

COMMENTARY

Enhancing Crisis Leadership in Public Health Emergencies

Scott Deitchman, MD, MPH, RADM, USPHS

ABSTRACT

Reviews of public health emergency responses have identified a need for crisis leadership skills in health leaders, but these skills are not routinely taught in public health curricula. To develop criteria for crisis leadership in public health, published sources were reviewed to identify attributes of successful crisis leadership in aviation, public safety, military operations, and mining. These sources were abstracted to identify crisis leadership attributes associated with those disciplines and compare those attributes with crisis leadership challenges in public health. Based on this review, the following attributes are proposed for crisis leadership in public health: competence in public health science; decisiveness with flexibility; ability to maintain situational awareness and provide situational assessment; ability to coordinate diverse participants across very different disciplines; communication skills; and the ability to inspire trust. Of these attributes, only competence in public health science is currently a goal of public health education. Strategies to teach the other proposed attributes of crisis leadership will better prepare public health leaders to meet the challenges of public health crises. (*Disaster Med Public Health Preparedness*. 2013;7:534-540)

Key Words: crisis leadership, disaster planning, emergency management, leadership, public health

Starting in the 1990s, terrorism preparedness prompted greater attention to public health's emergency preparedness for a range of hazards.¹⁻³ Great progress has been made in building technical capacities for public health emergency response including laboratory and epidemiological resources and pharmaceutical stockpiles. Although tabletop exercises have illustrated the importance of public health leadership, preparing public health officials to lead those responses has not received comparable attention.⁴ This shortfall was illustrated in the Top Officials (TOPOFF) 2000 exercise simulating a bioterrorist plague attack. Observers noted failures in crisis leadership including reliance on massive, interminable conference calls, inability to make critical decisions, and failure to avoid leader exhaustion.⁵

The 2001 anthrax attacks also showed that traditional public health decision-making processes were not adequate for complex, fast-moving emergencies.⁶ The US Government Accountability Office (GAO) found that the Centers for Disease Control and Prevention (CDC), which led the public health response, was hampered at that time because the agency's leadership lacked formal protocols for making timely crisis management decisions.⁷

An early assessment of the public health and medical response to Hurricane Sandy in 2012 identified

response gaps resulting from challenges to communication and coordination—key tasks of crisis leadership.⁸ This problem has not been confined to the United States. The French response to the 2003 European heat wave disaster was noted for difficulties in crisis leadership tasks such as making timely decisions and taking timely actions in spite of scientific uncertainty.⁹

To promote systematic management of disasters, the February 2003 Homeland Security Presidential Directive 5 (HSPD-5) directed the Secretary of the Department of Homeland Security to develop “a National Incident Management System (NIMS)... covering the incident command system [ICS]. ...”¹⁰ HSPD-5 mandates NIMS use by all US federal departments and agencies and recommends NIMS for all levels of government, nongovernmental organizations, and the private sector.¹¹ Public health preparedness standards identify NIMS certification as an emergency management competency.¹²

Implementing ICS alone, however, does not prepare leaders for a disaster response. Although Hurricane Katrina occurred 2 years after NIMS implementation was mandated, the White House-led assessment of the nation's response identified an absence of crisis leadership as a response deficiency.¹³

These observations do not mean that all public health emergency responses include failures of

crisis leadership. A GAO evaluation of the US government's response to the 2009 H1N1 influenza pandemic provided a complimentary assessment of leadership tasks such as federal coordination and public communication.¹⁴ The report, however, did not explicitly assess crisis leadership, indicating an unmet need to define and promote crisis leadership skills in public health.

CRISIS LEADERSHIP

One of the more concise definitions of a crisis is “a serious threat to the basic structures or fundamental values and norms of the social system which—under time pressure and highly uncertain circumstances—necessitates making critical decisions.”¹⁵ Under circumstances of extreme stress, crisis leaders must meet challenges that include: recognizing the crisis; making decisions rapidly in spite of limited and fragmented information; providing effective communications; and balancing centralization with delegation.¹⁵

Current Leadership Training in Public Health

Conventional public health leadership training teaches practitioners to manage organizations that apply traditional tools including epidemiology and laboratory investigations, sanitation, immunization, medical prophylaxis, and education.¹⁶ As emergency preparedness became a priority, educators and practitioners defined competencies for public health emergency leadership as familiarity with public health roles, command systems, and emergency response plans.^{17,18} Current assessments of public health emergency leadership in exercises focus on completion of tasks (eg, identify activities to be performed, interact with relevant officials, identify one's authorities, gather necessary resources, assist special needs populations) and scientific competencies involving knowledge of threats and hazards, clinical care, and epidemiologic investigation.¹⁹⁻²² Although ICS has been adapted for public health programs, curricula typically focus on ICS organization and roles rather than leadership challenges faced by incident leaders.²³

Public health practitioners are expected to lead responses to emergencies such as meningococcal meningitis clusters and foodborne disease outbreaks. In crises, however, even normal emergency functions cannot restore normalcy.²⁴ Public health crises include natural disasters such as earthquakes and hurricanes, biological terrorism, influenza pandemics, chemical releases, and radiological emergencies. Yet a search of medical and public health literature in PubMed yielded no definitive articles describing crisis leadership skills for public health, suggesting a need to learn from other disciplines.

Crisis Leadership in Other Disciplines

Methods

To identify traits of crisis leadership, Google and Google Scholar searches were conducted on the terms “crisis leadership” or “crisis management” narrowed by

“characteristics,” “traits,” “attributes,” and “training.” A similar search in the Web of Science used the terms (“crisis leadership” OR “crisis management”) AND (training OR attributes OR traits OR characteristics). Relevant books and articles were assessed for attributes of crisis leadership in various professions, which included aviation, military teams, police and fire services, nuclear power plant operations, and mining.

Aircrew Captains

Simulator-based research of aircrew performance during aviation emergencies has shown that crew leader personality affects performance, particularly in critical, high-workload situations. Crews led by successful crisis leaders made fewer errors and were more likely to successfully resolve the emergency. Aircrews led by captains with a constellation of traits nicknamed “the right stuff” (including self-confidence, striving for excellence, and interpersonal warmth) also reported less stress than crew members led by other personality types.^{25,26}

Crew resource management (CRM) originally was developed in aviation to reduce crew error and better use human resources among the flight deck crew.²⁷ The traits identified in successful aircraft captains using CRM include decisiveness, the ability to maintain awareness of the situation, and willingness to receive input from other crew members.

Military in Extremis Leaders

The concept of *in extremis* leadership was developed by COL Thomas Kolditz of the US Military Academy (West Point) to describe leadership when team and leader face immediate risk of death or injury. *In extremis* leaders are found in military combat units and among police and firefighters. The danger in these professions attracts leaders who are motivated by challenge and willing to share their followers' risk. Followers demand competence of *in extremis* leaders, and, in return, develop mutual trust in and loyalty to their leader and each other.²⁸

First Responder Incident Commanders

ICS leaders are called incident commanders. Key attributes of incident commanders in police and firefighting are decisiveness and the ability to conduct accurate situational assessments and execute either predefined or new courses of action as appropriate. Incident commanders coordinate across organizational and disciplinary boundaries, delegate responsibility and set priorities, and manage their own stress levels to avoid performance degradation.²⁹

Nuclear Power Plant Emergency Team Leaders

Crichton and Flin interviewed emergency response personnel at UK nuclear power plants to identify key nontechnical skills for various response positions.³⁰ Among decision makers who set strategic response goals, the nontechnical skills identified were decision making, communication, situation awareness and anticipation, promoting effective teamwork,

managing team stress, and displaying leadership that can be either directional or consultative depending on the situational need.

Underground Mine Fire Survivors

Crisis leadership attributes have been identified among miners surviving underground fires. In these settings, leaders tended to be alert to their environment and notice details—traits likely to facilitate survival. They were decisive yet open to input from others, and were flexible and willing to change decisions as circumstances evolved. They had a calming effect on other miners, and inspired confidence. Competence appeared to be important, particularly in the emergence of ad hoc leaders in mining emergencies; in some emergencies, an individual who was not in authority before the disaster emerged as a leader after demonstrating competence by providing consultation to the predisaster authority figure.³¹

Identifying Common Attributes of Crisis Leaders

The accompanying Table summarizes the referenced behaviors and attributes of successful crisis leaders. Where leadership characteristics were not explicitly cited, characteristics were abstracted from competencies or behaviors indicated in the source material. For some characteristics, the same term (eg, decisiveness) was used in more than 1 discipline. For others, different professions used different terminology to express similar attributes, eg, “maintain situational awareness” (aviation CRM) and “is aware of the environment” (leaders in mine fires). Similar attributes are grouped in the same columns in the Table. Attributes defining the emotional relationship between leaders and followers are grouped under “Emotional Awareness”. Unfilled cells indicate that the source did not describe an attribute in that category.

The disciplines surveyed for this assessment vary widely in their professional demands, training, and practice environment. An aircraft captain may supervise a crew of only 2 or 3 on the flight deck, while the incident commander at a large fire may oversee hundreds. Military leaders and commanders of first response organizations receive formal training in incident leadership, while the ad hoc leader of trapped miners may have no previous leadership role.

Nonetheless, as illustrated in the Table, certain traits consistently appear in crisis leaders across multiple settings. These traits include competence, decisiveness, situational awareness, coordination, communication, and inspiring trust. This commonality suggests that these traits can be applied to crisis leadership in other disciplines, including public health. Surprisingly, competence does not appear in every profession-specific list, suggesting professional competence is an implied and fundamental prerequisite for crisis leaders. The CRM experience, however, indicates that competence must be complemented by skills in coordination and in management of human resources.³²

Crisis Leadership in Public Health

The assessments of crisis leadership presented in the Table were compared with recent experiences in responses to public health emergencies to develop proposed attributes of public health crisis leadership. While other traits may apply, these attributes help define initial competencies for training public health crisis leaders and identifying individuals to serve in leadership roles during public health crises. The proposed attributes of public health crisis leadership are as follows:

1. Competence in public health science: Competence is needed to ensure that response decisions are made on the basis of sound professional judgment. It also is required to earn the trust of other public health professionals, collaborators in other organizations, and the public. The skills previously defined for public health emergency response and emergency leadership identify necessary scientific and technical competencies.¹⁷⁻²² No leader can be an expert in all aspects of public health, but the crisis leader must sufficiently understand these disciplines to critically evaluate the information and recommendations being provided.
2. Decisiveness: The ultimate responsibility for decisions made during the response rests with the crisis leader. However, the leader actively seeks information from diverse sources to inform those decisions. In all cases, the intent is to ensure that response decisions are as timely and as broadly informed as possible.
3. Situational awareness: The leader must maintain as clear as possible an understanding of the current situation to make appropriate decisions. Sources of information include NIMS reporting and planning functions, informal reporting by staff, and outreach to counterparts in other organizations. Situational awareness also includes integrating and interpreting the information to identify strategic priorities and conveying that perspective back to the response team. Given that most public health leaders report to higher authorities, the leader likewise ensures that this strategic assessment is presented to higher leadership. The crisis leader thus has a bidirectional responsibility for interpreting the situation to both subordinates and superiors.
4. Coordination: The leader coordinates the response. Using ICS tools facilitates this coordination, but the leader must promote coordination both within and across organizations, a competency described as metaleadership.³³ This attribute frequently requires reaching across disciplines, in both public health and nonhealth response organizations, to support the broadest collaboration possible.
5. Communication: The public health leader promotes communication, both within the leader’s own organization and across other organizations and disciplines. Consistent with the CRM goal of promoting input from team members, the leader must create an atmosphere in which staff can air disagreements and, if necessary, present the leader with difficult challenges or bad news.³⁴
6. Inspires trust: The crisis leader will instill in the team a sense of confidence and trust in both their comrades and

TABLE

Attributes of Crisis Leadership in Different Disciplines^a

Attributes Disciplines	Decisive/ Confident	Competent	Aware of Situation	Accepts Information From Others	Emotional Awareness	Coordinates/ Communicates	Other
Aviation: the "right stuff" ^{16,17}	Self-confidence				Displays interpersonal warmth and sensitivity		Preference for challenging tasks Being active Strives for excellence Competitiveness
Aviation: crew resource management ²⁴	Makes decisions systematically		Maintains situational awareness Regulates information flow	Accepts crew input		Coordinates Promotes communication	
In extremis leadership ¹⁹		Competent			Inspires and builds trust Inspires and displays loyalty	Shares values-based lifestyle	Shares risk
Incident commanders ²⁰	Makes decisions		Assesses situation (awareness and interpretation) Monitors response	Assesses situation (awareness and interpretation)		Coordinates team Communicates	Manages stress Delegates Prioritizes
Nuclear power plant emergency response leaders	Decision-making		Maintains awareness of situation and anticipates	Consultative leadership ("in slower-paced situations")		Promotes communication within and in/out of plant	Manages own and team's stress
Leaders in mining disasters ²¹	Decisive but flexible	Competent, knowledgeable	Aware of environment	Accepts input from others	Inspires confidence and trust Calming		
<i>Proposed public health crisis leadership attributes</i>	<i>Decisive</i>	<i>Competent</i>	<i>Maintains situational awareness</i>	<i>Interprets data to provide a situational assessment</i>	<i>Displays warmth and sensitivity Inspires trust</i>	<i>Coordinates and communicates meta-leadership</i>	

^aIndividual professional disciplines are listed in rows. Where possible, similar traits associated with different professions are in the appropriate column. Traits described for only 1 discipline are listed under "Other" and are not grouped by similarity.

their leaders, often in the midst of the most difficult circumstances. The crisis leader is also responsible for the welfare of the team, and must remain sensitive to the pressures being experienced by other team members who need appropriate rest, sustenance, and emotional support.³⁵

DISCUSSION

Past crises demonstrate that traditional public health leadership training, which blends management skills with public health science knowledge, is necessary but not sufficient preparation for crisis leadership.³⁶ Public health tends to be a collaborative, democratic process, considering all stakeholder perspectives and then building consensus.⁵ This model does not meet the need during an emergency to make decisions quickly in spite of incomplete information. The long, indecisive conference calls during the 2000 TOPOFF exercise illustrate the difficulty in relying on traditional tools to reach consensus. Anticipating this challenge, others have suggested that public health decision-making in a crisis should follow a model that is more autocratic than democratic.³⁷

Promoting autocracy, however, carries risk. Lessons from aviation CRM indicate that autocratic leaders risk missing crucial information provided by team members. This situation may be characteristic of settings in which team members contribute diverse expertise (ie, the situation in public health), and suggests that effective crisis management should not employ a rigid command and control hierarchy. Instead, an examination of other disciplines reveals that leadership that promotes exchange of information, clarifies communication, and maintains an open atmosphere even while directing activities toward timely decisions is a more useful approach.³⁸

The importance of open communication, even during a fast-moving crisis, was cogently observed by United Airlines Captain Al Haynes, who in 1989 led the crew that landed a DC-10 crippled by loss of its hydraulic controls. No training existed for this unprecedented scenario. Captain Haynes credited his team's use of CRM (then called CLR, crew leadership resource training), commenting: "why would I know more about getting that airplane on the ground under those conditions than the other three [flight crew members]. So if I hadn't used CLR, if we had not let everybody put their input in, it's a cinch we wouldn't have made it."³⁹

While team performance in public health emergencies has not been studied to the extent it has in other disciplines, my experience as a public health incident manager is consistent with the leadership models, such as CRM, that emphasize team input. Public health crisis leaders similarly must bridge extremes of unlimited democracy and rigid autocracy. Leading public health emergency response is a complex dance of reviewing data, soliciting opinions from diverse subject matter experts, carefully channeling debate and avoiding

digressions, bringing discussions to a timely decision, and executing those decisions.

Public health crisis leaders frequently report to elected or appointed officials, and, indeed, the elected head of government has final authority in the response.⁴⁰ As the primary liaison between the response staff and those officials, the crisis leader must integrate the demands of the response with the officials' guidance.⁴¹

Teaching Crisis Leadership in Public Health

The challenges of influenza pandemics, terrorist attacks, and natural disasters have brought public health officials into new positions of crisis leadership. Future assessments of public health leadership and preparedness skills should include attributes of crisis leadership. These assessments would benefit by further research to refine our understanding of those attributes in public health emergencies. Potential research projects include interviews with individuals who have led previous emergency responses and with members of their teams. After-action reviews of agency responses can explicitly assess crisis leadership challenges and how they were addressed.

Crisis leadership training can be included in public health leadership curricula in both academic degree-granting programs and continuing professional development. A recent project to identify core competencies in public health preparedness has identified a leader's responsibilities for situational awareness.⁴² Similar efforts by public health professional societies and academic programs could add other principles of crisis leadership. Given the recognized importance of crisis leadership in other professions, extensive literature describes methods of training crisis leaders. Techniques include didactic instruction, case studies, exercises, and computer simulations.⁴³

Didactic instruction is a familiar teaching tool in public health. While teaching materials focused on crisis leadership in health environments are needed, examples also can be drawn from business, aviation, and military literature.

Case studies can be used to teach leadership and decision-making, allowing students to role-play the complexities, ambiguities, and uncertainties confronting the leaders in the scenario.⁴⁴ Case studies based on events such as H1N1 influenza, severe acute respiratory syndrome (SARS), monkey pox, polonium, and the Deepwater Horizon oil spill could provide valuable insights into public health crisis leadership. The development of useful case studies depends on the willingness of leaders to share frank descriptions of the challenges, responses, successes, and failures experienced in leading their organizations through public health crises. Available guidelines for developing case studies in crisis management provide useful templates for identifying key leadership and organizational challenges.⁴⁵

Exercises are another tool for teaching crisis leadership. The Federal Emergency Management Agency (FEMA) indicates

that exercises can be used to provide individual training and evaluate an organization's execution of its emergency response plan. FEMA recognizes 6 types of exercises, ranging from orientation seminars to full-scale exercises involving field deployments that simulate emergency events as closely as possible.⁴⁶ While any of these allow trainees to practice crisis leadership, the intermediate choice, tabletop exercises can provide the experience of crisis leadership without the logistical challenges of a full-scale exercise. Training exercises should seek a balance between realism and logistic feasibility, and be designed to require completion of specific crisis leadership tasks during a limited period of time.⁴⁷

Computer games and simulations present new tools for teaching crisis leadership. Flight simulators have been used to study crisis response and train flight crews in CRM.²⁷ Computer-supported simulation has been used to train anesthesiology teams in CRM behaviors, and realistic virtual-world simulations for multiple players have been developed to teach emergency department personnel to respond to mass casualty events.^{48,49} Educational programs in the US military increasingly use computer-based simulations, some incorporating sophisticated artificial intelligence technology, to teach leadership in novel and challenging situations.^{50,51} While developing computer-based simulation specific to public health crisis leadership will require initial investments, the cost might be mitigated by adapting software developed for other disciplines, and the investment would yield software that could be used in educational institutions, public health agencies, and for self-study.

CONCLUSION

By defining the attributes of successful crisis leaders, both in public health and in other disciplines, the concepts of crisis leadership can be taught to those who will lead public health responses to future crises. As White House officials observed after Hurricane Katrina, "At all levels of government, we must build a leadership corps that is fully educated, trained, and ... populated by leaders who are prepared to exhibit innovation and take the initiative during extremely trying circumstances."⁵² Crisis leadership skills will better equip public health response leaders to meet that challenge.

About the Authors

National Center for Environmental Health and Agency for Toxic Substances and Disease Registry, Centers for Disease Control and Prevention, Atlanta, Georgia (Dr Deitchman).

Address correspondence and reprint requests to RADM Scott Deitchman, MD, MPH, CDC/NCEH-ATSDR, 4770 Buford Hwy F09, Atlanta, GA 30341 (e-mail: sed2@cdc.gov).

Disclaimer

The findings and conclusions in this report are those of the author and do not necessarily represent the views of the Agency for Toxic Substances and Disease Registry, Centers for Disease Control and Prevention.

Published online: September 4, 2013.

REFERENCES

- Noji EK. The nature of disaster: general characteristics and public health effects. In: Noji EK, ed. *The Public Health Consequences of Disasters*. New York: Oxford University Press; 1997:3-20.
- Khan AS, Morse S, Lillibridge S. Public-health preparedness for biological terrorism in the USA. *Lancet*. 2000;356:1179-1182.
- Centers for Disease Control and Prevention. Biological and chemical terrorism: strategic plan for preparedness and response. Recommendations of the CDC Strategic Planning Workgroup. *MMWR*. 2000;49 (No. RR-4):1-14.
- Lurie N, Wasserman J, Nelson CD. Public health preparedness: evolution or revolution? *Health Aff (Millwood)*. 2006;25:935-945.
- Inglesby TV, Grossman R, O'Toole T. A plague on your city: observations from TOPOFF. *Clin Infect Dis*. 2001;32:436-445.
- Gursky E, Inglesby TV, O'Toole T. Anthrax 2001: observations on the medical and public health response. *Biosecur Bioterror*. 2003;1(2):97-110.
- General Accounting Office. *Centers for Disease Control and Prevention: Agency Leadership Taking Steps to Improve Management and Planning, but Challenges Remain*. Washington, DC: General Accounting Office; 2004: 18. GAO-04-219.
- Abramson D, Redlener I. Hurricane Sandy: lessons learned, again. *Disaster Med Public Health Prep*. 2012;6:328-329.
- Thirion X, Debensason D, Delarozière JC, San Marco JL. August 2003: reflections on a French summer disaster. *J Contingencies Crisis Manag*. 2005;13(4):153-158.
- White House. *Homeland Security Presidential Directive 5*. Washington, DC: Government Printing Office; 2003.
- National Incident Management System*. Washington, DC: Department of Homeland Security, Federal Emergency Management Agency, December 2008: 3. FEMA Publication P-501 (Cat # 08336-1).
- Public Health Preparedness Capabilities: National Standards for State and Local Planning*. Atlanta, GA: Centers for Disease Control and Prevention, Office of Public Health Preparedness and Response; March 2011:30. <http://www.cdc.gov/phpr/capabilities/index.htm>. Accessed October 24, 2011.
- The Federal Response to Hurricane Katrina: Lessons Learned*. Washington, DC: The White House; 2006:73.
- General Accounting Office. *Influenza Pandemic: Lessons from the H1N1 Pandemic Should Be Incorporated into Future Planning*. Washington, DC: General Accounting Office; June 2011. GAO-11-632.
- Rosenthal, Charles, and t'Hart, cited in Boin A. Lessons from crisis research. *Int Studies Rev*. 2004;6:165-194.
- Calhoun JG, Ramiah K, Weist EM, Shortell SM. Development of a core competency model for the master of public health degree. *Am J Public Health*. 2008;98:1598-1607.
- Bioterrorism & Emergency Readiness: Competencies for All Public Health Workers*. New York, New York: Columbia University School of Nursing Center for Health Policy; 2002:6-8.
- Gebbie K, Merrill J. Public health worker competencies for emergency response. *J Public Health Manag Pract*. 2002;8:73-81.
- 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;124:138-148.
- Markenson D, DiMaggio C, Redlener I. Preparing health professions students for terrorism, disaster, and public health emergencies: core competencies. *Acad Med*. 2005;80:517-526.
- 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: 57-68.
- James JJ, Benjamin GC, Burkle FM, et al. Disaster medicine and public health preparedness: a discipline for all health professionals. *Disaster Med Public Health Prep*. 2010;4(2):102-107.
- Kohn S, Barnett DH, Galastri C, et al. Public health-specific National Incident Management System trainings: building a system for preparedness. *Public Health Rep*. 2010;125(suppl 5):43-50.

24. Lagadec P. *Preventing Chaos in a Crisis: Strategies for Prevention, Control and Damage Limitation*. New York, New York: McGraw Hill; 1993:3.
25. Chidchester TR, Kanki BG, Foushee HC, et al. *Personality Factors in Flight Operations: Leader Characteristics and Crew Performance in a Full-Mission Air Transport Simulation*. Houston, Texas: NASA Technical Memorandum 102259, April 1990; vol 1.
26. Bowles S, Ursin H, Picano J. Aircrew perceived stress: examining crew performance, crew position, and captains personality. *Aviat Space Environ Med*. 2000;71(11):1093-1097.
27. Helmreich RL, Merritt AC, Wilhelm JA. The evolution of crew resource management training in commercial aviation. *Int J Aviat Psychol*. 1999;9(1):19-32.
28. Kolditz TA. The in extremis leader. In: LeBoeuf J, Kolditz TA, Crandall D, et al, eds. *Leader to Leader, Leadership Breakthroughs from West Point: A Special Supplement*. San Francisco: Jossey-Bass; 2005:6-18.
29. Crichton M, Flin R. Command decision making. In: Flin R, Arbuthnot K, eds. *Incident Command: Tales from the Hot Seat*. Aldershot, United Kingdom: Ashgate Publishing Ltd; 2002:201-238.
30. Crichton MT, Flin R. Identifying and training non-technical skills of nuclear emergency response teams. *Ann Nuclear Energy*. 2004; 1317-1330.
31. Vaught C, Brnich MJ, Mallett LG, et al. *Behavioral and Organizational Dimensions of Underground Mine Fires*. Pittsburg, Pennsylvania: US Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health; May 2000:166-193.
32. Safety Regulation Group. *Flight Crew Training: Cockpit Resource Management (CRM) and Line Oriented Flight Training (LOFT) (CAP 720)*. Middlesex, England: Civil Aviation Authority; 2002.
33. Marcus LJ, Dorn BC, Henderson JM. Meta-leadership and national emergency preparedness: a model to build government connectivity. *Biosecur Bioterror*. 2006;4(2):128-134.
34. Drechsler D, Allen CD. Why senior military leaders fail. *Armed Forces J*. 2009(July):34-37,44-45.
35. Heifetz RA, Linsky M. *Leadership on the Line*. Boston: Harvard Business School Press; 2002:227.
36. Leonard HB, Howitt AM. 'Routine' or 'crisis' – the search for excellence. *Crisis Response*. 2008;4(3):32-35.
37. Kizer KW. Lessons learned in public health emergency management: personal reflections. *Prehosp Disaster Med*. 2000;15(4):209-214.
38. Driskell JE, Adams RJ. *Crew Resource Management: An Introductory Handbook*. Washington, DC: Department of Transportation: Federal Aviation Administration; 1992. DOT/FAA/RD-92/26.
39. Haynes A. *The Crash of United Flight 232*. Edwards, California: NASA Ames Research Center, Dryden Flight Research Facility; May 24, 1991. <http://clear-prop.org/aviation/haynes.html>. Accessed November 28, 2011.
40. Labadie J. Problems in local emergency management. *Environ Manage*. 1984;8:489-494.
41. Somer S, Svava J. Assessing and managing environmental risk: connecting local government management with emergency management. *Public Adm Rev*. 2009;69:181-193.
42. *Public Health Preparedness and Response Core Competency Model, version 1.0*. Washington DC: Association of Schools of Public Health, December 2010. <http://www.asph.org/document.cfm?page=1081>. Accessed March 28, 2011.
43. Salas E, Cannon-Bowers JA, Weaver J. Command and control teams: principles for training and assessment. In: Flin R, Arbuthnot K, eds. *Incident Command: Tales from the Hot Seat*. Aldershot, England: Ashgate Publishing Ltd; 2002:239-257.
44. Franke V. Decision-making under uncertainty: using case studies for teaching strategy in complex environments. *J Milit Strategic Studies*. 2011; 13:1-21.
45. Stern E, Sundelius B. Crisis management Europe: an integrated regional research and training program. *Int Studies Perspect*. 2002;3:71-88.
46. *IS-139 Exercise Design, unit 11*. Washington, DC: Federal Emergency Management Agency, Emergency Management Institute; January 29, 2013. <http://www.training.fema.gov/EMIWEB/downloads/is139Unit11.doc>. Accessed December 7, 2011.
47. Dausey DJ, Buehler JW, Lurie N. Designing and conducting tabletop exercises to assess public health preparedness for manmade and naturally occurring biological threats. *BMC Public Health*. 2007;7:1-9.
48. Gaba DM, Howard SK, Fish KJ, Smith BE, Sowb YA. Simulation-based training in anesthesia crisis resource management (ACRM): a decade of experience. *Simulation Gaming*. 2001;32(2):175-193.
49. Heinrichs WL, Youngblood P, Harter PM, Dev P. Simulation for team training and assessment: case studies of online training with virtual worlds. *World J Surg*. 2008;32:161-170.
50. McAlinden R, Gordon AS, Lane HC, Pynadath D. UrbanSim: a game-based simulation for counterinsurgency and stability-focused operations. In: Craig S, Dicheva D, eds. *Proceedings of the 14th International Conference on Artificial Intelligence in Education, AIED 2009, July 6-10, 2009*. Brighton, United Kingdom: IOS Press; 2009;3:41-50.
51. Harvey J. Role-playing simulation environment. *Collins Center Update*. 2008;11:2-3.
52. *The Federal Response to Hurricane Katrina: Lessons Learned*. Washington, DC: The White House; 2006:72.