Disaster Medicine Training in Family Medicine: A Review of the Evidence

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When disasters strike, local physicians are at the front lines of the response in their community. Curriculum guidelines have been developed to aid in preparation of family medicine residents to fulfill this role. Disaster responsiveness has recently been added to the Residency Review Committee Program Requirements in Community Medicine with little family medicine literature support. In this article, the evidence in support of disaster training in a variety of settings is reviewed. Published evidence of improved educational or patient-oriented outcomes as a result of disaster training in general, or of specific educational modalities, is weak. As disaster preparedness and disaster training continue to be implemented, the authors call for increased outcome-based research in disaster response training.

(Fam Med 2011;43(1):13-20.)

Family physicians play a critical role in responding to the medical needs arising from both natural and man-made disasters (Table 1). When disasters strike, they are at the front lines of the response in their communities.[1] The reliance on local physicians in the early days of disasters was illustrated in the recent Haiti earthquake. Knowledge of how to respond to disasters and coordinate that response with other agencies and organizations is essential.

The literature suggests that physicians as a group are unprepared for this role,[2-5] due to inadequate training[5-7] and limited experience. Most professionals will not have real disaster response experience prior to being called to respond. Though there is limited evidence on the effectiveness of disaster training,[8-10] such activities make intuitive sense and have been discussed for decades.[11-14] A call for expanding disaster medicine training was published in 1995,[11] yet standardization of this training is lacking.[7,10] Paradoxically, one study even suggests that disaster medicine education has decreased since 9/11.[15] The Accreditation Council for Graduate Medical Education's (ACGME) Residency Review Committee (RRC) revised common program requirements for family medicine require that "community medicine…curriculum should include…disaster responsiveness." So how do residency programs teach this new competency?

In 2003, the American Academy of Family Physicians, in collaboration with the Society of Teachers of Family Medicine, the Association of Departments of Family Medicine, and the Association of Family Medicine Residency Directors published a curriculum guideline on this topic. The subject of major revision in 2008,[16] an update is due for release in 2010. In this document, they call for the competencies shown in Table 2. Focused on the provision of urgent clinical care, some emergency medicine (eg, rescue and recovery techniques) and public health (eg, provision of water and sanitation) topics are outside the scope of the current guidelines.[17]

These competencies are consensus based[18] rather than evidence based. Limited data is available regarding the effect of proficiency in any of these areas on patient-oriented outcomes during disasters[19,20] and is contradictory in some cases—notably in the area of critical incident stress management.[21-28] Most research has been done with other learners than those in family medicine. In spite of the lack of evidence of efficacy, disaster preparedness is being implemented on a large scale. Lack of evidence of benefit is not synonymous with evidence of lack of benefit; research into the most effective approach to disaster preparedness is ongoing.

In this paper, we summarize the evidence in the literature supporting the efficacy of training for each of the competencies set forth in the Curriculum Guidelines. It is not our intent here to debate or rewrite the

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Table 1: Types of Disasters

Natural	Accidents	Intentional Acts of Violence
Meteorological (eg, hurricane, blizzard, heat/cold wave)	*Transportation* (eg, airplane, bus, train)	*Bombing*
Geological (eg, earthquake, volcanic eruption, flood)	*Structural* (eg, building or bridge collapse)	*Shooting*
Other (eg, fire, explosion, disease outbreak)	*Nuclear* (eg, radioactive waste release, meltdown)	*Nuclear/radiological* (eg, fissile bomb, "dirty" bomb, or other types of radiological poisoning)
	Agricultural or industrial (eg, hazardous chemical or biological spill or other exposure, fire, explosion)	*Biological agent:* • Bacteria (eg, anthrax, cholera, plague, tularemia Q fever) • Virus (eg, smallpox, Venezuelan equine encephalitis, viral hemorrhagic fevers) • Toxin (eg, botulinum, staphylococcal enterotoxin B)
		Chemical agent: • Nerve agent (eg, sarin, insecticides, pesticides) • Blister agent (eg, lewisite, mustard) • Precursors (eg, chlorosoman, chlorosarin) • Choking agents (eg, phosgene, chlorine) • Blood agents (eg, hydrogen cyanide, cyanogen chloride) • Riot control agents (eg, tearing agents, vomiting agents)

Although intentional acts of violence may involve similar events and affect a similar number of victims, they may be sub-classified as either criminal acts (in which the focus of the act is the victim) or acts of terrorism (where the focus of the act is society).

established Guidelines but to review the available evidence for training in these competencies. Following a description of our methods, the results for training in each competency will be presented in the order in which they appear in the Guidelines.

Methods

We reviewed the literature for evidence of the efficacy of training in disaster medicine in general and in the specific competencies. Evidence was identified via electronic search of medical and educational research literature databases: PubMed, ERIC, and ERC. Search terms included "disaster medicine training," "safety training," "ICS training," "incident command system training," "NIMS training," "national incident management system training," "disaster triage training," "mass-casualty training," "psychological first aid training," "critical incident stress training," and "education" substituted for "training" in all the above searches. In addition to the "safety training" search results, 695 separate papers were identified. Excluding those that presented training programs without reference to outcomes of any sort, those not addressing disaster situations, and commentary pieces, a total of 37 remained that presented data on effectiveness of training, including nine systematic reviews. Only five studies addressed physicians specifically; the remainder had a health care team focus. Evidence of effectiveness of training was limited

Table 2: Recommended Disaster Medicine Curriculum Guidelines for Family Medicine Residents

Medical Knowledge	Patient Care	Systems-based Practice
A basic understanding of the primary importance of safety in disaster responses, including personal protective equipment, decontamination, and site security.	An understanding of the principles of triage and the ability to effectively perform triage in a disaster setting.	A basic knowledge of the National Incident Management System (NIMS) and the Incident Command System (ICS), including its application to the planning, coordination, and execution of disaster responses.
	The clinical competence to provide effective care in a setting of extremely limited resources.	An understanding of psychological first aid and caring for responders

primarily to changes in knowledge and attitudes, with occasional measurement of skills or performance indicators.[29] We found that reports of actual benefit in patient-oriented outcomes attributable to improved training in disaster medicine competencies are virtually nonexistent. Among the 17,757 references found by our search for safety training and education, we found only two studies of the effectiveness of safety training for disaster responders.

General Disaster Medicine Training

Several formats of disaster training have been used, including didactic-lecture sessions, simulated disaster drills, tabletop exercises, and computer simulation. These have demonstrated measurable educational effect,[30-33] though the effect of this training on patient-oriented outcomes in actual disasters has not been studied. In 2004, the Agency for Healthcare Research and Quality (AHRQ) released an Evidence Report[34] evaluating the literature on the effectiveness of these modalities in preparing hospital staff, including physicians, for mass casualty incidents. Extracting and synthesizing data from 21 studies, it found adequate literature to suggest that simulated drills were effective, with the caveat that methodological weaknesses limit the strength of these conclusions. Outcomes measured reflected process-oriented and knowledge-oriented, rather than patient-oriented, outcomes. This translates to SORT=C.[35] They found insufficient evidence to comment on the effectiveness of computer simulations or tabletop exercises. In the studies the authors cited, measures included debriefings, interviews, self-assessments, chart reviews of simulated patients, or observer evaluations; none included real-world disaster outcomes.

A 2008 systematic review of literature subsequent to 2000 on the effectiveness of disaster training for health care workers found insufficient evidence to determine if training interventions are effective in improving disaster knowledge and skills, based on the nine studies that they identified.[8] The same year, a small, single institution, prospective, randomized, controlled, longitudinal study was reported.[30] Eighty-five subjects were enrolled in an investigation to evaluate (1) didactic lectures and (2) lecture/tabletop-exercise combinations in training for management of pediatric disaster victims. Both interventions increased participants' scores on objective multiple-choice tests, but those who completed the combination form of training reported a greater subjective sense of confidence in their knowledge, which persisted for at least 6 months following the training. Another study reported that a 2-hour, awareness-level course including both didactic and experiential learning was evaluated using written pretests and posttests and showed increased knowledge and moderate retention of pediatric disaster medicine topics among residents.[36]

Computer-based and other simulations have demonstrated improved acquisition of knowledge,[37] though there is some evidence to suggest such methods may not be better than traditional approaches in the acquisition of clinical skills.[38] Unannounced, realistic full-dress-and-moulage mock disasters may be superior to either didactic or other simulation training.[14] Disaster training of health professionals needs to be subjected to scientific rigor to ensure the most effective methods are used.[9,39,40]

NIMS/ICS Training

Since 9/11, there has been an increased focus on standardization of disaster response in an effort to speed the implementation of relief and decrease the iatrogenic component of the chaos inherent to such situations. In the United States, the National Incident Management System (NIMS) has been developed in an attempt to facilitate a timely, coordinated, and effective response to disasters of any magnitude. NIMS training has been mandated for all response agencies, including health care facilities. Introductory courses are available online on the Federal Emergency Management Agency (FEMA) Web site (Table 3). Classroom and audiovisual formats are available in addition to the computerized version, with upper-level courses offered exclusively in the classroom format. Though mandated, evidence in the literature of the effectiveness of this training on disaster-relevant outcomes is limited, with some authors emphasizing that computerized training doesn't translate into field competence.[41]

Safety Training

Responders will often be called to work in unstable or unsafe environments. Yet there is limited literature on the efficacy of safety training in decreasing injuries to responders. Substantially more data are available regarding safety programs in industry and construction settings and are reasonable proxies for disaster settings. A challenge to evaluating the efficacy of safety training is that patient-oriented outcomes (eg, reduced frequency or severity of injury) are not often reported, and when they are, confounding variables are not taken into account.[42] Instead, surrogate measures such as attitude or knowledge are used.

A variety of methods have been used in safety training, including didactic lectures, a variety of simulations, and hands-on exercises. Safety instruction has been implemented both before the event and as "just-in-time" on-scene training.[43] Some authors recommend targeting content to specific subgroups of learners rather than aiming for generality across larger groups,[44] while others find the diversity present in a larger group offers advantages and reflects the multidisciplinary situation of real-world safety issues.[45] Convincing evidence for superiority of large diverse versus small homogeneous groups for safety training remains an open area for research.

Table 3: Online Resources for Training and Practice of Disaster Medicine

Training Resources
• Advanced Trauma Life Support: www.facs.org/trauma/atls/index.html
• American Heart Association (advanced cardiac life support [ACLS] course): www.americanheart.org/presenter.jhtml?identifier= 3011972
• American Heart Association (pediatric advanced life support [PALS] course): www.americanheart.org/presenter.jhtml?identifier=3012001
• Comprehensive Advanced Life Support (CALS): www.calsprogram.org/
• Federal Emergency Management Agency (NIMS, ICS, and other online training): www.fema.gov/about/training/index.shtm
• International Critical Incident Stress Foundation (management information and training): www.icisf.org/
• JumpSTART Pediatric Triage Tool: www.jumpstarttriage.com/
• National Disaster Life Support Foundation: www.bdls.com/
General Resources
• American Academy of Family Physicians: www.aafp.org
• American Hospital Association (AHA) Emergency Readiness: www.hospitalconnect.com/aha/key_issues/disaster_readiness/
• American Medical Association: www.ama-assn.org
• Association of State and Territorial Health Officials: www.astho.org
• Centers for Disease Control and Prevention: www.cdc.gov
• Centers for Disease Control and Prevention Emergency Preparedness and Response: www.bt.cdc.gov
• Federal Emergency Management Agency: www.fema.gov
• Johns Hopkins Office of Critical Event Preparedness and Response (CEPAR): www.hopkins-cepar.org/
• US Army Medical Research Institute of Infectious Diseases: www.usamriid.army.mil/index.htm
• US Department of Health and Human Services National Disaster Medical System (NDMS): www.hhs.gov/aspr/opeo/ndms/index.html

Surveys of emergency responders and hazardous materials workers provide self-reported evidence for the value of safety training.[46,47] A sizeable proportion of those answering the surveys reported the occurrence of incidences following their training, for which they found the training adequately prepared them.

Studies using formal assessment tools following completion of a safety program demonstrated that training resulted in knowledge and attitude improvement that was still measurable at 3 months.[48] A comparison of different versions of computer-based training found there were no significant differences between training groups on multiple-choice test scores, but in measures of higher learning ("transfer"), differences were seen.[49] Studies looking for a correlation between safety knowledge and injury experience found no relationship,[42] suggesting that while training may lead to increased knowledge, this does not translate to safer practices. While some have reported no relationship between safety climate and perceived risk, attitude toward risk, or training,[50] others have prospectively found a 16%–25% reduction in injuries following implementation of safety programs.[51]

Triage Training

Rapidly identifying the level of acuity, and allocating the available resources to maximize benefit to the population of disaster victims, is the essence of disaster triage. There are a variety of triage systems, covering both the general population and specific subpopulations such as geriatric or pediatric victims.[52-57] These systems were developed by consensus; there is limited evidence for their efficacy and even less to suggest the superiority of one strategy over another.[20,58] Nevertheless, some method of prioritizing care must be adopted, and proficiency in triage is important.

Studies indicate that triage-specific training improves performance.[56] Manikin-based simulation has demonstrated efficacy in cross-cultural triage training in the South Pacific.[59] Knowledge and performance scores, speed, and self-efficiency have also been shown to improve via utilization of virtual reality simulation.[60] Some exercises incorporate patient outcome simulations[61] and may allow comparison of different triage training methodologies.

The majority of individuals presenting for medical attention following disasters have chronic and low acuity conditions.[62] As a result, disaster response more often involves a high volume, low acuity patient load rather than a mass-casualty incident. The most widely promoted triage systems fail to address this

situation; additional triage strategies and training need to be developed to facilitate appropriate allocation of available resources for the care of these patients.

Training for Clinical Competence

A study attempting to define clinical competencies needed for disaster medicine surveyed physicians following a disaster response. Few reported a knowledge deficit. Instead, the transition from their usual environment to the practice in a disaster setting seemed to be the main challenge.[63] Authors concluded that the clinical and procedural skills already incorporated into medical training are an adequate basis for disaster medicine. This conclusion may not be universally applicable: the study population was a convenience sampling of attendees at a disaster response conference, who presumably would have acquired knowledge outside of their usual training through activities such as attending disaster medicine conferences.

There is a veritable alphabet soup of short courses in life support: ACLS, ATLS, PALS, CALS, ALSO, etc. In addition, there are specific disaster courses: ADMR (Advanced Disaster Medical Response), CDLS, BDLS, and ADLS (Core, Basic, and Advanced Disaster Life Support, respectively).[64] The former are useful to lay the foundation for clinical competence, the latter for extra-clinical aspects of disaster medicine. There is evidence in the literature that advanced life support training does improve clinical skills,[65] including those used in disaster settings,[66] though retention may diminish over time.[67] Initial learning and retention appear to be increased for those with some clinical experience when compared to those who complete the course prior to their clinical training.[68] The efficacy of the training varies with its format: video and face-to-face instruction result in comparable knowledge; both are superior to online computerized delivery of the educational material.[69,70] The disaster life support courses may help ease the transition to practice in disaster settings by familiarizing the participant with characteristics of these settings and an all-hazard response.[71] With certification courses, it is important to avoid "merit badge" mentality; merely completing the course does not imply competence, and absence of the wallet card does not imply lack of skills. These courses are training devices, not standards of care.[72]

Disasters often disproportionately impact at-risk subpopulations, including pediatric, obstetric, elderly, disabled, and psychiatric patients.[73-76] Family medicine training emphasizes specific care for all of these groups. By supplementing comprehensive family medicine training with disaster-specific topics, including chemical, biological, radiological, and nuclear (CBRN) incident response, the family physician can prepare for what they may encounter. In addition to formal courses, CBRN training resources include books and other printed materials,[77-83] journal articles,[84-91] and audiovisual materials.[92] There is insufficient evidence for the efficacy of self-study for disaster medicine training.

Rural and global health experiences during medical training are reported to improve clinical skills.[93-97] Experience in these relatively austere environments promotes reliance upon clinical ability rather than on technology; the absence of readily available interventionalists forces development of procedural skills. Intuitively, these clinical rotations would seem to bear directly on easing the transition to disaster medicine noted above. The value of this type of training in disaster medicine would be a worthy topic of research.

Psychological First Aid Training

Perhaps the most controversial aspect of disaster training surrounds mental health. This is also the aspect of disaster medicine for which we found the largest amount of evidence in our review of the literature. The stress accompanying critical incidents can cause post-traumatic stress disorder (PTSD) in both victims and responders. The goal of early intervention is to prevent the traumatic experience from becoming chronic PTSD. The current literature on crisis intervention reveals differing points of view on the methods that should be used.[21-28] Nevertheless, there is near universal endorsement of the value of acute psychological first aid (PSA),[98] and evidence-informed competencies have been developed.[99]

The essence of PSA is the belief that reducing disaster stress may best be accomplished through interventions designed to enhance resilience in psychologically healthy people.[100] Training in PSA prepares responders to deal with personal stress experienced in critical incidents and to assist others. Though data is sparse for disaster mental health interventions in general,[101] there is some evidence to suggest that both disaster victims and responders may benefit from group training in present-centered therapy, acute debriefing, and supportive, cognitive behavioral, and psychodynamic approaches.[102] Resources for PSA training are available from the National Center for PTSD,[103] the American Red Cross, and the International Critical Incident Stress Foundation (Table 3).

Conclusions

We have reviewed the literature for evidence of efficacy in training for the competencies identified in the Disaster Medicine Curriculum Guideline. The published evidence for improved outcomes for the majority of disaster preparedness, disaster response, and disaster medicine interventions is limited. Similarly, an evidence base of either educational or patient-oriented outcomes in support of disaster training in general, or of educational modalities for teaching specific competencies, is markedly deficient (Table 4). As disaster preparedness and training endeavors continue to be implemented, we call for further research in outcome-based disaster preparedness

Table 4: Strength of Recommendation Taxonomy (SORT) Table for Disaster Training, Arranged by the Compentencies Included in the Curriculum Guidelines[16]

Disaster Medicine Training Topic		Strength of Evidence for Specific Training Interventions
Disaster Training (Overall)		Didactic lecture = C Drills = C Computer = C Tabletop = C
Specific Competencies	NIMS/ICS	All methods = C
	Safety	All methods = C
	Triage	All methods = C
	Clinical competence	Short courses = C Other methods = C
	PSA	All methods = C

Note that in no case is there evidence of benefit on patient-oriented outcomes; while there is good evidence of effect on some process-oriented outcomes, the majority of the recommendations are consensus based.

training. Surrogate endpoints are necessary, since disasters are difficult to study prospectively. Patient-oriented outcomes are difficult to correlate to training interventions. In addition, response training in teams is critical, making physician-specific training hard to assess. Perhaps in a future review of this topic, a good evidence base will exist that can be cited, allowing definitive recommendations to be set forth.

ACKNOWLEDGMENTS: The authors thank Anna Gieschen for her assistance with the database searches.

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References

1. Gavagan TF, Noji E. Hurricane Katrina: response at the Houston Astrodome. South Med J 2007;100(9):926-7.
2. Stankovic C, Mahajan P, Ye H, Dunne RB, Knazik SR. Bioterrorism: evaluating the preparedness of pediatricians in Michigan. Pediatr Emerg Care 2009;25(2):88-92.
3. Bagatell S, Wiese J. The elite code grey team: a new model for residency preparedness and training in advance of a disaster. Am J Med Sci 2008;336(2):174-8.
4. Uddin SG, Barnett DJ, Parker CL, Links JM, Alexander M. Emergency preparedness: addressing a residency training gap. Acad Med 2008;83(3):298-304.
5. Shealy RM, Simpson WM Jr, Lee FW, et al. The gaping hole: physicians are missing from the front line of disaster preparedness training. J S C Med Assoc 2006;102(1):11-3.
6. Martin SD, Bush AC, Lynch JA. A national survey of terrorism preparedness training among pediatric, family practice, and emergency medicine programs. Pediatrics 2006;118(3):e620-e626.
7. Pesik N, Keim M, Sampson TR. Do US emergency medicine residency programs provide adequate training for bioterrorism? Ann Emerg Med 1999;34(2):173-6.
8. Williams J, Nocera M, Casteel C. The effectiveness of disaster training for health care workers: a systematic review. Ann Emerg Med 2008;52(3):211-22, 222.e1-2. Epub 2007 Dec. 11.
9. Hsu EB, Jenckes MW, Catlett CL, et al. Effectiveness of hospital staff mass-casualty incident training methods: a systematic literature review. Prehosp Disaster Med 2004;19(3):191-9.
10. Ablah E, Tinius AM, Konda K. Pediatric emergency preparedness training: are we on a path toward national dissemination? J Trauma 2009;67(2 Suppl):S152-S158.
11. SAEM. Disaster medicine: current assessment and blueprint for the future. SAEM Disaster Medicine White Paper Subcommittee. Acad Emerg Med 1995;2(12):1068-76.
12. De Lorenzo RA, Boyle MF, Garrison R. A proposed model for a residency experience in mass gathering medicine: the United States Air Show. Ann Emerg Med 1993;22(11):1711-4.
13. Feldstein BD, Gallery ME, Sanner PH, Page JR. Disaster training for emergency physicians in the United States: a systems approach. Ann Emerg Med 1985;14(1):36-40.
14. Campanale RP. Surprise realistic mock disasters. The most effective means of disaster training. Calif Med 1964;101:435-8.
15. Cummings GE, Della Corte F, Cummings GG. Disaster medicine education in Canadian medical schools before and after September 11, 2001. CJEM 2005;7(6):399-405.
16. AAFP/STFM/ADFM/AFMRD. Recommended Curriculum Guidelines for Family Medicine Residents: Disaster Medicine. AAFP Reprint 290. Leawood, KS: American Academy of Family Physicians, 2008.
17. Steele A, Clarke B. Problems of treatment process selection for relief agency water supplies in an emergency. J Water Health 2008;6(4):483-9.
18. Subbarao I, Lyznicki JM, Hsu EB, et al. A consensus-based educational framework and competency set for the discipline of disaster medicine and public health preparedness. Disaster Med Public Health Prep 2008;2(1):57-68.
19. Savoia E, Massin-Short SB, Rodday AM, Aaron LA, Higdon MA, Stoto MA. Public health systems research in emergency preparedness: a review of the literature. Am J Prev Med 2009;37(2):150-6.
20. Jenkins JL, McCarthy ML, Sauer LM, et al. Mass-casualty triage: time for an evidence-based approach. Prehosp Disaster Med 2008;23(1):3-8.
21. Robinson R. Reflections on the debriefing debate. Int J Emerg Ment Health 2008;10(4):253-9.
22. Bledsoe BE. EMS mythology, part 3. EMS myth #3: critical incident stress management (CISM) is effective in managing EMS-related stress. Emerg Med Serv 2003;32(5):77-80.
23. Bisson JI. Post-traumatic stress disorder. Clin Evid (Online) 2007:1752-8526.
24. Rose S, Bisson J, Churchill R, Wessely S. Psychological debriefing for preventing post traumatic stress disorder (PTSD). Cochrane Database Syst Rev 2001(3):CD000560.
25. Rose S, Bisson J, Churchill R, Wessely S. Psychological debriefing for preventing post traumatic stress disorder (PTSD).Cochrane Database Syst Rev 2002(2):CD000560.
26. Rose S, Bisson J, Wessely S. A systematic review of single-session psychological interventions ("debriefing") following trauma. Psychother Psychosom 2003;72(4):176-84.
27. Mitchell JT. From controversy to confirmation: crisis support services for the twenty-first century. Int J Emerg Ment Health 2008;10(4):245-52.
28. Everly GS Jr, Flannery RB Jr, Eyler VA. Critical Incident Stress Management (CISM): a statistical review of the literature. Psychiatr Q 2002;73(3):171-82.
29. Wakasugi M, Nilsson H, Hornwall J, Vikstrom T, Ruter A. Can performance indicators be used for pedagogic purposes in disaster medicine training? Scand J Trauma Resusc Emerg Med 2009;17:15.

30. Behar S, Upperman JS, Ramirez M, Dorey F, Nager A. Training medical staff for pediatric disaster victims: a comparison of different teaching methods. Am J Disaster Med 2008;3(4):189-99.
31. Edwards JC, Kang J, Silenas R. Promoting regional disaster preparedness among rural hospitals. J Rural Health 2008;24(3):321-5.
32. Henning KJ, Brennan PJ, Hoegg C, O'Rourke E, Dyer BD, Grace TL. Health system preparedness for bioterrorism: bringing the tabletop to the hospital. Infect Control Hosp Epidemiol 2004;25(2):146-55.
33. Savoia E, Testa MA, Biddinger PD, et al. Assessing public health capabilities during emergency preparedness tabletop exercises: reliability and validity of a measurement tool. Public Health Rep 2009;124(1):138-48.
34. Hsu EB, Jenckes MW, Catlett CL, et al. Training to hospital staff to respond to a mass casualty incident. Evid Rep Technol Assess (Summ) 2004(95):1-3.
35. Ebell MH, Siwek J, Weiss BD, et al. Strength of recommendation taxonomy (SORT): a patient-centered approach to grading evidence in the medical literature. J Am Board Fam Pract 2004;17(1):59-67.
36. Cicero MX, Blake E, Gallant N, et al. Impact of an educational intervention on residents' knowledge of pediatric disaster medicine. Pediatr Emerg Care 2009;25(7):447-51.
37. Issenberg SB, McGaghie WC, Petrusa ER, Lee Gordon D, Scalese RJ. Features and uses of high-fidelity medical simulations that lead to effective learning: a BEME systematic review. Med Teach 2005;27(1):10-28.
38. Letterie GS. Medical education as a science: the quality of evidence for computer-assisted instruction. Am J Obstet Gynecol 2003;188(3):849-53.
39. Bartley BH, Stella JB, Walsh LD. What a disaster?! Assessing utility of simulated disaster exercise and educational process for improving hospital preparedness. Prehosp Disaster Med 2006;21(4):249-55.
40. Gebbie KM, Valas J, Merrill J, Morse S. Role of exercises and drills in the evaluation of public health in emergency response. Prehosp Disaster Med 2006;21(3):173-82.
41. Kirkwood S. NIMS and ICS: from compliance to competence. EMS Mag 2008;37(2):51-2, 54-7.
42. Sinclair RC, Smith R, Colligan M, Prince M, Nguyen T, Stayner L. Evaluation of a safety training program in three food service companies. J Safety Res 2003;34(5):547-58.
43. Reissman DB, Howard J. Responder safety and health: preparing for future disasters. Mt Sinai J Med 2008;75(2):135-41.
44. Wojcik SM, Kidd PS, Parshall MB, Struttmann TW. Performance and evaluation of small construction safety training simulations. Occup Med (Lond) 2003;53(4):279-86.
45. Machles D. Evaluating the effectiveness of safety training. Occup Health Saf 2003;72(6):54-6, 58-63.
46. Weidner BL, Gotsch AR, Delnevo CD, Newman JB, McDonald B. Worker health and safety training: assessing impact among responders. Am J Ind Med 1998;33(3):241-6.
47. McQuiston TH, Coleman P, Wallerstein NB, Marcus AC, Morawetz JS, Ortlieb DW. Hazardous waste worker education. Long-term effects. J Occup Med 1994;36(12):1310-23.
48. Sokas RK, Emile J, Nickels L, Gao W, Gittleman JL. An intervention effectiveness study of hazard awareness training in the construction building trades. Public Health Rep 2009;124 Suppl 1:160-8.
49. Wallen ES, Mulloy KB. Computer based safety training: an investigation of methods. Occup Environ Med 2005;62(4):257-62.
50. Anderson E, McGovern PM, Kochevar L, Vesley D, Gershon R. Testing the reliability and validity of a measure of safety climate. J Healthc Qual 2000;22(2):19-24.
51. Bena A, Berchialla P, Coffano ME, Debernardi ML, Icardi LG. Effectiveness of the training program for workers at construction sites of the high-speed railway line between Torino and Novara: impact on injury rates. Am J Ind Med 2009; Oct 28.
52. START triage plan for disaster scenarios. ED Manag 1996;8(9):103-104, suppl 1 p.
53. Gebhart ME, Pence R. START triage: does it work? Disaster Manag Response 2007;5(3):68-73.
54. Kahn CA, Schultz CH, Miller KT, Anderson CL. Does START triage work? An outcomes assessment after a disaster. Ann Emerg Med 2009;54(3):424-30, 430.e1. Epub 2009 Feb 5.
55. Romig LE. Pediatric triage. A system to JumpSTART your triage of young patients at MCIs. JEMS 2002;27(7):52-8, 60-3.
56. Sanddal TL, Loyacono T, Sanddal ND. Effect of JumpSTART training on immediate and short-term pediatric triage performance. Pediatr Emerg Care 2004;20(11):749-53.
57. Dyer C, Regev M, Burnett J, et al. SWiFT: A rapid triage tool for vulnerable older adults in disaster situations. Disaster Med Pub Health Preparedness 2008;2:S45-S50.
58. Garner A, Lee A, Harrison K, Schultz CH. Comparative analysis of multiple-casualty incident triage algorithms. Ann Emerg Med 2001;38(5):541-8.
59. Vincent DS, Berg BW, Ikegami K. Mass-casualty triage training for international health care workers in the Asia-Pacific region using mannikin-based simulations. Prehosp Disaster Med 2009;24(3):206-13.
60. Vincent DS, Sherstyuk A, Burgess L, Connolly KK. Teaching mass casualty triage skills using immersive three-dimensional virtual reality. Acad Emerg Med 2008;15(11):1160-5.
61. Nilsson H, Ruter A. Management of resources at major incidents and disasters in relation to patient outcome: a pilot study of an educational model. Eur J Emerg Med 2008;15(3):162-5.
62. Nufer KE, Wilson-Ramirez G, Shah MB, Hughes CE, Crandall CS. Analysis of patients treated during four Disaster Medical Assistance Team deployments. J Emerg Med 2006;30(2):183-7.
63. Slepski LA. Emergency preparedness and professional competency among health care providers during hurricanes Katrina and Rita: pilot study results. Disaster Manag Response 2007;5(4):99-110.
64. Coule PL, Schwartz RB. The national disaster life support programs: a model for competency-based standardized and locally relevant training. J Public Health Manag Pract 2009;15(2 Suppl):S25-S30.
65. Baker TW, King W, Soto W, Asher C, Stolfi A, Rowin ME. The efficacy of pediatric advanced life support training in emergency medical service providers. Pediatr Emerg Care 2009;25(8):508-12.
66. Beasley JW, Dresang LT, Winslow DB, Damos JR. The Advanced Life Support in Obstetrics (ALSO) program: fourteen years of progress. Prehosp Disaster Med 2005;20(4):271-5.
67. Smith KK, Gilcreast D, Pierce K. Evaluation of staff's retention of ACLS and BLS skills. Resuscitation 2008;78(1):59-65.
68. Jensen ML, Lippert F, Hesselfeldt R, et al. The significance of clinical experience on learning outcome from resuscitation training—a randomised controlled study. Resuscitation 2009;80(2):238-43.
69. Weeks DL, Molsberry DM. Pediatric advanced life support re-training by videoconferencing compared to face-to-face instruction: a planned non-inferiority trial. Resuscitation 2008;79(1):109-17.
70. Jensen ML, Mondrup F, Lippert F, Ringsted C. Using e-learning for maintenance of ALS competence. Resuscitation 2009;80(8):903-8.
71. Colvard MD, Naiman MI, Mata D, Cordell GA, Lampiris L. Disaster medicine training survey results for dental health care providers in Illinois. J Am Dent Assoc 2007;138(4):519-24; quiz 536-7.
72. Advanced Life Support Courses. Ann Emerg Med 2009;54(1):141.
73. Hagan JF Jr. Psychosocial implications of disaster or terrorism on children: a guide for the pediatrician. Pediatrics 2005;116(3):787-95.
74. Seaman J, Maguire S. ABC of conflict and disaster. The special needs of children and women. BMJ 2005;331:34-6.
75. Freedy J, Simpson W. Disaster-related physical and mental health: a role for the family physician. Am Fam Physician 2007;75:841-6.
76. Palmer I. ABC of conflict and disaster. Psychological aspects of providing medical humanitarian aid. BMJ 2005;331:152-4.
77. American Academy of Family Physicians. Home Study Self-Assessment (HSSA), Home Study Monograph 276, Biological and Chemical Terrorism. Leawood, KS: American Academy of Family Physicians, 2002.
78. Briggs S, Brinsfield K. Advanced disaster medical response manual for providers. Boston: Harvard Medical International, 2003.
79. Gosden C, Gardener D. ABC of conflict and disaster. Weapons of mass destruction—threats and responses. BMJ 2005;331:397-400.
80. Hogan D, Burstein J. Disaster medicine, second edition. Philadelphia: Lippincott Williams & Wilkins, 2007.
81. Kortepeter M, Christopher G, Cieslak T, et al. USAMRIID's medical management of biological casualties handbook, fifth edition. Fort Dietrick, MD: USAMRIID, 2006.

82. Trotter G. The ethics of coercion in mass casualty medicine. Baltimore: Johns Hopkins University Press, 2007.
83. American Academy of Family Physicians. Home Study Self-Assessment (HSSA), Home Study Monograph 337, Medical Aspects of Disaster Management. Leawood, KS: American Academy of Family Physicians, 2007.
84. Birch M, Miller S. Humanitarian assistance: standards, skills, training, and experience. BMJ 2005;330(7501):1199-201.
85. Born CT, Briggs SM, Ciraulo DL, et al. Disasters and mass casualties: I. General principles of response and management. J Am Acad Orthop Surg 2007;15(7):388-96.
86. Born CT, Briggs SM, Ciraulo DL, et al. Disasters and mass casualties: II. Explosive, biologic, chemical, and nuclear agents. J Am Acad Orthop Surg 2007;15(8):461-73.
87. Macintyre A, Christopher GW, Eitzen E, et al. Weapons of mass destruction events with contaminated casualties: effective planning for health care facilities. JAMA 2000;283:242-9.
88. Noji E. ABC of conflict and disaster. Public health in the aftermath of disasters. BMJ 2005;330:1379-81.
89. Ryan J, Mahoney P, Macnab C. ABC of conflict and disaster. Conflict recovery and intervening in hospitals. BMJ 2005;331:278-80.
90. Waeckerle J. Domestic preparedness for events involving weapons of mass destruction. JAMA 2000;283:252-4.
91. Redmond A. ABC of conflict and disaster. Natural disasters. BMJ 2005;330:1259-61.
92. American Academy of Family Physicians. Home Study Self-Assessment (HSSA), Home Study Audio 276, Bioterrorism. Leawood, KS: American Academy of Family Physicians, 2002.
93. -DeWitt DE, Migeon M, LeBlond R, Carline JD, Francis L, Irby DM. Insights from outstanding rural internal medicine residency rotations at the University of Washington. Acad Med 2001;76(3):273-81.
94. Wilson NW, Bouhuijs PA, Conradie HH, Reuter H, Van Heerden BB, Marais B. Perceived educational value and enjoyment of a rural clinical rotation for medical students. Rural Remote Health 2008;8(3):999.
95. List JM. Learning to listen in a resource-poor international setting: a medical student's encounter with the power of narrative in Kenya. Virtual Mentor 2006;8:818-20.
96. Thompson MJ, Huntington MK, Hunt DD, Pinsky LE, Brodie JJ. Educational effects of international health electives on US and Canadian medical students and residents: a literature review. Acad Med 2003;78(3):342-7.
97. Drain PK, Holmes KK, Skeff KM, Hall TL, Gardner P. Global health training and international clinical rotations during residency: current status, needs, and opportunities. Acad Med 2009;84(3):320-5.
98. Everly GS Jr, Flynn BW. Principles and practical procedures for acute psychological first aid training for personnel without mental health experience. Int J Emerg Ment Health 2006;8(2):93-100.
99. Parker CL, Everly GS Jr., Barnett DJ, Links JM. Establishing evidence-informed core intervention competencies in psychological first aid for public health personnel. Int J Emerg Ment Health. Spring 2006;8(2):83-92.
100. Maunder RG, Leszcz M, Savage D, et al. Applying the lessons of SARS to pandemic influenza: an evidence-based approach to mitigating the stress experienced by health care workers. Can J Public Health 2008;99(6):486-8.
101. Terhakopian A, Benedek DM. Hospital disaster preparedness: mental and behavioral health interventions for infectious disease outbreaks and bioterrorism incidents. Am J Disaster Med 2007;2(1):43-50.
102. Johnstone M. Disaster response and group self-care. Perspect Psychiatr Care 2007;43(1):38-40.
103. Brymer M, Jacobs A, Layne C, et al. Psychological First Aid Field Operations Guide, second edition. Los Angeles: National Child Traumatic Stress Network and National Center for PTSD, 2006.