Disaster Medicine and Public Health Preparedness

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Concepts in Disaster Medicine

Cite this article: Alpert EA, Weiser G, Schul S, Mashiach E, Shaham A and Kobliner-Friedman D (2024). Models of Field Hospital Emergency Departments: The Israeli Experience. *Disaster Medicine and Public Health Preparedness*, **18**, e315, 1–7
https://doi.org/10.1017/dmp.2024.305

Received: 24 September 2023
Revised: 07 July 2024
Accepted: 02 October 2024

Keywords:
emergency department; disaster medicine; field hospital; World Health Organization; Israel

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Models of Field Hospital Emergency Departments: The Israeli Experience

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Abstract

The World Health Organization has classified Emergency Medical Teams (EMTs) into 3 types for international disaster response. They range from those that operate as daytime clinic facilities to those that have complete hospital capabilities that can provide 24/7 inpatient care. The most complex EMT (Type 3) includes a full-scale emergency department (ED), operating rooms, a medical/surgical ward, an intensive care unit, and laboratory services. The Israel Defense Forces Field Hospital was the first to be officially designated as a Type 3 EMT. Two models have been used by the Israeli EMT depending on the disaster response: standalone and hybrid. The standalone model is where the ED and hospital are set up in tents independent of any existing health care facilities. The hybrid model is where the equipment and personnel are combined with existing structures. Pediatric patients are examined in either a designated area staffed by specialized pediatric emergency physicians and nurses or integrated into the general ED. Models of ED layout, staffing, scheduling, and equipment are also described. While the Israeli team is a Type 3 EMT, the different models of ED organization can also be applied to other types of field hospitals to maximize care in the disaster setting.

In recent decades the world has seen numerous sudden-onset disasters (SOD) which have deeply impacted millions worldwide, the most recent having occurred in Turkey on February 6, 2023, when an earthquake with a magnitude of 7.8 with subsequent aftershocks struck southern and central Turkey and northern Syria. The events left catastrophic damage across 11 provinces and killed over 50 000 residents of Turkey and Syria.[1,2,3] On the day of the earthquake, the Government of Turkey issued a Level 4 alert calling for assistance from within the country and throughout the world.[4] At least 29 international Emergency Medical Teams (EMTs) from 22 countries assisted the local teams.[5]

In 2010, lessons from the health response to the earthquake in Haiti initiated the development of principles and standards for foreign medical teams. This propelled the publication of the Classification and Minimum Standards for Foreign Medical Teams in SOD (known as the "Blue Book") which led to the establishment of the Emergency Medical Team (EMT) initiative. This classification system was first implemented in response to Typhoon Haiyan in the Philippines in 2013. The EMT initiative aims to improve the timeliness and quality of health services provided by national and international teams and enhance the capacity of national health systems to lead the activation and coordination of rapid response in the immediate aftermath of a disaster, outbreak, or other emergency.

The guidelines classify EMTs into 3 types based on the ability to provide increasingly complex care to an increasing number of patients with a fourth type that provides specialty care. EMT Type 1 provides care during daylight hours for the stabilization of acute trauma or medical presentations and community-based primary care. Patients who need further investigation or inpatient care need to be referred to an EMT Type 2 or 3. EMT Type 2 adds inpatient surgical and hospital-based care. EMT Type 3, adds complex referral and intensive care capacity. The fourth type of EMT is specialized care teams. This includes advanced surgery teams, mental health professionals, and rehabilitation services.[6] Since the beginning of the program up to February 2023, 37 teams have been classified and only 2 are EMT Type 3. In 2016, the WHO certified the Israel Defense Forces Field Hospital (IDF-FH) as the first EMT to be awarded Type 3.[7]

The objective of this paper is to describe different emergency department (ED) models in terms of physical layout, organizational structure, personnel, and equipment that have been used by the Israeli Type 3 EMT in disaster response.

Discussion

Emergency Department Models

Standalone versus hybrid

While not defined by the WHO guidelines, the Israeli EMT has deployed 2 types of models- standalone and hybrid (also known as integrative, merged, or cooperative). The standalone model used after the devastating earthquake in Nepal in 2015 consisted of tents independent of any existing hospital.[8,9,10] The ED staffed solely by the Israeli team consisted of registration and triage at the entrance, a resuscitation zone, an acute care area, and an ambulatory care area. The acute care area consisted of 5 stretchers separated by curtains with children being seen in a separate pediatric area of 2 stretchers at the far end. The ambulatory area consisted of an array of chairs for walk-in patients. A separate tent was used for orthopedic and surgical procedures and an additional tent served patients with obstetric or gynecologic issues. Patients were either discharged home, sent directly to the operating room, or admitted to the hospital's medical/surgical ward or intensive care unit. Over 11 days, a total of 1668 patients were seen and treated in the ED (mean of 151.6 patients per day). Of this number, 450 patients were between the ages of 0-18 (27%) with 87 being 2 years of age or younger (5.2%). Unlike many hospitals, the consensus of the IDF-FH is that there should be no boarding in the ED as it is operating in a disaster zone. Once the medical/surgical ward became full, an additional tent was erected for the surplus patients.[11]

A hybrid model of the field hospital ED was implemented in the Philippines after Typhoon Haiyan in 2013. The team landed in the Philippines 5 days after the devastating typhoon and realized that a local infrastructure existed. The team integrated with the Severo Verallo Memorial District Hospital on the island of Cebu which included an ED, a single operating room, a delivery room, and 4 wards (pediatrics; maternity; male and female medical/surgery). Several tents were set up on the grounds of the hospital to serve as the ED which was staffed solely by the Israeli team with the help of local interpreters. There was a small resuscitation zone, and separate adult and pediatric areas. Patients could be discharged from the ED, although those who needed an operation or further care were admitted to the existing hospital and treated in conjunction with local teams. Over 10 days, a total of 2686 patients were seen.[12]

A similar model was used during the recent deployment to Turkey in February 2023 with the Israeli team working in the Necip Fazil City Hospital in the City of Kahramanmaraş. The core hospital staff were given a 1-month leave to care for their homes and families. From February 9, 2023, through February 14, 2023, the Israeli medical staff joined with Turkish volunteers to rehabilitate the existing structure and treat patients in the ED as well as the inpatient wards and intensive care unit of the hospital. The existing ED consisted of 2 large rooms designated as separate internal medicine and orthopedic/surgical areas which the Israeli team converted into acute care and ambulatory areas. The trauma/resuscitation room was in a separate area and consisted of 2 beds. There was a separate room for obstetrics and gynecology. The Israeli team using their own as well as existing equipment, worked closely with Turkish volunteer physicians and nurses throughout the ED. Over 6 days, 470 patients were seen by the Israeli team. This included 17 patients removed after 5 or more days from the rubble of the earthquake, 10 who underwent operations, 48 who were hospitalized in the inpatient ward, and 27 in the intensive care unit (Table 1) (Figure 1).

Table 1. Models of the Israeli Type 3 EMT - standalone versus hybrid

	Philippines (2013)	Nepal (2015)	Turkey (2023)
Type of Disaster	Typhoon	Earthquake	Earthquake
ED Design	Hybrid	Standalone	Hybrid
EMR	HAITI	HAITI	HAITI
Pediatrics	Separate	Separate	Integrated

Standalone versus hybrid models: advantages/disadvantages

Our experience indicates that both the standalone and hybrid models have their own distinct advantages and disadvantages. The selection of the appropriate configuration for any specific emergency medical mission should carefully evaluate the circumstances, including geography, available facilities, and medical culture in the disaster area.

Standalone field hospitals require significant available open space that is geographically close to the victims of the disaster. If such a space is available, then a field hospital can be quickly and efficiently deployed based on models that were improved over many drills and training exercises. Such a facility is more secure in earthquake disaster zones which are subject to multiple aftershocks. However, at the same time, the temporary structures of a standalone facility are exposed to extreme weather conditions. Patient records can be created, updated, and maintained in accordance with the uniform field hospital emergency medical record (EMR) system. Finally, EMT staff will utilize familiar equipment, medical kits, and consumables.

These advantages, however, require that EMT staff functioning in a standalone field hospital configuration reach out and develop working relationships with local medical caregivers at the earliest opportunity. These must include translation capabilities necessary for patient interviews, consent, understanding, and giving appropriate attention to local customs relevant to patient treatment and interaction with patients' families. It also requires adapting the field hospital EMR system so that patient records can be transferred to parallel local system equivalents; updating local medical staff regarding medical procedures performed; providing clear goals for continued patient care; and ensuring that these treatment plans are consistent with local medical practices and in alignment with the postoperative and rehabilitation capabilities in the affected country. The advantages of having the same language, cultural, and record systems in the patient treatment stages can become acute disadvantages in the patient hand-off stages.[13]

A standalone field hospital configuration must also coordinate with off-site local medical centers for the provision of certain supplementary services requiring equipment beyond the scope of those available in a field hospital, such as advanced imaging using CT or MRI. Finally, a standalone field hospital deployed in field conditions makes maintaining continuous appropriate sanitary and sterilization conditions difficult.

The hybrid model by which the staff of the field hospital is deployed within an existing facility requires integration of the various field hospital departments with the parallel departments of the existing facility. This integration involves identifying a suitable local medical facility within a safe and secure structure. The hybrid model further involves the difficult process of coordinating and integrating medical teams with different backgrounds, cultures, languages, treatment practices, recording

https://doi.org/10.1017/dmp.2024.305 Published online by Cambridge University Press

Figure 1. Models of the Israeli Type 3 EMT - standalone versus hybrid. (a) The hybrid model used in the Philippines depicting the emergency department in tents outside the existing hospital. (b) The standalone model used in Nepal depicting the Emergency Department in the foreground with the rest of the hospital in the background.

procedures, and medical ethics.[13] This also requires that management and chain of command conflicts must be anticipated and resolved, so that the decision-makers are identified and each of their responsibilities and authority is clearly defined. On the macro level, the medical director of the field hospital maintains constant contact with the medical director of the existing hospital. On the unit level, the director of each unit works directly with their partner from the existing facility. This is critical so that both medical treatment and ethical decisions can be made in a timely, efficient, and effective manner. This also necessitates

https://doi.org/10.1017/dmp.2024.305 Published online by Cambridge University Press

significant fluidity, adaptation, and individual initiative to avoid confusion and even conflict between the EMT and the staff of the local medical facility.

These apparent disadvantages can also develop into both strategic and tactical advantages for the EMT staff. On a macro level, the experience with, and exposure to local cultures, practices, recording systems, treatment methods, and patient discharge procedures give the EMT a broader view of medical practice and patient care, a significant advantage for a field hospital with a global reach. Similarly, the real-time coordination and integration with practitioners of different languages and cultures provide invaluable experience in integrating the field hospital within an existing local medical environment. On a micro level, working in close coordination with local medical teams facilitates communication with local patients resulting in increased patient confidence. Local medical teams can provide important insight into local cultural issues that can significantly impact treatment and care. The hybrid model gives the EMT access to additional facilities, equipment, and personnel available in an existing medical facility allowing for both increased patient volume and more efficient treatment and care. The integration of the EMT into a medical facility in a location already well-known in the community has obvious advantages over the deployment of a new facility in a location unknown to patients and local first responders. In Turkey, once volunteers from throughout the country came and were able to restaff the hospital, the team was able to finish their mission in 6 days although past missions lasted on average 2 weeks. Finally, the hybrid model facilitates a smooth transition from EMT to local medical care, ensuring proper follow-up patient care following local practice. The average cost of a mission whether standalone or hybrid is 15 million US dollars including the flights, equipment, and personnel.

Pediatric Issues

The pediatric population in a disaster area tends to be undertreated. Disparities exist for several reasons. The most important is the vulnerability of the pediatric population to the conditions and trauma caused by the disaster. The lack of food, water, and medical assistance leads to higher morbidity and mortality in the pediatric population. In addition, in many cases, the equipment available during such dire times is not compatible with the treatment of children. This has led to many disaster preparedness programs focusing on the pediatric population.[14,15,16,17]

The IDF-FH has designated staff and equipment for treating all pediatric populations from neonates to adolescents. This begins with a strong pediatric emergency department team including board-certified pediatric emergency physicians and nurses with extensive experience working in pediatric EDs in tertiary care medical centers throughout Israel. The treatment capabilities include pediatric intensive care unit-level monitoring when needed.

However, the configuration of the team and its equipment are case-dependent. The experience in the Philippines and Nepal was to separate the pediatric patients in the ED thus offering a dedicated triage team, less exposure to adult cases, and a more encompassing environment suitable to the young patients. This worked well while also allowing the physicians to aid on the adult side when needed.

In Turkey, care was conducted in cooperation with the local medical teams. They were not accustomed to separating the pediatric population (as there was a specific pediatric hospital in the city) and so all patients were treated within the same setting. This was challenging, as children were brought in alongside adults suffering significant illnesses and injuries. The staff adapted to this by ensuring that all shifts, including those overnight, had a dedicated pediatric emergency physician.

One challenge of having the pediatric population within the general ED was the lack of designated equipment. The Israeli team was working in a general hospital where children were usually sent to a nearby pediatric facility. This resulted in cases in which fluids were not available in volumes for pediatric patients and difficulties finding basic pediatric supplies (oxygen masks, bag valve masks, intravenous cannulas, etc.) as well as advanced equipment (intubation tubes, central line kits). In all cases, improvisation solved the problem. For example, a 10-month-old infant with a metabolic disorder arrived at the hospital. He needed fluids comprising the correct combination of dextrose and saline. However, there were no combined fluids. By using a local bag of dextrose 10% and adding a specific amount of sodium bicarbonate, a specific fluid was prepared with a combined dextrose and saline composition.

ED Workflow

Medical records

Throughout the missions in the Philippines and Nepal, the Israeli team used a comprehensive EMR system which includes file numbering, physician and nursing documentation, and medication and treatment documentation. This has been colloquially known as the "HAITI" system as it was first implemented by the Israeli team in that country as a response to the earthquake in 2010. It consists of both a wireless component as well as ethernet wires to cover both computer workstations, laptops, and handheld tablets. There is a tracking board and administrative logs can be easily downloaded. It also allows integration with portable radiology studies performed by a picture archiving and communication system. Every patient who was discharged from the ED or the hospital received a printed discharge letter.[18] Discharge of patients in Turkey was performed somewhat differently as according to the local policy, all discharged patients receive an oral explanation and printed prescription; no printed discharge letters were issued (Figure 2).

Registration and triage

In the Philippines, the IDF-FH, used the "HAITI" EMR system for registration and patient follow-up records. Para-medical staff were in charge of registration, which included demographic details, a frontal photo, and a numbered identification wristband. Patients were triaged to either the resuscitation zone, acute care area, or ambulatory area. Registration and triage were conducted similarly in Nepal. However, in Turkey, there was dual registration for some patients. All patients were entered into the hospital's EMR; however, the patients who were also treated by the Israeli team were also entered into the HAITI system. For all missions, the triage was based on severity with those who were hemodynamically unstable being triaged to a resuscitation area, those with severe illness or injuries going to the acute area, and stable patients going to an ambulatory zone.

Equipment

In general, as the FH team doesn't know what type of response will be required until arrival at the disaster site, all equipment is standard. However, that which is unpacked may change. In Nepal, all ED equipment was shipped from Israel including beds/stretchers, single-use paper bed covers, sharp containers, medications, ECG machines, Bair huggers, otoscopes, ventilators, monitors, and

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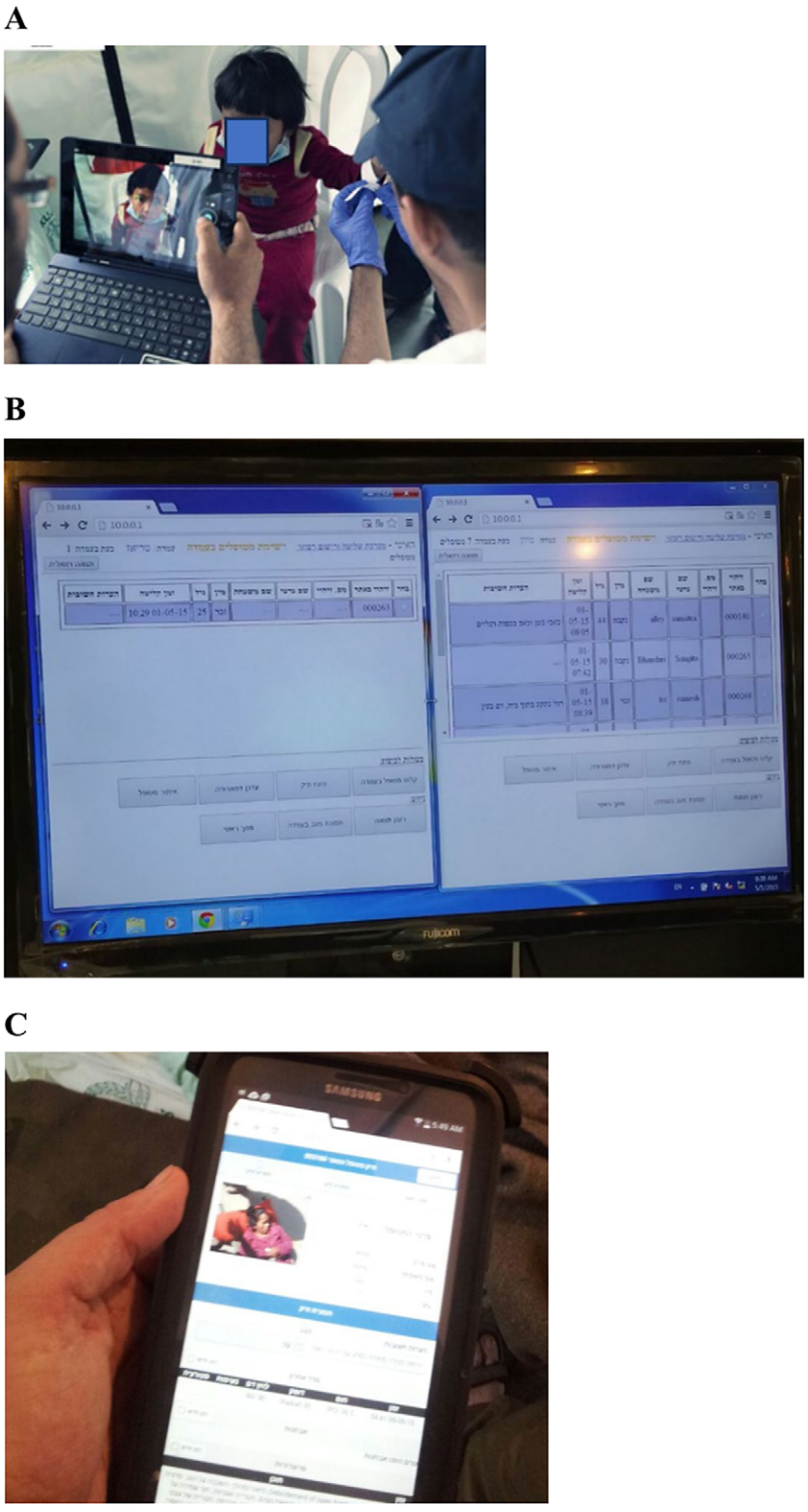

Figure 2. The Emergency Medical Record (EMR) used by the IDF-FH. (a) Registration and triage of a child entering the IDF-FH. (b) Example of the EMR- large screen view allowing patient status to be seen. (c) Tablet-based EMR.

portable ultrasound and x-ray machines. Patients in need of computed tomography imaging were transferred to a nearby military hospital. However, in Turkey, all logistical equipment and non-disposables were supplied by the local hospital with the Israeli team using their chest drainage kits, dental, and ob/gyn equipment. In addition, special equipment such as portable ultrasound machines, neonate-capable ventilators, and Bair huggers were supplied by the Israeli team. The imaging center at the hospital including computed

https://doi.org/10.1017/dmp.2024.305 Published online by Cambridge University Press

tomography and magnetic resonance imaging, was operating and the examinations were performed in a coordinated effort between the Israeli and Turkish teams.

Staffing

Leadership

The team, which can consist of up to 120 medical personnel, is led by a medical director and assistant medical director with extensive experience in the leadership of international medical missions. There are also directors of the emergency department, inpatient ward, intensive care unit, radiology department, and surgical department. Ancillary services also have department heads such that there are directors of the laboratory, pharmacy, medical supplies, and logistics.

Physician staffing

There is a core physician staff including the leadership, who are board-certified in either general emergency medicine or pediatric emergency medicine. This core staff is comprised of a minimum of 1 senior emergency medicine physician, 1 pediatric emergency medicine physician, and at least 3-4 physicians who may be residents or attendings in emergency medicine or general medical doctors. The residents were supervised by attending physicians as needed based on their level of training. Orthopedic surgeons, general surgeons, and an ob/gyn are available for consultation in the ED. Depending on the composition of the delegation, other consultants may include ophthalmology, otolaryngology, and plastic surgery.

Nursing staff

The core nursing staff comprises 9 reserve duty emergency/pediatric emergency medicine nurses. Seven nurses generally work with adult patients whereas 2 work specifically with pediatric patients. This ratio corresponds to the relative number of adult and pediatric patients based on actual experience in the field. However, it is important to note that all core nursing staff are qualified to treat both adult and pediatric patients. During humanitarian missions, the core nursing staff is reinforced with regular IDF Medical Corps nurses who may not necessarily have expertise in emergency medicine. The minimum standards as discussed in the Bluebook is a nurse-patient ratio of 1:8 per shift which is maintained in the Israeli field hospital. The minimum nurse-physician ratio is 1:3; however, the IDF-FH maintains a ratio closer to 1:2 with a team approach to patient care.[6] For example, if the nurses are overwhelmed with patient care, a physician may step in and help with intravenous line insertion.

Ancillary staff

Additional ED staff includes emergency medical technicians and paramedics. They have a role in registration and triage as well as patient care. The emergency medical technicians can give oxygen, insert intravenous lines, apply dressings, and serve as scribes. Paramedics are allowed to perform procedures and give medications that they administer daily in civilian life in Israel. This includes performing intubations, inserting intravenous lines, and administering intravenous pain medications. Logistics are coordinated by a logistics officer (one per shift) who is in charge of patient flow, equipment, patient transport, and communication between the central command and the various departments. This role allows the medical and nursing staff to focus on patient care.

Staff work hours

The working hours and shifts are a function of the respective operating model deployed in the specific humanitarian mission. Depending on the mission, the shifts are usually 8-12 hours with less staffing overnight as generally fewer patients arrive at the ED after dark in a disaster zone.

During the deployment in Nepal, the official admitting hours for patients were 8:00-20:00. Accordingly, the ED staff worked through a 12-hour daily shift with rests and breaks permitted based on the patient workload. During the evening off-hours, the ED was staffed by a standby team that included a physician, a nurse and an EMT, who were on-call for emergency and special cases. It is important to note that the deployment conditions of a field hospital are such that the entire hospital staff is available, and on-call as needed.

In the deployments to the Philippines and Turkey, the admission hours for patients were per the local hospital. In Turkey, most patient admissions were during the day such that the first shift was from 8:00-16:00 with a second shift from 13:00-21:00. The overlapping hours allowed reinforcement for mid-day rush hours as well as for staff lunches and breaks. The night shift comprised 2 doctors (1 EM specialist and 1 junior physician), a paramedic, and a nurse. A designated pediatric emergency physician was on-call as needed.

Team morale and high functioning

The overall experience in the above-mentioned conditions leads to a high rate of stress and team burn-out. This may stem both from the physical conditions and workload as well as the mental exhaustion from both difficult situations as well as ethical decision-making in dire circumstances. As such, there is an ongoing effort to ease these difficulties. On the physical level, limiting hours to shifts as well as having available reinforcement of staffing offers time to rest and recuperate. A daily debriefing session with the whole team helped with ventilation and bringing up both difficult cases as well as other problems that may arise. On every mission there is at least 1 specialist who can provide mental health support both for the patients as well as the staff- either a psychiatrist, psychologist, or social worker. The use of medical clowns as part of the team helped both with patient interaction as well as team health.[19] In addition, the IDF-FH tried offering outings to refresh and regroup as a means of avoiding burnout. In significant cases, there was an option for an ad-hoc meeting in the ED and, if needed, with the hospital leaders to discuss complicated ethical or other medical issues.[13,20]

Conclusion

The Israeli EMT Type 3 Field Hospital uses 2 general models for deployment: standalone or hybrid. The ED has incorporated workflow and staffing models to adapt to each of these configurations. The goal as much as possible is to apply the same professional standards of care in the disaster zone as at home. This includes board-certified EM and pediatric EM physicians and experienced and certified EM nurses. There is an electronic EMR system as well as durable hand-held ultrasound machines, monitors, and ventilators. However, the team is still trained and prepared to improvise when necessary. There is an emphasis on patient rights and respecting local practice. These models can also be used by Type 1 and Type 2 teams responding to disasters throughout the world.

Competing interest. The authors have no commercial associations or sources of support that might pose a conflict of interest. We acknowledge that there are no sources of funding for this paper.

https://doi.org/10.1017/dmp.2024.305 Published online by Cambridge University Press

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https://doi.org/10.1017/dmp.2024.305 Published online by Cambridge University Press