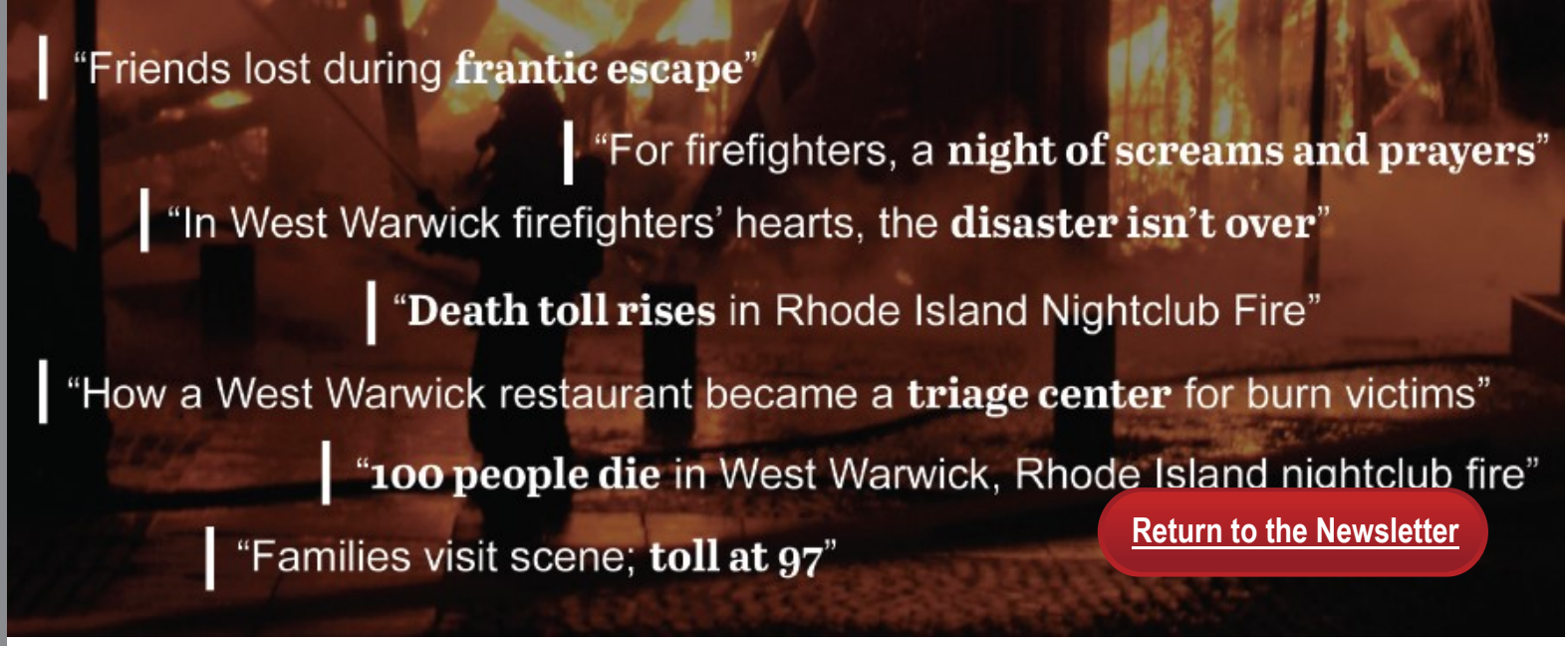

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Injuries Sustained and Lessons Learned from the 2003 Station Nightclub Fire

The 2003 Station nightclub fire—one of the deadliest in American history— resulted in over 200 injuries and 100 deaths.* At the time, Dr. Colleen Ryan was serving as the co-director of the Sumner Redstone Burn Center at Massachusetts General Hospital (MGH), where she provided care to numerous burn patients after this mass casualty burn incident (MCBI). We interviewed Dr. Ryan (currently a Professor of Surgery at Harvard Medical School, and Staff Surgeon at both Sumner Redstone Burns Center and Shriners Children's-Boston in Boston) to learn more about the incident and the progress that has been made in the MCBI and burn injury fields since 2003.

**Please note that injuries are graphically described in this article.*

Dr. John Hick, ASPR TRACIE Senior Editor (JH)

Please describe the details of the Station nightclub fire and the nature of injuries.

Dr. Colleen Ryan (CR)

I was under 30 years old when I started at MGH, and I had always been interested in medical disaster response. I was working at MGH over 10 years as a general, burn and critical care surgeon, when this disaster happened. It was a quiet day on February 20, 2003, but that turned on a dime to beyond busy.

The Great White band was playing at the Station nightclub, when pyrotechnic sparks ignited flammable insulation surrounding the stage and created a flash fire. Within minutes, the club was engulfed in flames and pandemonium followed. People fell to the floor and were crushed by others, including patrons who died on top of them. One of my patients trapped on the floor nearly drowned from the fire hose's water but was fortunately rescued in time. Few of the surviving patients that reached our centers had trauma or combined injury. People tried to rush to the exits, but the smoke rapidly made the doors unseeable. People outside threw snowballs in through the windows and doors shouting at people to run toward the snow.

Related Incident-Specific Resources

- Lessons Learned from a Nightclub Fire: Institutional Disaster Preparedness
- Normative Collective Behavior in the Station Building Fire
- Psychological Sequelae of the Station Nightclub Fire: Comparing Survivors With and Without Physical Injuries Using a Mixed-Methods Analysis
- Report of the Technical Investigation of The Station Nightclub Fire (NIST NCSTAR 2), Volume 1 and Volume 2
- The Long-Term Impact of Physical and Emotional Trauma: The Station Nightclub Fire

Local ambulances took patients based on protocol, and some people were transported by personal car. The following numbers were pulled from the article Lessons Learned from a Nightclub Fire: Institutional Disaster Preparedness:

- 439 patrons were in the building at the time of the fire
- 96 died on the scene; a total of 100 died
- 215 patients evaluated at area hospitals (64 at Rhode Island Hospital (RIH), 151 at 15 other facilities)
- 79 patients were admitted (47 to RIH, 32 to other hospitals)
- 8 patients were transferred from RIH to other Level 1 trauma centers

RIH had a 21 bed burn intensive care unit (ICU) which they emptied to manage the anticipated surge of patients. They also closed two floors and expanded the unit to 34 beds. Ultimately, the reports that waves of severely burned patients with inhalational injuries were incoming proved to be false; those burn patients who were transferred out of the units did not have to be.

In 2003, there was no formal system for load balancing hospitals for burns, particularly across states to transfer patients, so RIH felt like they needed to handle the surge by themselves. Later, we realized that they ended up transferring the most critically ill out of RIH to other facilities; had the surgeons known, they would not have sent them away. That said, there were many other hospitals in the Boston area treating these patients which came as a surprise to the RIH staff (again, there was no formal process in place).

At Massachusetts General Hospital, we (including receiving and treating surgeons Dr. Robert Sheridan and Dr. John Schulz) received 13 patients within hours and an additional patient a few days later. Our outpatient practice treated an additional three patients, while the Shriners Hospital (a children's hospital attached to MGH) treated four of those patients in their pediatric burn unit. This was the first time they had ever accepted adult patients. I basically rounded continuously with three residents and an escharotomy cart to monitor fluids and treat burn-induced compartment syndrome. We distributed patients all over the hospital; some went to the adult burn center, where we had five ICU beds. We sent some to the surgical and medical ICUs. We sent others to Shriners Hospitals for Children, where we had received emergency administrative exception for the treatment of adults with burns. These beds were an enormous resource, as they were all staffed with experienced burn nurses, and supplies for dressings were plentiful.

JH

What were patient demographics and injuries like?

CR

The average age of our 14 hospitalized patients was 31 (they ranged from 20-43 years old). Burn size ranged from 15-50% of total body surface area (TBSA), and 86% of our patients (12 out of 14) had smoke inhalation injury. More than 60% had deep burns to their heads and necks, extending to or into the skull. Eleven required escharotomies and/or fasciotomies. Patients' airways were markedly swollen, making it difficult to intubate them. In many cases, their ears and eyelids were gone. The depth of the burns was exceptional.

The typical severe Rhode Island Station nightclub fire upper extremity injury was characterized by black mummified fixed fingers, with dead tendons and fat extending up into the forearm. Allograft (i.e., skin from organ donors) was used to preserve any areas in the proximal forearm that might be alive. If the allograft survived, we knew the tissue underneath was healthy. We saw many injuries to faces and upper extremities, possibly because many patrons were waving their arms in the air at the time of the flash fire. Four out of 14 patients required at least one upper extremity amputation for lack of viable tissue despite prompt escharotomies and fasciotomies. I remember talking to my colleagues when this happened (in 2003) about the possibility of patients receiving hand transplants someday. At that time, extremity transplants were not possible. As we did the amputations, we did our best to set patients up for that possibility; one patient did have a hand transplant years later.

Several patients also experienced deep contact burns due to exposure to the hot foam insulation in the ceiling that fell during the fire. Others suffered from mold and fungal infections of their wounds, possibly inoculated with the organisms when they were rolled in the snow once they made it outside or other contact with a dirty environment at the scene. Acute patients required massive fluid resuscitation. They had multiple complications, including hypothermia, rhabdomyolysis (57%), and abdominal compartment syndrome (14%).

Almost three quarters of our patients (n=14) had acute respiratory distress syndrome, and 86% contracted pneumonia. Over half had chemical pancreatitis, and 43% experienced deep vein thrombosis/pulmonary embolism, partly due to the central venous access ports we were using (some patients had four ports). Two of our patients required a form of dialysis called continuous venovenous hemofiltration.

Overall, these 14 patients received a total of 200 operations (nearly 40 the first week, 100 during their acute course, and approximately 50 reconstructive operations over the first 2 years, with others later that have not been counted). This was not the end of their medical treatment, and these numbers only cover patients at MGH. There were more at Shriners and Rhode Island Hospital as well as other RI hospitals.

Four of the 14 MGH/Shriners admitted patients died. One died due to brain death; another patient had lost all facial structures and upper extremities and had a do not resuscitate (DNR) order; another patient had a DNR after a long ICU course that included fungal sepsis, renal failure, no facial structures, and bilateral upper extremity amputations; and one died from a massive pulmonary embolus.

JH

Once you were able to stabilize patients, what were some additional complications that arose? Were patients able to eventually go back to work or were they deemed permanently disabled?

CR

Some patients experienced typical long-term serious burn complications such as heterotopic ossification (where bone tissue forms in soft tissue or muscles outside of the skeleton) and neuropathy and cranial nerve palsy. One suffered from a large bowel obstruction due to a hypertrophic anal scar; one experienced bilateral optic nerve neuropathy causing blindness; and one experienced superior mesenteric artery syndrome (the artery was compressing the third part of the duodenum).

Many patients were able to return to work. Thirty percent were permanently disabled, and two out of three had a preexisting disability that contributed to that outcome.

JH

What about their mental health and wellbeing?

CR

I saw a group a couple of years ago at a burn survivor meeting held by the Phoenix Society for Burn Survivors. Many of the Station fire people stick together. As they recount when asked how they are doing, their reply to me was that there are those who have forgiven and those that haven't. The latter are living in anger and not doing very well. The other group became more resilient and active within the burn community.

One published article examined how the long-term mental health outcomes (e.g., post-traumatic stress disorder [PTSD]) differed between patrons who were in the building and not burnt and those who were. Both groups experienced the same level of PTSD. Those who were not burnt suffered terribly from survivors' guilt.

JH

What are some of the lessons you learned from this incident?

CR

It was so apparent that there was a lack of education with regards to burn care and burn resuscitation. Along with abdominal compartment syndrome, patients had compartment syndrome of the brain, the eyes, and all extremities. Later, we realized this was due in part to the large amounts of fluid administered in the prehospital and early hospital course.

There was no system for sorting out this type of incident. The Northeast Regional Burn System had just started after 9/11, but it wasn't fully developed. Burn center verification was still a new thing. Load balancing (e.g., Medical Operations Coordinations Centers, RDHRS) and having one regional commander/leader would have been so helpful. As one nurse remembers, "There were 30 leaders; every patient had their own leader."

There weren't enough supplies. The methods of resuscitation and related requirements were not as good as they are today. We did not have all the surgical tools, skin options and other materials we have today. We also had to do a lot of fasciotomies which could be necessary in any type of MCBI.

We also had a very difficult time sedating patients with our typical drips (e.g., morphine and versed). One of the psychiatrists said these medications do not cover the human fear response. Once we started using psychiatric medications that addressed fear, it helped significantly, and patients were much easier to ventilate. I am not sure if this explanation scientifically panned out, but the additional medicine certainly worked.

Due to injuries, some patients were very difficult to identify. At one point, we had one patient left who had not been identified. Two families were insisting she was their child, and arguing over how the care was delivered. That patient, finally identified, was in the ICU for quite some time and did not survive.

I had a defined team of excellent nurses. Finding nurses who were able to stay with and care for patients was a challenge due to the nature of the injuries. The MGH Surgical Service was very generous in support of this challenge, letting us use three rooms at once which allowed two surgeons to work simultaneously and assigned one room for turnovers. This left time after each operation to do dressings and therapy, clean and set up while the surgeon went on to the next case without stopping.

I was very thankful for the nurses who stayed. Every time I walked into an operating room, I had many residents and lots of help. They assisted with donor sites and amputations and helped lift extremities and position patients for very specialized treatment. We had to be progressive in our treatment and had many challenges including placing central lines anywhere we could.

Just as with any type of traumatic injury, it is important for a burn patient to have an advocate to help them, their loved ones, and their providers understand the impact of both short- and long-term treatment and outcomes. They underwent physical, occupational and reconstructive therapy, psychological treatment, pain control, peer support. We followed these people with burns for many years as outpatients. We met with case managers and insurance companies when needed. We lent support to the families and patients the best we could.

Having primary healthcare providers who understand the long-term outcomes a burn patient may experience for the rest of their lives is so important. Many cannot go to the dentist, have a colonoscopy, or have a mammogram because of scars. This was another issue we addressed in the outpatient clinic.

JH

What has changed in your region relative to preparing for and managing an MCBI?

CR

A MOCC would immediately be set up and Region I would be activated. One person per facility would be responsible for interacting with the regional burn coordinator. The coordinator would know where available burn beds were, what staff and supplies looked like, and where patients could be transferred if necessary.

The state plans and healthcare coalitions would have provided burn injury care training to healthcare providers. For example, the advanced burn life support class is available online. The attitude where you do it all yourself has gone to the wayside. Everyone now understands that responding to an MCBI is a team sport.

JH

What was the effect of this incident on caregivers? How did it affect you and your career?

Related ASPR TRACIE Resources

Burns Topic Collection

Burn Mass Casualty Incidents: Triage, Assessment, and Treatment Considerations

DASH Tool (Burn Supply Module)

Mass Burn Event Overview

Pre-Hospital Mass Casualty Triage and Trauma Care Topic Collection

Related ABA Resources

Disaster Response

Educational Resources for Healthcare Providers

Guidelines for Burn Patient Referral

CR

We didn't lose any staff, but one or two of our nurses changed careers and went into hospice after the incident. A couple of our residents told me it was the most educational experience of their residency, and they went on to focus on trauma. It changed me a lot; it was a terrible time in my life. I had two babies at home and my husband worked full time. I got sick about 10 months later and took time to recover. I changed my research focus from acute outcomes and bench work to studying the long-term outcomes of burn patients and developed that field. It is very important to me to understand and optimize the factors that contribute to positive mental health and wellness outcomes after such horrible burn injuries.

JH

How can we maximize telemedicine solutions in a similar incident in the future?

CR

Since the Station nightclub fire, we control the resuscitation from the moment a patient is referred through telehealth. If we couldn't do that, we would use our colleagues in another region for consultation. It's not just these large events. It's getting good care to the walking wounded. You've got a nurse practitioner seeing a hand burn that's severe but not life threatening at the moment. Being able to have an experienced burn care provider review that injury and suggest treatment would improve patient outcome and help the nurse practitioner. We missed this opportunity during the wildfires that recently struck Hawaii; people with very little real-life experience in burn care were treating the walking wounded.

JH

The ABA has done a good deal of work on burn care in austere environments. Aside from training, what are some tools that are best practices for smaller hospitals who might receive burn patients?

CR

ASPR TRACIE's Disaster Available Supplies in Hospitals (or DASH Tool) can help determine a facility's on-hand and needed supplies. Having the silver roller dressings (Silverlon) developed by ASPR's Biomedical Advanced Research and Development Authority would be ideal in an MCBI, as it keeps the patient warm, minimizes pain, and acts as an antibiotic. Making the request through the Strategic National Stockpile for these supplies early is key in a MCBI. Ensure you have a way to identify patients and manage their loved ones after an incident. We also need more education for healthcare providers in general and more burn surgeons and nurses.

Controlling the public message is also important when it comes to MCBIs. Sharing tips for caring for a burn, related pain, when to go to the hospital, and the potential outcomes of an injury via social and traditional media can help patients and their caretaker with the treatment and recovery process.

We have made a lot of progress preventing burn injuries using risk communication and other prevention measures. Promising new

The Disaster Available Supplies in Hospitals (DASH) Tool can help hospital emergency planners and supply chain staff estimate supplies they may need to have immediately on hand during various mass casualty incidents (MCI) and infectious disease emergencies until resupply is available. The free, online, interactive tool recommends average par levels for specific supplies based on user inputs about the size of their hospital, risks in the community, regional role/ designation of the hospital, and other characteristics.

Hospitals can use three of the four DASH Tool modules to inform their planning for an MCBI. The Burn Supply Module calculates the minimum amount of topicals, dressings, and other burn-specific supplies needed for the initial care of burn wounds. Hospitals can also use the DASH Tool's Trauma Supply Module to determine needed quantities of wound cleaning and debridement supplies. Resuscitation supplies – including airway management, fluids, tetanus prophylaxis, and analgesia – are included in the Trauma Supply and Hospital Pharmacy Modules. These three modules are complementary, and hospitals must complete all three to gain a holistic view of the supplies needed for a burn MCI.

Each module is accompanied by step-by-step instructions and a methodology document that describes the purpose and scope, outlines additional planning considerations, defines the assumptions underlying the DASH Tool, and offers suggested next steps.

For assistance using the DASH Tool or to provide user feedback, please contact askasprtracie@hhs.gov.

treatments have been developed to simplify critical care and surgical interventions. I now see injuries that could have been more devastating had certain measures not been put in place over the years. While MCBIs rarely occur, I strongly encourage healthcare facilities to have a plan in place to maximize available resources to help providers plan for and respond to them.