COMPREHENSIVE REVIEW

Challenges in Disaster Data Collection during Recent Disasters

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GIS = geographic information system

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Abstract

Gathering essential health data to provide rapid and effective medical relief to populations devastated by the effects of a disaster-producing event involves challenges. These challenges include response to environmental hazards, security of personnel and resources, political and economic issues, cultural barriers, and difficulties in communication, particularly between aid agencies. These barriers often impede the timely collection of key health data such as morbidity and mortality, rapid health and sheltering needs assessments, key infrastructure assessments, and nutritional needs assessments. Examples of these challenges following three recent events: (1) the Indian Ocean tsunami; (2) Hurricane Katrina; and (3) the 2010 earthquake in Haiti are reviewed. Some of the innovative and cutting-edge approaches for surmounting many of these challenges include: (1) the establishment of geographical information systems (GIS) mapping disaster databases; (2) establishing internet surveillance networks and data repositories; (3) utilization of personal digital assistant-based platforms for data collection; (4) involving key community stakeholders in the data collection process; (5) use of pre-established, local, collaborative networks to coordinate disaster efforts; and (6) exploring potential civil-military collaborative efforts. The application of these and other innovative techniques shows promise for surmounting formidable challenges to disaster data collection.

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Introduction

The rapid collection of data regarding key aspects of a disaster is critical to ensuring an effective disaster responses. The timely collection of data such as morbidity and mortality statistics, health needs (including mental health), infrastructure assessments, nutritional assessments, sheltering needs, and other disaster characteristics also is essential in specifically targeting the needs of each community.[1–4] However, the environment surrounding a disaster is chaotic, often hazardous, and usually possesses insufficient infrastructure to support the rapid collection and consolidation of key disaster data.

There are several predominant challenges in the disaster arena. Environmental challenges may drastically limit access to the disaster-affected area, destroying local roads and other transportation systems. The hazard creating the disaster may be ongoing and may present a significant hazard for disaster response personnel. Infectious diseases due to degraded infrastructure and lack of adequate water and sanitation facilities may affect the health of disaster responders and researchers. Societal insecurity and instability may arise due to the widespread loss of life and destruction of key infrastructure such as housing and utilities.

Complex disasters create political and economic challenges, includling the host government's refusal to accommodate certain aid agencies, or a desire by the government to minimize or change certain disaster data such as mortality estimates. Inadequate space or resources for data collection may result from the widespread destruction of key infrastructure. Economic challenges, such as a lack of adequate funding, may further impede data collection efforts. Cultural and language barriers also may complicate data collection, due to the need for translators in the event that aid and research personnel do not speak the local language. Finally, a lack of cooperation among disaster response organizations further serves to impede rapid and efficient data collection.

The purpose of this article is to discuss challenges in data gathering during recent disasters, including the Indian Ocean tsunami, Hurricane Katrina, and the ongoing

response to the 2010 Haiti Earthquake. Furthermore, this article will discuss methods to surmount these challenges in order to improve data collection in future disaster efforts.

Selected Key Disaster Data Indicators

Although an infinite number of potential disaster indicators could be discussed, for the purposes of feasibility, this discussion will be limited to the key indicators of mortality, injury/morbidity, rapid health assessments, shelter needs assessments, nutritional and food aid assessments, and infrastructure assessments. The selection of these indicators reflects the most fundamental needs in disaster planning and response, as described in the Sphere Project's *Humanitarian Charter and Minimum Standards in Disaster Response*.[5]

Indian Ocean Earthquake and Tsunami

The 2004 Indian Ocean earthquake and tsunami caused an estimated 229,866 deaths, as well as mass-population displacements.[6] During such a disaster, even the collection and reporting of such basic numbers are problematic. There is no standardized procedure for the verification of disaster statistics that are published in the lay press. Consequently, general estimates in the initial phases of a disaster may or may not have a factual or scientific basis. Such estimates may be printed and accepted as true by the public and remain in historical records, complicating analysis of disaster characteristics and responses.[7] Although the mortality numbers generally are accepted as correct, the source is a compilation of individual government estimates, and as such, may or may not have been verified by outside agencies and/or may be influenced to some degree by political factors.

Researchers in the post-tsunami environment faced challenges in data collection. Researchers at Johns Hopkins undertook a major morbidity and mortality data collection effort in one of the hardest hit areas, Aceh Province, Indonesia. Several districts within the Province had to be excluded due to concerns such as government non-cooperation, inaccessibility, or insecurity.[8] The city of Calang in Aceh Jaya, Indonesia was destroyed, along with all health records, most of the government officials, and all of the physicians who may have been sources of prior health and population data. As a result, most data were obtained from secondary sources, resulting in biases such as misclassification bias and recall bias.[9] Communication and translation challenges, as well as difficulties in transporting data collection teams were reported by the French Army Medical Service's health assessment surveys following the tsunami in Indonesia.[10] In many regions of Indonesia, poor prior health record-keeping also limited the comparative effectiveness of the health data collected following the earthquake and/or the tsunami, making it difficult to determine which health effects resulted from the tsunami, and which reflected pre-existing health problems.[11]

Mortality data collection teams in Sri Lanka also faced political challenges. A visiting forensic team tasked with identifying and recording 1,500 estimated deaths due to the tsunami striking a passenger train only was able to complete 250 records due to interference from the public and political pressure.[12] Governmental transparency was a key challenge in data collection in post-tsunami Thailand. Data collected by governmental groups in regard to water and sanitation efforts and other disaster data indicators, were not made public and were shared only internally, complicating response efforts.[13]

Sri Lanka's efforts were made all the more challenging given the massive displacement and poverty that existed in the setting of an ongoing 20-year war.[14] Understandably, Sri Lankan disaster health and shelter data collection teams in the post-tsunami environment felt that security was a challenge, particularly in areas such as Batticloa when attempting interview-based shelter and displacement data collection efforts of local women and public officials.[15] Skirmishes broke out occasionally during data collection efforts, and torture, suicide bombings, kidnappings, detentions, and assassinations occurred on a daily basis, dramatically complicating research efforts.[8] The violence and instability due to the two major warring factions and the authoritarian rule of the Libertarian Tigers of Tamil Eelam greatly hindered ongoing humanitarian aid operations in the Wanni region by hindering access to civil society organizations.[16] Researchers and disaster responders from Norway also faced stress as evidenced in a survey of 1,179 responders (with a response rate of 56%). Survey results indicated that stress resulted from witnessing death and chaos, and having to turn away some in need of help.[17] These increases in psychological stress created a barrier to effective data collection and aid operations.

Lack of national and local mass-fatality plans in Thailand limited the effectiveness of data collection there, and rapid decomposition of bodies after 24 to 48 hours made visual identification of the dead impossible. Furthermore, the sheer number of casualties and deaths overwhelmed the government and healthcare system.[18] These challenges were complicated further by the lack of adequate technical support from international agencies and lack of field guidelines for data collectors.[14] Cultural differences in the grieving process and a lack of mental health assessment tools not previously validated in Eastern cultures hampered mental health data and post-traumatic stress disorder (PTSD) assessments in Thailand.[19,20] In a survey of Australian Disaster Medical Assistance Team (DMAT) responders, although the food, water, and sanitation needs of responders were adequately met, only 64% of responders to a mail-based survey of healthcare providers stated that they felt security was adequate (although this survey had a low response rate of 50%).[21] Low response rates are another challenge facing disaster researchers. Although this is not unique to the disaster community (and indeed may be exacerbated due to the above challenges), researchers should utilize novel strategies or allocate additional personnel resources in order to maximize response rate and data quality.

Hurricane Katrina

Hurricane Katrina, which hit the coast of New Orleans on 29 August 2005, displaced >1 million people, was responsible for the deaths of >1,800 people,[22] and resulted in [US] $100 billion in property damage.[23] Due to the pre-existing public health infrastructure in the US, the disaster created by Hurricane Katrina posed different challenges in morbidity and mortality data collection. Mortality data after Hurricane Katrina were somewhat easier to collect than following the Indian Ocean tsunami, given the presence of death certificates for the victims at the Louisiana State Coroner's Office. Other mortality information was obtained through the death certificates of Louisiana citizens forwarded to the Coroners' Offices from other states to which they were displaced.[24] However, calculating mortality in this fashion is time-consuming, and necessitates waiting for the arrival of the certificates; thus, this method is not feasible for rapid mortality assessments following disasters. Additionally,

this method is more feasible in developed countries with centralized and well-established record-keeping networks. A further challenge to mortality data collection after Hurricane Katrina was that many medical and dental records were destroyed and the human remains, after prolonged exposure to water and heat, made visual identification impossible.[25] The wide dispersion of populations to other US states also provided a challenge to ensuring accurate mortality assessments.[26]

The completion of health assessments following Hurricane Katrina was complicated by the dispersion of the affected population. Although large numbers of people were present in mass-sheltering areas, those located outside of such mass-sheltering areas were difficult to include in these assessments, as their whereabouts were unknown.[27] Similarly, collection of health data on elderly persons has been problematic in disasters, perhaps due to disability and its resultant reduction in access to health services,[28] and lack of targeted efforts to evacuate and assist elderly and disabled persons.[29,30] The lack of a standardized data collection tool to be utilized across multiple agencies was cited as a challenge to morbidity data collection.[31] Illiteracy among some study subjects also complicated certain aspects of health data collection in the aftermath of Katrina, as functional illiteracy rates (an inability to fill out basic government forms) among New Orleans are approximately 44%.[32,33] Due to literacy concerns, surveys were read aloud in one mental health study, and mistrust of health researchers among African-American communities also may have limited to some extent, their participation in health-related studies.[34] In another study, health data from the period of September 2005 through January 2006on cardiac-related health events simply was not available, as the only remaining hospital with cardiac services was not operating at full functional capacity.[35] Due to the profound destruction of property sustained from Hurricane Katrina, researchers had difficulty locating residents in one geographically based study on mental health.[36]

Similar to data collection efforts following the Indian Ocean tsunami, disaster responses and data collection efforts in the aftermath of Hurricane Katrina were plagued by political challenges. Poor communication between federal, state, and local agencies complicated health and disaster assessments, particularly during the initial phase of the disaster.[37] Local authorities perceived that the federal government did not support them or let them "take the lead" in their respective areas of expertise, complicating a large, local needs assessment survey following the hurricane.[38]

Limited availability of point-of-care testing devices for common infectious pathogens and other laboratory diagnostic assays resulted in significant diagnostic delay and a resultant impairment in rapid health data collection in the aftermath of both Hurricane Katrina and the Indian Ocean tsunami. Among the teams who were equipped with these devices, point-of-care testing demonstrated value in disaster responses following Hurricane Katrina.[39]

In contrast to the Indian Ocean tsunami, data collectors and disaster responders after Hurricane Katrina did not face violent opposition to their efforts. However, in the initial aftermath of the hurricane, there were reports of lawlessness and public instability, such as a sniper attack on health workers at one New Orleans hospital attempting to evacuate injured patients.[40] The disaster caused by Hurricane Katrina may have been the only modern disaster in which the government and basic public health infrastructure of a major US metropolitan area collapsed completely.[41] This lack of basic public services contributed to challenges in the collection and reporting of routine and disaster-related health data.

2010 Earthquake in Haiti

The 12 January 2010 earthquake in Haiti resulted in the deaths of approximately 230,000 persons, 300,000 injured survivors, and left 1.5 million homeless.[42] This earthquake caused more than double the mortality of any 7.0 Richter scale event.[43] United Nations assessment teams estimate that 245,000 structures were destroyed by the earthquake, creating rubble and debris of 30 to 78 million cubic yards, enough to fill the Louisiana Superdome as many as 17 times.[44]

The lack of government regulation of and proper record-keeping of children in Haitian orphanages prior to the earthquake made data collection in regard to their health and well-being an even greater challenge following the earthquake than before the earthquake. Only 10% of Haitian children have a birth certificate on file with the government.[45] This lack of accountability rendered these children easy targets for individuals seeking to traffic or otherwise exploit them in the aftermath of the earthquake.[46] Physicians working in Haiti often had treated girls as young as 12 years of age for sexually transmitted infections, and the multitude of women reporting episodes of sexual assault in displaced persons camps has led the World Health Organization to launch a special investigation into the health needs of women.[47] However, these types of crimes often are difficult to document, even in the most ideal circumstances.

The lack of intact hospital records and the destruction of hospital infrastructure in Port-au-Prince has made collection of hospital inpatient information all but impossible.[48] There were very few remaining functioning laboratories and radiology resources that were available in the aftermath of the earthquake, making diagnosis and identification of diseases and injuries particularly challenging. Patients undergoing treatment for chronic illnesses such as HIV and tuberculosis, had no available medical records of prior treatment.[49] Minimal law enforcement resources in the initial days following the earthquake also complicated relief and data collection efforts,[50] although the arrival of military forces provided additional security for disaster responders and researchers.

A lack of cooperation among relief agencies plagued efforts in Haiti. There are reports of relief agencies refusing to share data, competing for available funding, and ignoring local grassroots organizations that may have better established networks for data collection and aid distribution.[51] A lack of knowledge of available resources also impeded patient diagnosis, treatment, and care, as agencies with similar missions often worked without knowledge of each other's projects and the complementary resources that may have synergistically assisted each in their endeavors.[52]

Surmounting the Challenges of Disaster Data Collection

There are a number of potential innovations that could assist in surmounting the political, security, environmental, cultural, infrastructural, and cooperation challenges to collecting data during and in the aftermath of a disaster. Internet-based data aggregation systems, such as geographic information systems (GIS) mapping, may prove revolutionary in the management of disaster efforts. The Harvard Center for Geographic Analysis,

in conjunction with the Massachusetts Institute of Technology (MIT) and Boston University, have joined efforts to establish the Haiti Earthquake Data Portal.[53] The Portal integrates all available GIS mapping of disaster-related data, such as sheltering needs, locations of hospitals and other health facilities, and almost all other conceivable data related to the disaster. Plotting such data on GIS maps helps to enable disaster responders to target the areas most urgently in need of food, identify areas most appropriate for the construction of temporary shelters, and plan the most effective locations for future construction (avoiding existing high-risk areas such as fault lines), among many other potential applications. A similar portal has been used by responders to China's earthquakes, and another is under construction for those assisting with disaster-response efforts to Chile's 2010 earthquake.

The utilization of an Internet-based morbidity and mortality surveillance system for Hurricane Katrina evacuees in the US state of Georgia was one highly effective way of capturing health data in a rapid manner. Public health officials in Georgia developed a one-page, health assessment form for disease surveillance in evacuation shelters and for a death registry for hospital-based physicians. This use of an Internet-based platform enabled public health officials throughout the state to have access to key health surveillance data, as well as rapid transmission and sharing of the data with the federal government.[54] The US Centers for Disease Control and Prevention CDC has developed a similar Internet-based, rapid, health assessment platform for sharing of health data called the Rapid Data Collector which has the further advantage of being deployable on personal digital assistants (PDAs).[55] The challenge of such a system is to ensure that other governmental agencies utilize the platform. The National Disaster Medical System also has initiated an electronic medical record, but the compatibility of the system with other agencies is as of yet, unknown. Other authors also had argued for the need for such a database in the early aspects of Hurricane Katrina, in order to rapidly disseminate information, better inform decision-makers, and avoid duplication of efforts.[56]

Conducting brief interview-based surveys at "mega-shelters" such as those established at the Houston Astrodome and Reliant Park complex is one example of efficient and rapid data collection in a disaster scenario. In a 2.5-week period, nearly 30,000 health surveys were completed. These data proved invaluable to healthcare providers and health professionals, and helped to identify disease outbreaks and the overall health status of a large population displaced by Hurricane Katrina. Although this type of mass sheltering may not always be feasible, it highlights an effective and efficient way of meeting a disaster-affected population's sheltering needs, and quickly monitoring the health status of the survivors.[57]

One study analyzing mortality data in Aceh Province, Indonesia—one of the areas hardest hit by the earthquake and tsunami—employed a cluster survey design. Two stages of cluster surveys were conducted using probability-proportional-to-size methodologies for collection of data. Study authors sampled 1,653 tsunami-displaced households. Measurements of household size before and after the earthquake and tsunami were collected. Demographic data regarding those injured or killed were collected, as well as of the survivors.[58,59] Results were extrapolated to generate mortality and injury estimates for the entire Province.

Another method for collecting health surveillance data in a disaster is the use of a collaborative "hotline" for infectious disease outbreaks. Following Hurricane Katrina, the state of Mississippi implemented a surveillance system via a telephone hotline. Health providers at American Red Cross shelters in Mississippi were directed to report suspected cases of selected infectious diseases through a hotline to the Mississippi Department of Health. Reporting in this manner was much more expeditious than with the previous paper-based system.[60]

Other forms of technology may assist in health-related data collection. The rapid deployment of first responders with handheld, point-of-care testing devices for common infectious pathogens could facilitate the diagnosis of disease outbreaks. Such devices already are available and would "bridge the gap" in terms of diagnostic testing until more sophisticated laboratory facilities become available.[61] For example, the iSTAT rapid diagnostic device already has proved essential in Haiti in the rapid identification of patients with crush injury syndrome and potentially in need of life-saving dialysis for rhabdomyolysis.[52]

The establishment of pre-disaster collaborative networks is another method to facilitate and streamline disaster data collection.[62] Following Hurricane Katrina, a pre-existing local collaborative disaster response network in Houston established an incident command structure and was the portal through which all resources related to the ongoing displaced population from Hurricane Katrina was routed. Local community leaders and physicians were the leaders of this disaster response network. An Internet website was used for the purposes of organizing data related to the disaster response network and communicated the status of relief efforts, such as health needs, sheltering needs, personnel available, and other key aspects of the disaster.

Another successful method of data collection in the disaster environment is Community-Based Participatory Research. In one study conducted by Springgate *et al*, the key community stakeholders in post-Katrina New Orleans were developed to assist in identifying local health needs and barriers to meeting these needs. This type of data collection strategy is particularly effective in that it involves community leaders in the process, and builds a community/academic coalition that then can use the data to formulate and implement interventions to improve local population health.[63] Such a community-based, participatory strategy also was helpful for identifying mental health needs and improving mental health care in schools post-Hurricane Katrina.[64]

Military forces were "unequivocally integral" to the efforts of medical personnel in one report. United States military forces rapidly arriving in the aftermath of the Haitian earthquake quickly established crowd control and security, which allowed medical, relief, and research teams to most efficiently carry out their mission.[50] The judicious implementation of military forces in future disaster operations may support disaster data collection by providing a safe and secure environment for relief and research personnel to work.

Conclusions

The post-disaster environment presents a multitude of challenges for those attempting to collect essential data, such as health and sheltering assessments, key infrastructure assessments, and morbidity and mortality data. These challenges include political, environmental, cultural, economic, cooperation, security, and infrastructural elements. Many of these key challenges readily are evident in recent major disasters, such as the Indian

Ocean earthquake and tsunami, Hurricane Katrina, and the 2010 earthquake in Haiti. However, numerous innovative and novel strategies, such as the establishment of GIS mapping disaster databases, internet surveillance and data repositories, involvement of key community stakeholders in the data collection process, civil-military collaborative efforts, and use of pre-established, local, collaborative networks to coordinate disaster efforts show promise in surmounting the formidable challenges that exist to disaster data collection. The use of such novel strategies will serve to save countless lives through rapid collection and dissemination of key health data and the resultant efficient employment of critical, disaster response resources.

References

1. Noji EK: The public health consequences of disasters. *Prehosp Disaster Med* 2000;4:147–157.
2. Noji EK: Disaster epidemiology: Challenges for public health action. *J Public Health Policy* 1992;3:332–340.
3. Anker M: Epidemiological and statistical methods for rapid health assessment: Introduction. *World Health Stat* Q 1991:44;94–97.
4. Smith GS: Development of rapid epidemiological assessment methods to evaluate health status and delivery of health services. *Int J Epidemiol* 1989;18:S2–S15.
5. The SPHERE Project: Humanitarian Charter and Minimum Standards in Disaster Response. Available at http://www.sphereproject.org. Accessed 13 April 2010.
6. United Nations Office of the Special Envoy for Tsunami Recovery Website. New York. Available at http://www.tsunamispecialenvoy.org/default.aspx. Accessed 13 April 2010.
7. Thieren M: Health information systems in humanitarian response. *Bull World Health Organ* 2007;3:218–224.
8. Fernando GA: Assessing mental health and psychosocial status in communities exposed to traumatic events: Sri Lanka as an example. *Am J Orthopsychiatry* 2008;2:229–339.
9. Brennan RJ, Rimba K: Rapid health assessment in Aceh Jaya District, Indonesia, following the December 26 Tsunami. *Emerg Med Australa*s 2005;4:341–350.
10. Meynard JB, Nau A, Halbert E, Todesco A: Health indicators in children from Meulaboh, Indonesia, following the tsunami of December 26, 2004. *Mil Med* 2008;9:900–905.
11. Centers for Disase Control and Prevention (CDC): Assessment of health-related needs after tsunami and earthquake—three districts, Aceh Province, Indonesia, July-August 2005. *MMWR* 2006;4:93–97.
12. Rohan RP, Hettiarachchi M, Vidanapathirana M, Perera S: Management of dead and missing: aftermath of tsunami in Galle. *Leg Med (Tokyo)* 2009;11 Suppl 1: S86–S88.
13. Englande AJ: Katrina and the Thai Tsunami – water quality and public health aspects mitigation and research needs. *Int J Environ Res Public Health* 2008;5:384–393.
14. Morgan OW, Sribanditmongkol P, Perera C, Sulasmi Y, Van Alphen D, Sondorp E: Mass fatality management following the South Asian tsunami disaster: Case studies in Thailand, Indonesia, and Sri Lanka. *PloS Med* 2006;6:e195.
15. Ruwanpura KN: Putting houses in place: rebuilding communities in post-tsunami Sri Lanka. *Disasters* 2009;3:436–456.
16. Culbert V: Civil society development versus the peace dividend: International aid in the Wanni. *Disasters* 2005;1:38–57.
17. Thoresen S, Tonnessen A, Lindgaard CV, Andreassen AL, Weisaeth L: Stressful but rewarding: Norwegian personnel mobilized for the 2004 tsunami disaster. *Disasters* 2009;3:353–368.
18. Johnson LJ, Travis AR: Trimodal death and the injuries of survivors in Krabi Province, Thailand, post-tsunami. *ANZ J Surg* 2006;5:288–289.
19. Van Griensven F, Chakkraband ML, Thienkrua W, *et al*: Mental health problems among adults in tsunami-affected areas in southern Thailand. *JAMA* 2006;5:537–548.
20. Thienkrua W, Cardozo BL, Chakkraband ML, *et al*: Symptoms of posttraumatic stress disorder and epression among children in tsunami-affected areas in southern Thailand. *JAMA* 2006;5:549–559.
21. 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;5:284–290.
22. Beven JL II, Avila LA, Blake ES, *et al*: Annual summary: Atlantic hurricane season of 2005. *Mon Wea Rev* 2008;136:1131–1141.
23. Rosenbaum S: US health policy in the aftermath of Hurricane Katrina: *JAMA* 2006;295:437–440.
24. Brunkard J, Namulanda G, Ratard R: Hurricane Katrina deaths, Louisiana, 2005. *Disaster Med Public Health Prep* 2008;2(4):215–223.
25. Donkervoort S, Dolan SM, Beckwith M, Northrup TP, Sozer A: Enhancing accurate data collection in mass fatality kinship identifications: Lessons learned from Hurricane Katrina. *Forensic Sci Int Genet* 2008;4:354–362.
26. Kanter RK: Child mortality after Hurricane Katrina. *Disaster Med Public Health Prep* 2010;1:62–65.
27. Rodriguez SR, Tocco JS, Mallonee S, Smithee L, Cathey T, Bradley K: Rapid needs assessment of Hurricane Katrina evacuees — Oklahoma, September 2005. *Prehosp Disaster Med* 2006;6:390–395.
28. Mortensen K, Wilson RK, Ho V: Physical and mental health status of Hurricane Katrina evacuees in Houston in 2005 and 2006. *J Health Care Poor Underserved* 2009;2:524–538.
29. Brodie M, Weltzien E, Altman D, *et al*: Experiences of Hurricane Katrina Evacuees in Houston shelters: implications for future planning. *Am J Public Health* 2006;8:1402–1408.
30. Eisenman DP, Cordasco KM, Asch S, Golden JF, Glik D: Disaster planning and risk communication with vulnerable communities: Lessons from Hurricane Katrina. *Am J Public Health* 2007;97 (Suppl 1):s109–s115.
31. Millin MG, Jenkins JL, Kirsch TD: A comparative analysis of two external health care disaster responses following Hurricane Katrina. *Prehosp Emerg Care* 2006;4:451–456.
32. Associated Press: New Orleans confronts low literacy rate. Available at: http://www.msnbc.msn.com/id/26413788/ns/us_news-life/. Accessed 19 April 2011.
33. Steinberg PE, Shields R: *What is a City?: Rethinking the Urban after Hurricane Katrina*. Athens: University of Georgia Press, 2008, p35.
34. Flory K, Kloos B, Hankin BL, Cheely CA: Clinical research after catastrophic disasters: Lessons learned from Hurricane Katrina. *Prof Psychol Res Pr* 2008;1:107–112.
35. Gautam S, Menachem J, Srivastav SK, *et al*: Effect of Hurricane Katrina on the incidence of acute coronary syndrome at a primary angioplasty center in New Orleans. *Disaster Med Public Health Prep* 2009;3:144–150.
36. Sastry N, VanLandingham M: One year later: mental illness prevalence and disparities among New Orleans residents displaced by Hurricane Katrina. *Am J Public Health* 2009;99 Suppl 3:s725–s731.
37. Gheytanchi A, Joseph L, Gierlach E, *et al*: The dirty dozen: Twelve failures of the Hurricane Katrina response and how psychology can help. *Am Psychol* 2007;2:118–130.
38. Post DE, Kasofsky JM, Hunt CN, Diaz JH: A regional human services authority's rapid needs assessment of evacuees following natural disasters. *Am J Disaster Med* 2008;5:253–264.
39. Kost GJ, Tran NK, Tuntideelert M, *et al*: Katrina, the tsunami, and point-of-care testing: Optimizing rapid response diagnosis in disasters. *Am J Clin Pathol* 2006;4:513–520.
40. CNN. Sniper fire halts hospital evacuation. Available at http://www.cnn.com/2005/WEATHER/09/01/katrina.hospital.sniper/index.html. Accessed 19 April 2010.
41. Klein KR, Pepe PE, Burkle FM Jr, *et al*: Evolving need for alternative triage management in public health emergencies: A Hurricane Katrina case study. *Disaster Med Public Health Prep* 2008;2 (Suppl 1):s40–s44.
42. BBC News. Haiti quake death toll rises to 230,000. February 11, 2010. Available at http://news.bbc.co.uk/2/hi/americas/8507531.stm. Accessed 21 April 2010.
43. Bilham R: Lessons from the Haiti earthquake. *Nature* 2010 Feb;7283:878–879.
44. Booth W: Haiti faces colossal and costly cleanup before it can rebuild. Available at http://www.washingtonpost.com/wp-dyn/content/article/2010/03/06/AR2010030602544.html?hpid=artslot. Accessed 21 April 2010.
45. UNICEF: Haiti emergency response update: March 17, 2010. Available at http://www.reliefweb.int/rw/RWFiles2010.nsf/FilesByRWDocUnidFilename/MDCS-83PC9M-full_report.pdf/$File/full_report.pdf. Accessed 21 April 2010.
46. Balsari S, Lemery J, Williams TP, Nelson BD: Protecting the children of Haiti. *N Engl J Med* 2010;9:e25.
47. United Nations Office for the Coordination of Humanitarian Affairs. Haiti earthquake situation report #30. Available at http://www.reliefweb.int/rw/RWFiles2010.nsf/FilesByRWDocUnidFilename/VVOS-83PQ24-full_report.pdf/$File/full_report.pdf. Accessed 21 April 2010.
48. Curran M: Haiti—A view from the ship. *N Engl J Med* 2010;11:e41.
49. Bayard D: Haiti earthquake relief, Phase Two—Long term needs and local resources. *N Engl J Med* 2010 Apr 14. [Epub ahead of print.]
50. 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;10:e32.
51. Growth of aid and decline of humanitarism. *Lancet* 2010;9711:253.

52. Vanholder R, Gibney N, Luycks VA, *et al*: Renal Disaster Relief Task Force in Haiti earthquake. *Lancet* 2010;9721:1162–1163.
53. Haiti Earthquake Data Portal. Available at http://cegrp.cga.harvard.edu/haiti/. Accessed 21 April 2010.
54. Cookson ST, Soetebier K Murray EL, *et al*: Internet-based morbidity and mortality surveillance among Hurricane Katrina evacuees in Georgia. *Prev Chronic Dis* 2008;4:A133.
55. Natural disaster surveillance resources. Atlanta (GA): Centers for Disease Control and Prevention. Available at http://www.bt.cbc.gov/disasters/surveillance/resources.asp. Accessed 21 April 2010.
56. Mills EJ, Robinson J, Attaran A, Clarke M, Singh S, Upshur RE: Sharing evidence on humanitarian relief. *BMJ* 2005;7531:1485–1486.
57. Murray KO, Kilborn C, DesVignes-Kendrick M, *et al*: Emerging disease syndromic surveillance for Hurricane Katrina evacuees seeking shelter in Houston's Astrodome and Reliant Park Complex. *Public Health Rep* 2009;3:364–371.
58. Doocy S, Rofi A, Moody C, *et al*: Tsunami mortality in Aceh Province, Indonesia. *Bull World Health Org* 2007;4:273–278.
59. Doocy S, Robinson C, Moodie C, Burnham G: Tsunami-related injury in Aceh Province, Indonesia. *Glob Public Health* 2009;2:205–214.
60. Cavey AM, Spector JM, Ehrhardt D, *et al*: Mississippi's infectious disease hotline: A surveillance and education model for future disasters. *Prehosp Disaster Med* 2009;1:11–17.
61. Kost GJ, Hale KN, Brock TK, *et al*: Point-of-care testing for disasters: Needs assessment, strategic planning, and future design. *Clin Lab Med* 2009;3:583–605.
62. Mattox KL: Hurricanes Katrina and Rita: Role of individuals and collaborative networks in mobilizing/coordinating societal and professional resources for major disasters. *Crit Care* 2006;1:205.
63. Springgate BF, Allen C, Jones C, *et al*: Rapid community participatory assessment of health care in post-storm New Orleans. *Am J Prev Med* 2009;6 Suppl 1:s237–s243.
64. Kataoka SH, Nadeem E, Wong M, *et al*: Improving disaster mental health care in schools: A community-partnered approach. *Am J Prev Med* 2009;6 Suppl 1:s225–s229.