

## Chapter 22

# A Systems Framework for Modeling Health Disparities in the Prevalence in Chronic Conditions following a Natural Disaster Event

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### ABSTRACT

*Natural disaster events impact both the short- and long-term health of a region's population. Due to variation in the vulnerability among population segments, a severe storm event can be expected over time to have a greater public health impact upon traditionally underserved and medically fragile populations. This research illustrates the causal relationships leading to a change over time in the prevalence of chronic conditions among black and non-black populations within U.S. Hampton Roads. Using a system dynamics approach, the authors develop and integrate a macro model that captures change in regional economic and demographic profiles with a micro model that focuses on access to health services and the ability to respond within the context of the changing regional environment. The authors' study finds that: (1) the disparity in the prevalence of chronic conditions increases over time following the event, (2) the growth in health disparity may be slowed by regional resiliency intervention policies, and (3) mitigation efforts result in greater reductions in growth of chronic conditions among the black population relative the non-black general population. Knowledge of the disparate impact that such an event will have on the long-term health of underserved and medically fragile populations may be used to inform mitigation investments.*

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## INTRODUCTION

Natural disaster events have meaningful consequences for the long term health of a region's population. The natural disaster event can not only be the source of new injuries and illness, but the disorder in the region's built, economic, and social environments may alter normal systems of access to care and health management (Walker & Warren, 2009). The disruption in the continuity with a medical home may aggravate existing conditions and promote the onset of new conditions (Behr & Diaz, 2010). The disruptive nature of the natural disaster event has consequences for nearly all populations segments, yet due to variation in the vulnerability of individual population segments, the storm event can be expected to have a greater health impact upon some populations relative others, particularly traditionally underserved and medically fragile populations (Diaz, Behr, Jeng, Liu, & Longo, 2012). Further, the storm event occurs within the context of exiting disparities in the prevalence of chronic conditions.

The natural disaster's shock to the system may set in motion regional economic and demographic changes that may condition, over time, trends in prevalence of chronic conditions resulting in the widening of health disparities. Health disparities have been identified as an influential component in both population vulnerability and public response before, during, and after natural disaster. For example, Jones-DeWeever et al. (2006) analyze gender, race, and class disparities during Katrina. Peacock et al. (1997) analyze ethnicity and gender disparities as well as the sociology of disaster while hurricane Andrew. Franklin (2006) describes the issues raised in what is called a new kind of medical disaster in a retrospective analysis of race and class during hurricane Katrina. In addition, Gullette (2006) examines the politics of late life when hurricane Katrina took place. The issue of cultural competency in disaster recovery is analyzed by Seidenberg (2009). Vulnerable populations, in particular, children, elderly, and

those who suffer chronic diseases and are subject to health disparities are more susceptible to natural disasters. Rath et al. (2009) investigate adverse health outcomes for children and adolescents with chronic conditions post-Katrina. Reis et al. (2004) analyze healthcare issues for people with disabilities.

The Hampton Roads region within U.S. Virginia is second only to New Orleans in susceptibility to severe flooding and is subject to frequent tropical and occasional hurricane force storms. This is largely due to the region's geography of low lying coastal areas extending into the Atlantic. Both hurricane and the associated severe surge pose potentially significant hazards to the Hampton Roads population and infrastructure. Especially vulnerable are medically fragile populations, such as those with mobility and sensory disabilities, and residents of its economically challenged communities (Diaz et al., 2012; Diaz, Behr, Jeng, & Tulpule, 2011). Despite the fact that past catastrophic events have increased situational awareness as well as generated greater local and regional collaboration, undeveloped is an understanding of the immediate and longer-term vulnerability of many traditionally underserved communities and vulnerable population segments within Hampton Roads. Knowledge of the disparate impact that such an event will have on the long-term health of underserved and medically fragile populations may be used within emergency planning simulations and as well as to promote informed mitigation policies and investments. The two primary hypotheses guiding this modeling are as follows.

## Hypotheses

The object of this research is to provide a framework illustrating the causal relationships leading to a change over time in the prevalence of chronic conditions among black and non-black populations within Hampton Roads. The black population within Hampton Roads has fewer resources relative the non-black general population to respond

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