Hurricane Katrina: A Signature Cascading Risk Event and a Warning

See also Kim-Farley, p. 1448, and the *AJPH* Hurricane Katrina 15 Years After section, pp. 1460–1503.

On August 29, 2005, Hurricane Katrina triggered failures in engineered systems and human services in New Orleans, Louisiana, and its environs. Water topped the unfinished levees and dikes, found seams between them and infiltrated underneath them. More than 1800 people died, more than 30 000 had to be rescued from the flood waters, thousands relocated, the impact was disproportionately felt by poor predominantly African Americans, and the economic cost of this one event was more than $100 billion.[1–3]

I make no pretense of adding to information about the event itself, which has been heavily studied. Instead, I use Katrina to highlight the need to systematically analyze how a single event—a hurricane, wildfire, earthquake, blizzard, or industrial or transportation accident—can cascade into multiple failures that substantially multiply consequences. Katrina was a painful opportunity to learn about cascading events when one hazardous event triggers others, producing even more severe consequences.

TRIGGER EVENTS AND DEADLY CONSEQUENCES

The American Society of Civil Engineers called the flooding of New Orleans "the worst engineering catastrophe in US History."[3] There is no doubting the physical power of Katrina to cause damage, nor of hurricanes and tropical storms Sandy, Rita, Ike, Irene, Andrew, and Ivan just in the 21st century. Although tropical storms are at the top of the list of events leading to presidential disaster declarations, nor'easters, pandemics and epidemics, tornadoes, chemical spills, transportation accidents, and other hazardous events can cause disastrous cascading consequences. In addition, less noticeable events such as seemingly minor malfunctions in the electrical grid, construction in vulnerable locations, poorly designed and operated control panels, pipeline fires, and explosions can trigger serious multihazard events.

Each cascading event is unique because of geography and trigger event. Yet, some patterns repeat. Typically, tropical storms trigger communication and electricity failures. Fire, police, and other first responders are cut off and not able to effectively respond. The ability of transportation, water, and sewer system operators as well as health care providers are compromised, especially because they lack the ability to communicate and coordinate, all of which occurred during Katrina.

A WARNING AND SOLUTIONS

Pescaroli and Alexander[4] urge that we not wait for cascading events to happen. They argue that we need to understand interdependences among systems, the degree of amplification when a cascading event occurs, and the kinds of secondary disaster that can result. We need to model cascading event progression and prevent the events or build in resilience. This modeling includes engineered systems, human service interactions with each other and with engineered systems, and economic effects, including direct impacts on the surrounding area as well as indirect ones that can occur thousands of miles away as demand and consumption change.

We have good starting points, beginning with the acknowledgment that these events need to be considered. In the United States in regard to climate change, the multiagency US Global Change Research Program Office for Coastal Management[5] discusses cascading events in the context of the climate challenge. Increasingly, we have access to more accurate data supported by publicly available software packages that allow planners and health and risk analysts to map local attributes and study their vulnerability. Researchers have developed processes that allow users to uncouple key systems, build models of the systems, and better understand the risks.[6] Although we do not know which coupled cascading hazards are the potentially most disastrous in each location, we need to begin with some obvious ones stemming from climate change, freshwater availability, temperature, precipitation, storms, flooding, drought, fire, and water and food security. Science has been embracing the challenge.

Government has been much slower to engage these events in the form of providing resources. There already is a mechanism; we do not need to invent a new process. Changes to the Robert T. Stafford Act of 2000 require states and local governments to prepare and update hazard mitigation plans to be eligible for federal disaster relief funds. The

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Stafford Act does not preclude consideration of cascading events. Nor, however, does it insist that they be included.

I believe the key is to require each county and city as part of their next required hazard mitigation plan update to explicitly and briefly discuss the potential worst cascading events. An additional two to three pages in a document that often exceeds 250 pages should not be an undue burden. If the county or city is persuaded that one or more cascading events are truly threatening, they should be able to apply for a special competitive grant program that would provide additional funds for a more thorough assessment. This is not a pie-in-the sky idea. The federal government created the competitive Brownfields Program, which provided additional funds.[7] Successful studies led the federal government to help these places access federal grants and technical assistance.

I have been documenting coverage of cascading effects in each state and in large cities and metropolitan regions. New Orleans is one of the cities. In 2005, a few months after Katrina struck, the New Orleans hazard mitigation plan focused on establishing a network of cooperative participants. Discussions of cascading events appear in two places in the report and acknowledge the interconnectedness of issues. The 2015 parish document (https://bit.ly/32DSouU) includes 11 mentions or discussions of interconnectedness, including specific examples, such as Katrina's floodwaters causing toxins to flow out of warehouses, stranded or abandoned autos, and homes as well as infrastructure failure, especially electricity. However, the document does not appear to elevate the priority of any of these in its requests for resources. I do not mean to criticize the report. In fact, the 2015 New Orleans parish report seems the norm, that is, regions are more aware of the challenge than their earlier reports show. The reports focus on singular risks. For example, electrical power loss is a focus. The downstream consequences have to be inferred. Portland, Oregon, Los Angeles, California, and New York City wrote a great deal more about cascading events in their most recent reports than did New Orleans.

Overall, progress has been made. Yet I am concerned, as I expect the consequences of cascading events to markedly increase because of climate change, globalization, and urbanization. Katrina was an early warning that we have been too slow to heed. My anxiety is high for large US metropolitan areas and even higher for the more than 30 megacities located mostly in Asia, where millions of people live in high-risk areas, for interconnected natural and human hazard events. We need to guard against fatalism and do the unglamorous work of preparing and implementing protective programs that are grounded in resilience principles and detailed in plans crafted long before the event occurs, are periodically practiced, are activated during an event, and follow through to postevent recovery.

My contention is that the vast majority of cascading event–related disasters would be less harmful if we accepted them as realities of our globalizing, urbanizing, and climate change–affected world, created scenarios of how a single event could trigger others, and worked seamlessly together to reduce consequences. This requires careful analyses, planning, and prudent decisions, which require the elevation of cascading event challenge to the national level and additional resources, albeit modest resources initially for detailed studies. Perhaps my suggested solution—which is to offer an opportunity to local governments to compete for extra funding that would completely focus on the cascading risk challenge—is too simple. Time will tell if I am overstating the case for this approach. I believe that I am understating the collective risk we face from cascading events. AJPH

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CONFLICTS OF INTEREST

The author has no conflicts of interest to declare.

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