Original Article

Mass Casualty Management of Aircraft Accident Victims during COVID-19 Pandemic

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Abstract

Background: Quality management system involves organizational structure, procedures, processes, and resources involving multiple stakeholders with different cultural characteristics. For an accredited private corporate hospital, mass casualty combined with multiple stressful situations proves to be a litmus test for the preparedness of the hospital to meet the quality patient care needs during such events. One such tragic incident considered for this article is the aviation accident that occurred during the closing hours of the day on August 7, 2020, involving – Air India Express Flight 1344, a Boeing 737–800 operating an international repatriation flight which crashed on landing at Kozhikode International Airport, Kerala, India. The accident occurred when COVID – 19 pandemic had shaken the entire world including India. During that time, the South-West monsoon had also set in this part of the subcontinent, which added to the recipe of the catastrophic accident. **Materials and Methods:** Aster DM Healthcare is an emerging healthcare provider in India, with an inherent emphasis on clinical excellence. It provides primary, secondary, tertiary, and quaternary healthcare through our network of 14 hospitals across India. One among them is ASTER Malabar Institute of Medical Sciences Ltd (MIMS) situated in Calicut, Kerala. This is a case study that describes the actual disaster management by ASTER MIMS that received and managed the 47 patients transferred from the accident site. **Results:** The outcome of this study revealed the leadership-driven robust nature of the quality management system that prevailed in the organization. The leadership had the capacity to harmonize, coordinate, and control each staff member of the hospital to understand their roles and responsibilities through repeated drills and training programs. Some of the measurable outcomes were response time, fast adjustments of duties, low mortality, length of stay, and patient satisfaction. **Conclusion:** As Avedis Donabedian's description model of quality, good structure leads to good processes, good processes lead to good outcomes, the mass casualty management system of the hospital through the implementation of proper policies, procedures, and practices catered to better patient care and outcomes.

Keywords: Air accident, COVID-19 pandemic, mass casualty management, quality management system

Introduction

Convention on International Civil Aviation Annexure 13 defines an aviation accident "as an occurrence associated with the operation of an aircraft, which takes place from the time any person boards the aircraft with the intention of flight until all such persons have disembarked, and in which a person is fatally or seriously injured, the aircraft sustains significant damage or structural failure, or the aircraft goes missing or becomes completely inaccessible."[1] As of April 2020, there have been 33 aviation incidents with more than 200 deaths.[2]

The current article concerns the air accident that occurred on August 7, 2020, involving – Air India Express Flight 1344, a Boeing 737–800 operating an international repatriation flight, crashes on landing at Kozhikode International Airport, Kerala, India, skidding off the runway and plunging into a gorge, killing 21 occupants that included the two pilots in the evening of August 7, 2020 (7.30 PM – Dubai to Calicut). During the above casualty, there was an active transmission of COVID-19 pandemic. Hospitals were overwhelmed with sick COVID patients, with intensive care unit (ICUs) filled up to the

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capacity. Mass repatriation was being done due to the sudden surge of COVID-19 cases which involved many countries, including India. COVID-19 cases were also surging in Calicut, where the accident occurred. The Southwest monsoon season which starts early June and lasts up to the end of September torrential rains were at its peak in the Indian subcontinent. Kerala receives around 3000 mm of rainfall annually of which about 85% of the rainfall is received during the Southwest monsoon (2250–2500 mm). Hence, the hospital had to deal with three stressful situations and maintain adequate quality patient care - Mass casualty, Pandemic, and Incessant rains.

Mass Casualty Incident (MCI) is defined as "an event that overwhelms the local healthcare system, where the number of casualties vastly exceeds the local resources and capabilities in a short period of time."[3] The systematic management of the victims of the MCI which aims to minimize disabilities and loss of life is called as mass casualty management (MCM). Hospitals develop MCM protocols considering the different situations such as floods, accidents, and terrorist attack based on principles of MCM. Most often, these are only tested by conducting mock drills once a year to check the organizations preparedness when such events occur, as MCIs are not a common occurrence.

Preparedness of the hospital toward mass casualty management

ASTER MIMS is one of the first hospitals in India to be accredited by the National Accreditation Board for Hospitals and Healthcare Providers in 2006. In addition to the hospital being accredited as a whole unit, the Emergency Department (ED), Nursing Services, and laboratory services are independently accredited. The protocols for the MCM of the hospital are very much in line with the National Disaster Management Guidelines, which consists of the command and coordination, information management, including communication and documentation, human resource mobilization and management, safety and security, logistics, supply chain and finance management, triage, retrieval, creating surge capacity, patient handling, continuity of other services, volunteer involvement, and management, post-disaster recovery.[4] This was tested twice annually through mock drills. It was also tested by the external government agencies periodically for area-level networking of hospitals and coordination with state disaster preparedness initiatives, and in 2010, the hospital was part of the aircraft accident mock drill at Calicut Airport by the State Disaster Management.

Materials and Methods

ASTER MIMS, Calicut is a 500 bedded multispecialty quaternary care hospital situated in the northern part of the state of Kerala which is located to the South of the Indian Peninsula. ASTER MIMS has over 20 years of track record inpatient care. The focus of this case study is disaster preparedness, response of the hospital, and the lessons learned from the management of the mass casualty arising out of this accident during the pandemic and incessant rains. The study commenced after obtaining approval from the Research Committee of Consortium of Accredited Health care Organization (RC/009/2021) in April 2021.

Results

Incident report and timeline of events

First information was received by the hospital at 20:10 IST by the Sub Inspector of the Medical College Police Station. At 20:21 IST, hospital received the official communication from the District Collector to send all their ambulances to the airport for retrieval of the victims. Mass casualty code was activated in the hospital immediately, and three ICU ambulances were moved to the airport. The first patient was brought to the hospital at 20:41 IST. Information was sent to the doctors, nurses, and other support staff required to reach the hospital. Table 1 shows the timeline of events. The hospital managed 47 victims of the accident. Five deaths were recorded – 3 were brought dead, one child died after trying to resuscitate, and one more died after admission. Table 2 shows the details of the patients brought to hospital.

Table 1: Timeline of events

Time	Event
20:10 IST August 7, 2020	First alert call from Sub Inspector of Police, Medical College Police Station. ICU ambulances sent to Airport. Mass casualty code activated. Non-COVID portion of ED vacated and set aside for receiving patients. Nearby departments converted to the temporary receiving area. Radiology, Pharmacy, Blood Bank, OTs and other allied functions were prepared. Adequate PPE sourced from stores
20:21 IST August 7, 2020	Official communication from district collector to send ambulances to airport for retrieval
20:41 IST August 7, 2020	First patient received. Triaging done. All patients were considered COVID suspect
21:20 IST August 7, 2020	35 patients received. Counter opened for liaison with public and a whiteboard installed at the entrance with details of admissions. 4 dedicated helpline numbers activated and published
23:21 IST August 7, 2020	47 patients admitted in total. 16 patients in red category, 22 in yellow category, 5 in green category and 4 patients were brought dead. This included 21 in the pediatric age group. District Collector and Deputy Collector came to spot to help liaison with other departments and hospitals. WhatsApp group started by District Collector for Hospitals to share patient information
03:00 IST August 8, 2020	A briefing given to the by-standers and relatives of all patients. Chance to visit the patient given to all except ICU admissions. All patients moved out of the receiving area
07:00 IST August 8, 2020	COVID screening completed for all patients and 2 were found positive. Medical Bulletin with all details on patients and condition passed thrice a day. Cafe made 24 h and available to the people waiting

ICU: Intensive care unit, ED: Emergency department, OTs: Operation theaters, PPE: Personal protective equipment, IST: Indian Standard Time

Table 2: Details of air traffic accident patients brought to hospital

Parameter	*n*
Gender	
Male	21
Female	26
Total	47
Age (years)	
<5	6
5-18	15
18-60	25
>60	1
Length of stay	
<1 week	28 (died 5)
1-2 weeks	6
2-3 weeks	4
3-4 weeks	3
More than a month	6
Type of injury	
Ortho spine	3
Ortho limb	36
Based on triage color code	
Red	16
Yellow	22
Green	5
Brought dead	4

Discussions

Challenges as a result of the mass casualty and pandemic

Air accident occurred in the evening on a rainy monsoon morning when the COVID-19 pandemic was threatening the population. The hospital was an approved COVID-19 facility, therefore, receiving mass casualty patients, triaging, and caring for them were the primary challenges faced by the hospital. To facilitate this, the hospital had to identify areas for segregating these patients from those already admitted COVID patients to the hospital. A separate area had to be identified, equipped, staffed to receive and treat Mass casualty victims. Surge areas were created and patients that were suspected to be COVID positive were moved to these areas. The next immediate challenge was the line listing of triaged cases and their mobilization within the hospital, including ICU and occupational therapy (OT).

Separate suspect ICUs and OTs had to be created to manage these patients. Since the accident happened during the pandemic, every patient coming into the hospital was suspected to be COVID-19 positive, and necessary protocols were followed accordingly. Sufficient quantities of rapid antigen detection kits had to be mobilized to overcome this challenge. Mobilization of essential staff members, shift location to manage the patients to handle the mass casualty in the existing pandemic situation was a real challenge. The hospital was able to mobilize 74 doctors, 76 nurses, and 58 support staff that assembled within 20 min through the activation of code to meet the Mass Casualty. Staff who were already on duty were asked to extend their duty hours and transportation was provided to mobilize the next shift staff. Decision was taken to mobilize volunteers, and accordingly, the chief pharmacist mobilized the pharmacists from nearby pharmacies for support.

All clinical support departments were opened and manned for availing blood products, medicines, consumables, and diagnostics services to manage the victims. Logistic preparedness such as obtaining PPE in large quantities and rapid antigen kits was a challenge. Nearly 1000 PPE were used in the first 24 h. Identifying of a place for donning and doffing of PPE was a challenge, more so identifying the person in PPE was challenging as well. The use of color codes at the triage area helped in prioritizing cases for treatment. The management of biomedical waste was the most important challenge in the pandemic situation which had to follow the government guidelines.

Crowd management, dealing with anxious relatives, press, and public, was very challenging and overwhelming. Due to the pandemic restrictions, communication became the pivotal part of this exercise. This was managed by setting up an information center, patient information was passed on to the identified family member to ensure patient privacy, and a medical bulletin was released twice daily. With the establishment of intrahospital and external communication, the hospital spokesperson was able to inform the patient's relatives as well as the press.

The management of the accident as per the existing documented plans of the hospital is as follows:

a. Command and co-ordination: As per the protocol the Chief Executive Officer (CEO) as the head of administration, took charge as the incident commander assumed responsibility for the management of resources and both external and internal communication. The CEO was the spokesperson of the hospital, he was assisted by the Chief Operating Officer. The head of the facility was responsible for getting the alternate site prepared for receiving the victims and also surge areas to treat these patients. The head of ED was responsible for all critical care operations starting from initial triaging, initial management until the patient was stabilized and transferred to the concerned clinical departments for further management.
   The clinical heads mobilized doctors from their teams and managed patients needing their specialty help. They also provided clinical manpower and support to the ED. The nursing supervisor (NS) was responsible for patient transfer from triage and also interdepartmental transfers. NS was also responsible for mobilizing nursing staff and communicated directly with the CEO regarding the progress, the problems, and shortfalls. NS mobilized the support staff for transportation of the patients to diagnostic areas and to the clinical areas. NS coordinated with the hospital infection control team to ensure that quarantine and PPE protocols were followed by staff until the patients

were declared COVID negative by a rapid antigen test

b. Mobilization of staff: The medical, nursing, and support heads assigned responsibilities to their respective team members to contact and mobilize their teams. This was initiated within the first 20 min on declaration of the incident command, within 3 h, 74 doctors, 76 nursing staff, and 56 other staff were mobilized
c. COVID Testing: All patients were tested using Rapid Antigen Test or TrueNAT or RTPCR to determine if the they were COVID-positive, till such time, they were all treated as suspected COVID. Two patients were found to be COVID positive and were shifted to the isolation ward for treatment
d. Space management: Areas for handling the patients of mass casualty were identified. The non-COVID area in the ED was identified for receiving patients and the not-so-sick patients were shifted to the nuclear medicine waiting area. ICU care, triaging for radiological investigations, space for donning and doffing and for the Biomedical Waste Management were also addressed. Since every patient had to be treated as COVID suspect, as a precautionary measure, they were all put on PPE to prevent any cross infection if they turned out to be positive
e. Supply chain management: All other normal activities were put on hold to meet the emergency situation. All health care professionals were provided with appropriate PPE. Mobilization of medication, blood products, and consumables instruments were managed by the respective department heads under the supervision of their line managers reporting on an hourly basis to the CEO
f. Communication: Channels were established to communicate with the media, public, and relatives. The CEO was the spokesperson for the hospital and became the single point of contact for external media communication. Helplines were set up. Social media handles were posted with the contact information. Counters were opened to liaise with the public, and whiteboard were installed at the entrance with details of admissions. Four dedicated helpline numbers were publicized for the relatives to contact the hospital.

Review of the mass casualty management by the hospital

The number of flights operated globally by the airline industry increased steadily since the early 2000s and reached 38.9 million in 2019. Due to the COVID pandemic, the number of flights dropped to 16.4 million in 2020. Despite some pronounced year-to-year differences, the number of fatalities has reduced overtime. India had 95 fatal civil aviation accidents have been recorded from 1945 to April 2021. The current article concerns one such aviation accident that occurred on August 7 involving – Air India Express Flight 1344, a Boeing 737–800 operating an international repatriation flight carrying 174 passengers, 10 infants, 2 pilots, and 5 crew members on board, crashed on landing at Kozhikode International Airport, skidding off the runway and plunging into a gorge. A total of 21 occupants were killed, including both the pilots.

In a study from Amsterdam, the aftermath of an air crash showed that a minimal documentation of prehospital triage was found, and no exact numbers could be recollected. During in-hospital triage, 28% were triaged as P1, of which 10% had an ISS ≥16 and 3% met the modified Baxt criteria for emergency intervention. Forty percent were triaged as P3, of which 72% had an ISS ≤ 8 and 63% were discharged from the ED after evaluation. In hospital over-triage was up to 89%. The critical mortality rate was 0%. It was also found that 9% of P3 casualties and 17% of "walking" casualties had serious injuries, 22% of all casualties were transported with spinal immobilization. Of the all casualties that were diagnosed with spinal injury 22% were not transported with spinal immobilization.[5]

The findings from this study were in contrast to the present case study with regard to mortality rate and type of injury among the survivors.

Another report reviewed the emergency medical preparedness of an airport and also examined the effects on medical response following an air crash. Singapore airline (SQ) Boeing 747 crashed on October 31, 2000, on the runway at midnight during a typhoon in Taiwan. Of the 179 passengers and crew on board, 79 died immediately, with 100 initial survivors. During this disaster, the anticipated benefits from the new MCI plan and prior medical preparedness were not achieved. Furthermore, poor compliance with the new MCI plan by the airport authority was noted. Victims were not triaged and did not receive adequate field medical care. Site medical teams responding from hospitals could not function as per the designed plan. Operation problems during emergency medical response to the SQ Airliner Crash included: Incident field status not well evaluated and reported; medical incident command system failure; equipment not properly stored and packed; field triage failure; inadequate field medical care; ambulances and emergency vehicles traffic packing and congestion; inadequate patient dispatch control to hospitals; and information management, communication failure.[6]

The findings with regard to the Emergency Medical Response from the Amsterdam and SQ crash case study were very poor unlike the present case study. The facility and case management had shown significant improvements in the past 20 years.

The objective of this case study is the disaster preparedness, response of the hospital, and the lessons learned in the management of the mass casualty arising out of this accident during the pandemic and incessant rains. This incident is a true reflection of a complex mass casualty following an aviation accident, which had facilities adapt themselves to manage COVID-19 pandemic as well as react to a monsoon showers which could potentially delay the procedures of

transportation of the victims from the accident site to the hospital. Furthermore, it could affect both internal and external communication system and delay staff mobilization. The hospital administration was geared with a response time of 11 min to receive the first set of patients. Ambulance was sent to the site of the accident for transporting the other patients. In another 2 min, they were ready to receive the other patients with triaging as per the hospital protocol.

All necessary staff to manage the influx of patients were present in the hospital within 20 min from the time the disaster was announced. This clearly depicts the readiness of the hospital to meet the needs of such MCIs. It also speaks about the hospital's communication strategies, mobilization of staff, staff knowledge regarding their roles and responsibilities during such incidents. The response time clearly shows the preparedness of the facility to handle such MCIs which in turn highlights the professional standards of the organizational preparedness, delegation of authority for various activities, and training at all levels. Due to the pandemic situation, all patients were treated as potential COVID positive. All patients were tested by the Rapid Antigen Test, which was practical, economical, and a guide to segregate the positive and negative cases. All positives were segregated for further management. The allocation of space was almost decided spontaneously. The facility department did its part getting the place organized. The ED chief took control of the admitted patients as they were brought into the triaging area. Hospital triage was used for primary triage. Similarly, for the management of Trauma cases, CRAMS triaging was used along with major trauma scale.[7] For pediatric cases, a separate child triage system was used. This helped in the prioritization of the cases, including listing of cases for surgery. The results are evident in the form of outcome.

Triage at hospital level usually follows a standard protocol.[8] Color codes followed at the hospital for the MCI is presented in Figure 1. Initial care, including the laboratory and radiological investigations, was done promptly, and the turnaround time was observed to be 4–5 h from admission. Laboratory took up the initial investigation for the categorization of the patients into COVID positive and negative groups based on rapid antigen tests done at the bedside. Subsequently, radiological investigations were done to categorize the patients that need to be allotted to different specialty consultation and management. Clinical heads started managing patients once the laboratory and radiological results arrived. Patient movements to these areas were performed under the guidance of the NS. The NS mobilized the supply of medication from pharmacy and sterile supplies from the CSSD. The entire operation was carried out in a cohesive and sequential manner which improved patient outcomes, reduced morbidity and mortality, and reduced hospital stay for many patients. In the background, the administration took care of the needs of the patient attendants' right from registration, food and medication facility, security, and sharing of the patient information. In addition, the administration also handled the external communication with press and media. These operations were also coordinated with the state and local government authorities.

Figure 1: Triage color codes

Priority	Color	Severity
Priority 1	Red	Immediate/Critical
Priority 2	Yellow	Severe
Priority 3	Green	Minor
Priority 4	Brought dead	Brought dead

The Mass Casualty kit was not opened, and therefore, the identity tags for the members were not distributed. There was chaos as the staff had come from different areas who did not know each other and the presence of full PPE added to the confusion. This was noted in the debriefing meeting as a breach in the protocol. The incident report of the hospital showed that three persons, including the pilot and the copilot, were brought dead and one child died in the hospital during treatment. This is a clear indication that at the site of the accident initial triaging was not available as per the norms of the international flight safety,[9,10] guidelines. Triaging categories helps segregate patients based on their acuity levels, such as those who could survive but requiring immediate medical attention to be given as a priority – Category one is for transfer followed by those requiring ordinary medical attention, then comes priority four and the last priority is for those sure of dying. Applying this strategy, the three who were brought dead should have been transported after the other needy patients. This appears to be a failure in following the triaging protocol at the scene of the accident, which is determined to be out of the scope of this article. The entire exercise was collective, coordinated, and cohesive.

Conclusion

Hospitals become the first to be affected after any disaster. Due to heavy demands placed on the services of hospitals, they need to be prepared to for the element of surprise such as unusual workload, which necessitates for a documented and tested disaster management plan. This plan has to be evaluated to see if it addresses its purpose. The evaluation is done through drills that could be physical drills, computer simulations, and tabletop or other exercises.[11] The purpose of the drills is to train the staff to respond, to evaluate and validate the readiness and effectiveness of the plan, and to incorporate advancements in knowledge and technology. Drills should test the components of incident command, communications, triage, patient flow, drugs and consumables stock, reporting, and security.[12]

The analysis of the management of mass casualty during the pandemic by the tertiary care hospital clearly demonstrates the preparedness of the hospital. In other words, the hospital was simultaneously able to manage an ongoing pandemic and huge influx of patients due to a mass casualty. It also demonstrates the compliance to quality management system of the organization. Documentation was well-evidenced in the

incident reporting. Quality system also speaks of the culture of the staff of the organization that came forward to meet the challenge at such a short notice. The mock drills and the regular drills during accreditation assessments were responsible in a big way in the preparedness to deal with disaster of such magnitude. This preparedness was also responsible in a large way for the clear-cut job responsibility of the various staff members and was responsible for preventing chaos during the management. That helped in having better patient outcomes.

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Conflicts of interest

There are no conflicts of interest.

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