

Disaster Response to a Mass Casualty Incident in a Hospital Fire by Regional Disaster Medical Assistance Team: Characteristics of Hospital Fire

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ABSTRACT

Objective: A disaster in the hospital is particularly serious and quite different from other ordinary disasters. This study aimed at analyzing the activity outcomes of a disaster medical assistance team (DMAT) for a fire disaster at the hospital.

Methods: The data which was documented by a DMAT and emergent medical technicians of a fire department contained information about the patient's characteristics, medical records, triage results, and the hospital which the patient was transferred from. Patients were categorized into four groups according to results of field triage using the simple triage and rapid treatment method.

Results: DMAT arrived on the scene in 37 minutes. One hundred and thirty eight (138) patients were evacuated from the disaster scene. There were 25 patients (18.1%) in the Red group, 96 patients (69.6%) in the Yellow group, and 1 patient (0.7%) in the Green group. One patient died. There were 16 (11.6%) medical staff and hospital employees. The injury of the caregiver or the medical staff was more severe compared to the family protector.

Conclusions: For an effective disaster-response system in hospital disasters, it is important to secure the safety of medical staff, to utilize available medical resources, to secure patients' medical records, and to reorganize the DMAT dispatch system.

Key Words: disaster medicine, fire, mass casualty incidents, emergency medical dispatch

South Korea has experienced many recent disasters. Specifically from the 1990s to the early 2000s, a series of disasters claimed many lives and caused much physical damage. These included a ship sinking, a bridge collapse, a department store collapse, arson in a subway, and an airplane crash.¹ These disasters emphasize the importance of disaster medical assistance, and the importance of the activities of Disaster Medical Assistance Teams (DMAT) which usually consist of 4-5 professionals per team. Teams are composed of doctors, nurses, paramedics, and administrative staff, and in Korea are managed by regional centers responsible for disaster prevention.

Despite reports on the activities of DMAT during various disasters, few reports have been issued on responses to disasters in hospitals, which are particularly serious and quite different from other disasters as hospitalized patients are often physically and mentally limited. This study discusses the unique features of hospital disasters.

REPORT

Fire Breakout and Extinguishing and Rescue Operations

A fire broke out in a 366-bed public hospital located in Incheon city, South Korea at 6:00 PM on May 2, 2014. The hospital was designed to provide professional and systematic treatment to industrial accident patients and focused primarily on rehabilitative therapy. The hospital was located relatively far from the city center, and traffic volume in its vicinity is usually high as there is a highway entrance slip road nearby.

The hospital building had two wings connected by a new eight-story building. The fire broke out in a mechanical facility between the first and second floors of the new building and consumed interior and insulation materials which generated a large amount of smoke. The smoke flowed along ventilation pipes, spread to all floors, and injured many patients by smoke inhalation. The fire was reported at 6:17 PM, fire-extinguishing efforts began at 6:27 PM, and the fire was completely extinguished at 6:54 PM (Table 1).

TABLE 1

Timeline of disaster response of disaster medical assistance team (DMAT)

Time	Events
18:17 PM	Emergency Operation Center (EOC) of the fire department received the first report
18:33 PM	Regional emergency medical center (Hospital A) received dispatch request for hospital ambulance from the regional fire and disaster headquarter. Doctor on duty (emergency physician) recognized the disaster
18:42 PM	Report given to the chief of the regional emergency medical center
18:45 PM	The disaster was reported to the other staff in the hospital.
18:54 PM	Succeeded in extinguishing the fire
19:10 PM	DMAT arrived at the scene by hospital ambulance. EOC installation. DMAT began to Triage (1 Emergency physician, 2 nurses)
19:26 PM	One emergency physician joined the DMAT and inquired for available medical resources in the nearby hospital.
20:20 PM	Disaster medical support vehicle and 1 Emergency physician arrived at the scene. Relocation of DMAT (3 members for Triage and management, 2 members for Transportation of patients)
20:25 PM	EMTs from the fire department evacuated all the patients in the hospital
20:30 PM	One administrative staff arrived at the scene. He investigated the availability of medical resources in nearby hospitals (4 members for Triage and management, 2 members for transportation of patients)
21:00 PM	Completion of primary triage and transportation
23:00 PM	Completion of Secondary triage and transportation
23:10 PM	Report about mission completion provided to the head of Central Countermeasure Headquarters. Withdrawal of DMAT

Emergency Medical Technicians (EMT) of the fire department searched hospital rooms and evacuated the patients to the lobby on the first floors of the older buildings, which acted as a temporary evacuation shelter. However, they faced many difficulties searching for patients because there were many hospital rooms and no power was available, as the fire had damaged electrical facilities. As a result, it took hours to completely evacuate patients. The search was completed at 8:25 PM, when all fires were extinguished and rescue operations were complete.

Initial Disaster Communication and Arrival at the Scene

At 6:17 PM, the fire was reported to the emergency operation center (EOC) of the fire department. At 6:33 PM, the EOC notified the emergency room of Hospital A, a regional emergency medical center, that a number of patients were

injured in the fire and requested additional ambulances. The number of doctors in the affected hospital was few and lacked experience in disaster response. As a result, the fire department called the regional emergency medical center for a DMAT. At 18:50, a three-person advance party that included one emergency department physician departed first in an ambulance and was joined by another emergency physician near the scene. Additional members of the DMAT departed in a vehicle (Table 1) and finally, three emergency physicians, two nurses and one administrative officer were active at the disaster scene.

Triage Outcomes and Transport

The DMAT advance party arrived at the scene at 7:10 PM, the field EOC controlling the scene of their arrival, and discussed locations for triage. As a result of triage, near asymptomatic patients that could move independently were instructed to wait in the lobby of one of the older buildings. Patients already hospitalized in the intensive care unit (ICU) or those who reported serious shortness of breath were transported to the emergency room to receive first aid while they were waiting for ambulance transfer. The Emergency Room (ER) proved to be very useful for treating patients waiting for transportation.

One hundred and thirty-eight patients were transported by ambulance to another hospital. Eighty-one men (58.7 %) were transported, and overall average patient age was 57.2 years. Ninety-five percent of the patients reported shortness of breath due to smoke inhalation. There were 25 patients (18.1 %) in the Red group and 96 patients (69.6 %) in the Yellow group. There were 16 patients (11.6 %) with unclear classification records. There was no difference between these two groups in terms of age or gender. Patients, caregivers, and hospital employees (staff in departments not directly participating in medical care) were classified into the high severity group when compared with family protectors (in general terms, family members or relatives caring for the patient). Seventeen patients (68.0%) in the Red group were admitted to an ICU, and 68 patients (70.8%) in the yellow group were admitted to a general ward. One of the ICU admitted patients in the Red group died. In this group, 13 patients (52%) were transferred to a regional emergency center, and 12 (48%) were distributed to eight local emergency centers. In the yellow group, 61 (63.5%) were transferred to 8 local emergency centers and 25 (26.0%) were transferred to 7 local emergency facilities (Table 2).

Before the DMAT arrived, the firefighters' Triage did not know if START (Simple Triage and Rapid Treatment) had been applied. It was assumed that firefighters used their own classification criteria. According to the firefighters' classification criteria, rescued patients are classified as Severe, Mild, or Dead. In the present study, the START classification was used,

TABLE 2

	START ^b grade				p value
	Red (n = 25)	Yellow (n = 96)	Green ^c (n = 1)	Unknown (n = 16)	
Age (year, mean±SD ^a)	60.2 ± 8.7	56.0 ± 14.2	51 ± 0.0	59.4 ± 9.46	0.421
Sex					0.543
Male	16 (19.8)	53 (65.4)	1 (1.2)	11(13.6)	
Female	9 (15.8)	43 (75.4)	0 (0)	5 (8.8)	
Position					0.022
Patient	22 (22.0)	67(67.0)	0 (0)	11(11.0)	
Family protector ^d	0 (0.0)	16 (16.0)	1 (4.6)	5 (22.7)	
Hospital employee, ^e	3 (18.8)	13 (81.3)	0 (0.0)	0 (0.0)	
Caregiver					
Signs					<0.001
Smoke inhalation	24(18.3)	92 (70.2)	0 (0.0)	15 (11.5)	
Altered mentality	0 (0.0)	2 (66.7)	0 (0.0)	1 (33.3)	
Inhalation burn	1 (50.0)	1 (50.0)	0 (0.0)	0 (0.0)	
Others	0 (0.0)	1 (50.0)	1 (50.0)	0 (0.0)	
Results at ER					<0.001
to ward	8 (32.0)	68 (70.8)	0 (0.0)	10 (62.5)	
to ICU	17 (68.0)	15 (15.6)	0 (0.0)	3 (18.8)	
Home discharge	0 (0.0)	13 (13.5)	0 (0.0)	3(18.8)	
Death	1 (100.0)	0 (0.0)	0 (0.0)	0 (0.0)	n/a
Transferred to hospital					<0.001
Regional center (1 site)	13 (52.0)	10 (10.4)	0 (0.0)	0 (0.0)	
Local center (8 sites)	12 (4.0)	61 (63.5)	1 (100.0)	15 (93.8)	
Local facility (7 sites)	0 (0.0)	25 (26.0)	0 (0.0)	1 (6.2)	

^a SD = Standard deviation

^b START = Simple Triage And Rapid Treatment

^c Green : Patients with minor symptoms who were transferred by the bus were not recorded

^d Family protector: Family members or relatives

^e Hospital employee: Staff in departments that do not directly participate in medical care

according to which Severe, Mild, and Dead were classified as Red, Yellow, and Black, respectively. The radial pulse of all patients was palpated. Therefore, the criteria for classifying the Red and Yellow groups were respiratory rate and mental status. For example, a 75-year-old female patient with cerebral infarction was clearly conscious, but had tachypnea and needed oxygen therapy, and was thus classified into the red group. There was no tachypnea in a 57-year-old female patient, but she showed a confused appearance and was classified into the red group. In the final example, a 56-year-old male patient who was being treated for lower limb paralysis was unable to move, but breathing and consciousness were normal. This patient was classified into the yellow group. Majority of patients with minor symptoms in the lobby were transferred to other rooms in the index hospital to continue therapy, and thus were not documented on transportation records. Some asymptomatic patients and caregivers requested transfer to another hospital, and were transported collectively using a bus provided by the index hospital. They were considered a ‘Green’ group, and were not investigated because they were not included in the transport records. Nevertheless, one caregiver with bruises who cared for a Red-classified patient was categorized as Green and transported with the patient

in an ambulance. At 11:10 PM, triage and transfer of all patients were complete, and the DMAT was dissolved after giving a final report to the emergency rescue control group.

Discussion

Disasters involving hospitals differ markedly from other disaster situations, but articles reporting actual disasters in hospitals are extremely rare. The latest report concerned response to a fire disaster in a pediatric hospital in 2002.² The hospital had 375 beds, and the situation under which evacuation was performed was similar to that described in this article. However, it described the evacuation of patients by its staff, and did not deal with DMAT response and involvement.

A disaster in a hospital involves greater physical discomfort to individuals concerned, and thus, it takes more time for evacuation.³ In fact, 100 (75 %) of the injured people in the present study were in-patients (Table 2). Although the fire was extinguished quickly, it took more than two hours for firefighters to search all hospital rooms and evacuate patients (Table 1), which meant that the severities of patient conditions inevitably worsened. In particular, deteriorations of existing diseases

due to loss of previously-available medical resources were more problematic for ICU patients than fire-associated injuries. In general, when a disaster occurs, it is assumed during triage that the consciousness and physical abilities of patients were normal before the disaster. This type of consideration is addressed in the first step of triage, and is covered by SALT (Sort, Assess, Lifesaving, Interventions, Treatment/Transport) and START protocols.^{4,5} However, in the situation described in this report, it was difficult to accurately classify patients using the traditional triage method, and the in-patients' Electronic Medical Records (EMR) could not be accessed due to a power outage. The DMAT was able to access EMRs, check patient information, and perform triage more smoothly only after power was restored.

Accordingly, we believe it would be better to provide personal medical information on patients tags, as this could be used for triage and first aid when patients are unable to communicate. The importance of such information should not be underestimated during hospital disasters.

RESULTS

The results of this study show that the injury severity of caregivers and the medical staff was relatively high when compared with family protectors. Most hospitals have a disaster protocols that must be followed in an emergency,⁶ that clearly explain patient evacuation procedures. However, during patient evacuation, medical staff and caregivers in this study received less attention. In fact, many caregivers and hospital staff were injured, but few transfer orders were issued. Accordingly, we stress that triage should be undertaken objectively based on the subjects' symptoms and signs, regardless of occupation. If a member of the medical staff has symptoms, then adequate triage, treatment, and transport should not be delayed. The protection of medical professionals should be included in hospital disaster protocols.

In addition, during a disaster, it should be ensured that hospital facilities, personnel, equipment, and other available resources are fully utilized. In the described situation, patients awaiting triage were accommodated in two places. Patients with relatively mild injuries waited in the hospital lobby, while patients requiring oxygen supply and vital sign monitoring waited and received treatment in the emergency room. Using these methods, triage was performed consecutively on many people, who were then transported according to the severity of their conditions. In a hospital disaster situation, measures must be taken to care for patients as much as possible using existing medical resources.⁷

This study has several limitations. Regarding triage categories, the number of patients in the Green group was much smaller

than in other groups. Most patients in the Green group were hospitalized in another room in the subject hospital and not transported. These patients had no fire associated injuries, and mild underlying conditions. The DMAT confirmed that they could remain at the same hospital and continue treatment. When these patients expressed concern and requested transport to another hospital, a bus or other ordinary vehicles were used; which is why they were not included in the DMAT's triage and transport records. Furthermore, long-term follow-up of transferred patients was unsuccessful. Despite records of patients' conditions at the subject hospital, their status after transportation was not determined. As a result, it was not possible to determine how the incident had affected patients' existing conditions.

CONCLUSION

As demonstrated by the described incident, hospital disasters differ from ordinary disasters in terms of how they develop, and the characteristics of casualties. We advise that DMATs should be able to identify casualties with existing medical conditions and acquire patient medical information with minimal delay, and that the hospital's human and physical resources should be fully utilized during such incidents. Finally, means of protecting medical staff during such disasters should be established.

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