



## CHAPTER THIRTEEN

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# DISASTER PREPAREDNESS

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The concept of actively preparing for disasters is relatively new. Recent natural disasters and disasters resulting from deliberate acts of violence have shown that nations and communities still have much to learn about the factors that influence the consequences of disasters and how to prepare for these events. Today, disaster preparedness is an issue in the forefront of public health care professionals' attention, and this chapter offers two explorations of it. In the prologue, Sandro Galea and Craig Hadley discuss the social and ecological factors that may influence the consequences of disasters, how these factors intersect, and why consideration of these factors must be part of a comprehensive public health approach to mitigate the consequences of these events. Then, within this social and ecological context, Stephen Morse provides implementation strategies for health care professionals to adopt in preparation for and in response to disasters.

## Prologue

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Although definitions of disasters and the approaches used to study them may be quite disparate (Mileti, 1999; Quarantelli, 1995; Tierney, Lindell, & Perry, 2001; Hoffman & Oliver-Smith, 2002), the scientific literature generally recognizes that disasters are a relatively common human experience. In one survey of U.S. residents, 13 percent of the sample reported a lifetime exposure to natural or human-generated disaster (Burkle, 1996). In a large survey representative of the general population of the United States, 18.9 percent of men and 15.2 percent of women participants reported a lifetime experience of a natural disaster (Kessler, Sonnega, Bromet, Hughes, & Nelson, 1995). Although comparable international data are limited, large proportions of populations in many countries worldwide have been exposed to terrorism, forced relocation, and violence, suggesting that worldwide the overall prevalence of exposure to disasters is probably considerably higher than it is in the United States (Kessler, 2000; Corradi, Fagen, & Garretton, 1992).

Several recent, high-profile natural disasters (for example, the Southeast Asian tsunami of 2004 and the Gulf Coast hurricanes in the United States in 2005) and terrorist events (for example, the September 11, 2001, terrorist attacks in the United States and the March 11, 2004, train bombings in Madrid, Spain) in various parts of the world have heightened our awareness of disasters as determinants of population health. However, academic and public health interest in disasters remains episodic at best, surging when highly visible disasters occur and abating to a lower-level priority as these events fade in the public consciousness. In addition, much of the public health attention that is devoted to disasters frequently centers on a medical model of disaster preparedness. Such efforts highlight threat detection and development of elaborate protocols for evacuation, triage, and treatment.

We consider disasters to be traumatic events that are experienced by many people and may result in a wide range of mental and physical health consequences (Norris et al., 2002). We consider both acute onset, time-delimited events (for ex-

ample, floods, transportation accidents) and events that take place over a longer period of time (for example, famines, conflicts, complex humanitarian emergencies) as disasters. This broad perspective, rooted in socioecological perspectives on the determinants of health (Krieger, 1994; Kaplan, 1999), highlights the range of contextual factors that contribute to population health after disasters.

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### Underlying Socioecological Vulnerability to the Consequences of Disasters

Briefly, socioecological perspectives suggest that factors at multiple levels of influence contribute to individual and to population health. These factors may include contextual factors, such as political structures, and individual-level factors, such as race or ethnicity. Building on this line of thinking, we suggest that multiple social and economic factors determine population vulnerability and play a role in shaping the population health consequences of disasters.

The study of vulnerability and its relation to disasters is certainly not limited to the realm of public health. When examining postdisaster outcomes, diverse academic disciplines have considered vulnerability a characteristic both of individuals and of populations (Bankoff, 2003; Turner et al., 2003; Cohen & Hamrick, 2003). Although definitions of *vulnerability* vary in the scientific literature, it is generally considered to be the capacity for harm in an individual or system in response to a stimulus. It has been postulated that different types of vulnerability exist, including genetic and biologic vulnerability at the individual level (Cohen & Hamrick, 2003; Heath & Nelson, 2002) and social vulnerability at the group level (McKeehan, 2000). Individuals who possess specific characteristics are frequently termed *vulnerable*; for example, children, homeless persons, and minority inner-city populations have been termed vulnerable in recent scientific publications, suggesting they are more likely to be harmed by external stressors than are others in the overall population (Stergiopoulos & Herrmann, 2003; Shi, 2000). In the study of disaster preparedness it has long been recognized that certain populations are also more vulnerable to the effects of disasters than are others (Oliver-Smith, 1996), although we are not aware of any systematic reviews that have considered how key social and ecological contextual factors may contribute to population vulnerability in the disaster context.

In the following discussion we adopt a population health perspective. Our primary focus is on factors that influence *rates* of disease after a disaster, rather than on how these factors may influence individual risk. Therefore we do not discuss individual-level factors (for example, individual race or ethnicity or individual

socioeconomic position) that undoubtedly also contribute to the impact of disasters. We refer the reader to other, principally epidemiologic reviews (for example, Norris et al., 2002; Galea, Nandi, & Vlahov, 2005) that consider the role of individual-level factors in influencing individual health after disasters.

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## Contextual Determinants of Population Health After Disasters

We discuss nine determinants of population health in the wake of a disaster: geography, political structure and governance, community socioeconomic status, relative distribution of income and wealth, culture, health and social services infrastructure, physical environment, social environment, and civic society.

### Geography

We start our discussion with a brief mention of the role of geography as a contextual determinant of disasters. Although disasters are a global phenomenon, the impact of disasters remains grounded in local context. Geographic factors render specific areas at particularly high risk of disasters. Areas below sea level or particularly close to bodies of water that change levels frequently (for example, the Gulf Coast region in the United States and river deltas in Bangladesh) are particularly prone to flooding. Similarly, human settlements in arid areas (for example, Southern Australia) are vulnerable to fires (Gillen, 2005). The threat of disasters in many such areas is endemic, and floods, bushfires, and earthquakes are recurrent events, with varying degrees of intensity in different seasons. In these areas the risk of recurrent disasters is virtually unavoidable, and the exigencies of geography highlight the fact that there is likely no solution for total elimination of these disasters, except, for example, complete resettlement of the at-risk human populations into lower-risk areas. Geography also plays an important role in structuring the postdisaster response. News of a disaster in isolated communities may take far longer to reach aid agencies or the media (as in the case of the Darfur famine in 2004 and 2005) than will news of disasters in more readily accessible locations. Similarly, the ability of agencies to actually provide aid may well be limited in geographically distant or difficult locales. For example, it took more than a week for domestic and international aid efforts to reach some victims of the devastating 2005 earthquakes in the Kashmir region of Pakistan that killed an estimated 54,000 people (Agence France Presse, 2005).

### political Structure and Governance

Political structures and systems of governance establish the parameters (for example, taxation, federal-state relations) that shape many of the other contextual factors that then shape health. Democratic governance is typically associated with greater government openness and responsiveness to domestic criticism, and there is some evidence that such regimes are less prone to state failures. For example, analyses of state failures in Liberia and Somalia that preceded disasters or predisposed these nations' citizens to disasters show that such events are far more likely to occur in partial as compared to fully democratic regimes (Esty & Ivanova, 2002). There is also evidence that disasters occurring in alternate political systems are substantially mitigated by effective governance. Perhaps a more consistent feature of political structures that relates directly to the mitigation of disaster consequences is the *effectiveness* of political structures and governance. Effectiveness of government can span a broad spectrum. At the extreme are a few societies worldwide without an effective government of any sort. For example, Somalia has not had a central government since 1993. In its stead, informal organizations, typically organized along clan lines, have emerged to provide a loose form of governance that typically organizes response to mass disasters such as famines, in terms of both providing relief for persons in affected communities and dealing with international aid organizations and outside offers of help. Less dramatically, within well-established national political structures there have been several recent examples of both effective and ineffective government response to disasters. Focusing on the United States as an example, during the past three decades subsequent U.S. federal administrations have devolved more government functions to state and local governments; taxes have been cut at the federal, state, and local levels; some environmental and consumer regulations have been loosened; and many previously public services (for example sanitation, water, and health care) have been privatized (Katz, 1989; Gans, 1995). Limited regulation of municipal water supplies has been considered at least in part responsible for water-borne disease outbreaks in various North American cities (Krewski et al., 2002; Corso et al., 2003; Garrett, 2000). Most recently, ineffective and uncoordinated U.S. government response to Hurricane Katrina in August and September 2005 has been widely attributed to devolvement of central government authority and to poor coordination between federal, state, and municipal levels of government (Nates & Moyer, 2005).

### Community Socioeconomic Status

Postdisaster evidence has demonstrated an association between individual poverty and lower perception of disaster risk, poorer disaster preparedness, more limited

from disasters, and more limited access to emergency response after disasters (Forthergill & Peek, 2004). However, the disaster literature has focused almost exclusively on *individual* poverty rather than low community socioecological status (frequently also referred to as community deprivation). There is an abundance of research in public health demonstrating that aggregate community socioeconomic status is associated with health independent of individual socioeconomic position. Low community socioeconomic status encompasses multiple domains, including high rates of poverty (Berkman & Kawachi, 2000) and unemployment (Berkman & Kawachi, 2000) and low education and income levels (Krieger, 1994; Berkman & Kawachi 2000). Empirically, low community socioecological status is a determinant of health outcomes, including health-related behaviors, mental health, infant mortality rates, adult physical health, coronary heart disease, and mortality, even after accounting for individual-level factors (Diez-Roux, 2001; Pickett & Pearl, 2001; Diez-Roux et al., 1997). Community deprivation may also be associated with differential access to medical care (Mandelblatt, Yabroff, & Kerner, 1999) and with the limited availability of other salutary resources, such as healthy food (Cheadle et al., 1991; Sooman, Macintyre, & Anderson, 1993).

Low community socioeconomic status can affect residents' health by means of two primary mechanisms: (1) through limiting the availability of salutary resources that may be beneficial to residents' well-being and (2) through psychosocial stress accompanying chronic shortage of essential resources (Williams, Lavizzo-Mourey, & Warren, 1994). Both these mechanisms also explain how community socioeconomic status may influence health in the disaster context. After disasters, when both formal and informal resources are limited, societies with fewer resources to begin with are less likely than better-supplied societies to have access to salutary resources such as health and social services or food reserves. Similarly, postdisaster circumstances are likely to heighten preexisting stressors and may lead to poor coping health behaviors (for example, substance abuse). Evidence about the consequences of disasters across communities with different levels of deprivation comes, for example, from research after 1992 earthquakes in Humboldt County, California. Rio Dell, a more marginalized town, that had worse disaster response, a more limited and slower recovery, than Ferndale, an equally affected but more affluent community (Rovai, 1994).

### Relative Distribution of Income and Wealth

Recent evidence, although controversial, suggests that inequalities in income distribution, as distinguished from outright material deprivation, may contribute to health differentials (Wilkinson, 1992; Kaplan, Pamuk, Lynch, Cohen, & Balfour, 1996;

Pappas, Queen, Hadden, & Fisher, 1993). Relative deprivation (frequently operationalized as degree of income inequality) has been shown to be an important correlate of homicide (Land, McCall, & Cohen, 1990; Kaplan et al., 1996; Cubbin, Williams Pickle, & Fingerhut, 2000) and mortality (Kaplan et al., 1996; Galea et al., 2003).

Psychosocial stress associated with living in communities with high income disparities may be associated with greater interindividual tension and likelihood of interpersonal violence. Also, perceived and actual inequality caused by the discrepancies in income distribution erodes the social trust and diminishes the social capital that shapes societal well-being and health (Kawachi, Kennedy, Lochner, & Prothrow-Stith, 1997) and may lead to underinvestment in public goods. Income inequality also may be associated with disinvestment in material resources in communities (Kaplan et al., 1996). Congruent with our discussion about the role of community socioeconomic status, these mechanisms also may be particularly relevant in the postdisaster context. Community income inequality may be associated with greater risk of psychopathology after a disaster, independent of the contribution of individual income.

## Culture

The role of culture in shaping health in general and health in the postdisaster period in particular is difficult to quantify but probably pervasive. *Culture* as a notion lends itself to diverse definitions and interpretations. For the purposes of this discussion we consider *culture* to be "shared, learned behaviors and meanings that are transmitted socially" (Marsella & Christopher, 2004, p. 529). Therefore social relationships associated with formal social and religious institutions are elements of the cultural context that may shape health. Similarly, religiously sanctioned or endorsed behaviors and practices have the potential to influence health in the predisaster context. For example, a religious prohibition on alcohol use is associated with much lower rates of alcohol dependence among Muslims compared to non-Muslims (Cochrane & Bal, 1990). Evidence suggests that other manifestations of a dominant culture, such as patterns of social congregation in public places, are associated with social transmission of health behaviors and norms (Henrich & McElreath, 2003). Complex social security networks, which serve to minimize the risk of resource shortfalls, have also been identified as important informal sources of assistance that are called on during disasters (Shipton, 1990). It is important to note that this *moral economy* of sharing is also linked to community socioeconomic status, which in turn influences the efficacy of informal support networks. Less affluent communities may be less able than more

affluent ones to mobilize material resources to assist others (Hadley, Borgerhoff Mulder, & Fitzherbert, under review), although this may or may not be true for other domains of social support. Strong cultural norms about societal organization and altruism may influence social cohesion in the postdisaster period and contribute to communal efforts to restore public places and other physical structures to their predisaster state. However, conversely, destruction of culturally significant places may be associated with communal grief (Bode, 1989), which has been associated with elevated rates of depression in the aftermath of disasters (Goenjian et al., 2001).

### **Health and Social Services Infrastructure**

Predisaster availability of health and social resources is inextricably linked to post-disaster recovery. Rich countries and communities are characterized by an array of health and social services, particularly in comparison to poorer countries or communities (Casey, Thiede Call, & Klingner, 2001; Felt-Lisk, McHugh, & Howell, 2002). In the United States even the poorest communities often have dozens of social agencies, each with a distinct mission and service package. Many of the public health successes in wealthy countries over the past few decades, including reductions in HIV transmission and tuberculosis control, have depended in part on the efforts of these groups (Freudenberg et al., 2000). However, social and health services in poorer communities and countries are often limited. In poor communities and in less wealthy countries, social and health services are frequently susceptible to changing national and donor fiscal realities, with any resultant decreases in service frequently coinciding with times of greater need in the population (Felt-Lisk et al., 2002; Friedman, 1989). For example, in the United States in the past few decades the decline in the national economy and in tax revenues has forced many cities and states to reduce services at the very time unemployment and homelessness were increasing (National League of Cities, 2003; Freudenberg, Fahs, Galea, & Greenberg, in press).

Different disasters have varying scopes and magnitudes and may be associated with decimation of all, some, or none of the predisaster health and social services. When preexisting health and social services continue to function post-disaster, the contribution of these resources to preserving or restoring health in a population is self-evident. However, these preexisting resources are relevant even in devastating disasters where most formal resources are destroyed. Local health and social service practitioners have local knowledge, are accepted by local community members, and are much more likely to be able to provide continuity of care than are services provided by outside aid agencies (Fissel & Haddix, 2004).



## Physical Environment

Multiple features of the physical environment are associated with health, with a vast empirical literature demonstrating links between the physical environment and well-being. The human built environment can influence both physical and mental health; empirical evidence about the relation between the built environment and health conditions has been discussed for, among other issues, asthma and other respiratory conditions, injuries, psychological distress, depression, and child development (Frumkin, 2002; Krieger & Higgins, 2002; Northridge, Sclar, & Biswas, 2003; Weich et al., 2002; Cohen et al., 2000). Other authors have linked various aspects of the built environment to specific health outcomes. For example, features of the built environment such as quality of housing, density of development, mix of land uses, scale of streets, aesthetic qualities of place, and connectivity of street networks may affect physical activity (Handy, Boarnet, Ewing, & Killingsworth, 2002) and in turn, all cause mortality (Diez-Roux, 2003; Pate et al., 1995). Infrastructure is also a critical part of the physical environment and determines how a city provides water, disposes of garbage, and provides energy (Melosi, 2000). Water scarcity and water pollution are serious problems in less wealthy countries. It is estimated that nearly 1.5 billion people lack safe drinking water and that at least 5 million deaths per year can be attributed to water-borne diseases (Krants & Kifferstein, 1998). The World Health Organization (WHO) estimates that the majority of urban populations in developing countries do not have access to proper sanitation (WHO, 1997). Inadequate provision for solid waste collection frequently results in contamination of water bodies, presenting a substantial risk for rapidly spreading epidemics (Alexander & Ehrlich, 2000; Chanthikul, Qasim, Mukhopadhyay, & Chiang, 2004; Satterthwaite, 2000).

The physical environment is perhaps one of the most obviously central features of the context for postdisaster recovery. Structures like buildings, bridges, and skyscrapers may be vulnerable to natural or human-made disasters, as recent earthquakes in Japan and Iran and as the September 11, 2001, terrorist attacks on New York City and Washington, D.C., demonstrated. Features of the physical environment can be immediately linked to the fatality rate after disasters (Daley et al.; 2005). Recent earthquakes of comparable magnitude in Kobe, Japan, in 1995, and Bam, Iran, in 2003 were associated with 5,200 and 26,000 deaths, respectively. Much of this difference was attributed to differences in the quality of buildings; Japanese buildings had been reinforced to cope with earthquake tremors and did so, whereas much of the Iranian city of Bam collapsed with the earthquake, killing thousands of residents ("Major Earthquakes," 2005). Somewhat less immediately in terms of effects, infrastructure damaged in an earthquake or hurricane can strain already taxed systems and contribute to the

construction of the local physical environment may contribute to prolonged community suffering after a disaster, limited job opportunities, and a slower recovery of population physical and mental health.

### **Social Environment**

The social environment has been broadly defined to include "occupational structure, labor markets, social and economic processes, wealth, social, human, and health services, power relations, government, race relations, social inequality, cultural practices, the arts, religious institutions and practices, and beliefs about place and community" (Barnett & Casper, 2000, p. 465). This definition, by its very complexity, suggests that there are multiple ways in which the social environment may affect health. Social order, stability, and integration are conducive to conformity, whereas disorder is conducive to crime and poor integration into social structures (Shaw & McKay, 1969). Limited social cohesion may predispose persons to poorer coping and adverse health (Kawachi & Berkman, 2001; McLeod & Kessler, 1990). Social capital effects are thought to offer general economic and social support on an ongoing basis and also make specific resources available at times of stress. Social capital has been shown to be associated with lower all-cause mortality (Kawachi et al., 1997; Skrabski, Kobb, & Kawachi, 2004), reduced violent crime (Kennedy, Kawachi, Prothrow-Stith, Lochner, & Gupta, 1998), and self-reported health (Subramanian, Kim, & Kawachi, 2002). Spatial segregation of racial or ethnic and socioecological groups may enforce homogeneity in resources and social network ties, suppressing diversity that may benefit persons of lower socioeconomic status. Persons who live in segregated communities may have disproportionate exposure, susceptibility, and response to economic and social deprivation, toxic substances, and hazardous conditions (Williams & Collins, 2002).

Predisaster community cohesion is a base on which postdisaster recovery can be built (Torry, 1986; Oliver-Smith, 1996). In addition, preexisting social stressors, influenced by racial or ethnic and socioecological strains, may influence post-crisis interactions during the recovery phase. For example, strained relations between Somali and Somali Bantu groups have carried over into resettlement communities and forced resettlement agencies to tread carefully along these ethnic lines (Van Lehman & Eno, 2003). Preexisting social stressors may also influence social interactions between disaster-affected communities and those attempting to provide postdisaster aid. This was evident in the aftermath of Hurricane Katrina in New Orleans in September 2005, as racial tensions in the racially segregated city played out repeatedly on U.S. national television as clashes with military and paramilitary aid workers. Also, in the context of limited postdisaster resources, predisaster social relationships that enforce or reward equitable

distribution of resources may be essential to ensure that resources are available to those individuals who are most vulnerable to the consequences of disasters.

### **Civic Society**

Although related to features of the social and cultural environment, civic society frequently plays a distinct role in shaping a context that is beneficial to population health. Civic society defines the space, not controlled by government or the market, where residents interact to achieve common goals. Several participants in civil society influence the health of populations. For example, community-based organizations such as neighborhood associations and tenant groups provide services, mobilize populations, and advocate for resources. Community-based organizations (CBOs), or nongovernmental organizations (NGOs), have a long history of working to improve living conditions both in their home countries and internationally (Halpern, 1995). For example, in the 1960s and 1970s in the United States, sometimes with government support, CBOs promoted economic development, established health centers, advocated for improved public education, and built new housing (Halpern, 1995). In the 1980s and 1990s, CBOs were at the forefront of the struggle against the AIDS epidemic in the United States (Freudenberg & Zimmerman, 1995). Many of these organizations developed into effective international NGOs advocating for global AIDS control in the 1990s. Places of worship and faith-based organizations offer social support, safe space, and political leadership (Lincoln & Mamiya, 1990; Thomas, Quinn, Billingley, & Caldwell, 1994). In many instances, civic society in the aftermath of a disaster may well be the only formal societal structure standing that has the population's respect and trust. Particularly in human-made disasters, when population suspicion of formal government authority may be high, civic society can serve as an honest broker, delivering aid relief and helping to rebuild the social and physical environments. For example, during the extended conflict between Israel and Lebanon in the 1980s and 1990s, local civic institutions, many predating the conflict, played a central role in providing health and social services to local populations in contested territory.

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### **Covariation of Contextual Factors That Influence Postdisaster Health**

Although we have discussed contextual factors in isolation, this is not meant to

aging infrastructure coupled with declining local municipal resources may challenge communities' ability to continue to provide safe water and sanitation for their residents when the system is strained by an unexpected crisis (Glaab & Brown, 1976). In rapidly urbanizing areas too, frequently in less wealthy countries, cities are often challenged to maintain an adequate fresh water supply to the growing numbers of urban residents, and to transport the accumulating sewage and other waste. The likelihood of a breakdown of the sanitary infrastructure after disasters is much higher in systems that are already taxed, have no built-in redundancies, and no tradition of rapid response to remedy breakdowns. Other contextual factors that might also contribute to postdisaster population health include, but are not limited to, population demographics, urbanization, and migration.

## Summary

The recognition that predisaster context is inextricably linked to postdisaster outcomes naturally raises questions for those interested in public health promotion about the course of action available to public health professionals that might influence the factors identified here. It might reasonably be argued that affecting features of the social environment that influence postdisaster health is a challenge beyond the scope of most public health practitioners. However, we suggest that although structural and systematic change to influence underlying context may seem daunting, a focus on the fundamental determinants of population health is inevitable if we are interested in mitigating the consequences of disasters. Leonard Syme (1997) has argued effectively that interventions that take account of and act on only the individual level will doom public health to small positive effects. In addition, interventions that are misdirected (either at the wrong modifiable variable or at the wrong level) may well have unintended consequences and result in unanticipated changes in behavior and its consequences. It is critical for health care professionals to understand the *context* of disaster and to consider efforts to ameliorate this context, to change structures and ecologies, before a disaster occurs (Wodak & Des Jarlais, 1993).

We suggest that there are two primary implications of the observations drawn here for the role of those concerned with public health promotion. First, health care professionals interested in mitigating the consequences of disasters need to consider both policies that might improve the underlying determinants and practicable population-based interventions that might be implemented rapidly in the postdisaster period. Although policy change that influences some key underlying factors, such as income distribution in communities, may well be considered out-

side the realm of public health practice, we suggest that it is the role of public health to influence the determinants of health at all levels. For example, it was public health efforts to improve sanitary conditions in cities that led to sentinel improvements in European cities' infrastructure and attendant reductions in morbidity and mortality throughout the nineteenth century (Coleman, 1982). Effecting structural changes requires sentinel shifts in policies that may influence underlying determinants. The current increased awareness of disasters and their potential consequences creates an opportunity for advocacy and action to improve underlying features of context that may influence the health of populations after disasters. This then represents a plausible, and desirable, goal for those interested in health promotion.

Second, the role of multiple contextual determinants in shaping population health postdisaster is likely to be complex. Therefore, public health efforts to improve context to mitigate the consequences of disasters have to center around locally responsive population-based interventions, as detailed in the second half of this chapter. Emerging research methods such as community-based participatory research and emerging technologies such as Web-based communications may represent opportunities to ameliorate local context and to prepare communities for disasters and their potential consequences.

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