



# Incorporating mass casualty incidents training in surgical education program

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## Introduction

Mass Casualty Incidents (MCIs) represent events where the number of patients arriving in a short time period is too great for the capabilities of local resources to manage [1]. Examples of MCIs include natural disasters (floods, earthquakes, tornadoes), multi-vehicle collisions, explosions, structure fires, terrorist attacks, and other acts of violence. While data regarding the nationwide prevalence of MCIs is sparse, a study utilizing the 2010 National Emergency Medical Service(EMS) Database reported a total of 14,504 EMS

responses designated as MCIs representing 9913 unique incidents over a 1-year period [2]. In addition, deaths and injuries from mass shootings have increased from 11 in 2010 to 704 in 2017, according to data from the Mother Jones Project, and there were 315 natural disasters causing 11,804 deaths in 2018 alone [3, 4]. It is therefore reasonable to assume that hospital systems throughout the United States will continue to face MCIs in the future. Any event which generates a large number of patients over a short period of time can not only overwhelm the local healthcare system, but also disrupt the normal conduct of Graduate Medical Education (GME) programs. [5, 6]

Given the structure of hospital systems and postgraduate training programs, residents are likely to comprise an important component of the frontline response to an MCI [7]. For example, residents in New Orleans in 2005 were faced with managing patients independently following Hurricane Katrina, surgical residents responded to patients injured in the Boston Marathon bombing, and general surgery residents were called upon to treat multiply injured patients after a 2016 mass shooting in Orlando [6, 8, 9]. Involvement in caring for patients injured by an MCI can have a long-lasting impact on the healthcare team and healthcare infrastructure. While some of these effects resolve, such as the strain that multiple patients put on the healthcare workforce, the psychological impact on healthcare providers can persist long after the acute event. The intense pace of a surgical training program, combined with the hierarchical structure of the healthcare system makes residents particularly vulnerable to psychological distress that is unaddressed after an MCI. Up to 30% of residents, caring for patients after the Orlando nightclub shooting reported major stress, depression, and burnout 6 months after the event [10]. Despite the potential for profound effects on the residency training program and the mental health of involved residents, there is a scarcity of

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literature describing either pre-event training or post-event response strategies for surgery training programs.

## Current practices

There is some literature describing pre-event MCI training focused on preparing the healthcare team for the triage and technical skills required to manage many patients simultaneously. One such study described “an optimal MCI/disaster management plan should consider all four phases of the so-called disaster cycle: mitigation, planning, response, and recovery” [1]. The Eastern Association for the Surgery for Trauma Committee on Disaster Preparedness surveyed emergency medicine and general surgery residents regarding disaster preparedness, finding that both specialties lacked training and that a resident’s confidence in their abilities stemmed from previous experience with disaster. They also found that emergency residents felt more prepared than their general surgery counterparts [11]. Similarly, a study published in 2005 found that general surgery residents had significantly less training on disaster management than their anesthesia or emergency medicine colleagues [12]. One Emergency Medicine program director described his own struggle with how best to aide residents with the recovery phase following a Mount Sinai structure fire [13]. Given the paucity of literature detailing best practices for MCI preparation and recovery for surgical training programs, our aim is to summarize the current literature, and propose strategies for surgery residency programs to prepare for and recover from an MCI event.

## MCI training technical considerations

The importance of training for MCIs in the context of trauma systems is well established and includes teaching key skills such as patient triage, rapid assessment and transport, and organization of the trauma team with the ability to re-deploy providers efficiently [14]. Several non-surgical residency programs have implemented MCI training [14–16]. However, general surgery residency programs have lagged in integrating these training programs into their GME curriculum. Although a few programs have included some form of disaster plan or training [17–19], literature suggests that most general surgery residents are not well prepared to provide adequate care in the event of an MCI [11, 12]. To address this educational gap, several resources have now been developed, including the Terror and Disaster Surgical Care (TDSC) course. This course aims to provide training in advance of an MCI to improve the care rendered by the health care system to the injured patient [20]. The American College of Surgeons (ACS) provides courses and educational resources

on Advanced Trauma Life Support (ATLS) that provides a systemic approach to the care of the trauma patient [21], as well as a 1-day Disaster and Emergency Preparedness course intended for acute aid providers [22]. However, training on MCIs in those courses is limited [22]. Finally, the Association of Program Directors and ACS created a Surgery Resident Skills Curriculum that includes one module of teamwork in the trauma bay. [23].

## MCIs virtual training

The use of virtual tools for MCI training through reality simulation has shown positive results [24, 25]; prototypes that could be extrapolated for general surgery residents. The TDSC course, along with their tabletop simulation game, was created in 2017 with the purpose of providing training based on real-life mass casualty cases that allows healthcare workers to triage patients and allocate resources appropriately. By 2019, 20 courses had been implemented in several cities with 437 participants, the majority of whom rated the course as good or satisfactory [20]. A recent study concluded that training of emergency medicine residents in disaster triage with virtual reality (VR) provides an appropriate alternative that compares favorably to standardized patient drills [24]. Similar results have been shown for paramedicine students, nursing students, and pediatric care personnel [26–28]. Tele-simulation [29], VR [24, 28], and tabletop simulation games [25] provide an immersive experience of the aftermath of a mass casualty. These platforms offer consistent, repeatable, mobile, and on-demand training, as well as aid in the development of assessment protocols, performance standards, and triage capabilities, all of which determine the survival of the critically injured [24]. Training residents for varied scenarios allows them to better prepare for the less frequent, atypical, and sometimes extreme events and consequences of MCIs [24, 29]. The implementation of this type of learning for trainees allows healthcare systems to efficiently manage these situations, a proven necessity on both a national and international level. [29, 30].

As MCIs are increasing globally and affect healthcare systems worldwide, global preparation of all healthcare works, including administrative, technical, nursing, and medical personnel, remains a priority. A survey of major trauma centers in Australia, Canada, England, and New Zealand found a shortfall of surge capacity, human resources, and post-disaster recovery after MCIs [31]. An international survey during the World Society of Emergency Surgery conference in 2015 revealed that although half of the centers managed up to three MCIs in the last 5 years, only one-third of the responders participated in an MCI management course [32]. Therefore, hospitals should consider the use of video conferencing and webinars, particularly for remote, socially,

and economically disadvantaged locations, as the cost-effectiveness of virtual resources versus in-person simulation can facilitate implementation [24]. Continued neonatal resuscitation education through video and VR for healthcare workers in low-resource settings demonstrated important positive results [33]. Efforts to maintain education through virtual platforms during the COVID-19 pandemic have also proven valuable and applicable, including at-home hands-on surgical training [34]. These tactics allow simultaneous training of large groups, even in different countries [29], which could translate to a higher number of well-prepared individuals for when tragedy strikes.

### MCI psychological effects

A perceived disadvantage of using virtual reproduction, however, includes a lack of emotional demand, which leaves residents feeling unprepared for the overwhelming emotions that follow a MCI [26]. In-person training and simulation drills have also failed to include emotional and psychological guidance. Although previous training cannot fully prepare residents, familiarity with a standardized process facilitates making quick decisions and feeling comfortable while doing so [24]. Current surgical education resources already include online resources, such as digital articles and books, educational videos, podcasts, question-banks, and even social media. Social media offers an experience-based, real-time and interactive platform for education insights, advice, and support from healthcare providers around the world. This communication could be of particular importance and utility when a mass casualty happens. Therefore, the addition of such tools allows not only the formation of well-rounded general surgery residents but also serves as resources for understanding and maintaining their well-being through and after MCIs.

Furthermore, there is mounting evidence of the emotional and psychological toll exacted on healthcare providers involved in an MCI. Both resident and faculty well-being can be profoundly affected by such educational disrupters [9, 35, 36]. Many surgical residency programs incorporate wellness training in their curriculum, recognizing the role that personal wellness plays in reducing burnout. However, very few resources exist for addressing well-being and resiliency regarding MCIs. This would include pre-training in psychological health, resources to support healthcare providers during an MCI, as well as support after the event in addressing post-traumatic emotional stress. Equipping both residents and faculty to weather the “storms” of MCIs is a responsibility of all surgical departments, and is a key component to building resiliency, fostering wellness, and reducing burnout. Programs must ensure that their residents do not

themselves become victims of these tragedies and therefore provide the necessary support to prevent this from occurring.

### Discussion

It is evident that surgical literature about MCIs is sparse and additional research is necessary to better address preparation and recovery—but particularly strategies for recovery. Given the increase in MCIs, as evidenced by the rising number of mass shootings in particular, GME training programs should incorporate MCI training into their curriculum to address technical skills and the psychological effects of MCIs. [5, 37] Compared to other specialty programs, surgical trainees are not adequately trained in MCI response, nor are the psychological effects recognized or adequately addressed.<sup>11,12</sup> It is recognized that the COVID-19 pandemic presented many of the challenges experienced by those caring for patients during a MCI, including resource-constraints, workforce shortages, and profound emotional stress. However, we focus on MCIs as defined above in the following guidelines, as the recommendations for maintaining continuity of surgical training during a global pandemic is beyond the scope of this work. We therefore propose the following framework for developing MCI response curricula for surgical training programs:

1. Provide formal resident training in MCI skills including command center structure, triage, and teamwork. The ATLS course provides a basic framework that is readily available to surgical training programs. These skills could be further honed by use of MCI simulation incorporated into general surgery training program curricula.
2. Build contingency plans to support the surgical workforce (horizontal deployment) and individual residents (emergency preparedness funds) for when an MCI causes damage to infrastructure (homes/property) or takes residents out of the workforce due to needs at home or in the community. Horizontal deployment is an organizational strategy to utilize the existing workforce to perform duties that are outside of their usual job description, cross-training them in any necessary skills. Many programs designed such plans for horizontal deployment during the multiple peaks of the COVID-19 pandemic and these can be operationalized into a long-term strategy for addressing the infrequent MCI.
3. Partner with specialty-specific medical boards to accommodate the need for flexibility in training length, in case training is affected long-term by an MCI.
4. Establish methods for debriefing of healthcare providers after an MCI, to begin a discussion about the psychological effects. Operational debriefing is a routine and formal part of an organizational response to an MCI.

Critical Incident Stress Debriefing (CISD) is a formalized, structured method whereby a group of healthcare workers reviews the stressful experience. Mental health workers acknowledge it is an integral practice that may help survivors acquire an overall sense of meaning and a degree of closure. However, this does not take the place of formal mental health counseling, and follow-up and referral to mental health resources, if necessary, is fundamental.

5. Create a psychological support team to assist with identifying healthcare providers who may suffer long-term psychological effects, to provide counseling and support, and to address issues of burnout resulting from psychological strain.
6. Foster emotional resiliency by creating a culture of psychological support that continues long after an MCI.

While these proposals serve as a framework by which surgical training programs may begin to address the need for formal curricula around MCIs, much work remains to be done. Questions which remain unanswered involve domains of recovery, debriefing, posttraumatic stress disorder, and the long-term effects on the GME education structure after MCIs. Additionally, given the increasing frequency with which residents face MCIs, it may be beneficial for national societies to enter the dialogue, collaborate, and instruct best practices.

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## Declarations

**Conflict of interest** None to declare.

## References

1. Lomaglio L, Ansaloni L, Catena F, Sartelli M, Coccolini F. Mass Casualty Incident: Definitions and Current Reality. In: Kluger Y, Coccolini F, Catena F, Ansaloni L, eds. *WSES Handbook of Mass Casualties Incidents Management*. Hot Topics in Acute Care Surgery and Trauma. Springer International Publishing; 2020:1–10. [https://doi.org/10.1007/978-3-319-92345-1\\_1](https://doi.org/10.1007/978-3-319-92345-1_1)
2. Schenk E, Wijetunge G, Mann NC, Lerner EB, Longthorne A, Dawson D. Epidemiology of mass casualty incidents in the united states. *Prehosp Emerg Care*. 2014;18(3):408–16. <https://doi.org/10.3109/10903127.2014.882999>.
3. US Mass Shootings, 1982–2021: Data From Mother Jones' Investigation – Mother Jones. <https://www.motherjones.com/politics/2012/12/mass-shootings-mother-jones-full-data/>. Accessed 15 June 2021
4. Natural Disasters 2018 | Centre for Research on the Epidemiology of Disasters. <https://www.cred.be/natural-disasters-2018>. Accessed 26 Sept 2021
5. Smith CP, Cheatham ML, Safcsak K, et al. Injury characteristics of the Pulse Nightclub shooting: lessons for mass casualty incident preparation. *J Trauma Acute Care Surg*. 2020;88(3):372–8. <https://doi.org/10.1097/TA.0000000000002574>.
6. Griffies WS. Post-Katrina Stabilization of the LSU/Ochsner Psychiatry Residency Program: Caveats for Disaster Preparedness. *Acad Psychiatry*. 2009;33(5):418–22. <https://doi.org/10.1176/appi.ap.33.5.418>.
7. Lam CM, Murray MJ. The Multiple Casualty Scenario: Role of the Anesthesiologist. *Curr Anesthesiol Rep*. 2020;10(3):308–16. <https://doi.org/10.1007/s40140-020-00398-2>.
8. Schneidman D. Surgeons put planning, preparation, past experience to work in efforts to save Boston Marathon bombing victims. *Bull Am Coll Surg*. 2013;98(9):9–17.
9. Havron WS, Safcsak K, Corsa J, Loudon A, Cheatham ML. Psychological effect of a mass casualty event on general surgery residents. *J Surg Educ*. 2017;74(6):e74–80. <https://doi.org/10.1016/j.jsurg.2017.07.021>.
10. Russo RM, Galante JM, Holcomb JB, et al. Mass casualty events: what to do as the dust settles? *Trauma Surg Acute Care Open*. 2018;3(1):e000210. <https://doi.org/10.1136/tsaco-2018-000210>.
11. Dennis AJ, Brandt M-M, Steinberg J, et al. Are general surgeons behind the curve when it comes to disaster preparedness training? A survey of general surgery and emergency medicine trainees in the United States by the Eastern Association for the Surgery for Trauma Committee on Disaster Preparedness. *J Trauma Acute Care Surg*. 2012;73(3):612–7. <https://doi.org/10.1097/TA.0b013e318265c9d9>.
12. Galante JM, Jacoby RC, Anderson JT. Are surgical residents prepared for mass casualty incidents? *J Surg Res*. 2006;132(1):85–91. <https://doi.org/10.1016/j.jss.2005.07.031>.
13. Egan DJ. When a mass casualty is your own. *J Grad Med Educ*. 2018;9(6):775–6. <https://doi.org/10.4300/JGME-D-17-00429.1>.
14. Uddin SG, Barnett DJ, Parker CL, Links JM, Alexander M. Emergency preparedness: addressing a residency training gap. *Acad Med*. 2008;83(3):298–304. <https://doi.org/10.1097/ACM.0b013e3181637edc>.
15. Walker AD, Fusco N, Tsau J, Ganti L. Development of an interactive curriculum and trainee-specific preparedness plan for emergency medicine residents. *Int J Emerg Med*. 2020;13(1):37. <https://doi.org/10.1186/s12245-020-00295-9>.
16. Sarin RR, Biddinger P, Brown J, et al. Core Disaster Medicine Education (CDME) for Emergency Medicine Residents in the United States. *Prehosp Disaster med*. 2019;34(05):473–80. <https://doi.org/10.1017/S1049023X19004746>.
17. Surgery | Westside Regional Medical Center. <https://westsideregional.com/physicians/graduate-medical-education/surgery/>. Accessed 3 Sept 2021
18. Disaster Plan & Policy - Graduate Medical Education Consortium. <https://gme.wustl.edu/policies-procedures/disaster-plan-policy/>. Accessed Sept 26 2021
19. General Surgery Residency - Temple, TX | BSWHealth.med. <https://www.bswhealth.med/education/Pages/gme/temple/general-surgery-residency.aspx>. Accessed 3 Sept 2021
20. The Deployment, Disaster, Tactical Surgery Working Group of the German Trauma Society, Bieler D, Franke A, et al. Evaluation of the Terror and Disaster Surgical Care course. *Eur J Trauma Emerg Surg*. 2020;46(4):709–16. <https://doi.org/10.1007/s00068-020-01418-w>.
21. Advanced Trauma Life Support. American College of Surgeons. <http://www.facs.org/quality-programs/trauma/atls>. Accessed 3 Sept 2021
22. Disaster Management and Emergency Preparedness. American College of Surgeons. <http://www.facs.org/quality-programs/trauma/education/dmep>. Accessed 3 Sept 2021
23. ACS/APDS Surgery Resident Skills Curriculum - Phase 3 | American College of Surgeons | Online Learning. <https://learning.facs.org>.

- [org/content/acsapds-surgery-resident-skills-curriculum-phase-3#group-tabs-node-course-default1](https://doi.org/10.1007/s00068-020-01441-x). Accessed 3 Sept 2021
24. Andreatta PB, Maslowski E, Petty S, et al. Virtual reality triage training provides a viable solution for disaster-preparedness: virtual reality triage training and disaster-preparedness. *Acad Emerg Med*. 2010;17(8):870–6. <https://doi.org/10.1111/j.1553-2712.2010.00728.x>.
  25. The Deployment, Disaster, Tactical Surgery Working Group of the German Trauma Society, Achatz G, Friemert B, et al. Terror and disaster surgical care: training experienced trauma surgeons in decision making for a MASCAL situation with a tabletop simulation game. *Eur J Trauma Emerg Surg*. 2020;46(4):717–24. <https://doi.org/10.1007/s00068-020-01441-x>.
  26. Mills B, Dykstra P, Hansen S, et al. Virtual reality triage training can provide comparable simulation efficacy for paramedicine students compared to live simulation-based scenarios. *Prehosp Emerg Care*. 2020;24(4):525–36. <https://doi.org/10.1080/10903127.2019.1676345>.
  27. Wiese LK, Love T, Goodman R. Responding to a simulated disaster in the virtual or live classroom: is there a difference in BSN student learning? *Nurse Educ Pract*. 2021;55:103170. <https://doi.org/10.1016/j.nepr.2021.103170>.
  28. Lowe J, Peng C, Winstead-Derlega C, Curtis H. 360 virtual reality pediatric mass casualty incident: a cross sectional observational study of triage and out-of-hospital intervention accuracy at a national conference. *J Am Coll Emerg Phys Open*. 2020;1(5):974–80. <https://doi.org/10.1002/emp2.12214>.
  29. McCoy E, Alrabah R, Weichmann W, et al. Feasibility of tele-simulation and google glass for mass casualty triage education and training. *WestJEM*. 2019;20(3):512–9. <https://doi.org/10.5811/westjem.2019.3.40805>.
  30. Pucher PH, Batrick N, Taylor D, Chaudery M, Cohen D, Darzi A. Virtual-world hospital simulation for real-world disaster response: Design and validation of a virtual reality simulator for mass casualty incident management. *J Trauma Acute Care Surg*. 2014;77(2):315–21. <https://doi.org/10.1097/TA.0000000000000308>.
  31. Gabbe BJ, Veitch W, Curtis K, et al. Survey of major trauma centre preparedness for mass casualty incidents in Australia, Canada, England and New Zealand. *EClinicalMedicine*. 2020;21:100322. <https://doi.org/10.1016/j.eclinm.2020.100322>.
  32. Ben-Ishay O, Mitaritunno M, Catena F, Sartelli M, Ansaloni L, Kluger Y. Mass casualty incidents - time to engage. *World J Emerg Surg*. 2016;11(1):8. <https://doi.org/10.1186/s13017-016-0064-7>.
  33. Umoren R, Bucher S, Hippe DS, et al. eHBB: a randomised controlled trial of virtual reality or video for neonatal resuscitation refresher training in healthcare workers in resource-scarce settings. *BMJ Open*. 2021;11(8):e048506. <https://doi.org/10.1136/bmjopen-2020-048506>.
  34. Greenberg JA, Schwarz E, Paige J, Dort J, Bachman S. At-home hands-on surgical training during COVID19: proof of concept using a virtual telementoring platform. *Surg Endosc*. 2021;35(5):1963–9. <https://doi.org/10.1007/s00464-021-08470-6>.
  35. Schulte EE, Bernstein CA, Cabana MD. Addressing Faculty Emotional Responses during the Coronavirus 2019 Pandemic. *J Pediatr*. 2020;222:13–4. <https://doi.org/10.1016/j.jpeds.2020.04.057>.
  36. Mills LD, Mills TJ. Symptoms of post-traumatic stress disorder among emergency medicine residents. *J Emerg Med*. 2005;28(1):1–4. <https://doi.org/10.1016/j.jemermed.2004.05.009>.
  37. Tobert D, von Keudell A, Rodriguez EK. Lessons From the Boston Marathon Bombing: An Orthopaedic Perspective on Preparing for High-Volume Trauma in an Urban Academic Center. *J Orthop Trauma*. 2015;29(Supplement 10):S7–10. <https://doi.org/10.1097/BOT.0000000000000413>.