




# Disaster planning for a surgical surge: when mass trauma threatens to overwhelm your operating rooms

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► Additional supplemental material is published online only. To view, please visit the journal online (<http://dx.doi.org/10.1136/tsaco-2023-001224>).

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Received 1 August 2023  
Accepted 27 September 2023

## SUMMARY

Mass casualty events particularly those requiring multiple simultaneous operating rooms are of increasing concern. Existing literature predominantly focuses on mass casualty care in the emergency department. Hospital disaster plans should include a component focused on preparing for multiple simultaneous operations. When developing this plan, representatives from all segments of the perioperative team should be included. The plan needs to address activation, communication, physical space, staffing, equipment, blood and medications, disposition offloading, special populations, and rehearsal.

The American College of Surgeons (ACS) Committee on Trauma requires that trauma centers participate in development of their hospital disaster plan as part of the trauma center verification process.<sup>1</sup> There are few specifications as to what these plans must include. Most disaster plans and available planning resources focus on initial triage and emergency department treatment of injured patients with limited attention directed toward what happens beyond the emergency department, especially in situations where multiple injured patients require simultaneous urgent or emergent surgeries.<sup>2</sup> Events such as the Las Vegas shooting and the Boston Marathon shooting have emphasized the need for these plans.

There is an abundance of research studies and protocols that detail the initial triage and management of injured patients during a mass casualty incident; however, research and guidance beyond this initial phase of care extending into the operating room (OR) and the post anesthesia care unit (PACU), is limited. The Centers for Disease Control-funded Terrorism Injuries: Information, Dissemination, and Exchange project in 2009 released educational materials on medical response to terror attacks including a ‘Surgical Department Crisis’ template outlining suggested planning for mass casualty response for surgical departments based on the 2004 Madrid terrorism attack.<sup>3</sup> The American Society for Anesthesiologists Committee on Trauma and Emergency Preparedness created the *Operating Room Mass Casualty Management* checklist in 2015.<sup>4</sup> This checklist outlines step-by-step instructions for OR staff to execute once a mass casualty incident is announced and it is meant to be adapted to each facility’s unique needs. The role

of anesthesiologists in a mass casualty response has been highlighted several times in the literature.<sup>5,6</sup> Similarly, the Japanese Society of Anesthesiologists joined the Academic Consortium on Emergency Medical Service and Disaster Medical Response Plan during the Tokyo Olympic and Paralympic Games in 2020 to create a guide to assist hospitals in planning for mass casualty incidents.<sup>7</sup> They focused specifically on OR management during these incidents.

It is imperative that comprehensive disaster planning include provisions for a surgical surge, which would anticipate needs from the time of decision to operate through the PACU and final in-hospital disposition. This plan should be specific to a given institution but incorporate key components that would be applicable to all hospitals. The surgical surge plan should be integrated into the overall hospital disaster plan to ensure that care of patients requiring immediate surgery is well coordinated. This type of plan should account for children, older adults, and patients with special needs who are injured in a disaster and may require emergent or urgent care by any hospital regardless of optimal resources. This paper will discuss key elements to consider when disaster planning for a surgical surge.

## PLAN DEVELOPMENT

When developing the surgical surge plan, key stakeholders from both the surgery and anesthesia departments and OR should be involved in collaboration with the committee responsible for hospital incident command. This planning team should include a surgeon, preferably a trauma surgeon, anesthesiologist, and OR nurse manager. Additional interested parties that should be included to optimize plan development may include OR technicians, pharmacy staff, central sterile processing staff, administration, blood bank, PACU staff, respiratory therapy, pathology, interventional radiologists, hospital security/law enforcement, and bed flow coordinators. The members of the planning team should be familiar with the broader hospital disaster plan and include the hospital emergency management team. In addition, there should be inclusion of intensivists and hospitalists who would help care for patients while surgeons are operating.

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**To cite:** Kelley KM, Toscano N, Gestring ML, et al. *Trauma Surg Acute Care Open* 2023;**8**:e001224.

## PLAN COMPONENTS

The following components should be considered in surgical surge planning. These components are summarized in the checklist found in online supplemental appendix 1.

### Activation criteria

Not all disasters or mass casualty incidents will require a significant mobilization of surgical resources. The planning team should establish objective criteria for the activation of a surgical surge plan based on the scenario (eg, mass shooting vs building collapse), number of estimated casualties, age range and other demographics of the casualties, and timing of the incident (eg, workday vs night/weekend/holiday). Activation of a surgical surge will have different implications depending on time of day and day of the week. For example, a surgical surge during the middle of a weekday would require thoughtful consideration of how to manage ongoing elective surgeries to free up rooms, while a Saturday may present challenges such as method of disaster plan recall of staff for additional ORs, presence of adequate OR turnover personnel, surgical equipment sterilization protocols (night/day/weekend), and surgical supply warehouse access and staffing.

### Communication

A communication strategy is usually developed as part of the main hospital disaster plan. A surgical surge plan should be coordinated with this overall plan and include notifications of the OR and all impacted personnel (ie, blood bank, nursing, bed board) that an event is unfolding that will heavily involve the OR and all surgery-related resources. This strategy should be applicable at any time of day and any day of the week as OR utilization frequently varies depending on these factors. For example, a disaster or mass casualty incident notification should be distinguishable from a request for someone to work an extra shift. There should be ongoing communication between the trauma triage surgeon, the OR triage anesthesiologist, the recovery room triage physician, the intensive care unit (ICU) triage physician, and ward triage physicians. There should be a backup plan for multiple alternatives if the primary mode of communication (cell phones) becomes inoperable.

### Physical space

The plan should include an assessment of the number of ORs that can be used at a given time. Further consideration must be given to all times of day. For a mass casualty event during a normal operating day, consideration must be given to canceling elective cases and opening additional rooms. Depending on the severity of the event and size of the facility, elective cases may need to be more expeditiously completed. To optimize OR resources, surgeons will need to emphasize damage control techniques.

Conversely, at night and on weekends there will be more open rooms but fewer available staff necessitating different plan considerations. Given these differences and variations in shift times at different hospitals, the surgical surge plan should consider several different times of day for a possible event. Incorporating unused or elective procedural spaces such as ambulatory surgery spaces or endoscopy rooms should be examined.

As operations conclude patients will need to be moved to the PACU. This will require that patients already in PACU be more rapidly discharged and dispositioned to other locations within the hospital. There should also be consideration of expanding PACU bed space to other monitored settings. The planning team

should consider the potential consequences of limitations on their normal overflow procedures.

The planning team should broadly consider the types of events that may impact the physical space and capability of the OR environment. This should include a 'hazards and vulnerabilities' discussion focused on the facility and circumstances. Examples of this discussion may include situations such as: hospital power failure, a potential evacuation (fire or bomb threats), water and gas supply failures, chemical and biological agents, IT infrastructure collapse, rumored or actual active shooter on the premises, etc. As particular threats to the environment are identified, the group should attempt to outline the best possible contingencies for those events.

### Staffing

The coordination of staffing, determination of, and mechanism used to call in staff should be done in conjunction with hospital incident command; however, having a predetermined and trained system and location for response is crucial to decrease chaos. Additional nursing, scrub technicians, cleaning staff, and PACU nurses should be notified of a disaster response through a different mechanism than is usually used to request overtime shift coverage. The number of individuals needing to be called in and the method for notification may need to vary depending on the time of day. Nurses and other staff may need to be flexed from or into other units to cover the influx of patients. Depending on the capability of its facility, the planning team may identify procedures which are normally performed in the OR, which could be performed in the emergency room, ICU, or other procedural spaces with the assistance of OR staff.

Surgeons will need to be available to complete required cases. One senior trauma surgeon should be responsible for surgical triage in the emergency department or critical casualty assessment area. This surgeon will need to remain in communication with the trauma assessment teams and operative teams, as well as the hospital incident command center. They may also need to direct surgery staff and residents away from the emergency department to other areas to prevent overcrowding. If a senior triage surgeon is not available, there should be a backup plan in place using a trained senior nurse or advanced practice provider. A senior surgeon should also be present at the OR to triage all cases entering the ORs and to monitor the progress and appropriateness of cases underway. An OR staff member, or other pretrained staff member such as a nursing supervisor or surgical intensive care unit nurse, should be assigned to the triage surgeon to expedite communication between the triage surgeon and OR booking personnel, and assist in rapid movement of the highest priority patients to the OR. Additional non-trauma surgeons should be notified of the event and be available to assist as needed in the OR. Other subspecialties, particularly neurosurgery, vascular, cardiothoracic, and orthopedics, should be involved in planning and have a system for calling their own backup as needed. Special circumstances may require urology, ear-nose-throat, plastic surgery, gynecology, and pediatric surgery to respond and a system for contacting available subspecialists should be in place. It should also be noted that surgeons may operate somewhat beyond their normal scope of practice in a mass casualty situation. There should be a method for notifying all staff surgeons of a disaster event at once, and this method should be distinguishable from routine calls. While focus on immediate response always predominates, any surgical surge plan should account for the need to sustain a response over many hours or, potentially, days. This would need to include

plans for relief teams and rest periods for responding staff. The determination of the need for relief shifts should be made in conjunction with the hospital incident command. Additionally, the OR disaster plan should include how non-disaster-related surgical emergencies will be prioritized.

Anesthesia attendings and certified registered nurse anesthetists (CRNAs) will need to be notified of the event in a method distinct from normal call-in notifications. Anesthesia providers will need to assist in opening additional rooms and expeditiously completing ongoing cases. They may also need to assist with airway emergencies and critical care if the surgical and other intensivists are encumbered in the response. One anesthesiologist should oversee coordinating their staff based on resources, that is, sending residents/CRNAs to less critical cases that are wrapping up while experienced personnel are directed toward major cases.

A predetermined staging area outside of the emergency department should be designated as a location for surgeons to gather to strategize and debrief, rather than arriving in the already chaotic and congested emergency department. A notification and staging plan should be established. A parallel social work plan should be developed and integrated to assist with patient disposition for unaccompanied children, elderly or special needs patients, and reunification needs.

### Equipment/Supplies

Instrument processing should be reviewed to assess the capability of providing sterile instruments for multiple operations at different times of day. Special consideration may be required if instruments are routinely processed off site or in bulk at night. In extreme circumstances, this may include alternative sterilization techniques. Mass casualty events may require utilization of more than typical amounts of disposable supplies and a plan should include methods of resupply or a special stock only to be used in a disaster. Administration for Strategic Preparedness and Response has developed the Disaster Available Supplies in Hospitals (DASH) tool, which can help hospitals determine how much equipment/supplies to stockpile for trauma-specific disasters.<sup>8</sup> This tool should not be used as a definitive list of supplies but rather an adjunct to the planning process. Hospitals should stock equipment and supplies for types of patients they do not normally treat, such as children and burn patients.

Essential personal protective equipment and sterile attire including gowns, gloves, masks, and scrubs should be readily available in sufficient quantities to accommodate a large influx of OR personnel on short notice. This may require extra planning in facilities that use automatic machines to distribute OR attire with limited ability to ramp up supply when needed.

The planning team should account for supplies and equipment, that are damage control or temporizing in nature, that may have a direct impact on the throughput of patients. Examples include vacuum assisted closure (VAC) supplies, orthopedic external fixation sets, splinting supplies out of the OR environment, chest tubes and Pleur-evac canisters, etc. Attention should be paid to the prevention of hypothermia.

### Blood and medications

The blood bank should have a plan to provide multiple simultaneous blood transfusions to support multiple ongoing surgical procedures in the OR. The planning team should develop an alternate plan for mass transfusion for a true mass casualty incident so that the first one or two patients do not receive all of the available blood products. Planning should include an assessment

from the blood bank of how many massive transfusions can be supported simultaneously, what their flex capability is, and what regional resources can be used.

Hospital pharmacies should have a method of restocking anesthesia medications and antibiotics during a disaster. This may require additional pharmacy staff to be called in during off hours. The pharmacy may need enhanced tetanus immunization capabilities. DASH includes a specific tool to estimate the need for pharmaceutical stockpiles.<sup>8</sup>

### Disposition offloading

The surgical surge plan should be coordinated with the ICUs and medical/surgical care units to maximize patient offloading from the OR and PACU. To optimize surgical surge capacity, discharge of appropriate patients should be expedited, and patients with disposition-related needs (transportation, prescriptions, etc) moved to alternative holding areas to free up patient care areas. Patients may need to go to medical units under the care of non-surgeons to allow surgeons to remain in the OR. Bed controllers for each inpatient unit need to be identified by the emergency operations center, so that forward patient flow is coordinated. Depending on the hospital, consideration should be made to use transfer agreements with other regional hospitals to help offload excess patients. Large-scale disasters will overwhelm healthcare resources, including hospitals, commonly with a 'geographic effect' where the closest facilities to the event location are the hardest hit. If surgical resources are being overwhelmed, but other facilities are still capable of receiving and caring for surgical patients, a plan to move patients to different care sites should be made in advance by the planning team. A regional medical operations center or an equivalent system can expedite and streamline this process.<sup>9</sup> The bed flow coordinator will need to be involved in the planning and implementation of this patient flow. For hazardous materials and weapons of mass destruction incidents, there should be access to the healthcare coalition or local disaster planning organization leadership and subject matter experts that could be contacted for assistance. Plan development should include agreements with other healthcare facilities/coalitions/stakeholders.

### Special populations

The planning team should consider the special populations of patients that their facility may care for that could impact the plans that are developed. This may include patients that are immunocompromised, pediatric, burns, complex cardiac, transplant, etc. Those patients already in the facility often require significant resources and care which cannot be easily flexed in a crisis. This may include surgical patients whose operations cannot be canceled or quickly completed, and the patients cannot easily be evacuated. There are patients who may be part of a mass casualty event requiring care at the facility (at least initially) even if they are not in the normal scope of practice.

### EDUCATION AND TRAINING FACTORS

During a surgical surge, it will be important for OR teams to be competent as individuals and as teams. All team members, particularly plan developers, would benefit from the ACS Disaster Management and Emergency Preparedness course.<sup>10</sup> Intentional planning for disaster or mass casualty incidents should involve damage control surgery techniques for all surgeons, not only the trauma surgeons, as all will be expected to have basic damage control skills. The ACS Advanced Surgical Skills for Exposure in Trauma and Advanced Trauma Operative Management are good examples of courses that



can assist in the development and maintenance of these skills. OR nurses and surgical technicians should cross train throughout the OR to ensure they can fill in as needed in any role. Anesthesia personnel should undergo refresher training for trauma resuscitation on a periodic basis. Nurse practitioners, physician assistants, medical technicians, and scrub technicians should all have an opportunity to cross train as surgical first assists in preparing for a surgical surge. It should be recognized that OR teams who work together on difficult cases on a usual basis will function more efficiently and effectively in a crisis situation and this must be considered in planning for a surgical surge response. In the initial and ongoing triage of patients, expectant patients may be identified and comfort care and ongoing observation may be initiated in order to provide lifesaving care to others. It is important to remember that if a patient becomes ‘expectant’ in the OR, consideration should be given to redirecting care and resources to other patients with potentially life-threatening injuries.

### PLAN COORDINATION AND REHEARSAL

The surgical surge plan should be coordinated and integrated with all the components of the hospital disaster plan and must be rehearsed along with other disaster plan components. This should be done at various times of the day and the week. Drills should also incorporate the time constraints of a given operation including tying up the room and staff and using instruments and disposables. Rehearsals internal to the OR may be conducted in a team cycling fashion to ensure preparedness for large-scale hospital-wide drills. After drills are completed, the planning team should review the outcomes and make modifications to the plan as necessary. Regular tabletop exercises together with annual (at minimum) OR surge drills should be coordinated to integrate with hospital disaster preparedness.

### CONCLUSION

Multiple casualty incidents such as mass shootings unfortunately are increasing and the need to provide immediate surgical intervention to many patients at once is no longer a rare event. Conventional disaster and mass casualty planning has historically neglected the importance of OR surge capacity. The active engagement of OR and perioperative support leadership along with expansion of hospital disaster plans to include OR surge capacity will be critical to preparing for these situations going forward.

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**Acknowledgements** We would like to thank the other members of the AAST Disaster Committee for their support of this work: Joanelle Bailey, Avi Bhavaraju, Alfredo Cordova, Eleanor Curtis, Michael Dalton, Bradley Dennis, Alexander Eastman, Lee Faucher, Peter Fischer, Jane Keating, and Alison Smith.

**Contributors** KK, KR, and NT drafted the manuscript. All authors contributed to content development and manuscript preparation.

**Funding** The authors have not declared a specific grant for this research from any funding agency in the public, commercial or not-for-profit sectors.

**Competing interests** None declared.

**Patient consent for publication** Not applicable.

**Ethics approval** Not applicable.

**Provenance and peer review** Not commissioned; internally peer reviewed.

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## Appendix 1: Checklist for disaster planning for a surgical surge

Plan Development	
<input type="checkbox"/>	Involve key stakeholders from all components of the perioperative team in the planning process
<input type="checkbox"/>	Develop clear objective activation criteria
Communication	
<input type="checkbox"/>	Identify a clear communication strategy separate from everyday modes of communication
<input type="checkbox"/>	Identify all impacted personnel that would require notification (anesthesiology, blood bank, nursing, etc)
<input type="checkbox"/>	Ensure communication strategy can remain active throughout entirety of event
<input type="checkbox"/>	Create a backup plan for communication if primary mode of communication becomes inoperable
Physical Space	
<input type="checkbox"/>	Identify a physical space that can be utilized during a surgical disaster for assessment and post-operative management
<input type="checkbox"/>	Consider operating room work flow and number of available rooms and how best to allow for OR surge
<input type="checkbox"/>	Develop a plan to rapidly discharge and/or transfer patients from recovery room and other hospital locations to ensure bed availability
<input type="checkbox"/>	Create a contingency plan in the event current resources become unavailable (power failure, loss of resources) requiring immediate transfer of patients
Staffing	
<input type="checkbox"/>	Create a plan to provide adequate staffing and call-ins in coordination with hospital incident command
<input type="checkbox"/>	Determine a predetermined location for staging and regularly exercise staff mobilization
<input type="checkbox"/>	Define surgeon response which should include a senior trauma surgeon for triage and surgeons for surgical response in the operating room
<input type="checkbox"/>	Create a system for mobilization of subspecialty services including neurosurgery, orthopedic surgery, critical care
<input type="checkbox"/>	Create a plan to coordinate anesthesia in OR and for airway emergencies
Equipment	
<input type="checkbox"/>	Instrument processing procedures should be reviewed to assess capability to provide multiple resources at various times of day as well as days of the week
<input type="checkbox"/>	Determine a method for resupply or special restock if instruments/resources run low during a disaster
<input type="checkbox"/>	Ensure optimal PPE/sterile attire available for staff
<input type="checkbox"/>	Ensure adequate supply of specialty resources utilized during damage control (VAC dressings, external fixation devices, chest tubes, Pleur-evacs®, etc)
Blood and Medications	
<input type="checkbox"/>	Create a plan to provide multiple massive transfusion protocols simultaneously and fairly
<input type="checkbox"/>	Determine resupply plan with regional blood bank
<input type="checkbox"/>	Pharmacy should determine method of restocking anesthetic medications and antibiotics
Disposition Offloading	
<input type="checkbox"/>	Coordinate with the intensive care units and medical/surgical units to maximize patient offloading
<input type="checkbox"/>	Hospital Incident Command should identify bed controllers for each unit to ensure forward patient flow is coordinated and optimize bed availability
<input type="checkbox"/>	Develop transfer agreements with outside hospitals which can be coordinated with a RMOC
Special Populations	
<input type="checkbox"/>	Consider unique populations (pediatric, complex cardiac, transplant) to determine capabilities of your institution in caring for these patients and determine offload/transfer plan if needed
Plan Coordination and Rehearsal	
<input type="checkbox"/>	Rehearse the disaster plan for surgical surge and review outcomes to optimize plan execution