21 Prevention of Disaster Impact and Outcome Cascades

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Overview: The Intersection of Prevention Science and Disaster Health

When disasters strike, human populations are exposed to a variety of hazards during impact and to a multiplicity of hazards, losses, and life changes in the aftermath (Reissman, Schrieber, Shultz, & Ursano, 2009; Shultz, Espinel, Flynn, Hoffman, & Cohen, 2007a; Shultz, Espinel, Galea, & Reissman, 2007b; Shultz, Neria, Allen, & Espinel, 2013c). Once set in motion, disasters frequently trigger a succession of compounding consequences (Buldyrev, Parshani, Paul, Stanley, & Havlin, 2010; Lorenz, Battiston, & Schweitzer, 2009). Disasters are complex, nonlinear phenomena, and for the disaster-affected community, the situation tends to go from bad to worse and often very fast (Cavallo, 2010, 2013, 2014; Cavallo & Ireland, 2014; Ramalingam, Jones, Toussainte, & Young, 2008).

This chapter considers the "prevention potential" for disasters through the lens of prevention science. The application of prevention science offers the prospect of diminishing the severity of extreme events' impacts and perhaps reducing the frequency of disaster occurrence. While extreme events are not usually preventable, it may be possible to reduce the preimpact "risk landscape" and thereby minimize the disastrous impacts of an event. To limit the degree of human exposure and the extent of disaster consequences, it is possible to intervene preventively at various points along the disaster risk and impact cascades when

Authors' Note: Figures 21.1–5 adapted from Shultz, Espinel, Cohen, Smith, & Flynn, 2006a. Figure 21.6 prepared for this chapter.

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natural hazards occur and along the disaster outcome cascade in the aftermath. This approach integrates complexity sciences into disaster risk reduction (DRR) and disaster risk management (DRM) (Cavallo, 2010, 2014; Cavallo & Ireland, 2014; Helbing, 2013; Helbing et al., 2015; Johnson, 2007; Shi et al., 2011).

Aligned with the goals of the *Cambridge Handbook of International Prevention Science*, this chapter focuses on disaster prevention and interweaves discussion of the psychological dimensions of disasters and extreme events (Reissman et al., 2009; Shultz, 2007a, b; 2013a, b, c).

Prevention of disasters is a continuum concept. Some disasters may truly be prevented. Strategies can be applied to prevent some human-generated (anthropogenic) disasters, such as climate change impacts – assuming that what is "human-generated" has the potential to be "human-prevented." In other instances, harm to human populations may be prevented even though the "forces of harm" cannot be deterred, as examples, by evacuating persons away from barrier islands prior to landfall of an approaching hurricane or through "preventive resettlement" of entire populations at extreme risk for disaster. More commonly, it is possible to blunt the impact of extreme events when human populations cannot be separated from the hazards.

This chapter consists of narrative interspersed with illustrative case examples. Beginning with the central theme of this *Handbook*, we ask whether disasters can be prevented and respond by providing a case study where prevention was achieved (Shultz et al., 2013b). We next present a primer of disaster basics and follow this with the description of an internationally significant "hybrid" disaster involving both natural and human-generated technological components (Shultz et al. 2011, 2013a). Details are then presented describing how disasters produce psychological consequences. Expanding on this point, the final case study describes an armed conflict disaster that has evolved into a long-duration humanitarian crisis (Shultz et al., 2014a, b, c). With each case example, the prevention perspective is discussed following the synopsis of the event.

Part 1: Can Disasters Really Be Prevented?

Responding to the question, "Can disasters be prevented?" Muralee Thummarukudy, Chief of Disaster Risk Reduction at the United Nations Environment Programme, apparently thinks so. His popular TEDx talk is unequivocally titled "All Disasters Are Preventable."[1] The title is phrased to attract viewers to give a listen and consider Thummarukudy's thesis. In his presentation, Thummarukudy does not actually suggest that all disasters can be prevented outright (most cannot), but he demonstrates that the magnitude of harmful consequences to human populations and the natural environment can be substantially reduced in many cases.

1 www.youtube.com/watch?v=GTm7564Vyg.

Part 1 Case Example

Successful prevention of flooding along the Red River of the North at Fargo, North Dakota, USA, 2009.

Disaster Classification: Natural hydrological river valley and overland flood disaster related to seasonal thawing of winter snowpack.

Considering whether disasters can be prevented, we present a case illustration describing community-involved mitigation of river flooding (Shultz et al., 2013b).

To achieve "universal" prevention, sparing an entire community from disaster impact and consequences despite an imminent threat, requires two uncommon ingredients: (1) the ability to precisely predict the future occurrence of a hazard in terms of time, place, and impact and (2) the availability and timely application of effective risk reduction interventions to neutralize the threat. The coincidence of these two necessary conditions is extraordinarily rare, but instances of successful universal disaster prevention have occurred. We present a case in point, involving the coincidence of disaster predictability and successful mitigation leading to impact prevention.

Natural hazards usually cannot be eliminated, but sometimes their impacts on humans can be deflected. In the case study to be presented, the hazard was present and threatening, but human populations were successfully shielded.

In 2009, during an episode of historic flooding, a river community of one hundred thousand residents was able to safeguard its citizens and infrastructure by erecting a system of levees that held back floodwaters that ringed the city on all sides. Fargo, North Dakota, USA, is an exemplar of the practical application of prevention science and a showcase for community resilience.

The Red River of the North originates in northerly latitudes and then flows much farther north, one of very few rivers worldwide with this distinction. The Red River meanders in a loopy ribbon along the eastern flanks of the cities of Fargo and Grand Forks, North Dakota, before entering the province of Manitoba, Canada, bypassing the capital of Winnipeg via the Red River Floodway diversion, spilling into Lake Winnipeg, and eventually emptying into Hudson Bay.

Flood specialist, Dr. Donald Schwert, lucidly describes the geographic features that shape the springtime Red River flood threats at Fargo:

> Fargo lies at the center of the Red River Valley, which is the lakebed of ancient Glacial Lake Agassiz and one of the flattest land surfaces on Earth. When the Red River of the North floods, waters spill out of its shallow floodplain onto the old lake plain, creating vast floods that are slow-flowing and shallow. But spring flooding is predictable, based on the depth of the developing snowpack over the winter; hence, major flooding can be predicted weeks in advance of the actual event (Shultz et al., 2013b, p. 40).

Since the memorable and devastating Red River Valley Flood of 1997, when Grand Forks was almost completely submerged and Fargo sustained significant inundation, Fargo has successfully activated its citizens every March and April to engage in sandbagging and construction of dikes and levees to prevent flooding of the city. In local parlance, citizens transform themselves into "Flood Fighters" for several weeks each spring. Fargo citizens faced their greatest challenge in 2009 when the Red River waters rose to unprecedented heights, twenty-four feet above flood stage. The 2009 "flood fight" relied upon the strong backs and energized efforts of eighty-five thousand individuals. Working nonstop shifts inside the Fargo Dome (dubbed "Sandbag Central"), students, community citizens, and volunteers collectively filled 8.5 million sandbags. Concurrently, with precision coordination, brigades of citizens were deployed to vulnerable sections of riverbanks, where they were met by flatbed trucks laden with palletized sandbags. Since subfreezing temperatures are the norm, sandbags had to be stored inside the heated Fargo Dome and then transported just in time to rendezvous with the waiting teams. Parka-clad citizens had just minutes to stack the bags, while the sand remained sufficiently malleable to sculpt into tight-packed levees. For weeks, Fargo's Flood Fighters braved blizzard conditions to construct sandbag fortifications.

Stress was palpable and rising steadily along with the river level. The levees required continuous monitoring; Fargoans knew that a single breech in the barricades would result in widespread flooding. Fortunately, the levees did not fail and the icy waters of the engorged Red River of the North were held back.

The prevention perspective. As illustrated, when the opportunity presents, invoking effective "universal" prevention measures can effectively short-circuit a major disaster threat. Hence, the cascade of harmful impacts was averted. So too were the series of consequences that an impacting flood disaster would trigger. Citizens were spared from exposures to glacially cold waters filling their homes and to the attendant damage, destruction, infrastructure disruption, resource loss, displacement, physical harm, and psychological distress.

Savvy to both stress and psychological distress inherent in the flood operation and the uncertainty of success during a year when the river reached record heights, Fargo developed contingency plans that incorporated universal, selective, and indicated components of prevention. Plans were in place to shelter children, frail elderly, and other subpopulations of persons with special needs, as well as to maintain services and safeguard psychiatric medications for the subpopulation of persons with severe and persistent mental illness. The North Dakota director of medical services, a psychiatrist, was at the table with the mayor of Fargo, civic leaders, and emergency managers. He was frequently broadcasting messages on themes of resilience and coping – and identifying available resources and support services – to Fargo and Red River Valley communities via a range of media channels.

Having experienced widespread flooding in 1997, the citizens of Fargo responded with grit and determination to prevent a recurrence. Beginning in 1998, Fargo had fourteen consecutive years when the Red River rose above flood stage, and every year the flood fighters emerged victorious. The city has not flooded again. This year-over-year success of Fargo's citizens supports the notion that DRR prevention coupled with mitigation, preparedness, and risk governance) deserves increasing prioritization relative to the traditional emergency management emphasis on the crisis management phases (response and recovery).

The natural phenomenon of river flooding was not prevented in 2009. Indeed, at Fargo, the Red River rose to a historical record of forty-two feet and overflowed its banks, with water extending for miles across the shallow floodplain. Fortunately, the flat landscape made it possible to erect a levee fortress around the city of Fargo, even as the flood submerged large expanses of farmland on all sides. Aerial views showed Fargo appearing like a dry island encircled by a vast liquid landscape of floodwaters. What was prevented was the disastrous impact of floodwaters inundating the neighborhoods of Fargo. Over years of coming together for a common purpose, the annual Fargo citizen flood response has melded into the community's identity and solidified with the creation of a not-for-profit organization entitled Red River Resilience.

Part 2: Disaster Basics and Conceptual Building Blocks

This section provides a primer of disaster terms and concepts (Shultz, et al. 2007a, b).

Disaster. What is a disaster? Among many definitions for the term "disaster," here are two:

1. "A disaster is characterized as an encounter between forces of harm and a human population in harm's way, influenced by the ecological context, in which demands exceed the coping capacity of the disaster-affected community" (Center for Disaster and Extreme Event Preparedness [DEEP Center], quoted in Shultz et al., 2007a, p. 18).
2. "A disaster is an occurrence that causes damage, ecological disruption, loss of human life, deterioration of health and health services on a scale sufficient to warrant an extraordinary response from outside the affected community area."[2]

Across a spectrum of definitions, including these two examples, five commonalities emerge (see Table 21.1). First, disasters are social-ecological phenomena, typically affecting human populations, often entire communities, and the ecosystems they rely on, often spanning large regions (Walker & Westley, 2011). Second, disasters are frequently notable for the extraordinary magnitude of harm inflicted. Third, disasters produce differential and often disproportionate effects on subpopulations of vulnerable groups and persons. Fourth, in a disaster, the demands exceed the community's capacity to respond. Fifth,

2 www.who.int/gender/gwhgendernd2.pdf.

Table 21.1 *Disaster Definitions: Five Common Elements*

1. Disasters are socio-ecological phenomena
2. Magnitude of harm
3. Disproportionate effects on vulnerable populations
4. Demands exceed affected community's capacity to respond
5. Disaster-affected communities typically require outside help

affected communities require outside help. The two upcoming case illustrations possess all five of these defining characteristics.

Disaster Ecology Model. The DEEP Center definition for disaster was developed in tandem with the creation of the Disaster Ecology Model (DEM) (Shultz et al., 2007a, b). The model diagram embodies the definition, concurrently displaying the three pillars of the DEM: forces of harm, affected populations in harm's way, and the ecological context.

Forces of harm refer to exposures to disastrous hazards, losses, and changes. The *affected population in harm's way* is comprised of multiple tiers of persons and communities that, directly or indirectly, are threatened or impacted by the forces of harm, or sustain losses and changes associated with the disaster event. Finally, the *ecological context* is made up of an array of risk and resiliency factors, operating at many levels (Shultz et al., 2007a, b). These factors interact collectively, and in a complex manner, to influence the degree of physical and psychological harm sustained during a disaster and in the aftermath. The DEM provides a framework for simultaneously considering the interrelationships among these three components (Figure 21.1). As a socioecological model, the DEM attempts to better understand how disasters affect human communities and provides a guiding structure for how to enhance resiliency for communities that are threatened or impacted by disasters (Shultz, et al., 2007a, b).

Disaster frequency. Disasters are locally rare but globally common. Natural disasters occur with an average frequency of more than one per day. For the period 2003 to 2012, an average of 388 natural disasters was registered annually (Guha-Sapir, Hoyos, & Below, 2014). Nonintentional anthropogenic/technological disasters also occur, on average, more often than daily.

Disaster continuum. Extreme events affect communities differentially, depending in part on the seesaw balance between the demands imposed by the event and the response capacity of the community. Three terms – emergency, disaster, and catastrophe – describe a continuum that interrelates demand and capacity (Shultz et al., 2007a). An *emergency* is an event where community assets are able, and sufficient, to respond to the demands. In a *disaster*, demands exceed the coping capacity of the disaster-affected community. The term *catastrophe* is reserved for the uncommon disaster of such magnitude that not only do demands exceed capacity, but also the impact actually destroys response capacity. Examples of catastrophes include the

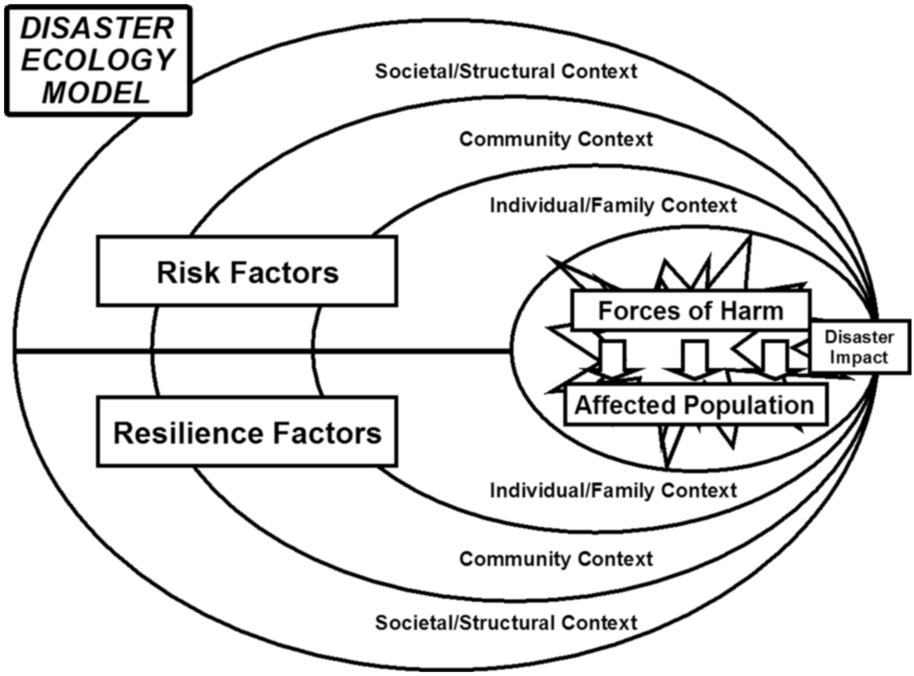

Figure 21.1. *Disaster Ecology Model.*

2010 Haiti Earthquake, the 2011 Great East Japan Disaster, and the 2013 Super Typhoon Haiyan in the Philippines.

Disaster classification. Disasters are characteristically subdivided into natural disasters (acts of nature) and human-generated or "anthropogenic" disasters. Some disasters have prominent natural and anthropogenic elements combined, leading to their description as "hybrid" disasters. The Centre for Research on the Epidemiology of Disasters (CRED), based in Brussels, Belgium, maintains the official international tallies of natural disasters (Guha-Sapir et al., 2014) and what CRED describes as "technological" human-generated disasters. CRED has recently introduced a database to tabulate "complex emergencies."

Natural disasters. CRED's disaster taxonomy distinguishes five subcategories of natural disasters: (1) *meteorological,* "events caused by short-to-medium term atmospheric events," including winter storms, tornadoes, cyclones, and hurricanes; (2) *hydrological,* "events caused by deviations in the normal water cycle," including river and flash floods, storm surges, and mudslides; (3) *geophysical,* "events originating from solid earth," including earthquakes, landslides, and volcanoes; (4) *climatological,* "events caused by medium-to-long-term climate change processes," including extremes of heat and cold, wildfires, and droughts; and (5) *biological:* "disasters caused by exposure of living organisms to pathogens and toxins," including epidemics/pandemics, insect infestations, animal diseases, and plant blights (Guha-Sapir et al., 2014).

Anthropogenic disasters. Within anthropogenic disasters, the DEEP Center specifically differentiates nonintentional/technological disasters, including transportation crashes and hazardous materials spills, from intentional events, including armed conflicts and acts of mass violence (Shultz et al., 2007a, b). Moreover, many potentially disastrous phenomena of global environmental change, including climate change, are considered anthropogenic (IPCC, 2012).

Disaster consequences. Disasters produce excess mortality, morbidity (injury and disease), and economic costs (Shultz et al., 2007a, b). During the decade 2003 to 2012, an annual average of 107,000 deaths were attributed to disasters, 215 million persons were affected each year, and annual economic costs associated with these natural events were estimated at U.S. $156.7 billion (Guha-Sapir et al., 2014).

An expanded array of disaster consequences includes (1) morbidity and mortality (injury, disease, death); (2) material losses (damage, destruction, economic losses); (3) social disruption (damage to infrastructure, lack of survival necessities, population displacement); (4) psychosocial impact (distress, detrimental behavior change, psychopathology, loss, bereavement and grief); and (5) socioecological impact, including cultural impact (Shultz et al., 2007a, b).

Disaster prevention. The fields of disaster management, disaster public health, disaster medicine, and disaster nursing routinely address prevention using the classical approach to the topic: primary, secondary, and tertiary prevention. In contrast, throughout this volume, a more contemporary conceptualization of prevention is used. Based on the seminal work of Gordon (1983), prevention is conceived at three levels: universal, selective, and indicated. The National Research Council (U.S.) and Institute of Medicine (2009) provide the following concise descriptions that distinguish universal, selective, and indicated prevention:

> *Universal prevention* includes strategies that can be offered to the full population, based on the evidence that it is likely to provide some benefit to all (reduce the probability of disorder), which clearly outweighs the costs and risks of negative consequences. *Selective prevention* refers to strategies that are targeted to subpopulations identified as being at elevated risk for a disorder. *Indicated prevention* includes strategies that are targeted to individuals who are identified (or individually screened) as having an increased vulnerability for a disorder based on some individual assessment but who are currently asymptomatic. Selective and indicated prevention strategies might involve more intensive interventions and thus involve greater cost to the participants, since their risk and thus potential benefit from participation would be greater (National Research Council and Institute of Medicine, 2009, p. 61).

Cascading disaster risks, impacts, and consequences. Disasters expose human populations to harm and produce consequences. For many disaster events, the timeline can be simplified into three phases: preimpact, impact, and postimpact. This before-during-after sequence has great utility for organizing disaster risk management strategies. Furthermore, the DRR approaches of prevention, mitigation, and preparedness are best applied preimpact, while the crisis management strategies, response and recovery, are initiated during impact and extend far into the postimpact periods.

We can also describe cascades in a tripartite fashion. Preimpact, the "risk landscape" may be comprised of a complex set of risks that mutually interdepend and build upon each other. When disaster strikes, the impact cascades are foremost. In the aftermath, consequence cascades come to prominence.

While some disasters involve a one-time single impact, many disasters involve multiple simultaneous, sequential, or cascading impacts. Disaster consequences typically occur in multiples. Furthermore, in relation to the exposures experienced, disaster consequences interact, synergize, compound, amplify, exacerbate, and cascade.

Major disasters are frequently distinguished by their multidimensionality and their interrelated and interacting components (hallmarks of complexity). The next case example, the Great East Japan Disaster, is notable for its composite of cascading events. The storyline consists of three parts: an underwater earthquake set off a tsunami that caused a radiation release at a nuclear power plant. Natural phenomena (earthquake, tsunami) and human-generated/technological elements (radiation disaster) combined to create a hybrid disaster of daunting scope and complexity that required remarkable ingenuity to counteract.

Part 2 Case Example

A multiple impact "hybrid disaster": The Great East Japan Disaster, 2011.

Disaster Classification: Natural geophysical earthquake/tsunami disaster triggering anthropogenic (nonintentional human-generated) radiation release leading to a complex humanitarian crisis.

On the afternoon of March 11, 2011, an extreme seismic phenomenon – a 9.0 moment magnitude (Mw) earthquake – precipitated multiple cascading events leading to what would collectively be called the Great East Japan Disaster (Shultz et al. 2011, 2013a). The undersea megathrust earthquake involved the subduction of the Pacific plate beneath the tectonic plate that supports Japan's largest island, Honshu. Originating at profound ocean depths about one hundred kilometers from Japan's eastern coastline, the earthquake was the strongest ever to hit Japan – and the fourth most powerful in recorded earthquake history. Earthquake shock waves were experienced on the Japanese mainland within seconds. The earthquake set off a massive tsunami at the ocean's surface, directly above the epicenter, sending waves toward the coastline, traveling at the flight speed of a commercial jet aircraft. The "run-up" of the tsunami waves inundated hundreds of kilometers of coastal territory, toppling structures and bulldozing piles of debris far inland. Towering tsunami waves came ashore in the Fukushima Prefecture and overtopped the protective seawalls buttressing the Fukushima Dai-ichi nuclear power plant. Surging seawater scuttled the plant's safety systems, ultimately triggering meltdowns in three reactors. Radiation releases resulted in limited direct exposure of human populations in the area and contaminated the water supplies, agricultural products, and ocean fish and shellfish populations (Shultz et al., 2013a).

Populations in the area of the power plant experienced a triple threat situation during the impact phase: powerful earthquake ground shaking within seconds of the underwater event, tsunami waves rushing ashore with deadly effect within the first hour, and radiation exposure over days and weeks (Shultz et al., 2011).

In the aftermath, many survivors were dealing with psychological trauma while grieving their lost loved ones, some of whom were swept away by the waves. Many of these survivors were concurrently recovering from physical injuries sustained during harrowing escapes from the onrushing tsunami. Near the power plant, populations in closest proximity were evacuated and displaced with almost no chance of return to their radiation-contaminated properties. To this day, disaster survivors in the hardest hit areas, as well as their products and services, have been victims of stigma, ostracism, and discrimination.

A detailed "trauma signature analysis" of the Great East Japan Disaster has been published, detailing the multiplicity of psychological risk factors operating in relation to each and all of the three hazards comprising this catastrophic event (Shultz et al., 2013a). The Japanese population was subjected to multiple impacting hazards, with each one ranked at extreme magnitude on the respective rating scales (Shultz et al., 2013a).

The prevention perspective – enriched by complexity sciences. This brief synopsis presents a streamlined account of the events. Even so, this description highlights the cascading, amplifying, aggravating sequence of impacts and outcomes that distinguished the Great East Japan Disaster.

Disasters are complex and nonlinear events. There is increasing recognition that disasters need to be viewed as such to better respond to the intricate web of challenges posed once an event, such as the Great East Japan Disaster, is rolling onshore – in the most literal sense. Complexity scientists are grappling with how best to deal with the richly populated disaster "risk landscape" and how to infuse preparation for the "unknown unknowns" into emergency management planning and response (Cavallo, 2010, 2014; Cavallo & Ireland, 2014). Traditional, regimented, hierarchical, compartmentalized approaches to disaster management are rigid and antiquated. Paradigmatic change is necessary at this critical juncture.

The application of complexity sciences, defined as "the study of the phenomena which emerge from a collection of interacting objects" (Johnson, 2007, p. 3), is highly relevant. More than most complex phenomena, disasters routinely break the mold of predictability, logical sequences, and linear causality. Major disasters tend to be dynamic, complex, unpredictable, nonlinear, cascading events. In order to integrate prevention science into DRR and DRM planning and operations, and to forge a path toward community disaster resilience, it is necessary to grapple with the complexities of disaster events.

In the case of the Great East Japan Disaster, the fact that an undersea earthquake could give rise to a surface-riding tsunami was anticipated. A similar scenario played out seven years earlier when the deadly 2004 Southeast Asia tsunami originated from a 9.2–9.3 moment magnitude (Mw) earthquake with its submarine epicenter close to Aceh, Indonesia. Tsunamis are generated by sudden displacements in the seafloor, landslides, or volcanic activity. In the language of complexity science, the highly predictable occurrence of a tsunami that was produced by the powerful earthquake of March 11, 2011, was not "emergent." To be emergent, a phenomenon needs to be unpredictable, trigger a downward causal sequence, and create organization or order on an unexpected scale.

Instead, what was "emergent" was the tsunami-induced radiation disaster at the Fukushima Dai-ichi nuclear power plant. Once the tsunami waves surmounted the protective seawalls, the generators for the cooling systems were submerged in salt water and shut down. This led to system failures and ultimately to the meltdown of three nuclear reactors. The Fukushima Dai-ichi nuclear power plant disaster was an unpredictable encounter with "unknown unknowns" (e.g., unanticipated tsunami wave heights) leading to a downward causal sequence that was unstoppable but orderly (the meltdown and local area contamination unfolded in stages, progressively and inevitably).

What was also "emergent" was the stranding of pockets of coastal residents who became geographically isolated by the tsunami waters that pooled onshore. Unreachable for days by rescue personnel, these populations were exposed to harsh March winter conditions without access to shelter or survival supplies.

What was also "emergent" were the psychological effects for persons exposed to three compounding impacts from earthquake, tsunami, and radiation. We have previously described these phenomena as a "triple threat trauma" (Shultz et al., 2011).

Nevertheless, despite the extraordinary demands and the level of complexity, Japan mounted a model disaster mental health response that we have previously documented (Kim, 2011; Kim & Akiyama, 2011; Shultz et al., 2013a; Suzuki & Kim, 2012; Takeda, 2011). This response incorporated elements of universal, selective, and indicated prevention (Gordon, 1983; National Research Council and Institute of Medicine, 2009).

Part 3: Psychological Dimensions of Disasters

We are now at a pivot point to move the conversation into a domain where prevention science and complexity science have not met previously – examining the psychological dimensions of disasters. Prevention science has been applied effectively to the promotion of psychological health and the prevention of psychological consequences of a variety of exposures throughout the lifespan. This *Handbook* is a testament to the state of the science. Complexity science has not been fully infused into the social sciences generally or into the psychological dimensions of disasters. This is an unexplored frontier. Moreover, within the domain of the psychological aspects of disasters, prevention science and complexity science have yet to shake hands. Part 3 of this chapter is intended to make this introduction, presenting two interrelated sections – on the psychological consequences of disasters and on disaster behavioral health concepts – before providing a third case example that exemplifies a very high degree of complexity.

Psychological Consequences of Disasters

When applying prevention science to the area of disaster health, it is useful to understand the four primary attributes of the psychological consequences of disaster (Shultz, 2013a, b). This section summarizes key teachings from disaster behavioral health trainings conducted for more than twenty thousand public health, mental health, health care, hospital, and emergency management professionals throughout the United States and Canada, and in a series of international venues, by DEEP Center professionals (Shultz et al., 2006b, 2007a, Shultz, Allen, Bustamant, & Espinel, 2009). This information has been previously published, upon invitation, by the Substance Abuse and Mental Health Services Administration's (SAMHSA) Disaster Technical Assistance Center (U.S.), and the following discussion closely parallels our previous writing (Shultz, 2013a, b).

In a disaster, the psychological consequences (1) are widespread, (2) extend across a spectrum of severity, (3) persist for a prolonged duration, and (4) reflect the unique and defining features of the specific disaster event. These distinguishing psychological features relate directly to exposure of a population to the physical forces of harm in a natural or anthropogenic disaster and to perpetrated actions during situations of armed conflict.

Psychological consequences of disaster are widespread and pervasive. The most basic premise is that in a disaster, more people are affected psychologically than are harmed physically (see Figure 21.2). This can be illustrated by showing that the "psychological footprint" of a disaster is larger than the "medical footprint" (Shultz, 2013a, b).

The application of multiple levels of prevention – universal, selective, and indicated – provides an excellent starting point. When preparing for disasters, it is very important to identify a range of special populations that are more vulnerable when disasters strike. What is unappreciated is the fact that disasters produce "new" special populations. Persons who, prior to impact, were healthy, functional, and "needs-free" may suddenly become candidates for a disaster-created "special population" of persons who have sustained, as examples, traumatizing exposures to the forces of harm, loss of home leading to displacement, loss of a loved one and subsequent bereavement, personal life-changing injury, or disruption of ecosystem services. Each of these instances creates needs that did not previously exist and cause psychological distress. Psychological repercussions may occur for persons far from the scene who are socially

In a disaster, the size of the psychological "footprint" greatly exceeds the size of the medical "footprint."

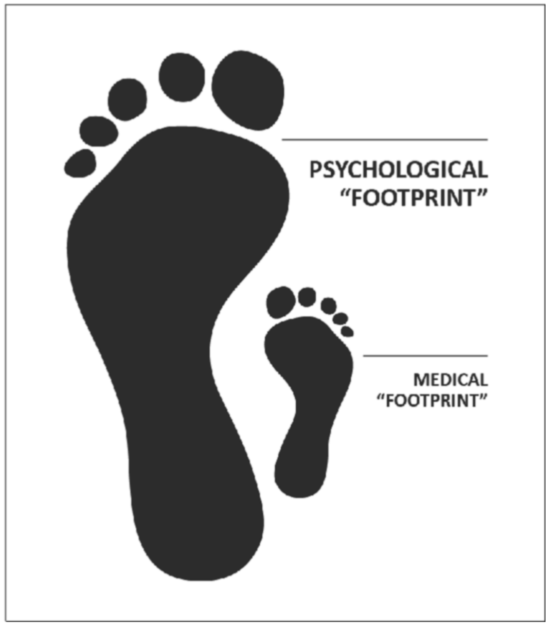

Figure 21.2. *Psychological consequences of disasters: widespread and pervasive.*

connected to direct victims of the disaster. So, following a disaster, persons who may need psychological support tend to be larger in number and geographically more dispersed than persons sustaining harm at the epicenter of destruction.

Psychological consequences of disaster are arrayed across a spectrum of severity. Almost everyone exposed to a disaster experiences fear and distress. This is a common, expectable, and nearly universal reaction. Many who are initially affected will rebound rapidly and regain full functioning without need for intervention. However, some disaster-exposed persons will exhibit detrimental behavior changes such as when unharmed-but-fearful citizens converge on area hospitals. A smaller proportion of persons, especially those with the most intense exposures, will experience more pronounced psychological consequences, leading to diagnosis of common mental disorders (CMDs) such as posttraumatic stress disorder (PTSD), major depression, generalized anxiety disorder, panic reactions, somatic complaints, and/or increased use of substances. Persons who have lost a loved one are likely to experience traumatic bereavement or complicated grief. There are individual differences, but a general rule of thumb is that the intensity of exposure to the disaster event predicts where disaster survivors fall along this continuum from transient distress to psychopathology (Shultz, 2013a, b). There are higher rates of severe psychological consequences and diagnosable psychiatric disorders among those who have a "ground zero" exposure to the disaster compared to survivors who are more peripherally exposed.

Figure 21.3. *Psychological consequences of disasters: spectrum of severity.*

From a prevention science vantage point, it is possible, based on historic disaster experiences, to plan and prepare for the magnitude and extent of psychological needs for persons exposed to common disasters across a spectrum of intensity (see Figure 21.3). Based on experience, disaster mental health professionals can estimate the proportions of survivors exposed to varying levels of injurious or potentially traumatizing events and to provide active outreach to persons in geographic areas or shelter environments who are most likely to need mental health and psychosocial support.

Psychological consequences of disaster extend across a range of duration. While the exposure to disaster hazards during impact may be relatively brief, hardships in the aftermath, associated with losses, lifestyle changes, and socio-ecological disruptions, often persist for extended periods of time (Shultz, 2013a, b). Accordingly, psychological stressors maintain even after the physical forces have ceased to do harm (see Figure 21.4). Disaster survivors who have lost loved ones must cope with the tasks of disaster recovery and reconstruction while grappling with traumatic bereavement and, often, with prolonged grief disorder.

Psychological consequences of disaster relate to the defining features of the event. The type of disaster matters. Each disaster creates a unique composite of psychological risk factors unlike any other event (see Figure 21.5). What survivors experience and witness in a particular disaster event shapes what becomes consolidated into traumatic memories of the event. The novelty of each disaster episode, leading to a specific pattern of potentially traumatizing exposures, has been operationalized into an evidence-based method called trauma signature (TSIG) analysis (Shultz & Neria, 2013).

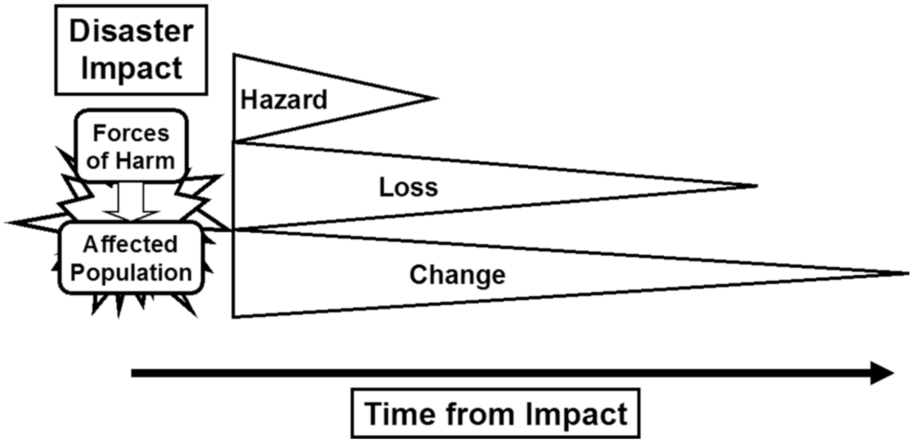

Figure 21.4. *Psychological consequences of disasters: range of duration.*

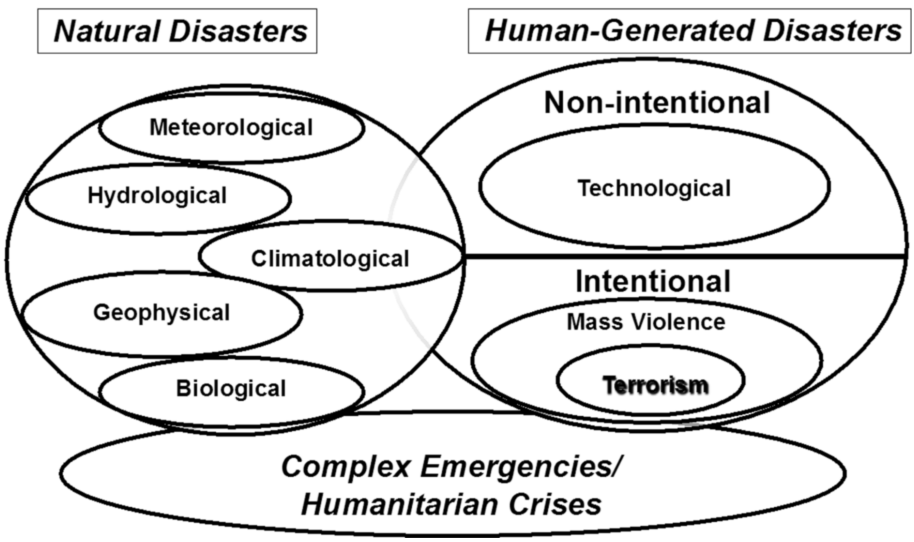

Figure 21.5. *Psychological consequences of disasters: type of disaster.*

Disaster Behavioral Health Concepts: A Review of the Scientific Evidence

Disasters can be traumatic via three interacting pathways: (1) disasters can be perceived as threats of bodily injury and potential death (Neria, Nandi, & Galea, 2008); (2) disasters can lead to temporary or permanent loss of assets, resources, and services (McFarlane, Van Hooff, & Goodhew, 2009; Norris, Friedman, Watson, Byrne, & Kaniasty, 2002); and (3) disasters can lead those affected to experience physical and/or psychological disorders (Neria & Galea, 2008).

Studies have suggested that anthropogenic disasters can lead to more, and more complex, psychological problems than natural disasters (Galea, Nandi, &