Setting Foundations for Developing Disaster Response Metrics

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ABSTRACT

There are few reported efforts to define universal disaster response performance measures. Careful examination of responses to past disasters can inform the development of such measures. As a first step toward this goal, we conducted a literature review to identify key factors in responses to 3 recent events with significant loss of human life and economic impact: the 2003 Bam, Iran, earthquake; the 2004 Indian Ocean tsunami; and the 2010 Haiti earthquake. Using the PubMed (National Library of Medicine, Bethesda, MD) database, we identified 710 articles and retained 124 after applying inclusion and exclusion criteria. Seventy-two articles pertained to the Haiti earthquake, 38 to the Indian Ocean tsunami, and 14 to the Bam earthquake. On the basis of this review, we developed an organizational framework for disaster response performance measurement with 5 key disaster response categories: (1) personnel, (2) supplies and equipment, (3) transportation, (4) timeliness and efficiency, and (5) interagency cooperation. Under each of these, and again informed by the literature, we identified subcategories and specific items that could be developed into standardized performance measures. The validity and comprehensiveness of these measures can be tested by applying them to other recent and future disaster responses, after which standardized performance measures can be developed through a consensus process. (*Disaster Med Public Health Preparedness*. 2017;11:505-509)

Key Words: emergency preparedness, natural disasters, disaster planning, capacity building, relief work

In April 2015 an earthquake rocked Nepal, resulting in over 8500 fatalities and more than 17,000 injuries.[1] In the aftermath of such disasters, questions surrounding the quality of relief efforts arise and point to the need for performance measures that can provide relief workers and agencies with an evidence-based approach to ongoing and future responses.

Clear, standardized metrics that comprehensively assess the quality of disaster response can help to identify successes and challenges from past incidents and streamline future responses with the potential of improving outcomes for impacted communities. The United Nations has recognized the need for such performance measures.[2] Existing measures are typically agency specific, however, and are not standardized for application across responding entities. For example, the United Nations Office for Coordination of Humanitarian Affairs conducts several performance evaluations with the goal of "promoting transparency, accountability and learning through systematic and objective judgments about the relevance, efficiency, effectiveness and impact of humanitarian interventions."[2] The US government's National Response Framework mandates evaluation, generally in the form of after-action reports, with 2 separate tools available to evaluate US response: the Continuity Evaluation Tool, to assess federal planning, and the Continuity Assistance Tool, for nonfederal entities.[3] However, tools such as these are designed for interagency use rather than for use in guiding disaster response more widely. The World Health Organization recently released guidelines to establish minimum standards for expatriate teams and a registration process for responding teams.[4]

Previous work has primarily focused on identifying disaster preparedness metrics through expert opinion. Existing preparedness guidelines largely consist of infrastructure and resource requirements for relief delivery, such as medical station capacity, equipment inventories, and triage guidelines.[5] Past efforts toward developing response performance measures have focused on processes and outcomes, such as quality of resource coordination or post-disaster measures of morbidity, mortality, and quality of life.[6] A concerted effort needs to be made to expand on existing measures and to develop standardized performance measures that can be used across responding groups and agencies to systematically evaluate the quality of disaster relief.

The evaluation of response is often limited by the lack of standardized indicators for measuring performance.[7] Toolkits have been developed to address this but are often tailored for measuring performance in response

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exercises or infectious disease outbreaks.[7,8] Without performance measures commonly agreed upon and used, responders risk repeating mistakes of the past: limited coordination, suboptimal utilization of aid, and limited access to lifesaving care.[9]

Review of past disaster responses can inform the construction of performance measures that ultimately will improve disaster relief.[10] With the practical need for standardized performance measures in mind, we sought to identify factors critical to response that may serve as the underpinnings of a disaster response performance measurement framework and the basis for developing such measures. To do this, we conducted a comprehensive review of published literature on 3 disasters: the 2003 Bam, Iran, earthquake; the 2004 Indian Ocean tsunami; and the 2010 Haiti earthquake. We chose these events because they garnered a rapid and significant response from national and international sources.[11-13] Also, these events occurred within the last 15 years and thus reflect current disaster response capabilities and challenges. The prolonged responses to these events and resulting complexity revealed items essential to address in future disasters.

METHODS

We conducted a review of articles published on the 3 disasters. The review focused on any literature published from the time of each incident through 2015. Inclusion criteria developed a priori were (1) English-language articles and (2) pertaining to health-related disaster response. Reviews, original research, and practice pieces were included. We performed the review in May 2015 by use of the PubMed (National Library of Medicine, Bethesda, MD) search engine with separate searches for each event with use of the terms "disaster response" or "disaster relief" or "humanitarian response." We excluded articles not related to these events. All retrieved titles and abstracts were reviewed by at least 1 of 3 authors (NP, SAB, MA), followed by a full-text review by 1 of 3 authors (NP, MA, OA). Data extraction was completed by one author (NP) and reviewed by an additional author for agreement (MA). We collected information on author, year, study title, journal, disaster type and date, population, methodology, aims of study, and summary of findings. Table 1 summarizes the results from our search strategy.

RESULTS

We initially identified 710 articles and retained 496 after removing duplicates. Of these, 146 articles met the inclusion and exclusion criteria based on review of titles. We then reviewed the abstracts for these and excluded 22 additional articles, resulting in a final sample of 124 articles. Seventy-two articles pertained to the Haiti earthquake, 38 to the Indian Ocean tsunami, and 14 to the Bam earthquake (Table 1).

Based on a careful review of the 124 papers, we identified 5 categories of activities or themes, each with a number of key subcategories and specific types of activity. These categories were informed by recurrent barriers to disaster response and factors critical to success identified in the peer-reviewed literature related to the incidents under study. This article describes these findings and creates an organizing framework that can serve as the basis for development of standardized performance measures for disaster relief (Table 2).

TABLE 1

Search Strategy

Concept Area Key Words	Total Retrieved	Articles Excluded	Final Articles Included
A Disaster Response or Disaster Relief or Humanitarian Relief [DR or DR or HR]	66,396	-	-
B [DR or DR or HR] + Haiti Earthquake	254	182	72
C [DR or DR or HR] + Bam Earthquake	25	11	14
D [DR or DR or HR] + Tsunami	217	179	38

Personnel

All 3 disasters had reports of varying levels of preparation by teams. In multiple reports, team members did not receive physical or mental health screenings or screenings of their capabilities.[13-15] Few organizations had a ready list of volunteers with information regarding their medical or disaster training and their passport status. Even disaster-response-oriented nongovernmental organizations reported difficulty in deploying a sufficient number of well-trained staff.[16] In Haiti, trauma surgeons, orthopedists, and neurosurgeons were deployed.[17] Further out from the event, generalists handled postoperative care and the population's overall health care needs.[18] As the weeks progressed, many obstetric and gynecologic issues were encountered.[17] In all 3 incidents, the need for general, primary care and nursing providers was greater than the need for specialty care, especially over the long term.

Ultra-specialized forces such as search and rescue teams were deployed in each disaster. At one point during the Haiti response, there were close to 2000 international search and rescue professionals on the ground saving 132 people.[19] Some of these teams did not arrive until several days after the quake, by which time their particular skill set was less useful than in the hours immediately after the disaster.[20]

The efficacy of responders was inhibited by language and cultural barriers. Translators were identified as a rate-limiting step in relief operations.[21]

Supplies and Equipment

Issues surrounding supplies and equipment constituted a notable theme across incidents. Difficulty with tracking

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TABLE 2

Framework for Developing Performance Measures for Disaster Relief

1. Personnel
   - Pre-deployment[a] screening of potential relief workers
     - physical and mental health
     - formal training, experience, expertise
     - passport status
     - availability
     - language capability
   - Pre-deployment needs assessment for specialty vs general care
     - assessment completed
     - roster or inventory of potential relief workers, by area of expertise
2. Supplies and Equipment
   - Pre-deployment assessment of needed supplies, equipment (including food)
     - assessment completed
     - organized list of supply and equipment needs prepared
   - Pre-deployment supply and equipment screening
     - dynamic mechanism for assessment/inventory of arriving supplies, equipment, food
     - assessment of requirements and capacities for food supplies: storage, cooking
   - Accounting for needs of special populations
     - women
     - other (specify which, and how their needs are addressed)
3. Transportation
   - Assessment of arrival hubs
     - Capacity: personnel, space for arriving conveyances, storage space, logistical management systems
     - Customs processes and procedures
   - Assessment of transport systems
     - functional status (intact or disruption: nature, degree, location)
     - capacity: vehicles, personnel
   - Considering a role for military forces
4. Timeliness and Efficiency
   - First 24 hours
     - local response capacity: personnel, matériel, systems
     - external response capacity: personnel, matériel, systems
   - First 24 to 72 hours
     - local response capacity: personnel, matériel, systems
     - external response capacity: personnel, matériel, systems
   - After 72 hours
     - local response capacity: personnel, matériel, systems
     - external response capacity: personnel, matériel, systems
5. Interagency Coordination
   - Needs assessment
     - assessment conducted
     - independent vs. coordinated assessment
   - Distribution of personnel and matériel
     - independent or coordinated
   - Ongoing response and recovery
     - coordinating point (eg, host government, specific relief organization) identified
     - coordination structure in place
     - coordination processes in place
     - functional coordination achieved

[a]Pre-deployment in this context refers to screening before sending personnel or goods.

supplies and deploying unneeded or insufficient supplies were noted repeatedly. The majority of medical supplies brought were for the treatment of acute illness or injury. Nations were burdened by "the receipt of vast quantities of un-inventoried supplies, ranging from high to very low priority items, which created bottlenecks at the airport."[22] Medications became useless due to prescriptions being written in foreign languages or being expired.[22,23] Screening methods before supplies were accepted would have allowed for the refusal of unusable items.[24] When appropriate supplies were brought, they were quickly depleted across all incidents. The need for tetanus immunoglobulin was underestimated in both Haiti and the tsunami[13] and providers did not have appropriate storage equipment.[25] Antibiotics were in short supply, whereas less useful medications such as amiodarone were at hand.[24] In Haiti, most food and water supplies for patients were provided by family members.[26] An adequate assessment of appropriate food supplies should include consideration of the need for cooking, refrigeration, or disinfection. Consideration should be given to locally available foods.[15] Supply rations such as the US military's MREs (meals ready to eat) proved somewhat useful.[15] However, in one example, meals containing pork were dropped into an area where religious beliefs prohibited their use. During the tsunami response, some areas received an overabundance of food with much wasted, whereas other regions went without.[23,27] Across all 3 disasters, the needs of special populations were not adequately accounted for.

Transportation

Articles on all 3 disasters noted issues related to both the transport system and arrival hubs. Damage to infrastructure made existing roads impassable.[27] The overwhelming burden of personnel and equipment arriving at international ports congested transport hubs and occupied ground transport. For example, the Haitian airport lacked coordination and staffing and could not handle the large amounts of incoming personnel and supplies.[19,28-30] Also, tsunami response accounts describe how equipment and supplies were held at ports of entry as the result of customs regulations that were not adapted to facilitate post-disaster receipt of goods.[31]

The coordination of military forces, both international and local, was useful in distributing supplies.[32] One report of the Indian Ocean tsunami response noted that US Navy Blackhawk helicopters cooperated with the US Agency for International Development in Indonesia to deliver supplies to devastated areas.[33]

Timeliness and Efficiency

In the first hours and days after the Haiti earthquake the greatest numbers of life-threatening injuries were encountered. International responders with the capabilities to care for these conditions mostly arrived after this 72-hour time period.[17,34] Local residents recovered the greatest number of survivors and transported the majority of patients.[16] In Bam, 85% to 95% of survivors were extricated within 24 hours.[12] The Iranian military was operational within hours of the event.[12] The majority of search and rescue teams arrived in

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Bam after most rescues had already taken place. In Haiti, as the response shifted from rescue to recovery, the initial responders found their capabilities insufficient to address current needs. Nations including the United States had deployed disaster medical assistance teams whose skills could address acute injury or illness or even exacerbations of chronic illness but did not contribute to infrastructure recovery efforts. This demonstrates the importance of coordinating the timing and nature of resource deployment with the post-disaster phase.

Interagency Coordination

Interagency coordination was problematic in all 3 responses. A significant number of the international responders did not obtain an accurate assessment of the needed resources in advance. Many relief organizations operated independently and conducted their own needs assessment. There was limited to no interagency agreement on which locales and populations would most benefit from aid or what type of aid was appropriate.[14,16,22,25] Moreover, inadequately prepared responders at times placed a burden on local resources.[22] In one example, a province in Thailand reported having to coordinate the activities of 14 volunteer organizations.[35]

RESEARCH AND POLICY IMPLICATIONS

The review presented here focused on observations from responses to 3 disasters that gave rise to a notional framework for developing standardized performance measures for disaster relief. Through a careful review of the peer-reviewed literature related to these incidents, we identified key barriers to disaster relief and factors that were noted to be important to successful response. We identified 5 categories of themes or activities that we considered to be key to these responses: (1) personnel, (2) equipment and supplies, (3) transportation, (4) timeliness and efficiency, and (5) interagency coordination. Under each one, again informed by our literature review, we identified key subcategories and specific activities that collectively can serve as a basis for developing standardized performance measures. The validity and comprehensiveness of these categories and items can be tested by applying them in a checklist fashion to recent or future disaster responses, after which standardized performance measures can be developed through a consensus process. While these may not be exhaustive, the framework proposed here lays the groundwork for further development of standardized performance measures for disaster response. Future work should apply a formal consensus process such as a Delphi process with a number of experts to determine which measures are best suited for standardization, which in turn can inform policy and practice guidelines for disaster relief.

CONCLUSIONS

Development and application of performance measures to evaluate past and future disaster response efforts can improve the quality and timeliness of such efforts. A comprehensive review of 3 disasters helped identify 5 key categories, subcategories, and specific activities that can serve as an organizational framework for developing standardized performance measures through a future consensus process.

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REFERENCES

1. Reuters. Nepal quake death toll becomes highest on record; dozens still missing. *Reuters*. http://www.reuters.com/article/2015/05/17/us-quake-nepal-idUSKBN0O20LL20150517#ivHJjkIbo1uoCx7g.97. Published May 17, 2015. Accessed January 5, 2017.
2. United Nations Office for Coordination of Humanitarian Affairs. Performance and Accountability Framework. UNOCHA website. http://www.unocha.org/cerf/reportsevaluations/evaluations/country-reviews. Published 2015. Accessed January 5, 2017.
3. Federal Emergency Management Agency. *National Response Framework*. FEMA website. http://www.fema.gov/national-response-framework. Accessed January 5, 2017.
4. Norton I, von Schreeb J, Aitken P, et al. *Classification and Minimum Standards for Foreign Medical Teams*. Geneva, Switzerland: World Health Organization; 2013.
5. Adini B, Verbeek L, Trapp S, et al. Continued vigilance - development of an online evaluation tool for assessing preparedness of medical facilities for biological events. *Front Public Health*. 2014;2:35. http://dx.doi.org/10.3389/fpubh.2014.00035.
6. Rådestad M, Jirwe M, Castrén M, et al. Essential key indicators for disaster medical response suggested to be included in a national uniform protocol for documentation of major incidents: a Delphi study. *Scand J Trauma Resusc Emerg Med*. 2013;21(1):68. http://dx.doi.org/10.1186/1757-7241-21-68.
7. Agboola F, Bernard D, Savoia E, et al. Development of an online toolkit for measuring performance in health emergency response exercises. *Prehosp Disaster Med*. 2015;30(5):503-508. http://dx.doi.org/10.1017/S1049023X15005117.
8. Belfroid E, Hautvast JLA, Hilbink M, et al. Selection of key recommendations for quality indicators describing good quality outbreak response. *BMC Infect Dis*. 2015;15(1):166. http://dx.doi.org/10.1186/s12879-015-0896-x.
9. Daftary RK, Cruz AT, Reaves EJ, et al. Making disaster care count: consensus formulation of measures of effectiveness for natural disaster acute phase medical response. *Prehosp Disaster Med*. 2014;29(5):461-467. http://dx.doi.org/10.1017/S1049023X14000922.

https://doi.org/10.1017/dmp.2016.173 Published online by Cambridge University Press

10. Kun KE, Rose DA, Morris T, et al. Conceptualizing and measuring community preparedness within public health preparedness and response: complexities and lessons learned. *J Public Health Manag Pract*. 2014; 20(4):E1-E5. http://dx.doi.org/10.1097/PHH.0b013e3182a5bbcc.
11. McCunn M, Ashburn MA, Floyd TF, et al. An organized, comprehensive, and security-enabled strategic response to the Haiti earthquake: a description of pre-deployment readiness preparation and preliminary experience from an academic anesthesiology department with no preexisting international dis. *Anesth Analg*. 2010;111(6):1438-1444. http://dx.doi.org/10.1213/ANE.0b013e3181f42fd3.
12. Abolghasemi H, Radfar MH, Khatami M, et al. International medical response to a natural disaster: lessons learned from the Bam earthquake experience. *Prehosp Disaster Med*. 2006;21(3):141-147. http://www.ncbi.nlm.nih.gov/pubmed/16892878. Accessed May 1, 2015. http://dx.doi.org/10.1017/S1049023X00003599.
13. Bridgewater FHG, Aspinall ET, Booth JPM, et al. Team Echo: observations and lessons learned in the recovery phase of the 2004 Asian tsunami. *Prehosp Disaster Med*. 2006;21(1):s20-s25. http://www.ncbi.nlm.nih.gov/pubmed/16602269. Accessed May 1, 2015. http://dx.doi.org/10.1017/S1049023X00015831.
14. Zoraster RM. Barriers to disaster coordination: health sector coordination in Banda Aceh following the South Asia Tsunami. *Prehosp Disaster Med*. 2006;21(1):s13-s18. http://www.ncbi.nlm.nih.gov/pubmed/16602268. Accessed May 4, 2015. http://dx.doi.org/10.1017/S1049023X0001582X.
15. Aitken P, Leggat P, Robertson A, et al. Health and safety aspects of deployment of Australian disaster medical assistance team members: results of a national survey. *Travel Med Infect Dis*. 2009;7(5):284-290. http://dx.doi.org/10.1016/j.tmaid.2009.03.005.
16. Telford J, Cosgrave J. The international humanitarian system and the 2004 Indian Ocean earthquake and tsunamis. *Disasters*. 2007;31(1):1-28. http://dx.doi.org/10.1111/j.1467-7717.2007.00337.x.
17. Millard WB. Starting from scratch: Haiti's earthquake and disaster planning. *Ann Emerg Med*. 2010;55(5):A17-A22. http://www.ncbi.nlm.nih.gov/pubmed/20425904. Accessed May 1, 2015. http://dx.doi.org/10.1016/j.annemergmed.2010.03.018.
18. Jaffer AK, Campo RE, Gaski G, et al. An academic center's delivery of care after the Haitian earthquake. *Ann Intern Med*. 2010;153(4):262-265. http://dx.doi.org/10.7326/0003-4819-153-4-201008170-00266.
19. Hopmeier MJ, Pape JW, Paulison D, et al. Reflections on the initial multinational response to the earthquake in Haiti. *Popul Health Manag*. 2010;13(3):105-113. http://dx.doi.org/10.1089/pop.2010.1331.
20. Peleg K, Kreiss Y, Ash N, et al. Optimizing medical response to large-scale disasters: the ad hoc collaborative health care system. *Ann Surg*. 2011; 253(2):421-423. http://dx.doi.org/10.1097/SLA.0b013e318206bedf.
21. Lane DA. Medical support to Sri Lanka in the wake of tsunamis: planning considerations and lessons learned. *Mil Med*. 2006; 171(10 suppl 1):19-23. http://www.ncbi.nlm.nih.gov/pubmed/17447616. Accessed May 1, 2015. http://dx.doi.org/10.7205/MILMED.171.1S.19.
22. Smith J, Fink S, Hansch S, et al. Session 1.4: health services delivery: a critical review of experience. *Prehosp Disaster Med*. 2005;20(6):389-392. http://www.ncbi.nlm.nih.gov/pubmed/16496619. Accessed May 2, 2015. http://dx.doi.org/10.1017/S1049023X00002946.
23. Roy N. The Asian tsunami: Pan-American Health Organization disaster guidelines in action in India. *Prehosp Disaster Med*. 2006;21(5):310-315. http://www.ncbi.nlm.nih.gov/pubmed/17297900. Accessed May 1, 2015. http://dx.doi.org/10.1017/S1049023X00003939.
24. Bayard D. Haiti earthquake relief, phase two–long-term needs and local resources. *N Engl J Med*. 2010;362(20):1858-1861. http://dx.doi.org/10.1056/NEJMp1003839.
25. Auerbach PS, Norris RL, Menon AS, et al. Civil-military collaboration in the initial medical response to the earthquake in Haiti. *N Engl J Med*. 2010;362(10):e32. http://dx.doi.org/10.1056/NEJMp1001555.
26. Rosborough S. A tale of two responses: Haiti earthquake highlights the need for training in international disaster response. *Disaster Med Public Health Prep*. 2010;4(1):21-23. http://www.ncbi.nlm.nih.gov/pubmed/20389191. Accessed April 29, 2015. http://dx.doi.org/10.1017/S1935789300002378.
27. Yamada S, Gunatilake RP, Roytman TM, et al. The Sri Lanka tsunami experience. *Disaster Manag Response*. 2006;4(2):38-48. http://dx.doi.org/10.1016/j.dmr.2006.01.001.
28. Birnbaum ML. STOP!!!!! *Prehosp Disaster Med*. 2010;25(2):97-98. http://www.ncbi.nlm.nih.gov/pubmed/20467984. Accessed May 2, 2015. http://dx.doi.org/10.1017/S1049023X00007780.
29. Van Hoving DJ, Wallis LA, Docrat F, et al. Haiti disaster tourism–a medical shame. *Prehosp Disaster Med*. 2010;25(3):201-202. http://www.ncbi.nlm.nih.gov/pubmed/20586008. Accessed March 27, 2015. http://dx.doi.org/10.1017/S1049023X00008001.
30. Bateman C. Haiti tragedy shakes up SA's emergency response planning. *S Afr Med J*. 2010;100(9):552-553. http://www.ncbi.nlm.nih.gov/pubmed/20822635. Accessed May 1, 2015. http://dx.doi.org/10.7196/SAMJ.4429.
31. De Silva T, Chikersal J, Snoad N, et al. Panel 2.18: logistics, information technology (IT), and telecommunications in crisis management. *Prehosp Disaster Med*. 20(6):464-467. http://www.ncbi.nlm.nih.gov/pubmed/16496638. Accessed February 23, 2016.
32. Kapila M, McGarry N, Emerson E, et al. Health aspects of the tsunami disaster in Asia. *Prehosp Disaster Med*. 2005;20(6):368-377. http://www.ncbi.nlm.nih.gov/pubmed/16496615. Accessed May 1, 2015. http://dx.doi.org/10.1017/S1049023X00002909.
33. Joyce N. Civilian-military coordination in the emergency response in Indonesia. *Mil Med*. 2006;171(10)(suppl 1):66-70. http://www.ncbi.nlm.nih.gov/pubmed/17447628. Accessed May 1, 2015. http://dx.doi.org/10.7205/MILMED.171.1S.66.
34. Lee VJ, Low E, Ng YY, Teo C. Disaster relief and initial response to the earthquake and tsunami in Meulaboh, Indonesia. *Ann Acad Med Singapore*. 2005;34(9):586-590. http://www.ncbi.nlm.nih.gov/pubmed/16284685. Accessed May 1, 2015.
35. Rapid health response, assessment, and surveillance after a tsunami–Thailand, 2004-2005. *MMWR Morb Mortal Wkly Rep*. 2005;54(3): 61-64. http://www.ncbi.nlm.nih.gov/pubmed/15674183. Accessed May 4, 2015.

https://doi.org/10.1017/dmp.2016.173 Published online by Cambridge University Press