FIELD REPORT

Analysis of Disaster Medical Response: The Sejong Hospital Fire

Daihai Choi, MD;[1] Jangsun Lim, MD;[2] Myeong-Il Cha, MD;[3] Changshin Choi, BS;[4] Seungyoul Woo, BA;[4] Seongmi Jeong, BS;[4] Seong Youn Hwang, MD;[5] Inbyung Kim, MD;[2] Heebum Yang, MD[6]

1. Department of Emergency Medicine, CHA University Gumi Hospital, Gumi, Korea
2. Department of Emergency Medicine, Myongji Hospital, Goyang, Korea
3. National 119 EMS Control Center, National Fire Agency, Sejong, Korea
4. National Emergency Medical Center, National Medical Center, Seoul, Korea
5. Department of Emergency Medicine, Samsung Changwon Hospital, Sungkyunkwan University School of Medicine, Changwon, Korea
6. Department of Emergency Medicine, Uijeongbu Eulji Medical Center, Eulji University, Uijeongbu, Korea

Correspondence:
Heebum Yang, MD
Department of Emergency Medicine
Uijeongbu Eulji Medical Center
Eulji University 712, Dongil-ro
Uijeongbu-si, Gyeonggi-do
Republic of Korea, 11759
E-mail: heebeom@gmail.com

Conflicts of interest/funding: The authors declare none.

Keywords: disasters; emergency response; mass-casualty incidents

Abbreviations:
DMAT: disaster medical assistance team
EMS: Emergency Medical Services
FEMP: field emergency medical post

Received: October 16, 2021
Revised: December 1, 2021
Accepted: December 8, 2021

doi:10.1017/S1049023X22000334

Event Identifiers:

a. Event Type: Fire
b. Event Onset Date: January 26, 2018
c. Location of Event: Miryang city, Gyeongsangnam-do (Gyeongnam), South Korea
d. Geographic Coordinates: 35.2834° N, 128.4558° E
e. Date of Observations Reported: January 26, 2018
f. Response Type: Medical Response

Abstract

This paper provides a field report on a fire that broke out on January 26, 2018 at Sejong Hospital in Miryang, South Korea, engendering the establishment of a committee to investigate the hospital fire response. This field report analyzes the disaster medical response. The official records of the disaster response from each institution were examined. On-site surveys were conducted through interviews with government officials and other health care workers regarding communication during the disaster response without using a separate questionnaire. All medical records were abstracted from hospital charts. There were 192 casualties: 47 victims died, seven were seriously injured, and 121 suffered minor injuries. Emergency Medical Services (EMS) arrived three minutes after the fire started, while news of the fire reached the National Emergency Medicine Operation Center based in Seoul in 12 minutes. The first disaster medical assistance team (DMAT) was dispatched 63 minutes after the National Emergency Medicine Operation Center was notified. The disaster response was generally conducted in accordance with disaster medical support manuals; however, these response manuals need to be improved. Close cooperation among various institutions, including nearby community public health centers, hospitals, fire departments, and DMATs, is necessary. The response manuals should be revised for back-up institutions, as the relevant information is currently incomplete.

Choi D, Lim J, Cha MI, Choi C, Woo S, Jeong S, Hwang SY, Kim I, Yang H. Analysis of disaster medical response: the Sejong Hospital fire. ***Prehosp Disaster Med.*** **2022;37(2):284–289.**

Introduction

On January 26, 2018 at 07:32, a fire started at Sejong Hospital in Miryang, South Korea on the first floor of the emergency department, caused by an electrical wiring spark in the pantry ceiling. It quickly spread through Sejong Hospital to the adjacent Sejong Nursing Hospital, causing 192 casualties. A committee comprising individuals from both hospitals was established on February 28, 2018. Based on its investigation, the committee prepared a report to alleviate current institutional limits on disaster response in medical institutions and to set standards for disaster medical response.

A study of a recent, large-scale disaster in South Korea raised issues concerning field triage and hospital transport dispersion.[1] Sejong Hospital and Sejong Nursing Hospital both engaged in emergency preparation using their own fire extinguishers and conducting firefighting drills with local fire departments annually or biannually; however, no manual provided fire response guidance. This field report investigates and analyzes the medical disaster response and preparedness concerning the Sejong Hospital fire to identify difficulties experienced and to provide recommendations. The fire was distinctive due to inadequate preparedness and the presence of older patients with underlying diseases, such as dementia,

in the nursing hospital. This field report may aid in improving disaster responses in South Korea.

Sources

An on-site survey was conducted to address discrepancies in casualty count and at the time of data compilation. Moreover, records of local hospitals and funeral homes were reviewed to determine which facility victims were transferred there. Disaster response guidelines and the manuals of individual agencies were also analyzed.

Records were gathered through various information disclosure systems held by the Ministry of Health and Welfare (Sejong, South Korea), National Fire Agency (Sejong, South Korea), Miryang City Hall (Miryang, South Korea), and National Emergency Medical Center (Seoul, South Korea). The hospital's emergency department log was also reviewed. Emergency Medical Services (EMS) records noted during ambulance transport were excluded because some information necessary for patient identification was missing; instead, fire department's internal records were used to identify the number of patients transferred by ambulance and those who died.

Surveys were conducted involving field trips, on-site interviews, in-person interviews, or telephone communication. Survey participants included personnel from the Gyeongnam Emergency Medical Assistance Center (Changwon, South Korea) and other disaster-related agencies in the province of Gyeongsangnam-do, including the Fire Department Headquarters, Disaster and Emergency Medicine Operation Center (Seoul, Korea), Miryang Fire Station, Miryang Community Health Center, and transfer hospitals.

This field report was approved by the Institutional Review Board of the Nowon Eulji Medical Center, Eulji University in Seoul, Korea (EMCS 2019-10-007). The need for informed consent was waived because of the retrospective nature of the report.

Observations

The fire resulted in mass casualties at Sejong Hospital and Sejong Nursing Hospital. At Sejong Hospital (fifth floor above ground level; gross floor area 1,485m^2 with 95 beds) and Sejong Nursing Hospital (sixth floor; gross floor area 1,285.49m^2 with 98 beds), there were 83 and 94 inpatients, respectively. There were 192 casualties: 47 deaths, seven serious injuries, and 121 minor injuries. The remaining 17 patients were either sent to rehabilitation facilities or returned home. Forty-six of the casualties were male (24.0%). The average age was approximately 80 years. Eighty-three (43.2%) were inpatients at Sejong Hospital and 88 (45.8%) at Sejong Nursing Hospital, including 19 (9.9%) hospital staff and two (1.0%) caregivers; 111 patients (57.8%) were transferred to local hospitals in the Miryang area.

The death toll on the day of the fire was 37, with two additional people dying within 72 hours. Of the 39 people who were fatally injured, 35 were inpatients from Sejong Hospital, one from Sejong Nursing Hospital, one was a doctor, and two were nurses.

Field Disaster Medical Activity

The first 10-member firefighter unit and two ambulances arrived three minutes after the initial report. The firefighters had to dedicate all their efforts to confronting the blaze and rescuing patients.

The ambulances that arrived in the meantime began to transfer rescued patients. No triage was performed at the scene as cold weather conditions (−11°C) made it impossible to leave patients outside. Later-deployed ambulances continued to transport patients as they were rescued. Eight ambulances had transported 18 patients (including two deceased, two with serious injuries, and 14 with minor injuries) to four local hospitals in Miryang before an emergency medical post was established.

When Miryang Community Health Center staff arrived at the scene, they began installing a field emergency medical post (FEMP) near the on-site command post in front of Sejong Hospital's main entrance, as instructed by the emergency rescue and control team. Then, the FEMP was moved to the parking lot because the rescued patients were not being carried to the FEMP but being taken to ambulances parked in a vacant lot north of Sejong Hospital (Figure 1). The fire rescue team used radio to communicate, although the health center staff could not access this system, hampering communication between them and the fire station rescue team.

When the disaster medical assistance team (DMAT) of Pusan National University Yangsan Hospital (Yangsan, South Korea) arrived, they began to perform triage and first aid. However, patient information was either scarce or nonexistent, and ambulances could not provide timely services to all the rescued patients. Patients complained mainly of their illness rather than of the fire or its effects; the triage tags indicating severity classifications were insufficiently informative.

Twenty-four ambulances dispatched from fire stations in Miryang and nearby cities transported 113 patients to local hospitals (Table 1).

After the fire started, it took three minutes for EMS to arrive and 12 minutes for the local fire station to reach the National Emergency Medicine Operation Center. The first DMAT was dispatched 63 minutes after the National Emergency Medicine Operation Center was contacted.

Inpatient Hospital Care

Miryang Yoon Hospital (Miryang, South Korea), approximately 1.6km from the incident scene, was the only regional emergency medical center in the area. Only one emergency physician was on duty and the hospital was unequipped to treat so many patients at once. Fortunately, the emergency room shift change was at 08:00, meaning both night and day shift nurses were present, and they were also helped by other doctors in the hospital. On the day of the incident, 43 patients were admitted to Miryang Yoon Hospital. Among the patients analyzed, 35 were suffering from smoke inhalation, one from smoke inhalation and burns, and five were dead on arrival. The majority (leaving aside the fatally injured) had complications from smoke inhalation (81.3%) and only recovered after oxygen therapy was administered.

Analysis

Disaster management of the Sejong Hospital fire was marred by multiple problems at every stage. As incident recognition and disaster situation assessment unfolded, for example, there were communication problems between the situation room and on-site staff making it difficult to gauge the scale of the initial casualties. Further, there was a lack of on-site management personnel, delaying identification of the number of inpatients at Sejong Hospital and awareness of the adjacent nursing hospital. At first, too few firefighters were dispatched given the disaster's magnitude; instead of communicating with the situation room, they had to expend every effort to extinguish the fire and to move inpatients outside. The Fire Department Headquarters' situation room did not identify the number of patients hospitalized or that there was a nearby

https://doi.org/10.1017/S1049023X22000334 Published online by Cambridge University Press

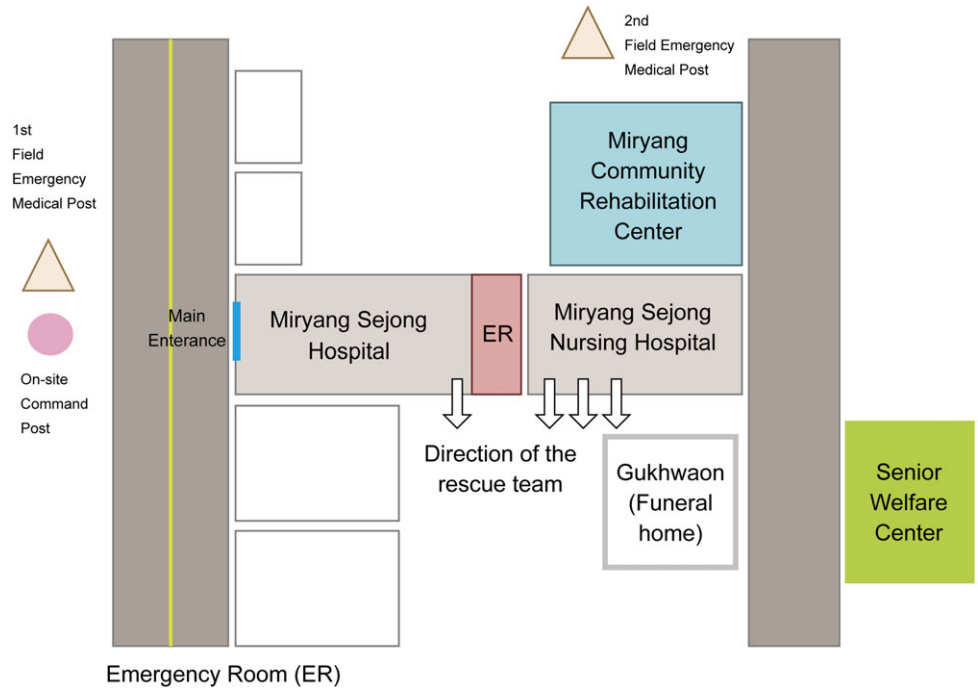

Figure 1. Schematic Representation of the Incident Site.
Abbreviation: ER, emergency room.

nursing hospital. Consequently, too few firefighters were deployed to begin the initial operation.

No FEMP had been set up for operations until community health center staff arrived. The emergency rescue and control team of Miryang Fire Station had no installation vehicle and lacked sufficient field medical post resources to administer appropriate on-site care to all patients suspected of carbon monoxide poisoning.

Triage tag use was inadequate at the scene due to the conditions of most patients, with many either unconscious due to an underlying disease (eg, dementia) or unable to move or complete a complicated form; consequently, the large number of patients, lack of time and information, and triage tag loss during transport (due to insufficient string for attachment to patients) hampered the response.

The different communication systems with no integration features, as well as the lack of prior collaboration between the emergency medical and on-site command posts (meaning a lack of familiarity with each other's procedures), hindered disaster emergency medicine communication network effectiveness, making collaboration among DMAT members, community health center staff, and firefighters difficult. At the transfer stage, most patients were moved to the nearest report-filing post for admission to either the emergency department or regional emergency medical center. However, these facilities were not informed of the incident; thus, they lacked a response plan and appropriate readiness and, hence, were unprepared to treat the large number of disaster victims.

The major transfer hospital responded by paging off-duty staff for assistance and extending the treatment space outside the emergency room. Many patients had to be re-transferred because initial transport took place without considering the local hospitals' capacities and capabilities or patients' condition. For example, a nursing hospital inpatient who only needed to be evacuated was transported to an acute care hospital. Too many patients (36.4%), including the deceased, were transported to the nearest hospital to the regional emergency medical center during the early rescue stage, adding to the confusion.

Deaths and injuries from building fires are mostly caused by smoke inhalation rather than burn injuries,[2–4] which the Miryang Yoon Hospital medical records confirm was the case here.

Organizations that had manuals responded accordingly, although this response was insufficient due to inadequate guidelines in manuals concerning protocols to be followed and lack of inter-organizational training in cooperation.

Although the disaster response was generally in compliance with the disaster medical assistance manuals, there remains room for improvement. For example, the on-site communication system did not work well; triage was only partial; FEMP setup was delayed; and DMAT dispatch did not occur immediately upon request.[5]

To address these shortcomings, on-site staff must be trained and avenues established for accurate communication and rapid video transmission from the scene to the situation room. Above all, on-site response personnel need training. Furthermore, personnel must be capable of managing multiple-causality rescue or triage operations at the on-site command post.[6,7] Resources for an all-weather, on-site emergency medical post must be secured in advance with an adequate inpatient transportation plan in place. Disaster response scenarios tailored to regional characteristics are also needed. Problems posed in any disaster management course, such as Korean Disaster Life Support programs, should form part of the training. Finally, priority concerning inpatient evacuation, evacuation methods, and chronic patient triage should be determined during disaster preparation.

https://doi.org/10.1017/S1049023X22000334 Published online by Cambridge University Press

Hour	Rescue Operation	Hour	First-Aid Operation
07:32	First report to the Gyeongnam Fire Department Headquarters' situation room. Dispatch order.		
07:35	Arrival of the first dispatched firefighters (ie, Gagok pump, Gagok rescue, and first aid).		
	Information acceptance at the situation management center.		
07:37	Issue of Response Stage 1. Rescue and entry via escape stairs.		
07:38	Fixed-line situation report to the National Fire Agency, Gyeongnam Fire Department Headquarters, Gyeongnam Governor's Office, and Gyeongnam Emergency Situation Management Center.		
07:39	Fixed-line notification to Korea Electric Power Corporation and Miryang City Hall night-duty room.		
07:42	Dispatch request to the Central 119 Disaster Center.		
	Response advanced to Stage 2.		
	Rescue of 7 people requiring saving.		
	Arrival of the Gyeongnam emergency rescue and control team at the scene.		
		07:44	The National Emergency Medicine Operation Center is notified.
07:45	Arrival of the Miryang Fire Station's Chief at the scene.		
		07:46	Confirmation of the fixed-line report at the Gyeongnam Fire Department Headquarters situation room. Fire on the first floor of the hospital. The magnitude of the fire and casualties remains unknown.
		07:47	Disaster Medical Control Center mobile situation room launch.
			Notice from Miryang City Hall to the community health center night-duty room. Recognition of the Sejong Hospital fire.
			Unsuccessful attempt by the National Emergency Medicine Operation Center to contact the community health center disaster hotline (until 07:53). Unsuccessful attempt at fixed-line communication with Sejong Hospital.
		07:50	Situation recognition and standby at the Gyeongnam Emergency Medical Assistance Center.
07:52	Fixed-line notification of Gyeongnam Disaster Situation Center to Miryang City Hall and the community health center.		
	Request to the National Emergency Medicine Operation Center to dispatch DMATs (Samsung Changwon Hospital).		
	Request to assist with the rescue of the nursing hospital.		
07:53	Transport of 9 patients.		
07:54	Patient admission information check with local hospitals by the National Emergency Medicine Operation Center.	07:54	National Emergency Medicine Operation Center dispatches request to the Community Health Center primary response team.
07:55	The Miryang rescue team saves 2 patients.	07:55	Confirmation notification of the National Emergency Medicine Operation Center to Gyeongnam Fire Department Headquarters situation room of 9 slightly injured patients being transported to hospital. Medical assistance request due to fatality risk.
		07:56	Request from the mobile situation room to dispatch the DMATs of Pusan National University Yangsan Hospital and the Gyeongnam Emergency Medical Assistance Center.
		07:58	Dispatch of 3 first responders from the Community Health Center Primary Response Team.
		08:01	Dispatch of Gyeongnam Emergency Medical Assistance Center staff to the scene.
		08:02	Sharing of bed information for all hospitals within a 50-km radius of Sejong Hospital at the mobile situation room. High-pressure chamber situation sharing.
		08:10	Rescue of 9 people (status check), including first aid and transport.

Table 1. Timeline for the Rescue and First-Aid Operations (*continued*)

https://doi.org/10.1017/S1049023X22000334 Published online by Cambridge University Press

Hour	Rescue Operation	Hour	First-Aid Operation
08:12	Assistance request to the Busan Fire Department Headquarters' special rescue team.		
		08:14	Arrival of the first responders of the Community Health Center primary response team on the scene.
08:15	Rescue operation for 3 people requiring saving on the third floor.	08:15	
	Assistance request to the Ulsan Fire Department Headquarters.		Fixed-line confirmation by the Gyeongnam Emergency Situation Management Center.
08:17	Rescue of 1 person from the sixth floor. Search on the fifth floor.	08:17	Nine slightly injured patients and 1 seriously injured patient transported to Miryang Yoon Hospital. One slightly injured patient transported to Nano Hospital.
	Arrival of the head of the Gyeongnam Fire Department Headquarters at the scene.		Dispatch of the DMATs of Pusan National University Yangsan Hospital and the Gyeongnam Emergency Medical Assistance Center to scene.
08:20	Arrival of the Acting Gyeongnam Governor at the situation room (status check and instruction). Fixed-line conversation with the Miryang Fire Station's Chief.	08:20	Arrival of the community health center director and assumption of the command of the emergency medical post.
		08:22	Arrival report of the primary response team to the emergency rescue and control team head.
08:25	Installation of the emergency rescue and control team's on-site command post at the main entrance of Sejong Hospital.		
		08:27	Information sharing about bed availability for fire victims (Samsung Changwon Hospital, Dong-A University Hospital, Pusan University Hospital).
		08:30	Installation of the emergency medical post on the narrow street near Sejong Hospital (later the location of the emergency rescue and control team) on instruction of the emergency rescue and control team.
		08:34	Fixed-line confirmation by the Disaster Medical Control Center in Gyeongnam with the Emergency Situation Management Center: 12 transported, 40 rescued, more than 20 in need of rescue.
08:35	Installation of resources standby post in the empty lot of a construction site.	08:35	Arrival of Gyeongnam Emergency Medical Assistance Center staff at the scene. Operations begin.
		08:39	Status confirmation (fixed-line) by the Disaster Medical Control Center with the Miryang Yoon Hospital: full capacity reached by the admission of 12 patients with minor injuries.
			Report that the rescued are leaving the building through exits other than the main entrance.
08:40	First name search for Sejong Hospital patients.	08:40	Emergency medical post moves to the parking lot on the first floor of the Miryang Community Rehabilitation Center.
		08:44	The Gyeongnam Emergency Medical Assistance Center installed at the scene notifies the mobile center of their need for dispatch of the Samsung Changwon Hospital DMAT.
08:45	Operation completed to rescue 1 person from the rooftop using the Gyeongnam Fire Department Headquarters' helicopter.	08:45	Dispatch request to the Samsung Changwon Hospital DMAT.
			Fixed-line confirmation by the Disaster Medical Control Center with the Gyeongnam Emergency Situation Management Center: The transport of 13 people completed; the presence of people in need of rescue at Sejong Nursing Hospital next to Sejong Hospital.
		08:48	No accurate information regarding the rescue need.
		08:50	Installation of a situation board in front of the rehabilitation center and operation initiation of the primary response team.
			Arrival of the Pusan National University Yangsan Hospital DMAT at the scene.
			Role allocation of medical assistance staff.
			The primary response team: patient transport; dispatch of liaisons to 8 hospitals in the region.
		08:55	DMAT: triage; first aid of the rescued patients.

Table 1. Timeline for the Rescue and First-Aid Operations (*continued*)

https://doi.org/10.1017/S1049023X22000334 Published online by Cambridge University Press

Hour	Rescue Operation	Hour	First-Aid Operation
		09:00	Installation and operation of a temporary mortuary at the office on the first floor of the rehabilitation center.
			Interim casualty count: 114 (14 deaths, 4 severe injuries, and 96 minor injuries).
		09:10	Dispatch of the Samsung Changwon Hospital DMAT.
09:29	Primary fire suppression.		
		09:34	Report of a discrepancy in the count between the number of inpatients at the Sejong Hospital and patients transferred to the Gyeongnam Emergency Medical Assistance Center. Request to check whether patients are still in the hospital.
		09:37	On-site report by the Gyeongnam Emergency Medical Assistance Center: triage in the first-floor office of the Miryang rehabilitation center and transport to the nearby hospital.
			Arrival of the Samsung Changwon Hospital DMAT on the scene (triage and first-aid assistance).
09:40	Media briefing by the Miryang Fire Station's Chief.	09:40	Last rescues (n = 3, in a state of cardiac arrest).
10:26	Firefighting operation complete.		
		10:30	Secondary triage of 39 nursing hospital patients evacuated to the funeral home, followed by hospital allocation.
		17:30	Total number of casualties: 180 (37 deaths, 7 severe injuries, and 136 minor injuries).
20:20	Termination of Stage 2 response.		

Table 1. *(continued).* Timeline for the Rescue and First-Aid Operations
Abbreviation: DMAT, Disaster Medical Assistance Team

References

1. Cha MI, Kim GW, Kim CH, et al. A study on the disaster medical response during the Mauna Ocean Resort gymnasium collapse. *Clin Exp Emerg Med.* 2016;3(30): 165–174.
2. You KC, Ahn ME, Cho YJ, et al. The problem and countermeasure of emergency treatment at the incident scene through the analysis of the fire victims by large scaled fire. *J Korean Soc Emerg Med.* 1997;8(2):193–200.
3. Gill JR, Goldfeder LB, Stajic M. The happy land homicides: 87 deaths due to smoke inhalation. *J Forensic Sci.* 2003;48(1):161–163.
4. Dal Ponte ST, Dornelles CF, Arquilla B, et al. Mass-casualty response to the Kiss nightclub in Santa Maria, Brazil. *Prehosp Disaster Med* 2014;30(1):93–96.
5. National Emergency Medical Center. *Emergency Response Manual of Disaster Emergency Medical Service*. Seoul: National Emergency Medical Center; 2016.
6. Risavi BL, Salen PN, Heller MB, et al. A two-hour intervention using START improves prehospital triage of mass casualty incidents. *Prehosp Emerg Care.* 2001;5(2):197–199.
7. Deluhery MR, Lerner EB, Pirrallo RG, et al. Paramedic accuracy using SALT triage after a brief initial training. *Prehosp Emerg Care* 2011;15(4):526–532.

https://doi.org/10.1017/S1049023X22000334 Published online by Cambridge University Press