The medical response to the Boston Marathon bombings

Several factors combined in the aftermath of the bombings to facilitate the delivery of medical care. Herman Leonard and Arnold Howitt highlight 10 elements of the emergency medical response that saved dozens of lives in Boston.

Some important lessons can be learnt from the medical response to the bombings that occurred at the Boston Marathon. The immediate response appears to have been swift and sure. The video of the bomb near the finishing line clearly shows that people were instantly pushed away from the impact zone by the blast wave itself, but, within seconds, they began to run back toward the blast area to render help. The number of people who climbed over barricades, tore barricades down in order to allow others to enter, and rendered aid with whatever means available to them, shows that people spontaneously helped each other, across cultures and ethnicities and nationalities.

Moreover, the medical response, from both trained responders at the scene and ‘civilian’ bystanders, who together placed tourniquets, held pressure, and transported survivors to the medical tents and on to the ambulances beyond, and then teams of doctors, nurses, and clinical staff at hospitals, was immediate and skilled. A very large number of the grievous wounds from the blast and shrapnel would in almost any other circumstances have proved fatal – but here, it appears that every person who was alive when definitive medical help was applied – in most cases, within minutes of the blast – is still alive today. This is a largely unprecedented level of success in providing care to gravely wounded blast and shrapnel survivors. We can identify 10 main factors that contributed to the swift application of medical training, knowledge and technology that undoubtedly saved dozens of lives in Boston.

Ten factors in the rapid application of medical treatment

1. The response by survivors themselves and by bystanders was nearly instantaneous. The high density of the crowd contributed to the large number of injuries – but it also meant that there were many people immediately available to render aid, and that is what they began to do, within seconds;

2. There were literally hundreds of medically trained personnel located near to where the bombs went off. This was the result of detailed centralised and coordinated planning in advance of the event, and learning based on many previous Boston marathons and other events. With thousands of runners coming off the course in an ordinary year with medical needs ranging from blister care to heartstroke to possible cardiac problems, a wide range of medical services were pre-arranged and pre-positioned. While those medical services were not specifically designed to render aid to bomb victims, the array of capabilities that had been arranged through careful centralised planning was broad enough, and the personnel on the scene adaptable enough, to deploy that set of capabilities effectively to stabilise bomb survivors;

3. The centralised planning for this event drew on a strong culture of preparing for large ‘fixed’ events (events whose time and location are known well in advance) across multiple disciplines (police, fire, emergency medical services and so on). In the aftermath of 9/11, when Boston faced the challenge of preparing for a ‘National Special Security Event’ – the 2004 Democratic National Convention – it formed a multi-agency, multi-jurisdictional, multi-level planning group. Out of this (generally successful) effort grew many lessons for future collaboration – and an emphasis on the importance of joint planning for such events. Large-scale events – from First Night to the 4 July Esplanade celebration to the arrival of Tall Ships to parades for national champion baseball, football, basketball, and hockey teams – are recurrent in the Boston Metropolitan Area, and a strong pattern of collaborative planning for such events has become routine;

4. Significant changes from previously established medical practices for treatment of blast and shrapnel trauma victims, developed in bitter experience in Iraq and Afghanistan, had made their way into equipment and practices for trauma response on the home front. In particular, the use of tourniquets to staunch blood loss from major injuries to extremities was shown in battlefield experience to save lives, and tourniquets are therefore now recommended in cases like the many grievous injuries to extremities inflicted by this attack. This change in doctrine – accompanied by the deployment of tourniquets in the equipment of emergency medical services personnel – allowed for rapid application of life-saving means at the site of the blasts;
Medical facility concentration surrounding the blast zones

First explosion
The first explosion took place close to the finishing line and medical teams.

Second explosion
The second explosion occurred seconds after the first, also near the finishing line.

Legend
- Hospital
- Bomb explosion
- Marathon route
The bomb blasts did not themselves directly degrade the medical capabilities on the scene. In the immediate aftermath of the blast, the medical personnel and equipment were almost fully intact, allowing for rapid application of what was immediately needed by survivors. By contrast, for example, in the Haiti earthquake most of the immediate response capability in Port-au-Prince was destroyed by the earthquake in the same moment that it came to be needed. (In the Boston Marathon case, this was in part a matter of good fortune, but it has implications for future planning with regard to the concentration of response resources);

Boston has an extremely high concentration of tertiary medical facilities – technology, together with highly trained people – with five of the nation’s leading teaching hospitals and one of the nation’s leading children’s hospitals, each with an emergency room and major trauma unit and with extensive state-of-the-art advanced medical services available in many relevant specialties (orthopedics, vascular surgery, neurosurgery and so on). Five of these six facilities are located within two miles of the bomb blast. This permitted definitive in-hospital care to begin within less than half an hour for a number of critically injured patients, saving many who would otherwise have perished;

Those medical facilities had specifically engaged in extensive planning, practice and training for ‘mass casualty’ events – events like a plane crash that might suddenly produce a rapid influx of seriously wounded patients. While much of this was not specifically oriented to casualties from a bomb attack, MGH had actually consulted with experts from Israel about how to handle a sudden flow of blast and shrapnel survivors – and the emphasis on the possibility of having rapidly to handle massive numbers of casualties had prepared trauma teams throughout the city for what they had to do during this event;
Several factors came together to increase the medical capacity available to serve survivors of the blasts. Since the Boston Marathon is run on the day of a state holiday, hospitals generally do not perform elective surgeries, so a large number of operating rooms were idle and available. Though it was a holiday, hospitals were nonetheless staffed, precisely because it was ‘Marathon Day’. Moreover, Boston has a coordination process to oversee allocations of patients and resources among the city’s hospitals (a ‘war room’ of sorts) that it stands up on three days each year – on New Year’s Eve (‘First Night’), on the 4th of July for the Independence Day celebration… and on Marathon day – so that process was already up and running. And, in a stroke of luck on an otherwise dark day, at least one of the major medical centers was undergoing a shift change at the time of the blasts – and so had available both the medical staff from the first shift (which stayed) and from the second shift (which was arriving);

The medical teams in the emergency rooms throughout Boston found resources they did not know they had when they suddenly needed them. The surge of patients that they faced on Monday afternoon was beyond their experience, planning, and established capacity, but instead of being overwhelmed, the medical teams met the surge of patients with a surge of resources and resourcefulness, coping as effectively as they could.

We will know more when we have had an opportunity to debrief participants in detail, but it seems reasonable to suppose that the teams showed a good deal of improvisation and creativity in handling the unprecedented demands that they confronted; and

The response by medical personnel on the site of the blast and in the hospitals was almost completely without need of direction. Doctors and nurses with relevant medical skills converged on the emergency rooms of their hospitals without having to be called; as ambulances delivered patients groups of clinicians self-organised into trauma teams and undertook the work without having to be instructed or given directions. Several of the emergency room ‘incident commanders’ commented that they had to give but few instructions, because the people who came to the task brought experience, skill, and knowledge and could figure out on their own what to do… and had for the most part already done so before any instructions could be issued.

In one emergency room, people who were not needed to provide direct care realised that there was a congestion problem, and self-organised themselves, moving to a side room from which they could be called as their particular skills were needed.

‘Commanders’ became coordinators, helping to move resources as necessary within the bigger picture. As one emergency room director said, “everybody spontaneously knew their dance moves.”

Taking these lessons forward

The apparent success of this effort was aided by the good fortune of having leading medical facilities close at hand, and by the fact that the on-site medical capabilities were immediately outside the blast zone – and was thus a product of a combination of highly centralised planning and pre-positioning, followed by a decentralised adaptive response at every scene (both in the immediate area of the blast and in the hospital emergency rooms where survivors were transported).

In spite of the fortunate apparent success of the medical effort, we need to be careful not to be too complacent about the level of preparations in place going forward. Skillful action and a self-organised surge of medical resources beyond what had been planned kept the flow of severely injured patients from completely overwhelming the medical response capability. But even as we appreciate that the medical system managed to handle the needs of blast survivors as well as it did, we need to be mindful that a larger attack could well have produced enough additional casualties to overstretch even the expanded capacities that the medical system found in itself. Terrible as this attack was, we need to recognise that approximately 250 surviving casualties is not by any means the largest mass casualty event that our system may be called upon to address.

This article is an edited extract from the paper: Preliminary Thoughts and Observations on the Boston Marathon Bombings, April 2013, by Herman B Leonard and Arnold M Howitt, who are Faculty co-Directors for the Program on Crisis Leadership at the John F Kennedy School of Government, Harvard University