Actionable, Revised (v.3), and Amplified American Burn Association Triage Tables for Mass Casualties: A Civilian Defense Guideline

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Burn care remains among the most complex of the time-sensitive treatment interventions in medicine today. An enormous quantity of specialized resources are required to support the critical and complex modalities needed to meet the conventional standard of care for each patient with a critical burn injury. Because of these dependencies, a sudden surge of patients with critical burn injuries requiring immediate and prolonged care following a burn mass casualty incident (BMCI) will place immense stress on healthcare system assets, including supplies, space, and an experienced workforce (staff). Therefore, careful planning to maximize the efficient mobilization and rational use of burn care resources is essential to limit morbidity and mortality following a BMCI. The U.S. burn care profession is represented by the American Burn Association (ABA). This paper has been written by clinical experts and led by the ABA to provide further clarity regarding the capacity of the American healthcare system to absorb a surge of burn-injured patients. Furthermore, this paper intends to offer responders and clinicians evidence-based tools to guide their response and care efforts to maximize burn care capabilities based on realistic assumptions when confronted with a BMCI. This effort also aims to align recommendations in part with those of the Committee on Crisis Standards of Care for the Institute of Medicine, National Academies of Sciences. Their publication guided the work in this report, identified here as "conventional, contingency, and crisis standards of care." This paper also includes an update to the burn *Triage Tables- Seriously Resource-Strained Situations (v.2)*.

The Institute of Medicine (IOM) of the National Academies' vision of the delivery of the best possible healthcare in a catastrophic event requires a robustly prepared system that can rapidly self-assemble to deliver medical care as soon as possible after the event. Reducing the period of chaos presumably reduces preventable death and disability following the event. Accessible, reliable, valid, evidence-based tools to triage patients and allocate resources that are fair, responsive to specific needs and circumstances of individuals and the population are invaluable to reduce the period of chaos following the event. These tools need to be equitable, transparent, consistent, proportional, accountable, collaborative, and follow the rule of law in order to fulfill the duties of compassion and care, steward resources, and maintain the trust of the public.[1]

"Triage Table-Seriously Resource Strained Situations for clinicians, when faced with a surge of patients with burn injuries" was first published by Saffle et al in 2005[2] and later revised by Taylor et al in 2014.[3] These landmark papers represented the burn field's first attempts to create evidenced-based tables to predict expected mortality of a population due to burn injuries based on age and burn size and whether or not they were treated at a burn center. The purpose of this paper is to revise and update these tables to bring them in line with the IOM's new definition of Crisis Standards of Care (CSC) and with the goal to make the tables collaborative tools that would engage providers in their development, structure, and application through exercises and use. The new tables need to be accessible, responsive to individuals and populations, and proportional to the event at hand.[3] This, the third version of tables, was created by relying on the data used in the 2014 (Version 2) and represents input from subject-matter experts (SMEs) representing the American Burn Association (ABA). The draft tables were used during a regional exercise in 2019. This paper will also highlight key findings from the exercise that have broad application to the use of the tables.

BACKGROUND

Significant burn injuries were once associated with high mortality rates.[4] Today, patients with critical burn injuries typically survive with an expected livable social recovery provided

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the patient receives the standard of care found at a modern ABA-verified burn center.[5] ABA-verified burn centers contain the trained personnel, programmatic infrastructure, and resources to deliver state of the art burn care and to achieve optimal outcomes. ABA-verified burn centers also include the capabilities to provide long-term follow-up with rehabilitation services and reconstructive care as well as access to psychosocial and peer support. Under normal conditions, a severely burned patient, while resource and labor-intensive to treat, can become a critical care success story. Nevertheless, the story of any burn survivor is often full of challenges, and their care involves an entire multidisciplinary team of highly trained and specialized providers that continues from the field through the hospital to rehabilitation and the home long after the initial care and discharge. This level of success that is now expected in modern burn systems is generally thought to be dependent on the extraordinary effort and resources required to support these systems.

In a disaster, the provision of burn care, either alone or in association with care for other insults such as polytrauma or acute radiation exposure, can easily become a complex and overwhelming problem. In a disaster situation, in order to achieve the IOM's goal of "Zero Preventable Deaths and Disability after Trauma,"[6] it must be recognized that burn care can quickly become a critical bottleneck in the healthcare system response due to relative lack of burn-specific resources and an absolute shortage of adequately trained personnel to care for the potential surge of patients.

Across the United States, there are 133 burn centers staffed by approximately 300 burn surgeons, comprising approximately 2000 specialty burn beds. (Of the 133 burn centers, 72 have completed the ABA verification process, and they represent approximately 75% of the burn bed capacity). Not only is the current cadre of trained burn surgeons therefore small, but it is also becoming increasingly difficult to preserve and pass on the collective expertise of existing burn experts for the future. The frequency of major burns is declining due to a number of public health, public safety, and other interventions. In addition, burn care has been dropped from the standard curriculum of surgical training in the United States coincident with the reduction in resident work hours over a decade ago. Given the scarcity of the trained expert workforce in burn care and the substantial complexity of skilled burn-specific resources required for the best possible outcomes for burned patients (surgery, intensive care, nursing, rehabilitation), it is easy to imagine that the medical system may struggle greatly to meet the care needs of large numbers of patients with burn injuries.

How to best plan for response to a burn mass casualty incident (BMCI) has been discussed at various times in the literature of the American burn community for 30 years.[7] However, following various catastrophes, acts of terrorism, and military conflicts that have ushered in the 21st century, the focus on disaster research and how to improve disaster burn care systems has intensified dramatically. Recent efforts have included a general framework for disaster burn care put forth by ABA leadership.[8] State and regional research and disaster preparedness efforts have also been advanced and have been highlighted in places such as the Southern Region,[9,10] and Capital Region,[11] as well as the states of New York,[12,13] New Jersey,[14] California,[15] Florida, North Carolina,[16] and other areas of the country.

Currently, disaster planning within the ABA remains the responsibility of the Disaster Subcommittee of the Organization and Delivery of Burn Care Committee (ODBC).[17] A key recent product of this committee has been a collection of articles describing the current opinion of experts for the approach to the care of the burn-injured patient in austere circumstances when all resources are exhausted.[18] This set of articles focuses on topics ranging from the basics of care to include airway, fluids, and ventilator management,[19] nonsurgical wound management,[20] as well as situations including chemical, radiation, and blast injuries,[21] and others special topics.[22]

Because it is conceivable that, even with the best plans and training, larger-scale burn disasters have the potential to create more patients than the healthcare system can accommodate, a critical component in planning for a BMCI is to develop evidence-based tables that offer guidance that can be applied in a disaster by those tasked with triaging and caring for large numbers of patients with burn injuries. The first effort to use the National Burn Repository (NBR) data to create a predictive survivability table known as *Triage Table- Seriously Resource-Strained Situations* for clinicians, when faced with a surge of patients with burn injuries, was published by Saffle et al in 2005.[2] A subsequent version *(Version 2)* of this work was released by Taylor et al in 2014.[3] This paper offers an update to the 2014 tables in response to recent projections regarding new and emerging threats and expanding numbers of potentially anticipatable burn casualties.[23] This paper also examines the intersections that occur between burn surge response and overall healthcare system disaster response and provides additional guidance as to the adequacy of resources available for the care of patients declines during increasing severity of BMCI events.

METHODS

We began this work with a review of the six priority groups previously identified in the initial work by Saffle et al, which included BMCI patient triage categories of Outpatient, Very High, High, Medium, Low, and Expectant.[2] Clinicians' ability to utilize these groupings in a BMCI was evaluated for accuracy vs complexity. The authors then attempted to integrate this prior work with the newer principles and terminology that have arisen from the *Committee on Crisis Standards of Care (CoCSoC): A Toolkit for Indicators and Triggers; Board on Health Sciences Policy; Institute of Medicine, National Academies of Sciences* by Hanfling et al.[1] That effort, as well as previous and subsequent research by Hick et al, has defined what has been termed conventional, contingency, and crisis standards of care in disaster situations.[24–26]

Committee on CSC as adapted for the Burn Profession 2014[27]	
Conventional	The spaces, staff, and supplies used are consistent with daily practices within the institution. These spaces and practices are used during an MCI that triggers the activation of the facility emergency operations plan (EOP). For a BMCI, it relies on the spaces, staff, and supplies within a given emergency department (ED) providing care during a BMCI, triggers facility EOP, and may require staff to manage some burn-injured patients up to 6 hours with existing staff and existing supplies, pharmaceuticals, and equipment (SPE). The Standard of Care is maintained.[27]
Contingency	The spaces, staff, and supplies used are not consistent with daily practices but maintain or have minimal impact on usual patient care practices. These spaces or practices may be used temporarily during a major mass casualty incident or on a more sustained basis during a disaster (when the demands of the incident exceed community resources). For a BMCI, it relies on the spaces, both within the ED and designated areas within the facility. It relies on staff who are appropriately credentialed but do not routinely manage patients with injuries of this nature and relies on SPE that may be marginally sufficient from on-hand stock or available through a rapid deployment from government or vendor resources for a period of 6–24 hours. Standard of care is maintained but could be only marginally sufficient.[27]
Crisis	Adaptive spaces, staff, and supplies are not consistent with usual standards of care but provide sufficiency of care in the setting of a catastrophic disaster (ie, Provide the best possible care to patients given the circumstances and resources available.) For a BMCI, relies on adaptive spaces such as rapidly deployed tents in the parking area, or adjacent buildings, relies on staff, mutual aid personnel, and volunteers who may or may not be routinely credentialed to manage patients with injuries of this nature, relies on SPE from on-hand stock, rapidly deployed stock from a government or vendor resources, and still may not initially meet the needs for a period of 24–120 hours.[28] Depending on the nature of the disaster, it could extend beyond 120 hours. Some care during this period will be provided outside the typical Standard of Care.[27]

We concurrently reviewed the top 15 U.S. Department of Homeland Security (DHS) planning scenarios to identify the potential BMCI scenarios that could arise in the DHS-defined, gravest potential threats which could affect the United States.[29] The authors then utilized the CoCSoC recommendations and terminology to jointly consider the potential implications for the need for mass burn care and the ability of the existing burn care resources in the United States to meet those needs. The authors used the results of these analyses to develop the *Triage Tables- Seriously Resource-Strained Situations (Version 3, DRAFT)*.

Finally, the draft triage tables were examined for face validity during a functional exercise of the component of the U.S. Health and Human Services' Assistant Secretary for Preparedness and Response (ASPR)-funded Regional Disaster Health Response System (RDHRS) pilot program in August 2019. The RDHRS pilot program is a new federally funded initiative designed to improve healthcare system disaster response and includes formal appointment of a local burn clinical SME who advises a Medical Director within the RDHRS, who works with public health and healthcare responders in a BMCI. The functional exercise scenario featured a fictional mass casualty event caused by the spontaneous ignition of colored dust thrown in the air at a family concert attended by 30,000 people and created more than 450 critical burn and traumatic injuries and more than 1500 patients overall. During the exercise, local and state health representatives and RDHRS leaders worked with regional and national ABA representatives to apply the tables in the fictional situation and assess how they would guide use of burn resources in such a disaster burn surge situation and how individual burn patients would be optimally placed throughout the Northeast Burn Region and beyond.

RESULTS

In the initial analysis, it was recognized that many BMCIs will not surpass what is identified here as crisis care. While in such events, many patients may initially be transported to nonburn center hospitals, once many disaster scenarios begin to stabilize (reach a surge equilibrium),[30,31] secondary triage should be able to connect seriously burned patients with available burn center resources. In most regions of the United States, burn care can be provided (based on the conventional standard of care) for approximately 50 to 200 patients depending on the range and criticality of the burn injuries, the capacities and capabilities of the hospital and healthcare system at the time of the surge (ie, burn only, or multiple trauma plus burn-injured patients), and the availability of reliable medical transportation resources. Once a given scenario creates more than approximately 200 patients, however, the system is unlikely to be able to support the conventional standard of care.

When the number of patients with a burn injury exceeds the 50 to 200 previously discussed, maintaining a conventional standard of care becomes more problematic. Based on current data, we determined that the U.S. burn care community, calling on all burn centers, could manage approximately 2000 patients within approximately 120 hours[28] if sufficient transportation resources[32] existed to redistribute the patients from their initial hospital care sites to specialized burn centers. Therefore, beyond the 2000 patient threshold, by comparing the known resources that constitute the capacity of the American burn care system in conventional care with the patient needs predicted by the current national disaster planning scenarios,[29] we have determined that it is necessary to describe a new, fourth standard of care or burn surge termed "catastrophic," reflecting the profound gap between current capacity and potential demand in certain scenarios.

As an example, in a scenario involving the detonation of a nuclear device over a populated area, while significant deaths are likely near the epicenter, for the survivors, 30% of the injured are expected to have burn wounds.[33] Such a catastrophic event that produces tens and potentially hundreds of thousands of patients with burn injuries. These burns might be caused by radiation injury, by the initial flash, by structure fires that occur as a result of the blast, or by injuries related to the aftermath of the disaster.

Admittedly, the threshold for the "catastrophic" standard could be greater than 2000 if the degree of burn injury is minimal for many of the patients, but it could also be lower if the injuries sustained were more substantial yet survivable and if the existing census of patients requiring intensive burn care was unusually high at the time of the disaster event. The threshold could also be lower if another disaster is simultaneously playing out such as a pandemic that has commanded portions of the acute care resources otherwise available to burn care. Therefore, the tables within this document present patient number ranges as a guide, and this guideline emphasizes the role burn injury severity plays in estimating capacity and capability for absorbing a surge of patients.

RATIONALE

- TABLE 1 **CONVENTIONAL BURN CARE** is for use during a conventional surge of burn victims that can be managed by the existing local and regional burn system (estimated 50–200 burn victims, depending on injury severity and location/available resources within the burn regions).
- Alternative Tables 2 to 4 are meant to be used at the scene/initial receiving hospitals or other agencies responsible for the triage process in a significant BMCI where resources are either stressed, destroyed, or inaccessible and not expected to be restored within the immediate future when deciding which patients to prioritize for transfer to burn centers
    - TABLE 2, **CONTINGENCY BURN CARE**, estimated 100 to 500 significant burn victims,
    - TABLE 3, **CRISIS BURN CARE**, estimated 500 to 2000 significant burn victims,
    - TABLE 4, **CATASTOPHIC BURN CARE**, estimated 2000+ burn victims, describes a crisis care scenario that is catastrophic and for a period of time, considered an austere environment.
- The triage categories refer to injury profiles for patients that should be prioritized for transfer to burn centers (yellow) and for injury profiles for patients recommended for medical care outside burn centers such as outpatient environments, local hospitals, or at, if possible, a trauma center if this resource if available (white). Furthermore, it assigns a third group for comfort care/secondary triage when resources are available (gray).
- These tables do not account for other coexisting conditions or concomitant trauma, which should also be considered in transfer/triage decisions.

Table 1. Conventional burn care (estimated 50–200 significant burn victims)

Age in Years	Burn Size Group (%TBSA)								
	0–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	>80
0–4	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
5–19	White	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
20–29	White	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
30–39	White	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
40–49	White	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
50–59	White	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
60–69	White	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Gray	Gray
>70	Yellow	Yellow	Yellow	Yellow	Yellow	Gray	Gray	Gray	Gray

White: patients with injury profiles that should be triaged to ***medical care outside burn centers, ideally with burn center consultation***. Yellow: patients with injury profiles that should be prioritized for ***transfer to burn centers***. Gray: patients with injury profiles recommended for ***comfort care with secondary triage when resources are available, and family consultation if possible prior to resuscitation***. The ***pediatric patients*** who are triaged as outpatient, to a nonburn center should receive burn center consultation or outpatient follow-up referral if the American Burn Association (ABA) criteria for burn center referral are met.

Table 2. Contingency burn care, estimated 100–500 significant burn victims

Age in Years	Burn Size Group (%TBSA)								
	0–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	>80
0–4	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
5–19	White	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Gray
20–29	White	Gray	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Gray
30–39	White	Gray	Yellow	Yellow	Yellow	Yellow	Yellow	Gray	Gray
40–49	White	Gray	Yellow	Yellow	Yellow	Yellow	Yellow	Gray	Gray
50–59	White	Gray	Yellow	Yellow	Yellow	Gray	Gray	Gray	Gray
60–69	White	Yellow	Yellow	Yellow	Gray	Gray	Gray	Gray	Gray
>70	White	Yellow	Gray	Gray	Gray	Gray	Gray	Gray	Gray

White: patients with injury profiles that should be triaged to ***medical care outside burn centers, ideally with burn center consultation***. Yellow: patients with injury profiles that should be prioritized for ***transfer to burn centers***. Gray: patients with injury profiles recommended for ***comfort care with secondary triage when resources are available***.

- These are not standard disaster death tables but tools to implement them.
- ***These tables are templates that require personalization for each disaster***. Each disaster is different, and once the on-scene burn medical expert and local command obtain situational awareness data then, in collaboration with them and the ABA president or designate with input/discussion with ABA board members/disaster and ODBC chair/ABA regional coordinator(s) as he/she deems appropriate, a recommendation regarding which table to deploy is made by the ABA to the local hospitals or other agencies responsible for the triage process. Individual cells of the table might vary depending on the situation. The decision regarding this recommendation, time, data on which decision is made, and decision-makers are recorded and a copy is kept on file at the ABA office. This process might occur more

Table 3. Crisis burn care, estimated 500–2000 significant burn victims

Age in Years	Burn Size Group (%TBSA)								
	0–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	>80
0–4									
5–19									
20–29									
30–39									
40–49									
50–59									
60–69									
>70									

White: patients with injury profiles that should be triaged to ***medical care outside burn centers***. Yellow: patients with injury profiles that should be prioritized for ***transfer to burn centers***. Gray: patients with injury profiles recommended for ***comfort care with secondary triage when resources are available***.

Table 4. Catastrophic burn care, estimated 2000+ burn victims including catastrophic care in an austere environment

Age in Years	Burn Size Group (%TBSA)								
	0–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	>80
0–4									
5–19									
20–29									
30–39									
40–49									
50–59									
60–69									
>70									

White: patients with injury profiles that should be triaged to ***medical care outside burn centers***. Yellow: patients with injury profiles that should be prioritized for ***transfer to burn centers***. Gray: patients with injury profiles recommended for ***comfort care with secondary triage when resources are available***.

than once during a disaster situation, as changes in the situation become known.

- The recommended table is delivered to the hospitals or other agencies responsible for the triage process for implementation in patient triage/distribution.

Burn Center Triage Base Table- Seriously Resource-Strained Situations

Role of the ABA Presidential Team in Real-Time Choice and Adjustment of the Tables

One key feature of a fair CSC is that the standard is responsive to the specific needs of individuals or populations involved in the disaster. For example, as demonstrated in the exercise, it is possible that during a disaster, the age range and burn size of the victims might not be evenly distributed. There could be, for instance, many children with large burns. Based on the situational awareness known in real time, the medical content (burn) expert advising the regional medical incident commander is able to discuss changes in the distribution of resources favoring particular groups of patients with highly experienced experts (the ABA president and his team) who provide an opportunity for shared decision-making. This process will help to ensure equitable processes with a transparent, predetermined, accountable structure. This removes the full burden of this decision from a single local burn expert and places the national organization at his/her side to help them make the best decision possible under the circumstances.

Recommendations

Building on previous versions of the *Triage Table- Seriously Resource-Strained Situations* (Saffle et al 2005[2] and Taylor et al 2014[3]) we have developed the revised *Triage Table- Seriously Resource-Strained Situations – Version 3* (Tables 1–4), that align with the CoCSoC guidelines[1] with one noted exception. (These tables should only serve as an initial guide and when available, secondary triage should be conducted to more specifically direct patients to receive the best care available.)

Conventional burn care (Table 1)—is based on the spaces, staff, and supplies within a given emergency department (ED) providing care during a BMCI. For a facility with burn care expertise, that hospital can manage the patients or triage and transfer to other burn centers if needed. Largely, this is due to the supplies, pharmaceuticals, and equipment (SPE) that are needed and are either on hand or readily available, and the personnel and space are adequate to absorb the surge of patients. Thus, the standard of care is maintained. Conventional burn care can accommodate approximately **50 to 200** patients depending on the range and criticality of the burn injuries, the nature of the hospital and healthcare system at the time of the surge (ie, burn only, or multiple trauma plus burn-injured patients), and the availability of reliable medical transportation resources.

Contingency burn care (**Table 2**)—relies on the spaces, both within the ED and designated areas within the facility, to accommodate patient care. It relies on staff who are appropriately credentialed but some may not routinely manage patients with injuries of this nature and relies on SPE that may be marginally sufficient from on-hand stock or available through a rapid deployment from a state/regional disaster medical team for a period of 24 to 72 hours.

With contingency burn care, the typical standard of burn care is maintained but may only be marginally sufficient. Contingency burn care can handle approximately **100 to 500** patients, depending on the range and acuity of the burn injuries, the capacity of the hospital and healthcare system, proximity of other burn centers, and medical transportation resources at the time of the surge. Contingency care suggests that due to limited availability of space, staff, or SPE, to reach an equilibrium, many patients will need to be transferred to one or more additional burn centers.

Crisis burn care (Table 3)—relies on adaptive spaces, such as rapidly deployed tents or use of adjacent buildings, and calls on staff, mutual aid personnel, and volunteers who may or may not be routinely credentialed to manage patients with injuries of this nature. (Volunteers and mutual aid personnel include members of organized state or federal response teams, or individuals who are registered through state Emergency System for Advance Registration of Volunteer Health Professionals [ESAR-VHP].)[34] It also relies on SPE from on-hand stock or rapidly deployed stock from a state, regional,

Classification of a Burn Disaster or BMCI follows the NIMS[37]	
Type III Burn Disaster or BMCI	Mass casualty incident that only includes or primarily includes patients with burn injuries such as a night club fire.
Type II Burn Disaster or BMCI	Mass casualty incident that includes patients with both burn injuries as well as other nonburn-related trauma.
Type I Burn Disaster or BMCI	Mass casualty incident that includes patients with both burn injuries, as well as other nonburn-related trauma and the care environment, is compromised (infrastructure damage) due to natural or man-made disaster such as an earthquake or terrorist attack.

This information has been used in various publications related to BMCI planning and preparedness activities. It is based on the NIMS classification system that is used for all "resource typing" as defined in the NIMS process.[28,31]

or federal resources, and still may not initially meet the full patient needs for 72 to 120 hours. Crisis care can likely accommodate approximately **500 to 2000** patients depending on the range and acuity of the burn injuries, and the nature of the hospital and healthcare system at the time of the surge.

Crisis care measures should be temporary if at all possible ($x < 120$ hours), and steps should be taken to begin triage to redistribute patients to other burn centers and regions once surge equilibrium occurs. Previous research has suggested that during crisis care, it may take up to 120 hours (or perhaps more) to initiate care and distribute patients with medical transport services to other burn centers across the country.[28] Preparedness efforts in the crisis care situation should be directed at shortening the amount of time spent in a crisis standard of care mode.

Catastrophic burn care (Table 4)—there are scenarios where the number of patients with burn injuries will dramatically overwhelm the initial clinicians and overrun the national system potentially for weeks or months (an extended period).[35,36] Hostile military action such as a nuclear weapon attack will potentially produce tens of thousands of people who have burn injuries creating an austere environment and leave the crisis care scenario of 500 to 2000 unworkable. The current U.S. healthcare system is simply not designed to quickly absorb thousands of patients with burn injuries.

The general standards of care include conventional, contingency, and crisis. We chose to add a fourth classification (**catastrophic**) to reflect the divide between the crisis standard of care scenarios where it is reasonable to believe that contingency or conventional standard of care can be resumed within 120 hours,[28] a period needed to either treat or redistribute patients relying on transportation resources (achieving surge equilibrium)[31] as has been previously discussed in other research. For those scenarios where that 120-hour window is unrealistic and reflects crisis care for an extended and potentially indefinite period, that is a ***catastrophic*** event. These catastrophic events are what were envisioned during the creation of the ***Austere Guidelines***.[19–22]

We also compared these standards of care to the types of BMCIs that were (in a previous work) identified as a Type I, Type II, or a Type III Burn Disaster or BMCI. That work relied on the National Incident Management System (NIMS). (NIMS is a commonly used system in the disaster management profession to classify resources and events.) The three most common types of BMCIs were identified for national disaster planning purposes.

The examples that have been used include managing patients from a night club fire where most if not all of the injuries are burn-related. In this scenario, other clinicians, such as emergency physicians and general surgeons who would assist with an MCI with only burn patients such as a night club fire (Type III BMCI), are actively taking care of patients. However, many of those clinicians may be occupied and not available in a complex event such as an explosion with a variety of injuries included patients with burn injuries (Type II BMCI) as well as other traumatic injuries that are not burn-related. The most complex event scenario includes an MCI with a variety of injuries including patients with burn injuries as well as damage to infrastructure (Type I BMCI), further limiting surge capacity at area hospitals. (Examples include one or more hospitals are damaged in the disaster, highways are damaged limiting access, a military action limiting or eliminating military resources for civilian assistance in a disaster, etc.) Regardless, the austere setting of catastrophic care means the return to contingency or conventional care is unlikely for the immediate future.

Pediatric Patients—One finding that became clear as we moved from the academic side of developing these tables to the actual exercise included the impact of pediatric patients. The definition of a pediatric patient for state hospital regulation and bed licensing purposes varied from hospital to hospital in the exercise and ranged from newborn up to a range of 14 to 18 years of age. In some cases, it might be preferable to place a six-foot-tall 14- or 16-year-old with a large burn in an adult burn center bed, rather than a pediatric general hospital, and reserve the pediatric burn bed for the 2-year-old.

There are also burn units that have flex beds (available for both adult and pediatric burn patients). For those scenarios, the consensus from the SMEs was that pediatric patients should receive priority assignment of those resources. Furthermore, the pediatric patients who are triaged as outpatient, to a nonburn center should receive burn center consultation or outpatient follow-up referral if the ABA criteria for burn center referral are met. Additionally, the definition of the age at which a patient is considered an adult or a child for hospital credentialing purposes varied across the state. Adult hospitals would possibly be able to accept a 16-year-old with special legislation, while a 4-year-old would be problematic.

Finally, the pediatric (or adult) patients who are triaged to outpatient status, or a nonburn center status for their acute care should receive burn center consultation and/or burn center outpatient follow-up if the ABA guidelines for burn center consultation/referral are met as soon as this is possible.

While these triage tables are useful during a specific time period after a burn surge event, patients in the prolonged hospitalization, rehabilitation, and recovery phases of burn injury all benefit from connection to the burn center system. Long-term follow-up in burn centers provide burn survivors with access to specialized expertise in reconstruction, rehabilitation techniques, understanding of the chronic nature of the condition, and centralization of access to social support systems.[38,39] The ABA stands ready and willing to assist decision-making in a BMCI when requested by state and federal agencies managing a BMCI. This includes activating the ABA presidential team (representative SMEs including burn surgeons). They retain the right (based on their clinical expertise) to adjust the tables and create a personalized timed table recommended for use. Those decisions will be based on situational awareness. During the RDHRS exercise, the ABA presidential team was consulted throughout the exercise and offered valuable guidance to local clinical decision-makers. While this function has been exercised through the federal medical disaster agency (ASPR), a more specific structured process is currently under development. Currently if needed, activate the ABA presidential team through your regional burn disaster plan, or through ASPR.

DISCUSSION

There are many inherent challenges in effective burn disaster planning. This ranges from triage to the number of available burn beds in the United States. There are (approximately 2000) staffed burn beds that meet the supply and demand needs for day-to-day care. However, during a disaster, that demand can fall well short given the potential scenarios.

The patient ranges identified here; conventional care (50–200), contingency care (100–500), crisis care (500–2000), and catastrophic care ($x > 2000$) reflect two compelling facts that are difficult to fully account for and standardize from one region of the United States to another. The first is the range of types of injuries. As an example, a 40-year-old patient with a 50%TBSA full-thickness burn who is otherwise healthy will require far more resources than a 40-year-old patient who is otherwise healthy and has 20% TBSA partial or full-thickness burns. The second depends on the number of facilities and their proximity to one another as well as transportation resources to move the patients.

The 50 to 200 and 100 to 500 ranges are broad and ambiguous. Those range variations reflect the regional differences in capacity and the transfer process, which is easier to perform in some regions than others. For local planning efforts, we recommend working with local burn centers to identify specific numbers for the purpose of improving accuracy.

Mortality-Associated Risk Factors

Under ideal circumstances, other mortality-associated risk factors, such as the presence of concomitant trauma, inhalation injury, comorbidities, and functional status, should all be triage considerations. However, based on the data, the two most reliable factors in predicting outcome for all patients with burn wounds (are age and %TBSA) were chosen for this paper's model. Those involved in the triage decision-making should consider other lifesaving/life-threatening injuries such as arterial exsanguination. However, aside from immediate life threats, it is not possible to assess all of these other risk factors in a field-triage environment in addition to the burn wound.

Inhalation injury is an often discussed complication that contributes to increased mortality.[40–42] However, even under ideal circumstances, most clinicians cannot reliability and precisely predict the severity of smoke inhalation injury in an individual on initial physical exam and makes it a less useful parameter for MCI triage.

Crowd Out Effect—A Complicated Scenario

Previous research has shown that relying on conventional standards of care, most hospitals will be substantially challenged to manage a significant number of burn-injured patients with most, easily overwhelmed. A Type II Burn Disaster (both traumatic injuries and burn injuries)[28] occurred following a 2015 concert in Taiwan where colored corn starch powder was used in the festivities. A large amount of powdered (colored) corn starch was being sprayed throughout the crowd into the air using air blowers and compressed gas. This created a colorful cloud of dust that was suspended over the large group of nearly 1000. An unknown ignition source ignited the dust cloud leaving hundreds with serious burn injuries. With 400+ patients arriving at an already busy hospital, this created substantial difficulty for anyone to receive care consistent with the conventional standard of care. Yang et al referred to this as the "Crowd out effect."[43]

As more patients arrive, particularly those with complicated or complex burn injuries, the level of care being provided for the MCI/BMCI, the patient care environment may change to what is considered either a contingency or crisis standard of care. Also, as more patients arrive, other complications may arise in the triage process. During the RDHRS exercise, one challenge that confronted clinicians included the ethical decision-making of a bad decision for a child vs an adult or when an earlier triaged patient received a bed that may now be more appropriate for another patient.

Delayed Triage and Telemedicine

Delayed triage for transfer to definitive burn care should take place as soon as conditions of the event allow the standard of care to transition from crisis care to contingency care. However, while that may be possible where a disaster has pushed the number of patients into what may be considered crisis care, there are scenarios where this may be the new normal for an extended period, described herein as catastrophic care. Patients who are not identified for immediate care based on the triage crisis or catastrophic tables, but who would otherwise have been a candidate for burn care at a burn center should nonetheless be considered for triage to a burn center relying on a telemedicine evaluation when and if it becomes available.

Medical Transportation Resources

During a BMCI, it is essential to include planning for the timely transport and distribution of the burn-injured patients to burn centers. Transportation resources are typically coordinated through local emergency medical services (EMS) agency, fire department, and either local or state emergency management. Based on the number of injuries and the availability of local and regional resources, this could lead to a broader distribution of patients across several states. While this is typically outside the scope of BMCI planning for a burn center, having someone who has access to and a working knowledge of the resources available will be essential in assuring patients are flowing either into a burn center or being redistributed during a BMCI.[32]

Additional Pediatric Considerations

In addition to the recommendation for pediatric patients, we have included our additional observations here. Given the number of burn centers, burn beds, and burn surgeons, there are limits to what care can be provided relying on conventional care standards for the adult population. Even more scarce are those burn centers with the expertise to provide pediatric care.[44] Nevertheless, the science indicates those most capable of surviving even otherwise catastrophic burns are very young patients.[45]

Legal Considerations

The legal issues surrounding the delivery of burn care in a BMCI are complex. However, the common definition of the standard of care refers to what a prudent provider would do under similar circumstances. Because it is logical that prudent providers should desire to follow the best evidence-based professional guidance guiding medical care during a disaster, it could be surmised that providers are following the standard of care by utilizing the ABA tables in a BMCI.

Limitations

There are further limitations to this work. First, the tables were based on data from the National Burn Registry that described a population that might change in demographics, clinical characteristics, and outcomes over time. The tables will require periodic updating. The tables also need to be adjusted, or "coproduced" during use by providers in the course of exercises and real-world events where lessons are learned or outcome measurement indicate optimization is needed. It is through this engagement of the stakeholders that dissemination of the tables will occur resulting in accessibility for the use of this tool during appropriate real-world disasters.

The tables are also static, and potentially these tables could be computerized and calculated real time based on machine learning and artificial intelligence taking into consideration complex variables such as available transportation resources and supply chain information. Finally, carefully structured outcome assessments must be developed, deployed, and monitored short and long term to assess whether the allocation decisions made pursuant to the CSC guidance resulted in improved outcomes.[46–48]

The purpose of this work focused solely on the gravest of situations. If conventional care is being provided, everyone deserves the best efforts to survive, even the most critical injury. The *Triage Tables- Seriously Resource-Strained Situations (Version 3)* were developed to reflect statistical survivability and may be used to guide clinicians in making these difficult decisions. The tables should serve as merely a starting point until experienced SMEs can be involved and assist with the triage process.

Finally, on the individual level, optimization of patient endpoints beyond mortality, such as social participation and quality of life or social and practical issues, for example, keeping family members together, would and should affect an individual patient's placement. Other ethical considerations will likely weigh on fair and equitable resource allocation. Currently available data and situational awareness algorithms cannot yet provide a resource for these decisions and further research is required. Research and quality metrics are needed to assure that the resources freed up by the crisis standards of care in place are appropriately stewarded to in fact, save the many more people that they were meant to save and that the benefits to society are achieved.

TBSA Accuracy

A common mistake in burn care is the clinician's error in assessing the %TBSA.[49] It is of paramount importance that someone who can accurately perform a TBSA assessment plays a key role in the triage process. Otherwise, none of these tools will be useful. The use of telemedicine or burn nurse, advanced practice providers, and physicians can help ameliorate this risk.

CONCLUSION

A competent triage process focuses on the allocation of resources to assure the greatest number of lives are given the greatest opportunity to survive based on the capability and capacity of those providing the care. From the first iteration of the *Triage Table-Seriously Resource-Strained Situations* to the *Version 3* revisions found in this paper, and the 2017 publication of the Burn Care under Austere Conditions guidelines, these tools were created to assist clinicians and responders with decision-making in difficult situations. Furthermore, the ABA leadership stands ready to assist local and regional clinicians with BMCI triage decision-making, should the need arise. Regardless, as soon as conditions improve, a secondary triage should follow.

We developed these tables based on historical data and adjusted our draft after testing them during a large regional exercise in August 2019. While these tables reflect the current science, they merely serve as guidelines for a starting point. Experienced clinicians should play a pivotal role in triage decisions. Furthermore, as the situational awareness, or resources vary or change, or based on the range of adult/pediatric patients and their acuity, it is reasonable that the triage tables should be personalized and adjusted during the incident.

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