Primary Triage, Evacuation Priorities, and Rapid Primary Distribution between Adjacent Hospitals—Lessons Learned from a Suicide Bomber Attack in Downtown Tel-Aviv

Moshe Pinkert, MD, MHA;[1] Ofer Lehavi, MD;[2] Odeda Benin Goren, RN, PhD;[2] Yaron Raiter, MD;[1] Ari Shamis, MD;[3] Zvi Priel, MD;[4] Dagan Schwartz, MD;[6,7] Avishay Goldberg, PhD;[6] Yehezkel Levi ,MD;[5] Yaron Bar-Dayan, MD, MHA[1,6]

1. Home Front Command Medical Department
2. Sorasky Medical Center Tel Aviv, Israel
3. Director, Sheba General Medical Center, Tel-Hashomer, Israel
4. Deputy Director, Edith Wolfson Hospital, Tel-Aviv, Israel
5. Israeli Defense Force Medical Corps, Surgeon General Headquarters
6. Faculty of Health Sciences, Ben Gurion University, Beer-Sheva, Israel
7. Israeli EMS, Magen David Adom, Medical Division

Correspondence:
Col. Dr. Y. Bar-Dayan, MD, MHA
16 Dolev St. Neve Savion
Or-Yehuda, Israel
E-mail: bardayan@netvision.net.il

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Abbreviations:
ATLS = advanced trauma life support
DISAST-CIR = Disastrous Incidents Systematic AnalysiS Through—Components, Interactions, and Results
EMS = emergency medical services
HFC = Home Front Command
MCI = mass-casualty incident
MOH = Ministry of Health

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Abstract

Introduction: Terrorist attacks have occurred in Tel-Aviv that have caused mass-casualties. The objective of this study was to draw lessons from the medical response to an event that occurred on 19 January 2006, near the central bus station, Tel-Aviv, Israel. The lessons pertain to the management of primary triage, evacuation priorities, and rapid primary distribution between adjacent hospitals and the operational mode of the participating hospitals during the event.

Methods: Data were collected in formal debriefings both during and after the event. Data were analyzed to learn about medical response components, interactions, and main outcomes. The event is described according to Disastrous Incidents Systematic AnalysiS Through—Components, Interactions and Results (DISAST-CIR) methodology.

Results: A total of 38 wounded were evacuated from the scene, including one severely injured, two moderately injured, and 35 mildly injured. The severe casualty was the first to be evacuated 14 minutes after the explosion. All of the casualties were evacuated from the scene within 29 minutes. Patients were distributed between three adjacent hospitals including one non-Level-1 Trauma Center that received mild casualties. Twenty were evacuated to the nearby, Level-1 Sourasky Medical Center, including the only severely injured patient. Nine mildly injured patients were evacuated to the Sheba Medical Center and nine to Wolfson Hospital, a non-Level-1 Trauma Center hospital. All the receiving hospitals were operated according to the mass-casualty incident doctrine.

Conclusions: When a mass-casualty incident occurs in the vicinity of more than one hospital, primary triage, evacuation priority decision-making, and rapid distribution of casualties between all of the adjacent hospitals enables efficient and effective containment of the event.

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Introduction

The frequency of mass-casualty incidents (MCIs) due to terrorist attacks has increased in recent years both in Israel and worldwide. These events can occur in central or peripheral towns, in urban or rural areas. Events already have occurred in Israel, in the vicinity of several Level-1 to Level-3 Trauma Centers.[1–5]

The management of such events differs, depending on the location, character of the event, number and the severity of the casualties, rate of evacuation vehicle accumulation, experience and skills of the field first-aid teams, number and level of the nearby hospitals and ability to reach them.[6] Researching the unique characteristic of the management and outcomes of every one of these events produced different, new lessons.[1–6] These lessons can be used by plan-

Figure 1—A terrorist bombing in Neve Shaanan, very close to the central station in Tel-Aviv

ners, scene commanders, and responders, regardless of the nature of the event. In order to generalize the conclusions of different events, lessons learned from such an event must be researched prospectively and described using the same methodology. This methodology of research was described recently by this set of authors.[7]

On 19 January 2006, a suicide bomber detonated a bomb near a fast food stand in downtown Tel-Aviv (Neve Shaanan). The area impacted by the explosion was densely populated and crowded with buildings and fast food restaurants on the side of the road. Customers usually are crowded in front of the fast food restaurants. A photograph of the area is in Figure 1.

The aim of this study was to describe the unique characteristics of this incident, focusing on injury patterns, its overall management, timetable, medical resources used, prehospital care and evacuation, and primary triage.

Methods

Pre-Event Organization

The medical staff of the Israeli Home Front Command (HFC) is comprised of soldiers and officers, physicians, nurses, and medic-officers. The Medical Operational Center is a 24-hour "war-room", staffed with one officer and 2–3 experienced soldiers. The Operational Center is able to communicate with relevant organizations that provide the center with information or receive information and operative instructions from the Center. Such organizations include all Israeli general hospitals, the National Emergency Medical Services (EMS) Center and districts, other military or HFC rooms, the fire brigade, police headquarters, search-and-rescue units, military medical units including nuclear, biological, or chemical units, the Israeli Air Force, and the Hazardous Material Information Center. The Operational Center also is in contact with the Ministry of Health (MOH) and the Ministry of the Environment.

The Event

Hospitals received early notification of a mass-casualty incident (MCI) from EMS and the HFC Medical Department. The relevant hospitals were instructed by the latter to activate their MCI protocols. Officers from the HFC Medical Department were sent to the disaster area and various hospitals. These officers, physicians, and nurses gathered information and updated the Operational Center. They also try to draw a clear picture of the evolving incident and pass this crucial information directly to hospital managers and emergency responders.

Post-Event

Debriefings were performed in the Medical Department, Israeli Defense Forces Medical Corps Trauma Branch, Israeli EMS center, participating hospitals and the MOH. They were performed according to a standardized protocol—each organization reported its own data, answering questions asked in the protocol. Post-MCI debriefings are closed to the media, allowing free communication between organizations. Data were organized according to the Disastrous Incidents Systematic AnalysiS Through-Components, Interactions, Results (DISAST-CIR) methodology.[7]

	Components
Medical teams at the scene	EMS: 20 ambulances, 10 mobile ICU, 1 medical supply vehicle. 3 physicians, 18 paramedics, 64 medics.
Secondary medical institutions	Two level 1 trauma centers One level 2 general hospital
Medical command and operations	EMS central operation center Home Front Command Operational Center Police commandment

Table 1—Components of the medical system operated at the event (EMS = emergency medical services; ICU = intensive care unit)

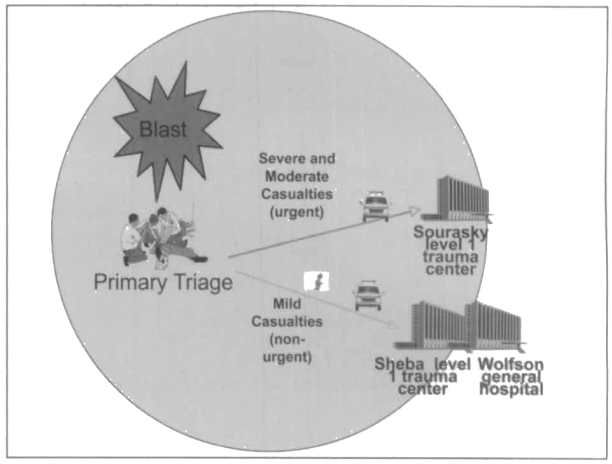

Figure 2—Interactions (according to DISAST-CIR methodology) between different responders or self-referral to close circle hospitals (mainly Sourasky Medical Center)

Hospital	Mild	Moderate	Severe	Total	Admissions	Operations
Sourasky	17	2	1	20	8	1
Sheba	9	0	0	9	4	1
Wolfson	9	0	0	9	1	0
Total	35	2	1	38	13	2

Table 2—Primary triage of casualties, admissions, and operations

DISAST-CIR Methodology

This methodology uses the information gathered by systematic, structured debriefings of all the organizations involved in the event and review of the computer system data and the patient medical charts from EMS and the hospitals. The data gathered from medical charts include symptoms and signs, physical examination data, radiographic and laboratory findings, diagnosis, medications administered, and operations performed. The DISAST-CIR methodology presents the data in a uniformly structured set of figures and tables to allow emergency managers and other readers to compare events systematically. The DISAST-CIR figures include a map of the scene, a flowchart of casualties at the national level, and one of casualties in the hospitals. The DISAST-CIR tables include data on the components of the medical system that operated during the event, the timetable, the distribution of casualties between hospitals, and the injury distribution of casualties.

Statistical Processing

Data were entered and descriptive statistics calculated using a commercially available spreadsheet (Microsoft Excel 2003, Microsoft Inc., Redmond, WA).

Results

The components of the medical responses in this event included the Israeli EMS, two Level-1 Trauma Centers, one Level-2 general hospital, and the Central Operational Center of the police, the HFC, and EMS (Table 1).

Interactions between the components of the medical response system are diagrammed in Figure 2. The main challenges of this event were to synchronize the EMS response with the evacuation needs and the distribution of the casualties among three hospitals after rapid and accurate triage and rapid alert and preparedness of the hospitals. These challenges could be met by effective interactions between the EMS Operational Center with the EMS ambulances, the police and HFC Operational Centers and the receiving hospitals.

Thirty-eight casualties were primarily triaged to three hospitals (Table 2). The severe and moderate casualties were evacuated by ambulances to the nearby (five minute drive) Sourasky Level-1 Trauma Center. The mild casualties were distributed by EMS to three hospitals: Sourasky and Sheba Level-1 Trauma Centers, and the Wolfson Level-2 General Hospital, located 5 to 20 minutes from the scene. One victim (the terrorist) died at the scene. Eleven mild casualties were evacuated by private cars to the hospitals a few minutes to a few hours after the event. Four casualties needed urgent surgery. All had a good outcome. None of the casualties died in the hospitals.

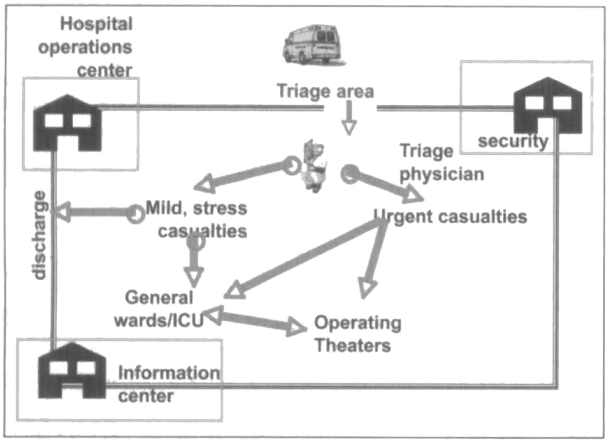

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Figure 3—Interactions (according to DISAST-CIR methodology) inside Sorasky Medical Center

Event	Time	Time from Event (minutes)
The explosion	15:41	0
Arrival of 1st EMS vehicle	15:45	4
Alert 3 hospitals	15:43–15:50	2–9
Arrival of the 1st casualty to Sourasky Medical Center	16:00	19
End of evacuation from the scene	16:10	29
End of the whole event at the hospitals	16:53	1,012

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Table 3—Timetable of the event

Type of injury	n (%)
Blast injuries	15 (39)
Penetrating injuries	4 (11)
Soft tissue injuries	11 (29)
Stress, anxiety and somatization	14 (37)

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Table 4—Injury distribution of casualties. Total percentage exceeds 100% due to multiple injuries per casualty

Hospitals were prepared rapidly according to MCI doctrine including: (1) reinforcement of the emergency department by medical personnel; (2) triage at the entrance by a traumatology specialist; and (3) distribution of the casualties by mild, moderate, or severe sites. Advanced trauma life support (ATLS) was provided to all the injured victims (Figure 3).

The timetable of the event is in Table 3. Sourasky Medical Center was informed officially about the event (by the HFC Medical Operation Center) four minutes after its occurrence (before the arrival of the first casualty to the emergency department). All of the casualties were evacuated from the scene within 29 minutes. The severe casualty was the first casualty evacuated from the scene (within 14 minutes) and arrived to Sourasky Level-1 Trauma Center five minutes later.

Injuries included blast injuries (15; 39%), somatization injuries (14; 37%), soft tissue injuries (11; 29%), stress, anxiety, and penetrating injuries (4; 11%; Table 4).

Discussion

A total of 20 of the 38 casualties, including all the severely injured patients and most moderate to mild patients arrived at Sourasky, while the two other more distant hospitals received a total of 18 casualties. The severely injured patient was evacuated rapidly to the nearby hospital (within 19 minutes) where his condition could be better evaluated and stabilized in the emergency department and the operating room. Medical systems must be prepared to manage MCIs. Preparedness planning is crucial for good quality outcome.

All MCIs are different, regarding location, number and distribution of casualties, severity, type and nature of injuries, size of available rescue teams, time and equipment needs, damage to roads, distance from hospitals, designated hospital trauma level, and other variables. One of the lessons learned from the management of MCIs is not to set fixed protocols, but was based only on principles. By applying principles adapted to the situation, managers will be able to perform better.[6]

Previous experiences in terrorist bombing MCIs has shown that as events can happen anywhere, all hospitals, not only trauma centers, should participate in ATLS preparedness courses and MCI drills, and should be prepared for a high flow of casualties.[2–5,7,9–10]

The dilemma of life support in the field or rapid evacuation to a nearby hospital is critical for the management of MCIs. Similarly, giving clear instructions to hospitals regarding the operational mode needed for the specific incident is mandatory. Proper triage, appropriate resuscitation, and timely evacuation decrease morbidity and mortality in trauma patients and facilitate utilization of the available resources appropriately.[8]

A four-step approach was suggested to establish a national medical management and response plan to terrorism: (1) analysis of a scenario based on past incidents; (2) description of relevant capabilities of the medical system; (3) analysis of gaps between the scenario and the expected response; and (4) development of an operational framework.[9]

Large-scale terrorist attacks also can occur in peripheral areas, which are located near a country's borders, far from its main medical facilities, involve multi-national casualties and responders. Following the terrorist bombing of Tabba in 2004, a total of 185 injured survivors were repatriated. A forward medical team landed at the border town's airport, which provided reinforcement in the field and in the local hospital. Israeli and Egyptian search-and-rescue teams collaborated at the site of the bombing. One hundred sixty-eight injured patients arrived at the small border hospital

that rapidly organized itself for the MCI, operating as an "evacuation staging hospital". Twenty-three casualties were distributed secondarily to two major trauma centers in the south and center of Israel either by ambulance or by helicopter. Eventually, no casualty was hospitalized at the "evacuation staging hospital".[2]

A MCI also may occur outside of a major metropolitan area. In such circumstances, the nearest hospital can be a Level-2 Trauma Center, and located >40 minutes by land from a Level-1 Trauma Centers. Moreover, EMS capabilities in such areas might be limited, which may compromise prehospital care and the speed of evacuation. At the 2005 Hadera, Israel terrorist bombing, a total of 58 injured survivors were injured. Forty-nine of the wounded arrived to the nearby Hillel Yafe Hospital, where they were given advanced hospital-based resuscitation. Casualties needing care beyond the capabilities of this facility were distributed secondarily to Level-1 Trauma Centers. To alleviate the burden placed on the local hospital, some of the mildly injured victims can be evacuated primarily to more distant, higher level hospitals. This mode of operating a hospital is regarded as the "selective evacuation" mode.[10]

When a MCI affects a small town in the vicinity of a small, Level-3 hospital, where Level-1 or Level-2 Trauma Centers are located <30 minutes away by land, the small hospital becomes a critical component of medical event management. Urgent casualties must be evacuated rapidly to it, given advanced, hospital-based resuscitation, and secondarily distributed to Level-1 centers, probably by air. Mildly injured casualties, arriving independently at the local hospital, should be discharged for ambulatory follow-up. This mode of operating a hospital is regarded as the "semi-evacuation hospital" mode.[5]

As in this event, MCIs can occur within major metropolitan areas. In such circumstances, several hospitals, Level-1 or 2 Trauma Centers, are in close proximity. In such scenarios, the EMS capabilities in such areas are professional and expert. In the 2006 Tel-Aviv, Neve Shaanan, terrorist-bombing attack, 38 people were injured: one was severely injured, two were moderately injured, and 35 were mildly injured. The casualties were distributed among three hospitals; two to a Level-1 Trauma Center and one to a Level-2 Trauma Center. The war room in the EMS district managed the MCI by enabling a rapid concentration of a large number of ambulances at the scene and by promoting a rapid primary distribution of the casualties between the hospitals. Computer systems between hospitals provide crucial information regarding the hospital's capacities to receive casualties. The primary triage in the field, the evacuation priority decision-making, and rapid distribution of casualties between the hospitals made by the EMS war room enabled efficient and effective solution to the event. The distance to the equipped and trained hospitals and the rapid response of the trained EMS enabled the EMS district war room to distribute the casualties in nearby hospitals. The outcome of the casualties' medical conditions (no fatalities) might be related to the effectiveness of the solution given by the war room for this specific MCI. This may be due to the correct triage decisions made at the scene, to the nature of the injuries of the victims and to the treatment provided at the hospital.

As terrorist events and MCIs became a worldwide problem, additional research must examine how transfer times, hospital surge capacity, and the "density" of urgent casualties affect survival.

Conclusions

When a MCI affects an urban area in the vicinity of more than one hospital, the preferred mode of action is based on a rapid arrival of a large number of EMS ambulances, rapid primary triage, evacuation priorities, and rapid distribution of casualties among all hospitals in the area in order to contain the MCI rapidly and effectively. Emergency medical systems must build an operational facility that can rapidly build a clear picture of a mass-casualty incident and react properly according to the principles suitable to the specific event.

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