

Elizabeth Hardister

UGA Libraries' Undergraduate Research Award

Hurricane Forecasting and Coastal Healthcare Facility Evacuations

When I began my research my freshman year, I scheduled a meeting with Ian Thomas in order to learn more about the resources the library provides that would enhance prospective research in the health sciences. He provided me with an introduction to GALILEO, Web of Science, PubMed, and Google Scholar. He recommended that I use these search engines to find review articles for accessible and comprehensive overviews of potential research areas. When I began my research with the Institute for Disaster Management, I used Web of Science's "most cited" filter to browse for influential articles concerning the ethics of disaster medicine. I came across an article reporting the story of Dr. Anna Pou, a physician that faced criminal charges for the deaths of several patients awaiting rescue from a New Orleans hospital during Hurricane Katrina. After discussing this case with my research mentor, I began a project evaluating Georgia's emergency plans for evacuations of coastal healthcare facilities threatened by hurricanes.

My research assesses the feasibility of Georgia's evacuation plans with regard to the accuracy of current hurricane forecasting models. The evacuation of hospitals, nursing homes, hospices and other healthcare facilities is complicated by the medical and access needs of their patients and residents. These evacuations require a number of complex tasks such as coordinating transportation, matching patients to beds in inland healthcare facilities and special shelters, and transferring medical records, medications, and any necessary equipment. Because of the vulnerability of patients and the complexity of these evacuations, facilities are expected to evacuate far in advance of the general population. My review of Georgia's current emergency management planning revealed that healthcare facilities are expected to begin preparations for an evacuation more than four days in advance of the predicted landfall of a hurricane. However, as the amount of time in advance of a

hurricane increases, the likelihood of having an accurate forecast of its future location and intensity decreases. My project examines the implications of the reliability of early hurricane forecasts on coastal healthcare facilities' compliance with evacuation plans.

I started my research project by looking for data on hurricane forecasting. My search of GALILEO's Weather and Climatology databases led me to the U.S. National Oceanic and Atmospheric Administration (NOAA) Storm Events Database, which I used to confirm that Georgia has not faced a major hurricane in the past twenty years. Continuing my search with NOAA resources, I found the National Hurricane Center's official error trends for Atlantic Basin storms and hurricanes. This data indicated that forecasts several days in advance had large margins of error in predicting a hurricane's path and intensity. Current methods of forecasting hurricanes are not accurate enough to consistently support Georgia's healthcare evacuation plans.

After characterizing the imprecision of early hurricane forecasts, I wanted to examine the consequences of the failure to evacuate in advance of a hurricane. With the case of Dr. Anna Pou in mind, I decided to search for lawsuits involving healthcare providers following hurricanes. I visited the Law Library in order to learn more about legal sources that could aid me in my research. There, I was instructed to try the Lexis Nexis database. With some help from the reference team at the law library, I found several lawsuits involving healthcare facilities and hurricanes. One case was a wrongful death suit involving the owners of a New Orleans nursing home in which many patients died during Hurricane Katrina. Another was a class action lawsuit against the City of New York for violating the Americans with Disabilities Act for failing to accommodate for the needs of medical patients and other disabled residents in the city's response to Hurricane Sandy, during which officials failed to evacuate healthcare facilities prior to the storm. These cases provided me with extensive, detailed records of incidents that demonstrated the results of healthcare facilities not adhering to evacuation plans.

After finding these cases, I wanted to see if I could find any information on recent healthcare evacuations specifically in Georgia. The last major evacuation was in 1999 for Hurricane Floyd, a storm that ultimately spared the state. My online searches for information on this evacuation yielded few results, and little that pertained to the evacuations of healthcare facilities. I had a breakthrough when I visited the microfilm section of the Main Library in order to view newspapers published in coastal areas of Georgia around the time of the hurricane. When I viewed microfilms of the *Savannah Morning News* from the week of the evacuation for Hurricane Floyd, I found several articles that described the evacuations of area nursing homes and hospitals. I discovered one major detail about the evacuation that I had previously missed: the only fatalities in the state of Georgia attributed to Hurricane Floyd were those of two nursing home residents who died during the evacuation, which was greatly prolonged due to a failure to depart prior to the evacuation of the general population.

Going forward, I plan to interview healthcare providers about their emergency plans and their awareness of hurricane forecasting error. Also, I am working to identify specific examples of hurricanes whose forecast inaccuracies would violate the assumptions of current evacuation timelines. With my research, I aim to draw attention to the gaps in Georgia's current hurricane plans. I hope to develop recommendations on how to improve the evacuations of healthcare facilities in order to increase their resilience in the face of disasters, and most importantly, the safety of their patients.

Project Reference List

Hospice Evacuation Plan Format. C. C. E. M. Agency.

"Hurricanes and Climate Change." Hurricanes. from <http://www.c2es.org/science-impacts/extreme-weather/hurricanes>.

NOAA's List of Coastal Counties. T. B. o. t. Census.

(1999). "Elsewhere: 2 Die in Evacuation." Savannah Morning News. Savannah, GA.

(2006). Georgia Coast 2030: Population Projections for the 10-county Coastal Region, Center for Quality Growth and Regional Development at the Georgia Institute for Technology.

(2007). Motorcoach Fire on Interstate 45 During Hurricane Rita Evacuation Near Wilmer, Texas September 23, 2005. N. T. S. Board: 142.

(2013). Georgia Hurricane Plan. G. E. M. Agency: 133.

(2014). Georgia Disaster Facts. G. E. M. Agency.

(2014). "Hurricanes in Georgia." Preparedness. from <http://www.gema.ga.gov/gemaohsv10.nsf/c6049b8deb5d38a185257726003aa1dd/68ec9214ddb5b64a8525773500716735?OpenDocument>.

(2014). Official error trends. N. H. Center.

(2015). Annex to Georgia Emergency Operations Plan: Vulnerable Population Coastal Evacuation Transportation Operations Plan. G. E. M. Agency.

Adalja, A. A., Matthew Watson, Nidhi Bouri, Kathneen Minton, Ryan C. Morhard, Eric S. Toner (2014). "Absorbing Citywide Patient Surge During Hurricane Sandy: A Case Study in Accommodating Multiple Hospital Evacuations." Annals of Emergency Medicine: 9.

Blake, E. S., Edward N. Rappaport, Christopher W. Landsea. (2010). The Deadliest, Costliest, and Most Intense United States Tropical Cyclones from 1851 to 2010. The Deadliest, Costliest, and Most Intense Reports, NOAA.

Bradford, H. G. a. K. H. (2006) "After Katrina: Hospitals in Hurricane Katrina: Challenges Facing Custodial Institutions in a Disaster." The Urban Institute.

Brandeau, M. L., Jessica H. McCoy, Nathaniel Hupert, Jon-Erik Holty, Dena M. Bravat (2009). "Recommendations for Modeling Disaster Responses in Public Health and Medicine: A Position Paper of the Society for Medical Decision Making." Medical Decision Making 29(4): 23.

Brown, L. M., David M. Dosa, Kali Thomas, Kathryn Hyer, Zhanlian Feng and Vincent Mor (2012). "The Effects of Evacuation on Nursing Home Residents With Dementia." American Journal of Alzheimer's Disease and Other Dementias 27(6): 7.

Czajkowski, J., Emily Kennedy (2010). "Fatal tradeoff? Toward a better understanding of the costs of not evacuating from a hurricane in landfall counties." Population and Environment 31(1): 29.

Czajkowski, J., Kevin Simmons, Daniel Sutter (2011). "An analysis of coastal and inland fatalities in landfalling US hurricanes." Natural Hazards 59: 19.

Davis, R., Kevin Johnson (2005). "La. looks into 215 Katrina deaths." USA Today. Ipswich, MA.

Dosa, D. M., Nancy Grossman, Terrie Wetle, Vincent Mor (2007). "To Evacuate or Not to Evacuate: Lesson Learned From Louisiana Nursing Home Administrators Following Hurricanes Katrina and Rita." Journal of the American Medical Directors Association: 8.

Downey, E. L., Knox Andress, Carl H. Schultz (2013). "External Factors Impacting Hospital Evacuations Caused by Hurricane Rita: The Role of Situational Awareness." Prehospital and Disaster Medicine 28(3): 8.

Downey, E. L., Knox Andress, Carl H. Schultz (2013). "Initial Management of Hospital Evacuations Caused by Hurricane Rita: A Systematic Investigation." Prehospital and Disaster Medicine 28(3): 7.

Goldman, J. (2005). "NOAA Revisits Historic Hurricanes." NOAA News Online.

Kelman, J., Kristen Finne, Alina Bogdanov, Chris Worrall, Gregg Margolis, Kristin Rising, Thomas E. MaCurdy, and Nicole Lurie (2014). "Dialysis Care and Death Following Hurricane Sandy." American Journal of Kidney Diseases.

Knabb, Rick (2011). "2011's Top 5 Hurricane Overdue Cities." The Weather Channel. from http://www.origin.weather.com/outlook/weather-news/news/articles/2011-hurricane-overdue-cities_2011-05-27?page=1

Laditka, S. B., James N. Laditka, Sudha Xirasadar, Carol B. Cornman, Courtney B. Davis, Jane V.E. Richter (2008). "Providing Shelter to Nursing Home Evacuees in Disasters: Lessons From Hurricane Katrina." American Journal of Public Health 98(7): 6.

Landers, Mary (1999). "Evacuation a long wait for most, life and death to the frail." Savannah Morning News. Savannah, GA.

MPH@UNC. "Decade of Destruction: The High Cost of Hurricanes." oBizMedia.

Ng, M., Joshua Behrc, Rafael Diazc "Unraveling the evacuation behavior of the medically fragile population: Findings from hurricane Irene." Transportation Research Part A: Policy and Practice 64: 13.

Okie, Susan (2008). "Dr. Pou and the Hurricane — Implications for Patient Care during Disasters." The New England Journal of Medicine 358: 1-5.

Preston, J., Sheri Fink and Michael Powell (2012). "Behind a Call That Kept Nursing Home Patients in Storm's Path." The New York Times, The New York Times Company.