Identified Acute Care Needs for Responding to a Detonated Improvised Nuclear Device in The New York City Region

A Collaboration

of the

Greater New York Hospital Association (GNYHA),

Participating GNYHA Member Hospitals,

and

New York City Department of Health & Mental Hygiene (DOHMH)

November 1, 2019

Purpose

The purpose of this document is to provide emergency response partners at all levels of government a clearer understanding of likely needs to support the acute care hospitals, with a goal to decrease overall morbidity and mortality after detonation of an improvised nuclear device (IND) in the New York City region.

Background

From the fall of 2018 to the summer of 2019, the NYC Department of Health and Mental Hygiene (DOHMH) in collaboration with the Greater New York Hospital Association (GNYHA) conducted a series of workshops with hospital and government representatives to determine and describe key hospital response strategies during the first 72 hours after detonation of a nuclear device in the New York City region. The objectives of these workshops were three-fold: 1) to produce a planning document that hospital emergency mangers could use to develop response strategies for a nuclear detonation scenario, 2) to provide an understanding to state and federal partners of the likely posture and actions of the hospital sector in the immediate 72 hours after detonation of a 10 kilo-ton (kT) device in the New York City region, and 3) to identify the gaps, or needs from state, regional and federal partners to improve the overall response and contributions of the healthcare sector to such an event.

After an initial scoping meeting, workgroup members were assigned to one of three zone groups – Moderate Damage Zone (MDZ), Light Damage Zone (LDZ), or Beyond Damage Zone (BDZ) as defined in existing documents[1] and modeling[1]. DOHMH and GNYHA then hosted a series of three workshop days, each of which focused on a specific damage zone and a 24-hour period from the time of detonation D (D+24h, 48h and 48 to 72h). Early on, workgroup planners decided that key response actions should be organized by the Joint Commission six critical areas of emergency management (i.e. communication, resources and assets, safety and security, staff responsibilities, utilities management, patient clinical and support activities) plus a section for incident command, as these are well understood by the hospital emergency management community and reflect how they frequently organize planning documents.

Based on these meetings, the workgroup developed a Key Hospital Actions Grid, organized by time period, damage zone and the Joint Commission critical areas. While there are certainly many actions that hospitals can take on their own, participants concluded that many response strategies require additional support (likely from state, regional or federal partners) to be operationalized. Identified needs fall into three broad categories of: 1) Guidance; 2) Situational Awareness/Communication; and 3) Staffing/Supply Support.

- *Guidance* was identified primarily as a preparedness need for tasks vital to response planning but where hospital expertise is lacking.
- *Situational Awareness/Communications* was identified as a need from all facilities to trigger key response actions during the initial hours and days following a detonation including gathering information to keep staff and patients safe as well as plan for possible surge or evacuation as needed based on zone.
- Articulated needs related to *Staffing/Supplies* primarily focus on supplies and staffing requirements to support evacuation of MDZ facilities or managing surge and unique patient needs in Light and Beyond Damage Zone facilities (LDZ and BDZ). A more detailed summary of these needs is shown in **Tables 1-3** below.

[1] National Security Staff Interagency Policy Coordination Subcommittee for Preparedness & Response to Radiological and Nuclear Threats, *Planning Guidance for a Response to a Nuclear Detonation*, 2nd Ed., June 2010. https://www.fema.gov/media-library/assets/documents/24879

Table 1 – Identified Acute Care Response Needs from Local, State and Federal Partners – **General Guidance Requests**

Requests	Description:	Applies To:	Time Period Required in:
1. Basic and practical radiation monitoring guidance	A) Guidance on use of radiation monitoring equipment including portal monitors, survey meters, and personal radiation dosimeters in damage zones for all operational periods. B) Support recommended pre-planning efforts including the following pre-emergency tasks: Prepare and make available "How-to-Use" documents for survey meters and portal monitors; and make available all equipment manuals in hardcopy form.	MDZ, LDZ, and BDZ hospitals	Planning phase
2. Shelter-in-Place (SIP) checklist of protective actions	Recommendations for safety and security personnel while sheltering in place. Methods for decreasing risk of external and internal contamination.	MDZ, LDZ, and BDZ hospitals	Planning phase
3. Simplified Acute Radiation Sickness (ARS) triage toolkit	Toolkit to help providers assess for ARS and categorize patients. The ARS toolkit should help standardize the terminology and lexicon regarding ARS to communicate accurately among sending and receiving hospitals	MDZ, LDZ, and BDZ hospitals/Helpful for outpatient-primary care	Planning phase
4. ARS Just-in-Time Training (JITT)	Training materials on the identification and triage of ARS + subsequent care of patients. Includes training on triage toolkit (see previous item), serial evaluation, timing, standard order sets, and symptom documentation tool or SOAP[2] notes.	MDZ, LDZ, and BDZ hospitals/Helpful for outpatient-primary care	Planning phase
5. Crisis Standards of Care	A) Guidance on allocation of limited medical resources e.g., ventilators, blood products, antibiotics, etc. B) Create recommendations for those involved in setting/re-setting the alternate standards of care in all phases of the response. Personnel may include: lawyer, clergy or ethicist, internist, critical care physician, pediatrician.	MDZ, LDZ, and BDZ hospitals	Planning phase

Workshop participants would find a comprehensive "Nuclear Detonation Guide" that includes items 1 to 4 in Table 1 to be of great value.

Radiological assessment of the indoor environment was recognized as a function of the on-site radiation safety officer (RSO) and staff. These staff will also be invaluable for determining if the HVAC system has been contaminated and whether air-filters can be safely replaced. These functions will likely be fulfilled in-house assuming enough radiation safety staff are on-site at the time of the incident. Performing radiological surveys and interpreting the results is a skill that RSOs should be able to perform under post-detonation circumstances. However, the radiation safety staff will be taxed to perform other tasks (dosimetry and incoming patient contamination surveys). If the RSO staff is not on-site, their vital contribution to the hospital response will be missing.

→ State and federal partners should recognize the importance of the RSO and other hospital radiation specialists to the hospital response. A JITT on basic radiation safety with relevance to a nuclear detonation and for conducting personnel surveys would be useful. Relevant for MDZ, LDZ and BDZ hospitals.

Acute Radiation Syndrome (ARS) is unknown to most emergency room physicians and other staff due to its rarity. And it has a few unique clinical indicators, making detection and triage challenging.

→ A toolkit and education campaign (or Just-In-Time-Training) for diagnosing and triaging ARS is crucial to the medical response given the potential of 1 million or more casualties. Ideally the toolkit is a concise course in Acute Radiation Syndrome available electronically but with an advisory to create hard copy versions

[2] SOAP notes are a cross-disciplinary method used by healthcare providers to track a patient's progress. They are a component of the electronic medical records system utilized in most hospitals.

for use in the resource poor environment post-nuclear detonation. Although REMM tools via the App are helpful, they may be inaccessible due to infrastructure damage. A national campaign to teach physicians and staff of major cities about ARS using the toolkit would be very helpful. Additional planning related to the provision of radiological countermeasures from the Strategic National Stockpile (SNS) to areas and hospitals where patients will be treated would also be advantageous. Relevant for MDZ, LDZ and BDZ hospitals.

Crisis standards of care, a critical issue for medical practitioners in catastrophic events, takes on new importance in the resource poor post-detonation environment where trauma and the relatively unknown acute radiation syndrome can dominate the medical response. Participants foresee a need for recommendations to formulate alternate standards of care as resources diminish over the initial 72 hours post-detonation (and beyond). This can be coupled with recommendations about medical-supply and equipment usage throughout the period.

→ Hospital leadership and clinicians will require guidance to develop alternate care standards. Such standards will likely be needed due to infrastructure damage and the potential for a hazardous outdoor radiation environment, directly impacting the ability to care for patients. Relevant for MDZ, LDZ and BDZ hospitals.

Table 2 - Identified Acute Care Response Needs from Local, State and Federal Partners – **Situational Awareness/Communications Requests**

NOTE: these are requests for local, state and federal partners to implement in the event of a nuclear detonation.

Requests	Description:	Applies To:	Time Period Required in:
1. Communications	a. Notify public and hospitals of shelter-in-place recommendations to decrease exposures to fallout radiation; also provide alert when SIP is lifted. b. When known, rapidly communicate alternate-care site locations to hospitals allowing them to direct uninjured persons potentially exposed to radiation for ARS screening. Government should also message exposure/symptoms or to stay home dependent on fallout plume to minimize surge to medical facilities c. Hospitals should be provided a pre-planned schedule for receiving vital information via the 800 MHz radio network. In addition to situational awareness, information about current status of area hospitals is critical. d. Establish set schedule and channel(s) to inform hospital operations and decision-making. Priority information should include nuclear detonation location, fallout plume direction, fallout decay, and SIP advisory timeline. Later phase information should include details (especially timing) of medical supply distribution logistics and shelter/assembly center locations, locations of operational hospitals, recommended patient transit routes and availability of transport equipment including wheelchairs and vehicles. e. Establish call down schedule for individual hospitals to inform response partners of current status. Pre-establish Essential Elements of Information that will be requested.	General Public, MDZ, LDZ and BDZ hospitals	Planning phase (develop / test messaging); Early phase post-detonation
2. Identify lead federal agency	Identification of the lead agency whose directives and recommendations will be transmitted to hospitals is important to assure the credibility of the information provided.	MDZ, LDZ and BDZ hospitals	Planning phases
3. Credentialing	Improve the state, regional or national credentialing system that helps hospitals rapidly accept volunteer and transferred staff	MDZ, LDZ and BDZ hospitals	Planning phase
4. Disaster telemedicine	Explore telemedicine capabilities that could be utilized to support clinical care in LDZ and BDZ hospitals.	MDZ, LDZ and BDZ hospitals	Planning phase

Probably one of the most concerning issues for hospital emergency planners is the lack of situational awareness both internal to their facility and external. It is not a given that a nuclear detonation will be immediately recognized and if so, that the associated consequences will be understood. A declaration of a nuclear detonation, warnings to shelter-in-place as a precaution against fallout, and follow-up statements about the outside conditions are necessary for internal messaging to be properly formulated for hospital staff, patients and visitors. Hospital Incident Command Systems also require accurate intelligence to direct life-saving response operations. A critical response action based on such information is the decision to move patients, staff and visitors away from perimeter and top-floor locations to protect against fallout radiation.

→ An improved understanding of how government-to-hospital communications will occur are needed. Relevant for MDZ, LDZ and BDZ hospitals.

Communication related to fallout presents another concern. Fallout can arrive within 30 minutes of a detonation and it is potentially lethal when people are exposed to it without protection. Even with shielding provided by robust buildings such as hospitals, it can be expected that some penetrating indoor radiation exposure will occur. Compiling an accurate fallout map to transmit to local government officials, emergency responders and hospitals, will take time. It is likely that the map will be irrelevant, since moving patients, staff and visitors to inner core areas is time consuming. It will have to be implemented and transmitted rapidly to inform critical hospital actions.

Fallout maps are perhaps most useful in later phases of the incident, particularly in the 72-hour time frame when hospital evacuation and transport of patients might commence. By then, the fallout footprint and the exposure rate it produces will be much reduced from the original. The map would be used to help develop evacuation routes and the locations of receiving hospitals, assembly centers, and other medical facilities where patients from MDZ and LDZ hospitals can be transported.

→ Communicating environmental radiological data in a straightforward format is essential for MDZ and LDZ hospitals whose goal may be to terminate operations and move patients to a safer environment, based on infrastructure damage, personnel and supply availability, and the external environment.

Some workshop participants did not feel that the credentialing system as currently configured was optimal for identifying medical staff from other institutions in a post-disaster environment.

→The current credentialing system should be reviewed and any gaps identified and addressed. Relevant for MDZ, LDZ and BDZ hospitals

Table 3 - Identified Acute Care Response Needs from Local, State and Federal Partners – **Staffing and Supplies Requests**

Requests	Description:	Applies To:	Time Period Required in:
1. Hospitals to be prioritized for security support	Prioritize hospitals for security support (after shelter-in-place is lifted). Pre-assign specific agencies and units to an area hospital and develop complementary procedures.	MDZ, LDZ and BDZ hospitals	Recovery phase
2. Staffing support	Clarify process and timeline for providing staffing support. Hospitals will identify priority staffing needs via communication pathways outlined earlier.	MDZ, LDZ, and BDZ hospitals	Response phase
3. Federal assets	Fully develop planning related to activation, coordination and deployment of medical federal assets including Department of Defense (DoD), Disaster Medical Assistance Teams (DMAT), and Disaster Mortuary Operational Response Team (DMORT). Educate hospital community regarding these plans.	MDZ, LDZ, and BDZ Hospitals	Planning Phase
4. Potable and non-potable water	Prioritize the delivery of potable and non-potable water to hospitals based on expressed needs, as water supply is vital to hospital operations.	MDZ, LDZ and BDZ hospitals	Planning phase
5. Supply needs and resupply method	Develop alternative supply pathways for critical medial and general supplies including medical items, linens, food, and generator fuel. Consider water routes and airdrops.	LDZ, and BDZ hospitals	As soon as possible

Safety and Security was a continuing refrain during the workshops. Protecting the hospital staff, patients, and visitors from a deluge of injured and worried well, potentially including a criminal element was of grave concern. Controlling radioactive contamination at ingress points was another. Hospital planners considered implementing lockdowns but also felt that care should be delivered to those with life-threatening injuries. Therefore, they were flexible about adjusting the hospital perimeter and the points of ingress.

→ Hospital emergency planners expressed a desire to investigate whether local law enforcement and other services e.g., National Guard (NG) could be integrated into their facility security force. In fact, they would like security support to be a top priority for outside response along with resupply and information about the disaster. Relevant for MDZ, LDZ and BDZ hospitals

Re-staffing the hospital with appropriate clinical and operational staff is a major concern. It is understood that hospitals will likely have to operate with existing on-site staff for a significant period of time. However, it is critical to develop plans to backfill these individuals as early as possible and to provide the specialties needed.

→If the disaster medicine skillset can be pre-planned (and the correct personnel are available) then a relief staffing-solution should be explored with governmental partners. Relevant for MDZ, LDZ and BDZ hospitals

Resupply is not meant to keep hospitals operational indefinitely, but to provide them needed medicine and other patient-care equipment to maintain a standard of care commensurate with the overall hospital situation until evacuation is completed or until new commercial supply routes can be established (for hospitals in BDZ). The workshop participants were interested in exploring drop-off points for marine, aircraft and even drone delivery of supplies.

→ Federal and state partners may wish to investigate the practicality of novel resupply methods to extend hospital operations long enough for termination of operations to be completed with relative success. Relevant for MDZ and LDZ hospitals

Inputs and Assumptions for Workgroup Discussion

Below is a description of information and assumptions that was provided to workgroup members to help them understand the overall environment in which they would be operating, and the expected response of government agencies.

Nuclear Detonation

The detonation model presented to workgroup participants involved a ground-level detonation of a 10kT nuclear device in Times Square. While we used available modeling from a Times Square detonation, the approach used by the workgroup emphasized planning for a detonation anywhere in the region. Therefore, hospitals worked to develop key actions that could serve hospitals in the three defined damage zones which would be determined by distance from GZ. Regardless of the location of ground zero (GZ), fallout and wind patterns can rapidly put residents, commuters and visitors to the metropolitan into life-threatening circumstances.

Local Responder Actions

Workgroup members assumed that local responders including police, fire, and emergency management would initially be instructed to shelter-in-place to wait out fallout decay. During this time, first responder agencies would attempt assessment of their capabilities. First responders would then likely function in a decentralized, borough-based command mode while attempting to reestablish a more consolidated unified command structure. Search and rescue operations in the LDZ and MDZ would likely commence after shelter in place was lifted. Therefore, the ability of first responder agencies to support healthcare facilities would not be a priority, at least initially.

Likely Detonation Impacts

Participants also received basic education about the likely effects of a 10 kT nuclear ground detonation including light flash, heat, prompt radiation, and blast damage zone boundaries based on federal planning initiatives for US cities, specifically for New York. Issues that were more difficult to define such as the availability of communications and the effects of the electromagnetic pulse (EMP) were also presented. Based on current knowledge, it was assumed some communications would continue especially via 800 MHz radio. Other key affects that drove the discussions included: electrical power loss, possible disruption of the hospital water supply, potential effects of fallout on hospital heating, ventilating and air-conditioning (HVAC) systems, and poor or non-existent local, state or federal governmental emergency messaging. It was stressed that information about the direction of fallout would not be readily available in the immediate hours and once available, the quality of communications may be unpredictable. Thus, hospital participants from each damage zone took the conservative approach that their facility would be affected by the fallout and would therefore plan to shelter-in-place for at least the first 24 hours without the benefit of additional staff or supplies during that period.

Casualty Estimates

Casualties from trauma and exposure from fallout radiation were presented based on previously published federal estimates for the NYC Scenario assuming a workday population in Manhattan of 3.6 million people (**Table 4**). As per these estimates, it is anticipated that approximately 100,000 people with low to moderate

total exposure to radiation can be saved if identified and treated post-detonation (yellow highlighted rows in Table 4).

Table 4 – 10 kT NYC Scenario Casualty Estimate[3]						
Exposure Range (rad)	**Exposure Range (Gray)**	**Symptoms**	**Latency Period to Symptoms**	**Initial Survivors***	**Untreated Fatalities**	**Treatment can save…**
50 – 70	0.5 – 0.7	Asymptomatic	No manifest phase	**200,000**	-	
70- 125	0.7 – 1.25	Minor transient effects – if any	~ 1 month	**200,000**	**200**	**200**
125 – 300	1.25 – 5	Mild to moderate	3-4 weeks	**300,000**	**75,000**	**51,000**
300 – 530	3 – 5.3	Moderate	~ 2 weeks	**150,000**	**109,500**	**42,000**
530 – 830	5.3 – 8.3	Moderate to severe	< 1 week	**100,000**	**98,000**	**11,000**
830 – 1500	8.3 - 15	Severe – fatality in weeks	None	**100,000**	**99,000**	**1,000**
Total				**1,050,000**	**381,700**	**105,200**

*The number of initial survivors was modeled using estimated trauma from each zone that included a radiation exposure obtained from 2 hours of unprotected exposure to fallout radiation. These approximately 1 million survivors are estimated to result in about 380,000 fatalities that go untreated. Treatment, including the recognition of acute radiation syndrome or its potential can save about 105,000 people. Modeling indicates that if the public were educated to quickly SIP post detonation, preventable casualties from fallout could potentially number in the hundreds of thousands or more due the protection afforded by the varied NYC building stock[4]. That estimate assumes an outdoor fallout exposure of 24 hours.

State & Federal Planning

Workshop facilitators from DOHMH and GNYHA also gathered all available information regarding likely actions of state and federal partners. This information was assembled from existing concepts of operations and planning documents, as well as phone calls with staff of various agencies. Throughout the workshop series, the facilitators worked to continuously gather information regarding known planned actions and points of intersection among and between agencies. This information was critical to shaping hospital key actions developed by the workgroup as well as highlighting gaps that informed Tables 1-3.

Emergency Messaging: After a nuclear detonation, the federal government is expected to disseminate emergency messaging within approximately 15 minutes utilizing public warning systems, the standard communications networks maintained by Centers for Disease Control and Prevention, and Health and Human Services, and various first responder networks. Public messaging will include instructions on sheltering in place, self-decontamination, checking on neighbors, and remaining calm. Messaging is expected to emphasize that individuals should only go to a hospital for life-threatening circumstances, once it is safe to do so.

State Response: The National Guard (NG) is likely to be one of the first response assets mobilized. Various teams and units of the NG, each with certain hazardous materials capabilities, will deploy in a planned sequence. For example, under "normal emergency conditions" the Weapons of Mass Destruction – Civil Support Teams can deploy within 3 hours and arrive 8 to 12 hours after initiation of the incident, although in the case of a nuclear detonation, the effects of fallout may modify that timeline. Some of these units, including the Chemical, Biological, Radiological, Nuclear and high-yield explosive (CBRNE) Enhanced Response Force Package (CERFP), and the Homeland Response Force (HRF), possess varying capability to perform search and rescue, medical

[3] Buddemeier, Brooke. Response Needs for the Aftermath of Nuclear Terrorism. Lawrence Livermore National Laboratory, LLNL-PRES-677346, slide 55. September 2015.
[4] Key Planning Factors for the Aftermath of Nuclear Terrorism; NYC Edition, p. 40, September 2014.

triage, decontamination, medical evaluation, and casualty transport. Some of these forces fall under the command of the federal Department of Defense.

Federal Response: Additional DoD assets would be expected to support / backfill the NG response. In particular, the Defense CBRN Response Forces (DCRF), and the Command and Control CBRNE Response Element (C2CRE) are specifically built to respond to CBRNE events and add capabilities including engineering support, logistics, aviation medical / casualty evacuation, and command and control resources. For those who appear to have moderate levels of acute radiation syndrome (and are therefore salvageable), plans include transport to a Radiation Injury Treatment Network (RITN) hospital in another US city. It is unclear what types of transportation have been designated to support this operation and what transportation modes will be functional. The US Air Force Air Mobility Command is tasked with aeromedical evacuation (AE) of patients to and between medical treatment facilities under the care of Air Force medics.

Unstaffed / Spontaneous Response: The current federal government draft response to a nuclear detonation envisions that medical triage sites, referred to as Radiation Triage, Treatment, and Transport Sites (RTRs) will spontaneously arise as first responders, local Emergency Medical Services and other medical personnel gather in locations such as shelters, police, or fire stations. While specific details on capabilities do not exist, likely functions may include stabilization of trauma victims, and decontamination. Assembly Centers are more advanced radiation screening sites intended for those without trauma. These sites are expected to stand-up at locations capable of supporting public assembly and that have not sustained severe structural damage.

The US Department of Energy (DOE) response is primarily a large-scale environmental measurement effort that generates radiological situational awareness for responders, local government officials, and the public. The Federal Radiological Monitoring and Assessment Center (FRMAC) conducts fallout plume modeling and radiological dose assessment informed by radiation measurements obtained at ground-level, in the air, and is supported with current meteorological data. Various components of the FRMAC activate over a 36-hour period beginning with a request to the DOE after the incident begins.

Summary of Hospital Strategies (D+0 to D+72 hours)

In developing key actions, hospital representatives relied upon their professional training, and their recent experiences with other large-scale emergency incidents such as Superstorm Sandy. This is not surprising as impacted hospitals faced – at least superficially - similar infrastructure and operational challenges as compared to the immediate effects of a nuclear detonation. Common issues include evacuation operations, sheltering operations, receiving patients from other facilities, infrastructure damage, communication issues, decreased staffing, diminishing supplies, and difficulty obtaining needed transportation assets.

Of course, the one unique aspect of a nuclear detonation, fallout radiation, prompts a distinct set of emergency responses: that of needing to continuously perform radiation monitoring including personnel dosimetry to determine safe areas, and patient movement into the better protected core areas of the hospital. Participants were keen to call upon in-house radiation safety staff, as well as medical personnel with radiation knowledge including radiologists, nuclear medicine specialists, and oncologists.

NOTE: *All hospitals will assume that they are in a fallout zone until proven or informed otherwise.*

The sequence of 24-hour operational periods after detonation was a moderate driver of emergency response strategies. Often, the responses initiated in one time period were carried into another. Because these facilities

shared many strategies, **Table 5** summarizes the responses for the MDZ and the LDZ hospitals over all three time periods combined.

> NOTE: *The overall strategy in the MDZ and LDZ was to work towards evacuation and termination of hospital operations unless infrastructure and other conditions, such as availability of critical utilities warranted continuing services beyond the 72-hour period considered in the workshop.*

The overall strategy of BDZ hospitals was to act as receiving facilities, either temporarily or otherwise. That role being sufficiently different from LDZ and MDZ hospitals warranted a separate **Table 6** of response activities.

Table 5 – Summary of Hospital Strategies	
Light & Medium Damage Zones Only	
Overall Strategies: Protect facility, staff, patients & others within facility & assess/maintain facility operations MDZ Hospitals: Maintain medical capabilities in environment of diminishing resources LDZ Hospitals: Can act as a waystation for patients arriving from MDZ and, to a lesser extent, for the public seeking services and information.	
Situational Issues →	-Infrastructure damage to regional hospital facilities are initially unknown and challenging to ascertain due to communications disruption and lack of experience with this type of incident. -Maintaining the security of the hospital will be an area of focus, given the anticipated surge of injured and worried well seeking assistance, especially immediately after the Shelter-in-Place period. -In the hours immediately after detonation, hospitals will only have on-site staff. After the Shelter-in-Place period, it is likely that many of those staff will want to leave and there may be little replacement staff. -Acute Radiation Syndrome (ARS) will be unfamiliar to clinical staff and is difficult to diagnose and triage.
Joint Commission Critical Areas	
Incident Command	-Activate HICS and EOC/Establish forward planning team -Establish brief operational periods for continuous reassessment of needs and maintain for 72 hours; drive frequent internal communication with creation and dissemination of situation reports -Initial objectives: 1) Protect facility, staff, patients, visitors 2) Assess and maintain facility operations -Attempt to ascertain outside situational awareness: determination of fallout areas, and intelligence about other hospitals in/out of system & other stakeholders -Eventually attempt communication w/ police & fire via 800 MHz radios for situational awareness -Set hospital evacuation goal/Attempt to ascertain locations of off-site patient treatment centers -Set termination-of-operations goal in coordination with government response partners
Resources & Assets	-Identify depleted supplies needed most urgently (monitor burn-rate and efficacy of rationing) -Work to replenish supplies from off-site storage and neighboring institutions, though this may be difficult due to hostile outdoor environment -Curtail services as part of altered standards of care, on advisement of clinical leadership and -based on resource availability to -Limit incoming patients to those who are critically ill/injured -Place emphasis on security of high-demand resources such as generator fuel

Table 5 – LDZ & MDZ Hospital Strategies

	-Manage radiation measurement and decontamination supplies, especially personnel dosimeters
Staff Responsibilities	-Adapt existing staff management and hoteling plans to maximize use of onsite staff/Due to potential radiation exposure, staff should work brief shifts (i.e. 2 hours) and rotate often -Set up staff information function to ascertain family status for on-site staff; this is key to enable on-site staff to be able to continue to work -Initiate Psychological First Aid -Internal communications should stress that is safer to remain in the hospital than to venture outside -Attempt to ascertain where it is safe to go for staff that depart after SIP order is lifted
Safety & Security	-May be challenging for in-house engineering staff to assess integrity of hospital structure -Emphasis on movement of staff and patients to core of facility to protect against fallout radiation -Supplement radiation-safety staff monitoring to determine indoor radiation exposure rate -Prepare for expected surge of injured and worried well; could easily overwhelm the facility endangering staff and patients - Limit and secure points of entry. Surge security staff first using in-house staff and later potentially volunteers -Institute decontamination procedures for entering casualties -Establish sheltering area for deconned public or send to a designated medical care area if injured
Utilities	-Check & shut off oxygen lines & other medical gases, as necessary -Initiate generator rationing/Utilize alternate power sources where feasible -Determine effect of fallout on HVAC filters (radiation measurements needed) -Ascertain radiological status of unfiltered air systems -Restore services as possible and work with what is available; e.g. may have multiple services on different electric grids requiring movement of patients or equipment
Patient Care and Support Activities	-Move patients to building core to protect against fallout -Create existing patient census, and cohort patients -Establish simple way to document basic medical information, especially signs/symptoms pertinent to ARS, that can travel with the patient -Use non-traditional spaces to create a large patient-care zone -Consider facility's ability to receive non-emergency patients: If can receive, set up patient-care zone. If cannot, direct those not requiring care to Assembly Points if location is known/Use signage and loudspeakers to do so in order to limit entry into facility -Triage and manage incoming individuals with medical needs based on existing mass casualty response protocols -Triage and cohort those exhibiting signs of ARS/Utilize standing order sets to determine exposure as supplies and testing capabilities allow -Initiate modified triage based on survivability (i.e. consider age, co-morbidities) -If there are medical countermeasures on site, determine who should receive these and distribute -Establish a temporary morgue -Prepare most-acute patients for transfer to outlying hospitals, when able to do so -Outlying LDZ hospitals prepare to receive MDZ patients/adopt "way-station" strategy

Table 5 – LDZ & MDZ Hospital Strategies

	-Send staff with transported patients
Communications	*External* -Identify operational modes of communication (cell, satellite phones, radios, Internet) -Seek situational awareness by all means including contacting police and fire personnel (800 MHz radios) -Institute Mass Casualty Incident communications protocols -Send communications to off-duty staff/share what is known and set expectations -Develop signage or loudspeaker messaging about hospital's limited capability i.e., only providing service to those experiencing life-threatening emergencies -Direct off-shift staff to provide support to hospitals in BDZ hospitals, especially within their own health system -Attempt to communicate with NYC incident command to communicate hospital status *Internal* -Communicate available situational information including status of healthcare system to staff, patients, visitors/provide frequent updates -Emphasize remaining in facility for safety -Use radiation safety and radiology staff to craft messaging on rad-safety -Formalize a process for staff to contact families in concert with staff information function.

Table 6 – Summary of Hospital Strategies	
Beyond Damage Zone Only	
Overall Strategies: • Protect facility, staff, patients & others within facility & assess/maintain facility operations • Determine where to send uninjured & concerned survivors • BDZ Hospitals: Act as Receiving Hospital for MDZ and LDZ patients and as way station for further transport to RTIN or other medical facilities	
Situational Issues →	-Manage concerned public seeking medical attention -Preserve staffing and medical resources for the expected surge of patients from MDZ and LDZ -Acute Radiation Syndrome (ARS) will be unfamiliar to clinical staff, and is, difficult to diagnose and triage -Gather situational awareness regarding governmental assembly and other triage centers -Investigate transportation options for patient movement -As identified, prepare ARS patients for transport to RITN or other facilities
Joint Commission Critical Areas ↓	
Incident Command	- Activate HICS and EOC/Establish forward planning team -Establish brief operational periods for continuous reassessment of needs and maintain for 72hours; drive frequent internal communication with creation and dissemination of situation reports - Main objectives: 1) Protect facility, staff, patients, visitors 2) Meet needs of arriving injured 3) Determine where uninjured concerned survivors can seek shelter and other assistance -Attempt to obtain information about other hospitals in/out of system & other stakeholders -Prepare to receive MDZ and LDZ patient transfers and self-referrals -Consider implementation of task force response model for mental health, security, staffing, etc./Maintain through 72hour operational period - In 48 – 72h period anticipate activation of a larger command element that connects to government for situational awareness, and coordination of patient care in the context of evacuation and use of assembly centers -Be prepared to voice current and anticipated facility needs
Resources & Assets	-Continually monitor supplies and project burn rate (sustainability grid based on likely SIP time)/begin rationing resources as needed -Seek immediate resupply & additional resources from local health departments, network clinics, urgent care centers, and other facilities in the hospital network/contact vendors and hospitals farther from incident, as well as seeking supplies from non-traditional sources -Consider supporting operational facilities in the LDZ & MDZ w/ supplies -Determine accessibility of local, state or federal stockpiles, and how to request and acquire needed items -Replenish supplies related to radiation monitoring, decon & mass sheltering -Use network vehicles for supply transport -Consider receipt of supplies by air/water routes -Leverage available transportation resources to bring in needed staff

Table 6 – BDZ Hospital Strategies

Staff Responsibilities	-Assume staff present at time of detonation will remain on-site for 24 h/Initiate existing staff management & hoteling plans -Set up staff information function to ascertain family status for on-site staff; this is key to enable on-site staff to be able to continue to work. -Initiate Psychological First Aid -Forward plan to surge staffing levels once shelter in place order has been lifted. Plan to bring in available facility staff as well as staff from sister facilities in the LDZ and MDZ who cannot report to work/Include non-facility healthcare staff -Oversee departure of current staff and entry of new staff after 24 h (when SIP is lifted) -Debrief current workers who wish or want to leave (focus on mental health / well-being)/Develop plan to retrieve them for other shifts -Provide support to staff who live in the MDZ or LDZ, such as shelter, clothing and food -Enable incoming staff to bring family & pets -Set up shifts with expectation that staff will stay for an extended period/Establish on/off shift cohorts to ensure adequate rest cycles -Incorporate staff from other facilities and potentially volunteers who have come to assist
Safety & Security	-Activate lockdown procedures to secure building/Activate complementary procedures to secure building perimeters -Surge existing security staff with in-house staff; assess new security concerns as they arise -Determine if security can be augmented with resources from courts, banks, law enforcement agencies and National Guard (NG) -Surge existing decon team with JITT training. Implement gross decon procedures for anyone entering the facility/Maximize use of existing decon and monitoring equipment -Initiate radiation monitoring with available subject matter experts & equipment to determine if the facility is in the fallout zone -Train additional staff on radiation monitoring, set up a monitoring protocol, and data collection method/Require incoming patient screening/set levels for triggering decon -Based on results of radiation monitoring, reduce or increase the footprint of the hospital to areas deemed safe for staff and patients. Be prepared to continue to move inward and downward if radiation levels around the established perimeter rise to dangerous levels/Maintain the integrity of these perimeters -Anticipate self-evacuating individuals who will need medical care/Create arrival pathways that enable decon and triage -Institute decon procedures for incoming individuals -Consider supplying staff to fulfill security, radiation monitoring & decon roles to off-site facilities treating minor injuries or providing mass care/screening
Utilities	-Based on ongoing monitoring, determine when risk of fallout has subsided -Initially, turn off HVAC systems/Seal off labs -Reference utility plans/Conduct full reassessment of critical equipment (medical gases, water, HVAC)

Table 6 – BDZ Hospital Strategies

	-After 12-24 h, determine if HVAC needs replacement/Unfiltered HVAC may need radiological assessment before resuming use -Initially, check/shut off oxygen lines and other medical gases -Assess power/Turn on generators/Assess duration facility can run on generator with current supplies -Assess water lines/Determine if incoming water is usable or if back-up supply is needed -Work to maintain operations based on availability and a power-rationing plan/conserve fuel using electricity only at night or for limited time periods/Prioritize areas of hospital to get power -Determine if some utilities can run on alternate power sources such as natural gas -Return to grid power when available/Restore services when feasible/Recognize multiple services on different electric supplies which may require movement of patients or equipment
Patient Care and Support Activities	-Cease all non-emergent/elective surgery procedures -Begin procedures to decant facility once deemed safe to do so/Work to discharge patients and send high acuity patients to outlying facilities -Utilize mutual aid agreements for patient transfer/movement to other facilities -Make preparations to receive self-evacuating patients & patients transported by first responders. -Cohort incoming exposed patients together utilizing alternative care space/cohorting limits the need for staff training to deal with ARS. Employ a basic documentation system to record location at time of detonation/symptoms. Utilize standing order sets to determine exposure as supplies and testing capabilities allow -Maintain separation of existing patients and those that arrive post-detonation -Maintain the highest standard of patient care possible, continuously assessing standards of care based on existing personnel and supplies -If medical countermeasures are available, determine who should receive them -If not a burn center, stabilize patients/move toward definitive care -Use tents and parking lots as alternate care sites within the hospital -Attempt to establish or connect to alternate care sites for individuals with less acute injuries/Seek support from primary care or urgent care centers as alternate care sites (e.g., CityMD, etc.) for treatment of minor injuries -Determine which patients will go to Assembly Centers, once locations are known
Communications	-Identify operational modes (cell, satellite phones, radios, Internet…) -Seek situational awareness by all means including contacting police and fire personnel (800 MHz radios)/Collect information about detonation, public messaging, fallout zone, and available services/assistance, including decontamination and mass sheltering operations -Institute Mass Casualty Incident communications protocols -Send communications to off-duty staff/share what is known/set expectations for the next 24-hour period -Deter worried well to stay away from hospitals/Repeat as needed/Use all modes including signage and loudspeakers/Inform concerned survivors about locations of mass care, information, and radiation screening (if known)

Table 6 – BDZ Hospital Strategies

	-Communication strategy MUST align with facility's then current security posture -Communicate with NYS DOH and other government agencies as is possible -Communicate utility needs/ Offer contingency strategies to government/Share "high priority" needs for continuation of facility operations. -Contact healthcare system and sister systems to communicate needs for surge staffing *Internal* -Communicate available situational information including status of healthcare system to staff, patients, visitors/provide frequent updates/ Emphasize danger to staff if they leave the hospital & importance of keeping themselves safe for their families and patients -Communicate frequently with internal/external staff/Relay any messaging regarding safety of travel & availability for hoteling family and pets -Use radiation safety and radiology staff to craft messaging on rad-safety -As other medical care and mass care sites are established prioritize communication with these & stress importance of aligning messages

The complete Hospital Key Actions Grid is available through the Greater New York Hospital Association.

Conclusion:

It is expected that hospitals will play a key support role in response to a nuclear detonation in the New York City region, not just in continuing to care for patients, families and staff in the immediate aftermath (including protecting them from fallout), but also patients that will seek care for related trauma or acute radiation sickness. To help coordinate medical response and minimize overall morbidity and mortality, regional hospitals have identified critical response strategies as well as needed support to help operationalize these strategies. This document was developed to share these identified needs with local, state, and federal partners in order to spur discussions and planning to facilitate the best possible response to a nuclear device detonation in this region.