



# Unraveling the evacuation behavior of the medically fragile population: Findings from hurricane Irene



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## ABSTRACT

Despite the widely recognized importance of evacuation planning for residents with special needs – in this paper referred to as the medically fragile population – there is virtually no research available to guide such planning, as opposed to the numerous empirical research studies on the evacuation behavior of the general population. In this paper, we provide these long-overdue insights using data from a large-scale phone survey (over 7000 samples) conducted in the aftermath of hurricane Irene in the Hampton Roads region in Virginia. Via aggregate and disaggregate analyses, we start to unravel the behavior of this heavily understudied, and potentially vulnerable population group. Special emphasis will be placed on the differences between the medically fragile and non-medically fragile population. Two alternative definitions for what constitutes medically fragile are examined in this paper. Using the broader definition, it was found that a key difference between these two groups relates to the importance of having a strong network of family members in the area. When considering a more narrow definition, we found that being a single parent household, likelihood of neighborhood flooding and knowing most of the names of one's neighbors have significantly different impacts on the two population groups.

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## 1. Introduction

In the past decade(s), extensive research has been conducted on the hurricane evacuation behavior in the United States. These studies, however, tend to focus on the general population, e.g. see Baker (1991), Whitehead (2000), Gladwin et al. (2001), Dow and Cutter (2002), Fu and Wilmot (2004), Lindell et al. (2005), Elliott and Pais (2006), Czajkowski (2011), and Dash and Gladwin (2007). Particularly, when it comes to the evacuation behavior of residents living with a disability – in this paper referred to as the medically fragile population – research is minimal (Zhao et al., 2010). This is somewhat surprising since a sizable fraction (12.1%) of the United States population is considered disabled (U.S. Census, 2011). In the state of Virginia, approximately 10.9% of the population is considered disabled (Erickson et al., 2012), and in the Hampton Roads (HR) region in Virginia – the focus of this paper – this percentage is about 10.1%.

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HR encompasses twenty-four counties and cities, mainly in southeastern Virginia (HR also includes two small counties in North Carolina). The bulk of the HR population resides in one of its seven major cities: Chesapeake, Hampton, Newport News, Norfolk, Portsmouth, Suffolk, and Virginia Beach, see Fig. 1 for a map of HR. The 1.8 million HR residents represent over 22% of Virginia's population (U.S. Census, 2011). HR regularly experiences hurricanes, is home to the United States Navy Atlantic Fleet, houses the sixth largest port in the country, and is the most vulnerable area to flooding anywhere on the East Coast: The sea level in HR is rising at 1.8 mm per year (Boon et al., 2010). This, in combination with the sinking land in the HR region – known as land subsidence – has placed HR as the second most vulnerable area in the United States for coastal flooding (the aforementioned 1.8 mm per year excludes the effect of land subsidence), directly behind New Orleans in Louisiana (Thieler et al., 2001).

The lack of behavioral studies of the medically fragile population becomes even more surprising once one realizes that numerous studies have concluded that it is of paramount importance to account for the special needs of this group during evacuations. For example, Litman (2006) pointed to the vital importance of appropriate accommodations for the ill and disabled during hurricane Katrina. He indicated that the most vulnerable population group was the citizens with disabilities, for which the city of New Orleans had left much of the responsibility, safety, and evacuation on the individual. The criticality of effective communication to those with sensory disabilities was highlighted in a report by the National Council on Disability that cited congressional hearing testimonies explaining how people with disabilities had comprehension problems when evacuation instructions were given for hurricane Katrina and Rita. It also concluded that the majority of the fatalities was among the elderly and/or the disabled during hurricane Katrina (National Council on Disability, 2006). The generalization of the population in terms of their needs during evacuations, and how these needs might vary from those with and without disabilities has been comprehensively discussed in a report on behalf of the U.S. Department of Transportation and Federal Transit Administration (Zhao et al., 2010). In their report “Hurricane Evacuation Planning for Special Needs Population”, Zhao et al., identified vulnerability indicators associated with the residents of Miami-Dade county in Florida. One of their main findings was that much more research is needed on the special needs population.

To the best of our knowledge, the only study on the hurricane evacuation behavior of the medically fragile population is by Van Willigen et al. (2002) who analyzed and compared the unequal experiences that the disabled population had versus the non-disabled. For their research, they interviewed citizens with physical disabilities that lived in the coastal counties of North Carolina who experienced hurricanes Bonnie, Dennis, and Floyd. Their study focused on the difficulties associated with being disabled and how these conditions affected their evacuation decision process. Possible reasons for not evacuating were examined, in addition to perceived flood risk, property damage, the extent of the damage costs and hurricane planning. It was concluded that households that had a disabled member were affected differently than those without.

Hurricane Irene made landfall on August 27, 2011 in North Carolina. Irene moved up the coast and affected every east coast state outside of Florida. Irene has been ranked as the 7th costliest U.S. hurricane of all time – \$16.5 billion in damage

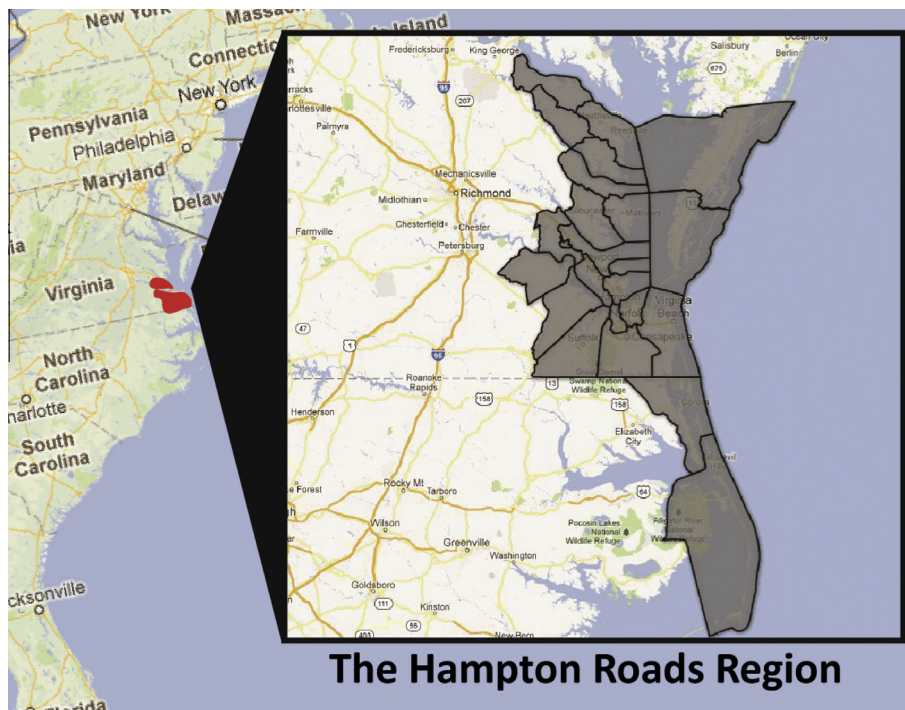


Fig. 1. The 24 counties/cities in Hampton Roads. Source: [www.googlemaps.com](http://www.googlemaps.com).

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