.7% have no important opinion with the statement Q7J. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, important, and extremely important with the statement.

For Q7K, comparisons of opinions (Not important and Moderately important) null hypothesis has accepted as its p-value 0.455, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 32.1% of the participants have a moderately important opinion. In comparison, 1.5% have no important opinion with the statement Q7K. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, important, and extremely important with the statement.

For Q7L, comparisons of opinions (Not important and important) null hypothesis has accepted as its p-value 0.640, which is statistically not significant as it is larger than the significant level of 0.05, indicating that 32.8% of the participants have important opinions.

In comparison, 3% have no important opinion with the statement Q7L. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, moderately important, extremely important with the statement.

For Q7M, comparisons of opinions (Not important and Moderately important) null hypothesis has accepted as its p-value 0.896, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 44% of the participants have a moderately important opinion. In comparison, 1.5% have no important opinion with the statement Q7M. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, important, and extremely important with the statement.

For Q7N, comparisons of opinions (Not important and Moderately important) null hypothesis has been accepted as its p-value 0.789, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 27.6% of the participants have a moderately important opinion. In comparison, 7.5% have no important opinion with the statement Q7N. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, important, and extremely important with the statement.

For Q7P, comparisons of opinions (Not important and important) null hypothesis has rejected as its p-value 0.000, which is statistically significant as it is less than the significant level of 0.05. Therefore, the null hypothesis has been rejected.

For Q7Q, comparisons of opinions (Not important and important) null hypothesis has rejected as its p-value 0.000, which is statistically significant as it is less than the significant level of 0.05. Therefore, the null hypothesis has been rejected.

For Q7R, comparisons of opinions (Not important and important) null hypothesis has accepted its p-value 0.249, which is statistically insignificant. It is larger than the significant level of 0.05, indicating that 36.6% of the participants have important opinions. In comparison, 0.7% have not important opinion with the statement Q7R. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, moderately important, extremely important with the statement.

Table 4. 46 The chi-squared test 2 for the rate of the importance of hospitals of critical factors to keep hospitals safe and secure

Test 2					
Rate of the importance of critical factors to keep hospitals safe and secure			**Chis squared test**		**Result on Hypothesis**
Code	Null Hypothesis (H0)	Alternative Hypothesis (Ha)	Estimate	P-Value (0.05)	
Q7A	26.1% of the participants have extremely important, and 8.2% have not important perceptions of managing medical equipment.	26.1% of the participants do not have extremely important and8.2% have not important perceptions of managing medical equipment.	0.789	>0.05	Retain the null hypothesis
Q7B	27.6% of the participants have important, and 4.5% have not important perceptions in the rate of controlling medicine supply.	27.6% of the participants do not have important, and 4.5% have not important perceptions in the rate of controlling medicine supply.	0.869	>0.05	Retain the null hypothesis
Q7C	34.3% of the participants have extremely important, and 4.5% have important perceptions about providing continuous energy.	34.3% of the participants do not have extremely important, and 4.5% have important perceptions about providing continuous energy.	0.659	>0.05	Retain the null hypothesis

Q7D	26.9% of the participants have little important, and 4.5% have not important perceptions about the rate of providing continuous energy.	26.9% of the participants do not have little important, and 4.5% have important perceptions about the rate of continuous energy.	0.671	>0.05	Retain the null hypothesis
Q7E	30.6% of the participants have moderately important and 3% have not important perceptions in rate of providing Sufficient water and food.	30.6% of the participants do not have moderately important, and 3% do not have important perceptions of the rate of providing Sufficient water and food.	0.249	>0.05	Retain the null hypothesis
Q7F	24.6% of the participants have moderately important, and 5.2% have not important perceptions of enough equipment and supplies in the sterilization services.	24.6% of the participants do not have moderately important, and 5.2% have not important perceptions of enough equipment and supplies in the sterilization services.	0.455	>0.05	Retain the null hypothesis

Q7G	31.3% of the participants have moderately important and 5.2% have not important perceptions in rate of keeping communication system such as phone, internet, etc	31.3% of the participants do not have moderately important and 5.2% have not important perceptions in rate of keeping communication system such as phone, internet, etc	0.640	>0.05	Retain the null hypothesis
Q7H	30.6% of the participants have moderately important, and 1.5% have not important perceptions about keeping heating and ventilation.	30.6% of the participants do not have moderately important, and 1.5% do not have important perceptions of the rate of heating and ventilation.	0.896	>0.05	Retain the null hypothesis
Q7J	26.9% of the participants have moderately important, and 6.7% have not important perceptions of Controlling nuclear medicine and radiation therapy.	26.9% of the participants do not have moderately important, and 6.7% have not important perceptions in rate of Controlling nuclear medicine and radiation therapy.	0.789	>0.05	Retain the null hypothesis

Q7K	32.1% of the participants have moderately important, and 1.5% have not important perceptions in the rate of managing radiology and imaging devices.	32.1% of the participants do not have moderately important, and 1.5% do not have important perceptions of the rate of managing radiology and imaging devices.	0.455	>0.05	Retain the null hypothesis
Q7L	32.8% of the participants have important, and 3% have not important perceptions in the rate of mitigating physical damages to facilities.	32.8% of the participants do not have important, and 3% have not important perceptions in the rate of mitigating physical damages to facilities.	0.640	>0.05	Retain the null hypothesis
Q7M	44% of the participants have moderately important and 1.5% have not important perceptions of making patient's document safe and reachable.	44% of the participants do not have moderately important and 1.5% have not important perceptions about making patient's document safe and reachable.	0.896	>0.05	Retain the null hypothesis

Q7N	27.6% of the participants have moderately important, and 7.5% have not important perceptions of controlling human resources such as hospital's personnel and volunteers.	27.6% of the participants do not have moderately important, and 7.5% have not important perceptions of controlling human resources such as hospital's personnel and volunteers.	0.789	>0.05	Retain the null hypothesis
Q7P	29.1% of the participants have important, and 0.7% have not important perceptions about keeping operation theatres and recovery rooms safe and accessible.	29.1% of the participants do not have important, and 0.7% have not important perceptions about keeping operation theatres and recovery rooms safe and accessible.	0.000	<0.05	H0 rejected
Q7Q	31.3% of the participants have important, and 3.7% have not important perceptions of keeping hospitals accessible to everyone.	31.3% of the participants do not have important, and 3.7% have not important perceptions in rate of keeping hospitals accessible to everyone.	0.000	<0.05	H0 rejected

Q7R	36.6% of the participants have important and 0.7% have not important perceptions in rate of managing collaboration with other organisations in connection with disaster management.	36.6% of the participants do not have important and 0.7% have not important perceptions in rate of managing collaboration with other organisations in connection with disaster management.	0.249	>0.05	Retain the null hypothesis

4.3.2.4 Having regular training for hospital staff

The following table demonstrates the chi-square goodness-of-fit test results for the importance of having regular training for hospitals with equal values for the respondent's perceptions.

The results indicate the statement got 0.000 as a p-value, which is less than 0.005; that is, test statistics are statically significant. Therefore, the null hypothesis has been rejected. Thus, it can be concluded that there's a statistically significant difference in the respondent's perceptions in agreeing with the statement.

Table 4. 47 The chi-squared test 1 for the rate of providing regular training for the hospital's staff

Test 1				
Rate of providing regular training for the hospital's staff		**Chi-squared test**		**Result on Hypothesis**
Null Hypothesis (H0)	Alternative Hypothesis (Ha)	Estimate	P-Value (0.05)	
There is an equal preference on respondent's perceptions in the rate of providing regular disaster training.	There is not an equal preference on respondent's perceptions in the rate of providing regular disaster training.	0.000	<0.05	H0 rejected

To conduct test 2 in this part of the questionnaire researcher formulated another two hypotheses with different values in the respondent's opinions for each statement, as demonstrated in the following table.

For Q8, comparisons of opinions (Not important and important) null hypothesis has been accepted as its p-value 0.184, which is statistically insignificant. It is greater than the significant level of 0.05, indicating that 29.9% of the participants have important opinions. In comparison, 3% have no important opinion with the statement Q8. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, moderately important, extremely important with the statement.

Table 4. 48 The chi-squared test 2 for the rate of providing regular training for the hospital's staff

Test 2				
Rate of providing regular training for the hospital's staff		**Chi-squared test**		**Result on Hypothesis**
Null Hypothesis (H0)	Alternative Hypothesis (Ha)	Estimate	P-Value (0.05)	
29.9% of the participants have important, and 3% have not important perceptions in rate, providing regular disaster training.	29.9% of the participants do not have important, and 3% have not important perceptions in rate providing regular disaster training.	0.184	>0.05	Retain the null hypothesis

4.3.2.5 Impact of disaster on facilities of hospitals

The following table demonstrates the chi-square goodness-of-fit test results for the disaster's impact on facilities of hospitals events with equal values for the respondent's perceptions.

The chi-square goodness-of-fit test results for Q11A got 0.053, and Q11E got 0.173 which are more significant than 0.05. Thus, it concludes that no significant difference exists, and the null hypothesis is accepted in Q11A and Q11E. However, in the Q11A and Q11E, the null hypothesis was accepted. Still, in the rest of the statements, the results indicate that all the statements got 0.000 as p-value, and it is lesser than 0.05, which is test statistics are statically significant. Therefore, the null hypothesis has been rejected for them, and it can be concluded that there is a statistically significant difference in the respondent's perceptions in agreeing with those statements.

Table 4. 49 The chi-squared test 1 for the impact of the disaster on facilities of hospitals

Test 1					
Impact of disaster on facilities of hospitals			**Chi-squared test**		**Result on Hypothesis**
Code	Null Hypothesis (H0)	Alternative Hypothesis (Ha)	Estimate	P-Value (0.05)	
Q11A	There is an equal preference on respondent's perceptions in the rate of importance of medical equipment	There is not an equal preference on respondent's perceptions in the rate of importance of medical equipment	0.053	>0.05	Retain the null hypothesis
Q11B	There is an equal preference on respondent's perceptions in the rate of importance of medicine storage and blood resources	There is not an equal preference on respondent's perceptions in the rate of importance of medicine storage and blood resources	0.000	<0.05	H0 rejected
Q11C	There is an equal preference on respondent's perceptions in the rate of importance of patient's document	There is not an equal preference on respondent's perceptions in the rate of importance of patient's document	0.000	<0.05	H0 rejected
Q11D	There is an equal preference on respondent's perceptions in the rate of importance of water and food resources	There is not an equal preference on respondent's perceptions in the rate of importance of water and food resources	0.000	<0.05	H0 rejected

Q11E	There is an equal preference on respondent's perceptions in the rate of importance of energy supply systems	There is not an equal preference on respondent's perceptions in the rate of importance of energy supply systems	0.173	>0.05	Retain the null hypothesis
Q11F	There is an equal preference on respondent's perceptions in the rate of importance of resource allocation for the staff of the hospital	There is not an equal preference on respondent's perceptions in the rate of importance of resource allocation for the staff of the hospital	0.000	<0.05	H0 rejected
Q11G	There is an equal preference on respondent's perceptions in the rate of importance of accessibility to hospital	There is not an equal preference on respondent's perceptions in the rate of importance of accessibility to hospital	0.000	<0.05	H0 rejected
Q11H	There is an equal preference on respondent's perceptions in the rate of importance of coordination and collaboration with others	There is not an equal preference on respondent's perceptions in the rate of importance of coordination and collaboration with others	0.000	<0.05	H0 rejected

Q11J	There is an equal preference on respondent's perceptions in the rate of importance of resource allocation for volunteers	There is not an equal preference on respondent's perceptions in the rate of importance of resource allocation for volunteers	0.000	<0.05	H0 rejected
Q11K	There is an equal preference on respondent's perceptions in the rate of importance of communication systems	There is not an equal preference on respondent's perceptions in the rate of importance of communication systems	0.000	<0.05	H0 rejected

To conduct test 2 researcher formulated another two hypotheses with different values in the respondent's opinions for each statement, as demonstrated in the following table.

For Q11B, comparisons of opinions (Not important and Extremely important) null hypothesis has accepted as its p-value 0.552, which is statistically not significant as it is greater than the significant level of 0.05, which indicates that 32.8% of the participants have an extremely important opinion. In comparison, 7.5% have no important opinion with the statement Q11B. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have little, moderately important, and essential perceptions of the statement.

For Q11C, comparisons of opinions (Extremely important and Moderately important) null hypothesis has been accepted as its p-value 0.522, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 35.8% of the participants have a moderately important opinion. In comparison, 5.2% have a critical opinion with the statement Q11C. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions of not important, little important, and important with the statement.

For Q11D, comparisons of opinions (Not important and important) null hypothesis has been accepted as its p-value 0.485, which is statistically insignificant. It is greater than the significant level of 0.05, indicating that 32.8% of the participants have important opinions. In comparison, 4.5% have no important opinion with the statement Q11D. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions of little importance, moderately important, and extremely important with the statement.

For Q11F, comparisons of opinions (Not important and Little important) null hypothesis has accepted as its p-value 0.204 which is statistically not significant as it is greater than the significant level of 0.05 which indicates that 32.1% of the participants have little important opinion while 7.5% have not important opinion with the statement Q11F. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions of the statement as important, moderately important, and extremely important.

For Q11G, comparisons of opinions (Not important and Moderately important) null hypothesis has been accepted as its p-value 0.626, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 24.6% of the participants have a moderately important opinion. In comparison, 6.7% have no important opinion with the statement Q11G. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, important, and extremely important with the statement.

For Q11H, comparisons of opinions (Not important and Moderately important) null hypothesis has been accepted as its p-value 0.204, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 35.8% of the participants have a moderately important opinion. In comparison, 5.2% have no important opinion with the statement Q11H. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, important, and extremely important with the statement.

For Q11J, comparisons of opinions (Not important and Moderately important) null hypothesis has been accepted as its p-value 0.108, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 38.8% of the participants have a moderately important opinion. In comparison, 8.2% have no important opinion with the statement Q11J. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, important, and extremely important with the statement.

For Q11K, comparisons of opinions (Not important and important) null hypothesis has been accepted as its p-value 0.494, which is statistically insignificant. It is greater than the significant level of 0.05, which indicates that 30.6% of the participants have important opinionss. In comparison, 4.5% have no important opinion with the statement Q11K. Therefore, the null hypothesis cannot be rejected. Moreover, some participants have perceptions with little important, moderately important, and extremely important with the statement.

Table 4. 50 The chi-squared test 2 for the impact of the disaster on facilities of hospitals

Test 2					
Impact of disaster on facilities of hospitals			**Chis squared test**		**Result on Hypothesis**
Code	Null Hypothesis (H0)	Alternative Hypothesis (Ha)	Estimate	P-Value (0.05)	
Q11B	32.8% of the participants have extremely important, and 7.5% have not important perceptions in the rate of the importance of medicine storage and blood resources	32.8% of the participants do not have extremely important, and 7.5% have not important perceptions in the rate of the importance of medicine storage and blood resources	0.552	>0.05	Retain the null hypothesis
Q11C	5.2% of the participants have extremely important and 35.8% have moderately important perceptions in rate of patient's document	5.2% of the participants do not have extremely important, and 35.8% have moderately important perceptions in the rate of patient's document	0.522	>0.05	Retain the null hypothesis

Q11D	32.8% of the participants have important and 4.5% have not important perceptions in rate water and food resources	32.8% of the participants do not have important, and 4.5% have not important perceptions in rate water and food resources	0.485	>0.05	Retain the null hypothesis
Q11F	32.1% of the participants have little important, and 7.5% have not important perceptions in the rate of resource allocation for the staff of a hospital	32.1% of the participants do not have little important, and 7.5% have not important perceptions in the rate of resource allocation for the staff of a hospital	0.204	>0.05	Retain the null hypothesis
Q11G	24.6% of the participants have moderately important and 6.7% have not important perceptions in rate of accessibility to hospital	24.6% of the participants do not have moderately important, and 6.7% have not important perceptions in rate of accessibility to hospital	0.626	>0.05	Retain the null hypothesis
Q11H	35.8% of the participants have moderately important and 5.2% have not important perceptions in rate of coordination and	35.8% of the participants do not have moderately important, and 5.2% have not important perceptions in the rate of coordination	0.204	>0.05	Retain the null hypothesis

	collaboration with others	and collaboration with others			
Q11J	38.8% of the participants have moderately important, and 8.2% have not important perceptions in the rate of resource allocation for volunteers	38.8% of the participants do not have moderately important, and 8.2% have not important perceptions in the rate of resource allocation for volunteers	0.108	>0.05	Retain the null hypothesis
Q11K	30.6% of the participants have important and 4.5% have not important perceptions in rate of communication systems	30.6% of the participants do not have important and 4.5% have not important perceptions in rate of communication systems	0.494	>0.05	Retain the null hypothesis

4.3.3 Relevant important index

Relative important index (RII) has been widely used in different types of research. In particular, use multiple questions to determine the relative importance of surveyed variables (Holt, 2014). Using the following formula, RII was computed for filtered hypothesis from the chi-squared test in both questionnaires. Where W, which is the weighting given to each factor by the

$$\text{Relative Importance Index} = \frac{\sum w}{AN} = \frac{5n_5+4n_4+3n_3+2n_2+1n_1}{5N}$$

respondent, ranges from 1 to 5; A is the highest weight (i.e., 5 in the study), and N is the total number of respondents. Goodness-of-Fit is a statistical hypothesis test used to see how closely observed data mirrors expected data. It is often used to evaluate whether sample data is representative of the full population. After completing the Chi-squared test result, the researcher was ableing to verify better which factor represents the whole idea from the full population. After conducting a Chi-squared test for all the above factors, it was able to identify the rank order of each element from the highest to least importance. After that, RII was calculated for all the filtered factors, and the results were summarised in the following table.

As per the results, the most influential critical factor for keeping hospitals safe and secure was providing energy, water, and food. In the following, managing collaboration with other organizations connected with disaster management with a 0.676 RII value was 3rd. Managing radiology and imaging devices with a standard of 0.674 RII were in 4th place. Enough equipment and supplies in the sterilization services were also placed in 5th place with a 0.673 RII value. Managing medical equipment with standard of 0.671 RII value was 6th. Controlling medicine supply and controlling nuclear medicine and radiation therapy put in the 7th and 8th place with RII value of 0.670 RII and 0.668 RII. In the following, keeping heating, ventilation, and controlling human resources such as hospital's personnel and volunteers had an equal RII value (0.658 RII) and ranked in 9th place. The least three factors for keeping hospitals safe and secure were Q7G, Q7L, and Q7M factors with RII Values of 0.653, 0.643, and 0.625.

Table 4. 51 Ranks and RIIs of the rate of critical factors for keeping hospitals safe and secure

	Critical factors	Results on Hypothesis	RII Value	Rank
Q7C	Providing continues energy	supported	0.701	**1**
Q7E	Providing Sufficient water and food	supported	0.695	**2**
Q7R	Managing collaboration with other organizations in connection with disaster management	supported	0.676	**3**
Q7K	Managing radiology and imaging devices	supported	0.674	**4**
Q7F	Enough equipment and supplies in the sterilization services	supported	0.673	**5**
Q7A	Manging Medical equipment	supported	0.671	**6**
Q7B	Controlling Medicine supply	supported	0.670	**7**
Q7J	Controlling nuclear medicine and radiation therapy	supported	0.668	**8**
Q7H	Keeping heating, ventilation	supported	0.658	**9**
Q7N	Controlling human resources such as hospital's personnel and volunteers	supported		
Q7D	Having Reserve Fuel	supported	0.656	**10**
Q7G	Keeping communication system such as phone, internet, etc	supported	0.653	**11**
Q7L	Mitigating physical damages to facilities	supported	0.643	**12**
Q7M	Making the patient's document safe and reachable	supported	0.625	**13**

To better understand the most facilities rate of impact of a disaster on hospitals' facilities after conducting the chi-squared test, all the above facilities were ranked from 1 to 10.

The most influential facility is medicine storage and blood resources with a 0.714 RII value. Water and food resources were ranked in the 2nd and 3rd places with a 0.689 and 0.673 RII value in the following communication systems.

The patient's documents and medical equipment were ranked in the 4^{th} and 5^{th} places with RII values of 0.520 and 0.667. The most minor five influential facilities are Q11G, Q11H, Q11E, Q11F, and Q11J.

Table 4. 52 Ranks and RIIs of the rate of impact of a disaster on facilities of hospitals

	Facilities	**Results on Hypothesis**	**RII Value**	**Rank**
Q11B	Medicine storage and blood resources	Supported	0.714	**1**
Q11K	Communication systems	supported	0.689	**2**
Q11D	Water and food resources	supported	0.673	**3**
Q11C	Patient's document	supported	0.520	**4**
Q11A	Medical equipment	supported	0.667	**5**
Q11G	Accessibility to hospital	supported	0.665	**6**
Q11H	Coordination and collaboration with others	supported	0.653	**7**
Q11E	Energy supply system	supported	0.644	**8**
Q11F	Resource allocation for the hospital staff	supported	0.613	**9**
Q11J	Resource allocation for volunteers	supported	0.602	**10**

4.4 Summary & Link

The chapter addressed the quantitative methods and findings from data analysis. The questionnaire was designed in three sections to address this research study's first and second objectives.

The survey results were presented using both descriptive and inferential statistics. The descriptive statistics were implemented to provide simple summaries about the sample and the measures using graphics, numbers, and tables. In contrast, the inferential statistics allowed conclusions drawn that represented a broader population of disaster managers connected with hospitals. The respondents' background profile indicates that almost 50% of respondents are disaster management researchers, and more than 18.7% of participants have been involved with disaster events as a volunteer. Besides, about 13.4% of respondents are resilience researchers. The background profile results also outline respondents categorized into six main parts, namely N/A, less than one year, 1-3 years, 3-5 years, 5-10 years and more than ten years of experience in disaster management.

The last few questions in section one of this questionnaire were about the responsible person and organization to keep the hospital safe and secure in a disaster event.

The results of section two of this questionnaire were designed to identify hospitals' importance and evaluate some critical factors in disaster events. At the beginning of this section, hospitals' reputation in disaster events was questioned, and almost 48.5% of the respondents agreed on hospitals as extremely important during and after disaster events. Some critical factors that might keep hospitals safe and secure during disaster events were asked for ranking in the following. In the last section of this questionnaire, some adverse impact of disaster events on hospitals was examined.

After a descriptive analysis of all of the questionnaire's questions, the inferential analysis was implemented to understand better. The cross-tabulation was implemented to understand better the association of questions 3, 6, and 8. Besides, Chi-square goodness of fit was implemented in questions 3,6,7,8 and 11of Of this questionnaire to understand better that the result of this sample size can be entire this research population.

Chapter 5

CHAPTER 5: QUALITATIVE DATA COLLECTION AND ANALYSIS

This chapter illustrates the second stage of data collection and data analysis for this research. The rationale for the case studies is presented in this chapter. This chapter also discusses the strategy for qualitative data collection and analysis of results from the semi-structured interview with some experts connected with disaster management with two case studies. In this chapter, the researcher explores more qualitative data regarding evaluating the existing mitigation and preparedness measures in hospitals and identifying most barriers and obstacles against disaster managers to implement appropriate disaster management strategies in hospitals.

The primary purpose of qualitative data and analysis is to gain a deeper appreciation and better understand current disaster management strategies in hospitals and explore more about challenges and barriers to having less impact on hospitals during disaster events. This chapter finally illustrates the finding of interviews.

5.1 Exploratory of case studies

In this chapter, it has been pointed out that two different cases were investigated by interviewing some experts in connection with disaster management and giving health services in hospitals during disaster events. The purpose of having two case studies for this research is to understand better different challenges and barriesrs against hospitals and health facilities at disaster events. Moreover, by implementing two different case studies, the impact, challenges, and barriers against hospitals during two different popular types of natural disaster events will be considered. By using two case studies, also researcher is getting a better perspective of providing health service during other types of natural disasters. These interviewees responded to questions reflecting their experience with previous disaster events and these two case studies. Qualitative data analysis has been carried out in this chapter to comprehend and discuss interviewees' alternatives with the challenges and strategies in each case.

5.2 Kermanshah Earthquake

Iran is one of the top 10 disaster-prone countries globally, with almost nighty per cent of its total population exposed to natural disasters such as earthquakes and flooding (Pourhosseini, Ardalan, & Mehrolhassani, 2015). Besides, Iran has been ranked in 6 globally (Wilson et al., 2017). So far, several fatal flooding and earthquake have happened in Iran in the last four decades. Among that Bam earthquake and Rudbar had the highest rate of death. (Akbari, Farshad, & Asadi-Lari, 2004).

On November 12, 2017, at 21:48 local time zone, an earthquake with a significant moment magnitude of 7.3 struck Ezgeleh, Kermanshah Province, in Iran. It was estimated that between 800 to 1000 people were killed or disappeared, and more than 12,000 were injured. The Iran earthquake of November 12, 2017, is one of the most significant earthquakes throughout Iran's history, which shook regions of North-West of the Zagros Mountains, Sarpol-e Zahab Region Northwest of Iran (Goorabi, 2019).

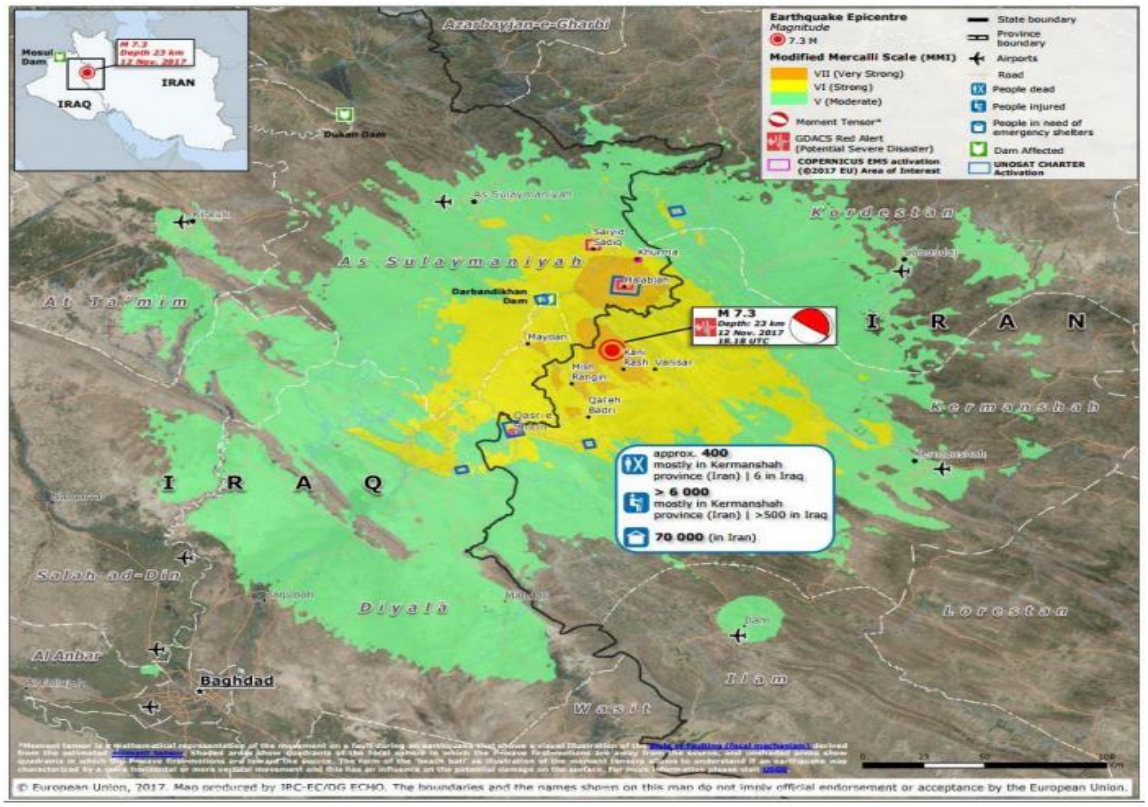

Figure 5. 1 Kermanshah Earthquake 7.3 magnitude November 12, 2017

This earthquake hit the Province of Kermanshah, with a magnitude of almost 7.3 on the Richter scale and lasted about 30 seconds and at a depth of about 11 km beneath the Earth's surface, 5 km from the town of Ezgeleh in Kermanshah Province at 21:48 local time on November 12, 2017 (Yousefi, Pirani, & Sahebi, 2018). This earthquake had three massive foreshocks based on information delivered from the National Seismological Center and Geophysics Institute. The largest of them was at 4.5. Richter magnitude was reported at 21:05 local time (Miyamjima et al., 2018).

Besides the western, northern and southwestern, central and northern regions of Iran, particularly Kermanshah, Ilam, Kurdistan, Western Azerbaijan and Khuzestan, this earthquake was also felt in the neighbouring countries such as Iraq, Kuwait, and Bahrain (Karimzadeh et al., 2018). During the days after the earthquake, more than 1000 aftershocks were recorded, the largest of which was an aftershock with a magnitude of 4.7 on the Richter scale at 7:57 local time 16:46 local time on November 13 (Kuang et al., 2019).

Regions affected by the earthquake encompassed a vast area west of the country, including Dalahu, Javanrood, Gilan-e Gharb, Ghasreshirin, Eslam Abad-e Gharb, Sar-e pole Zahab, Salas-e Babajani, and parts of the city of Kermanshah with a population of 427000 people. Also, 85 rural residential areas from 5 to 15 km from the epicentre sustained 80% destruction (Mahani & Kazemian, 2018). This unfortunate event allowed the Iranian disaster management department to pause to re-examine, thereby improving Iran's disaster planning, preparedness, mitigation, and program responses (Safarpour, 2018).

Computer-mediated technologies such as the Telegram messaging service were highly beneficial. These technology and applications assisted mobilized local, global and national support for victims of this disaster. Social media facilitated immediate assistance for thousands of people post-earthquake, but it also enabled victims, families, and friends to share their valuable and timely information (Ahmadi & Bazargan-Hejazi, 2018). This proved to assist in release and relief efforts for those affected by this incident. However, some technology and computers cannot prevent or reduce injury or fatalities on themselves. In December 2003, Bam, a city in the southeast region of Iran, was experienced an enormous earthquake with a magnitude of about 6.6. This destroyed about 90% of the town and left approximately 41,000 dead (Mirhashemi et al., 2007a).

Post-quake assessments revealed the lack of comprehensive disaster management plans and a lack of an adequate emergency medical service system. Local hospitals and health facilities were found to be structurally deficient. Poor communication between and across disaster relief organizations was also blamed for the high number of casualties and problems (PEYRAVI, MARZALEH, & KHORRAM-MANESH, 2019). It is certainly unfortunate that what should have been learned from the Bam disaster and other natural disasters in the past was not actualized in the Kermanshah earthquake. Many government agencies were not well-coordinated, agile, and did not have current technology and up-to-date information about the area that needed relief efforts (Yang et al., 2018; Zare et al., 2017). Perhaps, as a result, earthquake victims tended to rely on those in their own family and social networks for rescue and relief rather than on government agencies and services. This may be due in part to their distrust of and lack of confidence in government officials' wisdom and efficacy in disaster response and management (Taghinia, Vasseghi, & Jabbarzadeh, 2019). The substantial damage to the newly-built Islamabad and Sar-e-Pole Zahab Hospitals, for example, reveals perhaps non-compliance with the "Iranian code of practice for the seismic-resistant design of buildings (standard no. 2800)" as well as severe deficiencies in Iranian disaster prevention and mitigation plans and measures. From a humanitarian perspective, it must first express gratitude to every individual, group, organization and nation that responded so swiftly to the Kermanshah disaster and provided generous relief and assistance (Ostadtaghizadeh et al., 2018). It must also consider the power and impact of technology and what we see as infrastructure, communication, and administrative shortcomings. These lead us to several important conclusions and recommendations. It is critical for those affected by disasters such as a significant earthquake to have immediate and accurate information about finding shelter and obtaining medical and social services, food and clean water, and other essentials (Yon et al., 2015). A cloud-hosted emergency information website with mapping capabilities can inform residents about the extent of damage in their area, road closures, open petrol stations, distribution centres of essential supplies, and medical and shelter sites (Goda et al., 2015). The recent Nepal, Haiti, and Christchurch (New Zealand) earthquakes show that combining open-source and propriety software and maps and secure data-sharing and free electronic tools and apps are quick and cost-effective responses in times of crisis (Goda et al., 2015).

Besides, reliable and accurate electronic databases of property and structures allow for fast information retrieval, repair and rebuilding. Such systems can also help volunteers and first-responders locate and assist victims immediately after a catastrophic event and facilitate longer-term recovery efforts by monitoring and coordinating activities to avoid waste, redundancy, bottlenecks and traffic congestion (Ahmadi & Bazargan-Hejazi, 2018). Natural disasters, such as major earthquakes, are tragic and unfortunate. However, out of crisis emerge opportunities for innovation and improvement. The ideas and proposals that result are often bold and novel and less constrained and shackled by policy, rules, regulations and norms. The Ezgeleh earthquake allows us to overcome shortcomings and learn more about crowdsourcing to collect information during a crisis to reduce injury and mortality from future disasters in Iran.

5.2.1 Challenges and Strength of Hospitals in Kermanshah Earthquake

Regarding the importance of the quick and vital responsiveness of the health system, especially the human force and facilities in connection with health, this study was done and aimed at investigating the strengths, weaknesses, and health-related needs in the first ten days after the large earthquake in the west of Iran. During the earthquake in Kermanshah, public hospitals faced a variety of challenges, and it made some difficulties to have an appropriate health service for injured people. Thus some of the challenges and strengths of public hospitals are reviewed and named in the following:

5.2.1.1 Field hospital

Various medical specialities were accessible in the mobile hospital. Some field hospitals were located on the city's outskirts, and the considerable point was the shallow distance of the three field hospitals from each other. Frankly, assessing the location of the field hospitals was incomplete (Khankeh et al., 2018). There were issues such as imperfect setup of Incident Command System (ICS), absence of some of the environmental health personnel for spraying the hospital, shortage of drugs, surgical instruments, and operating room, shortage of the emergency box and surgical sets, shortage of a helicopter near the hospital to dispatch sick patients, lack of specialities of orthopaedics, internal medicine, emergency medicine, paediatricians, general practitioners and nurses (predominantly female nurses), lack of radiological devices, and few numbers of security forces in the field hospitals (Khankeh et al., 2018).

5.2.1.2 Drug Strengths

Most of the drugs were given to those who demanded them. The drugs were distributed in special centres such as health centres, rural health centres, and mobile hospitals(Safarpour, 2018). There was a severe lack of these drugs; anti-cough and allergy syrups of Diphenhydramine, Dextromethorphan, and Ketotifen; antibiotics of Amoxicillin, Cefixime, and Azithromycin; the ophthalmic drugs of Sulfacetamide and Chloramphenicol; gastrointestinal pills and painkillers such as gelofen, acetaminophen and Codeine-acetaminophen; Piroxicam gel; and medications for reducing blood pressure (Captopril) and diabetes (Metformin and Glibenclamide); there was a severe shortage of these drugs. Due to high-stress levels among the earthquake survivors, many were affected by Herpes simplex; hence, Aciclovir ointment was consumed largely (Safarpour, 2018).

There was an alcohol pad, sieve, Betadine, the drugs such as gelofen, Chloramphenicol, Betamethasone, Piroxicam gel and A+D, eye drops, and painkillers (Bavafa et al., 2019). The drugs were distributed based on the patients' words, and there was no examination regarding the necessity of the drug by a pharmacist or pharmacist technician; in fact, there was no monitoring. One of the experts said: “Health care staff distributed widely and widely drugs among people, which could create long-term problems for the future. There is no supervision on the distribution of drugs at all”(Feizolahzadeh et al., 2019).

5.2.1.3 Nutrition Strengths

In the first week, the following works were done: quick assessment of the children below five years old using mid-upper arm circumference, evaluation of the malnutrition status of the children below five years old, screening the nutritional status of the infants and nursing mothers, providing proper nutrition to the patients with diabetes and those with high blood pressure, investigating the diet portion of the families, A+D supplements and calcium for the children below two years old, iron pill, and multivitamins (PEYRAVI et al., 2019). Lack of nutrition specialists was seriously felt in the first ten days after the earthquake. In the first week after the earthquake, hot food was distributed among the earthquake survivors; there were some problems regarding the food's health status and maintenance. The distribution of expired tuna and canned beans exacerbated the nutritional condition of the people. Lack of coordination between the Ministry of Health and Medical Education and the Red Crescent Society was also seriously felt regarding the food supply and distribution (Pasdar et al., 2019).

5.2.1.4 The employees of the contagious diseases established contagious diseases: The syndromic care system

No case of infectious diseases was discovered in the first ten days. Pediatric vaccination was carried out based on the immunization program; however, diphtheria and tetanus vaccines were injected in some cases (Kazemi et al., 2018). Fortunately, no case of Cholera, Measles, and Meningitis was observed in the affected region. The specialists diagnosed some cases of Pediculosis and Scabies. Due to the cold weather (HabibiSaravi et al., 2018). There were many cases of acute bloody diarrhoea, especially in children. Since the affected region is an endemic region of Cutaneous leishmaniosis, there should be an appropriate control over the reduction of the Phlebotomus.

5.2.1.5 Mothers', infants', and children's health

some necessary measures were taken for the affected society including visiting and examining the pregnant women and the children below one year old, examining the nutritional status of the infants with breastmilk and needs assessment of the nutrition of children and pregnant women, conducting delivery, visiting the girls and women in reproductive age, providing services for seniors and the children below one year old, helping vulnerable groups, distributing baby formulas, diapers, sanitary pads, baby bottles, distributing the facilities for birth control among people, vaginal examination (if needed), and checking the vital signs and fetal heartbeat, but lack of contraceptives, especially condoms, lack of fetal electrocardiography, lack of multivitamins and, in some cases, excessive intake of vitamins, lack of midwifery Sonic aids and Pinard, thermometer, otoscope, ophthalmoscopy, flashlight, tongue depressor, gloves and mask, blood pressure measurement device, baby scale, suture thread, and dressing set were seriously felt. Moreover, there were very few drugs such as methyldopa pill, magnesium sulfate and hydralazine ampoule for the pregnant women affected by high blood pressure (MirMohamadaliIe et al., 2019).

5.2.1.6 Mental health

In the affected region, the psychologists screened all people and referred the individuals with the acute disorder to the psychiatrist. The actions taken by the mental health team included establishing effective communication with families, sympathy and expression of feelings to gain confidence, and identifying primary psychological reactions and signs and symptoms of anxiety (Ghanjal, Bahadori, & Ravangard, 2019).

5.2.1.7 Environmental health

Very appropriate measures had been adopted regarding the control and inspection of the drinking water resources, providing healthy water by adding Chlorine, turbidity test, monitoring the mobile water tanks and Chlorine residual testing, visiting the temporary housing camps, monitoring the kitchens, visiting food preparation and distribution centres, and disinfection of the mobile toilets and baths by Chlorine (Kazemi et al., 2018).

In the first eight days after the earthquake, the Chlorine residual in the water was 0 ppm, and the turbidity of the urban water was over 5 NTU; however, the Chlorine residual level gradually rose to around 1.5 ppm, and turbidity of the water fell to lower than 5 NTU (Karami et al., 2018). Various problems were observed such as lack of human force and the necessary equipment for the environmental health teams, lack of trash bags in the tents of the earthquake survivors, the inappropriate burial of garbage, the release of leachate in the environment because of raining, inconvenient transportation and distribution of the hot food, distribution of mouldy bread and rancid dates among the affected people, disposal of animal manure in rural environments, presence of the corpses of the cattle and livestock in the city, lack of a few numbers of healthy water tanks and restrooms in the town and villages, and the presence of louse and scabies (Ahmadzadeh, Mohammadi, & Babaei, 2019).

Lack of toilets and weak disposal of wastes and wastewater are two serious dangers that increase the incidence probability of contagious diseases among earthquake survivors. The following table demonstrates the different challenges and strengths of the Kermanshah earthquake.

Table 5. 1 Challenges and Strength of Hospitals in Kermanshah Earthquake

Category	*Sub-Category*	*Sub-Sub-Category*
Environment Health	Challenges	lack of trash bags
		Inappropriate burial of garbage
		Inappropriate transportation and distribution of the hot food
		Disposal of animal manure in rural environments
		The presence of louse and scabies
	Strengths	Visiting the temporary housing camps
		Visiting food preparation and distribution centers
		Disinfection
		Control the rodents
		Wastewater management
Mental Health	Challenges	Overexcitement
		Sleep disorder
		Insomnia
		Suicidal tendency
		Lack of psychologists
	Strengths	The psychologists screened all of the people
		Primary training
Mothers', infants', and children's health	Challenges	Lack of contraceptives
		Lack of fetal electrocardiography
		Lack of multivitamins
		Lack of midwifery instrument
		Non-sterilization of the tools
		Lack of midwives and gynecologists
	Strengths	Visiting and examining the pregnant women and the children
		Examining the nutritional status of the infants
		Conducting delivery
		Visiting the girls and women in reproductive age
		Distributing baby formulas
		Checking the vital signs
Field hospital	Challenges	Lack of drugs
		Lack of surgical instruments
		Lack of staff and specialist
		Few number of security forces
	Strengths	Various medical specialties
Nutrition	Challenges	Lack of nutrition specialists
		The distribution of the expired foods
		Lack of coordination between the organization
	Strengths	Quick assessment of the children
		Screening the nutritional status
		Training proper nutrition to the patients
		Distributing baby formulas and supplements
Contagious diseases	Challenges	Outbreak of infectious diseases
		The syndromic care system was established
	Strengths	Pediatric vaccination was carried out
Drug	Challenges	Shortage of the general drugs
		Lack of control over the distribution of drugs
	Strengths	The drugs were distributed in especial center
		There were vital medicines available

Over the past decade, natural disasters have killed more than five hundred thousand people, and over two million people were injured and affected more than two billion people worldwide (Bartlett, 2004). An earthquake is one of the most natural catastrophic disasters that may cause many issues (Li et al., 2012). Considering an earthquake-prone country in the Middle East, such as Iran is ranked as one of the world's most dangerous countries and has likely high potential.

23 earthquakes with an intensity of more than five magnitudes have been recorded in Iran since 2000 (Saberian et al., 2019). In the past, Iran has experienced several earthquakes in different areas, causing severe economic damage and heavy casualties, and the record number of people killed in the earthquakes in the last century has been over 73,000, which the actual number is likely to be more than that (Guha-Sapir & Ph, 2015). After an earthquake, various health systems and treatment centres are encountered with many patients (Li et al., 2012). Emergency medical service (EMS) is a crucial component of the health care system in this situation (A. Djalali et al., 2011b). The main goal of EMS in responding to a crisis is coordination and management of the health system services, as well as the continuation of medical services through triage, life-saving activities on the scene, rapid diagnosis and treatment, or the transfer of the injured to emergency departments (McKay, 2008). It has been proven that timely emergency services will improve patients' outcome, especially the time-sensitive ones (MacKenzie et al., 2006). Although there is a structured approach to the EMS system's response to crises, recent studies indicate that more activities are still needed to improve (Hardy et al., 2018). One of the last earthquakes recorded in Iran occurred on November 12, 2017, near Sarpol-e-Zahab, Kermanshah province. Iranian Seismological Center reported this earthquake at 7.3 magnitudes and a depth of 18.1 kilometres. The earthquake had three foreshocks: 1.9, 2.3, and 4.4 volumes one hour before the main earthquake and hundreds of aftershocks. This significant event was felt across a large area in all directions with maximum intensity in the earthquake's eight focal areas. According to the statistics, 620 people lost their lives, and thousands of structures suffered serious damage. The two major cities of Ezgeleh (10 km north of the earthquake centre) and Sarpol-eZahab (36 km south-east of the earthquake centre) collapsed completely. Despite the significant challenges in responding to this major crisis, local and national organizations' responses to this crisis were substantial. As the first responder in the health system, the EMS was responsible for coordinating and managing health services in this incident. Earlier, other earthquakes like the one that occurred in Bam of magnitude 6.6 in 2003 and Varzaghan of magnitude 3.6 in 2012 resulted in significant casualties.

The experience of significant events can positively impact organisations' awareness and direct their policies to the conduct of incident management activities (Seyedin, 2008). In the following, the researcher describes the actions taken by the Emergency Management System (EMS) after the earthquake in Kermanshah, some strengths and weaknesses of the emergency response program, and the challenges of this system in dealing with these significant crises.

5.2.1.8 Local and national response capacity

The national government, army and The Iranian Red Crescent (IRC) responded to the earthquake across the affected province; however, search and rescue efforts have been called off. IRC and the Government have sent assessment teams to the impacted areas. IRC has sent 300 search and rescue teams to 15 provinces to provide medical care, construct emergency shelters, distribute over 100,000 food kits and offer other services. In addition to this, the IRC has deployed 40 ambulances, 55 4WD vehicles, nine rescue vehicles, and five helicopters have been dispatched. The government is also tankering water to Sarpol-e Zahab city and establishing field hospitals (Janati et al., 2018).

5.2.1.9 International response capacity

There has been no request for international assistance at this time. However, 20 international teams monitor the situation; the UNDAC mechanism has been activated for immediate deployment upon request. The WHO global EMTs network is alerted and also monitoring the status. UNOSAT has activated the space charter for mapping support (Sorani et al., 2018)

5.2.1.10 Post-earthquake response activities

Response activities after the earthquake focused on the priorities of the response were immediately performed. Government officials and international communities made a joint effort in the first week after the tragedy (Shah et al., 2019). The following table demonstrated detailed post-earthquake response activities compared earthquakes between Bam, East Azarbaijan, and Kermanshah.

5.2.1.11 Rapid warning and response

Due to the severity of the earthquake, which was felt by most of the officials in Kermanshah, relative preparation was made at local authorities from the first minutes. Immediately after the earthquake, the LEOC was activated. Since there was no damage to the region's ambulances, EMS forces of the area immediately began to provide services to the injured. Notification to the NEOC was performed according to preplanned protocols for warning levels and activation levels. The emergency committee's first meeting was held at the NEOC site (Mortazavi et al., 2019). Local and central hospitals rapid response teams at local, regional and national levels were called.

The disconnection of communication and telecommunication networks in the affected areas has caused difficulties in calling, estimating damages, correct locating and evaluating the required resources. The affected areas' reports were collected from the Health Information Management Unit, developed at NEOC (Yousefi et al., 2018). All local, regional and capital hospitals were on standby. One of the significant strengths of the incident was its concurrence with the Arbaeen ceremony.

Fortunately, these forces had been stationed on the country's western border to manage mass gatherings from months ago, resulting in a more comprehensive, efficient and faster response. In total, 90 ambulances, 19 ambulance buses, two mobile communication vehicles were sent from the Mehran border to the earthquake zone, which began serving the wounded from the beginning hours. In the Varzaghan earthquake, the LEOC was immediately activated, and the call for forces was made 5 minutes after the earthquake. Coordination was conducted to deploy forces from the province, road stations and neighbouring provinces, and backup EMS teams were sent from the road stations, city and the province, and adjacent provinces of West Azerbaijan, Ardebil Zanjan. The provincial teams were presented at the damaged site at 19:00 (Yousefi et al., 2018). Unfortunately, in the Bam earthquake, the EOC structure was not established at the local and national levels. Due to the severity of the area's destruction, the first relief teams in the affected region were announced at 8:40 (3:14 after the earthquake). There was no comprehensive warning and response system, which was one reason for the lack of coordination in response plans.

5.2.1.12 Surge capacity

Due to the extent of the Kermanshah earthquake, the care needs of patients and injured were more than available resources; therefore, the medical emergency system's main focus was on increasing care capacity. Starting from the very early hours after the incident, the surge capacity in three axes of man resources, equipment and structure was started. Based on reports and evidence available, hours after receiving earthquake news, medical teams were called from most of the province's hospitals. But the damage to some health centres poses serious challenges to treatment operations (Feizolahzadeh et al., 2019). According to the EMS Capacity Assessment system and reports on the extent of damage, the amount of need for force, equipment, and an ambulance was estimated by the Committee of the Emergency of health system crisis. The resources were immediately called and deployed to the region. All units located on the western border for the Arbaeen ceremony were settled immediately after the incident's early hours (Omidi, Omidi, & Asgari, 2019).

5.2.1.13 Rapid Response Team

Following the earthquake in Kermanshah, 100 rapid response teams (RRTs) of the EMS system were sent to the site to assess and respond to the injured's medical needs (Sahebi, Ghomian, & Sarvar, 2019). After the earthquake, 50 Disaster Medical Assistance Teams (DMATs) were immediately recalled by the NEOC and served the injured (Sahebi et al., 2019).

5.2.1.14 Increasing the capacity of health facilities

Considering the damage to the health centres, there was no possibility to provide quick services to the injured in these centres, and the transfer of these injured to hospitals in Kermanshah province or neighbouring provinces could create serious challenges for these injured; the rapid launching of field hospitals led to the transfer of the injured with critical priority to these centres and provided essential treatment and medical services to these patients and injured near the incident site before they were transferred to a permanent hospital. Performing various surgeries such as hand transplantation is one of the crucial functions of these hospitals. In this incident, considering the severity of the incident in the Sarpol-e-Zahab area and the destruction of the only regional hospital, the first 30-bed field hospital was set up in less than 6 hours of the incident in the area, followed by field hospitals in West Islamabad and Salas Babajani also launched (Feizolahzadeh et al., 2019).

Interagency coordination and management carried out by the NEOC was another strength of the incident; as early as the incident's aftermath, the Islamic Revolutionary Guard Corps (IRGC) and the Army arrived at the scene (Feizolahzadeh et al., 2019). The establishment of three field hospitals by the military forces in the region provided a great deal of assistance in managing injured and casualties. Another effective action to increase health facilities' capacity was to discharge non-emergency patients, which was done by alerting all medical centres in Kermanshah and neighbouring provinces. There are no accurate statistics on the extent of the medical centres (Yousefi et al., 2018).

The next effective action was converting the nonmedical centres into temporary medical centres and converting single speciality hospitals to multi-speciality hospitals; in Varzaghan, the Martyr Madani and Taleghani single speciality hospitals were transformed into general hospitals through the establishment of specialist expeditions from neighbouring provinces.

Upon completing the debris removal and the prediction of the second wave of injured, gyms No. 1 and 2 of the medical university were equipped with emergency facilities and turned to the health centres to be used to encounter a large number of patients. Also, by equipping all the capacities available in Imam Reza, Shohada, Sina and Razi hospitals, these hospitals' capacity increased by 200 beds (Ghanjal et al., 2019).

5.2.1.15 Increasing transfer capacity

Immediately after assessing the situation, 30 ambulances from Kermanshah province and 90 ambulances settled on the country's western border for Arbayeen; 3 helicopters and 12 ambulance buses were deployed to the site. In some of the affected centres where treatment facilities were severely damaged, the EMS bus ambulances were utilized as the outpatient and temporary treatment sites. According to coordination by the NEOC, with the commander of the army and the commander of IRGC, four aircraft and 20 helicopters were provided to EMS to transfer the injured. A total of 206 flight missions resulted in the transfer of 2165 injured (Sahebi et al., 2019).

5.2.1.16 Handling, transportation and distribution of injuries

After the occurrence of the earthquake and the presence of EMS forces, the triage of the injured and basic and advanced life support was carried out by EMS forces according to the predefined protocols and the transfer and distribution of the injured to the health centres was begun (Sahebi et al., 2019). Calls from the scene to the referral hospitals were often difficult due to communication problems, as well as lack of awareness of the capacity of the hospitals, which requires direct and specific contact, so the capacity of the local, regional and Tehran hospitals using the Medical Care Monitoring Center (MCMC) was determined and the patients were distributed by the coordination of MCMC with referral hospitals. Of the 7350 Kermanshah earthquake missions, 93.9% (6906) were transferred to provincial hospitals and 1.8% (134 persons) to Hamedan province and 4.2% (310 people) to Tehran and Alborz in 20 hours. 29.4% (2165 people) were transferred via air medical service, and 70.5% (5185 people) via land medical service. The EMS of the country created a triage point with medical teams at the airport. Patients with the higher priority of treatment were immediately triaged at the airport's delivery point and soon after referred to referral hospitals in accordance with defined protocols and prior notification (Ghomian & Sarvar, 2018).

5.4 Central Flood in 2019

Global climate change leads to increasing the number and severity of weather events such as floods. Floods have been reported as one-half of all weather-associated disasters with high impacts on countries. Global warming causes a different rainfall pattern in Iran, causing long-term drought since 30 years ago and recent heavy rain, which led to a massive flood in this country. It is predicted that the health subsequences of the Iran 2019 flood, such as communicable diseases, vary due to the geographical extent and climates of flooded areas. However, observing long term and short term preventive measures can effectively reduce the high impact of floods in Iran (Sharifi & Bokaie, 2019). Global climate change, deforestation, rising sea levels, and population growth increase the number and severity of weather events such as floods. Floods have been reported one-half of all weather-associated disasters, have affected 2.3 billion people and are responsible for 157,000 deaths during 1995–2015 worldwide (Wahlstrom & Guha-Sapir, 2015). It has been predicted that the number of threatened people may reach 2 billion in 2050 ("Science Daily," 2004). Floods impose a high economic burden, near 60 billion USD annually, mostly in developing countries ("Climate Central," 2013). Asia is at more risk of flood compared to other parts of the world.

Annually about 400 million people are at direct exposure to floods in Asia. The number of flood-related lives lost in this area is near to 93% of all flood-related deaths worldwide (Bich et al., 2011). The risk class of Iran for natural events is 8 out of 10. In the previous four decades in Iran, natural disasters have caused more than 109,000 deaths and 150,000 injuries (Ardalan et al., 2014). Global warming causes a different rainfall pattern in Iran than in other parts of the world. Due to the climatic changes, Iran experienced a long-term drought nearly 30 years ago. Many ecosystems have changed, many parts of forests have disappeared, and lands diminished, rivers and lakes dried up during this period. People have moved and settled in areas where used to be river banks and beds before the drought. These alterations lead to a catastrophic flood in Iran. Almost all 31 provinces of Iran had heavy rains lacking trees and bushes and washed away the unprotected ground (Yadollahie, 2019).

Based on the Iranian Red Crescent report, more than 2000 cities were affected by flash floods. The overwhelming flood-impacted 10 million Iranian people in some ways. At least 78 deaths have been reported, and the number of injuries reached 1136 cases, and 500,000 people had to displace their houses permanently or temporarily ("IFRC," 2019). Iran's flood has been accompanied by snake attacks in the country's north and locusts attacking the south. Financial losses have been calculated at around 8 billion USD because of the enormous destruction of roads, houses, infrastructures, agricultural lands, and animal farms (Yadollahie, 2019). The Golestan floods, caused by heavy rains starting on 19 March, have affected ten cities in northeast Iran (Gorgan, Bandar Turkman, Azad Shahr, Aq Ghala, Gonbad-e Kavus, Bandar-e Gaz, Ali Abad, Kalleh, Kordkuy, and Minodaasht). The government is investigating local reports on the Water Authorities' lack of mitigation measures (Nasirzadehdizaji, Akyuz, & Cakir, 2019). The worst affected areas are in the cities of Aq Qala and Gonbad Kavous and their surrounding villages, where large parts are submerged. As a safety measure power supply was cut off in several areas. Of the estimated 60,000 displaced, most stay with relatives in nearby villages. At least 10,000 people are provided emergency shelter assistance in stadiums, exhibition areas, schools and other large public facilities provided by IRCS...Other areas in the west and south-west of Iran have been affected by heavy rains. Namely, the Provinces of Lorestan, Kurdistan, Kermanshah, Khuzestan, Fars and Kohkilouyeh. As of 25 March, floods in Shiraz, Poldokhtar, Khoramabad, Doreh, Khoramshahr, Abadan, Aligoudarz and Saghez were also reported. In Shiraz flash, floods killed at least 20, injured 94, and an unverified number of people are still missing. In the city of Dezful in Khuzestan, southwest of Iran, an emergency is declared (Fazel & Mahdian, 2019).

Continued rainfall has caused floods in 586 cities and villages across Iran. Flood water has destroyed infrastructure, livestock, agriculture and livelihoods, with estimated damage of USD 150,000 million, in Golestan and Mazandaran provinces alone. The disaster struck in the middle of Nowruz, the Iranian New Year holidays. National Metrological service predicts more rainfall for the coming week. IRCS has reported 45 persons dead and at least 434 persons injured. The most affected areas are Golestan, Mazandaran, North Khorasan, Kohgiluyeh and Boyer-Ahmad, Fars, Kermanshah, Khuzestan, Semnan, Ilam and Hamedan. IRCS has assisted 156,531 flood-affected persons and is provided temporary shelter for 50,732 people (Babaie et al., 2019). The death toll after heavy rains, floods, and landslides affecting northern, western and south-western parts of Iran continues to increase. As of 4 April at 8.00 UTC, 62 people are reported to have died and hundreds injured. Tens of thousands of displaced people shelter in the open, and food and non-food items are urgently needed. UNICEF IRAN has provided immediate assistance to the affected provinces, Fars, Lorestan and Golestan. Sixty villages in Lorestan are under floodwater, 78 intercity roads have been blocked, 2 199 rural roads and 84 bridges have been damaged (Peyravi & Marzaleh, 2019).

Iranian authorities have reported 70 deaths as of Sunday resulting from flooding affecting several parts of the country. Mass evacuations have been ordered in the south-western province of Khuzestan, affecting approximately 400 000 people. The Karkheh Dam, which is at near capacity, was opened to discharge excessive water build-up to prevent catastrophic failure. Local media reports that more than 12 000km of roads representing a third of the country's network have been damaged (Nazari, Taleshi, & Mirzaali, 2019).

As of 9 April at 8.00 UTC, 1 900 cities have been affected, with Lorestan, Khuzestan and Golestan the worst impacted provinces. Seventy-seven schools have been destroyed (55 in Lorestan and 22 in Golestan). There is a significant risk of additional flooding from the Karkheh dam (Khuzestan Province). Six cities and 210 villages have been evacuated, 61 of which have been flooded. Heavy rain and thunderstorms are forecast in southern provinces, with moderate rainfall in north-western provinces. As of 6 September, the floods affected 10 million people leaving two million persons in need of humanitarian assistance. Seventy-eight persons lost their lives, while 2,408 people were reported injured.

The floods have hit more than 4,893 cities and villages; 179,000 houses were destroyed/damaged. Over 1,200 schools and 70 hospitals/health centres were damaged/destroyed. About 365,000 people were temporarily displaced, staying in emergency / temporary shelters, with relatives or host families. Agricultural areas were heavily hit, nearly one million hectares of farmland flooded (Abdi & Lohrasbi, 2019). Abdi and Lohrasbi (2019) State that heavy rain affected the provinces of Sistan and Baluchestan, South Khorasan Fars and Hormozgan from 1-4 October, causing flash floods casualties. According to the Iranian Red Crescent, as of 7 October, five people died in two separate flooding incidents in Hormozgan province. One hundred thirty-seven have been displaced and 300 affected. At least 22 cities and villages have been flooded, mainly in Sistan and Baluchestan. The actions taken for management for reducing the impact of the flood included performing initial evaluations by the Red Crescent; monitoring the forecasting reports of the Aerology Organization and Khuzestan water and power authority, alerting the readiness Crisis Management Committee of Khuzestan province, reducing the amount of water behind Dez and Karkheh dams; reconstructing flood protectors by people and; organizations in charge; professionally preventing the leakage of flood protectors by water and power authorities; providing emergency relief by Red Crescent to 3455 families; establishing several emergency camps in Khuzestan province by Red Crescent; and establishing a field hospital and sending relief helicopters to the flooded regions; distributing items like assistance tents, blankets, carpets and covering nylons; distributing monthly food packages among people; and transforming vulnerable individuals and appropriate cooperation with people.

5.4.1 Challenges and Strength of Hospitals in Central Flood

Regarding the importance of the quick and vital responsiveness of the health system, especially the human force and facilities in connection with health, this study was done and aimed at investigating the strengths, weaknesses, and health-related needs in the first ten days after the significant flood in the centre of Iran, some of challenges and strengths of hospitals reviewed and named in following:

5.4.1.1 Lack of an up-to-date data bank for professional volunteers

Due to the extent of the Central Flood, the care needs of patients and injured were more than available resources; therefore, the medical emergency system's main focus was on increasing care capacity. In 2019 Flood public hospitals suffered from a lack of appropriate management of volunteers, which requires the use of the intellectual power of all organizations such as the Parliament, Guardian Council, Red Crescent Society, and researchers. There is no up-to-date data bank in this regard, and professional volunteers cannot be dispatched quickly when a disaster occurs unless coercive and hierarchical policies are reinforced. “System of registration should be designed to require professional volunteers to comply by their commitment in terms of disasters. This should be done because many professional volunteers back out when their support is needed at times of disasters, and it was a severe challenge in Central Flood 2019.

5.4.1.2 Surge capability

Inappropriate management of resources was another challenge for public hospitals in central flood 2019. Some public hospitals had a few problems in terms of equipment. The shortcomings are related to organization, coordination, and education. For instance, the Golestan Hospital could not be operational for different reasons like lack of information about what resources were needed in the first hour, when and by whom the resources should be deployed, and above all, the security of the resources.

5.4.1.3 Unclear mechanism of workforce deployment

The recruitment and deployment of the workforce were more systematic than ever before. It was possible to recruit forces from universities located outside the capital. However, there was no appropriate transportation mechanism in this regard. The constant use of human resources on a single shift can cause exhaustion and medical errors. There was no incentive for deploying a specialized workforce such as orthopaedic surgeons. In addition, it was impossible to seek help from other organizations due to the complex nature of the medical profession.

5.4.1.4 Lack of coordination among organizations involved in the crisis

Coordination is not considered as interference in the affairs related to other organizations but is the mutual use of the equipment and facilities as synergy. Poor crisis management in the aftermath of the central floods in Iran has highlighted the weaknesses of management in the country. Deficiencies have become apparent on all levels, whether it is crisis prevention and management or lack of coordination and clarity of responsibilities among various state organs. Before the flooding, commentators argued that Iran had developed a strong sense of crisis management as a country that had faced numerous and regular natural disasters. Nonetheless, the recent failures have pointed to important deficiencies that need to be addressed. A 2014 report from the Iranian National Disaster Management Organization found that "Iran has developed an effective and internationally recognized disaster preparedness and response capacity at the national and local levels, but disaster prevention and risk reduction are areas that will require extensive longer-term efforts as well as multi-sectoral and multi-stakeholder planning in development sectors such as health, education and urban planning." It added, "At the same time, comprehensive concepts and standards of risk reduction, including social dimensions and physical aspects of disaster prevention, can be further improved." The above statement captures the critical problems in crisis management that also connect directly to some of the governance issues in Iran. The most alarming realization in assessing the performance of Iranian authorities in managing disasters is the complete lack of coordination between various institutions. This lack of coordination and the continuous sense of competition between state institutions and individuals also contributed to this 2019 flood on a different level in public hospitals.

5.2 Interview Findings

In this section, the researcher presents a discussion of the extracted findings from the analysis of semi-structured interviews. By doing these interviews, researchers aimed to achieve the 3rd and 4th objectives of this research study. The main themes and question areas extracted from 8 in-depth semi-structured interviews are presented. The data were analysed using a thematic analyses approach. The researcher was able to have eight interviews when the saturation point was achieved. After completing the data collection stage, the data analysis process began. The researcher achieved an adequate size when reached the saturation point in data collection. This point is achieved when no new themes are discovered or new information is received (Kumar, 2011; Saunders et al., 2016). Saunders et al.

In the following table, two main themes and question areas are demonstrated.

Table 5. 2 Themes and sub-themes extracted from the interviews

Main Themes	Question Areas
Strategies	Understanding disaster management in hospitals
	Strength and weaknesses of strategies
	Improvement after implementation
	Rehearsal strategies
Challenges	Disaster Management roles
	Barriers against disaster management teams
	Impact on hospitals and health services
	Organisations and person obligations

Two main Themes are extracted into four sub-themes, which contributes the researcher to have a better understanding of those main themes and address the 3rd and 4th objectives of this research. The different themes were extracted from data collected from in-depth semi-structured interviews. Each theme was developed with varying sets of subthemes. In the following section, the themes subthemes are presented alongside interview quotations reviewed in connection with two case studies. Each interview was coded as A-H. For instance, if a quotation was extracted from interview one, then the presentation in the text will be such as “the quotation” (IN-A), and interview 2 “the quotation” (IN-B). In the following table, eight interviewees participated in this research illustrated with some background.

Table 5. 3 Interviewees codes and their involvments in case studies

Interviewees	Codes	Case studies involvment
1st Interviewee	IN-A	Case 1, and 2
2nd Interviewee	IN-B	Case 1
3rd Interviewee	IN-C	Case 2
4th Interviewee	IN-D	Case 1, and 2
5th Interviewee	IN-E	Case 1, and 2
6th Interviewee	IN-F	Case 2
7th Interviewee	IN-G	Case 1, and 2
8th Interviewee	IN-H	Case 1, and 2

5.3 Strategies

The first central main theme of the interview is strategies. In this theme, four-question areas were released, which explains in the following.

5.3.1 Understanding disaster management in hospitals

This question aims to explore Intra-organizational disaster managers of disaster management in the context of hospitals. Disaster managers must understand what disaster management means to them and their perspective to keep hospitals safe and secure during disaster events. Most disaster managers understand the lack of adequate disaster management in hospitals to endangering controlling affected regions and provide appropriate health service to the injured people. The understanding of disaster management in the concept of hospitals by interviewee IN-H as:

"Disaster management means controlling the more negative impact of disasters on injured people, and keeping hospitals safe and secure to have appropriate health service during rush hours of disaster events."

However, interview IN-G agrees and adds: *"If hospitals collapse or do not give appropriate health service in the disaster events, there can be other disaster events in the centre of the disaster."*

The following IN-E describes the critical role of hospitals during disaster events as the heart of town:

"*The critical role of hospitals regarding past disaster events in Iran and some local hospitals' failures has been increased. Hospitals are like the heart of town in disaster events, which can significantly mitigate the risk of disaster events."*

Interview IN-A added to the above discussion by saying that:

"Generally, disaster management in the hospital should be considered in all four stages of the disaster management cycle. The importance of hospitals and health facilities can be identified regarding the location and vulnerability in case of disaster events."

In terms of that, all hospitals and health facilities should be prepared to manage and control hospitals during and after disaster events. Hospitals should also update their strategic plans and personnel to mitigate the risk of disasters and give better health services to demand during and after.

Interview interviews had different opinions to implement the appropriate strategy to mitigate disaster risk on hospitals' health services. Still, all had a mutual statement that each hospital has a different strategy regarding the disasters' circumstances and conditions. For instance, IN-A stated that:

"In terms of strategy to mitigate the risk of disaster events and give better health services to demanded people, each hospital has a different strategy. In terms of the type of disasters and threats in hospitals' face, mitigation strategies will be planned."

Moreover, interviewee IN-H noted that the disaster management strategy for managing hospitals during and after disaster events is based upon each hospital's type and condition.

"... strategy of the hospital is designed based upon the type of disaster, the intensity of that and how the hospital and health centre is facilitated and ready to manage it."

Understanding disaster management and implementing appropriate hospitals to mitigate the risk of disaster events in hospitals has been a challenging topic as it means different things to different scholars. There have been many seminal and effective works on managing hospitals during disasters and, after the previous periods, increased understanding among many practitioners in the disaster management department.

However, IN-H argues that *"…the concept of disaster management in the concept of hospitals is sometimes confused with other terms such as environment, condition of hospitals, and type of disasters." But the IN-B stated: "Most hospitals structures and buildings are the same in the cross of country and are not designed with different locations. Thus, based upon the*

This clarity regarding the appropriate implementing strategy to mitigate the risk of disaster events on providing accurate health service for injured people in hospitals during disaster events needs to be considered precisely based upon the nature of the disaster and hospitals' condition. According to IN-A, *"…To implement the best strategy in the mitigation stage, different methods have been defined in two specific areas: a structural and non-structural part. In the structural part, some strategies such as Building codes, relocating the building to a higher level and improving access to the building. In terms of non-structural strategies can be named disaster management culture improvement, improvement management, and planning."*

Moreover, Interviewee *IN-D noted that "In terms of the type of disasters, should be reviewed that which strategy is the most suitable strategy to mitigate the risk of disaster to have a secure place to provide better health service to injured people."*

Finally, interviewee IN-F stated, "*In recent research regarding damages affected to hospitals in Kermanshah and recent flooding understood that about 40% was for non-structural elements, almost 38% was for functional elements of health centres, and just 20% was related structural elements of hospitals."*

The above discussion illustrates intra-organisational disaster management and understanding disaster management in hospitals in Iran. Even though there are variations in disaster managers understanding of disaster management in the idea of hospitals. The importance of disaster management was raised by interviewees and mostly declared that disaster management strategy should be implemented by a type of disaster, condition of hospitals, and the region's environment.

IN-A, IN-B, IN-D, IN-E, and IN-H mostly agreed that there was good progress since the Bam earthquake in different disaster management areas in Iran. In particular, disaster management knowledge was raised, and the preparation of varying organisations has been developed much more organised.

5.3.2 Strength and weaknesses of strategies

The adoption of any disaster management strategy has got some pros and cons. It was essential to understand better the strengths and weaknesses of strategies implemented in disaster events at hospitals to mitigate disasters' risk of providing health service. Thus in the following, both sides of strategies are discovered.

5.3.2.1 weakness

There has been some improvement since the Bam earthquake, and different disaster management strategies have been implemented and tested. Still, there have been some failures and weaknesses to mitigate disasters after implementing those strategies. Regarding the interviewees, some shortcomings in current disaster management strategies are mentioned. For instance, according to IN-A, the most weaknesses since the Bam earthquake can be lack of trained human resources, lack of coordination, failure to distribute volunteers and donated stuff, and lack of resources. In the following, these weaknesses will be explored:

Lack of training and knowledge

Training and improving knowledge of ordinary people as long as hospitals' personnel can be critical. A lack of adequate understanding about activities might impact different people and other activities once the disaster occurs. Regarding interviewees, disaster management knowledge has been improved since Bam and Rodbar earthquake. However, there is still some lack of good understanding and expertise to manage disaster events for different groups such as volunteers, hospital personnel, or ordinary people. For instance, IN-H stated: “There has been an averagely 20% improvement for hospitals regarding preparedness and managing hospitals during disaster events, which resulted from *improving disaster management knowledge of people and making systematic disaster management system in case of disaster events.”*

Moreover, the other interviewee agreed that there is a failure and less improvement in different elements, such as hospitals' structural elements. Still, there has been some excellent progress in increasing disaster management knowledge in Iran. Despite this improvement, the IN-B belives still are not sufficient and should develop disaster management knowledge more. In terms of that, IN-B noted that *"In terms of structural elements, Iranian hospitals have not been developed well. In late 2009, some disaster management programme was started at Iranian universities, and people's disaster management knowledge improved significantly. However, there is still a lack of knowledge regarding disaster management in some parts of the country."*

Another interviewee stated that this lack of disaster management knowledge could be seen in the disaster management department's sensitive position in Iran. IN-F added to the above discussion by saying that *"…With a lack of systematic and lack of proper management teams who do not have a good experience to manage disaster events with a good understanding of disaster management knowledge in high level is another weakness*."

Therefore it is frankly that lack of disaster management and having an excellent experience to mitigate the risk of disaster events in hospitals is crucial and should be considered more.

Structural of hospital

Several interviewees mentioned another weakness of the weaknesses to control of the structure of hospitals. Many interviewees pointed out that hospitals' structure building is not based on each region's condition, and generally, most hospitals have been built in the structure design or material. For instance, the hospital's structure is mostly the same in some locations where the feasibility of the flood is high, the places are totally dry, and the feasibility of the earthquake is high. For instance, the IN-G noted that *"Most hospitals' structures and buildings are the same in the cross of country and are not designed with different locations."* Besides the opinion of IN-B, the IN-H stated that *"The most weakness of our hospitals are related structural elements."* Furthermore, IN-E, IN-A, IN-H, IN-D, and IN-B noted that the hospitals collapsed during the earthquake of Sare pole Zahab, and the flood happened in Kermanshah. Those hospitals were built less than a few years and were new hospitals, but none were built based on the regional environmental conditions and were not sustained in the disaster events. For instance, IN-E added that: "…For example, in recent flooding in Golestan, the hospital was built in the last five years, but after the disaster, all hospital structures collapsed and were useless.

For another example, in recent flooding, nevertheless, the hospital of Mother and child in Shiraz was located about 10 miles far distance from flooding was useless because had not been done any good research to build a hospital with better access roads." Therefore, the recent disaster events' weakness was proper study and implementing good structure design for hospitals, particularly in different regional environmental conditions.

Failure distributing of injured people

During and after disaster events, managing injured people are significantly crucial. In terms of the size and type of disaster, the number of injured people can be different. Thus, having a good understanding of hospitals' capacity and distributing injured people to various hospitals should be done with good conditions and capabilities. Unsuitable distribution was mentioned by IN-F and was given an example of Kermanshah earthquake failures to have a proper distribution of injured people. IN-F noted that *"Another weakness of our disaster management strategy in case of hospitals can be mentioned as unsuitable distribution of injured people, and unsuitable distribution of hospitals. The distribution of injured people from collecting point should have equal distribution and delivering patients and injured people to facilitated health centres."*

Regarding the IN-E and IN-B interviewees, assembly points in the early hours of disaster events are very high. However, there has been good progress about that. Still, in the last few disaster events, the failure allocated location of assembly points made some difficulty provide a better situation for giving better service to injured people. IN-F noted that *"Regarding the non-suitable distribution of hospitals in a different location, we had significant problems. For instance, in the Kermanshah earthquake, after collapsing two hospitals in the town, another one was more than 20 miles distance that made the problem. Besides, there is a significant issue with our hospitals and buildings are not constructed well and in a good location with natural hazards."* The IN-E further stated that "In the centre of disasters or the radius of 10 miles to disaster events based on current disaster management protocol, there was no EMS(emergency service centre) or any hospital. For instance, in Islam Abad E Gharb, the hospital was collapsed totally."

This protocol was legislated in Iran, but still, it has not been implemented. IN-F mentioned previously that the hospitals' locations are not appropriately allocated, and assembly points are crucial. For instance, in Kermanshah, some hospitals collapsed totally and were not usable, but some were usable. Still, they needed some preparation time to manage those injured people in the early hours of the disaster. Thus, those assembly points better organised this and provided a few hours to pass the first shocking hours after a disaster.

Coordination and collaboration

Whilst disaster happens in the region, the confusion and chaos become the domain picture at the scene. To avoid this confusion or have a less devastating situation, the coordination and collaboration of different organisations are very important. However, there has been progressive cooperation and coordination after the Bam earthquake, but regarding some interviewees, there is still a lack of appropriate coordination and collaboration between different organisations and hospitals.

For instance,, IN-D explained that "In terms of coordination and collaboration in most disaster events, there had been a variety of non-skilled people who *made serious chaos. These people at different levels can make a problem. For instance, one of our challenging in the hospital of Kermanshah was managing volunteer people, donating medicine and, in some cases, lack of hospital's personnel. In some cases, due to shock of the disaster, some personal escaped their post to get their family."* Further, the IN-G interviewee noted that about the weaknesses of collaboration agreements between different organisations and hospitals, which are not fully implemented and not assessed by experts. IN-G interviewee added that *"The main issue for these agreements is about lack of understating about the capability of each organisation, hospitals, and NGO's."* Moreover, IN-H stated, "Based on previous experiences, these agreements are not productive *due to lack of understanding of capacity and capability of two parts of agreements."* Regarding collaboration, there have been some agreements between different organisations and hospitals and Emergency medical service teams. Still, these agreements were not tested and evaluated correctly and cannot be implemented in disaster events properly. For example, IN-F added *that "some agreements have been made between different hospitals with no equal capacity and capability in rush time."*

Thus, it is necessary to reconsider these agreements based on their ability to better manage disaster events. Regarding that, IN-A explained that with an example, *"if one hospital has a good equipment, thus with these factors should make an agreement, and if one hospital has a better capacity to allocate injured people, then this can be considered in the urgent moment to move injured people from overloaded hospitals to that hospital."*

Finally, IN-C stated *that "Generally, hospitals should make an agreement based upon their abilities and should be realistic instead of paperwork with less efficiency in disaster conditions."*

Lack of communication

Lack of communication was another weakness was mentioned by some of the interviewees. It is widely known that effective communication of organisations and hospitals is crucial in disaster events to mitigate stress and provide appropriate information. IN-F stated that "One *of the most important, and often overlooked, parts of any highly efficient disaster response is effective information exchange between information sources, emergency managers and those impacted by the disaster or emergency event."*

In the following interviewee, IN-H explored about lack of good communication between hospitals and different sources. *"Poor communication between nurses and other health care providers made a significant negative effect on patient safety, quality of care, patient outcomes, and patient and staff satisfaction in some cases in Kermanshah earthquake."*

Lack of appropriate just in time decisions

Within emergency disaster management, the people charged with making decisions have to take account of several factors. Despite this, it is crucial to make an accurate decision in disaster events. Still, some of just in time decisions made in the recent disaster events were inappropriate and made more challenges for hospitals. For instance, IN-H interviewee added that with lack of disaster management experience of those people in charge of disaster events, more challenges occurred during disaster events *"Another issue can be said disaster managers made just in time decision that was not successful in most cases because of lack of proper experience in disaster events and made several difficulties to have appropriate health service in some Kermanshah's hospitals."* The lack of union decision making in disaster events by those people are in charge was stated by IN-*B "In compare of different disaster events in Iran, for instance in the Bam earthquake, the structure of Bam's hospitals were not sustained, and it collapsed. The most weaknesses can mention the lack of proper management and union decision-maker."*

Besides, lack of enough experience for disaster managers to make an appropriate decision was added by IN-F *"Another issue was about those people were not expert and were not part of the disaster management team to make a decision."*

Lack of regular assessment and monitoring

Several interviewees mentioned another weakness: the lack of regular assessment and monitoring hospitals and health centres to respond more effectively to injured people. For instance, IN-E noted that *"One serious issue can be a lack of good monitoring and assessment for building hospitals."* For instance, IN-H stated that if the hospital in one of the hospitals in Kermanshah was assessed, the access to a building could be considered, it was not assessed. The hospital was blocked during disaster events. IN-F finally noted *that "Accessing to hospital in one of Kermanshah was not activated, and disrupting injured people to hospitals is not managed well, because of not good preparedness assessment."*

5.3.2.2 Strength

Interview responses revealed several strengths in Kermanshah and major flood disasters in the concept of hospitals. For instance, response time was improved from the previous disaster events due to disaster management knowledge. In terms of that, IN-B and IN-G stated quicker responses compared with earlier cases in the past. IN-B noted that *"EMI or Emergency Medical Team had incredibly emergency service to injured people in early hours in comparison with similar cases in the past."*

However, there were several weaknesses in managing disaster events in hospitals, but due to implementing some tools and technologies, personnel of hospitals, disaster management teams, and even some volunteers had a better understanding of the region and buildings. In terms of implementing tools and technologies, IN-D stated that *"Hospital simulation system which helped the disaster management team to have a better understanding about hospitals and vulnerability of them against disaster events. By doing this simulation system, different functions and factors of hospitals can be assessed than in the next step attitude of people and hospital personnel can be reviewed. As a result of all of this, we can control and monitor the process of hospitals' preparedness to mitigate the risk of disaster events."*

One of the most strength was stated by several interviewees is collecting points or assembly points IN-B endorsed the advantage and strength of collecting points by saying that *"collection point lessons was learned since Kermanshah earthquake was to allocate several collection points in the different area preferably far distance of central zone of disaster."* Also, IN-C expressed similar thoughts about the collecting points and stated that *"By doing these people and injured people can be distributed to safe locations and give much more time to pass shock moments after disaster events. Afterward,s advance medical hospitals can be organised and distribute injured people to hospitals, shelters, and advance medical hospital points."*

Moreover, IN-H added that *"In case of Kermanshah some hospitals were collapsed totally and were not usable, but some of them were usable, but they needed some preparation time to get ready to manage those injured people at the early hours of a disaster. Thus, those collection points better organised this and provided a few hours to pass the first shocking hours after a disaster."* In addition to the above *discussion,* IN-E stated that "In the first 24 hours, the most priority was to prepare a movement to a safe and secure location." Also, IN-H added that *"move ordinary people to collect points close to town. This helps rescue teams give a better service to injured people."*

5.3.3 Improvement after implementation

This question aims to explore the improvement that has been achieved after the implementation of new strategies. When the interviewees were asked about the progress of disaster management strategy in the concept of hospitals, the responses were varied but shared some expected improvement by implementing new strategies. Most of the interviewees pointed out that there has been a good improvement in mitigating the risk of hospital disaster events after implementing new systems. Some of those believed more efforts and activities should be made to have better results. To illustrate the above, the interviewee, IN-B, stated that about the structure and non-structure elements in hospitals by saying that: *"In terms of structural elements of Iranian hospitals due to majority hospitals were built more than 45 years cannot modify those too much, but in terms of non-structural elements good preparedness strategies were implemented to control and managing hospitals during and after disasters."* Interviewee IN-F also commented about the improvement in the entire country happened after Bam earthquake by saying that: *"There was good progress since Bam earthquake in different areas of disaster management in Iran. In particularly disaster management knowledge was raised, and preparation of different organisation has been developed much organised."*

Moreover, the interviewee IN-H noted that improvements have been achieved in terms of preparedness, mitigation, and disaster management knowledge by saying that: *"There has been averagely %20 improvements for hospitals regarding preparedness and managing hospitals during disaster events which were a result of improving disaster management knowledge of people and making systematic disaster management system in case of disaster events."* However, there has been stated about some improvement after these years in the disaster management department. However, interviewee IN-D raised some failures that should be considered, such as accessing hospitals and distributing injured people by saying that: "Accessing to hospitals was not activated and disrupting of injured people to hospitals is *not managed well. However, the lack of coordination and collaboration since the Rodbar earthquake in 1990 were obvious. Still, after almost three decades, there has been a good improvement, and from big chaos, we can say now we can say that there is some systematic plan in most cases."*

According to some interviewees, the effectiveness of Hillal Ahmar organisation has been improved to mitigating pressures on hospitals during disaster events. For instance, interviewee IN-D noted, "However, there were above weaknesses in the past, but there have been good improvements in *disaster management knowledge and good progress in Hillal Ahmar."*

Hilal Ahmar is a charitable organization, the equivalent of the International Red Cross. Hilal Ahmar is a humanitarian non-profit organization that provides emergency assistance, disaster relief, and disaster preparedness in Islamic countries. In addition to interviewee IN-D, another interviewee IN-C commented, "In recent years, there was a good improvement in Hilal Ahmar and good collaboration and coordination *between different organizations such as fire rescue service and hospitals."*Regarding controlling hospitals and evaluating health centres to get ready for disaster events, it was stated from IN-C and IN-D. For instance, IN-C noted that *"Another good improvement has been done recently; there is one assessment for each hospital that shows how hospitals are capable of managing disaster events."* And besides, IN-D added that *"this leading hospital to have a better understanding of their capacity to manage and mitigate the risk of disasters*." Moreover, the interviewee IN-D noted that the lessons learned from the past and those lessons have been implemented in the future disaster management strategies, but as long as setting legislation controlling, and assessment of hospitals should be considered more.

Also, this interviewee stated with this improvement still, there is lack of union-management, lack of preparation plan, and lack of good assessment and monitoring before and during a disaster on structural and non-structural elements of hospitals by saying that: *"Totally about lessons have been learned from previous disaster event, there has been a good improvement from the past in different parts to manage disaster events, but lack of good and union management, lack of a proper preparation plan, and lack of good assessment and monitoring before and during a disaster on structural and non-structural elements of hospitals can be named. Finally, I recommend that instead of setting rolls without the implementation, it is much better to have a better system for monitoring and controlling events."*

According to interviewees IN-A, IN-F, and IN-F, there has been a good improvement in increasing disaster management knowledge and implementing technologies to mitigate disaster risk in hospitals in recent years. For instance, IN-A endorsed "significant improvement since the Bam earthquake and disaster management knowledge of ordinary people, and people in connection with disaster management have *improved."* And another interviewee IN-F added that *"There was proper progress since the Bam earthquake in different areas of disaster management in Iran. In particular, disaster management knowledge was raised, and different organisation preparation has been developed much more organised. Implementation of tools and technologies helped to have a better understanding of disaster locations to implement better strategies."* In terms of improving implementing technologies to reduce the risk of disaster events in hospitals, hospital simulation was mentioned by interviewees IN-B and IN-H. For instance, interviewee IN- B stated, "In terms of disaster management tools and strategies, it can be mentioned about "Hospital simulation system" which helped disaster management team better understand hospitals and their vulnerability *against disaster events."* Also, IN-H added that *"By doing this simulation system different functions and factors of hospitals can be assessed than in the next step attitude of people, and hospital personals can be reviewed."* Interviewee IN-F stated that implementing simulation tools improved the EMI or Emergency Medical Team to have quicker health service during disaster events by saying that, *"EMI or Emergency Medical Team had incredibly emergency service to injured people in early hours in comparison with similar cases in the past."*Several interviewees stated another improvement about structural improvement in hospitals. According to IN-F, *"In Iran, preparedness of structural elements have been paid more attention than other elements."* However, the IN-F was stated that there was a good improvement in structural elements. Still, another interviewee noted that this validity has been assessed by self-assessment.

It is not fully validated *"hospitals have improved up to 25% in terms of structural and non-structural elements. However, it was a great improvement, but this result has come out with self-assessment reports, and the validity of that is not accurate."* The final improvement has been stated by several interviewees about the effectiveness of implementing regular drills and how it has been improved since the Bam earthquake to increase the disaster management knowledge. For instance, the interviewee IN-G stated that *"In terms of drills, there has been good improvement since the Bam earthquake. For instance, drills and disaster management training sessions have become compulsory for hospitals and should be done regularly."* However, there has been mentioned about this improvement. Still, IN-F and IN-F noted that about the principles and protocols to have a regular rehearsal for personnel of hospitals to become ready in disaster events, but still there are some issues to have a fully productive drill. The interviewee IN-F noted that *"However in terms of principles and protocols, there have been good efforts to have regular drills and have a better understanding of disaster events, but evaluation of these activities are based upon self-assessment and in some cases are not validated totally."*

Besides, interviewee IN-F noted that *"Some hospitals due to getting more credits than others prepare these drills, but these are not as the main objective of them and mostly with less attention gets done."* According to the interviewee, IN-F believed that the improvement of providing regular drills are so useful for hospitals. Still, it does not implement and not fully paid attention by saying that, *"these drills as mentioned previously might give extra credits to hospitals to get the better situation to claim more budget. Thus, with my experience, these drills are not paid full attention, and the most concentrations of hospital's personals are not learning, and it is about getting credit instead."*

Finally, IN-F noted that *"In fact, the main aspect of drills is not fully considered, and the main objective for hospitals is getting promotion credit."* The impact of rehearsal strategies is discussed in the next section.

5.3.4 Rehearsal strategies

To ensure effective and rapid disaster management in hospitals in disaster events, the disaster management strategy should be strengthened and developed by conducting joint exercises and training with the relevant organisations and hospitals. For instance, interviewee IN-H stated that *"training and decision-making practices"* seem vital for controlling processes. Similarly, interviewee IN-F proposed *"increasing the competent cadres and conducting joint exercises with the relevant organisations".*

Interviewee IN-D went on to add two recommendations in connection to *"holding periodic seminars and meetings with all the personals of hospitals and staff members in the field of controlling and administrating the accident site to teach them how to deal with orders and instructions"* and *"circulating the instructions concerning accidents management and control by using official documents and punish all oppose to such documents".* Interviewee IN-H raised a new critical point in terms of implementing *"a comprehensive assessment of the risks, vulnerability, and the available capacity at all levels and by multi-region"*. Moreover, interviewee IN-B emphasized *"accurate resource estimating"* due to its role in the preservation of resources. Interviewee IN-A added to the above discussion by saying that, *"In terms of drills in the long term and short term will be provided for different organizations regularly which helps to develop their knowledge and getting ready in the events."* Besides that, the interviewee IN-H stated implementing *"knowledge attitude practice assessment"* in hospitals that are improving the efficiency of hospitals. Despite the above discussions about the impact of drills to enhance the disaster management knowledge for personnel of hospitals, the interviewee IN-G stated that *"all universities must have one lesson in connection with disaster management during their programme. Each year, one drill should be taken regularly, and every 3-5 years should have a functional drill."* In furthermore, IN-H noted that *"drills are necessary to test the outcome of them and making sure these drills have added value to our disaster management system. There are different tools to test drills."* Finally, the IN-D added a note about the lack of assurance policy to have an appropriate outcome from training and exercises by saying, *"In terms of drills, due to lack of assurance policy to implement disaster principles and lack of proper controlling during drills in most hospitals may not get a good outcome from that."* Thus, despite it being vital to implement regular disaster management drills for hospitals' personnel, evaluating that is much more important. Challenges facing disaster managers in disaster events to keep hospitals safe and secure are discussed in the next section.

5.4 Challenges

The second main theme from the interview is strategies. In this theme, question areas were revealed that would be discussed in the following.

5.4.1 Disaster Management roles

Disaster events have devastating consequences and affect the different aspects of hospitals. Thus, the importance of appropriate legislation to manage disasters in hospitals are very high. IN-F added that the *"Government's role in disaster management is to provide a central, coordinated plan of action to address the damage caused by such an event and the needs of the people affected."* Notably, most of the interviewees agreed after the Bam earthquake, there has been a good improvement from the government to legislate many disaster management roles in particular for managing hospitals in those events. However, still, there are some lack of adequate evaluation of those roles or a lack of paying attention to implement them. For instance, IN-C stated about not correctly paying attention to disaster management legislation in hospitals by saying that, "…after the Bam earthquake was planned to have a disaster manager in each hospital, but after a few years this person did not have enough right to make a decision or in some cases, we did not have this person in some of the hospitals due to saving budget or redundancy strategies." Interviewee IN-H noted that this role might not be financially affordable for all the hospitals to hire some disaster management experts by saying, *"Financially it would not be possible to have a DM unit in each sector. It means we couldn't have a separate organisation to respond to disasters because nothing might happen during the next few years. Also, this organisation wouldn't have adequate resources to respond to big disasters, so the current resources must be prepared to respond to disasters. I propose educating staff and asking them to spend some of their time on disaster preparedness activities. All of these activities can be done by a coordinating organisation."* This interviewee agreed that investing in educating personnel and ordinary people can have more effective results.

Another interviewee IN-E stated that general principles might not be implemented in all regions and hospitals due to differences environmental conditions, types of disasters, and hospital conditions, and noted that *"For mitigation of disaster risk some protocols and principals have been made, but in case of disasters regarding location, type, and situation of injured people cannot be implemented in all of the hospitals, but its uses as a guideline."*

Interviewee IN-B stated about structural and non-structural elements of hospitals disaster management legislation control. This interviewee IN-B noted that most of the hospital's buildings are very old, and the legislation to renovate or reconstruct those are not implemented fully. Still, in the non-structured elements, there has been a very productive improvement. According to IN-B, "In terms of structural elements of Iranian hospitals due to majority hospitals were built more than 45 years cannot modify those too much, but in terms of non-structural elements, good preparedness strategies were implemented to control and manage *hospitals during and after disasters."*

Interviewee IN-F added that to the above discussions about the legislation for organising drills for hospitals and different organisations to become more ready in disaster events. This interviewee stated that *"However, in terms of principles and protocols, there have been good efforts to have regular drills and better understand disaster events, but evaluation of these activities is based upon self-assessment and in some cases are not validated totally."* It was revealed that these assessments are based upon self-assessments and are not being evaluated properly. Regarding these self-assessments, another interviewee (IN-F) pointed out, "Some hospitals due to getting more credits compared *with others prepare these drills, but these are not as the main objective of them and mostly with less attention gets done."* Thus, this might not fully pay attention and have some purpose plan for some hospitals to get more credits and more budget. Therefore, hospitals might be in the face of trouble in the disaster events and can be created some challenges for disaster managers to control and manage hospitals safe and secure. In the following section, some barriers and drivers are noted by interviewees are presented.

5.4.2 Barriers against disaster management teams

How hospitals respond to the demand for medical attention during and after a disaster event can be extremely challenging. Regarding most interviewees, there have been some barriers against disaster management teams to implementing appropriate strategies to mitigate the risk of disasters in hospitals. In the following, those barriers were noted by interviewees are presented. Barriers against disaster management teams in hospitals during disaster events are categorised into lack of planning, Inadequate Organizational Management, Insufficient Coordination and collaboration. In the following section, the interviewees opinion is presented.

Lack of Planning:

Lack of appropriate planning caused various barriers against disaster managers to keep hospitals safe and secure during disaster events. Regarding most of the interviewees, several lacks of planning made it difficult to have a proper and appropriate health service for injured people. For instance, IN-F stated that *"…Most people think plans are unnecessary because everyone else thinks everybody already knows what to do. However, everything will be managed badly; cooperation is not coordinated beforehand. Chaos ensues during a disaster resulting in more loss of lives and property…".*

Furthermore, many interviewees pointed out some failures and inadequate planning to keep hospitals safe and secure during disaster events. Different points of view were revealed from interviewees about the *"Lack of plans for providing health services"*. Interviewee IN-H added that, *"… We should prepare our staff and train them in advance… facilities and the rate of destruction should be estimated…management must be in place in advance, a training class, a plan for the transfer of the injured to safer places…the persons who help have official authority. Accordingly, not everybody should be allowed to help …".* Moreover, the IN-H stated that about the *"shortage of locations for providing services".* Regarding this interviewee *"hospital capacities are not responding the high demand of injured people".* In adding that another interviewee IN-B stated that *"… as unsuitable distribution of injured people, and unsuitable distribution of hospitals. The distribution of injured people from the collecting point should have equal distribution and delivering patients and injured people to facilitated health centres. We had a significant problem regarding the non-suitable distribution of hospitals in a different location.*

For instance, in the Kermanshah earthquake, after collapsing two hospitals in the town, another one was more than 20 miles distance that made the problem. Besides, there is a significant issue with our hospitals and buildings are not constructed well and in a good location with natural hazards." In the following of the above discussion, another barrier was raised with some interviewees about the "*Overlapping and interference of groups and volunteers"* by saying, *"The most challenging in disaster events for hospitals and health centres can be coordinating human resources, volunteer people, and managing donations."* Also, interviewee IN-H stated that *"most of the volunteers have not any experience regarding disaster events. They only try to help others, regarding that with lack of disaster knowledge and experience of these groups makes disaster management teams some difficulties."* Besides, the above interviewees, the IN-G, stated about the shortage of staffs of hospitals that should be substitute with volunteers by saying that *"In past experiences, once disaster occurred some personal of hospital escaped from their positions due to their fear or reaching to their families. Also, managing volunteers with a lack of hospital experience and disaster knowledge make some barriers for disaster management teams."*

The other barrier was that most of the interviewees noted the "The necessity of preparedness before the occurrence of disasters" The interviewee IN-F stated the importance of appropriate preparedness by saying, *"It is indisputable that preparedness is essential for disaster survival."* Another interviewee (IN-H) pointed out the necessity of preparedness personnel in hospitals "*Learning from the disasters happening around the world, and the resulting death tolls, health consequences and impact on people, nurses should be aware of the importance of being prepared for disastrous events. As the largest subgroup of the healthcare workforce, nurses are one of the community's most vital resources in dealing with unforeseeable disasters; their preparedness and involvement in disaster management in terms of prompt responses, effective management and aftercare are crucial for the health and welfare of the community."* Finally, in the planning section several interviewees pointed about *"the lack of national, provincial, and local or regional plans".* For instance, the Interviewee IN-A noted that *"The occurrence of crisis and disasters is not associated with legal boundaries. Responsibilities and Commitments are not clear at various levels of government (federal, state and local). Communications and trust among the different government levels and even affiliated organizations are barriers to collaboration. Besides, putting the organizations into organizational silos can further provide competition than cooperation and interaction."*

Inadequate Organizational Management:

Several interviewees reflected on the challenge in the organization of the response effort. The interviewee IN-B asserted that *"the lack of division of labour"* seems vital for disaster management teams' control process during disaster events. Similarly, the interviewee IN-E proposed that *"the interference in healthcare services by laypeople and volunteers"* is challenging to control providing health service appropriately during disaster events at hospitals. Interviewee IN-F added two problems that can cause by poor organisations *"duplicated efforts"* and *"overlapping responsibilities and activities".* Interviewee IN-H and IN-H raised the new critical point in avoiding poor organisation by *"using professionals to perform tasks that needed no special competence".* Moreover, the *interviewee IN*-C emphasised *"The* networking and organizing of health groups in the provinces in advance".

Insufficient Coordination and Collaboration:

Problems with coordination were common in hospitals and health facilities during disaster events and were mostly mentioned by all of the interviewees. Successful coordination and cooperation often lead to lives saved; much suffering alleviated, and the safe and efficient use of response resources. Inefficient use or duplication of resources can lead to low consequences. To gain proper disaster management in hospitals, some barriers were pointed by interviewees. For instance, interviewees IN-B and IN-A stated that *"Lack of coordination within and between groups; lack of an information system and coordinators; self-centeredness"* can be vital barriers against disaster management teams to keep hospitals ready in disaster events. Besides, the interviewee IN-G asserted that with the lack of adequate coordination in disaster events, *"People's interference in the works of others, duplicated efforts"*.

Similarly, the interviewee IN-C noted that about "*Provision of the same services to people by different groups",* therefore in both force power of personnel of hospitals, or any volunteers can be wasted. According to Interviewees IN-A, IN-D, IN-F, and IN-E, the productivity of hospitals in disaster events can be mitigated with "*Lack of coordination within and between managers in emergency, hospital, and logistics".*

Finally, Interview IN-H provided an example of the Kermanshah earthquake. A lack of adequate coordination caused several problems for hospitals and disaster management teams to have appropriate service to demands by saying, *"…Unfortunately, nobody was there to coordinate. From the very beginning, we had some problems. Some places were visited several times, while others received no visits. There was no correlation between people and tasks. In some places we visited, there were no visiting groups or any special services …there was much that should have been done, and many people, volunteers, resources and equipment were available to do it…".*

5.4.3 Impact on hospitals and health services

Due to disasters, the demand for health care services can unexpectedly increase. Thus, there are many different impacts in disaster events, such as the hospital's ability to function, the direct impact on patients and health equipment, and the physical damage to hospital buildings. In this section, most of the interviewee's points are presented.

The interviewee IN-H stated about the impact of disaster events on hospitals: "*Natural disasters can overwhelm busy hospitals for days after storms dissipate. The reason: is a wave of medical needs beyond injuries from patients without resources, but when a natural disaster hits, health care workers' occupancy rates and stress levels can be pushed to the limit.* Regarding the impact on hospitals, several interviewees such as IN-A, IN-D, IN-H, IN-H, IN-F, and IN-F stated the short-term and long-term impacts of disaster events on hospitals. For instance, interviewee IN-A pointed out that *"damages on hospitals after disaster events might affect the health process in the short and long time period."*

Interviewee IN-D also stated about the different impacts can be seen in the hospitals after disaster events by saying that, *"There are different impacts that can be seen in disaster events, such as the impairment to hospital functions, the direct impact on patients and health equipment, and the physical damage to hospital buildings."*

Moreover, the interviewee IN-F noted long-term impacts by saying, *"…there are two different types of damage to hospitals, namely direct and indirect, and the sum of these two types comprise the total cost of a disaster."* Interviewee IN-H also mentioned *that "Direct damages refer to the financial and replacing the losses health equipment's."* The IN-H also stated the indirect long-term damages by saying that, "…damages to the town's infrastructure that can directly impact *hospital's health service such as shortage of power, water, etc."* In adding to the above discussion about the long term impact of disasters on hospitals, the IN-F stated, *"Direct damages refer to the loss of materials, hospital beds, medicines, and destroyed health equipment; thus it refers to damage that is the immediate consequence of a disaster and usually remains for a long period after a disaster event." In according to IN-C,* IN-A, IN-D, IN-H, IN-H, IN-F, and IN-F natural disasters can cause severe damage to "*health facilities imminently",* "*water supplies, and* systems", "patient", sewage "*energy power", "medicine",* and *"health equipment".* Regarding accessing routes to hospitals might be affected the interviewee IN-B expressed that, *"failure accessing to hospitals due to disaster caused for accessing road and especially it makes problem for disabled people, and those require health service".*

Another impact of disasters on hospitals was that several interviews lacked personnel or escaped from their positions. For instance, interviewee IN-G noted that *"In past experiences, once disaster occurred some personal of hospital escaped from their positions due to their fear of reaching their families."* Also, this interviewee added, *"damages caused by disaster events to medical equipment and staff of hospitals providing health service to demands might be affected".*

Finally, the IN-E stated about the shock impact to the personnel of hospitals in the first 24 hours after disaster occurring by saying, *"Regarding non-structural elements of hospitals within the first 24 hours after the disaster happened, there is a big shock in the area of disaster in, particularly hospitals. Thus, all the activities within the first 24 hours are based on a trial and error strategy. To better understand the importance of drills, those hospitals had good training sessions, and drills have got a better response."*

5.4.4 Organisations and person obligations

Manging disaster is everyone's business in the region; there might be hazards that threaten local communities and hospitals during and after disaster events. Thus, to know how to manage disaster community needs to be organised and prepared with the appropriate information and various tools that can effectively reduce the risk of disasters in hospitals and different parts of the region. It is necessary to classify the organisations and people responsible during disaster events to avoid any more chaos and further casualties. Regarding the commitment and obligations, most of the interviewees admit authorities in the region do not lack commitment, and the commitment is acceptable. Still, the lack of resources may affect or limit this commitment. For instance, the interviewee IN-H stated, "There is an acceptable commitment, but sometimes the lack of equipment, lack of sufficient number, *and the appropriate type of machinery may limit the effective intervention to reduce the impact of disasters in the hospitals."* Interviewee IN-F added, *"Sometimes lack of commitment is due to a lack of resources."* Thus, it is mentioned IN-D by saying that, *"the commitment of local authorities is acceptable to some extent depending on the available resources in these authorities such medical equipment, sufficient number and the appropriate type of machinery, qualified teams to deal with disasters in hospitals".* In *the* following interviewee, IN-C noted about the assigning obligation to disaster management team members in hospitals by saying that, "*In* terms of disaster management, there was assigned any task to a specific person and it was chaos in the first 24 hours of Kermanshah earthquake." However, there was assigned obligations. Still, the other interviewee IN-C noted about the *"overloaded obligations"* for some team members.

Lack of experience made it difficult for managing disaster events. In addition to the above discussion, another interviewee stated that if there were assigned obligations to different people, some are not appropriate with that responsibility due to lack of experience in disaster management. For instance, IN-D noted that *"some duties were ordered by higher disaster managers but were not completed accurately. In general, there was not a preparation plan and lack of disaster management knowledge and experience to deal with those situations."*

Moreover, most interviewees added the responsibility and obligation of some organisations, such as Hillal Ahamar, during disaster events and after that. For instance, Interviewee IN-C noted that *"In general, there was no preparation plan in advance. IN-F Emergency medical service in Iran and Hilal Ahmar organizations performed well in recent disaster events. Also, some contributions from non-profit organizations and volunteers have been increased in the last five years."*

Regarding obligations in the concept of appropriate coordination and collaboration between different organisations, most interviewees noted that there had been good progress, but still, there were many failures. For instance, IN-A stated about the *"Incident Control System"* by saying that *"each hospital has a specific system is called "Incident Control System" to coordinating a staff of hospitals. This system is implemented in different countries, such as the USA, called "FIMA". This interviewee noted that this system is implemented in Iranian hospitals and* stated that the person is allocated in each hospital regarding disaster events. IN-A pointed out, *"Basically, after the Bam earthquake was decided to assign one person as a disaster manager in each hospital, but it was not implemented in all of the hospitals and health centres."* Also, according to IN-D stated about some agreements between some hospitals and organisation to deal in these events, by saying that, *"there is a good collaboration between hospitals in case of an emergency and disaster events. There are some internal agreements between some hospitals to manage those difficulties with each other."*

5.5 Summary & Link

This chapter addressed the qualitative methods and findings from data analysis. The qualitative chapter contains three main parts; the exploratory qualitative data collection and analysis for this research study, exploratory case studies, and interview findings. The qualitative data collection process is described in the first part of this chapter. In this part entire process of gathering collective data such as pilot interviews, design strategy, transcribing and coding of interviews, and interview samples are explored. In the following chapter, two case studies are entirely explored. Before interpreting the interviewee's comments about the Kermanshah earthquake, the central flood 2019 in Iran was presented. The analysis of interview responses started by categorising interviewee comments into individual themes and sub-themes. The qualitative data collection was designed regarding this research study's 3rd and 4th objectives. Thus, two main themes were designed as strategies and challenges regarding these objectives.

Chapter 6

CHAPTER 6: DISCUSSIONS

6.1 Introduction

This chapter aims to conceptualise the research findings by comparing findings from the questionnaire survey, qualitative data, case studies, and the current literature to present recommendations to serve this research's aim. Following that, this chapter is divided into two sections. The first section compares and summarises findings from this study with current literature. The second section concludes with the validation process findings conducted with some experts in disaster management.

6.2 Disaster management training scheme in Hospitals

Training and rehearsal plans are essential for hospitals, disaster managers, and all the teams involved in the preparedness stage. This research illustrated an absence of an accurate disaster management training plan a lack of disaster medicine knowledge for medical personnel, hospital workers, and all of those teams involved in disaster events. Thus, the lack of a standardised training program stated with interviewees. Also, it was noted by previous research that the rehearsal plan for hospital-based employees is unavailable or insufficient in the recent disaster events that occurred. Even though research finding illustrates that it is possible to conduct a standardised nationwide training program to enhance the knowledge of a considerable number of medical personnel regarding hospital preparedness and disaster management issues in a short period.

Moreover, the effectiveness of disaster management rehearsal courses for personnel of hospitals and those teams might be involved in disaster events medical personnel has also been illustrated in other research (A. R. DJALALI, 2012a). Although, the available evidence is insufficient to determine whether a given training intervention in disaster preparedness for health care providers effectively improves the knowledge and skills in disaster response (Williams, Nocera, & Casteel, 2008).

Although the importance of training is frankly, implementing educational subjects in a curriculum as the foundation for new educational initiatives and training has been proposed and utilized by earlier studies such as control of diseases and relief and rescue skills and have proven to raise the awareness and knowledge of both medical students and other medical staff.

Medical teams can be a valuable resource at the time of disaster events. Although they require to be trained and engaged appropriately through formal education and simulation training, different vital subjects are discussed and trained in an environment where they can make mistakes and learn. Thus, it is critical to validate and evaluate these educational initiatives and disaster training for hospital teams and other groups in disaster events (Sarin et al., 2019). Despite the importance of training and disaster management education, there is no certain defined optimal measure for the quality and strategy control of educational programs that could be a reason for ineffectiveness (Pezzuto, 2016). As a result, developing and conducting a structured nationwide training course on disaster medicine for Iran's medical system and providing regular training disaster practice for developing the ability of hospitals and all groups working in the events is vital (Habte, Addisie, & Azazh, 2018).

After implementing the proper and regular disaster management training, another critical step should be to develop a consensus-based standardised all-hazard disaster core curriculum for medical personnel and follow more precise methods in design, conduct, and evaluation of the training courses (Sarin et al., 2019). This might promote disaster preparedness conditions in Iran's hospitals and mitigate the risk of disasters.

6.3 Lack of standardizing preparedness planning

In Kermanshah, Bam earthquake and Central flood pre-hospitals planning were not appropriate and were not standardised and lacked necessary resources and procedures with respect to triage, primary medical care, and transportation. In the Kermanshah earthquake, injured people without any primary medical treatment and, after a long delay, were transferred to hospitals, primarily out of Kermanshah (Goodarzi et al., 2015).

In transferring injured people in significant flooding and the Kermanshah earthquake, transportation was not medically standardised. There was no system for coordination and communication between the pre-hospital system and receiving hospitals. Comparing the result of the Kermanshah earthquake and central flooding with the Bam earthquake that occurred in 2003 was consented by Nakhaei et al. (2014) that still hospitals and managing injured people suffered from the same lack of standardizing preparedness planning.

The result of this research study are consistent with other research studies in the concept of disaster management in hospitals in Iran by (Nakhaei et al., 2015), (A. R. Djalali, 2012b), (Mirhashemi et al., 2007b),(Saghafinia et al., 2007), however, in this research study, some factors have evaluated the function of the entire chain of pre-hospital medical preparedness to mitigate the risk of disasters on medical activities, also has explored the barriers and facilitators of this chain of functions (Barillo, Rizzo, & Broger, 2019). Due to the extensive human impact and the rapid onset of disasters, there would usually be some challenges to providing a quick and appropriate pre-hospital medical service to the casualties (Farahani et al., 2020).

The lack of the three main functions in pre-hospital medical facilities, i.e., triage, treatment and transport, may increase mortality and morbidity at the scene, as does the less efficacy of hospitals response to the disaster. As a result, the health service to casualties would not be appropriate (Bertrand et al., 2019). As a result, the less efficacy of hospital functions in disaster events might be a consequence of the imbalance between injured people or types of casualties and hospital resources.

Thus, comprehensive preparedness planning of the medical system is necessary concerning natural disasters and their high frequency and severity in Iran. To have an adequate health service facility, an integrated disaster management plan, mutual support, and an accurate coordination system between pre hospitals and hospitals. Doing this risk of disasters on health services would be mitigated. The emergency medical services and other pre-hospital medical services must have an integrated disaster management plan.

6.4 Lack of accurate disaster management preparedness and mitigation plan

The current study illustrated that the lack of disaster management preparedness and a mitigation plan was an important obstacle to having an efficient pre-hospital medical service to the Bam, Kermanshah earthquake, and major flooding. The lack of a standardised plan was the primary reason for the lack of triage, basic treatment and medical transport to the hospitals.

This research study's finding is consistent with previous research studies of other disasters across the globe.

The shortage of appropriate and precise disaster preparedness and mitigation plan has been reported after the different natural disaster events such as; the Asian tsunami in 2004, the Pakistan earthquake in 2005 and the Gujarat earthquake in 2001(de Goyet, 2007; Rajkumar, Mohan, & Tharyan, 2013; Roy et al., 2002; Schwartz et al., 2006)

In similar studies from the European continent, Deebaj, Castrén, and Öhlén (2011) stated that disaster preparedness and mitigation plan in disaster events impact health services. It devastates hospitals an appropriate response to many casualties during the Asia tsunami. As a result, a comprehensive disaster management plan is the basis of preparedness to mitigate natural disasters' risk of an effective medical response to disasters.

In this research study, data gathered through a qualitative and quantitative research method illustrates the crucial failure in the medical disaster management system of Iran, also emphasises a worldwide issue concerning medical response to disasters. Iran's medical system should develop an integrated, comprehensive disaster management plan for both hospitals and pre-hospital services. It will result in providing medical services to necessary casualties. A literature review has shown that the medical system's preparedness at disaster scenes significantly reduces the number of patients requiring transport to hospitals (Soomaroo & Murray, 2012) and mitigates casualties' workloads**.**

6.5 Lack of necessary require medical equipment

The availability of necessary medical equipment, concerning amount and type, is an important subject of all parts of a disaster management system, including response, logistics, planning and the financial sections of a disaster response system (Pralle, 2019).

This research study showed a lack of necessary medical equipment in the Kermanshah, Bam earthquake, and central flood in Iran (Ardalan et al., 2016; Haghparast-Bidgoli et al., 2010; Motamedi et al., 2009). In contrast with other disaster events in across the globe, there was a variety of lack of evacuation vehicles; thus, there were issues with the transportation of the victims to hospitals (Schultz et al., 2012); there was also a shortage of medical supplies (Zoraster, 2006). Besides, during the Pakistan earthquake (2005), there was a lack of medical resources and supplies (Malik et al., 2009), and in the Chi-Chi earthquake in Taiwan and the Haiti earthquake (A. Djalali et al., 2011a; Missair et al., 2010). On the contrary, an excess of equipment and medical resources has also been reported as the main challenge in medics and emergency medical teams face to a mass casualty incident in Norway (Romundstad et al., 2004). Peltz et al. (2006) is stated that the availability of sufficient and appropriate resources is a criterion of good disaster management. A shortage of medical equipment is one of the main issues during the first few days of disaster events. Besides logistic problems and the distribution of equal medical resources to all pre hospitals, the absence of a coordination and communication system is why this condition (Chan et al., 2006; Shokouhi et al., 2020).

In consequence for mitigating the risk of natural disasters to have appropriate disaster planning, it is so important that Iran's medical system takes into account the entire aspect of resource management, including a coordination system between pre-hospital services, hospitals and logistics centres, and providing enough necessary medical resources and equipment for the pre-hospital medical services at the disaster events.

6.5 Lack of disaster medic teams in disaster events

Disaster medical assistance teams are defined as "*mobile, trained medical teams that can be rapidly deployed during the acute phase of a disaster, provide medical treatment and relief activities and assist in transferring casualties from disaster-affected areas to appropriate medical facilities"* (Asaoka et al., 2020). This research study illustrated that there was a lack of an appropriate standard disaster medical assistance team to respond since the Bam earthquake and in the following disaster events such as the Kermanshah earthquake and central flood was one of the main issues to manage disaster events, and the lack of structured medical teams in disasters has been reported from other disasters (Kondo et al., 2009; V. J. Lee et al., 2005; Missair et al., 2010).

The lack or absence of medical teams directly affects the triage, treatment and transportation of disaster injured people to get a quick health service during and after a disaster. Standardised medical teams' role is vital while the local medical system is destroyed (S. Lee, Onye, & Latif, 2020), as seen in the Bam earthquake. Understanding the importance and advantages of structured medical teams from previous disasters resulted in the development of disaster medical assistance teams, first in the United States in 1985, then in other countries (Lee, Low et al. 2005; Kwak, Shin et al. 2006; Mace, Jones et al. 2007; Kondo, Koido et al. 2009; Fuse and Yokota 2010; Grindlay, Young et al. 2010). It is crucial to establish robust disaster management assistance teams in Iran. These teams' number, location, and purpose should be based on local disaster management plans, including hospitals' relevant disaster plans.

6.6 Organising medical volunteers

This research study illustrated that in the first few hours after Kermanshah, Bam earthquake and central flood occurred, there was an excess of medical personnel both as organised groups from the medical system and individual volunteers. Their participation facilitated the on-scene medical course to provide various medical services, such as triage. Our results are consistent with other studies regarding the medical response to the Bam earthquake (Akbari, Farshad et al. 2004; Nia, Nafissi et al. 2008; Motamedi, Saghafinia et al. 2009). Also, during the Gujarat earthquake (India), the Kashmir earthquake (Pakistan) and the tsunami in Thailand, large numbers of medical personnel from both the host area and abroad came to the disaster area to handle the medical needs of the victims (Roy, Shah et al. 2002; Schwartz, Goldberg et al. 2006; Yasin, Malik et al. 2009).

Volunteers play an essential role in mass-casualty incidents such as earthquakes and floods (Peltz, Ashkenazi et al. 2006). Implementing different types of volunteers like medical or nurse students, medical reserves in other regions, and allied health practitioners who are trained and have appropriate skills in medical care can make an enormous difference in improving the utilisation of human resources at an emergency site and thereby potentially improve treatment outcomes instead of implementing non-skilled people who might make chaos (Baldwin and Wilson 2008; Frasca 2010; Sapp, Brice et al. 2010). There is an uncountable amount of different types of volunteers in Iran, and frankly, organising them is not possible easily during the response phase of a disaster; however, it should be considered during the preparedness phase to have plans to implement the power of this group to mitigate the risk of natural disasters on hospitals. By organising volunteer teams, the impact of disasters on health services would be less.

6.7 Organising Military service contribution to health facilities

Many researchers have previously stated the constructive role of the military service contribution in the medical response to disasters (Abolghasemi, Poorheidari et al. 2005; Bricknell and MacCormack 2005; Zoraster 2006; Amundson, Lane et al. 2008; Stuart and Johnson 2011). In this research study, some of the main aspects of military service and public services during disaster events were mentioned by disaster manager experts, such as; participating in the airlifting of casualties and providing necessary resources. They also established field hospitals, transported medical and health care personnel to the disaster area and provided medical service to losses.

These results are supported by several research studies demonstrating the military's constructive role during the early phase of disaster events (Abolghasemi, Poorheidari et al. 2005; de Ville de Goyet 2007; Nia, Nafissi et al. 2008; Motamedi, Saghafinia et al. 2009).

In contrast, a similar contribution from the military services are reported in other natural disasters in the globe, for instance; the Haiti earthquake (Stuart and Johnson 2011), hurricane Katrina in the USA (Lezama, Riddles et al. 2011), the Tsunami in Thailand and Indonesia (Schwartz, Goldberg et al. 2006; Zoraster 2006) and the Chi-Chi earthquake in Taiwan (Hsu, Ma et al. 2002; Chan, Alagappan et al. 2006).

Thus, frankly, in disaster events, many different groups should contribute appropriately, such as the army, firefighters, volunteers, etc. The military plays a vital role in the early few hours in disaster events to reduce casualties and avoid chaos. The military may be implemented in all parts of the medical response to disasters and should be considered when developing a comprehensive disaster management plan. Therefore, proper integration planning between a medical disaster plan and military disaster programs is necessary for the preparedness and mitigation stages to manage disasters.

6.8 Contingency mitigation and preparedness plan

In this research study, Iranian hospitals' preparedness and a mitigation plan were not safe concerning contingency plans for different disasters, and disaster managers experts connected it during interviews. There was a shortage or lack of contingency plans, such as earthquakes and hazardous materials. A national report showed that nearly all hospitals in the United States had response plans for chemical releases, natural disasters, epidemics and biological incidents. In contrast, preparedness for explosive or incendiary incidents was less frequent (Niska and Shimizu 2011). An extensive survey in South Africa showed similar hospitals conditions (Stander, Wallis et al. 2011). Our results are supported by a study in Turkey, where most hospitals also have no contingency plans (Top 2010). For a hospital to have an effective response to a disaster in a short period of time, relevant contingency plans must be issued in advance (Li, Huang et al. 2008).

Iranian hospitals' lack of contingency plans results in delays or incompetency in response to disasters. Following an all-hazards approach and using a hazard vulnerability assessment will enhance Iranian hospitals' preparedness level concerning contingency plans for future disasters.

6.9 Availability of medicines, supplies and equipment

This research study demonstrated that Iranian hospitals are not fully prepared for resources and necessary equipment during disasters. Similar consequences have been stated from other research studies (Li, Huang et al. 2008; Top 2010; Stander, Wallis et al. 2011), even though either local or national research studies illustrated a high level of resource availability in the US hospitals (Kaji and Lewis 2006; Niska and Shimizu 2011). The unavailability of resources and the lack of mutual agreements with external organizations, which is a part of the operational plan, confirm that Iranian hospitals will not provide medical services for an influx of casualties during disasters. A comprehensive hospital disaster plan and sufficient financial resources may solve this problem. Moreover, another issue was the lack of a systematic and reliable method to estimate the necessary medical help. Iranian hospitals require a systematic method to calculate to guarantee the provision of necessary resources and medical equipment during disasters.

6.10 Validation

This research has identified various challenges and barriers to the effectiveness of Iranian preparedness and mitigation stages of Iranian disaster management in connection with hospitals.

Based on the primary data obtained from the semi-structured interview responses, the questionnaire, and reviewing two case studies (Kermanshah earthquake and Central flood), as well as the secondary data that was compared and discussed in detail within the context of the research themes, sets of recommendations, were suggested that enhance the current disaster mitigation and preparedness practices, to improve the overall process to effectively mitigate the risk of natural disasters on health services in Iranian hospitals during and after disaster events. Three executives responsible for disaster management in the main Iranian disaster management department (purposely selected) were invited to participate in semi-structured interviews to validate and verify the recommendations.

These recommendations were examined in terms of their appropriateness and whether they were classified appropriately under the different research themes. After giving the invitation letter and receiving the participation agreement, the validity interviews were conducted with three experts involved with disaster mitigation and preparedness teams. They demonstrated interest during the data collection stages for further support. The interviews with these experts were conducted in English.

The validation interviews were executed between 30 to 35 minutes, where feedback was taken simultaneously.

Before starting the interviews, the interviewees were briefed on the case study's current status about the recent disaster mitigation and preparedness practice by presenting the findings to enhance Iran's four Disaster mitigation and preparedness management stages. Accordingly, these sets of recommendations were presented.

6.11 Refinement of the Recommendations

In the previous section, the validation process of the recommendations was presented and discussed with three interviewees. To refine the recommendations, the interviewees were questioned about their appropriateness and checked whether they were classified appropriately under the different research themes.

A positive response was obtained combined with some suggested amendments to refine the recommendations related to the endowment of equipment, tools, infrastructure, coordination, planning process, Iranian disaster management concept, and health facilities. All the interviewees were satisfied with the classification under the different research themes. Feedback was received from three experts to reshape the recommendations' draft, and the final sets of recommendations were finalised after this validation process. The final guidance, after validation, is given in the following. From the recommendations received in the following, it would be seen that few recommendations and comments from experts suggested. In terms of that, the recommendation was given added to the final recommendation of this research; in fact, the experts felt that this was an accurate representation of Iran's context. Therefore, the recommendations were more frankly and more realistic for the Iranian disaster management context. This is a crucial point because different views are expressed in the primary and secondary data. For instance, the experts recommended having a centralisation with some flexibility in decision-making adopted in the final sets of recommendations. There were suggestions made, incorporated, and the recommendations modified to become the final recommendations, as shown in the following.

6.12 Endowment of Equipment, Tools, and Infrastructure

- Implementing more sophisticated equipment in connection with hospitals' concepts, including special rescue medical equipment, can mitigate the risk of natural disasters and become quick, precise, and more comfortable responding to the events.
- To set up effective incident management, an early warning system for all districts and towns has a high risk of natural disasters to mitigate the risk of crises before they happen and have better preparedness to deal with inevitable natural disasters.
- To develop telecommunications and informatics in central of each province.
- To obtain the most up to date and globally progressive GIS information systems.
- To implement the mobile network to spread early warning messages and vital information to citizens and hospitals before disaster events.
- To invest in the necessary technology to verify health facilities' capacity to avoid any overwhelming health facilities.

6.13 Education and disaster management knowledge and training

- Implementing continuous training for all groups might involve disaster events and medical teams at all levels by intensifying external and internal training courses to improve their ability in connection to disaster management.
- To obtain and provide disaster management education at all stages (primary, secondary, higher) to develop knowledge and awareness of disaster in high-risk regions.
- To educate the public through continuous communication, mainly through the media, to raise awareness about the role of disaster management.
- Joint exercises such as multifunctional training with different organisations are conducted according to disaster management and disaster management medical services.
- To incorporate the previous experience and global research on disasters when devising the mitigation and preparedness plan.
- To conduct training and practices in accurate and precise decision-making.
- To conduct a comprehensive risk assessment, to include vulnerability and available capacity at all levels and by multi-region and hospitals.
- Training and disaster management knowledge must be practical and theoretical in connection with integrating the theory learned into practice through the implementation of simulation.

6.14 Coordination and collaboration

- To connect directors of the disaster management department and all organisations might be involved in disaster hospitals with the e-government network for effective collaboration.
- To update the organisational structure of the disaster management department regularly according to the current situation requirements.
- Provide buildings with a specific location address such as a postcode by the authorities concerned and implement GIS.
- To strengthen cooperation between the Iranian disaster management department and the surrounding countries regarding disaster mitigation, preparedness, response, and recovery stages.
- Precise attention must be given to verify and coordinate organisational obligations.
- To create a sense of trust among the different stakeholders of hospitals and various organisations expected to work as a team during disaster events.

6.15 Preparedness and mitigation planning

- To concentrate on disaster forecasting and monitoring to mitigate the risk of natural disasters.
- To prepare additional accurate plans for different or unusual natural disasters.
- Conduct regular meetings with all the officers and staff members to improve the planning process based on their feedback and experience to prepare all organisations for natural disasters.
- To develop mechanisms, procedures, and systems to save and disseminate data concerning hazard and recovery.
- To introduce legislation to prepare plans and programs to mitigate the potential for disaster risk and find appropriate work environments for staff.
- The availability of expertise must be considered when planning and preparing for a disaster.
- To adopt a periodic review system of disaster management plans and assess them in conditions like the actual disaster situations and work to confront them.
- To develop the plans by practising, evaluating, and re-planning the plans to develop appropriately matched institutional responses and determine the scale of the disaster.
- Preparedness and mitigation planning must be "reality-based", grounded in what is likely to happen rather than myths and misconceptions long overturned by disaster research.

6.16 Decision-Making

- To provide central leadership with flexibility in decision-making.
- To assess situations accurately and prevent improvisational behaviour.
- New control techniques that adapt the principle of reward more than punishment might be required to raise and sustain morale.
- Efficient and effective decision-making requires to be investigated and understood, learned, practised and effectively executed during the response.
- To develop information and decision management competencies and procedures.

6.17 Risk Assessment and monitoring

- To identify, assess, and monitor all kinds of disaster risks, the priority of these risks according to their geographical distribution.
- To ensure the availability of multiple risk assessments of national and local damage in areas, including critical sectors focusing on urban centres or settlements.
- To ensure the necessary institutional capacity to assess loss, casualties, and damages.
- To determine the accurate scale and size of the disaster and obtain an appropriate decision to mitigate the risk of natural disasters.

6.18 Summary & LINK

This chapter has discussed the data analysis and findings of Iran's two case studies (Kermanshah earthquake and central flood). The primary data analysis results of the three methods presented in the previous chapter were discussed in conjunction with the data obtained from earlier scholars in the secondary data.

The next chapter will be the final chapter of the research, the conclusion and recommendations. It will revisit and discuss the summary of this research, including research aim objectives, presenting findings derived from the research, highlighting the contributions to knowledge, limitations for this research, and suggesting recommendations for further study.

Chapter 7

CHAPTER 7: CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

This research aimed to develop recommendations on mitigating the risk of natural disasters in hospitals during Iran's disaster events. This chapter revisits the research process from synthesising the literature review, research methodology, and analysis results through semi-structured interviews and experts' survey questionnaires. The research aim and objectives are also summarised. Furthermore, this research's contribution to knowledge is highlighted, and the limitations of conducting this research. Finally, the areas for further research are recommended.

7.2 Revisiting the Research Process

This research study was conducted by reviewing and synthesising the literature sources. Initially, the research problem, aim and objectives were identified (**Chapter 1**).

Chapter 2 presents the literature on disaster management and natural disaster, the importance of hospitals in disaster events, the impact of natural disasters on health services during disaster events, and explores challenges and barriers against Iranian disaster managers to keep hospitals safe and secure from previous disaster events. This research aimed to provide recommendations on enhancing the resilience of the healthcare facilities from floods and earthquakes in Iran by developing sets of recommendations for hospital disaster management for mitigation and preparedness phases of the disaster management cycle. Thus, it was required to identify the concept of natural disasters in Iran Iranian hospitals, identify critical factors of health facilities, and the impact of past natural disasters on hospitals' facilities.

Chapter 3 outlines the research methodology adopted to achieve this research's aim and objectives and meet the research questions' requirements. The philosophical approach, including epistemology, ontology and axiology, taken for this research was; interpretivism, subjectivism and value are laden. Besides, the research approach and mixed-method were adopted. The case studies were selected as the research strategy for conducting this research. The data collection method for achieving this research was semi-structured interviews through the experts' survey and case studies. Four experts from both academia and industry were selected for conducting the experts' survey.

Chapter 4 presents findings from the questionnaire survey distributed to 134 experts in disaster management concepts and hospitals' medic teams in Iran and across the globe. The results were analysed contently, with the aid of computer SPSS software, to find hospital operation management, explore critical factors of successful hospitals, and the importance of hospitals in disaster events and examine the impact of disasters on critical factors on hospital operation.

Chapter 5 Kermanshah earthquake and Central flood were explored as two case studies. The following data was gathered by in-depth semi-structured interviews with ten disaster managers and experts in disaster management and hospitals. The findings were analysed contently, with the aid of computer NVivo software, to evaluate the existing mitigation and preparedness measures in hospitals and verify barriers and challenges in the face of disaster managers to implement appropriate disaster management strategies to mitigate the risk of natural disasters.

Chapter 6 discusses the document survey findings, the expert's interviews, and case studies. The results from the primary data analysis of the three methods presented in the previous chapter were discussed in conjunction with the data obtained from earlier scholars in the secondary data. The recommendation was shared with three disaster manager experts to get their suggestions and validate the result. Finally, the experts' survey's feedback was adopted and, after some amendment, led to the final sets of recommendations to mitigate the risk of natural disasters in Iranian hospitals.

7.3 The research conclusion

This section presents this research's conclusion by reviewing the research aim and objectives (Chapter 1, Section 1.4) and how they have been achieved.

7.3.1 Research Aim

Therefore, this research aims to build the resilience of Iranian hospitals against earthquakes and floods by recommending appropriate mitigation and preparedness measures. This research attempts to gather a wealth of information about Iranian hospitals that do not receive adequate coverage in the hospital's disaster management and improve health services' continuity during natural disaster events.

7.3.2 Synthesis on the Objectives of the Study

As presented in the first chapter of this research study, this study aimed to evaluate and make recommendations to disaster mitigation and preparedness management in Iran with particular reference to hospitals, due to this research study is crucial, and the gap emerged from the literature review on the lack of studies carried out.

Therefore, to meet this research study's aim, sets of objectives and research questions were developed. All five research objectives have been examined to achieve the aim of this study. To accomplish this research's objectives, the literature review, the semi-structured interviews, the questionnaire survey, and reviewing two case studies in Iran were obtained to achieve the following five research objectives. The following sections will summarise and present the key findings in connection with each research objective of this research study.

Objective 1: To critically review the operational management procedures in hospitals and identify the critical factors of successful hospital management.

This objective has been achieved by reviewing the literature and quantitative data method collected. In this regard, relevant areas were investigated: hospital operation management and critical factors of successful hospital disaster management. It is widely acknowledged that disaster management is complex, difficult, and dangerous. Hospitals' complexity and the importance of critical factors keep the hospital safe and secure during natural disasters. Disaster management aims to mitigate the likelihood of a major incident or disaster occurring so that these incidents' consequences will mitigate when disaster happens. Hospital operation management in Iranian hospitals was investigated through the in-depth review of existing recent literature. The literature revealed that Iranian hospitals were in the face of implementing inappropriate operation disaster management in past disaster events. As a result, critical factors of hospitals affected to give an appropriate health service to casualties. In most events, they became overwhelmed.

Having investigated critical factors of successful hospitals revealed from existing recent literature and shared with some experts in disaster management with a questionnaire survey. As a result, hospitals ranked and prioritised critical factors to manage any hospitals' upcoming disaster events better. The results indicated that Iranian hospitals require collaborative planning for different emergencies. The equipment and supplies needed to meet surges need better operation management during disasters.

Hospital capacity can be quantified based on the severity, acuity, duration, magnitude or volume, and nature of the disaster event. It then may be possible to measure the speed and adequacy of the potential response.

Accordingly, disaster management aims to be proactive. To conduct proper disaster management, the sequence of activities that are logical, integrated and progressive should be acted as a cycle called the Disaster Management Cycle

The complexity of the disaster operation management in hospitals, in some cases, would be increased due to the high volume of potential casualties as well as the urgency of a quick response to casualties. Moreover, delays of minutes may cost lives and property because the impact of disaster on affected victims will be decreased by conducting efficient preparedness.

There are critical needs for developing effective disaster mitigation and preparedness measures to rapidly deploy resources in hospitals (e.g. medical resources, food, clothing, shelter, etc.) in any disaster events. Thus, such a critical need creates an economically costly and complex planning paradigm. Further, since disaster demands critical decisions that must be made in difficult circumstances, it was considered that responding to a disaster is a severe challenge. Disaster response presents a unique environment because of the immediate risk of significant loss, stress, and time pressure.

Objective 2: To evaluate and synthesise the current status of Iranian public hospitals in the case of disaster events and examine the impact of floods and earthquakes on critical factors of successful hospital management.

This objective was explored in the literature review and questionnaire survey through some disaster management and hospital areas. Hospitals play a vital role in the health, social structure, and economic life of a community. Patients expect hospitals, and health system workers, to be available to provide care for them in all circumstances. A level of preparedness viewed as adequate in the past is no longer seen as acceptable. To be more highly prepared and to be able to respond effectively, hospitals must make a substantial investment in equipment, training, facilities improvements, and supplies. It was identified that hospitals are vulnerable to the stresses of disaster responses due to several inherent characteristics: Complexity of services: Hospitals are facilities that provide healthcare but must also function as laundromats, hotels, office buildings, laboratories, restaurants, and warehouses.

Dependence on lifelines: Hospitals depend entirely on essential public services: water, sewer, power, medical gases, communications, fuel, and waste collection. Hazardous materials: The hospital environment contains toxic agents and poisonous liquids and gases. Dangerous objects: Heavy medical equipment, storage shelves, and supplies can fall or shift during an event such as an earthquake. The literature review suggested that A comprehensive hospital emergency management program must address several critical elements to adequately protect patients and staff and permit the facility to continue to operate. These are discussed in the following;

The Emergency Operations Centre will serve as the command post for operations during an emergency response. It should be fully operational and integrated into local and county emergency operations. Hospital disaster drills have often been treated as annoyances and are planned in ways to render them futile. Exercises are generally announced (unlike actual events), planned during regular business hours, and rarely include all hospital operations affected by an actual event. Hospitals are encouraged to drill individual units—frequently and during nights and weekends—and then build up to complete functional exercises involving management of moulage "casualties." Community participation is critical to identify elements that work or that need fine-tuning. The plan will be adequately stressed through exercise so that failure points are identified. These "freelancers" may cause problems or may even be impostors. A disaster will place significant demands on the food service system. The adequacy of food supplies for patients and staff should be evaluated. Because a hospital may need to be self-sufficient for several days in a disaster, a 3- to 4-day supply of food products is advisable. Foodservice personnel should be included in disaster exercises.

Volunteers may or may not be of assistance, depending on their relationship with the hospital and their background. A volunteer pool that consists of individuals who regularly serve at the facility, are familiar with standard procedures, and participate in exercises can add a valuable workforce to a disaster response effort. On the other hand, disasters will draw volunteers who wish to assist, a phenomenon known as "convergent volunteerism," where unexpected and uninvited healthcare workers arrive and want to render assistance at a large-scale incident. Hospital staff must receive timely and accurate notifications in a disaster, including when and where to report and for how long and other essential information. Contact information for all staff members must be continuously updated and tested. Additionally, the facility must be able to receive warnings and notifications from external agencies and send warnings.

A plan for working with the media will be needed. It is not recommended that media personnel be permitted access to a hospital during a disaster but rather be provided regular, factual updates on activities and the facility's status at a predetermined meeting place. Risk communications involve using credible experts to deliver carefully worded messages to communicate most effectively in a high-stress, low-trust environment, such as a disaster. Preparing hospital leaders in risk communications principles will ensure that they can communicate effectively to the public via the media. Despite “just-in-time” supply schedules and empty warehouses, hospitals should maintain dedicated disaster supplies and arrangements for rapid resupply in the event of a disaster. Disaster response will rapidly deplete critical supplies administrative as well as clinical. Conducting realistic exercises will help determine stock's adequacy and can be done without opening actual supplies to be restocked. Disaster supplies can be rotated into the daily-use stream to ensure stock does not expire.

To conclude, Iran and the Middle Eastern region do not receive adequate coverage in the disaster literature. Moreover, there is a dearth of research on the impact the current natural disaster status in Iran has had in addressing the problems. Very little empirical data is available in this context. Besides, disaster risk mitigation in Iran needs effective disaster preparedness and mitigation mechanisms, people-centred early warning systems, responsible enforcement of policies and legislation, careful development planning, scientific knowledge, public understanding, and political and legal commitment.

Objective 3: To critically evaluate the weaknesses in the existing disaster mitigation and preparedness management in Iranian public hospitals.

By obtaining the theoretical understanding from completing the first and second objectives, the researcher invests in designing the semi-structured interviews and literature review to achieve the third, fourth, and fifth objectives. A comprehensive literature review was conducted to evaluate the current disaster mitigation and preparedness measures properly. By reviewing a large amount of literature from the world, several acceptable practices for disaster mitigation and preparedness management were identified. The data were collected from both primary and secondary data to meet this objective.

Apropos primary data, the semi-structured interviews, and two case studies (Kermanshah earthquake and Central flood) were conducted to provide insight into the Iranian disaster management department's dynamic nature and Iranian hospitals. Such triangulation in data collection enhances the possibility of obtaining rich and comprehensive data. Most significantly, many of the shortcomings pointed out in the current disaster mitigation and preparedness management consist of weaknesses that are internal to the disaster management activities, such as education about disaster risk, the endowment of equipment, financial resources, the planning process, and supporting ordinances; and that are external to the disaster managing in different essential organisations as like as hospitals, such as citizens' irresponsible interventions, the particular security situation, coordination of organisations, and unplanned, random building development.

Overall, gaps in Iran's disaster mitigation and preparedness management were identified by implementing good practice disaster mitigation and preparedness management factors. It was revealed that acceptable practices for disaster mitigation and preparedness management are not sufficiently implemented compared to their importance.

Objective 4: To identify and critically evaluate the barriers and obstacles to the implementation of appropriate disaster mitigation and preparedness management in Iranian public hospitals.

This review of two case studies or lessons learned reports from sudden onset mass casualty in Kermanshah earthquake and Central flood, interviewing some disaster managers, and reviewing the literature have shown that managing such situations involves several hospitals' challenges during disaster events.

These challenges are connected to the ability to manage uncertainty, a shortage of conformity between the contingency plans and the actual situation, ineffective crises management organisations and inadequate information management, as well as the adaptation of medical and non-medical factors to ensure resilient crisis disaster management in different stages such as; mitigation, preparedness, response, or recovery. Being prepared for the unknown is an important part of disaster management, and this review confirms that unplanned and surprising situations occurred in all passed events. Thus, the 'black swan' metaphor for things that have never happened before or seem unrealistic do occur is an adequate reference for the mental preparation and training necessary to manage disasters adequately.

The gap between the disaster plans and the actual events found in this review were noticeable and deserved further attention. However, successful disaster management is not based on plans but on activity. This review also showed that medical perspectives and skills are needed in successful disaster mitigation and preparedness, but non-medical perspectives and factors strongly influenced the decision-making and response. Therefore, cross-agency planning and collaboration in the response are needed.

Objective 5: To develop a set of recommendations for effective implementation of appropriate disaster mitigation and preparedness measures in Iranian hospitals.

The recommendations of this research study were created to enhance disaster mitigation and preparedness management in Iran and Iranian hospitals through a series of expert interviews (Chapter 5), a questionnaire survey (Chapter 4), and a comprehensive literature review (Chapter 2). The sets of recommendations for the endowment of medical equipment, tools, and infrastructure, while recommendations for education about disaster management and coordination, and collaboration, preparedness and mitigation planning, risk assessment and monitoring. However, themes related to having specialist staff appeared in disaster events. Sets of recommendations emerged from this study prior to validation. After validation, the final set of recommendations was identified (Chapter 6). The final sets of recommendations were made up of different themes and, interestingly. This change would promote resilience and make such hospitals better able to survive future natural disaster events.

7.4 Research contribution to Theory

Despite the extensive literature on disaster management research studies in developed countries, there are a dearth of literature in disaster management and hospitals of developing countries like Iran. Due to too few research studies conducted in Iran, this research can contribute to the disaster management literature to develop disaster mitigation and preparedness context and Iranian hospitals, as it is unique in its findings. This uniqueness is due to limited attempts that have been made in the last few years to explore disaster mitigation and preparedness management and keep Iranian hospitals safe and secure during disaster events in Iran.

Thus, this research study can contribute to developing insight into the Iranian disaster management department's dynamic to manage disaster events and hospitals in different-scales destruction, besides offering ideas for lines of further inquiries. Exploring and evaluating the current situation connected with mitigation and preparedness of disaster management in Iranian hospitals has been identified to address the issues faced by effectively mitigating risk to disasters stemming from natural disasters. The character and nature of Iranian natural disasters, particularly floods and earthquakes, were sought as two popular natural disasters in this region and their risk of becoming a complex disaster. Besides that, challenges and barriers facing disaster managers to mi and preparedness management throughout the world were reviewed. Thus, this study contributes to the theory by identifying various challenges facing disaster preparedness and globally mitigation disaster management.

7.5 Research contribution to Practice

By conducting an appropriate and precise evaluation of the current disaster mitigation and preparedness practices by identifying weaknesses, strengths, and recommendations, the mitigation and preparedness disaster management would be improved, ultimately mitigating the loss of life and increasing health services casualties in hospitals.

Proposing recommendations for the Iranian disaster management department would increase awareness and possibly address these weaknesses and enhance disaster mitigation and preparedness management practices. Addressing these weaknesses will improve Iranian disaster management’s ability to have more efficient Iranian hospitals' disaster management.

Implementing that, enhancing disaster mitigation and preparedness practices would promote hospitals' resilience by improving their knowledge and awareness of disaster risks and training in how to act in a natural disaster event.

Moreover, the hospital building and institutional development support on disaster mitigation and preparedness management in Iran would be developed. This research study proposes recommendations and reveals disaster management's value in general and the disaster mitigation and preparedness management stages.

Decision-makers in Iran's government may benefit from this research in their mission to meet the disaster mitigation and preparedness management knowledge requires. Simultaneously, their mission to educate the disaster management professionals working in Iran's disaster management sector can be promoted by considering this research study's outcomes. This will, in turn, enhance the quick mitigation and preparedness performance of all disaster management authorities. This research might also be implemented in other countries at risk of natural disasters. Despite this, Iran's context is very particular, so careful consideration must be exercised to ensure that the context is similar enough to warrant the findings being implemented elsewhere globally.

7.6 Research limitation

Although the research aim and objectives were achieved, there were some unavoidable limitations. The following limitations were encountered during this research.

The evidence base in Iranian hospital disaster management is generally low, and many best practice recommendations are founded on lessons learned and shared experiences. However, a method for reporting and evaluating crisis management is not yet standardised. Therefore, the learning process and evidence development must rely on a comprehensive synthesis from experiences rather than traditional, randomised research studies.

As part of a review methodology, several analysis methods may be employed. The analysis process was inspired by the integrative review methodology incorporating both quantitative and qualitative data in this research study.

It should also be kept in mind that this review covers only two out of thousands of mass casualty or natural disaster events over the past ten years. Therefore, the results must be interpreted with some caution. They do not rule out other challenges that might be present during the management of a mass casualty or disaster situation. These challenges may provide a basis for further research studies to explore successful strategies further to respond to mass casualty and disaster situations. The research study is restricted to the Iran disaster management department; therefore, it cannot be generalised to other countries unless more research is conducted. There are only limited literature sources relevant to the research scope, mainly in Iranian disaster management and Iranian hospitals in natural disaster events. Thus, this research study has made a positive contribution to the current literature context.

7.7 Direction of future study

This study has investigated Iran's health disaster management system and indicated that although variety exists among organisations, there is a necessity to reform the current system. The research study implies the importance of taking precise approaches and looking at different subject areas. This has been the first study investigating the disaster management system using a comprehensive organisational and environmental approach.

However, due to the study population's limitations, which is restricted to the disaster management department and Iranian hospitals, it would be useful to conduct a national survey of all health organisations. Adopting an intra-disciplinary approach to health and non-health organisations and ministries to study their disaster management system efficiency could be possible for future work. Looking at the macro level, a comparative or non-comparative study to present an appropriate disaster management model for the whole set of organisations and stakeholders involved in disasters would be valuable in developing countries.

In some countries, such as the UK, there is an office for risk management in health organisations within the health system. The author suggests that risk management is a topic worthy of future study, particularly in the Iranian health system. Such a study could validate the findings of this study. Adopting this approach as it becomes more developed and studying risk management by looking at subfields could be a fruitful study. Furthermore, the incidence and epidemiology of major incidents and disasters, per cent of disasters in each area, their frequency and scale of risk are fruitful areas for future study.

7.8 summery

This chapter summarised the conclusion and recommendations of the research findings. It highlighted the purpose of this research following its objectives. Further, the contribution of this research to knowledge in terms of both academics and practitioners were presented. Finally, the limitations encountered while conducting this research and recommendations for future investigations by researchers were presented.

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Appendixes

APPENDIXES:

Appendix A: The list of Refereed Publication

Peer-reviewed Journals

- **Salamati Nia, S. P.,** & Kulatunga, U. (2017). **Safety and security of hospitals during natural disasters: challenges of disaster managers.** *International journal of safety and security engineering*, *7*(2), 234-246.

- Salehi, S., Jalili Ghazizadeh, M., Tabesh, M., Valadi, S., & **Salamati Nia, S. P**. (2020). **A risk component-based model to determine pipes renewal strategies in water distribution networks**. *Structure and Infrastructure Engineering*, 1-22.

Conferences

- **Salamati Nia, S. P.,** & Kulatunga, U ,Valadi, S. 2019. **Investigating the preparedness of Hospitals in catastrophic events,**1st Congress on Hospital Disaster Management Tehran university of medical science-March (DMPDH-2019) Mar 15, 2019, Tehran, Iran

- **Salamati Nia, S. P.,** Kulatunga, U., Udeaja, C. E., & Valadi, S. (2018). **Implementing GIS to improve hospital efficiency in natural disasters.** *The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, 369-373.

- **Salamati Nia, S. P**., & Keraminiyage, K., Kulatunga, U ,Valadi S. **Investigating the Disaster Preparedness of Iranian Hospitals in Disaster Events**.(2018). 3rd IFIP Conference on Information Technology in Disaster Risk Reduction (ITDRR-2018) Sep 21, 2018, Poland

- **Salamati Nia, S. P.,** & Kulatunga, U. (2018**). Improving Hospital Efficiency in Natural Disaster Events** 15th September ARCOM DOCTORAL RESEARCH WORKSHOP "The challenges of ageing society in Construction Industry" Sep 2018 University of Salford, Manchester, UK

- **Salamati Nia, S. P.,** & Kulatunga, U. (2017). **The importance of disaster management and the impact of natural disasters on hospitals**. The 6th World Construction Symposium 2017 Sri Lanka.

- **Salamati Nia, SP** and Kulatunga, U 2017, **The challenges of hospital disaster managers in natural disaster events ,** in: 5th International Conference on Disaster Management and Human Health: Reducing Risk, Improving Outcomes, 7-9 June 2017, Seville, Spain.

- **Salamati Nia, S. P**., & Kulatunga, U. 2016, **The importance of Disasters management and Impact of it into Hospitals**. *SPARC 2016 Book of Abstracts,* 51.The university of Salford, UK

Appendix B: Research Ethical Approval

University of Salford MANCHESTER

Research, Innovation and Academic Engagement Ethical Approval Panel

Research Centres Support Team
G0.3 Joule House
University of Salford
M5 4WT

T +44(0)161 295 5278

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3 April 2017

Dear Seyed Payam,

RE: ETHICS APPLICATION ST1617-70 - Hospital disaster management in Iran: Development of built environment specific strategies

Based on the information you provided, I am pleased to inform you that your application ST1617-70 has been approved.

If there are any changes to the project and/ or its methodology, please inform the Panel as soon as possible by contacting S&T-ResearchEthics@salford.ac.uk

Yours sincerely,

Dr Prasad Tumula
Acting Chair of Ethics
University of Salford
Maxwell Building, The Crescent
Greater Manchester, UK M5 4WT
Phone: + 44 161 295 3644
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www.salford.ac.uk/ethics

Appendix C: Participant Information Sheet Interview

Participant Information Sheet

Research Title: The importance of disaster management and impact of it in hospitals

I would like to invite you to take part in a research study. Before you decide you need to understand why the research is being done and what it would involve for you. Please take time to read the following information carefully. Ask questions if anything you read is not clear or would like more information. Take time to decide whether or not to take part.

This study is part of a Ph.D. research; this research will concentrate on the impacts and demolitions are made by natural disasters in hospitals. In this research two case studies will be considered in Iranian hospitals, in addition similar cases will be considered in cross of the world.

What is the purpose of the study?

The overall aim of this research is to develop a framework for Total Quality Management implementation in Iraqi Oil Companies.

Why have I been invited?

You were chosen due to your experience and previous research you have done in connection with this particular research. Also disaster managers and some representatives in different levels related to hospitals and built and environment in hospitals will be asked a number of questions, by structured interview.

What will happen to me if I take part?

- There is face to face interview.
- Each interview session will take 2 hours.
- Each interview will recorded by audio-taping, the main reason for that is help the researcher to take more important notes through replay the interview.

- All electronic data will be password protected. While the hardcopy data will stored in safe and secure place with limited access like me and my supervisor. Also all data will be backed up on DVD and stored in another safe place in case of losing some data.
- During the interview you will answer some questions. Your answers will be treated as qualitative data and will be analyse through one of analysis method.

What are the possible benefits of taking part?

We cannot promise the study will contribute you but the information we get from you will contribute in shedding lights on the main problems that in connection with this research.

What if there is a problem?

If you have a concern about any aspect of this study, you should ask to speak to the researchers who will do their best to answer your questions.

Will my taking part in the study be kept confidential?

All information which is collected about you during the course of the research will be kept strictly confidential, and any information about you which leaves the university will have your name and address removed so that you cannot be recognised.

What will happen if I don't carry on with the study?

If you withdraw from the study all the information and data collected from you, to date, will be destroyed and your name removed from all the study files.

Who is organising or sponsoring the research?

University of Salford

Researcher Name: Seyed Payam Salamati Nia
Phone No: 07908191696
E-mail: s.p.salamatinia@edu.salford.ac.uk
Supervisor Name: Udayangani Kulatunga
E-mail: u.kulatunga@salford.ac.uk

Appendix D: Interview Guideline

Seyed Payam Salamati Nia
Ph.D. Researcher
Room 413
School of Built Environment
4th Floor, Maxwell Building,
The Crescent,
University of Salford, Salford
United Kingdom
M5 4WT
Email: s.p.salamatinia@edu.salford.ac.uk

Dear Madam/Sir,

My name is Seyed Payam Salamati Nia. I am Ph.D. researcher at the University of Salford. I am currently working on my research that is the importance of disaster management and impact of it in hospitals. The aim of this research is evaluate the risk of natural disasters and impact of it into hospitals and health service during disaster events. As part of data collection for my PhD study, you are kindly invited to participate in this study by providing information that might be valuable to my Ph.D. research.

Therefore, I am requesting your kind cooperation in giving your time, experience and thoughts by answering my questions during the interview and the questionnaire form provided. Your cooperation is most essential as the deliverables of the case study could be beneficial to both the country and academia.

Thank you very much for your participation.

Yours faithfully,
Seyed Payam Salamati Nia

Appendix E: Interview Questions

Introduction

The main aim of this interview is to understand the interviewee's perspective on issues related to disaster mitigation and preparedness management in Iranian hospitals. The data collected from the interviews will help the researcher to understand the current issues and concepts of disaster response management as they currently exist in this context. Accordingly, there are no right or wrong answers for the upcoming questions, rather it is a matter of reflecting the interviewee's experience with the phenomena as they were conceived.

Your rights

You may decide to stop being a part of the research study at any time without explanation. You have the right to ask that any data you have supplied to that point be withdrawn or destroyed. You have the right to omit or refuse to answer or respond to any question that is asked of you. You have the right to have your questions about the procedures answered (unless answering these questions would interfere with the study's outcome). If you have any questions as a result of reading this information sheet, you may query the researcher at any time.

Section 1: Introduction

• As I understood from the questionnaire, you have been working in this directorate since ...., is this correct? Which department do you belong to? And how would you describe the disaster mitigation and preparedness management in hospitals?

Section 2: To identify and evaluating the existing mitigation and preparedness measures in hospitals globally. To identify barriers and obstacles to implement appropriate disaster management strategies in hospitals.

Part 1: To identify and evaluate the existing mitigation and preparedness measures in hospitals globally (Kermanshah earthquake and Golestan Flood).

What strategy did you implement to control hospitals during disaster events?

Did you have any specific protocol to mitigate the risk of a natural disaster in hospitals?

Could you tell me Three weaknesses and strengths of a disaster management strategy was implemented at previous events?

Have you done any modification for improving mitigation and preparedness strategy regarding last events?

Do you have any natural disaster drills to improve the capability of personnel of the hospital to manage better disaster events? If there is how often do you do it and could you describe it briefly?

In terms of implementing appropriate disaster management strategy, how do you test your mitigation and preparedness strategy to eliminate weaknesses?

How do you coordinate your personnel of the hospital during disaster events?

How do you collaborate with different organization and NGOs regarding disaster management?

Could you please share with me an example of how you helped coach or mentor someone? What improvements did you see in the person's knowledge or skills?

Section 3: To identify barriers and obstacles to implement appropriate disaster management strategies in hospitals.

What were the most challenges faced in disaster management during the mitigation and preparedness stages in hospitals (Particularly disaster events in Kermanshah earthquake and Golestan Flood)?

Could you list some barriers against that you experienced in those events particularly in preparedness and mitigation stages (Particularly in the hospitals and health centers)?

In terms of challenges against disaster managers, what strategy did you implement to have less impact?

Have you had any barriers to your disaster management strategies during training sessions?

What lessons have you got from those past disaster events to implement it in the future for mitigating negative impacts and improving the efficiency of hospitals in disaster events?

Do you have any recommendation for the overall disaster mitigation and preparedness process in hospitals?

Appendix F: Interview Transcription

Interview 1

I have got experience in disaster management and as an assistant professor at the University of Tehran did lecturing different modulus in connection with disaster management and resilience. Generally, disaster management in the hospital should be considered in all of four stages of the disaster management cycle. Importance of hospitals and health facilities can be identified regarding the location and vulnerability of them in case of disaster events.

In terms of that, all of hospitals and health facilities should be prepared and get ready to manage and control hospitals during and after disaster events. In addition, hospitals should update their strategy plans and their personals to mitigate the risk of disasters and giving better health service to patients.

Strategy:

To implement the best strategy in mitigation stage different methods have been defined in two specific areas, which is a structural and non-structural part.

In structural part, some strategies such as Building codes, relocate the building to a higher level, improve access to the building. In terms of non-structural strategies can be named as disaster management culture improvement, improvement management, and planning.

In terms of detecting and mitigating of the risk of disasters four strategies can be defined:

1) Risk elimination
2) Risk reduction
3) Risk transformant
4) Risk avoidance

In terms of the type of disasters, should be reviewed that which strategy is the most suitable strategy to mitigate the risk of disaster to have a secure place to provide better health service to injured people.

National Emergency Service has got a specific task to finalize disaster management protocols and sent to hospitals to be implemented.

The most weaknesses since Bam earthquake can be lack of trained human resource, lack of coordination, failure of distributing volunteers and donated stuff, and lack of resources.

However, there was a significant improvement since the Bam earthquake and disaster management knowledge of ordinary people, and people in connection with disaster management have been improved.

In terms of drills in the long term and short term will be provided for different organizations regularly which helps to develop their knowledge and getting ready in the events.
Regarding the efficiency of drills, we do “knowledge attitude practice” for each drill.
Regarding coordinating people and personals, each hospital has a specific system is called “Incident Control System” to coordinating staff of hospitals. This system is implemented in different countries such as the USA that is called “FIMA”.
Hospitals and health facilities based upon their pre-planned against of disaster event have collaboration with a different organization and NGO’s.
Basically, after the Bam earthquake was decided to assign one person as a disaster manager in each hospital, but it was not implemented in all of hospitals and health centers.
Based on general plan terms of collaboration between hospitals, organizations, and NGO’s in connection with disaster will be constructed,
The most challenging in disaster events for hospitals and health centers can be coordinating human resources, volunteer people, and managing donations.
In terms of strategy to mitigate the risk of disaster events and giving better health service to demanded people, each hospital has a different strategy. In terms of the type of disasters and treats can be in the face of hospitals mitigation strategies will be planned.
In finally strategy of hospitals are designed based upon the type of disaster, the intensity of that and how the hospital and health center is facilitated and ready to manage it.

Interview 2:

As lecturer and activist in disaster management, we had one workshop in Iran in 2010 from WHO. About 30 people were trained. After that, we understood that one guideline is required. Finally, we designed in 2015 and in early 2016 all of the hospitals and health centers must be implemented this guideline in case of disaster events. Since that time these credit assessment factors became compulsory for all hospitals and health centers to implement it.
In result, hospitals have had up to %25 improved in terms of structural elements and non-structural elements. However, it was a great improvement but this result has come out with self-assessment reports and the validity of that is not accurate.
In terms of structural elements, Iranian hospitals have not been developed well. Despite in late 2009, some disaster management programme was started at Iranian universities, and disaster management knowledge of people have been improved significantly, but still, there is a lack of knowledge in some parts of the country regarding disaster management.

In terms of that, it is necessary to get more collaboration between the disaster management department, health ministry, and education ministry of Iran.

In my experience with Bam and Kermanshah, there was a shock period time initially that took about 24-72hours after the disaster happened.

For instance, in Kermanshah earthquake one location in out of town as collecting point was allocated. Therefore, in the early moments after disaster occurred people were guided to get there. By doing that emergency teams, hospital crew, and other organisations such as fire fighters, and Red cross had more time to get ready after initial shock. In compare with Bam earth quake and other similar natural disasters had happened the preparedness of hospitals and other organisation were better organised in the early hours after disaster happened.

EMI or Emergency Medical Team had incredibly emergency service to injured people in early hours in compare with similar cases in the past.

In terms of collection point lessons was learned since Kermanshah earthquake was to allocate several collection points in different area preferably far distance of central zone of disaster.

By doing this people and injured people can be distributed to safe locations and give much more time to pass shock moments after disaster events. Afterward advance medical hospitals can be organised and distribute injured people to hospitals, shelters, and advance medical hospital points.

In case of Kermanshah some hospitals were collapsed totally and were not usable but some of them were usable, but they needed some preparation time to get ready to manage those injured people at the early hours of disaster. Thus, those collection points organised this better and provided a few hours to pass the first shocking hours after disaster.

In terms of structural elements of Iranian hospitals due to majority hospitals were built more than 45 years can not modify those too much, but in terms of non-structural elements good preparedness strategies were implemented to control and managing hospitals during and after disasters. In terms of disaster management tools and strategies, can be mention about “Hospital simulation system” which helped disaster management team to have better understanding about hospitals and vulnerability of them against of disaster events. By doing this simulation system different functions and factors of hospitals can be assessed then in the next step attitude of people, and hospital personals can be reviewed. In result with all of this we can control and monitor the process of preparedness of hospitals to mitigate risk of disaster events.

The most weakness of our hospitals are related structural elements.

Another weakness of our disaster management strategy in case of hospitals can be mentioned as unsuitable distribution of injured people, and unsuitable distribution of hospitals. In terms of distribution of injured people from collecting point should have equal distribution and delivering patients and injured people to facilitated health centres. Regarding non-suitable distribution of hospitals in different location we had significant problem. For instance, in Kermanshah earthquake after collapsing two hospitals in the town the another one was more than 20 miles distance that made problem. In addition, there is significant issue with our hospitals and buildings are not constructed well and in good location with natural hazards.

Most of hospitals structures and building are same in cross of country and they are not designed with different locations.

Another issue and challenges during disaster events for hospitals can be mentioned as lack of good accessing to hospitals due to disaster caused for accessing road and specially it makes problem for disabled people and those require health service.

There was a proper progress since Bam earthquake in different areas of disaster management in Iran. In particularly disaster management knowledge was raised and preparation of different organisation have been developed much organised.

There has been averagely %20 improvement for hospitals regarding preparedness and managing hospitals during disaster events which was result of improving disaster management knowledge of people and making systematic disaster management system in case of disaster events.

In the general plan for hospitals has been mentioned that hospitals must have regular drill plan to getting familiar with real disaster events. For instance, National Committee of Drills is designed from disaster management department. In terms of that all universities must have one lesson in connection with disaster management during their programme. One drill should be taken each year regularly and every 3-5 years should have a functional drill.

In terms of drills are necessary to test the outcome of them and making sure these drills have added value to our disaster management system. There are different tools to test drills and after testing we implement better strategy to have less risk in the disaster events. In terms of coordination and collaboration in majority of disaster events there had been variety of non-skilled people which made serious chaos. These people in different levels can make problem. For instance one of our challenging in hospital of Kermanshah was managing volunteer people, donated medicine and in some cases lack of hospital's personnel. In some cases, due to shock of disaster some personal escaped their post to get their family. Another issue can be said was disaster managers made just in time decision that was not success in most cases.

Interview 3:

Accessing to hospitals were not activated and disrupting of injured people to hospitals are not managed well. However, lack of coordination and collaboration since Rodbar earthquake in 1990 were obvious, but after almost three decades there has been a good improvement and from big chaos, we can say now we can say that there is some systematic plan in most cases.

For instance, in Kermanshah earthquake one location in out of town as collecting point was allocated. Therefore, in the early moments after disaster occurred people were guided to get there. By doing that emergency teams, hospital crew, and other organisations such as fire fighters, and Red cross had more time to get ready after initial shock. In compare with Bam earth quake and other similar natural disasters had happened the preparedness of hospitals and other organisation were better organised in the early hours after disaster happened.

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Interview 4-5:

In the center of disasters or in the radius of 10 miles to disaster events based on current disaster management protocol there was not any EMS(emergency service center) or any hospital. For instance, in Islam Abad E Gharb the hospital was collapsed totally.

In the first 24 hours, the most priority was to preparing a movement to a safe and secure location. Also, move ordinary people to collect points close to town. This helps to rescue teams to give a better service to injured people.

Basically, if the center of disaster events are located in popular locations rescue organizations such as hospitals and fire service buildings are getting out of service or there might be chaos.

In terms of disaster management, there was assigned any task to a specific person and it was chaos in the first 24 hours of Kermanshah earthquake. Otherwise, some duties were ordered by higher disaster managers but were not completed accurately. In general, there was not a preparation plan in advance.

In reality, there is no set plan for each person in advance. Thus there is no good coordination and also the distribution of duties between different people involved in the hospitals during disaster events.

There was a good improvement to establish some protocols and principals since 2015, that helps to organize all of the duties and have better coordination and collaboration between different organizations and people are being involved in disaster events.

Another good improvement has been done in recently there is one assessment for each hospital that shows how hospitals are capable to manage disaster events.

This leading hospitals to have a better understanding of their capacity to manage and mitigate the risk of disasters. Also how hospitals can increase their health service during or after disaster events. In the same way, hospitals must have an advance system and protocol to manage disasters and mitigate the risk of disasters on health services.

This system started in 2015 in Iran. In terms of managing disaster and capability of health centers to mitigate the risk of disasters, each hospital received different points. In result, disaster managers have a good understanding of the capability of each hospital in disaster

events. Thus for distributing budget to these hospitals this assessment is part of the distribution criteria.

This assessment in 2015 was implemented and it was called “Hospital safety index” that works as self-assessment for each hospital and health centers.

However each hospital must complete this self-assessment regularly, but it is not implemented perfectly in disaster events.

In compare of different disaster events in Iran, for instance in the Bam earthquake, the structure of Bam’s hospitals were not sustained and it collapsed. The most weaknesses can mention was the lack of proper management and union decision maker.

Another issue was about those people were not expert and were not part of the disaster management team to make a decision.

However there were above weaknesses in the past, but there have been good improvements regarding disaster management knowledge. Hilal Ahmar is a charitable organization; the equivalent of the International Red Cross. Hilal Ahmar is a humanitarian non-profit organization that provides emergency assistance, disaster relief, and disaster preparedness in Islamic countries.

In recent years there was a good improvement in Hilal Ahmar and also good collaboration and coordination there and between different organizations such as fire rescue service and hospitals.

One of the most barrier and problem in face of disaster managers can be lack of a proper disaster-oriented plan in hospitals.

After the Bam earthquake was planned to have a disaster manager in each hospital, but after a few years this person did not have enough right to make a decision or in some cases, we did not have this person in some of the hospitals due to saving budget or redundancy strategies.

In terms of drills, these exercises are part of those self assessments and give good credit to each hospital to become more ready and familiar with disaster events situation.

Along with hospitals, these drills are implemented in schools, and universities, but these are not so productive and just will be used on that date to complete the task and then might be forgotten.

In terms of coordination, there has been issued some agreements between different organizations, NGO’s, and hospitals, but these agreements are not implemented properly, and if it has been done in the past disaster event was weaknesses.

Managing volunteers and donation are too difficult in disaster events and can be a serious challenge for disaster managers. Basically, the lack of a proper system to manage volunteers and donated stuff during disaster events is highly required.

Disaster management department has established some principals which are mandatorily for all of the related organizations, but in reality when disaster events occur those are not being fully implemented. In simple word, in disaster events, decisions are based on the case, time, and location of the event will be made.

Regarding mentors and trainers in Iran assigned to Hilal Ahmar and Firefighters to prepare these drills for different organizations.

In disaster events, the main tasks for all of the hospital's personnel to give health service to demanded people, and before disaster making a good profit is a matter for them. Therefore attention to disaster preparation might not be in priority of them. Therefore most activities such as drills and preparation activities are taken to get more credit for their hospitals to get better health budget from the government. In reality preparation of hospitals are more for higher rank people in hospitals instead of all of the personals.

Another issue and barrier against disaster managers can be a lack of information for disaster managers about the capacity and capability of hospitals and health centers in advance. By doing this disaster managers have a better understanding of those facilities and know how to distribute injured people to them.

Also, a particular budget should have verified for preparing shelters and emergency hospitals for disaster events in advance, but most will be allocated during disasters that make a problem for disaster managers.

Totally about lessons have been learned from previous disaster event, there has been a good improvement from the past in different parts to manage disaster events, but lack of good and union management, lack of a proper preparation plan, and lack of good assessment and monitoring before and during a disaster on structural and non-structural elements of hospitals can be named. Finally, I recommend instead of setting rolls with out of the implementation, it is much better to have a better system for monitoring and controlling events.

Interview 6-7:

Since 2010 disaster management and HSE in hospitals have become important, and from that time I have been involved in different disaster events across the country.

The critical role of hospitals regarding past disaster events in Iran and some failures happened in local hospitals has been increased. Basically, hospitals are as like as the heart of town in disaster events, that can mitigate the risk of disaster events significantly.

In terms of those strategies have been implemented recently for structural elements of hospitals had not a good result in recent disaster events. For instance, In recent flooding in 2019 in Shiraz and Kermanshah, three hospitals were collapsed totally.

Generally, implementing strategies are related to those personal work at the hospitals during disaster events. In simple word means how they have been trained for managing hospitals

during disaster events. Also, what is their authority to implement disaster management decisions, or just follow those pre-planned principals that are not appropriate with type, and location of incidents?

For instance in recent flooding in Golestan the hospital was built in the last five years, but after the disaster occurred all of the structure of hospital was collapsed and was useless. For another example, in recent flooding, nevertheless, the hospital of Mother and child in Shiraz was located about 10 miles far distance from flooding was useless because had not been done any good research to build a hospital with better access roads.

For mitigation of disaster risk some protocols and principals have been made, but in case of disasters regarding location, type, and situation of injured people cannot be implemented in all of the hospitals, but its uses as a guideline.

One serious issue can be a lack of good monitoring and assessment for building hospitals.

For instance in Kermanshah, the hospital gave service was the hospital built 30 years ago and gave good service during a war, but the new hospital that was much modernized and facilitated better was out of service. This means there is no good controlling and monitoring during the building process of hospitals, and good research to build in a good location.

Regarding strengths about Iranian hospitals in disaster, events can mention that people and higher managers have been reached to a good understanding of the importance of hospitals during and after disaster events. Ministery of health and disaster management department had good progress for this improvement.

However, there was a good improvement since the Bam earthquake, but regarding weaknesses can be mention of some weird principles and lack of good assurance to implement those in case of any disaster events.

In terms of drills, due to lack of assurance policy to implement disaster principles and also lack of proper controlling during drills in most hospitals may not get a good outcome from that.

In reality, to deliver drills for hospitals, it is not the main objective for them.

For understanding the efficiency of drills, disaster managers distribute some questionnaires to get more feedback and also with monitoring the process get failures to improve them in future drills. In terms of testing these drills as I said previously there is no warranty or any assurance to implement drills appropriately or paying attention. For instance, if any equipment does not work accurately from the ministry of health give the notice to sort out that failure, but no organization gives any notice or warning regarding the inappropriate implementation of drills. Therefore in my opinion drills in hospitals are more about getting credits for their budget instead of practicing to manage the disaster in real events.

For drills, there is some principles and protocols but those are not fully implemented, or accurate assessing to get a good outcome.

In Iranian hospitals giving health service to injured people during disasters manage well even in a hard moment, but if the structure of hospital collapse the service get a serious challenge.
Regarding non-structural elements of hospitals within the first 24 hours after the disaster happened, there is a big shock in the area of disaster in, particularly hospitals. Thus all of the activities within the first 24 hours are based on trial and error strategy. To get a better understanding of the importance of drills, those hospitals had good training sessions and drills have got a better response.
The collaboration of different organizations had a very good improvement in comparison with the past but still requires more attention.
In terms of updating drills and disaster management training sessions, we had good improvement, and disaster management knowledge of ordinary people, hospital personnel, a higher level of managers significantly improved.
For instance, we had good drills in different aspects of disaster management, one of the recent drills had was about preparing food for the patient of the hospital if there is no gas or any other fuel. That was very success drilled in that case catering personnel of hospital prepared food with traditional methods to get more understanding if this situation happens in the future.
Also, there is a good collaboration between hospitals in case of an emergency situation and disaster events. Between some hospitals, there are some internal agreements to manage those difficulties with each other.
Most challenges are related to hospitals can be lack of good disaster management training. I recommend that for getting a better result in disaster events is valuable to pay more attention to disaster training sessions and drills regularly and with good monitoring of them to get the best result.
Another challenge can be the modification of hospitals, that are not based on hospital and construction engineering principles. These can cause a serious issue for managing hospitals in fire and flooding incidents.
Regarding drills, there are some challenges, for instance, organizers of these drills are Hilal Ahmar or Firefighters with collaboration with the health ministry. In case of drills if these organizations have not got good collaboration many issues can be caused. For instance, if Hilla Ahmar don provides their equipment hospitals are not able to deliver these drills. Therefore having good collaboration in drills are so important.

Finally, the most import part in hospital is providing one room as a disaster management room to store necessary items are required in the first 48 hours of incidents to keep hospitals safe ready to manage disaster events.

In some hospitals, this facility has been provided and it should be provided in rest of hospitals in Iran. Finally, from my past experience, in my opinion, the most important strategy to mitigate the risk of disasters and have better outcome is preparing proper drills and disaster training sessions. Assessing these drills should be improved and principles and protocols should be modified based upon location, types, capability of hospitals.

Interview 8:

In the mean time, I am working as a director of Behtab project. This project is funded by Iranianian and Japanese governments. This particular project is concentrated on preparedness of hospitals in disaster events and keeping hospitals active and alive during and after incidents. In particularly this project works based on earthquake and flooding due to the highest natural disaster events happen in Iran.

In this project variety of hospitals will be evaluated. Initially evaluation starts with rapid visual assessment and then with initial funding we test it with detail engineering analysis. In the final step of this project, we are planning to establish some principles and strategies which are compulsory for hospitals to implement it during disaster events.

For the next ten years, we are estimating to reach to better situation to have better preparedness and mitigation strategies for hospitals and health facilities.

In terms of non-structural elements of hospitals in this project, we consider different aspects of non-structural elements of hospitals such as functional elements as like as management strategies and also non-structural elements such as equipment, medicine, documents, and etc.

In recent research regarding damages affected to hospitals in Kermanshah and recent flooding understood that about 40% was for non-structural elements, almost 38% was for functional elements of health centers, and just 20% was related structural elements of hospitals.

In reality in Iran preparedness of structural elements have been paid more attention than other elements.

However in terms of principles and protocols, there have been good efforts to have regular drills and have a better understanding of disaster events, but evaluation of these activities are based upon self-assessment and in some cases are not validated totally.

Some hospitals due to getting more credits in compare with others prepare these drills, but these are not as the main objective of them and mostly with less attention gets done.

Basically, there are proper and accurate training sessions planned to be implemented by hospitals and health centers, but these are fully implemented by those.

For isnatnce, these drills for disaster events are similar with training sessions in incident condition for cabin crew. However both of those people get specific training, but in incident situation, cabin crew gets a better result because they paid better attention in past drills and training sessions.

Emergency medical service in Iran and Hilal Ahmar organizations had a good performance in recent disaster events. Also, some contribution from non-profit organizations and volunteers have been increased in the last five years.

However there was good improvement and strengths with those organization, but organizing of these activities, collaboration of these organizations together in disaster events, and distributing donated stuff, coordinating personnel and volunteers to demanded places still we have failures and we need to reconsider these failures to get better in future.

With a lack of systematic and lack of proper management teams who do not have a good experience to manage disaster events with a good understanding of disaster management knowledge in high level is another weakness. In some past disaster events, some wrong information was told to those managers and decision was made with wrong information. Thus it had a negative impact to mitigate the risk of disasters in hospitals.

Another weakness can be mentioned is about the chaos in an early moment of disaster occurred. This time can be about 24-72 hours after the disaster. In the past disaster events, different organizations and NGO'S were involved, but some of them were not capable and trained for disaster events in particular in hospitals. For instance in Kermanshah earthquake and recent flooding Iranian Military was involved to assist injured people and medical teams but in reality, the main aspect of military is defending, and with lack of experience and knowledge of them about disaster events made some difficulties for other people could give better help.

Basically, each disaster events have different conditions, therefore based on each disaster events mitigation strategies should be implemented. In some points can use general strategies but most strategies are based on case and condition of location and type of disasters. In terms of the difference between disaster events, it is necessary to make some decisions just in time. As it was mentioned with good experience these decisions can be made, unless it makes more issues. In terms of disaster different organizations and NGO's get involved in different areas, but some of them with lack of experience and lack of training in the past are not capable to get a proper decision. In terms of drills and evaluation of training sessions have done a good effort, but in Iran, there are two types of hospitals as private and state hospitals.

In private hospitals, the main target for hospitals after giving health service is making a good profit for a hospital in most cases these drills are not fully paid attention. In another type of

hospitals as state hospitals due to getting support from the public budget, it is necessary for them to get good credit and getter better result in regular evaluations. Their fore state hospitals keep practicing these drills and taking those training sessions, but it is not as the main target for them and getting better credit and more budget is the reason for them to prepare these drills. In this case, the output of drills are not that expected and in future it is likely to get some failures of personnale and hospitals to manage disasters. Therfore these two types of hospitals have direct impact to prepardness strategies.

On the other hand, in state hospitals there is another issue and weakness which happens during disaster events. When disaster occurs after a few hours' state hospital get more injured people and they getting stock with overloaded condition. However, they practiced in drills a few times these scenarios, but in some hospitals there might be chaos due to lack of attention was in drills from personals and management of hospitals.

Totally there is good condition regarding principals and rolls in Iran for disaster management. For instance, disaster management department have gathered about 15 different organisations, and in disaster events deputy manager of Iranian disaster management has duty to organise these 15 organisations and make a good collaboration during disaster events.

But in reality managing these 15 organisations are not simple as it seems. The coordination and collaboration between these organisation always have got different issues. Also some organisations such as NGO's and charities are not named in these 15 organisations and there is no specific principal to manage and distribute those during and after incidents.

In terms of challenges in face of disaster managers to mitigate risk of disasters in hospitals and keep hospitals safe and secure during disaster events can be mentioned lack of accurate duty for each organisation and person who might be involve in these events, also lack of proper evaluation of drills to prepare personals for real incidents.

The another challenge might be lack of compromising of current principals with our hospital's location. In simple word these principals used to be whiten for villages and small towns, but after some years those villages have been developed and have become small town or bigger. Therefore, it is necessary to update our principals regularly to avoid making chaos. Finally, it is necessary to improve the communication system to improve informing details truly to ordinary people and who might help during disaster events.

In terms of principals and making rolls for disaster management have been good improvement since Bam earthquake, but regarding implementation and evaluation of them still there should be more effort. Basically there is no systematic plan and collaboration between organisation and in most cases are not good efficient and precise. In terms of weak coordination and lack of good system to distribute donations, multi barriers happen during disasters against of disaster management teams and personal of hospitals.

Also with lack of good communication system and good informing details of disasters and requirements of suffered locations giving appropriate service to those areas might be distracted. Therefore, it is necessary to have union statistic to have better understanding about requirements and in response have better and quicker contribution.

And was part of the disaster management team in that area. We were given some warning notice in advance regarding weather condition and possibility of flooding.

Therefore, we had a good time before flooding strikes to hospital's buildings and towns.

Initially once we received warning notice, in those hospitals all of drainage holes were checked and cleaned deeply to avoiding any blockage.

Dredging of hospital's roof and drainage pipes were done, some barriers such as sand's bags prepared and placed in front of vulnerable areas in hospitals, all of windows were covered with tick plastic tapes, tried to fix some equipment to prevent running by flood, and also in lower level tried to rise level of most of equipment above 1 meter at least.

There have been established some protocols and rolls for eliminating risk of disasters. Some general principals are made to be implemented in case of disasters for hospitals, but these are not very good productive and completely appropriate for all cases and locations.

Therefore, it is necessary to update those principals and make to more appropriate for each scenario and more compromiser for different hospitals.

The main duty of hospital's personals to give health service to patients and treat them. Thus in normal condition or catastrophe situation the first and last duty of them should be giving health service. This means their tasks are based upon disaster management. In terms of improvement of disaster management in Iran can mention about having committee of disaster management in hospitals in recently, which is compulsory for all of private and state hospitals. This means there is one or a few people are assigned in hospitals permanently to manage hospitals and health facilities during disaster events and prepare these facilities ready to have high efficiency.

In terms of drills there have been good improvement since Bam earthquake.

For instance, drills and disaster management training sessions have become compulsory for hospitals and should be done regularly, but these drills as mentioned previously might give extra credits to hospitals to get better situation to claim more budget. Thus with my experience these drills are not paid fully attention and the most concentrations of hospital's personals are not learning and it is about getting credit instead.

In fact, the main aspect of drills is not fully considered and the main objective for hospitals is getting promotion credit.

In terms of evaluation of strategies are implemented in hospitals, some assessments are done by some experts to get improvement and learn lesson from past experience.

In terms of coordination there is one position in disaster management department that is called "controlling of incident room". The controlling of incident room is responsible to coordinate different people and observe personals, and organisation's activity to have a better collaboration in disaster events.

For instance, this controlling of incident room assign task to different people to mitigate risk of natural disasters. But in reality this controlling is more general and it is not in details. In simple word this is not working based on the location, type of disaster, and capacity of hospitals, and it comes from some principals, which are made generally.

Regarding collaboration there have been some agreements between different organisations and also with hospitals and Emergency medical service teams, but these agreements were not tested and evaluated properly, and cannot be implemented in disaster events properly.

The main issue for these agreements is about lack of understating about capability of each organisation, hospitals, and NGO's.

Based on previous experiences these types of agreements are not productive, due to lack of understanding of capacity and capability of two parts of agreements.

For example, some agreements have been made between different hospitals which have no equal capacity and capability in rush time.

It is necessary to reconsider these agreements based on their abilities to have better efficiency in disaster events.

For instance if one hospital have a good equipment, thus with these factors should make a agreement, and if one hospital have a better capacity to allocate injured people then this can be considered in urgent moment to move injured people from overloaded hospitals to that hospital.

If one hospital has better and more medicine team in necessary condition with a good agreement these experts can give service to another hospital.

Generally, hospitals should make an agreement based upon their abilities and should be realistic instead of paper work with less efficiency in disaster conditions.

In terms of challenges in face of disaster managers and hospitals can mention about lack of understanding about disaster and lack of knowledge about disaster management can be main challenges for managing hospitals.

In terms of challenges in face of disaster managers can mention about over loading task to someone. For instance giving disaster management task to someone who is already have different responsibilities. Thus this person cannot concentrate to managing disasters properly. The another challenge can be lack of medical equipment and staff of hospitals during disasters. In past experiences once disaster occurred some personal of hospital escaped from their positions due to their fear or reaching to their families. Also managing volunteers and distributing donations are the another challenge for disaster managers.

Appendix G: Questionnaire Cover letter

Seyed Payam Salamati Nia
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University of Salford MANCHESTER

Dear Madam/Sir,

My name is Seyed Payam Salamati Nia. I am Ph.D. researcher at the University of Salford. I am currently working on my research that is the importance of disaster management and impact of it in hospitals. The aim of this research is evaluate the risk of natural disasters and impact of it into hospitals and health service during disaster events. As part of data collection for my PhD study, you are kindly invited to participate in this study by providing information that might be valuable to my Ph.D. research.

Therefore, I am requesting your kind cooperation in giving your time, experience and thoughts by answering my questions during the interview and the questionnaire form provided. Your cooperation is most essential as the deliverables of the case study could be beneficial to both the country and academia.

Thank you very much for your participation.

Yours faithfully,
Seyed Payam Salamati Nia

Appendix H: Questionnaire

Improving the Efficiency of Hospitals in Natural Disasters

Questionnaire

Research Title: Improving the efficiency of hospitals in natural disasters
This questionnaire is based on an ongoing PhD which seeks to evaluate and synthesis the context of disaster preparedness and mitigation management stemming in hospitals. The questionnaire intends to capture the importance of hospitals and evaluating critical factors of that in disaster events. As such this questionnaire is divided into two major sections based on the first two objectives of this research and it will not take more than 10 minutes.
1) Evaluating hospital operation management and exploring critical factors of successful hospital management.
2) The importance of hospitals in disaster events and examining the impact of disasters on critical factors on hospital operation.

PARTICIPANTS' RIGHTS:
You may decide to stop being a part of the research study at any time without explanation. You have the right to ask that any data you have supplied to be withdrawn/destroyed. You have the right to omit or refuse to answer or respond to any question that is asked of you. You have the right to have your questions about the procedures answered (unless answering these questions would interfere with the study's outcome). If you have any questions as a result of reading this information sheet, you can query the researcher before the study begins.
CONFIDENTIALITY: The information collected will be used for the sole purpose of this study and for academic publications. The findings of the study will not be attributed to any specific personnel.
Scope: Is investigating disaster mitigation and preparedness management in Iranian hospitals.

PhD Researcher:
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UK

* Required

Untitled Title

Section 1: Professional background

The section is designed to identify your familiarity with disaster management

1. **1. Name**

2. **2. Main Role** *

3. **3. How would you rate your experience with disaster management?** *
Mark only one oval.

- ◯ N/A
- ◯ Very Low
- ◯ low
- ◯ Average
- ◯ High
- ◯ Very High

4. **4. Is someone in the hospital responsible for disaster management?** *
Check all that apply.

- ☐ Yes
- ☐ No
- ☐ I do not know

5. **If the answer of previous question is "yes" does this person interact with any of the following?** *
Mark only one oval.

- ◯ Ministry of Health (national headquarters level or local level in health centers or health posts or community health workers)
- ◯ Civil Protection
- ◯ National Disaster Management Office
- ◯ United Nations
- ◯ NGOs
- ◯ Other: _____

Improving the Efficiency of Hospitals in Natural Disasters

Section 2: Importance of hospitals and evaluating some critical factors of it in disaster events

This section is designed to identify based on your experience in connection with hospitals and importance of its in disaster events.

6. **6. Based on experience from the past disasters, how would you rate the importance of hospitals during disasters?** *
Check all that apply.

- ☐ Not important
- ☐ Important
- ☐ very important
- ☐ Extremely important

7. **7. How would you rate the importance of following critical factors for keeping hospitals safe and secure during disaster events?** *

Mark only one oval per row.

	Not Important	little Important	Moderately Important	Important	Extremely Important
Managing medical equipment					
Controlling medicine supply					
Providing continues energy system such as electricity and Gas					
Having reserve fuel storage					
Providing sufficient water and food to patient					
Sufficient equipment and supplies in the sterilization services					
Keeping communication system such as phone, Internet, etc operational.					
Keeping heating, ventilation, air-conditioning (HVAC) systems operational.					
Controlling the nuclear medicine and radiation therapy environmentally					
Managing radiology and imaging devices to have continuous service to injured people					
Mitigating physical damages to facilities					
Making patient's document safe and reachable					
Controlling human resources such as hospital's personnel and volunteers					
Keep operation theaters and recovery rooms safe and accessible					
Keeping hospitals accessible to everyone					
Managing colaboration with other organisations in connection with disaster management					

8. **8. How important is it to provide regular training for hospital's staff to have better understanding during a disaster events?** *

Mark only one oval.

- Not Important
- Little Important
- Moderately Important
- Important
- Extremely Important

9. **9. Does the early disaster management planning activities mitigate the risk of disaster on providing health service during disasters?** *
Mark only one oval.

- ◯ Yes
- ◯ No
- ◯ Maybe

Improving the Efficiency of Hospitals in Natural Disasters

Section 3: Examining adverse impact of disaster events on hospitals

This section is designed to identify based on your experience in connection with hospitals and evaluating some adverse impact might be caused by disasters.

10. **10. Based on your observation, rank the impact of disasters on the groups below?(1= Not important, 2=Little important, 3=Moderate important,4=Important)** *
Mark only one oval per row.

	1	2	3	4
Elder People	◯	◯	◯	◯
Disabled People	◯	◯	◯	◯
Children	◯	◯	◯	◯
Women	◯	◯	◯	◯
Others	◯	◯	◯	◯

11. **11. How do you rank the impact of disaster on following facilities and activities in hospitals during disaster?(1=less,5=Highest)** *
Mark only one oval per row.

	1	2	3	4	5
Medical equipment	◯	◯	◯	◯	◯
Medicine storage and blood resources	◯	◯	◯	◯	◯
Patient's document	◯	◯	◯	◯	◯
Water and food resources	◯	◯	◯	◯	◯
Energy supply systems	◯	◯	◯	◯	◯
Resource allocation for the hospital staff	◯	◯	◯	◯	◯
Accessibility to hospital	◯	◯	◯	◯	◯
Coordination and collaboration with others	◯	◯	◯	◯	◯
Resource allocation for volunteers	◯	◯	◯	◯	◯
communication systems	◯	◯	◯	◯	◯

12. **12. From the past experience you had what was the most challenging aspect of keeping the hospital safe and secure during disaster?**