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# How Does the Effect of Hurricane Katrina Influence Healthcare Infrastructure and Resilience?

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How does the effect of Hurricane Katrina influence healthcare infrastructure and resilience?

by

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## **Abstract**

In August 2005, Hurricane Katrina brought upon the city of New Orleans, LA one of the costliest natural disasters in U.S. history. This paper looks at how hospitals were prepared before Katrina, responded to, and grappled with the aftermath of this natural disaster. In the aftermath of Katrina, careful investigation of the healthcare system along with its hospitals, physicians, patients, and residents allow us to take innovative measures and provide guidance to create recommendations to better monitor and care for individuals in the future. Frameworks of resilience theories, studies, and recommendations display how and why disaster planning is essential. The lessons learned from Hurricane Katrina reveal how healthcare infrastructure has changed through numerous interventions in an aim to create a better healthcare system that improves healthcare coverage and emergency preparedness to withstand future disasters, thus creating a better and more resilient healthcare system.

## **Introduction**

On August 29th, 2005 Hurricane Katrina wrought enormous destruction upon the city of New Orleans, Louisiana and outlying areas - proclaiming as one of the worst natural disasters in US history. It left 80% of the city flooded, and 80% of its inhabitants evacuated with a death toll of over 1,800 people (Raulji et al., 2018). The devastation of Hurricane Katrina left the health system along with its hospitals in shambles by disrupting supplies and services. The number of patients needing medical care skyrocketed, leaving hospitals having to cope with limited resources and challenges to their services to aid those in need. Without access to services, many individuals had to resort to not obtaining medical care for months to come (Frey & Singler, 2006). In the aftermath of Hurricane Katrina, we take what we learned and apply our knowledge to increase resiliency of hospitals during catastrophic events. Preparing for these sorts of events

requires much public health planning and intervention, as such city-wide events require a lot of organization to be in effect beforehand. Numerous news articles have covered the topic of Katrina; however, this paper will primarily utilize articles that look at the healthcare effect of Hurricane Katrina through interviews, personal accounts, and statistics. This paper will review how hospitals were prepared before Katrina, responded to, and coped with the aftermath of Katrina (Rodriguez & Aguirre, 2006) in regards to healthcare infrastructure and resilience theories to support how and why disaster planning is essential.

## **Background**

The White House, in its report of “The Federal Response to Hurricane Katrina” (2006), indicated that Katrina had been the “most destructive natural disaster in U.S. history” (Rhodes et al., 2010; Rodriguez & Aguirre, 2006). The hurricane and subsequent flooding caused more than 1,500 lives to be lost and displaced over one million people, leaving evacuees all over the United States (Rodriguez & Aguirre, 2006). Along with this, approximately 850 schools were damaged, 18,700 businesses were destroyed, and 220,00 jobs were lost (Rudowitz, 2006). It also destroyed approximately 350,000 houses, leaving many stranded and/or homeless. For those returning to their homes post-Katrina, many were unable to rebuild as their homes and businesses were in shambles (Verderber, 2008)

In anticipation for Hurricane Katrina, many people and hospitals prepared with extra quantities of water, food, and medical supplies. Once Katrina arrived on U.S. soil, many were initially relieved by how the impact was not as destructive as expected. However, this all changed when flood waters started rising, causing a major gridlock for evacuations, transportation of supplies and aid, thus stranding hospitals and its people. Basements that were typically filled with stores of food, water, as well as a place for morgues eventually became

overrun with flood water. In some hospitals, stairwells became places for morgues. Amongst the chaos, waste started to accumulate and eventually scattered amongst the hospitals. Healthcare personnel struggled to cope with the overwhelming circumstances (Rodriguez & Aguirre, 2006). Additionally, even prior to the disaster, the healthcare infrastructure and services in the area were already ranked among the poorest in the country (Rodriguez & Aguirre, 2006), which further compounded the impact of the hurricane.

### **Pre-Katrina Healthcare**

Before Katrina struck U.S. soil, there were already healthcare disparities in the surrounding community. At that time, 23% of New Orleans residents were living below the poverty line, which was reflected in some of the country's worst healthcare statistics (Rudowitz, 2006). According to the *United Health Foundation's America's Health: State Health Rankings 2004*, Louisiana ranked 50th for overall health status before Hurricane Katrina (Hutton & Tilden, 2010). Underserved and poor communities were affected with multiple healthcare problems such as high infant mortality rate, chronic disease (heart disease & diabetes), and plagued by AIDS (Rudowitz, 2006). Lack of healthcare coverage exacerbated these issues, as many families had low rates of private health insurance coverage, leading to many having to depend on Medicaid (Rudowitz et al., 2006). Louisiana had the highest cost per capita of federally funded Medicare and the worst healthcare outcomes of any state in the U.S.A. In addition to this, Louisiana had one of the strictest criteria for state and federal healthcare assistance through Medicaid (Kahn & Sachs, 2018). Medicaid serves as a healthcare program that assists individuals and families with paying for medical expenses. Medicaid allowed for cheaper out of pocket expenses and a range of services but there this also led the poor to depend on institutional hospital care for the poor (Rudowitz, 2006).

Prior to Hurricane Katrina, nine acute care hospitals served the healthcare system in Orleans Parish, while nearby Jefferson Parish had seven (Rudowitz et al., 2006). Louisiana ranked eighth in the nation with the number of available hospital beds, at nearly four beds per 1,000 people versus the national average of 2.8 per 1,000 in 2004, thus leaving the New Orleans region with excess beds as compared to the national average. One major player in the collection of hospitals was Charity Hospital. It loomed over New Orleans and virtually everyone in the community knew about this hospital, making it the place where a majority of the poor and uninsured could obtain the appropriate care they needed. During previous storms other facilities and nursing homes often sent their patients to Charity for greater care (Gray & Herbert, 2007). It also stood as the only Level 1 trauma center on the Gulf Coast (Rudowitz et al, 2006). Charity Hospital's role as a Level 1 trauma center played a huge role in the disaster response as it meant that Charity was the only hospital that was capable of providing total care for every aspect of injury as they had all the equipment necessary. Charity Hospital stood as a symbolic place for the community. It was a place where multiple generations worked, socialized, wept, consoled each other, and celebrated life (Verderber, 2008).

### **Response to Katrina**

As response teams and hospitals confronted further rising waters, other problems started to emerge. Communication systems became sporadic, backup generators ran out of fuel, air conditioning systems failed, and sewage seeped. Eventually waste started to lie everywhere. Rising temperatures, power outages, and lack of resources made equipment inoperable as healthcare and EMS personnel tried whatever they could to keep operations at a bare minimum, patiently waiting for aid (Rodriguez & Aguirre, 2006). Patients were often transported from area to area and with many patients moving, some patients were separated from their records.

Because hospital information systems were overwhelmed, hospitals lost crucial information that included medications, diagnoses, and medical history, which further complicated delegating aid.

In correspondence with Louisiana State University School of Nursing, Danna et al. (2010) cited nurse-led experiences throughout the storm. Most hospitals had varied experiences, but the ones that received the most national attention were Charity Hospital, University Hospital, Tulane University Hospital, Veteran's Affairs Medical Center, Lindy Boggs Medical Center, and Memorial Medical Center (Gray & Hebert, 2007). Most staff members of these hospitals were instructed to provide supplies of food and water for themselves and their family members to last up to 3 days of work. Many hospital workers thought that if they worked hard for a few days they could return home after. Little did they know, most did not return until multiple weeks later. By the fourth and fifth day, food and water supplies were dwindling due to the influx of patients in hospitals and length of time for evacuation (Danna et al., 2010). Housing for hospital employees was also problematic as there was limited space for employees to rest. Evacuation for many became unlikely or impossible as communication systems with the outside were cut off as cell towers and phone services were down. Because of this, planning for a hospital evacuation became nearly impossible (Danna et al., 2010). Options for evacuation were extremely limited as many had to rely on boats and helicopters. These barriers to transportation meant that, in many cases, people had to be boated to areas that were accessible by land then transported via vehicle. The boats and helicopters used for these transports could only fit 1-2 patients at a time, thus making evacuation excruciatingly slow (Gray & Hebert, 2007).

A year after Katrina, limited hospital capacity remained as very few hospitals were operational and few clinics were open. Charity Hospital was shut down due to severe flooding and never reopened (Huelskoetter, 2015). Along with this, an estimated number of 4,500 active

physicians were dislocated from the New Orleans area after the storm (Rudowitz et al., 2006). Even so, the census of hospitals in the Orleans parish area dropped dramatically leaving a number of hospitals closed, but even when opened back up, hospitals faced financial hardships and staffing challenges (Rudowitz, 2006). In the New Orleans metro area, the number of inpatient beds dropped by more than half from about 4,000 to 2,000 (Huelskoetter, 2015; Rudowitz,2006). This sudden change in hospital beds negatively affected the landscape of residency programs in New Orleans. Without enough hospital beds and patients to fulfill accreditation requirements, residents could not get the required training needed, thus causing the suspension of these residency programs (Rudowitz et al., 2006). Medical and residency programs located in New Orleans, Louisiana State University, and Tulane were critical sources for providing care for the uninsured. The suspension of residency programs left young physicians untrained for the future workforce, limiting their expansion of building the critical skills and knowledge to care for future patients (Bergreen & Curiel, 2006; Rudowitz et al., 2006).

From the survivors' perspective, even though many had healthcare challenges beforehand, the storm made it even harder to obtain any sort of need. Traditionally, the New Orleans area heavily relied on the healthcare industry as a source of jobs and local revenue (Eaton, 2007). As businesses closed and jobs disappeared after the storm, an estimated number of 200,000 people lost their employer-based health coverage (Huelskoetter, 2015). From data collected in 2007, healthcare jobs were down 27% causing a shortage of healthcare workers (displacing people to different parts of the U.S.) and hospital beds (Eaton, 2007). The disappearance of healthcare providers and hospital beds left many without the proper care for prevention or rehabilitation, further causing worsening healthcare problems (primarily chronic disease) as time passed (Eaton, 2007; Kessler, 2007). Not only did this shortage of care



contribute to chronic disease, but it also caused emotional and mental trauma that led to depression, anxiety, post traumatic stress disorder (PTSD), and sleep problems that could not be addressed adequately. Emergency visits for both medical and psychiatric crises soared in the years following Katrina (Eaton, 2007)

### **Interventions Post Katrina**

Raulji et al. (2018) examined the impact of Hurricane Katrina on patients with hematological disorders and cancers at the Children's Hospital of New Orleans, Louisiana (CHNOLA). CHNOLA is a tertiary care facility administering care for children in the New Orleans area and was one of the few hospitals open immediately after the impact of Katrina. Patients with hematological disorders and cancer were chosen for the study because they were patients most susceptible to social and mental health problems during disasters and often needed constant monitoring to remain in good health (Raulji et al., 2018). The researchers surveyed patients and parents at Children's Hospital of New Orleans one year after Hurricane Katrina to allow for the implementation of improvements in care and emergency response. Based on survey results, it resulted in a "Hurricane Action Plan". This action plan included: identification of families' evacuation plans at each hurricane season's onset; hospital(s) and pharmacies in the intended evacuation area; updating roadmaps/treatment plans; and giving information to families requiring hematology/oncology services in evacuation areas (Raulji et al., 2018). Seven to eight years later, researchers distributed a second survey to assess the efficacy of the "Hurricane Action Plan." The survey found that the interventions and action plans implemented within the Action Plan allowed for better access to care by hematology/oncology patients after Hurricane Katrina, which resulted in better preparedness, easier acquisition of information, and possibly better continuity of care (Raulji et al., 2018).

Kessler et al. (2007) evaluated the care of survivors with chronic medical conditions who had their treatment disrupted during the Hurricane. They evaluated the prevalence of chronic medical conditions in a telephone survey to those with chronic illnesses who reduced or terminated treatments due to the disaster. The range of chronic diseases included cardiovascular disease, HIV/AIDS, renal disease, dementia, cancer, respiratory illness, and mental disorders. 73.9% of Katrina survivors had one or more chronic conditions in the year prior to the hurricane. Of this proportion, 20.6% cut back or terminated their treatment because of the hurricane. Those most disrupted in treatment were those who sustained housing needs, were uninsured, non-elderly, and asymptomatic individuals. Reasons for discontinued care included problems finding physicians (41.1%), medications (32.5%), insurance/financial issues (29.3%), and transportation (23.2%). To sum up, this piece indicated the severity of implications for the treatment of chronic disease for patients. It is also important to anticipate and re-establish care pertaining to those with chronic needs for future disasters. This can be addressed by the re-establishment of primary care services, access to medications, and emergency financial planning (Kessler et al., 2007)

Danna et al. (2010) highlighted the “Now” (current recommendations) from what was learned from the “Then” (during the storm). The ten recommendations that have been now implemented, primarily from the perspective of nurses, include planning (clarifying hospital chains of command, stockpiling enough food and supplies for 5-7 days, with a plan to replenish supplies), communication (backup communication radios), staffing (adequate staffing), safety & security (external security aid), housing (areas to allow employees to rest), evacuation (evacuation plans), personal disaster planning, psychosocial considerations (counseling programs), and nursing implications (Danna et al., 2010).

Traumatic events such as natural disasters have the ability to cause a range of life changes at the social, physical, and psychological level (Danna et al., 2010). As a result, many nurses found themselves thrust into the dual roles of caretaker and victim during and following Hurricane Katrina. In addition, they often filled the roles of nurse leaders functioning to create, advocate, organize, coordinate, and work with one another to respond and create a disaster plan (Danna et al., 2010). The disaster plan included personal recommendations and items that could help staff both in the short term and the long term. Other interventions included post-disaster staff stress reduction, counseling, onsite housing, donation sites, emergency financial planning, communication, and governmental aid (Danna et al., 2010). Much has happened to the city of New Orleans since these recommendations have been made. Studies and policies have been implemented to address these recommendations.

To track the development of New Orleans, a long term study published in 2015 from The Kaiser Family Foundation (Hamel et al., 2015) builds upon previous surveys that were conducted in 2006, 2008, and 2010. This survey investigated those living in Orleans Parish in 2015 and how they felt like the city has progressed since Hurricane Katrina when compared the city prior to the disaster. Over the 10-year period since the storm, many residents reported that they felt like their quality of life has either returned to its pre-Katrina state or improved since. In regards to the healthcare infrastructure, 72% stated that medical facilities and services have become more readily available. This is further supported through statistics of how residents perceive healthcare access, as 37% of participants have reported “a lot” of progress in making medical facilities and services available - this is a dramatic increase in comparison to the 14% of the population that felt this way in 2010 and 5% in 2008. Worries regarding access to healthcare have also dropped, with 54% of surveyors being “very” or “somewhat” worried, which used to

be 85% in 2006. Even though there are many persisting issues, 74% of those who lived through Katrina and returned, mention that their experience has made them more resilient with better ability to cope with stress in the end (Hamel et al. 2015). This project signifies that residents are optimistic for the near future and feel like the rebuilding of the healthcare infrastructure in Orleans Parish is being taken in the right direction towards reestablishing access to care. It's important to note that limitations to this survey depend on individual perception of questions.

Very few studies have tracked survivors over the last decade in what has happened post disaster, but one topic that has been extensively studied is how the disaster devastated the mental health of many individuals. Studies such as Raker et al. (2019) have tracked individuals with mental disorders throughout the years. Most individuals have mentally recovered from the aftereffects of Hurricane Katrina but there are still some who continue to struggle with signs of depression and post-traumatic stress disorder (PTSD). A survey from the Centers for Disease Control and Prevention (CDC) found that one-third of respondents within the Orleans and Jefferson parishes in October 2005, (two months after the hurricane) were experiencing PTSD and most likely needed mental health counseling (Huelskoetter, 2015). Raker et al. (2019) interviewed low-income individuals once before Hurricane Katrina and three times after documenting mental health changes. Other factors measured were socio-demographic and hurricane-related factors that could be associated with long term mental health repercussions. Other things worth noting, were that housing losses and trauma were related factors that negatively affected mental health. They found that post-traumatic stress symptoms (PTSS) declined at each follow-up post-Katrina, but 12 years after, one in six individuals still had symptoms that displayed stress problems likely attributed to PTSD. Non-specific psychological distress (PD) was also measured, finding that PD remained elevated throughout all three follow-

ups as compared to PD pre-Katrina. Overall, this study displays that there are still survivors that are suffering from signs of mental distress (Raker et al., 2019). Therefore, there is still a need for recovery resources such as psychiatric counseling, housing planning, and financial aid as traumatic events such as Hurricane Katrina, still play a strong toll on the individuals' mental health many years later.

Medicaid provided health care access post-Katrina but this was only for those who could obtain it. Eligibility rules prohibited some individuals from obtaining Medicaid under the Affordable Care Act which particularly included non-disabled adults without children. Even if individuals were eligible, the process was slow and required extensive documentation which did not arrive in the time where urgent care was much needed (Huelskoetter, 2015). In addition to limited eligibility, and slow process, the expansion Medicaid was not enacted until 2016. Prior to their Medicaid expansion in 2016, it was estimated that the state missed out on up to \$3 billion in federal funding in between the years of 2014 and 2015 (Norris, 2018). Due to the recent changes, it would be challenging to gauge the full potential of Medicaid and its effects on the state along with its residents post-Katrina. The expansion of Medicaid brought upsides to insurance rates, as an LSU survey found that the uninsured rate fell by half from 22.7% to 11.4% - between the years of 2015 and 2017, almost entirely because of the expansion of Medicaid. This expansion allowed for Medicaid coverage to adults whose incomes were under 138% of the federal poverty line, accounting to \$34,638 for a family of four as of 2018 (Karlin, 2019). It is worth noting, that the expansion in 2016 is a step in the right direction toward improved health care coverage as well as universal healthcare.

A year following Katrina, Congress created the Office of the Assistant Secretary for Preparedness and Response (ASPR) in the US Department of Health and Human Services

(HHS), with a required mandate. This mandate coordinated various government sectors and in order to orchestrate prevention, preparedness, and rapid response to the health effects of public health emergencies and natural disasters. The National Health Security Strategy now guides our national approach to preparing for health emergencies. Hospitals and health departments now utilize incident command centers that correspond with first responders, which improve coordination during disasters. With advancing technology, the nation has devoted a significant amount of time in changing the public health and health care system to better prepare for possible disaster. Electronic health records (EHRs), backup generators, and temporary hospitals are a few more of the steps that have been implemented as a result of this plan. These actions require extensive training and development in order to build a system of resilience that carries strong significance at the local, state, and federal levels. (Lurie et al., 2015).

Since Katrina, the healthcare system of Louisiana (particularly New Orleans) has dramatically transformed. The new system has been changed entirely and now stands as a model for cities across the country that strive to build healthier communities and stable health care (Sebelius, 2015). Tulane University School of Medicine (TUSOM) and the New Orleans public health system have rebuilt what was considered one of the country's worst health systems. Areas of education, research, and clinical care have been reformed (Kahn & Sachs, 2018). Currently, more than 22 organizations are operating a total of 60 neighborhood clinics offering primary care, preventative services (Todd, 2015), and mental health services - all of which are essential in the aftermath of natural disasters such as Hurricane Katrina. These organizations and neighborhood clinics offer services to more than 140,000 patients regardless of their ability to pay (Todd, 2015).

Along with this, Charity Hospital has been rebuilt under the new name of “University Medical Center,” serving as a new center fostering research, academic training, and a Level 1 trauma center in the heart of New Orleans. New Orleans has substantially improved access to healthcare for individuals by enhancing neighborhood-based primary care, mental health clinics, and the multiple levels of hospitals. These new changes help build a resilient system to meet residents demands, which allow them to live better, healthier lives, and a healthy community. Despite efforts to change the landscape of healthcare in New Orleans, the city continues to struggle with a high uninsured rate of 17%. Being uninsured, causes individuals to delay care or treatment until their situation becomes emergent (Todd, 2015).

### **Developing Resilience & Lessons from Katrina**

First, we must define and outline the framework of resilience. Resiliency focuses on the capacity to absorb, respond, and recover from either unexpected internal or external consequences to the system or community (Rodriguez & Aguirre, 2006). A resilient system is a system that is aware of all hazards, physical, biological, psychological, social, and cultural demands, and creates an action to minimize detrimental effects. In order to develop resilience, there has to be an enhancement to safety and security in the area, both of which require lots of awareness, planning, and training (Rodríguez & Aguirre, 2006). In this case, Hurricane Katrina caused a disruption of resources, increased the number of patients, and affected the physical plants of hospitals simultaneously. This conjunction of occurrences all at the same time caused Katrina to be one of the costliest and most destructive natural disasters in U.S. history (Verderber, 2008). This brings the question of, what can we do to create a resilient healthcare system?

The lessons learned from Hurricane Katrina represent a vital call to what is needed to create a resilient system in the New Orleans area and other areas vulnerable to hurricane events. Anticipating and addressing patients' needs must be accomplished prior to disaster, minimizing barriers to treatment, and disaster responses can be safer and more effective. The Health and Social Services Committee (2006) within New Orleans created a report including recommendations for preparing hospitals for future disasters. These recommendations included changes to existing health centers, evacuation plans (possible advanced evacuation), transportation, communication systems, outreach strategies, shelters for staff, reliable databases, and community-based care. This list of recommendations is similar to Danna et al. (2010), but together they enable us to develop an effective and resilient healthcare system and infrastructure (Brodie et al., 2006; Gray & Hebert, 2006; Rodríguez & Aguirre, 2006). To this day, protocols have been developed by the Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP) that work alongside other emergency response offices such as Parish Office of Homeland Security and Emergency Preparedness (Parish OHSEP) and the American Red Cross. As a direct result of Hurricane Katrina, GOHSEP has expanded communication systems through the Louisiana Wireless Information Network (LWIN) which is the largest statewide radio system in the country. This enables first responders to better communicate and respond quickly to natural disaster if one were to occur. In the past, the statewide 800MHz analog system was utilized, but Hurricane Katrina showed that this method of communication was unreliable (Louisiana Elected," 2015). In order to inform the community, GOHSEP has published an emergency preparedness guide which establishes how residents can benefit from experiences of past events and follow recommendations from experts in disaster preparation,



prevention, response, recovery and mitigation. This guide also helps families establish a plan for action if disaster were to occur (“Louisiana Emergency,” n.d).

Studies such as the one by Raulji et al. (2018), Kessler et al. (2007), and Raker et al. (2019), have provided insight into the needs of particularly vulnerable patients who need constant care, those with chronic needs, as well as those with mental health counseling. Understanding their needs allows us to be innovative and provide guidance to create recommendations to better monitor and care for these specific patients in any situation, but this is not limited to other patients as well. This also benefits the greater population as it allows for a more inclusive and accessible healthcare system that focuses on preventative care and management, thus preparing them for any unexpected changes or trauma. Measures taken (such as helping the individual find a primary care physician, obtaining appropriate tests, or even continuing prescriptions) lead to better continuity of care and is a step in the direction towards establishing a better and more resilient healthcare system as reinforced in Hamel et al. (2015).

Much of the funding is within the hands of the federal government. Since policies such as Medicaid have been enacted, this has helped stabilize the budgets in some states as they can focus on healthcare disaster relief and response (Huelskoetter, 2015). The expansion of targeted health policies provides immediate relief and long-term support in various ways, it provides better access to needed care (such as mental health care) and improved response times. The expansion of Medicaid would be a step that would enhance health care coverage coinciding with emergency preparedness in states across the country as well as Louisiana (Huelskoetter, 2015; Todd, 2015). The state still ranks 49th out of 50 states in the *United Health Foundation: America’s Health Rankings* as of 2019. In the years post-Katrina, the state fluctuated between rankings of 45th to 49th. So, it's hard to gauge what an expansion to Medicaid would do for the

state of Louisiana now, as the reason for the low ranking in 2019 was mostly due to high chronic diseases (such as obesity and cardiovascular death) within the state that is irreversible (United Health Foundation, 2019).

It's important to note that it's difficult to isolate the impact of Hurricane Katrina on the New Orleans community, because Hurricane Rita struck about half a month later, along with multiple other hurricanes throughout the years. The repetitive nature of natural disasters amongst New Orleans have hindered recovery efforts made throughout the city. Tracking migration away from and back to the area has also been difficult, with some people leaving and never returning, and others returning to entirely different addresses and workplaces. In 2016, the U.S. Census Bureau estimated that coastline counties are the country's largest hubs of population and economic activity (Cohen, 2016). While it may seem like good news that populations in these areas are increasing annually, it is also a worrisome challenge to prepare for and provide disaster services for an ever-growing population. It is also important to note that New Orleans is completely below sea level. Preventing a disaster without any acknowledgment of the landscape of New Orleans puts its residents in danger to consequences of flooding or sinking (Frank, 2020). While there are challenges to gauging the absolute long-term effects of Hurricane Katrina, there remains no doubt that it left permanent scars on the city and the outlying areas.

What was not discussed in this paper, was how this topic applies cross-culturally in countries outside of the U.S.. Many health resources (especially mental health) can help aid individuals with coping with natural disasters. This topic has been widely studied, in the context of Katrina, as well as disasters such as cyclones and typhoons in Southeast Asia (which could be an area worthy of further investigation). There is still much to learn from past natural disasters, as most interventions and policy changes can only reach a number of people. However, further

recommendations regarding this would require a completely different and multidimensional paper that would touch further on government intervention, policy changes, universal healthcare or even the establishment of work that would benefit the uninsured strongly. An example of this, would be comparing a country such as the United Kingdom or Canada in how they have changed their healthcare system surrounding natural disasters. In the end, it is clear that a resilient and effective healthcare system is one that can function to provide quality healthcare on a regular basis, and in times of crisis and disaster.

## References

- Berggren, R. E., & Curiel, T. J. (2006). After the storm—health care infrastructure in post-Katrina New Orleans. *New England Journal of Medicine*, *354*(15), 1549-1552.
- Brodie, M., Weltzien, E., Altman, D., Blendon, R. J., & Benson, J. M. (2006). Experiences of Hurricane Katrina evacuees in Houston shelters: Implications for future planning. *American Journal of Public Health*, *96*(8), 1402–1408.  
<https://doi.org/10.2105/AJPH.2005.084475>
- Cohen, D. A. (2018, August 6). *Coastline county population continues to grow*. The United States Census Bureau. <https://www.census.gov/library/stories/2018/08/coastal-county-population-rises.html>
- Danna, D., Bernard, M., Schaubhut, R., & Mathews, P. (2010). Experiences of nurse leaders surviving hurricane Katrina, New Orleans, Louisiana, USA. *Nursing & Health Sciences*, *12*(1), 9-13.
- Eaton, L. (2007, July 24). *New Orleans recovery is slowed by closed hospitals*. The New York Times. <https://www.nytimes.com/2007/07/24/us/24orleans.html>
- Frank, B. (2020, April 23). *The health effects of Hurricane Katrina*. Teach the Earth. [https://serc.carleton.edu/NAGTWorkshops/health/case\\_studies/hurricane\\_Katrina.html](https://serc.carleton.edu/NAGTWorkshops/health/case_studies/hurricane_Katrina.html)
- Frey, W. H., & Singer, A. (2006). *Katrina and Rita impacts on gulf coast populations: First census findings*. Washington: Brookings Institution, Metropolitan Policy Program.
- Gray, B. H., & Hebert, K. (2007). Hospitals in Hurricane Katrina: Challenges facing custodial institutions in a disaster. *Journal of Health Care for the Poor and Underserved*, *18*(2), 283-298.

Hamel, L., Firth, J., & Brodie, M. (2015, August 10). *New Orleans ten years after the storm: The Kaiser Family Foundation Katrina survey project*. KFF.

<https://www.kff.org/other/report/new-orleans-ten-years-after-the-storm-the-kaiser-family-foundation-katrina-survey-project/>

Huelskoetter, T. (2015, August 20). *Hurricane Katrina's health care legacy*. Center for American Progress.

<https://www.americanprogress.org/issues/healthcare/reports/2015/08/20/119670/hurricane-katrin-as-health-care-legacy/>

Hutton, A., & Tilden, H. (2010). Hurricane Katrina: Health aspects. In R. Powers & E. Daily (Eds.), *International Disaster Nursing* (pp. 529-548). Cambridge: Cambridge University Press. doi:10.1017/CBO9780511841415.033

Karlin, S. (2019, June 12). *Medicaid expansion made Louisiana an outlier in national trend of stalling insurance coverage*. The Advocate.

[https://www.theadvocate.com/baton\\_rouge/news/politics/legislature/article\\_030ab37c-8c96-11e9-beb5-6b3a1d8d9a62.html](https://www.theadvocate.com/baton_rouge/news/politics/legislature/article_030ab37c-8c96-11e9-beb5-6b3a1d8d9a62.html)

Kessler, R. C., & Hurricane Katrina Community Advisory Group. (2007). Hurricane Katrina's impact on the care of survivors with chronic medical conditions. *Journal of General Internal Medicine*, 22(9), 1225-1230.

Klein, K. R., & Nagel, N. E. (2007). Mass medical evacuation: Hurricane Katrina and nursing experiences at the New Orleans airport. *Disaster Management & Response*, 5(2), 56-61.

<https://doi-org.proxy.lib.pdx.edu/10.1016/j.dmr.2007.03.001>

*Louisiana elected officials emergency management manual (2)*. (2015). Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP), State of Louisiana.

*Louisiana emergency preparedness guide* (1). (n.d.). Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP), State of Louisiana.

Lurie, N., DeSalvo, K., & Finne, K. (2015, August 25). *Ten years after Hurricane Katrina: Progress and challenges remain for US emergency preparedness*. Health Affairs.  
<https://www.healthaffairs.org/doi/10.1377/hblog20150827.050201/full/>

Norris, L. (2018, November 21). *Louisiana and the ACA's Medicaid expansion: Eligibility, enrollment and benefits*. Healthinsurance.org. <https://www.healthinsurance.org/louisiana-medicaid/#:~:text=On%20June%201%2C%202016%2C%20Louisiana,would%20enroll%20in%20expanded%20Medicaid>

Paxson, C., & Rouse, C. E. (2008). Returning to New Orleans after Hurricane Katrina. *American Economic Review*, 98(2), 38-42.

Raker, E. J., Lowe, S. R., Arcaya, M. C., Johnson, S. T., Rhodes, J., & Waters, M. C. (2019). Twelve years later: The long-term mental health consequences of Hurricane Katrina. *Social Science & Medicine*, 242, 112610.  
<https://doi.org/https://doi.org/10.1016/j.socscimed.2019.112610>

Raulji, C., Velez, M. C., Prasad, P., Rousseau, C., & Gardner, R. V. (2018). Impact of Hurricane Katrina on healthcare delivery for New Orleans patients, 2005–2014. *Pediatric Blood & Cancer*, 65(12), e27406.

Rhodes, J., Chan, C., Paxson, C., Rouse, C. E., Waters, M., & Fussell, E. (2010). The impact of hurricane Katrina on the mental and physical health of low-income parents in New Orleans. *The American journal of orthopsychiatry*, 80(2), 237–247.  
<https://doi.org/10.1111/j.1939-0025.2010.01027.x>

- Rodríguez, H., & Aguirre, B. E. (2006). Hurricane Katrina and the healthcare infrastructure: A focus on disaster preparedness, response, and resiliency. *Frontiers of Health Services Management, 23*(1), 13.
- Rudowitz, R., Rowland, D., & Shartz, A. (2006). Health care in New Orleans before and after Hurricane Katrina: The storm of 2005 exposed problems that had existed for years and made solutions more complex and difficult to obtain. *Health Affairs, 25* (Suppl1), W393-W406.
- Todd, S. (2015, August 27). *10 years after Katrina, New Orleans has transformed primary care, behavioral health*. Modern Healthcare.  
<https://www.modernhealthcare.com/article/20150827/NEWS/150829878/10-years-after-katrina-new-orleans-has-transformed-primary-care-behavioral-health>
- United Health Foundation. (2019, December). *America's health rankings 2019 annual report*. World Health Foundation: America's Health Rankings.  
<https://www.americashealthrankings.org/learn/reports/2019-annual-report>
- Verderber, S. (2008). Evidence-based design for healthcare in post-Katrina New Orleans: Current dilemmas. *HERD: Health Environments Research & Design Journal, 1*(2), 71–76. <https://doi.org/10.1177/193758670800100212>