Assessment of Disaster Safety at Matara District General Hospital in Sri Lanka

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Abstract
Hospitals are essential infrastructures in responding to disasters. They are expected to remain functioning during and in the immediate aftermath of disasters. Sri Lanka has experienced a number of natural disasters such as tsunami of 2004, and experienced inadequate disaster preparedness at many local hospitals. However, very limited research has been conducted in Sri Lanka about safe hospital issues. This study attempts to fill this gap by examining disaster preparedness at Matara District General Hospital. When tsunami affected Sri Lanka, this hospital area was devastated, and it remains to be vulnerable to natural disasters.This paper examines how doctors and nurses perceived the preparedness of this hospital by analyzing the results of the questionnaire survey. The results illustrated challenging areas in responding to a large number of disaster victims. Most of the respondents were unaware of the disaster response plan at the hospital. Also, they had not participated in disaster drills. However, almost all the doctors and nurses demonstrated their willingness to improve their knowledge on disaster management and to serve in future disaster situations.

Keywords: Disaster, health facilities, Matara District, preparedness, safe hospital, Sri Lanka.

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1. Introduction

Disasters, both natural and manmade, are increasing globally (WHO, 2015). Health facilities, especially hospitals, are essential in responding to disaster situations, including emergency treatment and trauma care. Health facilities are expected to remain accessible and functioning at their maximum capacity during and after disasters, emergencies, or other crises (UNISDR, 2009).

Studies have shown that disasters cause proportionally more damage to developing countries and poor communities (WHO, 2015). Natural disasters are more likely to affect people in Asia and the Pacific regions (UNESCAP, 2017). One climate change vulnerability index indicates that all seven cities globally classified as "extreme risk" are in Asia (Reliefweb, 2012). Since the early 1990s, natural disasters have cost Asia nearly $1 trillion, almost half of the estimated global cost for natural disaster damages (ADB, 2013).

A study that projects future impacts of disasters for the period between 2020 and 2030 suggests that people in most Asia-Pacific countries will be at high risk for injuries and fatalities. The Asia-Pacific region will endure 40% of the total future economic losses from disasters. Countries with special needs, particularly, in small island developing states like Sri Lanka, may lose almost 4% of GDP due to disasters (UNESCAP, 2017).

The international community has placed disaster risk reduction at the center of sustainable development (UNESCAP, 2017). The Hyogo framework for action (HFA) 2005-2015 and its successor, the Sendai framework for action (SFA) 2015-2030, highlight the importance of ensuring the resilience of critical infrastructure such as hospitals by undertaking disaster risk reduction actions. The SFA has a direct link to health. It promotes the safety of health facilities (IFRC, 2015).

The World Health Organization (WHO) has published a number of safe hospital reports and toolkits. It defines safe hospitals as "health facilities whose services remain accessible and functioning at maximum capacity and within the same infrastructure during and immediately following disasters, emergencies or crises" (WHO, 2008). The WHO "Safe Hospital Initiative" (SHI) concept meant to be adopted by hospitals globally to ensure the structural integrity and functionality of health facilities under disaster situations (WHO, 2015). In addition, it argues that making healthcare facilities safe and resilient is a very cost effective investment compared to spending on reconstruction after a disaster event (WHO, 2008).

The Sri Lankan government basically follows these international guidelines and frameworks, but some gaps still exist in structural, non-structural and functional aspects of hospital disaster preparedness in vulnerable areas like Matara district, our study area. Our research has revealed that virtually no study has examined the perceptions among doctors and nurses regarding the disaster preparedness of hospitals in Sri Lanka. Hospital administrations generally give less priority to disaster safety due to budget constraints. Lack of strong policies, legislation, expertise and technical know-hows are some other

drawbacks to improve disaster safety of hospitals in Sri Lanka. Thus, this paper examines how doctors and nurses in vulnerable coastal areas of Sri Lanka perceive disaster preparedness. In the following discussion, we first introduce our study area and its significance in examining disaster preparedness. Then our questionnaire survey methodology and results are discussed. Finally, we analyze the implications of our survey results for Sri Lanka and other small island nations.

1.1 Matara District General Hospital

Matara district is located in southern Sri Lanka on the land area of 1,282 km² and home to 831,000 people in 2014 (DoCSSL, 2017). Matara District General Hospital (highlighted orange in the map) is the largest public hospital in the district and also one of the main referral centers in the southern province of Sri Lanka. This hospital has 1,050 beds and employs 33 medical specialists, 290 medical officers, 902 nursing staff and 543 supporting staff. It serves the public 24/7. The hospital is located within fifty meters from the Nilwala, the largest river in the district. This rivershed is prone to flooding during the southwest monsoon and cyclones. The Indian Ocean is just 500 meters away from the hospital premises. Therefore, the vulnerability of the hospital to flooding and tsunamis cannot be ignored. As such, it needs to be well prepared to withstand and continue functioning during future disasters.

Figure 1: Map of the study area

This hospital has one doctor who was trained for disaster management. He made the disaster plan mostly to manage mass casualties arriving in the hospital due to external disasters. Only one disaster drill has so far been conducted in the hospital, which was in 2014. No national or internal plan exists to deal with natural disasters that affect this hospital itself (e.g., power failure, telecommunication failure, loss of ground transportation or evacuation plan during floods).

2 Methodology

The data collection was based on a questionnaire survey, field visit, phone interviews, and personal work experience in this hospital. The questionnaire survey was conducted from 10 to 30 September 2017. It aimed to assess the perceptions among doctors and nurses about the current level of disaster preparedness at Matara District General Hospital. The questionnaire consisted of thirty-four questions. The first set of questions aimed to identify the demographic characteristics of the respondents. Other questions attempted to understand various aspects of preparedness, including vulnerability, disaster response and capacity, communication facilities, critical supplies, transport availability, morgue capacity, willingness of the respondents, and future needs. In creating these criteria, we used some ideas from the WHO toolkit for safe hospital, especially its functional aspects (WHO, 2010).

A convenience sample of 30 doctors and 30 nurses was selected from the different units of the hospital. Sixty hard copies of the questionnaire were distributed and 10 were emailed to the respondents. Fifty-five hard copies and five emails returned with effective answers. The response rate for hard copies was 92% and that for emails 50%. The average response rate was 86%.

The field visit to this hospital was done in August 2016. Phone interviews were conducted in October 2017 with several chief nurses and administrators. In addition, Nimali Munashinghe, the lead author of this paper, has four-year working experience at this hospital as a doctor in the medical intensive care unit. This experience has helped better understand and analyze the results of this survey.

3 Results and Discussion

3.1 Demographic Characteristics of the Respondents

Figure 2-6 shows the demographic characteristics of the respondents. About 47% of them were aged between 30 and 39 years and about 68% of them were females. Significantly, male to female ratio among nurses was high (1:5). However, this ratio among the doctors was approximately one-to-one (1:1). In general, male nurses are few in number compared to female nurses in the hospital. The lower number of males in the nursing profession could be similarly seen in other hospitals in Sri Lanka, and it is due to the prevalent concept of nursing as mainly a care-giving female profession.

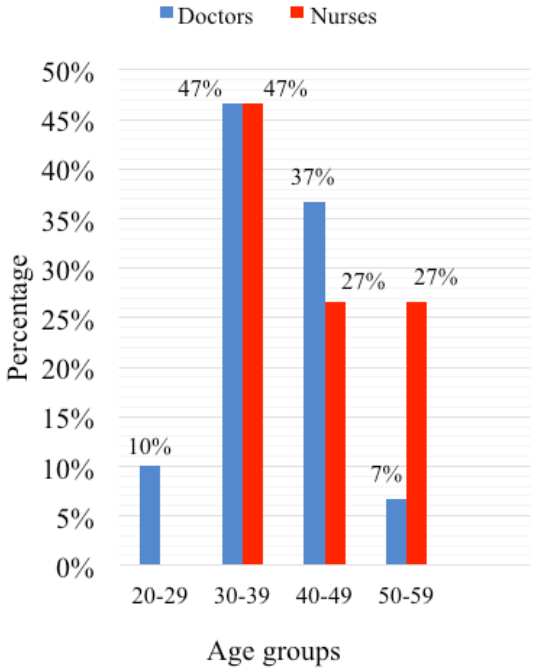


Figure 2: Age distribution

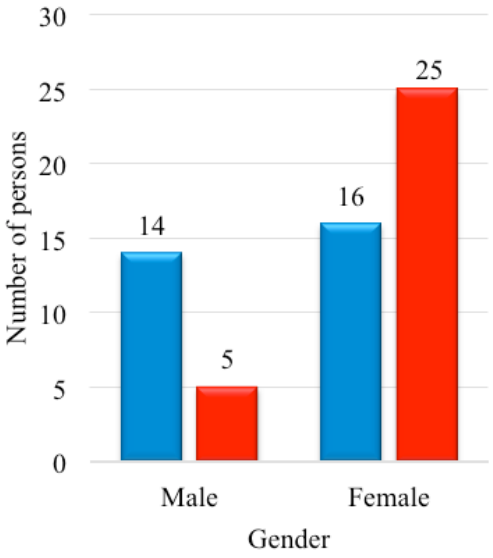
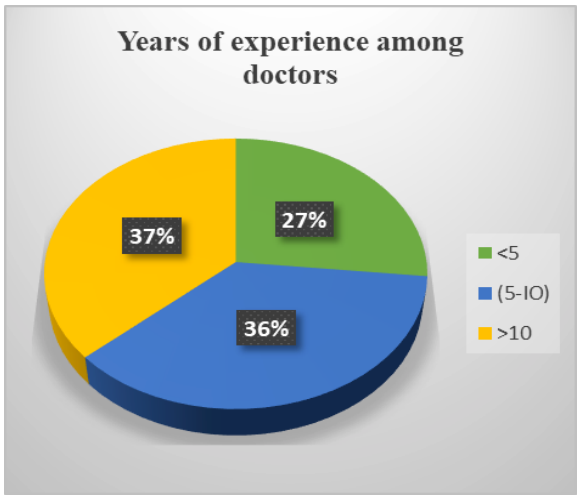


Figure 3: Gender distribution



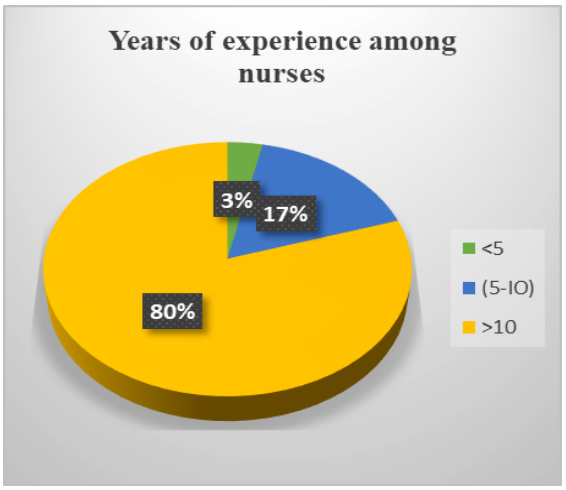


Figure 4: Years of experience among doctors Figure 5: Years of experience among nurses

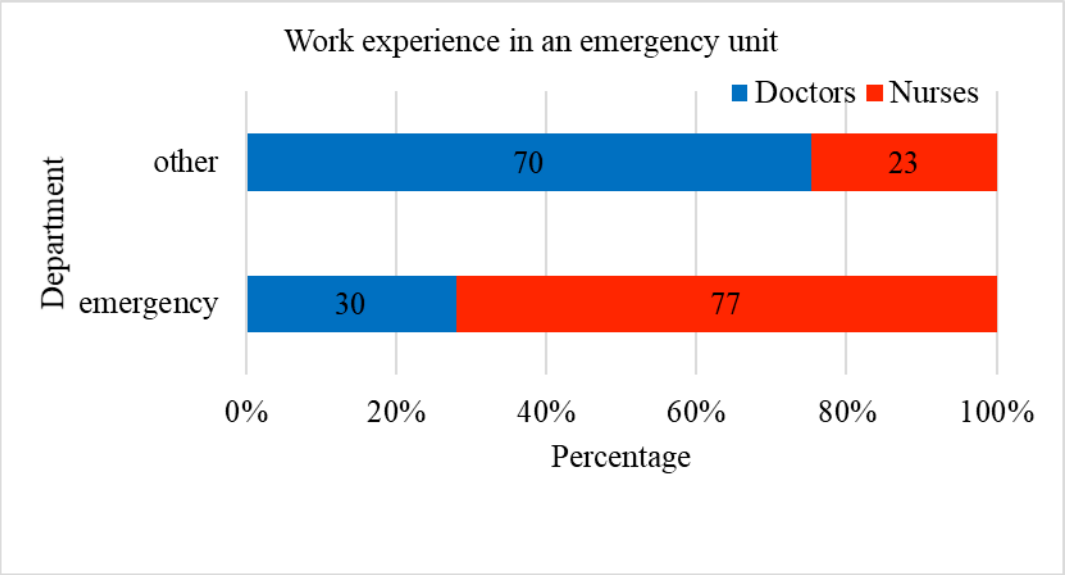


Figure 6: Work experience in an emergency unit

There were two administrative grade officers among the respondents, one consultant doctor and one chief nurse. The nurses had more work experience than the doctors in this sample. About 80% of the nurses had more than 10 years of work experience. Also, the majority of the respondents, mostly nurses, had worked in an emergency department. Nurses get their first appointment usually when they are about 23 years old whereas doctors do at about the age of 28. This means a five-year gap in work experience between the doctors and nurses. In Sri Lanka, doctors have to change the work place once every four years, but nurses are not required to do so. Therefore, nurses tend to be in the same duty station for a longer period of time.

From the total study sample, 57% had worked during a disaster situation. An equal number of doctors and nurses (17 persons each) had experienced some natural disaster in the area. Among them almost all had experienced floods or the tsunami of 2004.

Almost all the respondents agreed that the hospital is vulnerable to natural disasters. We provided six possible hazard categories to the respondents and asked them to rate each one's risk level in a five scale. Figure 7 below shows the result.

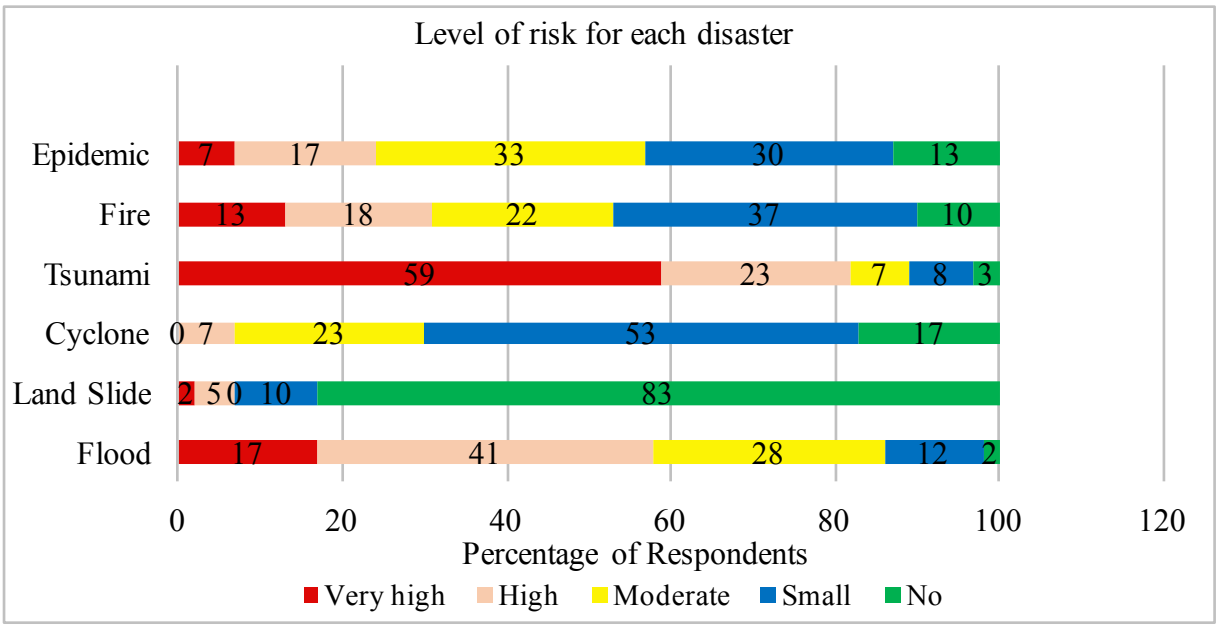


Figure 7: Level of risk for each disaster

We found that the doctors and nurses rated the tsunami as very high. Flood risk was rated mainly as high. Epidemic risk was moderate. Both cyclone and fire risks were rated as small risk. Landslides posed the least risk for them. The proximity of the hospital to the river (50m from the rear boarder of the hospital) and the sea (500m) at least partially explains this result. As the hospital is located in a flat land, the risk of landslide is almost nonexistent. Although there had not been any infectious disease outbreaks originating in the hospital, some external disease outbreaks were reported in the past. For example, in 2017 there was a deadly dengue epidemic throughout the country and this hospital was also overloaded with patients (Matara Interview, 2017).

3.2 Disaster Response and Capacity

Table 1 shows the respondents' perceptions about the disaster response and capacity at Matara Hospital. About 77% of them believed that the hospital would be accessible to the community if a disaster affected the area. This would be true if the hospital itself is not a victim of it. It is connected to four wide paved roads with several entrances and exits. Most doctors (70%) were aware of the disaster response plan, but 57% of nurses did not know about the plan. Also the majority of the respondents (70%) had not participated in disaster drills before. About 92% of the respondents were not familiar with their responsibilities in a disaster drill.

Table 1: Disaster response and capacity

Questions	Number of Doctors	Number of Nurses	Total
Accessibility of the hospital to the community			
Agree	23 (77%)	23 (77%)	46 (77%)
Not agree	7 (23%)	7 (23%)	14 (23%)
Awareness about the disaster response plan			
Yes	21 (70%)	13 (43%)	34 (57%)
No	9 (30%)	17 (57%)	26 (43%)
Participation for drills			
Yes	5 (17%)	13 (47%)	18 (30%)
No	25 (83%)	17 (57%)	42 (70%)
Familiarity with the responsibilities			
familiar	1 (3%)	4 (13%)	5 (8%)
Not familiar	29 (97%)	26 (87%)	55 (92%)
Awareness of evacuation area			
Yes	5 (17%)	13 (43%)	18 (30%)
No	25 (83%)	17 (57%)	42 (70%)
Number of casualties hospital could manage			
<=50	4 (13%)	5 (17%)	9 (15%)
50-100	11 (37%)	10 (33%)	21 (35%)
100-150	4 (13%)	12 (40%)	16 (27%)
>=150	11 (37%)	3 (10%)	14 (23%)
Adequacy of PPE			
Yes	6 (20%)	13 (43%)	19 (32%)
No	24 (80%)	17 (57%)	41(68%)
Adequacy of fire extinguishers			
Yes	3 (10%)	10 (33%)	13 (22%)
No	27 (90%)	20 (67%)	47 (78%)

Frequent drills and simulation exercises help people become more confident about and prepared for evacuation and their responsibilities. At Matara Hospital, however, only one disaster drill was conducted in 2014 (Matara Interview, 2017). We also found that 70% of the respondents were not aware of the designated evacuation area of the hospital. The available disaster plan did not address the evacuation from this hospital.

We then asked if the doctors and nurses have reasonably accurate ideas about hospital's capacity to treat disaster victims. We wanted to understand if they know how many victims the hospital can handle. Significantly, both the doctors and nurses in our survey had no clear idea about the number of patients they could effectively manage during a

mass casualty incident. The WHO suggests that prior preparation could prevent overloading the hospital. In case the hospital capacity is exceeded patients could be directed to neighboring hospitals (WHO, 2007).

In preparing for managing disaster situations at hospitals, doctors and nurses are expected to know if they have access to personnel protective equipment (PPE). We asked if the respondents think that Matara Hospital has adequate PPE for them. The result shows that 80% of the doctors disagreed. Also the majority (57%) of the nurses did not think PPE was adequate. Munasinghe's actual observation confirms this observation by the majority of the nurses. This result raises some concerns because, during epidemics or mass casualty incidents, the inadequacy of PPE leads to a further crisis, spreading infection among the staff and patients.

In connection to physical preparedness, we asked if Matara Hospital has properly installed fire extinguishers. Most respondents believed that available fire extinguishers were inadequate. During the field visit, I found only three fire extinguishers, and, the majority of the staff did not know how to use them. All the findings in this table highlight the inadequacy of their preparedness in emergencies and disasters.

3.3 Communication availability during disasters

Table 2: Availability of alternative communication facilities in the hospital

Alternative communication in case of blackout	Number of Doctors (%)	Number of Nurses (%)	Total (%)
Mobile	30 (100%)	30 (100%)	60 (100%)
Email	12 (40%)	5 (17 %)	17 (28 %)
Fax	3 (10%)	2 (7 %)	5 (8 %)
Walkie-Talkie	0	0	0
Ham Radio	0	0	0

When hospitals handle disaster situations and require additional help, it is important to secure communication. Often mobile phones become out of service during heavy disaster situations. So, we asked if doctors and nurses have knowledge about alternative communication methods. Table 2 shows the results. All the doctors and nurses said that they would relied solely on mobile phones in case landlines fail. Other than mobile phones, 28% said they would rely on emails. Only 8% of them would be able to use fax during a disaster situation at their hospital. No one mentioned about walkie-talkie, ham radio or any other communication facilities.

During a large-scale disaster situation land phones and mobile phones are rendered unusable due to power failures and damage to telecommunication infrastructure as Sri Lanka experienced soon after the tsunami of 2004 hit its coast. The situation would be the same with email communication. Walkie-talkie, ham radio or satellite communication facilities are very effective communication means during a disaster situation. However, none of these were available in this hospital.

3.4 Availability of critical supplies during a disaster

Table 3: Availability of critical supplies during a disaster

22.Critical resources availability	Number of Doctors (%)	Number of Nurses (%)	Total (%)
Running water			
1 day	8 (27%)	6 (20%)	14 (23%)
2 days	13 (43%)	3 (10%)	16 (27%)
3 days	4 (13%)	5 (17%)	9 (15%)
1 week	5 (17%)	16 (53%)	21 (35%)
Food			
1 day	14 (47%)	8 (27%)	22 (37%)
2 days	5 (17%)	3 (10%)	8 (13%)
3 days	6 (20%)	10 (33%)	16 (27%)
1 week	5 (17%)	9 (30%)	14 (23%)
Fuel reserves for generators			
1 day	5 (17%)	6 (20%)	11 (18%)
2 days	14 (47%)	9 (30%)	23 (38%)
3 days	6 (20%)	9 (30%)	15 (25%)
1 week	5 (17%)	6 (20%)	11 (18%)
Medicine, medical gases and blood products			
1 day	3 (10%)	0	3 (5%)
2 days	2 (7%)	1 (3%)	3 (5%)
3 days	10 (33%)	11 (37%)	21 (35%)
1 week	15 (50%)	18 (60%)	33 (55%)

Water, food and fuel reserves for backup generators, medicines, medical gases and blood products are the most essential supplies to continue the functionality of a hospital. Therefore, it is important for all staff to know how long these supplies last if additional supplies were not delivered. A water storage tank at this hospital is adequate only for one day if the municipal water supply is interrupted. The food supply is also on a daily basis, and no food storage facilities are available. The diesel fuel reserves for backup generators are adequate only for one day to keep the critical areas of the hospital functioning during a power failure. The storage of medicines, medical gases and blood products, however, are adequate for one week.

Table 3 above shows the perception of the doctors and nurses about these supplies. It revealed that both groups had poor understanding of the actual capacity of these supplies. The perception of the doctors was close to reality, whereas the nurses tended to exaggerate the availability of supplies. However, both groups had a reasonable understanding about the availability of medicines, medical gases and blood products as they are more familiar with these supplies during patient management. During disaster

situations, resources would be limited; so, effective and careful use of these scarce resources are very important.

3.5 Transport availability

Table 4 shows the transport availability of the hospital. The majority of the doctors and nurses (80%) did not agree it was adequate to bring in victims to the hospital in case of natural disasters. The hospital has eight ambulances with 1,050 beds. If patients in the hospital need to be evacuated, the available number of ambulances would be inadequate. Also, lack of a helipad is a major disadvantage if the ground transportation becomes impossible during floods. Also, Matara Hospital does not have prior agreements with transportation companies or private ambulance or boat suppliers (Matara Interview, 2017).

Table 4: Transport availability

Adequacy of ambulances with trained staff	Number of Doctors (%)	Number of Nurses (%)	Total (%)
Agree	6 (20%)	6 (20%)	12 (20%)
Do not agree	24 (80%)	24 (80%)	48 (80%)

3.6 Morgue capacity

The figure 8 shows the perception of the respondents on Matara Hospital's morgue capacity. Considering past experience, 70% of the doctors and 57% of the nurses agreed that the morgue capacity of the hospital is inadequate. The hospital morgue has the capacity to handle up to twenty bodies. However, the hospital and the premises were overloaded with thousands of dead bodies during the tsunami disaster in 2004. Therefore, they believed that during a major disaster, which results in many fatalities, the current morgue capacity is inadequate.

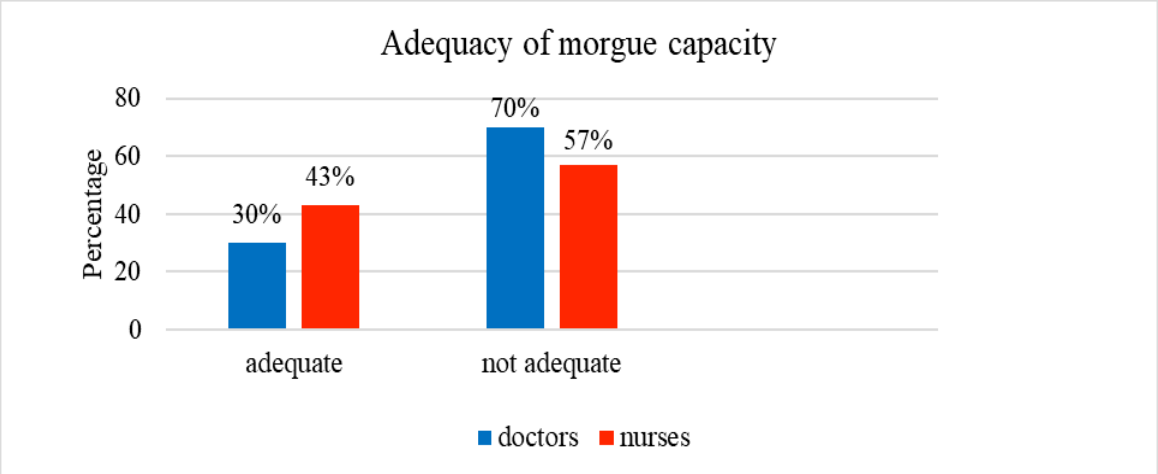


Figure 8: Morgue capacity

3.7 Willingness of the respondents

Table 5 shows the willingness of the respondents to improve their knowledge of disaster management. It also shows their willingness to work during future disasters. About 97% of the doctors and 80% of the nurses were willing to improve their knowledge of disaster management. Also, 90% of both groups were willing to serve during disaster situations. These results suggest that if the Sri Lankan government, Matara Hospital or other organizations can provide training, the respondents will improve their knowledge effectively and possibly become reliable disaster risk managers in the future.

Table 5: Willingness of the respondents

Willingness	Number of Doctors %	Number of Nurses %	Total %
Interested in improving knowledge			
Yes	29 (97%)	24 (80%)	53 (88%)
No	1 (3%)	6 (20%)	7 (12%)
Willing to serve during disasters			
Yes	27 (90%)	27 (90%)	54 (90%)
No	3 (10%)	3 (10%)	6 (10%)

3.8 Future needs

Table 6 shows the respondent's perceptions about the future improvements on hospital disaster plan. The majority of the respondents (65%) were of opinion that they needed a more comprehensive disaster management plan for the hospital. Also, most of the respondents believed that a disaster plan needs to be updated every six months or annually.

Table 6: Future needs

Future needs	Number of Doctors (%)	Number of Nurses (%)	Total (%)
Need more comprehensive disaster plan			
Agree	21 (70%)	18 (60%)	39 (65%)
Do not agree	9 (30%)	12 (40%)	21 (35%)
Frequency of update such a plan			
In 6 months	14 (47%)	22 (73%)	36 (60%)
Once a year	14 (47%)	6 (20%)	20 (33%)
In 2 years	2 (7%)	2 (7%)	4 (7%)

4 Conclusion

This survey revealed that Matara Hospital is more vulnerable to floods and tsunamis. The current disaster preparedness among its doctors and nurses is overall inadequate. The reasons were not attributed to gender, work experience and job types. This hospital's lack of preparedness was largely due to insufficient disaster drills and training. Nevertheless, both the doctors and nurses were willing to improve their knowledge about disaster management and willingness to serve in future calamities. Also, this study found that the available backup communication facilities, PPE (Personal Protective Equipment), fire protection, means of transport and morgue capacity of the hospital were inadequate.

Health authorities and the hospital administration should give priority to improve the identified gaps in the disaster preparedness to make the hospital more resilient in the future. A more comprehensive disaster plan should be prepared incorporating all possible hazards. This plan needs to be updated regularly. Also, our study revealed the existing high demands for capacity building and awareness-raising for the staff to deal with disaster situations in the future.

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