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Development of an Anesthesiology Disaster Response Plan



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KEYWORDS

- Disaster planning • Anesthesiology • Coronavirus • Earthquakes • Disasters
- COVID-19

KEY POINTS

- The COVID-19 pandemic has demonstrated the importance of thorough disaster planning for anesthesiologists.
- Work done in emergency medicine and prior experiences in disaster settings should inform disaster planning strategies for the future.
- Disasters put health care workers at risk for physical and emotional harm.

INTRODUCTION

The World Health Organization defines a disaster as “a serious disruption of the functioning of a community or a society causing widespread human, material, economic or environmental losses which exceed the ability of the affected community or society to cope using its own resources.”¹ Disasters can have a profound effect on the demand for health care and its delivery, as seen across a variety of events, including Hurricane Katrina; earthquakes in Bam, Iran, and in Haiti; and the response to regional or global pandemics, such as the Ebola outbreak in western Africa from 2014 to 2016 as well as the ongoing COVID-19 pandemic. Effectively caring for patients at all times requires disaster preparation. In the United States alone, the year 2020 has seen a significant number of disasters, including the COVID-19 pandemic, wildfires across the western United States, and a large number of devastating hurricanes and storms across the southeastern United States, all contributing to significant loss of life and property.

Managing the aftermath of these events has required coordinated, strong responses from the health care industry. Because many disasters give no warning, successfully managing the health care implications of a disaster requires the preemptive

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development of a thorough, comprehensive strategy to effectively use health care personnel, facilities, and equipment. Whether it is an isolated event, such as a flood, or a prolonged affair, such as the COVID-19 pandemic, disasters frequently are dynamic, and response plans must be adaptable to rapidly changing circumstances. In the case of a health care crisis, these may include changes in staffing models, geographic patient locations, personal protective equipment, and numerous other elements.

This article discusses different types of disasters, including those that cause disruptions to physical structures and ones that do not. The specific roles of anesthesiologists during a disaster response and the various ways that anesthesiologists can contribute individually and in collaboration with other health care providers are considered. A robust literature for disaster planning from different specialties and government agencies already exists, so the contributions from other medical fields, including trauma surgery and emergency medicine, are reviewed. Disaster planning and several examples of disaster plans, which are documents and strategies that guide the acquisition of resources and allow health systems to execute adaptive and flexible plans once a disaster does occur, are discussed. Special attention is paid to the role of anesthesiologists in the creation and implementation of a disaster response plan. The effects that responding to a disaster can have on medical personnel also are considered. Disasters can have a direct impact on health care providers (physical injuries) or secondary impacts, such as through financial loss or psychological trauma. The various types of injuries, both physical and psychological, and their impact on health care workers, are considered.

DISCUSSION

Types of Disasters

There are many ways to classify disasters, but, in terms of their impact on health care, one way to distinguish them is by considering whether or not they have caused physical damage to health care facilities and the infrastructure that supports them. In cases of many mass casualty events, ranging from transportation accidents to mass shootings, the stress on the health care system comes from the need to triage patients and to effectively manage a surge in demand from injured patients. In response to these disasters, hospitals in the United States largely use the Hospital Incident Command System, which outlines a command structure and responsibilities in the response to a mass casualty incident (Fig. 1).² A major consideration in these types of mass casualty events involves adequate marshalling of resources and triaging of patients.

Events, such as earthquakes, hurricanes, and other natural disasters, may cause an even more challenging situation, whereby health care infrastructure and the physical hospital may be damaged, thereby limiting the actual ability of physicians and the health care team to actually provide care. For example, during the earthquake in Haiti in 2010, 8 hospitals were destroyed and 22 seriously damaged in the 3 regions most affected by the earthquake.³ The destruction of these hospitals significantly limited their abilities to provide immediate care to patients. Similarly, following the fertilizer explosion in Beirut in 2020, several hospitals were destroyed or damaged, whereby they could not treat patients.

After a significant event, a damaged hospital may be unable to respond fully. Crucial supplies like water, oxygen, and electricity can be disrupted, as was the case where water supplies were disrupted at the main prefecture hospital following the Fukushima, Japan, earthquake in 2011. After that event roads were severely damaged, limiting the abilities of staff to commute to the hospital and transport patients or for

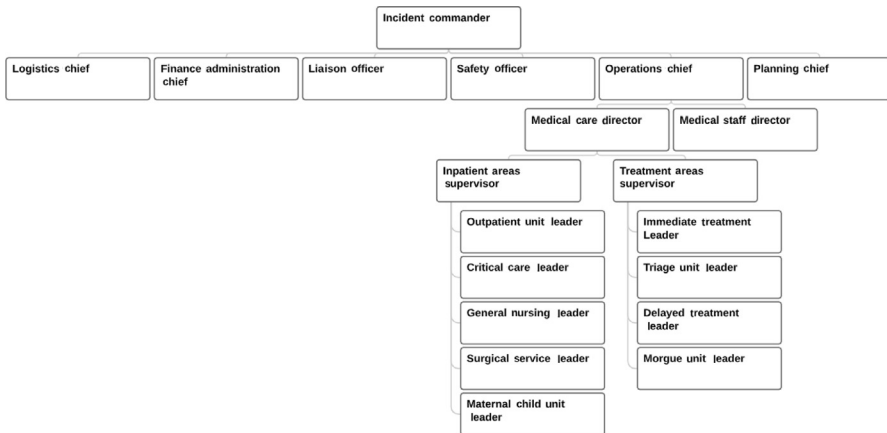


Fig. 1. Hospital incident command system. (Modified from Born CT, Briggs SM, Ciraulo DL, Frykberg ER, Hammond JS, et al. Disasters and Mass Casualties: I. General Principles of Response and Management, *J Am Acad Orthop Surg*, 2007.)

the health care system to move patients between facilities.⁴ In the perioperative environment, critical resources like lighting, oxygen, and water often are taken for granted, but during a disaster these basic utilities can be disrupted, necessitating the transfer of patients to other facilities. Comprehensive disaster plans must anticipate these challenges and outline plans to mitigate the effects of loss of critical infrastructure and mechanisms to transfer patients to intact health care facilities when needed.

The Role of Anesthesiologists During a Disaster

Anesthesiologists are uniquely qualified to participate in a disaster response (Fig. 2). Research has shown that after an earthquake approximately half of all injuries involve fractures of some kind, many needing operative interventions.⁵ Anesthesiologists have a variety of modalities for providing anesthesia, some of which are well-suited to disaster or limited-resource settings. Nevertheless, the anesthesia delivered under disaster conditions will likely vary significantly from the anesthetics typically provided under stable conditions.

Understanding the scope of anesthesia provided in low-income and middle-income countries helps illustrate the types of anesthesia that may be safely provided under disaster conditions. In a review of 467 hospitals in low-income and middle-income countries, only 50% had reliable electricity, defined as fewer than 2 outages per week. Only 61% of hospitals reported having a reliable oxygen source in the operating rooms, and 51% of hospitals had a functioning pulse oximeter. Similarly, the types of anesthetics delivered varied significantly from anesthesia typically provided in high-income countries. Ketamine was reported by 73% of hospitals as the most frequently used anesthetic because of its ability to preserve hemodynamic stability and allow patients to breathe spontaneously, without the need for supplementary oxygen.⁶

Similarly, in the setting of a disaster or an armed conflict, the types of anesthetics delivered vary significantly from those provided in stable, resource-rich environments. In a disaster setting, resources like oxygen and power may be unavailable. A review of Médecins Sans Frontières (MSF) anesthetics showed that in their response to the 2010 earthquake in Haiti, 66% of anesthetics were general (nonintubated), 21% were spinal, 4% other, and only 9% general anesthesia with endotracheal intubation. In MSF's response to the civil war in Syria, 48% of anesthetics were general

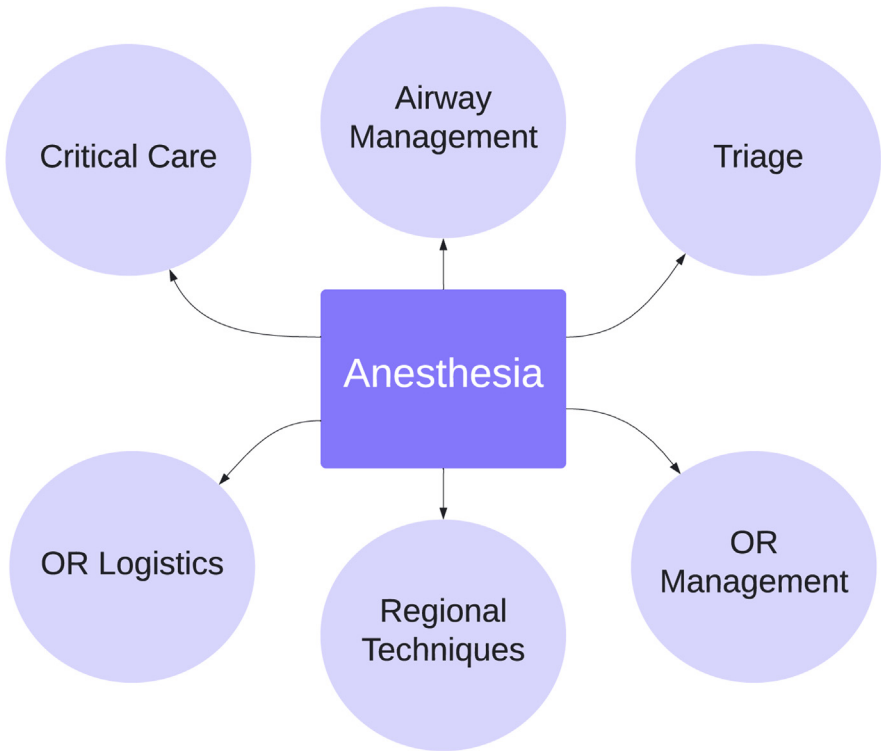


Fig. 2. Anesthesiologists are versatile members of a disaster response team and can participate in numerous clinical and leadership capacities. OR, operating room.

(nonintubated), 28% were spinal, and 18% were general anesthesia with endotracheal intubation.⁷ This stands in marked contrast to many developed countries, for example, the United Kingdom, where the National Health Service report that 77% of their anesthetics were general (44.6% of patients received an endotracheal tube and 51.3% received a supraglottic airway device).⁸ During a disaster, anesthesiologists most likely do not have the same equipment that is routinely available, and the anesthesia disaster response plan must reflect this. Stockpiles of drugs, such as ketamine and local anesthetics, more suited to providing anesthesia in disaster settings, should be maintained.

Regional anesthesia has many potential benefits in disaster or resource-limited settings, partially due to its ability to maintain a patient's spontaneous ventilation. Prior studies have demonstrated that regional anesthesia is a rapid and safe method for reducing pain caused by limb trauma. Therefore, it may have a role in improving pain management during the initial response to a major earthquake or other disaster where traumatic injuries are common. Unfortunately, no randomized studies exist examining the effectiveness, safety, or acceptability of regional anesthesia following a major earthquake.⁹

Anesthesiologists in a disaster setting can expect to be limited in terms of the drugs, resources, and logistical systems that they may be accustomed too, like oxygen or power, as discussed previously. Personnel shortages, however, such as not having enough anesthesiologists, may act as a bottleneck in the acute phase of a disaster

response. This may be evident particularly in disasters with many associated traumatic injuries that require surgical and, therefore, anesthesia services.

Anesthesiologists' training is broad, and their skill sets are widely applicable. By virtue of their extensive training in resuscitation and management of critically ill patients, anesthesiologists are competent to perform many procedures and to manage patients requiring intensive care. As airway specialists, anesthesiologists can be called to assist in intubations, placement of supraglottic airways, or obtaining vascular access. In events requiring rapid patient triage, anesthesiologists can assess a patient's degrees of hemodynamic instability and need for urgent intervention. Anesthesiologists often manage patient flow through the perioperative setting and may continue to oversee patient placement and transition between the preoperative, intraoperative, and postoperative phases.

Anesthesiologists involved with disaster management should leverage the already abundant literature and resources available from other medical specialties. Emergency medicine providers, in particular, have published extensive literature about disaster response and triage. Currently, the American College of Emergency Physicians lists 23 dedicated fellowship programs in disaster medicine.¹⁰ A multidisciplinary approach to disaster management planning is beneficial for all parties and may lead to more efficient and effective strategies for the hospital as a whole to approach a disaster.

In the case of COVID-19, the anesthesiologists' role during the pandemic included intraoperative as well as intensive care unit care, working in conjunction with practitioners from multiple medical specialties. A drop in surgical volume allowed anesthesia providers to be tasked to other jobs, such as critical care and respiratory therapy. Surgical volume fell during the pandemic across many specialties and may have created a backlog of cases for years to come. For example, a large number of spinal surgeries were delayed.¹¹

Disaster Planning

Disasters are defined by the Federal Emergency Management Agency as having 4 phases: mitigation, preparedness, response, and recovery.¹² Mitigation involves attempting to diminish the possibility or severity of a problem before it begins. These efforts can exist either on a local level, such as ensuring that building codes are enforced and adequate to withstand natural disasters like earthquakes, or on a global scale, by advocating for decreased carbon emissions in order to reduce the risk of catastrophic wildfires or hurricanes.

Governmental organizations are likely to have a significant role in outlining mitigation efforts, but anesthesiologists always will be able to advocate for this kind of action. Preparedness involves planning, training, and educational activities to respond to events that cannot be mitigated. Such activities may include creating and maintaining a stockpile of important medications, developing phone trees and chains of command for eventual disasters, or simulations. Once a disaster occurs, the 2 following phases are response and recovery. The response phase begins immediately after the event and involves the active response to a disaster. The final phase is recovery. During recovery, restoration efforts occur simultaneously with regular, predisaster types of operations and activities. The recovery period from a disaster can be prolonged and can lead to significant stress for those suffering from and responding to a disaster. Additionally, during all of these phases, patients continue to need health care, so a health care system must be able to provide medical care while also dealing with the acute injuries to patients harmed by the disaster.

Since September 11, 2001, there has been keen interest in improving disaster planning. Some regulatory bodies require that hospitals maintain up-to-date disaster plans. There also have been increased regulatory requirements for hospitals and other health care facilities to develop their own disaster planning and carry out regular testing and drills. Significant work into disaster planning already has been accomplished throughout the medical field, and a wide variety of disaster plans are available as templates from different institutions. This can be seen within both societies for anesthesiology and other academic societies in medicine. For example, the American Society of Anesthesiologists provides a checklist for mass casualty events. The American College of Emergency Physicians has put forward a hospital checklist (originally created as a survey for hospitals) that discusses many of the useful elements for a disaster plan and includes concrete questions about the preparedness and facilities available that may be used in the event of a disaster. By completing this checklist, a facility may learn about its own disaster preparedness and potential areas for improvement.¹³

Disaster plans vary between hospitals based on projected patient volumes, types of patients, and available resources. One important aspect of disaster planning involves the shifting of personnel and materials between different hospitals or health care facilities. In a disaster, different facilities may be affected at different times. Although 1 hospital may be overwhelmed, capacity may exist within the health system as a whole. This applies not only to physical bed availability but also to drug and personnel resources. This was seen during the COVID-19 pandemic, as many hospitals reported shortages of essential drugs, such as propofol, midazolam, fentanyl, rocuronium, and cisatracurium—all critical medications in the anesthesia and intensive care environments.¹⁴ Effective disaster planning requires a centralized system for assessing the supply needs of affected hospitals and redistributing resources as needed.

Disaster simulation can be a valuable tool in preparing for an actual event. A simulation held by the Italian Society of Anesthesia, Analgesia, Resuscitation and Intensive Care demonstrated that a multiday disaster simulation was deemed “an invaluable experience for the anesthesiology trainees, providing them with the skill set to understand the fundamental principles of a mass-casualty response.”¹⁵ Practically, simulation benefits participants by improving their abilities to manage disasters.¹⁶ Simulation of responses to a mass casualty incident has been shown to improve the ability of practitioners to triage patients correctly.¹⁷ By simulating disaster scenarios, hospitals will be able to perform more effectively and anticipate the potential difficulties in the event of a true calamity.

Preventing Harm to Health Care Workers

In responding to a disaster, health care workers may suffer physical or psychological harm. Disaster situations may create political instability where hospitals and health care facilities can either be targeted, as occurred in both Syria and Yemen, or fall victim to violence. A report by Physicians for Human Rights noted that during 2019, in countries where the organization worked, there were at least 1200 incidents of violence against health care workers, with at least 150 medical workers killed.¹⁸ A concrete plan for ensuring the security of health care facilities should be a provision of any disaster plan.

The COVID-19 pandemic clearly has shown the risk health care workers assume when working in a disaster environment. As of October 19, 2020, according to the Centers for Disease Control and Prevention, more than 180,000 health care workers have been infected with the novel coronavirus, resulting in 757 deaths.¹⁹ At the beginning of the pandemic, concern existed about supplies of personal protective

equipment, with many hospitals requiring reuse of masks. Extensive research into methods for conserving, disinfecting, and reusing such equipment is ongoing. Health care workers are at increased risk of contracting COVID-19, in particular those with inadequate personal protective equipment.²⁰

The danger posed to health care workers participating in disaster relief extends beyond the immediate risk to life and limb to more insidious psychological stressors. At baseline, health care workers are at an elevated risk of experiencing symptoms of anxiety, depression, or burnout. The prevalence of depression, or depressive symptoms, among resident physicians has been estimated to be as high as 28.8%.²¹ Compared with working US adults, US physicians were more likely to have symptoms of burnout (37.9% vs 27.8%, respectively) and to be dissatisfied with work-life balance (40.2% vs 23.2%, respectively).²² Physicians also have been shown to be at an increased risk of suicide compared with the general population.²³ Prior disasters have been shown to negatively affect the mental health of caregivers. A study comparing negative psychological outcomes among workers who took care of patients with severe acute respiratory syndrome (SARS) in Toronto, Canada, demonstrated significantly higher levels of burnout, psychological distress, and posttraumatic stress than their peers at hospitals that did not accept such patients.²⁴ It is clear that those who respond to a disaster are at elevated risk for developing significant problems, both psychological and physical.²⁵

Similar issues have been seen in health care workers during the COVID-19 pandemic. A survey of health care workers in China during the early phases of the pandemic demonstrated high levels of depression, stress, anxiety, distress, anger, fear, insomnia, and posttraumatic stress disorder, with the greatest risk factor for distress being a frontline or emergency health care worker.^{26,27} Although health care systems have faced similar types of challenges before, data suggest that the rates of distress among health care workers caring for patients with COVID-19 surpass those reported after Ebola, SARS, and other pandemics.²⁷

Interventions exist to mitigate the negative impact on the mental health of people who are caring for patients during a pandemic.²⁸ A comprehensive disaster plan should include strategies to support providers who suffer from posttraumatic stress disorder or other psychological effects due to providing care for patients during times of disaster.

SUMMARY

An effective response to a disaster requires the preemptive creation and practice of a disaster response plan. Anesthesiologists are well suited to play a central role in the drafting and implementation of such plans, at both the hospital and regional levels. Disaster planning already is required by many health care systems, but by actively engaging with disaster response teams in the hospitals and focusing on ways to collaborate with other departments, anesthesiologists can have a positive impact on care and patient outcomes during critical times.

CLINICS CARE POINTS

- Anesthesiologists should collaborate with hospital leadership during times of crisis to enact disaster response plans and optimize patient care.
- Anesthesiologists should draw from existing work and expertise in emergency medicine, prior disaster responses, and published protocols when creating a disaster response plan.

- Health care workers responding to disasters are at high risk for physical and psychological trauma. Although evidence-based best practices do not yet exist, preventing and ameliorating this harm are crucial.
- When providing clinical care in a disaster setting, anesthesiologists should consider regional and spinal anesthesia, which facilitates spontaneous ventilation.

DISCLOSURE

The authors have nothing to disclose.

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