

Lessons from Boston

Arthur L. Kellermann, M.D., M.P.H., and Kobi Peleg, Ph.D., M.P.H.

At 2:50 p.m. on April 15, nearly 3 hours after the first runner completed the Boston Marathon, two blasts ripped through the crowd that was gathered along the approach to the finish line, killing 3 people and injuring more than 260. Within moments, the crowd's initial panic was replaced by purposeful action, as bystanders ran to, rather than from, the horror to help the injured. Law-enforcement and emergency medical services (EMS) personnel swiftly converged on the scene. Within minutes, ambulances began transporting the most critically injured to nearby hospitals.

Once victims reached Boston's hospitals, the story continued in the same vein. Noted Harvard surgeon and author Atul Gawande described how quickly they arrived and how "everything happened too fast for any ritualized [disaster] plan to accommodate."¹ Praise for Boston's rapid and effective response is richly deserved. Clearly, lives were saved. But before memories fade, we should analyze the event for the lessons it offers. Although a formal after-action report will take time, enough is known for us to offer some initial observations.

First, the remarkably low mortality rate of the attack — 1% — was attributable in part to excellent care and in part to six factors that favored the rescuers:

- The bombing occurred at a major event where large numbers of police, security, and EMS personnel were already deployed.
- Because it was race day — indeed, a state holiday — it is likely that the city's operating

rooms and other clinical services were running at less than full capacity.

- The attack happened shortly before the 3 p.m. change of shift at area hospitals. As a result, a full complement of administrative staff and two shifts of health care providers were on site at each facility.
- The bombs were detonated in a city that is home to seven trauma centers and multiple world-class hospitals (see map in the Supplementary Appendix, available with the full text of this article at NEJM.org). Boston EMS personnel wisely distributed casualties among the area's trauma centers, so each one received a manageable number.
- The bombers detonated their relatively low-yield devices out-of-doors. A bombing inside a closed space (e.g., a building, bus, or train) produces more primary blast injuries (e.g., blast lung) and fatalities, because surrounding walls concentrate blast waves.² The absence of structural collapse facilitated the swift extrication of victims.
- Although most health care providers in the United States have never treated a bombing victim, lessons learned by military surgeons, emergency physicians, and nurses in Iraq and Afghanistan are progressively percolating through the trauma care community. Moreover, hundreds of Boston's prehospital and hospital-based responders had already learned the basics of blast-injury care and the operational challenges their city could face. In 2009,

Rich Serino, then Boston's EMS chief and now deputy administrator of the Federal Emergency Management Agency, hosted the first citywide "Tale of Our Cities" conference in Boston, at which doctors from India, Spain, Israel, Britain, and Pakistan who had managed the consequences of terrorist attacks explained the nature of the blast injuries they treated, the triage systems they used, and other lessons responders can use to save lives. More than 750 locals attended.³

Second, photographs taken shortly after the bombings vividly depict the vital role bystanders play in the initial response to mass-casualty incidents (see photo). Instead of fleeing the scene, runners tore off their shirts and either used them as tourniquets or applied direct pressure to control bleeding. Other bystanders pulled racecourse barriers aside to facilitate access to the victims and their rapid extrication to area trauma centers. Bystanders and runners with medical training started triaging victims. These courageous civilians were the true first responders.

Third, the seemingly spontaneous actions Gawande describes didn't happen by chance. The goal of a well-crafted disaster plan is to provide a framework for preconsidered action. Experience has shown that such a framework is necessary to ensure a well-coordinated response to a sudden mass-casualty event. Boston's health care providers reacted the way they did because they knew what they were supposed to do. Those who did not



Boston Marathon, April 15, 2013.

were smart enough to follow the lead of those who did. That's how a "ritualized" disaster plan works.

What is not clear is whether other U.S. cities, if faced with a challenge of similar magnitude, would have done as well. In contrast to Israel, a country that has ample experience with terrorist bombings, too many U.S. hospitals treat disaster preparedness as an afterthought. We would be wise to emulate Israel's doctrine, which emphasizes the importance of national coordination, standard operating procedures, constant attention to surge capacity, the avoidance of emergency-department overcrowding, the distribution of casualties according to type and severity, and the frequent conducting of rigorous drills.⁴ Because Boston followed many of these principles, it mounted an effective response. Our goal must be to ensure that every U.S. city can do the same.⁵

Finally, Boston's response illustrates the value of adopting a broad-based approach to disaster preparedness. In the early years after 9/11 and the anthrax attacks that followed, federal prepared-

ness efforts were too narrowly focused on bioterrorism and weapons of mass destruction. More recently, agencies have embraced a more flexible, all-hazards approach, as exemplified by the National Health Security Strategy first published by the Department of Health and Human Services (DHHS) in 2009,⁵ the Department of Homeland Security's Quadrennial Homeland Security Review published in 2010, and a monograph from the Centers for Disease Control and Prevention entitled "In a Moment's Notice: Surge Capacity for Terrorist Bombings" (released 2007, updated 2010).

The best way hospitals can prepare is to base their response on a strong foundation of daily health care delivery.⁴ The \$347 million in federal funding allocated to the DHHS's National Healthcare Preparedness Program cannot, by itself, transform our \$2.8-trillion-per-year health care industry; the economics don't work. Therefore, it is vital that hospitals weave the threads of preparedness into their daily routine.

As we reflect on Boston's re-

sponse, it's not enough to enumerate what went well; we must understand why. Otherwise, some citizens and health care professionals may erroneously conclude that it doesn't matter if emergency departments are crowded and if disaster plans and rigorous drills are lacking, because their hospital's medical staff will simply "rise to the occasion." That's a risky bet. The Red Sox benefited from some lucky breaks in the 2007 World Series, but their victory was largely due to preparation, teamwork, and execution. The same was true when the city of Boston was attacked on April 15. The rest of us should take that lesson to heart.

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From the RAND Corporation, Arlington, VA (A.L.K.); and the National Center for Trauma and Emergency Medicine Research, Disaster Medicine Department, Tel Aviv University, Tel Aviv, Israel (K.P.).

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