

Demography and Public Health Emergency Preparedness: Making the Connection

Heather Allen · Rebecca Katz

Received: 18 February 2009 / Accepted: 4 August 2009 / Published online: 21 August 2009
© The Author(s) 2009. This article is published with open access at Springerlink.com

Abstract The tools and techniques of population sciences are extremely relevant to the discipline of public health emergency preparedness: protecting and securing the population's health requires information about that population. While related fields such as security studies have successfully integrated demographic tools into their research and literature, the theoretical and practical connection between the methods of demography and the practice of public health emergency preparedness is weak. This article suggests the need to further the interdisciplinary use of demography by examining the need for a systematic use of population science techniques in public health emergency preparedness. Ultimately, we demonstrate how public health emergency preparedness can incorporate demography to develop more effective preparedness plans. Important policy implications emerge: demographers and preparedness experts need to collaborate more formally in order to facilitate community resilience and mitigate the consequences of public health emergencies.

Keywords Public health · Preparedness · Policy · Demography

Introduction

The field of public health emergency preparedness (PHEP) rests upon the fundamental tenet of public health: the health of an individual depends on the

H. Allen (✉)

The Trachtenberg School of Public Policy and Public Administration, The George Washington University, 805 21st, NW, Suite 601, Washington, DC 20052, USA
e-mail: haa9@gwu.edu

R. Katz

Department of Health Policy, School of Public Health and Health Services, The George Washington University, 2021 K Street, NW, Suite 800, Washington, DC 20006, USA
e-mail: rlkatz@gwu.edu

health of a population. Though demographic techniques and data can assist in describing and evaluating the health characteristics of a given population, demography has not been used by practitioners in the field of PHEP, despite the wealth of relevant information and expertise. In order to make effective preparedness plans, key methods in demography need to be systematically integrated into the discipline of PHEP. This article intends to justify the link between important population science techniques and the practice of PHEP. Subsequently, this article will (1) offer a brief narrative about the PHEP field, (2) lay the theoretical justification for this interdisciplinary connection through a literature review, (3) show the need for this connection by exploring ways in which demographic data or methods should be employed in PHEP, and (4) discuss the implications of incorporating the tools of population sciences into PHEP policy-making. Ultimately, more formal collaboration is generally required between practitioners of preparedness and practitioners of population sciences to help ensure the wellbeing of populations during a public health emergency.

Public Health Emergency Preparedness

The field of public health encompasses a variety of aspects. As opposed to the provision of health care services to individuals, public health utilizes population based measures such as disease surveillance to more broadly protect the public. Particularly in recent years, initiatives to control public health emergencies and events have become fundamental to the public health system (Katz and Levi 2008). The field of public health emergency preparedness (not even a decade old) can be defined as:

The capability of the public health and health care systems, communities, and individuals, to prevent, protect against, quickly respond to, and recover from health emergencies, particularly those whose scale, timing, or unpredictability threatens to overwhelm routine capabilities. (Nelson et al. 2007, S9)

According to the Centers for Disease Control and Prevention (CDC), there are six types of public health emergencies. These include: bioterrorism, chemical emergencies, radiation emergencies, mass casualties, natural disasters/severe weather, and acute disease outbreaks¹ (CDC 2008). An acute disease outbreak would include both an emerging infectious disease as well as a pandemic caused by a known or novel agent. For example, the appearance of an influenza virus strain that had the potential to cause a pandemic (as defined by the worldwide spread of disease with an enormous number of deaths and illnesses) would constitute a public health emergency (WHO 2009a). The 2009 novel H1N1 influenza A virus is such an example, and was declared a public health emergency of international concern (WHO 2009c).

The responsibility for PHEP planning is shared by a myriad of state and federal entities. The federal government released the National Response Framework (NRF),

¹ CDC formally refers to these as ‘recent outbreaks and incidents’.

which includes an Emergency Support Function that is explicitly devoted to public health services (Department of Homeland Security 2008a, b). Along with the Department of Homeland Security (DHS), there are 16 other federal agencies involved with PHEP per the NRF, led by the Department of Health and Human Services (HHS) and supported by the: Department of Defense (DOD), Department of Labor (DOL), Department of Agriculture (DOA), Department of Transportation (DOT), Department of State (DOS), and others (DHS 2008b). Within HHS, the Office of the Assistant Secretary for Preparedness and Response (ASPR) is responsible for matters involving public health emergencies and bioterrorism (HHS 2009a). In addition to this federal activity, states and localities have been actively involved in PHEP, particularly in the development of pandemic response plans (Katz and Levi 2008; HHS 2009b). The breadth and depth of government entities involved in PHEP is substantial and particularly in recent years, PHEP has increasingly been recognized as fundamental and closely related to the nation's security (Fidler and Gostin 2008).

Review of Literature

This literature review has a dual purpose. First, to discuss how disciplines related to PHEP—security studies, environmental sciences, and health systems research—have used methods and data from demography to systematically inform their research and practice. Second, to demonstrate how the existing use of population science methods in PHEP is extremely limited and rarely connected to actual preparedness plans or policy. The purpose of this section is to lay a convincing foundation for the need to systematically use demographic tools in PHEP practice.

Demography in Related Fields

The field of security studies has successfully integrated various aspects of the discipline of demography into theory and research, particularly in relation to the security and stability of populations. RAND recognized the important role of population sciences in security studies in a 2000 workshop (see Murawiec and Adamson 2001). Indeed, the concept of ‘political demography’ has developed, in other words, how demographic characteristics “affect the stability and security of states and societies” (Weiner and Russell 2001, p. 1). Literature has called for “greater recognition of the demographic transition as a security-relevant process” (Cincotta et al. 2003, p. 23). Broadly, population data and various demographic calculations have been seen as vital tools in the prediction and evaluation of government and social stability, national development, and likelihood of civil conflict (Brunborg and Urdal 2005; Cincotta et al. 2003).

Specific methods and data from demography have been seen as particularly useful to researchers. Data regarding the magnitude and rapidity of urban population growth can be analyzed to help forecast the likelihood of civil conflict and state stability (Cincotta et al. 2003). Characteristics such as population age and growth

projections can be used to estimate not only the capability of a nation-state or a particular population group to successfully wage war, but highlight critical strengths or weaknesses in the society's capacity to continue violent conflict (Duffy-Toft 2005). Hudson and den Boer (2005) present evidence that a surplus male population (emerging from government sex-selection policies) is likely to threaten national and international security. Finally, migration rates and flows are an important piece of demographic information that are closely tied to many security issues and can be used to develop practical policy recommendations (Goldstone 2002; Murawiec and Adamson 2001).

Population science data and methods have also been used in relation to environmental sciences, particularly regarding the interaction between humans and their environment. Demographic tools can help researchers theorize about potential or expected problems as well as analyze the extent of existing issues. The expansion of a given population and closer living proximity often means the disruption of environmental processes and more human–human and human–animal contact: population growth is a key factor in predicting the emergence of infectious diseases worldwide (Nelson and Williams 2007; Torrey and Yolken 2005). Calculations about population growth, socio-economic status (SES), and urbanization have been used to analyze, illuminate, and inform policy about issues of environmental degradation, associated resource loss, and subsequent social strife (Cincotta et al. 2003; Goldstone 2002; Weiner and Russell 2001).

Finally, demographic data have recently become more commonly incorporated into health systems research, particularly in the field of health disparities (Warnecke et al. 2008). Demographic information such as SES, migration, and urbanization are often key in understanding the safety and availability of food, water, and health care services. The Institute of Medicine in 2006 published a report that discusses how various population characteristics, such as biological risk factors and socio-economic conditions, are often important determinants of health care outcomes and therefore must be considered in policy (IOM 2006).

Demography in Public Health Emergency Preparedness

Certainly, a public health emergency could—without stretching the imagination—easily emerge from war, state instability, and the changing dynamics of a population. But despite the use of population sciences in these related fields, there is a notable absence of discussion in the PHEP literature about employing demographic data or methods. For example, when the keywords ‘demography’ and ‘preparedness’ are entered together as search terms into three major databases (JSTOR, Proquest, and EBSCOhost Academic Search Premier) only five articles emerge (searching abstracts for all available dates). In part, this is likely due from the fact that PHEP is a relatively young field. The very few examples of demographic methods being used in PHEP clearly demonstrates the lack of formal integration of data and population science tools in PHEP policy.

The most documented use of demographic data in PHEP research is using population characteristics—such as age and immigration information—to assess perceptions of preparedness within a given population (Carter-Pokras et al. 2007).

Studies have indicated that preparedness levels are correlated with demographic characteristics such as size of a given community, age, and migration flows (Carter-Pokras et al. 2007; Mathew and Kelly 2008). For example, immigrants, particularly those for whom English is not their first language, are often not as knowledgeable about how to prepare and react to a public health emergency (Mathew and Kelly 2008). At this writing, this information does not appear to have been formally integrated into improved preparedness plans, even though there is a recognition within the PHEP policy community of the need to address vulnerable populations in planning, including populations for whom English is not their first language.

We offer two instances where the U.S. government has employed population science methods for PHEP purposes. First, U.S. Census data were used to theoretically predict the impact of Hurricane Ike given its projected path and to highlight vulnerable populations on the Gulf Coast of Texas that may have needed special assistance if a public health emergency occurred (U.S. Census Bureau 2008). However, it is unclear from census information how this analysis actually led to a different or a revised preparedness plan for the region, or if additional assistance capabilities were implemented. Similar analyses on *past* public health emergencies have been completed in order to understand the subsequent changes that have occurred in given populations—for the California wildfires and Iowa floods in 2008, as well as for various tropical storms and hurricanes (U.S. Census Bureau 2008). Data are available indicating the impact of these events on a given population and subsequently on the economy, housing, and transportation. Calculation and analysis of the data for certain natural disasters is a definite step towards the integration of demographic data in PHEP planning. While retrospective analysis is undeniably useful to practitioners in other fields, this census information does not appear to have been prospectively incorporated into policy making to create more effective preparedness plans.

Second, the U.S. government has also employed data about populations to establish Emergency Planning Zones in the Army's Chemical Stockpile Emergency Preparedness Program, as well as Emergency Planning Zones around nuclear reactors in the United States (Sorensen and Carnes 1992; U.S. Nuclear Regulatory Commission 2007). These zones are created to mitigate chemical or radiological events, taking into account the sub-populations that surround these designated locations, with the objective of ensuring the safety of the larger population, in part, by planning that these zones be rapidly and comprehensively secured immediately following a public health emergency. This appears to be one of the few instances in which demographic data have actually been used to bolster the effectiveness of preparedness plans prior to an actual public health emergency.

Systematic use of Demography in Public Health Emergency Preparedness

Because effective preparedness plans require the understanding of population characteristics, demographic methods and data should underlie preparedness planning. Related fields have much more comprehensively and systematically

explored the link between demographic tools and their respective fields: there are very limited examples in PHEP, and few instances in which demography appears to be used systematically to inform policy. This section provides examples of how these data and methods can be used and demonstrates why their use in PHEP is necessary. This discussion moves from using population science at (1) a logistical level (infrastructure and materials), to (2) a population health level (sub-populations including vulnerable populations), to (3) a strategic level (predicting public health emergencies).

Logistical Level: Infrastructure and Countermeasure Requirements

Responding to a public health emergency, such as the intentional release of a biological agent, will require a certain level of infrastructure (transportation, hospital beds) and medical countermeasures (vaccines and other pharmaceuticals). A rapid response requires that plans take into account the likely surge of individuals into hospitals and other medical care centers and uncertainties regarding the magnitude and duration of such a surge. In order to effectively approximate the level of infrastructure required and the amount of medical countermeasures needed, PHEP practitioners must have sufficient and reasonably accurate information about a given population. Demographic data and calculations, such as age of a population, sex ratio, SES, and geographical dispersion are essential for formulating empirically-based preparedness plans. More specifically, employing certain population projections and non-emergent morbidity rates in the creation of policy can help to ensure that there are sufficient drugs, devices, hospital beds, transport, and care providers for a given population in the case of a public health emergency.

Remaining at the logistical level but going beyond simply the magnitude of infrastructure and countermeasures required, an effective preparedness plan must determine the appropriateness and estimated effectiveness of these necessities for any given group of individuals. Population level data can be used to evaluate the costs and benefits of preparedness policies and the development of particular levels and types of countermeasures and infrastructure (Zohrabian et al. 2004). Many pharmaceutical countermeasures are not appropriate for all ages or all individuals. In order to ensure that appropriate logistical considerations have been made, PHEP practitioners need to turn to demographers for information such as age distributions. Analyzing the age structure of a population should help to dictate the type and respective number of vaccines available in any national or regional stockpile. In fact, the Pandemic and All-Hazards Preparedness Act of 2006 (PAHPA) makes implicit reference to the age distribution of a population, stating that the Secretary may grant priority in establishing “advanced research and development of qualified countermeasures and qualified pandemic or epidemic products that are likely to be safe and effective” for both children and the elderly (PAHPA 2006, sec391(c)(6)). PAHPA also states that any stockpile of countermeasures needs to take these sub-populations into account (PAHPA 2006, sec2811(c)(1)). The utility of demographic data in preparedness has been recognized; the use of such information has not yet been achieved.

Population Health Level: Sub-Populations Including Vulnerable Populations

In order to protect a population from many disease outbreaks, PHEP planners must estimate the number of individuals that need to be inoculated to provide the population with indirect protection from herd immunity (Anderson et al. 1997). To do so without substantial demographic information is arduous. For example, some vaccines (such as Pertussis (whooping cough)) are administered to children but traditionally not re-administered to the general population later in life, even though protection from this particular vaccination is known to diminish over time (WHO 2009b). Again, preparedness experts need to carefully analyze population age distributions to determine how the sub-population that has ‘aged-out’ of the protective level of a vaccine.

Pandemics often impact particular age groups more significantly than others, and different types of public health emergencies are likely to affect different populations and various segments within those populations to differing degrees (Hall et al. 2007). For example, the H1N1 virus of 1918 targeted the healthiest individuals, which typically was the working-age and military populations (Barry 2004). Other flu strains—such as seasonal flu—disproportionately affect the very young and the very old. Other types of public health emergencies such as chemical or radiation emergencies are likely to impact individuals who are more susceptible to infection, such as the elderly, the very young, and those already in poor health (perhaps indicated by SES). An effective PHEP plan must recognize which groups are likely to be most severely impacted so that the public health community can respond efficiently, prioritizing aid: demographic data are required to understand how large these sub-populations are and where the predominately exist. Furthermore, in public health emergencies where resources are scarce, demographic information may inform PHEP ‘triage’, and help practitioners to identify where and to whom resources should be focused.

Preparedness plans should also address the possibility of emergencies that last for extended periods of time. Calculations such as dependency ratios can be used to illuminate important social and economic consequences. For example, demographers can help to estimate the number of working professionals in the labor force and the number of dependent (young or old) family members. Information about the number of working professionals in the labor force can help planners better formulate preparedness policies to take into account the impact of forced social distancing, such as school closures. Such information is also useful in the planning and development of infrastructure. As seen in the case of the 2009 H1N1 Influenza A outbreaks, there is a need for better information about the populations that will be impacted if schools close: How many primary caregivers are working full time?

In particular, demographic data can be used to identify vulnerable populations. These populations lack the resources needed to adequately prepare or respond to a public health emergency (see Brodie et al. 2006). PHEP plans must specifically account for these sub-populations as they are particularly susceptible to “risks such as disease...and hunger,” and are disproportionately affected by public health emergencies (Davis 1996, p. 868). Demographic studies that identify differing SES

status and minority communities among societies as well as the location of those communities within populations need to be employed by PHEP planners to identify these vulnerable groups. Morbidity measures are another tool that can indicate where “scarce health resources are already stretched by existing health priorities” and a public health emergency is likely to have a greater impact (Murray et al. 2006, p. 2211). The public health emergency of Hurricane Katrina highlighted the vulnerability of certain populations—underserved and dependent populations were much more likely to need basic medical services *in addition* to any medical care for illness or injury directly caused by the Hurricane (Krol et al. 2007). Furthermore, PHEP policy should incorporate information and the expertise of demographers regarding population movement, in order to approximate where vulnerable populations are likely to become particularly threatened by disaster and emergency in the future due to changes in the human activity (i.e. construction of shanty-towns) in cities and towns (Cutter and Finch 2007).

In addition, identifying vulnerable populations through demographic data allows PHEP to target groups for additional preparedness efforts or different forms of communication. PAHPA already recognizes that vulnerable individuals are a sub-population that must be addressed in PHEP, stating that core education and training about public health emergencies needs to take “into account the needs of at-risk individuals” (PAHPA 2006, sec304a(2)(A)). Preparedness plans need to employ population science methods to help achieve this theoretical objective: for example, immigrant sub-populations that can be identified from demographic data. In practice, according to the 2000 Census data, 23% of the population of southern California has limited English proficiency (Mathew and Kelly 2008). While many agencies offer materials in Spanish, and a majority offer some Asian language translation, service providers consistently have said that in an actual emergency, immediate translation is not rapidly available. While often providers are fortunate to have citizen volunteers, relying on informal mechanisms is a risky strategy (Mathew and Kelly 2008). Demographic data about migrants and vulnerable populations are largely available in the United States; this information needs to be absorbed into actual PHEP policy prior to an actual emergency.

Strategic Level: Predicting Public Health Emergencies

Preparedness planning must prepare for what has not yet occurred. Therefore, policy must proactively identify risk factors that could lead to public health emergencies. Changes in populations and collective human behavior is one of the six major factors that has been identified as a contributor to “disease emergence and reemergence” (Hughes 2001, p. 494). Furthermore, scientists have established that certain natural disasters result “from the interaction of a human use system with a natural events system” (Aguirre et al. 1993, p. 624). Immigration (including refugees and internally displaced persons) and rural–urban migration are also key potential risk-factors for public health emergencies such as bioterrorism, infectious disease outbreaks, mass casualty events, as well as natural disasters (Population Reference Bureau 2008). In terms of natural disasters, scientists have demonstrated from demographic and atmospheric data that tornados occur more frequently in

urban counties than rural counties (Aguirre et al. 1993, p. 623).² Deforestation, as related to urbanization, is closely related to a significant jump in malaria rates around the world, including in the Amazon and in West Africa (Caldas de Castro et al. 2006; Kaplan 1994). To effectively protect populations, preparedness plans must recognize these interactions and plan for their effects. There has been the call for better disaster preparedness to counter these “adverse consequences” (Population and Development Review 2006, p. 793).

Demographic calculations about a population—particularly measures about urbanization and population growth—can be used to determine where, how quickly, and to what magnitude these population changes are occurring. Tracking these measures over time can help PHEP practitioners predict where events are likely to occur and craft preparedness plans accordingly. For example, morbidity and mortality measures can indicate populations with poor sanitation and health care at high risk for disease outbreaks (that could turn into a public health emergency). Population growth broadly indicates climate change and resource use, both of which further contribute to the possibility of natural disasters such as floods and fires. Using these various tools of demography, PHEP policy makers can identify where public health emergencies are relatively likely to occur and target preparedness efforts efficiently and effectively.

Moreover, population characteristics can also potentially assist planners in predicting where an artificial public health emergency is likely to transpire. Migration information and population pyramids can be used to indicate where population characteristics may cause national instability. For example, the likelihood of civil conflict grows dramatically when there is a large youth population, rapid urbanization, and a low availability of cropland, water, or other resources (Cincotta et al. 2003, p. 71). AIDS has caused a large youth bulge in many nations (particularly in sub-Saharan Africa); such distorted population distributions are unstable and at risk for public health emergencies (Garrett 2005). Finally, while certainly a more distal cause of public health emergencies and a more novel topic in population sciences, understanding immigration flows may help understand remittance patterns to prevent such money from being used to actually fund artificial emergencies (bioterrorism, chemical/radiological emergencies, or mass casualty events) (see Kapur and McHale 2003). In sum, to ensure the relevance of strategic preparedness plans and improve the probability for their success, these demographic data need to be considered as policy is crafted.

Policy Implications and Recommendations

The field of PHEP is constantly evolving; even the best intentioned preparedness plan will not have contingencies for every unknown (Hall et al. 2007; Nelson et al. 2007). But preparedness policies can be improved by incorporating the expertise and tools of demographers. Formal collaboration is necessary for this to occur.

² This is related to heat and the impact of urbanization on atmosphere, not merely the number of urban counties compared to rural counties.

The PHEP community does not have the capabilities to independently collect or analyze extensive information about any given population. The field of preparedness must rely upon existing infrastructure, data collection methods, and organizations that collect population science data. However, demographers cannot help PHEP practitioners to analyze the data without mutual cooperation, communication, and understanding of the importance of such information in policy-making. In turn, preparedness experts must work to understand how, when, and to what extent demography needs to be used for effective plans.

Certainly there are limitations to population data. First, data about populations are rarely available in real-time. Therefore, using demographic data in PHEP requires serious considerations about the accuracy and reliability of estimates; policy makers need to be aware of the sensitivity of preparedness plans to changes in figures and rates. In addition, more localized geographical data may be needed in preparedness than are gathered by traditional demographic surveys or instruments. The sub-specialty in demography of survey specialists may help preparedness experts to develop appropriate surveys about populations who will potentially confront emergency situations. The PHEP community must exercise informed discretion in data use and acknowledge that 'perfect information' about a population does not exist. Demographers should also be clear about the limitations of their data and estimates.

The relationship between disciplines must be reflexive and interactive to improve public health preparedness plans. If preparedness policy is to be based on evidence and available knowledge, both demographers and public health preparedness practitioners should strive to obtain and incorporate the best information they can, given the obvious time and resource limitations. In order to be an effective tool in PHEP, population sciences cannot be political; unfortunately, history has given us numerous examples of when population estimates were skewed in order to achieve a particular end, or simply to ignore the severity or existence of a problem. Demographers, with appropriately collected information, can help public health preparedness move away from the focus on artificial state boundaries and towards other boundaries which exist between various populations both within and among nations which may have more practical relevance for PHEP interventions.

For PHEP, the better the demographic information, the better the policy: infrastructure and countermeasures will be more appropriately estimated, sub-populations and vulnerable populations will be better accounted for, and PHEP practitioners will be able to more aptly predict where both natural and artificial public health disasters will occur. We suggest that future research should seek to determine what the most critical demographic information is for preparedness policy, evaluate how sensitive policy prescriptions are to various changes in demographic calculations, and eventually develop a systematic method to incorporate demography into PHEP plans. In addition, a discussion needs to be undertaken about the various roles of public (federal, state, and local) and private entities in the collection and analysis of population data. However, without the formal recognition of the relationship between public health emergency preparedness and demographic techniques, as started in this article, any forthcoming research would be missing a foundational step.

Conclusion

While limited use of demographic information has occurred in public health preparedness, this paper has demonstrated specific ways at the logistical, population, and strategic level in which information about populations needs to be incorporated to develop effective and improved preparedness policy. Formal collaboration needs to occur between population scientists and PHEP practitioners to ensure there is both understanding about demographic calculations and systematic rather than coincidental data-sharing. There are numerous problems in public health preparedness—preparedness policy is no easy task (The U.S.A.'s emergency-medicine crisis 2006; Yellow fever preparedness 2008). To improve, PHEP must incorporate demographic methods and welcome the expertise of demographers. The health of a population relies on sufficient and reliable information about that population; the security and stability of a population is an interest that should be shared by both preparedness experts and demographers alike.

Acknowledgement This article was supported by Grant 5K01EH000288-02 from the Centers for Disease Control and Prevention (CDC). The contents are solely the responsibility of the authors and do not necessarily represent the official views of the CDC.

Open Access This article is distributed under the terms of the Creative Commons Attribution Non-commercial License which permits any noncommercial use, distribution, and reproduction in any medium, provided the original author(s) and source are credited.

References

- Aguirre, B. E., Saenz, R., Edmiston, J., Yang, N., Agramonte, E., & Stuart, D. L. (1993). The human ecology of tornadoes. *Demography*, 30(4), 623–633. doi:10.2307/2061810.
- Anderson, R. M., Donnelly, C. A., & Gupta, S. (1997). Vaccine design, evaluation, and community-based use for antigenically variable infectious agents. *Lancet*, 350, 1466. doi:10.1016/S0140-6736(97)03255-8.
- Barry, J. M. (2004). *The great influenza*. New York: Penguin Books.
- Brodie, M., Weltzien, E., Altman, D., Blendon, R. I., & Benson, J. M. (2006). Experiences of hurricane katrina evacuees in Houston shelters: Implications for future planning. *American Journal of Public Health*, 96(5), 1402–1408. doi:10.2105/AJPH.2005.084475.
- Brunborg, H., & Urdal, H. (2005). The demography of conflict and violence: An introduction. *Journal of Peace Research*, 42(4), 371–374. doi:10.1177/0022343305054084.
- Caldas de Castro, M., Monte-Mór, R. L., Sawyer, D. O., & Singer, B. H. (2006). Malaria risk on the Amazon frontier. *Proceedings of the National Academy of Sciences of the United States of America*, 103(7), 2452–2457. doi:10.1073/pnas.0510576103.
- Carter-Pokras, O., Zambrana, R. E., Mora, S. E., & Aaby, K. A. (2007). Emergency preparedness: Knowledge and perceptions of Latin American immigrants. *Journal of Health Care for the Poor and Underserved*, 18(2), 465. doi:10.1353/hpu.2007.0026.
- Centers for Disease Control and Prevention. (2008). *Emergency preparedness and response homepage*. Cited December 6, 2008 from <http://www.bt.cdc.gov>.
- Cincotta, R. P., Engelman, R., & Anastasion, D. (2003). *The security demographic: Population and civil conflict after the Cold War*. Washington, DC: Population Action International.
- Cutter, S. L., & Finch, C. (2007). Temporal and spatial changes in social vulnerability to natural hazards. *Proceedings of the National Academy of Sciences of the United States of America*, 105(7), 2301–2306. doi:10.1073/pnas.0710375105.

- Davis, A. P. (1996). Targeting the vulnerable in emergency situations: Who is vulnerable? *Lancet*, 348, 868–871. doi:10.1016/S0140-6736(96)02134-4.
- Fidler, D. P. & Gostin, L. O. (2008). *Biosecurity in the global age: biological weapons, public health, and the rule of law*. Stanford, CA: Stanford University Press.
- Duffy-Toft, M. (2005). The state of the field: Demography and war. *ECSP Report*, 11, 25–28.
- Garrett, L. (2005). *HIV and national security: Where are the links? Council on Foreign Relations Report*. New York: Council on Foreign Relations.
- Goldstone, J. A. (2002). Population and security: How demographic change can lead to violent conflict. *Journal of International Affairs*, 56(1), 3–21.
- Hall, I. M., Gani, R., Hughes, H. E., & Leach, S. (2007). Real-time epidemic forecasting for pandemic influenza. *Epidemiology of Infectious Disease*, 135, 372–385. doi:10.1017/S0950268806007084.
- Hudson, V. M., & den Boer, A. M. (2005). *Bare branches: The security implications of Asia's surplus male population*. Cambridge: MIT Press.
- Hughes, J. M. (2001). Emerging infectious diseases: A CDC perspective. *Emerging Infectious Diseases*, 7(S3), 494–496.
- Institute of Medicine. Committee on the Review and Assessment of the NIH's Strategic Research Plan and Budget to Reduce and Ultimately Eliminate Health Disparities. (2006). *Examining the health disparities research plan of the National Institutes of Health: Unfinished business*. Washington DC: National Academies Press.
- Kaplan, R. (1994). The coming anarchy. *The Atlantic*. Cited January 22, 2009 from <http://www.theatlantic.com/doc/199402/anarchy>.
- Kapur, D., & McHale, J. (2003). Migration's new payoff. *Foreign Policy*, 139, 48–57. doi:10.2307/3183737.
- Katz, R. L., & Levi, J. (2008). Should a reformed system be prepared for public health emergencies, and what does that mean anyway. *The Journal of Law, Medicine & Ethics*, (Winter), 716–721. doi:10.1111/j.1748-720X.2008.00327.x.
- Krol, D. M., Redlener, M., Shapiro, A., & Wajnberg, A. (2007). A mobile medical care approach targeting underserved populations in post-Hurricane Katrina Mississippi. *Journal of Health Care for the Poor and Underserved*, 18(2), 331. doi:10.1353/hpu.2007.0038.
- Mathew, A. B., & Kelly, K. (2008). Disaster preparedness in urban immigrant communities. A Tomás Rivera Policy Institute and Asian Pacific American Legal Center Report. Cited December 4, 2008 from <http://www.tpri.org>.
- Murawiec, L., & Adamson, D. (Eds.). (2001). *Demography and security: Proceedings of a workshop*. Santa Monica: RAND.
- Murray, C. J., Lopez, A. D., Chin, B., Feehan, D., & Hill, K. H. (2006). Estimation of potential global pandemic influenza mortality on the basis of vital registry data from the 1918–1920 pandemic: A quantitative analysis. *Lancet*, 23(30), 2211–2218.
- Nelson, K. E., & Williams, C. M. (Eds.). (2007). *Infectious disease epidemiology: Theory and practice*. Boston: Jones and Bartlett Publishers.
- Nelson, C., Lurie, N., Wasserman, J., & Zakowski, S. (2007). Conceptualizing and defining public health emergency preparedness [editorial]. *American Journal of Public Health*, 97(S1), S9–S11. doi:10.2105/AJPH.2007.114496.
- Pandemic and All-Hazards Preparedness Act. U.S. 109-417. (2006). Cited December 4, 2008 from <http://thomas.loc.gov/cgi-bin/bdquery/z?d109:s.03678>.
- Population and Development Review. (2006). The Stern Review on the economic effects of climate change. *Population and Development Review*, 32(4), 793–798. doi:10.1111/j.1728-4457.2006.00153.x.
- Population Reference Bureau. (2008). 2008 world population data sheet. Cited December 4, 2008 from <http://www.pbr.org>.
- Sorensen, J. H., & Carnes, S. A. (1992). An approach for deriving emergency planning zones for chemical munitions emergencies. *Journal of Hazardous Materials*, 30(3), 223–242. doi:10.1016/0304-3894(92)87001-V.
- The USA's emergency-medicine crisis [editorial]. (2006). *The Lancet*, 367, 2033.
- Torrey, E. F., & Yolken, R. H. (2005). *Beasts of the earth*. New Brunswick: Rutgers University Press.
- U.S. Census Bureau. (2008). Census data and emergency preparedness. Cited December 5, 2008 from <http://www.census.gov/Press-Release/www/emergencies/index.html>.
- U.S. Department of Health and Human Services. (2009a). Office for the Assistant Secretary for Preparedness and Response. Cited February 4, 2009 from <http://www.hhs.gov/aspr/>.

- U.S. Department of Health and Human Services. (2009b). [Pandemicflu.gov](http://www.pandemicflu.gov). State and Local Government planning and response activities. Cited February 4, 2009 from <http://www.pandemicflu.gov/plan/states/index.html>.
- U.S. Department of Homeland Security. (2008a). *National response framework*. Washington, DC. Cited February 4, 2009 from <http://www.fema.gov/pdf/emergency/nrf/nrf-core.pdf>.
- U.S. Department of Homeland Security. (2008b). *National response framework, emergency support function #8-public health and medical services annex*. Washington, DC. Cited February 4, 2009 from <http://www.fema.gov/pdf/emergency/nrf/nrf-esf-08.pdf>.
- U.S. Nuclear Regulatory Commission. (2007). Emergency planning zones. Cited December 7, 2008 from <http://www.nrc.gov/about-nrc/emerg-preparedness/protect-public/planning-zones.html>.
- Warnecke, R. B., Oh, A., Breen, N., Gehlert, S., Paskett, E., et al. (2008). Approaching health disparities from a population perspective: The National Institutes of Health Centers for Population Health and Health Disparities. *American Journal of Public Health*, 98(9), 1608–1615.
- Weiner, M., & Russell, S. S. (2001). *Demography and national security*. New York: Berghahn Books.
- World Health Organization. (2009a). Pandemic preparedness. Cited January 12, 2009 from <http://www.who.int/csr/disease/influenza/pandemic/en/>.
- World Health Organization. (2009b). Smallpox. Cited January 12, 2009 from <http://www.who.int/mediacentre/factsheets/smallpox/en/index.html>.
- World Health Organization. (2009c). Swine Influenza, 25 April 2009 WHO Statement. Cited April 30, 2009 from http://www.who.int/mediacentre/news/statements/2009/h1n1_20090425/en/index.html.
- Yellow fever preparedness [editorial]. (2008). *The Lancet*, 371, 786.
- Zohrabian, A., Meltzer, M. I., Ratard, R., Billah, K., Molinari, N. A., et al. (2004). West Nile Virus economic impact, Louisiana, 2002. *Emerging Infectious Diseases*, 10, 1736–1744.