Burn Disaster Response Planning: An Urban Region's Approach

Roger W. Yurt
Eliot J. Lazar
Nicole E. Leahy
Nicholas V. Cagliuso

Available at: https://works.bepress.com/nicholas_cagliuso/4/
The objective of this study was to describe a draft response plan for the tiered triage, treatment, or transportation of 400 adult and pediatric victims (50/million population) of a burn disaster for the first 3 to 5 days after injury using regional resources. Review of meeting minutes and the 11 deliverables of the draft response plan was performed. The draft burn disaster response plan developed for NYC recommended: 1) City hospitals or regional burn centers within a 60-mile distance be designated as tiered Burn Disaster Receiving Hospitals (BDRH); 2) these hospitals be divided into a four-tier system, based on clinical resources; and 3) burn care supplies be provided to Tier 3 nonburn centers. Existing burn center referral guidelines were modified into a hierarchical BDRH matrix, which would vector certain patients to local or regional burn centers for initial care until capacity is reached; the remainder would be cared for in nonburn center facilities for up to 3 to 5 days until a city, regional, or national burn bed becomes available. Interfacility triage would be coordinated by a central team. Although recommendations for patient transportation, educational initiatives for prehospital and hospital providers, city-wide, interfacility or interagency communication strategies and coordination at the State or Federal levels were outlined, future initiatives will expound on these issues. An incident resulting in critically injured burn victims exceeding the capacity of local and regional burn center beds may be a reality within any community and warrants a planned response. To address this possibility within New York City, an initial draft of a burn disaster response has been created. A scaleable plan using local, state, or federal health care and governmental institutions was developed. (J Burn Care Res 2008;29:158–165)

Key Words: Burn disaster response, mass casualty, emergency preparedness

Current practice standards recommend that seriously burn injured patients be referred to burn centers for specialized evaluation and care.1 Although adherence to such guidelines is expected under normal operating conditions, these burn center resources may be overwhelmed by a disaster that results in large numbers of critically burn injured adult and pediatric patients. Should such an event occur, existing health care systems must accommodate these victims until they can receive tertiary burn care.

In recognition of this possibility, the New York City Department of Health and Mental Hygiene (NYC DOHMH) and The Fund for Public Health in New York (FPHNY) with funding from the Federal Health Resources and Services Administration (HRSA) has taken steps to initiate plans for a regional response to a burn disaster exceeding local burn care resources. Through a competitive grant process, The New York City Hospital Preparedness Task Force for Patients with Burns (“the Task Force”) was convened to de-
velop a coordinated draft plan of best practice guidelines to support existing burn care facilities in New York City. The draft plan uses local, regional, and national resources to address the triage, treatment and transportation of up to 400 adult and pediatric victims of a burn disaster for the 3 to 5 days after injury until such time that a safe discharge or tertiary burn care is secured. This was based on guidelines from HRSA as described below.

METHODS

In response to the grant awarded by the NYC DOHMH Bioterrorism Hospital Preparedness Program (BHPP) in February 2006, a working group comprising members selected from NewYork-Presbyterian Healthcare System (NYPHS) convened under the leadership of the NewYork-Presbyterian/Weill Cornell Medical Center Burn Center Director and the NYPHS Chief Medical Officer. This initial working group included representation from large, academic medical centers and community hospitals and consisted of two physician co-investigators, three project coordinators, three Emergency Medicine physicians, and two Emergency Services administrators. Collectively, the NYPHS working group offered expertise in burn, trauma, and surgical critical care, emergency medical services (EMS), emergency medicine, emergency management, health policy and health care administration. Within weeks, the original working group was expanded to include a clinician from the NYC DOHMH, a pediatric burn or trauma surgeon from the New York City region and a burn center director from the Southeastern United States experienced in state-wide disaster planning. Submission dates and monthly meetings were scheduled to meet the contract deadline of August 31, 2006. This project was supported financially by the Fund for Public Health in New York, Inc. by monies distributed by the Federal Health Resources and Services Administration under Grant No.CFDA No. 93.889.

The overarching goal of the guidelines was to outline a disaster response that allows for large numbers of burn injured victims to be cared for 3 to 5 days after an event until such time that tertiary burn care can be secured or the patient is safe for discharge with appropriate follow-up outpatient care. Development of recommendations for best practices required coordinated involvement of hospitals, government agencies and other health care institutions to address several key points required by the DOHMH: The burn disaster response guidelines were to include the use of a tiered system that would allow for the ability to triage and treat the surge of patients in burn center and in nonburn center hospitals. To support this care, recommendations for competency based training for EMS, emergency department (ED), and intensive care unit (ICU) staff in nonburn center hospitals were to be made. Additionally, recommendations for burn care supplies for use at nonburn center hospitals and deployment from a citywide cache were to be compiled. Communications to facilitate emergency consultation and coordination of patient care between hospitals, public health agencies and first responder systems were also to be addressed. The RFP also required development of an operational plan to facilitate long distance transport of large numbers of critically ill burn patients to burn centers outside of NYC. For the purposes of disaster planning, the RFP limited the scope of patients to those who have been burned; planning for care of the multitrauma disaster patient was excluded at this time but may be addressed in future initiatives.

To address the eleven deliverables required by the RFP directive, group meetings were held monthly to review and finalize recommendations for inclusion into the burn disaster response guidelines. Source documents included public health policies, peer reviewed literature, and practice guidelines. Interim discussions with working group members, key stakeholders, public agencies and outside experts occurred on an as needed basis; subsequent feedback was incorporated.

For disaster planning purposes, several calculations and operational assumptions were made. Based on the 2000 U.S. census, the number of anticipated victims was calculated to be 400, according to the HRSA directive of 50/million population and the estimated NYC population of 8 million. Additionally, the response guidelines assume that the infrastructure of participating health care facilities remains intact and is neither a victim of the disaster event itself nor a target of intentional acts against it. The latter issue of “soft targets” being of particular concern to health care facilities given their relative openness to the general public, the constant presence of a large numbers of people and the ability to inflict significant casualties while instilling fear because the areas of refuge have become targets themselves. Although there is a paucity of reports of such incidents in the literature, the increasing frequency of terrorist events around the world makes such events more likely.

These guidelines were created to accommodate disaster victims who, not only present via ambulance but also by self-referral. The planning initiatives also assume that if New York City resources are fully used regional resources (i.e., burn centers within a 60 mile radius of NYC and other mutual aid assets) would be
available. To differentiate between a burn mass casualty incident (MCI) which might only involve a small number of victims readily accommodated by existing burn units, a *Burn Disaster* has been defined as an event that results in a number of critically injured burn victims that would overwhelm existing NYC burn care resources. The Task Force estimated the threshold of 100 patients as defining a burn disaster for NYC. This approximates the existing New York City burn bed surge capacity estimation of 105 beds; however, these guidelines have been designed to be scaled to an event or the daily burn bed availability throughout existing burn centers.4

**RESULTS**

To develop best practices guidelines for a response to a burn disaster resulting in a large number of adult and pediatric burn casualties that would overwhelm existing burn care capabilities in the New York City area, a guidance document that addressed each deliverable was developed. An overview of each major deliverable category follows:

**Tiered System**

Hospitals within the five boroughs of New York City and regional burn centers chosen for proximity to New York City were divided into four tiers of Burn Disaster Receiving Hospitals (BDRH), based on the New York State Department of Health (NYSDOH) categorical Specialty center designation (trauma center or nontrauma center designation), American Burn Association recognition, local ambulance destination guidelines, clinical resource criteria (Table 1), and voluntary participation.4–10 Facilities with existing NYS recognized burn units were designated Tier-1 BDRH with sub categorization for NYC and non-NYC locations. Trauma centers were designated as Tier-2 BDRHs, whereas nonburn center, nontrauma center facilities meeting specified criteria would be

### Table 1. Criteria for Tier 1–4 burn disaster receiving hospitals (BDRH)

<table>
<thead>
<tr>
<th>Tier</th>
<th>Definition</th>
<th>Responsibilities</th>
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<tbody>
<tr>
<td>Tier 1 BDRH</td>
<td>Recognized as a 911 receiving hospital per FDNY guidelines</td>
<td>Provide specialty burn care to victims of a fire, thermal or chemical incident, regardless of scope of event</td>
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<td></td>
<td>Recognized as a specialty referral center or burn center per FDNY guidelines</td>
<td>Accept the number of burn patients that can be accommodated within the surge capacity of the existing center should the scope of the disaster result in a large number of burn victims</td>
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<tr>
<td></td>
<td>Recognized by the respective New York State Department of Health as a recognized burn center</td>
<td>Provide assistance to nonburn center hospitals for triage and potential transfer of patients to a burn center</td>
</tr>
<tr>
<td>Tier 2 BDRH</td>
<td>911 receiving hospital per FDNY guidelines</td>
<td>Will accept and provide care for up to a maximum of ten (10) severely injured adult and pediatric (if applicable) burn injured victims of a disaster or MCI for a period of 3–5 days following the incident until such time that definitive burn care facility placement can be obtained</td>
</tr>
<tr>
<td></td>
<td>Recognized as a specialty referral center or trauma center per FDNY guidelines</td>
<td>Support and implement training of ED and ICU staff in care of the burn injured patients per the recommendation of these guidelines</td>
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<tr>
<td></td>
<td>Recognized by the New York State Department of Health as a designated trauma center</td>
<td>Will accept and provide care for up to a maximum of ten (10) severely injured adult and pediatric (if applicable) burn injured victims of a disaster or MCI for a period of 3–5 days following the incident until such time that definitive burn care facility placement can be obtained</td>
</tr>
<tr>
<td></td>
<td>Emergency department and intensive care unit staff has received supplemental burn care education as recommended by these guidelines</td>
<td>Support and implement training of ED and ICU staff in care of the burn injured patients per the recommendation of these guidelines</td>
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<tr>
<td></td>
<td>Tier 3 BDRH</td>
<td>Minimum of 125 total adult ICU + adult medical or surgical beds</td>
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<td></td>
<td>HRSA funded hospital as of January 1, 2006</td>
<td>May be required to provide initial care for patients of a burn MCI or disaster until beds are obtained at Tier 1–3 BDRHs</td>
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<tr>
<td></td>
<td>Tier 4</td>
<td>Speciality hospitals that are not 911 receiving hospitals</td>
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designated as Tier 3 BDRH. As a condition of voluntary participation, nonburn center hospitals (Tier 2 and 3) would support supplemental burn care training for select ID and ICU nursing and physician staff as outlined by these guidelines. Additionally, each Tier 2 and 3 BDRH would receive a stocked burn care supply cart to augment existing supplies.

Tier 1 BDRH hospitals included the four burn center institutions within the five boroughs and the five burn center hospitals within a 60-mile radius of NYC (Table 2). In the event of a burn disaster, the NYC facilities would accept burn injured patients until the self-reported surge capacity (estimated at 150% of normal operating capacity) is reached, allowing for approximately 105 burn patients to be treated within NYC burn centers. At such time that the Tier 1 NYC facility surge capacity has been reached, the Tier 1 BDRH regional facilities within the 60 miles of NYC would then admit the overflow of patients until that self-reported surge capacity (estimated at 150% of normal operating capacity) is reached. Additionally, the Tier 1 BDRH facilities would provide assistance to nonburn center hospitals for triage and potential transfer of patients to a burn center. Patients meeting the immediate criteria for burn center admission would remain in the Tier 1 BDRH facilities until a clinically appropriate discharge is secured. In the event that patients were initially admitted to a burn center but found to meet the Tier 2 or 3 triage guidelines as set forth in the matrix and patients meeting the Tier 1 criteria remained in outlying hospitals, the admitted patients requiring Tier 2/3 level care would be transferred to the appropriate, available bed until such time that a Tier 1 BDRH bed became available.

Tier 2 BDRH facilities (NYSDOH designated trauma centers) would admit and treat up to 10 critically injured adult and pediatric (where applicable) patients per institution for up to 3 to 5 days after the event, until such time that a (city, regional, or national) burn center bed became available or the patient was clinically appropriate for discharge.

In the event that the number of victims exceeds the bed availability of both the Tier 1 and 2 hospitals, participating Tier 3 BDRH facilities (nonburn or nontrauma center hospitals) would admit up to 10 patients per facility (including pediatric patients where applicable) for the initial 3 to 5 days after a burn disaster until such time that the patients could be transferred to a tertiary burn care facility or safely discharged.

Hospitals that receive patients but do not opt to participate as BDRHs would be categorized as Tier 4 BDRH facilities. Patients that present to these facilities would be referred to Tier 1–3 BDRH as clinically or operationally appropriate or would remain at the hospital until a BDRH bed became available. The Tier 4 hospitals may be requested to admit burn disaster victims in the event that all Tier 1–3 BDRH resources are overwhelmed because of the scope and magnitude of the event.

### Triage and Transfer Guidelines

Existing burn center referral guidelines were modified into a hierarchical BDRH matrix. Adult and pediatric burn disaster victims would be vectored to the appropriate tiered facility according to the BDRH triage matrix (Figure 1) based on age, percent total body surface area burn (TBSA) and presence of inhalation injury (IHI). This tool was based on survival outcomes as calculated using data from the National Burn Repository and was designed for use only in a disaster. This matrix can be scaled to the scope of the event or bed availability over time, allows for patients to be transferred out of burn centers when necessary, and can be used for either primary field triage or secondary re-triage in the hospital setting.

These burn disaster response guidelines offer recommendations that complement the initial disaster response of the Fire Department, City of New York Emergency Medical Service (FDNY EMS). Current EMS practice for this response includes implementation of the Incident Command System (ICS) and Simple Triage and Rapid Treatment (S.T.A.R.T.) procedures. Mutual aid resources can also be initiated, activated and mobilized as needed. Triage and transportation decisions would be directed per the ICS Triage and Transport Section Leaders who have been trained to allocate patients according to available hospital-specific resources. In the event that patients self-

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**Table 2. NYC and regional Tier 1 burn disaster receiving hospitals (BDRH)**

<table>
<thead>
<tr>
<th>Burn Center</th>
<th>Location</th>
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<tbody>
<tr>
<td>Tier 1 NYC Burn Disaster Receiving Hospitals (BDRH)</td>
<td></td>
</tr>
<tr>
<td>NY Presbyterian-Weill Cornell</td>
<td>New York, NY</td>
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<tr>
<td>Harlem Hospital</td>
<td>New York, NY</td>
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<tr>
<td>Staten Island University Hospital—North</td>
<td>Staten Island, NY</td>
</tr>
<tr>
<td>Jacobi Hospital</td>
<td>Bronx, NY</td>
</tr>
<tr>
<td>Tier 1 Regional Burn Disaster Receiving Hospitals (BDRH)</td>
<td></td>
</tr>
<tr>
<td>The Burn Center at St Barnabas Medical Center</td>
<td>Livingston, NJ</td>
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<tr>
<td>Nassau University Medical Center</td>
<td>Nassau County, NY</td>
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<tr>
<td>Westchester Medical Center</td>
<td>Westchester County, NY</td>
</tr>
<tr>
<td>Stony Brook Medical Center</td>
<td>Suffolk County, NY</td>
</tr>
<tr>
<td>Bridgeport Hospital Burn Center</td>
<td>Bridgeport, CT</td>
</tr>
</tbody>
</table>
refer and overwhelm a specific hospital (i.e., that closest to the event), patients would be triaged to other facilities by the Central Burn Triage Coordination Team, based on available resources. Coordination of emergency care, secondary triage and transfer of burn-injured patients would be coordinated by the Central Burn Triage Coordination Team consisting of expert burn clinicians and operational staff. Designated burn center clinician(s) at a clinical coordination center would communicate with referring institutions to assist in clinical assessment, emergency care as well as recommend the appropriate tiered facility for transfer. The clinician(s) would remain at the burn center. It is then anticipated that the designated operational liaison would track and relay that information to the NYC Office of Emergency Management (OEM), which coordinates municipal disaster response efforts. The operational liaison would be located at the OEM emergency operations command center. Based on the reported resource availabilities NYC OEM provides, burn injured patients could then be prepared for transfer or admission to the appropriate, available BDRH (Figure 2).

The primary focus of these burn disaster response guidelines is to facilitate care for a large number of burn injured patients for 3 to 5 days after injury. In the event that the number of victims exceeds the regional burn center bed availability, recognized burn centers from outside of the metropolitan area would be enlisted to accept transfers to provide definitive, tertiary burn care. It is anticipated that coordination of extraregional and national burn bed and resource availability triage would rely on communication and assistance between the Federal Department of Health and Human Services Burn Asset program, the American Burn Association, individual burn centers and other agencies as needed.
Communications

To support interfacility transport and patient care, these guidelines recommend the use of several cost effective communication modalities. Each participating BDRH would designate a Site Coordinator to be responsible for the installation and maintenance of a digital camera, Internet capable computer with support software, and designated email account. Upon arrival, victims of a burn disaster could be photographed by designated ED staff who would then send the images and necessary health information via email to the Central Burn Triage Coordination Team who would assist with assessment and triage. Additionally, designated phone lines directly connected from participating BDRH institutions to the Central Burn Triage Coordination Team communications center would also be installed and maintained in the event that Internet accesses was not possible. For redundancy, 800-MHz radios compatible with local NYC OEM frequencies would also be required for all participating tiered hospitals and health care agencies. Telemedicine capabilities could be used if operationally compatible and existing resources are available.

Equipment and Supplies

The burn disaster response guidelines recommend that each participating Tier 1–3 BDRH receive a predetermined cache of wound care supplies to be used for care of the burn-injured patient. Each participating Tier 2/3 BDRH would receive burn care supplies (ie, wound care dressings and supplies, intravenous fluids) ample to perform twice daily dressing changes for 10 critically injured adult patients with 50% TBSA burns for the first 1 to 2 days after injury. Supplies would be limited to wound care cleansing and dressings for adults and pediatric patients and would be distributed as one complete burn care supply cart per institution. Tier 1 BDRH facilities within New York City would receive comparable burn care supplies to be decided by each institution. As of this writing, medications will not be included in this distribution because of logistical and financial constraints. Additionally, five burn carts would be stored at a central location within the five boroughs of New York City for rapid deployment to institutions as needed.

Maintenance and use of burn cart contents during times of nondisaster are anticipated to be at the discretion of the hospital. As a requisite of receiving the burn carts, however, each institution will be subject to periodic equipment audits performed by NYCDOHMH at that agency’s expense. Additionally, if contents are used for routine patient care, it is the expectation that the supplies will be appropriately replaced at cost to the institution to maintain the integrity of the cart at any given time.

Supplemental Educational Modules and Practice Recommendations

To provide supplemental training to hospital providers who do not routinely care for critically burn injured patients (ie, Tier 2 and 3 BDRH staff), a 2-hour competency based training module will be developed and distributed to participating institutions. As a condition of BDRH participation, senior nursing staff and attending physicians in the ED and ICU would complete an interactive self learning module based on principles addressed in Advanced Burn Life Support Now (ABLS-Now®). To complement the didactic learning, recommendations include that nursing and physician staff would complete a clinical rotation in the New York Presbyterian/Weill Cornell Burn Center. Job action sheets for the ED staff outlining recommended protocols for a burn disaster response have also been developed and included into the guidance document.

The Task Force recommends that prehospital care providers complete a 2-hour classroom based module on care of the burn-injured patient as part of continuing education requirements. For EMS providers who would act as leaders in a disaster response requiring implementation of the ICS system, a self learning module outlining burn disaster response guidelines and use of the BDRH matrix will be developed and recommended for use.

Long Distance Transportation

As patients would require interfacility transfer to local, regional and possibly national sites, a coordinated transportation response would be required. This initial response will rely on local resources (if available via direct response or mutual aid agreements) to be mobilized to perform the transfers. Should such a response be impossible because of logistical or resource constraints, state or federal agencies would be called on to assist. At time of press, availability, procurement, and mobilization of specific, dedicated transportation resources require further discussion.

Examining the Impact of Existing Reimbursement, Legal, and Regulatory Issues on the Care of Burn Patients During a Disaster and Identification of Opportunities for Stakeholder Dialogue

Throughout this initial phase of this response plan, much attention has been invested in the development
of a memorandum of agreement for the transfer and admission of burn injured disaster victims and the subsequent financial reimbursement. Finalization of a transfer agreement and the resultant reimbursement warrant further development as of the time of this publication. However, discussions regarding these specific matters and the development of all aspects of this disaster response plan have brought together the stakeholders from city, state, and federal agencies in addition to those representatives from public health agencies and institutions to allow in depth discussion and further development of the principles of emergency management in relation to a burn disaster response.

**DISCUSSION**

A disaster, resulting in critically injured burn victims, that exceeds the capacity of local and regional burn center beds may be a reality within any community and warrants a planned response. To address this possibility in New York City, burn disaster response guidelines have been created. This scalable plan uses health care and governmental institutions at the local, state, or regional levels to create a coordinated, tiered response for the initial triage, treatment and transportation of these victims until definitive care in a burn center can be provided.

Individual agency and hospital responses to recent burn disasters including the terrorist attacks of September 11, 2001, and the Station Night Club Fire have been significant. However, these initial responses used institutional resources and did not rely on the presence or activation of an immediate, coordinated, regional response. Lessons learned from these and other experiences have highlighted the need for further development of coordinated efforts in emergency management and disaster responses to ensure public health and safety.

It is anticipated that the creation and activation of a regional burn disaster response plan will benefit patient care and resource use. Coordination and tracking of EMS assets will not only maximize the ability of the FDNY*EMS system to maintain 911 emergency response operations but will also allow for the scheduling of interfacility patient transfers using resources as needed and available. A tiered response plan will triage patients according to their clinical status, thereby matching resources to need and expediting care while avoiding the overcrowding of regional burn centers. Lastly, this disaster plan equips nonburn center providers with supplementary educational training and supplies that would not otherwise be available to hospitals which would likely treat seriously burn injured patients were a disaster to occur and a formalized plan not exist.

As a first step in New York City’s efforts to manage a large-scale burn disaster, these recommendations have several limitations. Although the guidelines have been discussed and revised according to feedback given by various stakeholders, many of the specific details and financial implications of interfacility or interagency transportation, communications infrastructure and software, redundancy, or interoperability, and training require further discussion, expansion and revision pending continued Federal HRSA funding. Additionally, operational feasibility of these guidelines has not yet been tested nor established; future intentions include the implementation of a table top drill or field exercise. The complexity of the management by the Central Burn Triage Coordinating Team is substantial and the dynamic nature of patient conditions and bed availability will likely require development of software to assist in the prioritization process. Lastly, the logistics of local, regional, or national interfacility transportation remain unresolved. Although this plan has made initial efforts to address this topic, further discussion is required to create a coordinated plan for transportation.

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