

*By
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Peter Burke spent 14 years building a surgical team that could handle the worst kind of emergencies. On April 15, that emergency arrived.

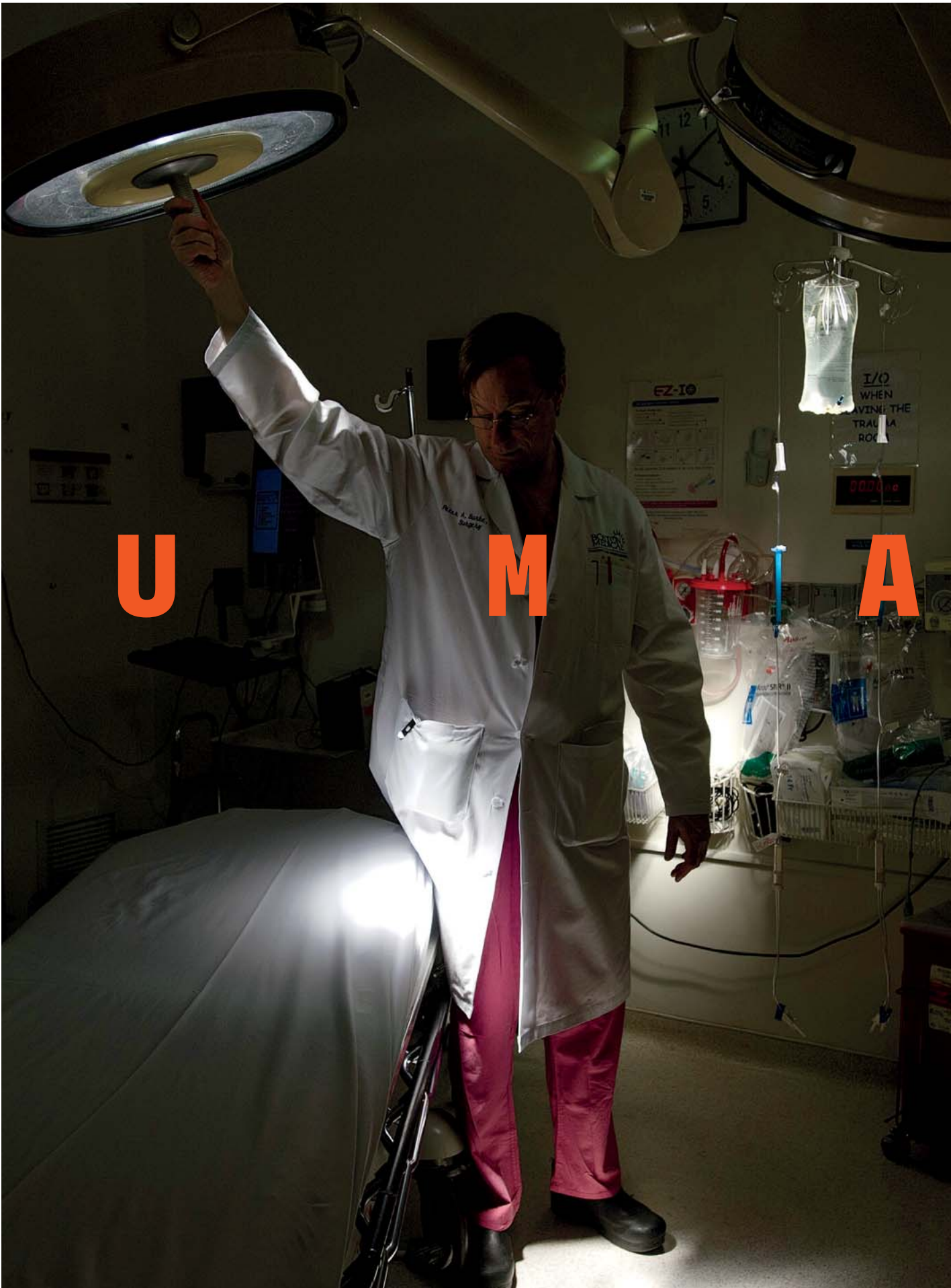
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Peter Burke had just finished the morning session of a medical conference at the Four Seasons Hotel Las Vegas when the news flashed on a lobby TV: two bombs had exploded near the Boston Marathon finish line, turning an annual celebration into a war zone.

Minutes later he received an emergency text message



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from Boston Medical Center (BMC), where he is chief trauma surgeon. The unit was inundated with the grievously injured from an attack that killed 3, among them BU graduate student Lu Lingzi (GRS'13), and wounded at least 260. Many of those rushed to BMC were battling for life, with mangled legs, collapsed lungs, and profound blood loss. Burke called his chief nurse to find out if there was any way he could help from a distance of nearly 3,000 miles. The answer was no.

When he arrived in Boston around midnight, Burke rushed from Logan Airport to BMC, one of the city's five adult Level 1 trauma centers, all of which were scrambling to stabilize the injured. BMC received 28 bomb victims; 19 were admitted, 11 with critical injuries.

In his 14 years at BMC, Burke had dealt with hundreds of multiple admissions from car crashes or shootings. But Marathon day presented a scene more familiar to trauma program manager Joseph Blansfield, a nurse practitioner who has been at BMC since 1992. An active colonel in the US Army Reserve, Blansfield (SON'78) had run combat support hospitals in Mosul and Tikrit, Iraq. As BMC trauma surgeons, anesthesiologists, and nurses mobilized, Blansfield was doing what had become second nature in those war-torn places: identifying the most

critically injured and getting them to the trauma bays.

Many of the wounded had limbs riddled with shards of concrete, wood, and plastic. Unlike the chest-level explosives typically used by suicide bombers, the Marathon bombs were left on the ground, so most injuries were to the lower body. In the sobering odds of trauma surgery this was lucky, says Burke, who is also a School of Medicine professor of surgery. Because the victims had been swiftly transported from a scene where emergency medical services personnel were already on hand, even those with legs completely severed arrived at the ER conscious and aware. The three most critically injured were a man in his 60s, who retained his legs but nearly died from blood loss, a 5-year-old boy with severely damaged lungs, and a man in his 20s who had traumatic double leg amputations. By the time Burke joined his team, they had performed amputations on five patients. Burke set to work on a patient whose legs were shredded, but, he determined, salvageable. He used forceps, probe, and scalpel to slice off dead tissue, a grueling process called debriding.

Fashioned from explosives, nails, and ball bearings stuffed into ordinary pressure cookers, the Marathon bombs released projectiles at speeds up to 2,700 feet a second. Such fragments

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can often do more damage than bullets, perforating vital organs and driving dirt deep into soft tissue. Dire wounds are inflicted by fragments of bomb, clothing, environmental debris, even "pieces of other people," says Burke.

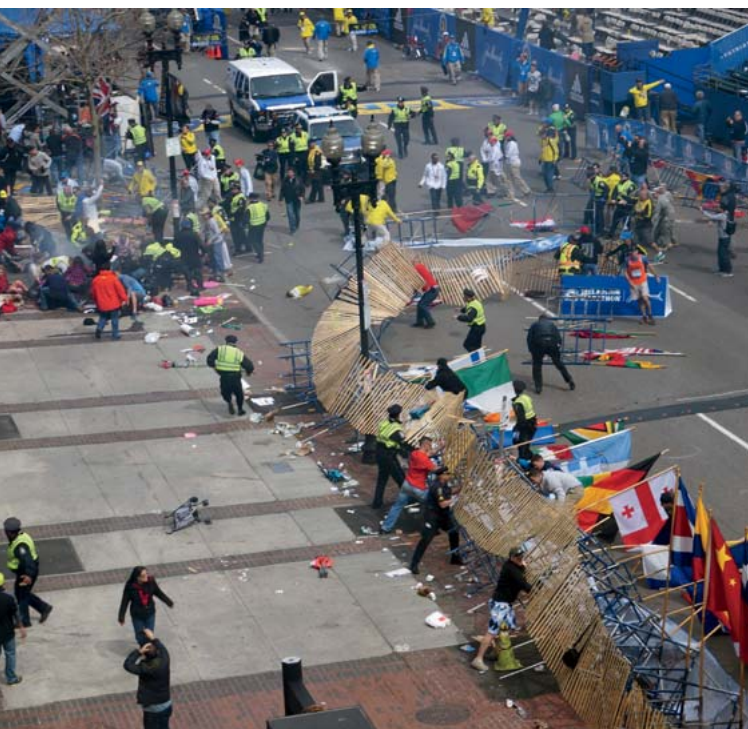
"When you remove fragments, a lot of it is done by feel, and you have to be really careful," he says. "The reality is we leave a lot of bullets in people, because to dig them out would cause more damage."

In the first 10 hours after the blasts, BMC surgeons would operate on 16 patients—a total of 7 limbs were lost from 5 people—and there were 52 more procedures in the next days and weeks.

Overseeing it all, Burke had many concerns, but the need to pull rank wasn't one of them; his team, which routinely reviews and often second-guesses its handling of surgical cases, operates more like a repertory company than a rigid hierarchy. From paramedics to surgical colleagues, Burke wants his people to think for themselves and speak up about what can be done better.

"He's definitely different from other surgeons I've worked with; instead of the typical surgical personality of my way or the highway, he's a consensus builder," says Blansfield, who occasionally wishes Burke were more of an autocrat. "He has a lot of humanistic qualities about him—he tries to approach people as peers."

Tall and pale, the 58-year-old Burke has a close-mouthed grin, an easy laugh, and a renegade lock of other-



AARON TANG/BOSTON GLOBE, GETTY IMAGES

The Marathon bombs, which killed 3 people and injured at least 260, were fashioned from explosives, nails, and ball bearings stuffed into pressure cookers. They released projectiles at speeds up to 2,700 feet per second.



“He was quite the man,” Burke says of his father. “I’ll never be as famous as he was, but that’s OK.”

wise kempt brown hair. He is one of four children of pioneering surgeon and Renaissance man Jack Burke, who left some outsized shoes to fill. Like his son, the elder Burke devoted time to the research laboratory as well as to the operating room.

“He was a big-time Harvard surgeon and a science guy,” says Burke, gesturing toward a shelf of textbooks written by his father, who died in 2011 at age 89. A former Army Air Corps pilot and research scientist, Jack Burke was a pioneer in the use of prophylactic antibiotics, tissue engineering, and the surgical treatment of deep burns. “He ran the Boston Shriners hospital for years, was internationally known, and did a lot of really important things. He was quite the man, and I had this wonderful relationship with him,” Burke says. “I’ll never be as famous as him, but that’s OK.”

Burke lives in Belmont, Mass., in the house he grew up in, with his wife, Rosie, a former social worker, and two cats. His son is working toward a doctorate in plasma physics, his older daughter does lighting design for a children’s theater, and his younger daughter just graduated from college. Burke unwinds by working in his vegetable garden and cooking the harvest. “I like to chop,” he says. As an undergraduate at Vassar, Burke majored in economics, but pursuing medicine had a certain inevitability, he says, because “I always wanted to take care of humans.” At Tufts Medical

School, he chose trauma surgery for its deliberate, urgent nature; when it goes well, he says, what’s broken is fixed.

BUSIEST AND MOST DIVERSE MEDICAL CENTER

Well known and respected in the city’s tight-knit, if competitive, circle of trauma physicians, Burke came to Boston Medical Center after 10 years at Beth Israel Deaconess Medical Center. “There are a lot of personalities in trauma care, and he manages them very well,” says Jonathan Gates, medical director of trauma services at Brigham and Women’s Hospital. “Their skill certainly was quite apparent after the Marathon bombs.”

Of the city’s urban medical centers, BMC is the busiest and most diverse. Its lobby is a place where one routinely hears Spanish, Creole, Arabic, Somali, Bengali, and Urdu, and sees traditional dress, ranging from djellabas to saris to boubous to hijab. The BMC Trauma Center admits more than 2,000 patients a year and receives the majority of Boston EMS ambulance transports, including trauma victims. BMC takes in the highest percentage of stabblings and gunshot wounds in the state. Falls constitute about 30 percent of BMC’s trauma admissions during the last few years, and an equal percentage of injuries results from violence. And some—too many in Burke’s mind—of the people he and his team put back together turn up again. “We see a lot of recidivism,” he says. “People do stupid things.”

Topping that list, for Burke, is gun violence. He is unnerved by its near-daily ravages: the 20-year-old multiple gunshot victim whose mother doesn’t recognize his destroyed face, the teenagers paralyzed from the waist down. In an open letter posted on his department’s blog in the wake of the fatal shooting of 20 children and 6 adults at Sandy Hook Elementary School in Newtown, Conn., in December 2012, Burke wrote that easy access to assault-type weapons and high-capacity ammunition clips are “an unnecessary and unacceptable threat to our society.”

“The young people get to him—the senseless violence, the alcohol-related

stuff, lifelong injuries and death from things that are clearly preventable,” says Lisa Allee, coordinator of BMC’s Injury Prevention & Outreach Program, who calls her boss a surgeon with a social worker’s heart. With Burke’s help, one multiple gunshot victim in his 20s, after treatment at BMC, went back to school to become an EMT. “Now he works for anesthesia in the OR,” says Burke. “That’s an example of our team approach: we took an interest in this guy, he responded, and we helped him get his life back in order.”

Mandated by the American College of Surgeons for all accredited Level 1 trauma centers, the grant-funded Injury Prevention & Outreach Program is little more than window dressing at some hospitals, Burke says. At BMC it provides crisis intervention at patients’ bedsides, mental health care to victims of violence and their families, a “matter of balance” program to help the elderly prevent falls, and a training program to help people learn how to install infant and child car seats, which have an 85 percent misuse rate. The vigor of such programs at BMC is largely because of Burke’s commitment to broadening the scope of prevention services and research. Under his watch, the department instituted a Facebook page and a blog with posts offering advice on a range of concerns, including infant safety, extreme weather precautions, and ways to keep furniture and TVs from toppling, which in 2011 injured more than 12,000 children in the United States. “If we want to try to change people’s behavior, we have to focus on where they are,” Burke says, and in ever-increasing numbers, they are online.

He “is in tune with substance abuse and mental health issues like no other surgeon I know,” says Allee. He takes a particular interest in a one-on-one behavioral approach to prevent drunk driving, which is a factor in nearly a third of all car crashes and ranks on a par with violence as the most preventable cause of traumatic injury. “There’s a lot of good data that says that if you have what we call a brief negotiated interview with patients, you can alter their behavior,” says

In the months since the Marathon bombings, Peter Burke, chief of trauma services at Boston Medical Center (BMC), and his colleagues at hospitals across the city are taking stock. And under normal circumstances, says Burke, having these professionals working together can be “like herding cats.”

This summer the hospitals, which have formed the Boston Level 1 Trauma Services Collaborative, were planning to publish an analysis of the medical response and present some of the findings at an October meeting of the American College of Surgeons in Washington, D.C.

“Could we have done better?” Burke asks. “Sure.” But the only ones who died, died at the scene. At BMC “everybody got the care they needed. Sometimes you can’t do that. Sometimes you have to do triage and say, ‘We don’t have enough resources to go around.’ But the city’s trauma centers had the capacity for everyone. Many more people could have died.”

KEEP RECORDS

BY HAND

One problem was that “we weren’t very good at documenting what we were doing,” Burke says. “Our system is set up for one patient at a time, and we had almost 20 at once. We need to keep track of them in a way that is simple and efficient.”

Staff improvised by giving patients packets, with account numbers that were later electronically merged into medical record numbers. Burke thinks it’s better to have a system that allows the speedy recording of admissions by hand. “What happens when the power goes out, when the next guy blows up a power plant and the electricity goes down? We have some written forms, but they’re too cumbersome. We need to make them smaller, better, and more streamlined,” he says. He is working with colleagues from other trauma centers to create an abbreviated disaster record. While some of the other centers, among them Brigham and Women’s Hospital, assigned numbers to unidentified patients, BMC was able to identify all but two patients immediately.

IMPROVE THE TELEPHONE TREE

In the hours following the bombings, BMC staff reported to their clinical areas—surgeons to the OR, staff to the ICU—and medical interns were paired with patients “for the duration,” says trauma program manager Joseph Blansfield. “One process we’re reviewing is improving our telephone tree and backup paging system,” says Blansfield. The phone tree, which had not been formally established outside trauma surgery, will be expanded to include all surgeons. The hospital is also considering putting nonclinical staff in an adjacent area, away from the emergency department, where they would be called upon as needed.

TRAIN PEOPLE TO USE TOURNIQUETS

Some of the procedures in the wake of the bombings will serve as models for mass injuries in the future. One, a staple of combat medicine, is simple: to keep the gravely injured from bleeding out, EMTs and paramedics used tourniquets. It’s true that tourniquets can cause problems if they’re not needed or are left on too long, says Burke, but in urban areas victims get to hospitals quickly enough, so the risk is negligible. This got his prevention side thinking: why not offer

LESSONS FROM THE MARATHON BOMBINGS

Focus on records, families, follow-up



BROOKS PAYNE/GETTY IMAGES

tourniquet training to laypeople, in the same way they’re encouraged to learn emergency CPR? It’s something all soldiers learn. “The army issues tourniquets to soldiers as part of their combat uniform,” he says. “All that’s really needed is a piece of rubber tubing and a clamp. C’mon, it’s really not that difficult.”

TAKE CARE OF THE FAMILIES

BMC faced another challenge: friends and family members who had no idea where their injured loved ones had been taken. One of them, a woman who was at BMC with her injured daughter-in-law, was desperately searching for her son. BMC president Kate Walsh made some calls and found he was being treated at Beth Israel Deaconess Medical Center.

Once families were identified, patients were able to use FaceTime or Skype until they could be together again in person.

“One of the things we did really well is quickly set up a family support center,” Burke says. “There were computers and telephones and simple things, like opportunities to recharge cell phones, along with food and drink.”

Burke says there has to be a centralized and uniform procedure to get information to people, something that is now being discussed by public health leaders.

“Having a standardized disaster record—a simplified, one-page document that can be used by all—and reporting it to a central agency will help,” Blansfield says, “and that’s under way.”

FOLLOW UP ON PATIENTS

Burke is also pondering more ways to avoid what he calls secondary psychological damage. In the months to come, he says, “when the dust settles and nobody is talking about this anymore, that’s when these people are going to hit the wall. And they’re going to need help.” He has directed counselors from BMC’s Violence Intervention Advocacy Program to follow up on the Marathon injured, he says, who are likely to experience lingering trauma in the same way gunshot victims do. SS

Burke. “So we launched this as part of a program to get people to stop drinking and driving.” His zeal for such efforts is by all accounts unusual in a chief surgeon. As his colleagues like to say, Burke seems intent on putting himself out of business.

ELABORATE CHOREOGRAPHY, CONCISE DIALOGUE

In a way, Burke’s trauma team had been preparing for an attack like the Marathon bombings for a very long time. The unit’s nine operating rooms are outfitted with high-tech monitoring and life-support equipment. But they also have wall-mounted digital stop clocks, so the teams can devise ways to shave off minutes, even seconds, when lives hang in the balance. “With head injuries or internal bleeding, the faster you treat them, the better the outcome,” says Burke. “Minutes count.” He runs the unit as a work in progress, engaging residents, nurses, and technicians to perpetually refine the elaborate choreography and concise dialogue of the OR.

Burke has been at the forefront of a surgical approach called damage control. “In the old days we tried to do everything at once—we’ve got a problem, go into the OR and deal with the problem, finish the surgery, and never have to come back,” says Burke. Then a 2006 study in the journal

Depending on overall health, age, and will to live, there’s a huge range in how well and how quickly a person heals.

Trauma concluded that nearly 90 percent of patients with the most severe injuries were dying of lung or heart failure after surgery, or would succumb to unstoppable bleeding. Consequently, he says, surgeons have “changed the way we think about time. Instead of doing the whole operation from beginning to end, we pay attention to stopping the bleeding and bringing them to the ICU, where we can restore their normal physiology.”

In the case of the Marathon bombing victims, patients were sent to the ICU with their wounds cleaned but left open. “The concept of damage control was critical to our successful outcomes,” says Burke. Damage control surgery treats the physiology rather than the anatomy of the patient, and the operations are often abbreviated and done in stages. A person’s physiological state signals whether it’s time “to truncate what I’m doing,” Burke says. Is the patient’s body temperature falling? Is his heart showing signs of distress? “Let him go to the ICU and warm him. Resuscitation is better done in the ICU than the OR. Doing this increases the likelihood of survival.”

Faced with BMC’s first multiple IED (improvised explosive device) injuries, Burke decided to check in with a surgeon who’d operated on such casualties routinely. He texted his friend Alan Murdock, a US Air Force lieutenant colonel based in Pittsburgh, who honed his combat surgical skills in Afghanistan. Over the next few hours, Burke typed a series of questions, among them: When do you go looking for nerves if there’s a nerve injury? How long do you keep these people on antibiotics?

From Murdock, Burke learned that because some of the fragments in the injured were parts of other human beings, the victims also faced exposure to blood-borne diseases such as hepatitis and HIV. All of the victims, even those with minor injuries, were tested for HIV as a baseline, and for hepatitis C and B, which could show up immediately. All of the patients tested negative.

As they worked to mend and restore circulation to the mangled limbs of the

Marathon victims, surgeons straddled a fine line. Amputations are best done as soon as possible, but they require careful consideration of long-term consequences. How well will the stump, which heals quickly but takes about a year to “remodel,” lend itself to a prosthetic leg? Sometimes doctors remove more limb than appears necessary to have a more functional outcome, Burke says.

As early as his days in medical school, Burke was interested in the different ways that people respond to similar injuries, an interest that has propelled him into the laboratory. “What Peter does well is combine clinical work and benchtop science, which is laudable and hard for a busy surgeon to manage,” says Brigham and Women’s Gates.

Trauma patients who die usually do so either in the first 24 hours, from severe head trauma or bleeding, or in the next few days, from infection or organ failure. Depending on overall health, age, and will to live, there’s a huge range in how well and how quickly a person heals. In recent years, Burke has received grants to study how fluctuations in liver proteins affect healing. “The liver undergoes big changes when people get hurt,” he says. “And when you’re healed, it appears to go back to normal.”

Burke believes that understanding this response could open the door to a gene-specific approach to treating the severely injured. He has studied the role of liver proteins, called transcription factors, in injured mice. By binding to specific DNA sequences, these factors control the flow of genetic information—the blueprint for all human tissues and cells. At the molecular level, he says, our livers respond to injury with changes in these factors, and their genetic variations might influence individual capacities to heal.

He concedes that to some extent the healing process is just mysterious, and will probably remain that way. “You can never discount the spirit in this process,” Burke says. “The reality is that we trauma surgeons and critical care doctors don’t really save anybody. People save themselves. We just help.” ■