



Enhancements to Hospital Resiliency: Improving Emergency Planning for and Response to Hurricanes

by
Daniel B. Hess and Lucy A. Arendt



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- 1 Associate Professor, Department of Urban and Regional Planning,
University at Buffalo, State University of New York
- 2 Assistant Professor, Management, Professional Programs in Business,
University of Wisconsin, Green Bay

MCEER

University at Buffalo, State University of New York

Red Jacket Quadrangle, Buffalo, NY 14261

Tel: (716) 645-3391; Fax: (716) 645-3399

Email: mceer@buffalo.edu; WWW site: <http://mceer.buffalo.edu>

Foreword

On September 1, 2008, at 10:00 a.m. CDT, Hurricane Gustav made landfall near Cocodrie, Louisiana, about 70 miles southwest of New Orleans, Louisiana. Hurricane Gustav was a strong Category Two hurricane, one mile per hour below Category Three (National Hurricane Center Bulletin, 2008). It dropped to a Category One hurricane four hours after landfall.

Several days prior to Hurricane Gustav's arrival, government officials began discussing the logistics of evacuating the New Orleans area. As Hurricane Gustav approached Louisiana, New Orleans Mayor Ray Nagin ordered a mandatory city evacuation effective August 31, 2008. "This is the real deal, not a test," said Nagin. "For everyone thinking they can ride this storm out, I have news for you: that will be one of the biggest mistakes you can make in your life" (NBC News, 2008, para. 4). Officials estimate that 1.9 million people evacuated the Louisiana Gulf Coast, including more than 200,000 from New Orleans (Anderson, 2008a).

After the city of New Orleans officially reopened on September 4, 2008—it was closed for four days—power was restored to a majority of customers (Maggi, 2008). Damage was limited primarily to downed trees and tree limbs, and street flooding. As of September 13, 2008, 43 deaths in Louisiana had been attributed to Hurricane Gustav, including six patients who reportedly died from natural causes while waiting to be evacuated (Anderson, 2008b; Carver, 2008). Cost estimates for Hurricane Gustav range from \$8.5 billion to \$18 billion, including \$4.5 billion to \$10 billion in property damage in Louisiana (both insured and uninsured losses); \$1.5 billion to \$3 billion in lost economic output during the primary evacuation period; and \$2.5 billion to \$5 billion in lost economic output from business interruptions (Louisiana Economic Development, 2008).

This report extends research previously conducted by the researchers about the maintenance of critical lifelines (water, power, hospitals) and critical infrastructure following extreme events. We examined hospital decision making in the immediate aftermath of Hurricane Katrina in 2005 (Arendt & Hess, 2006; Hess & Arendt, 2006) and Hurricane Gustav in 2008 (Arendt & Hess, 2008). During on-site interviews in New Orleans shortly after Hurricane Katrina, hospital administrators were quick to identify changes they intended to make to emergency procedures, most driven by the severely negative outcomes of Hurricane Katrina. The current research, which reports on

hospital experiences during Hurricane Gustav three years after Hurricane Katrina, represents the “post” phase of a naturally occurring “pre-post” experiment by documenting the changes to emergency planning—precipitated by hospitals’ experiences during Hurricane Katrina—and subsequently operationalized during Hurricane Gustav.

Acknowledgements

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Any opinions, findings, and conclusions or recommendations expressed herein are those of the authors and do not necessarily reflect those of either the National Science Foundation or MCEER. The authors are grateful to the many individuals in the New Orleans area who shared their time and insights.

Research participants were assured anonymity and confidentiality. The project received approval from the Social and Behavioral Sciences Institutional Review Board at the University at Buffalo and the Institutional Review Board at the University of Wisconsin-Green Bay. All photographs were taken in the New Orleans area by the authors during the week of September 14-18, 2008.

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1.0 Introduction

The story of Hurricane Gustav and its impact on acute care hospitals in New Orleans is best told in the context of the deadly and costly storm that occurred three years earlier – Hurricane Katrina. If Katrina and its aftermath had not swamped New Orleans in 2005, the outcomes associated with Hurricane Gustav might have been very different, and not in a good way. Katrina put people and organizations on alert; she taught indelible lessons about the need for preparation and ongoing collaboration among New Orleans area hospitals.

On August 29, 2005, Hurricane Katrina made landfall at Buras-Triumph, Louisiana, about 65 miles southeast of New Orleans, Louisiana. Hurricane Katrina would prove to be the undoing of New Orleans, as the aftermath of Hurricane Katrina included flooding that filled about 80 percent of the bowl-shaped city and that lingered for several weeks. Of the 15 acute care hospitals in the New Orleans area, including hospitals in Jefferson, Orleans, and St. Bernard Parishes, only three remained open by September 3, 2005. Four more would reopen by early November, 2005. When we visited New Orleans following Hurricane Katrina in early October 2005, a total of five acute care hospitals were open in the New Orleans area. It would take more than a year for another three to reopen. Five would remain forever shuttered, including Lindy Boggs Medical Center (Figure 1-1). The acute care hospital system in the New Orleans area had been tested by Hurricane Katrina and some hospitals did not survive (Rodriguez & Aguirre, 2006).

On September 1, 2008, Hurricane Gustav made landfall near Cocodrie, Louisiana, about 70 miles southwest of New Orleans, Louisiana. New Orleans was better prepared for Hurricane Gustav than it was for Hurricane Katrina—thanks to revised emergency plans—though many questioned the strength of its battered levee system. Still, Hurricane Gustav passed over New Orleans leaving minimal structural damage. The nearly two million people who had evacuated in advance of Hurricane Gustav began returning as of September 4, 2008. Of the 10 acute care hospitals in the New Orleans area, including hospitals in Jefferson and Orleans Parishes, all but two had remained open throughout Hurricane Gustav. Of the two that temporarily closed, one was evacuated pre-storm to a larger facility, and one was evacuated post-storm, when an emergency generator failed (Charatan 2008). When we visited after Hurricane Gustav in mid-September 2008, all 10 of the acute care hospitals were open in the New Orleans area.



*Figure 1-1. Lindy Boggs Medical Center in Mid-City New Orleans,
closed since Hurricane Katrina.
Post-Hurricane Gustav, September 2008.*

2.0 Purpose

The primary purpose of this field research is to determine whether New Orleans hospitals took adequate steps in the three years since Hurricane Katrina to be better prepared for disaster. This research investigates all acute care hospitals in the New Orleans area about two weeks after Hurricane Gustav made landfall. An earlier report briefly described how New Orleans hospitals responded to Hurricane Gustav vis-à-vis their experience with Hurricane Katrina (Arendt & Hess, 2008).

Perhaps more than most organizations, hospitals must learn from their disaster experiences and implement policy changes to strengthen resiliency against predicted and unpredicted events (Quarantelli, 1985). The public expects hospitals to be open and ready to cope with illness and injury no matter the nature, size, or scope of a given disaster. As such, and also because of their complexity and ubiquity in populated areas, hospitals merit critical research attention (Pan American Health Organization 1993; Sternberg, 2003). Lessons learned from the experiences of hospitals have widespread application to other organizations, such as schools and government agencies, that must overcome the challenges that disasters bring.

Organizations that fail to learn from disaster experiences are likely to repeat the mistakes that made them vulnerable (Corbacioglu & Kapucu, 2006). Sometimes, organizations (and people) must be confronted with a disaster of significant magnitude before adjusting their mitigation strategies against future vulnerability. Such disasters, like the 1999 Marmara, Turkey earthquake, represent “turning point(s)” that “chang(e) the nature of the response” (Corbacioglu & Kapucu, 2006, p. 221) to subsequent disasters.

The research reported here examines whether Hurricane Katrina was a “turning point” for emergency preparedness at New Orleans acute care hospitals. Unfortunately, the only way to know if a disaster is a turning point is retrospectively, in its response to a subsequent disaster. We suggest that Hurricane Gustav represents the first true test of whether New Orleans acute care hospitals reacted adequately to various lessons offered by Hurricane Katrina (Rodriguez & Aguirre, 2006). The 15 acute care hospitals that dotted the New Orleans healthcare landscape before Hurricane Katrina were devastated by the storm and subsequent flooding that affected about 80 percent of the city. Since then, about half of the hospitals have closed or been subject to ownership changes (see Table 2-1, Figure 2-1, Figure 2-2).

Table 2-1. Status of New Orleans area acute care hospitals

Facility (Parish)	Licensed Beds	Pre-Hurricane Katrina Ownership	Hurricane Katrina Outcome	Current (2008) Status
Chalmette Medical Center (St. Bernard)	None	Investor-owned (Universal Health Svcs)	Extensive Damage	Demolished
Meadowcrest Hospital (now Ochsner Westbank) (Jefferson)	199	Investor-owned (Tenet)	No Damage	Purchased by Ochsner
West Jefferson Medical Center (Jefferson)	451	Not-for-profit	Limited Damage	Open
East Jefferson General Hospital (Jefferson)	435	Not-for-profit	Limited Damage	Open
Ochsner Medical Center (Jefferson)	456	Not-for-profit	Limited Damage	Open
Tulane-Lakeside Hospital (Jefferson)	102	Investor-owned (Hospital Corporation of America)	No Damage	Open
Children's Hospital (Orleans)	218	Not-for-profit	Limited Damage	Open
Lindy Boggs Medical Center (Orleans)	None	Investor-owned (Tenet)	Extensive Damage	Sold; slated for demolition
MCL/NO Charity Hospital (Orleans)	None	Public	Extensive Damage	Closed
MCL/NO University Hospital (currently known as LSU Interim Public Hospital) (Orleans)	391	Public	Extensive Damage	Open
Memorial Medical Center (currently known as Ochsner Baptist) (Orleans)	25	Investor-owned (Tenet)	Extensive Damage	Purchased by Ochsner
Methodist Hospital (Orleans)	None	Investor-owned (Universal Health Svcs)	Moderate Damage	Closed
Touro Infirmary (Orleans)	506	Not-for-profit	Limited Damage	Open
Tulane University Hospital (Orleans)	243	Investor-owned (Hospital Corporation of America)	Moderate Damage	Open
Veterans Administration Hospital (Orleans)	None	Federal government	Extensive Damage	Closed

Source: Louisiana Hospital Association.

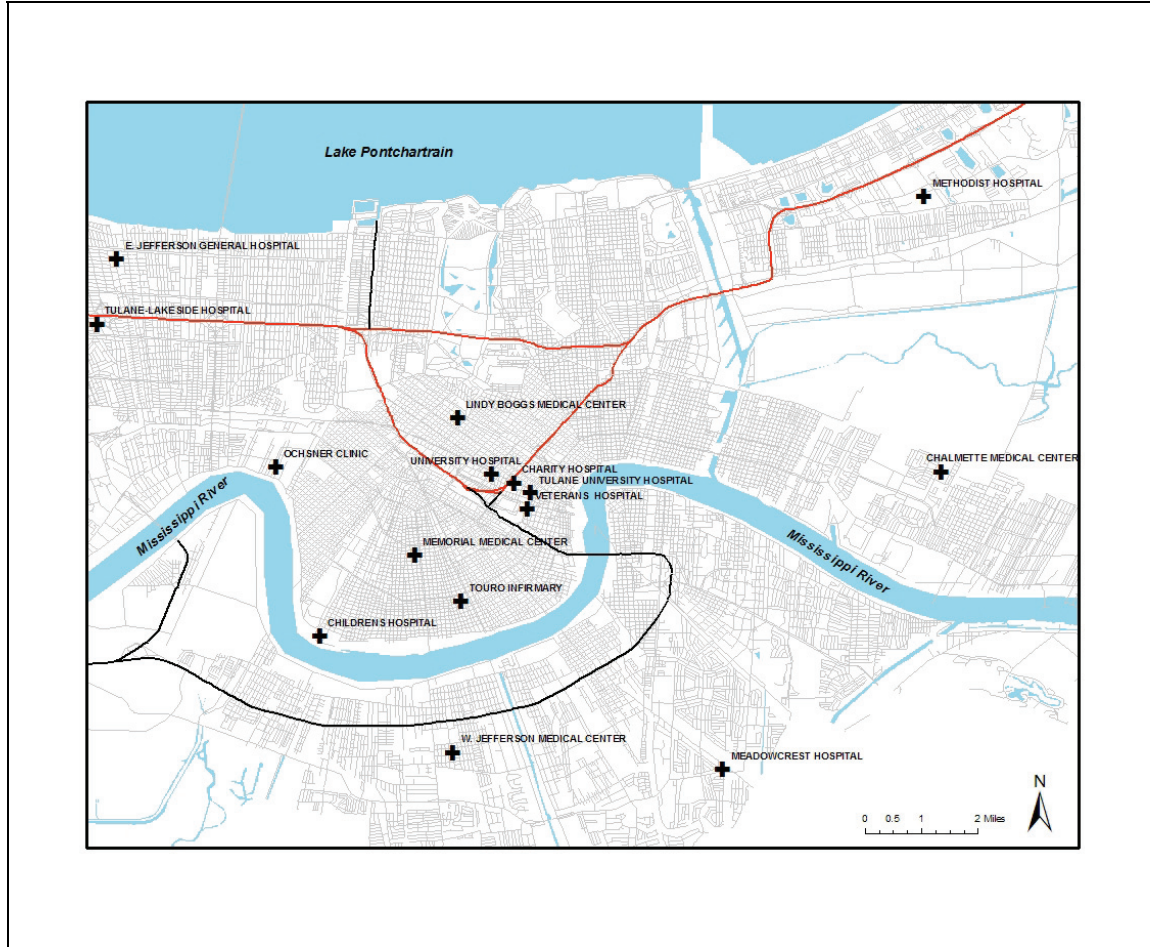


Figure 2-1. Location of 15 New Orleans Hospitals in 2005 before Hurricane Katrina.

Within the New Orleans central business district, two hospitals—LSU’s MCL/NO Charity Hospital and the Veteran’s Affairs (VA) Hospital—closed because of flood damage from Hurricane Katrina. Neither hospital has re-opened as an acute-care facility since Katrina. Charity remains shuttered, while the VA Hospital has been open as an emergency facility only. Plans to build a joint medical campus to replace both Charity and the VA Hospital have been met with opposition and controversy (Moran, 2008), because the plans require demolition of about 250 properties in the Mid-City neighborhood where the medical campus would be located.

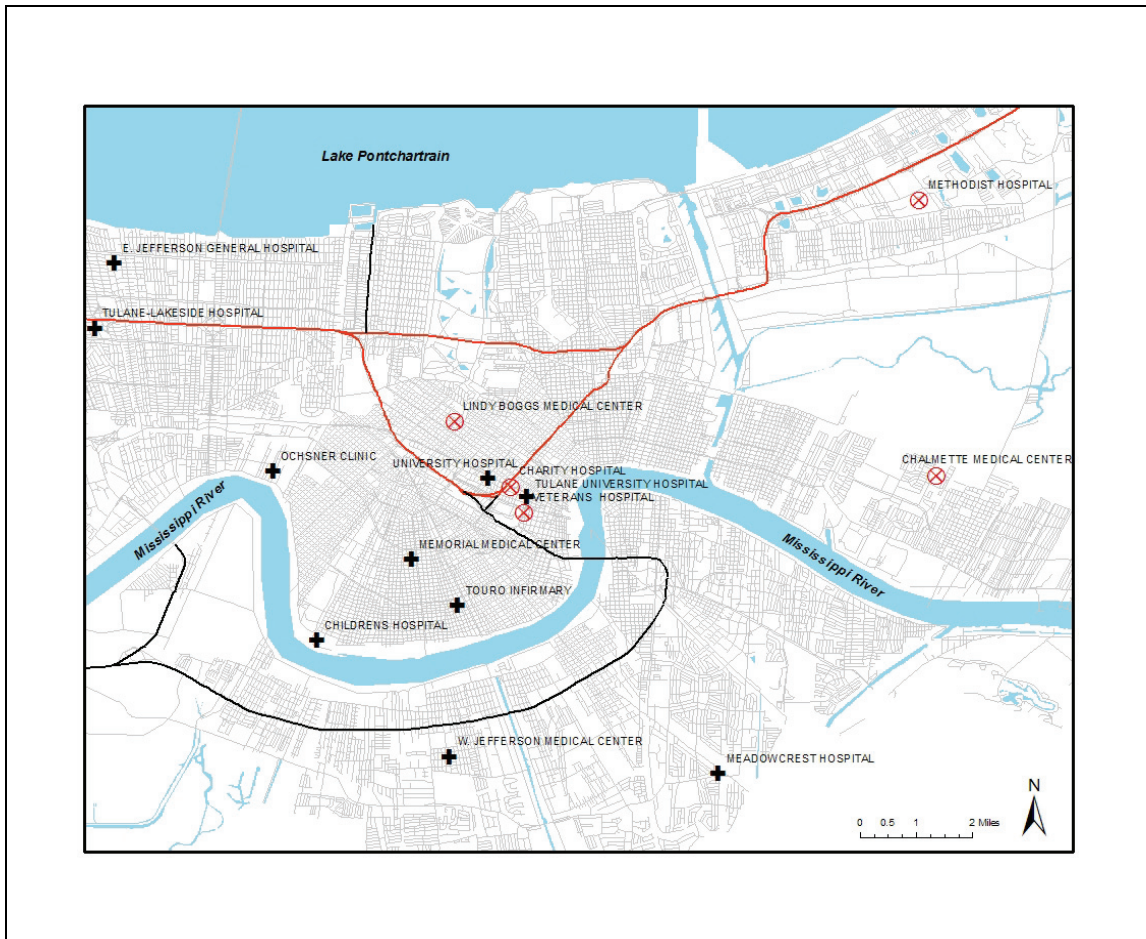


Figure 2-2. Location of 10 New Orleans Hospitals and Five Closed Hospitals (shown in red) in 2008 before Hurricane Gustav.

Elsewhere within Orleans Parish, Lindy Boggs Hospital in Mid-City closed because of flood damage. The property is now slated for demolition. Methodist Hospital in New Orleans East closed because of flood damage and in response to a severely diminished local population. Nearly four years after Katrina, the residents of New Orleans East continue without an acute-care hospital (Life stands, 2009). To the east of New Orleans in St. Bernard Parish, Chalmette Medical Center, the only acute-care hospital operating at the time of Katrina, was badly damaged by floodwaters and has since been demolished. Plans to build a replacement hospital are in the works (St. Bernard, 2008).

Several hospitals changed ownership. Meadowcrest Hospital on the west bank was sold by Tenet to Ochsner and renamed Ochsner Westbank.

Memorial Medical Center was also sold by Tenet to Ochsner and renamed Ochsner Baptist (Figure 2-3).

The acute-care hospital landscape in the New Orleans area looks dramatically different. There are fewer facilities open, fewer beds available, and fewer owners.

While the physical damage caused by Hurricane Gustav in the New Orleans area was not as severe as the damage associated with Hurricane Katrina, as Hurricane Gustav hospital emergency plans were operationalized, hospital Incident Command Centers (ICCs) were established, and hospitals evacuated patients (Milhollon, 2008; Sternberg & Marcus, 2008). These conditions provide a natural experiment for pre- and post- event analysis to investigate hospital emergency preparedness and outcomes.



Figure 2-3. Ochsner Baptist, formerly Memorial Medical Center, in Uptown New Orleans. Post-Hurricane Gustav, September 2008.

3.0 Methodology

We use quick response methodology to gather information via semi-structured, face-to-face interviews, observation of behaviors and facilities, and document acquisition. This qualitative approach provides a rich, context-aware understanding of the decision making by hospital executives in the New Orleans area. We traveled to New Orleans from September 14 to 18, 2008, two weeks after Hurricane Gustav made landfall in Louisiana. Conducting interviews within this time frame increases the probability that “perishable” data will be gathered before memories fade and perceptions of effectiveness change with time (Neal & Webb, 2006).

The research relies upon a theoretical sampling strategy (Glaser & Strauss, 1967), in which participants are chosen because of their direct and indirect association with New Orleans acute care hospitals. We conducted 11 face-to-face interviews with representatives of the 10 acute care facilities remaining in operation after Hurricane Katrina, as shown in Table 2-1. (It was not possible to conduct interviews at Chalmette Medical Center, Lindy Boggs Medical Center, Charity Hospital, Methodist Hospital, and Veterans Administration Hospital.) One researcher, the interviewer, was primarily responsible for asking questions of the participants, while the other researcher, the recorder, was primarily responsible for recording participant responses on a laptop computer. While professional titles of interviewees varied, all research participants were primarily responsible for emergency preparedness, response, and recovery of their hospital (and in some cases, hospital system). The interviewer also took handwritten notes, while the recorder asked clarification and follow-up questions as needed. The median interview time was 75 minutes.

Snowball sampling was used to identify additional relevant participants. Since the researchers were in New Orleans for only three business days, the face-to-face research was supplemented with four telephone interviews subsequent to the New Orleans site visit. In addition to interviews, while in New Orleans, we toured facilities to observe the placement of emergency equipment such as generators, wells, incident command centers, and food supplies. We also requested and received copies of several hospitals’ hurricane planning documents.

The interviews addressed the following topics:

-
1. How were hospital emergency plans revised after Hurricane Katrina? Who was involved in plan revision? What was the planning process? What barriers were encountered? How were they overcome? What factors were considered? How were the plans communicated to hospital employees and others outside the hospital (e.g., city officials)?
 2. Did hospitals collaborate with other organizations (including other hospitals, city planners, local government, etc.) in the creation and vetting of emergency preparedness policies?
 3. How were new emergency operations conducted during Hurricane Gustav?
 4. Describe communication with hospital employees immediately before, during, and in the couple of weeks since Hurricane Gustav. What methods were used? How effective were each of these methods?
 5. Describe the outcomes of new emergency procedures including fiscal outcomes, patient outcomes, staff outcomes, and outcomes for the physical plant.
 6. Describe the evacuation of patients for Hurricane Gustav. Was it carried out according to plan? Which aspects of the evacuation were successful and which were not? Did a decision to minimize the number of those sheltering-in-place yield any negative outcomes (e.g., patient deaths)?
 7. Describe lessons learned for subsequent revision of hospital emergency procedures. As you think about the major decisions made in the days immediately before, during, and after Hurricane Gustav, is there anything that you would do differently in the future? If yes, what? Given the positive/negative outcomes of new emergency procedures, what will you do next with respect to emergency preparedness and response?
 8. What are your reflections on the status of the healthcare landscape in New Orleans post-Hurricane Katrina and now post-Hurricane Gustav?
 9. Please provide other comments and suggestions not yet covered in the interview questions.

We used a grounded theory approach (Glasser & Strauss, 1967) to analyze the data as it was gathered. While in New Orleans, we processed the interview

and tour data at the end of each day. Notes taken on the laptop computer by the recorder were supplemented with handwritten notes taken by the interviewer. Discrepancies were discussed and eliminated through dialogue.

4.0 Preliminary Findings

Findings from the current research are reported using the seven themes identified in our earlier reports on New Orleans area acute care hospitals after Hurricane Katrina (Arendt & Hess, 2006; Hess & Arendt, 2006). That research relied on field data gathered within six weeks of Hurricane Katrina, in October, 2005. The themes were derived from interview data, observation, and document analysis. They address a variety of important challenges, including: constructing resilient building systems, planning to be self-sufficient, networking, staffing, communicating emergency plans before a disaster, communicating after a disaster, and leading effectively.

1. **Constructing Resilient Building Systems.** Lesson from Hurricane Katrina: Hospitals should establish their own power and water supplies (including emergency and/or back-up systems) independent of municipal utilities.

Emergency Plan Revision: Prior to Hurricane Katrina, only East Jefferson General Hospital and Ochsner Medical Center had on-site wells. Since Hurricane Katrina, most of the larger hospitals¹ have either dug wells or made arrangements to have adequate supplies of potable water delivered in advance of potential hurricanes. Ochsner Medical Center drilled a second well (Figure 4-1). Likewise, all of the larger hospitals have installed additional generators for emergency power, moved generators to higher locations (where a higher elevation for equipment reduces the chances of inoperability should a flood occur), moved generator switches to higher locations, or made arrangements to have portable generators delivered in advance of potential hurricanes. All of the larger hospitals have taken steps to connect air conditioning systems to emergency power, recognizing the necessity of air conditioning to staff and patient physical well-being and morale in New Orleans' hot and humid conditions. Rather than equip all of the smaller hospitals with wells and generators, the larger hospitals took one of three actions: (1) they evacuated a

¹ As of this report's writing, the organization of acute care hospitals in New Orleans consists of larger, primary hospitals and smaller, subsidiary hospitals. The larger, primary hospitals include Children's Hospital, East Jefferson General Hospital, MCL/NO University Hospital, Ochsner Medical Center, Touro, Tulane University Hospital, and West Jefferson Medical Center. The smaller, subsidiary hospitals include Ochsner Baptist, Ochsner Westbank, and Tulane-Lakeside. Table 2-1 lists the current number of licensed beds for each acute care hospital.

smaller hospital's patients to a larger hospital pre-storm and temporarily closed the smaller hospital (e.g., Ochsner Baptist); (2) they evacuated a smaller hospital's patients to a larger hospital pre-storm and kept the smaller hospital open and staffed during the storm (e.g., Ochsner Westbank); or (3) they made preparations to evacuate a smaller hospital post-storm if emergency power failed (e.g., Tulane-Lakeside). All of the larger hospitals have replaced gravel rooftops (with non-gravel roofing materials), since loose material on those rooftops proved dangerous during the strong winds of Hurricane Katrina. Many hospitals have replaced or reinforced windows to sustain against hurricane winds.



Figure 4-1. After Katrina, an additional well was drilled at the Ochsner Medical Center main campus in Jefferson Parish. Post-Hurricane Gustav, September 2008.

Outcomes: At some point during or after Hurricane Gustav moved past New Orleans, nearly all of the hospitals reported losing city power supplied by Entergy. All of the hospitals reported that their emergency power “kicked in” immediately, and that neither staff nor patients detected any change in power supply². In one hospital, emergency generators were set to provide air conditioning to several but not all of the hospital’s floors; patients were vertically evacuated pre-storm to the floors that would remain air conditioned regardless of power source. None of the hospitals reported problems with water or sanitation, as had occurred after Hurricane Katrina. Staff and patients at one of the smaller hospitals were evacuated to another hospital after an emergency generator failed (Charatan, 2008). None of the hospitals reported major damage to their physical plant or facilities.

Summary: Overall, the acute care hospitals in the New Orleans area did a commendable job of constructing resilient building systems post-Hurricane Hurricane Katrina. None of the hospitals’ staff or patients were unnecessarily inconvenienced during Hurricane Gustav or their safety threatened due to lack of power or water.

- 2. Planning To Be Self-Sufficient.** Lesson from Hurricane Katrina: Hospitals should expect to be on their own in the event of an emergency.

Emergency Plan Revision: Since Hurricane Katrina, many of hospitals arranged for delivery of greater quantities of fuel and critical supplies (e.g., food, medicine) before a storm. Some hospitals keep three to four weeks of supplies on hand in preparation for a hurricane, in contrast to the 3 days or week’s worth of supplies that were standard policy leading up to Hurricane Katrina. Other hospitals have agreements that permit them access to nearby grocery outlets and other discount stores post-storm if additional supplies are needed.

In the days leading up to Hurricane Katrina, most New Orleans area hospitals had worked to reduce their census pre-storm through (1) evacuating the most fragile patients (e.g., NICU babies)

² The same cannot be said for hospitals in Baton Rouge, Louisiana. There, many of the area’s acute care hospitals were left without power because city power was lost and because the hospitals did not have sufficient emergency generator capacity (Fink, 2008).

to other medical facilities, (2) discharging as many patients as possible, and (3) cancelling elective procedures. Doing so was standard practice. Still, most of the hospitals encountered great challenges in evacuating their facilities after Hurricane Katrina when a mandatory city evacuation was ordered, for several reasons (Arendt & Hess, 2006; Hess & Arendt, 2006): (1) surface transportation was largely unavailable due to widespread flooding; (2) air transportation was largely unavailable because most air resources were diverted for rescue of stranded citizens from rooftops; (3) most of the hospitals did not have helipads and could not accommodate air transportation even if it was available; and (4) there were many patients, staff members, family members, and others—including pets—on-site at hospitals requiring evacuation. The most fragile patients needed to be accompanied by medicine and equipment (e.g., portable ventilators) upon which they were dependent. All patients needed their written medical history (commonly known as a “chart”) with them.

When evacuations finally took place in the wake of Hurricane Katrina, many patients were transported out of the city to locations unknown to a discharging hospital’s staff. Finding these patients in the aftermath and reconnecting them with their family members took weeks and sometimes months.

Given the disorder that was made of most evacuations post-Hurricane Katrina, all of the hospitals had planned to shelter-in-place and reduce their census counts even more dramatically in the event of another hurricane. For example, Tulane (Figure 4-2) planned to shelter no more than 450 patients, staff, and family members as opposed to the 1,600 individuals who were sheltered during Katrina (Sloane & Roesgen, 2008b). Likewise, all of the larger hospitals had installed or had budgeted for helipads to facilitate air evacuation. All of the larger hospitals had established contractual agreements with surface and air transportation providers to be called upon as needed. Most mentioned that their contracts were designed to ensure that their hospital would be the first served. This caveat was added in response to problems faced in the aftermath of Katrina, wherein hospitals discovered that they were not first in line for a variety of reasons (e.g., transportation providers were double-booked, transportation was intercepted and used by government officials).



Figure 4-2. Tulane University Hospital in the Central Business District of New Orleans. Post-Hurricane Gustav, September 2008.

Outcome: All of the hospitals reported that they possessed adequate supplies of food and medicine when Hurricane Gustav arrived. For example, the hospitals that planned to do so were able to provide three hot meals per day for all patients, staff, and other individuals present during the storm.

One key decision that the hospitals made was to reduce the headcount of people housed in their facilities during the storm, thereby reducing the number of people who would need to be evacuated from the hospital should a mandatory city evacuation occur. The hospitals reported significantly lower patient census counts, staff, and other individuals (e.g., family members)

permitted in the facilities during Hurricane Gustav. Some accomplished this objective by changing hurricane policies such that family members of staff were not allowed, with few exceptions made (e.g., single parents without recourse were allowed to bring children). All exerted tremendous effort to increase the number of pre-storm evacuations of fragile patients.

New since Hurricane Katrina is a federally-organized pre-storm evacuation system (Louisiana Hospital Association, 2007). Hospitals are required to indicate pre-storm whether they plan to (1) shelter-in-place, or (2) participate in the federal evacuation system, or (3) assume responsibility for evacuating patients. Hospitals in New Orleans split on this decision; some participated, while others chose to execute their own evacuations.

Regardless of how the patients were evacuated, the hospitals worked to improve the system of sending medical histories along with the patients (e.g., some had their printed histories strung around their necks) and of tracking their patients' final destinations. All of the administrators interviewed indicated that this was an area requiring further attention. Many hospital administrators were dissatisfied with the federally-organized system, as the evacuation of patients was delayed relative to the hospitals' hurricane countdown. Several were frustrated by delays in return of evacuated patients.

Summary: Overall, the acute care hospitals in the New Orleans area did a commendable job of planning to be self-sufficient post-Hurricane Katrina. No hospital staff or patients were unnecessarily inconvenienced or their safety threatened due to lack of supplies or inability to evacuate pre-storm. Still, the hospitals' ability to evacuate post-storm was not tested by Hurricane Gustav, as the city did not experience widespread flooding comparable to Hurricane Katrina. Consequently, it is not possible to conclude with certainty whether the hospitals' contracts with surface and air transportation providers would have been sufficient to ensure timely evacuation.

- 3. Networking.** Lesson from Hurricane Katrina: Hospital staff members should build strong networks with local, regional, state, and national

sources of assistance (both governmental and private) and activate those networks when disaster strikes.

Emergency Plan Revision: Subsequent to Hurricane Katrina, acute care hospitals in the New Orleans area have forged strong bonds to support collaborative emergency preparedness planning. The larger hospitals belong to and are actively involved in the Metropolitan Hospital Council of New Orleans, which is associated with the Louisiana Hospital Association. “Established in 1926, the Louisiana Hospital Association (LHA) is a not-for-profit association representing all types of hospitals and healthcare systems throughout the state. LHA carries out its mission by supporting its members through advocacy, education and services” (LHA Home Page, <http://www.lhaonline.org/>). All the New Orleans area acute care hospitals are located in Region 1, show in Figure 4-3 (the State of Louisiana is organized into nine Health and Human Services regions). Five Region 1 hospitals are designated regional hospitals: East Jefferson General Hospital (Figure 4-4), Ochsner Medical Center, West Jefferson Medical Center (Figure 4-5), Touro Infirmary (Figure 4-6), and Children’s Hospital (Figure 4-7). Key staff members from two of the hospitals—Ochsner Clinic and Touro Infirmary—teamed with the HHS Administrative Designated Regional Coordinator to form the Hospital Designated Regional Coordinators for Region 1. Through their participation in the Metropolitan Hospital Council, all of the acute care hospitals in the New Orleans area have taken the opportunity to develop a network of relationships based on the desire to share emergency preparedness-based best practices such as installation of emergency power and water supplies and ensure the continued survival of the New Orleans area acute care healthcare system.

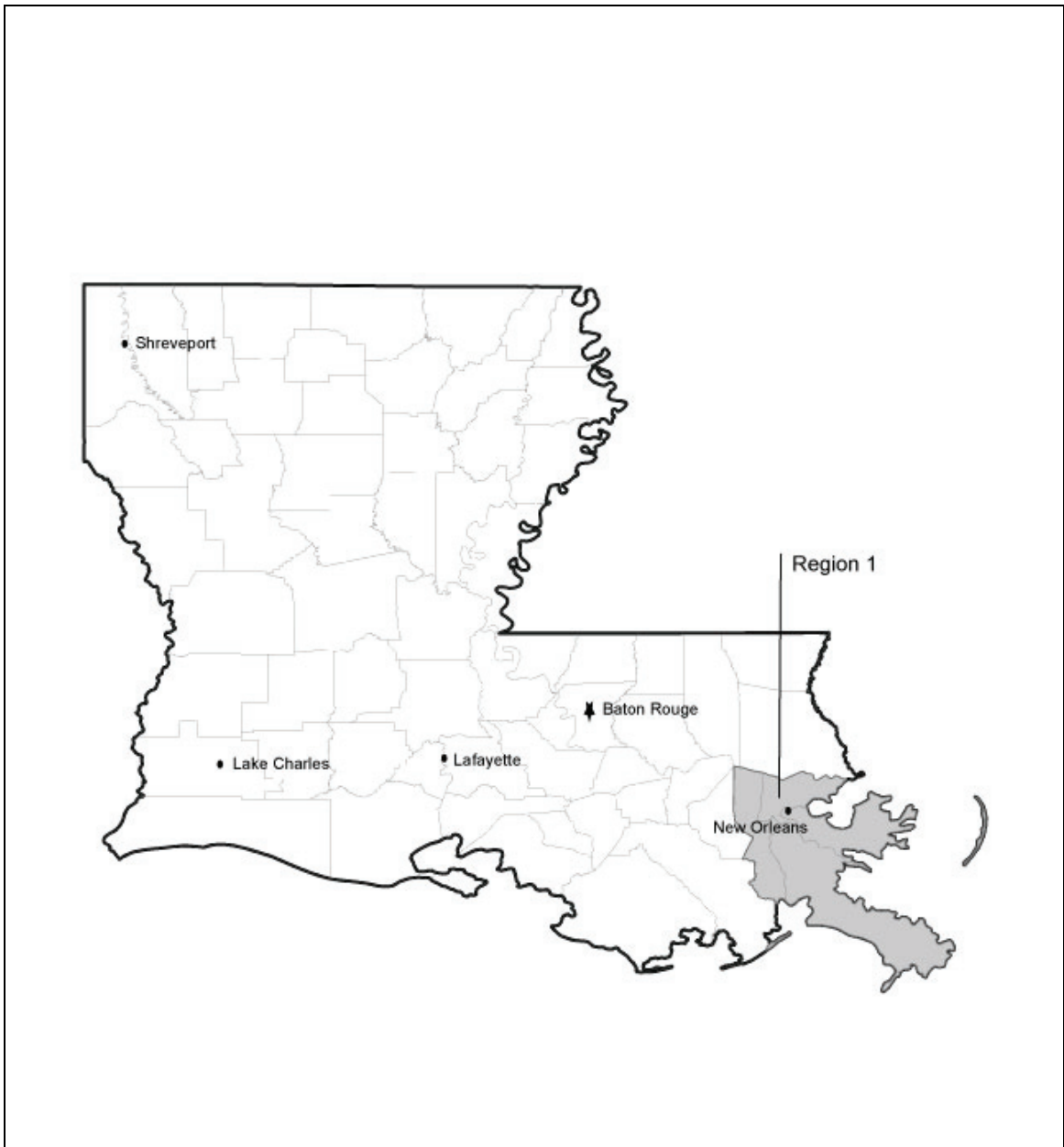


Figure 4-3. Location of Region 1 Defined by the Louisiana Hospital Association



*Figure 4-4. East Jefferson General Hospital in Jefferson Parish.
Post-Hurricane Gustav, September 2008.*



*Figure 4-5. West Jefferson Medical Center in Marrero (West Bank of Jefferson
Parish). Post-Hurricane Gustav, September 2008.*



*Figure 4-6. Touro Infirmary in the Garden District of New Orleans.
Post-Hurricane Gustav, September 2008.*



*Figure 4-7. Children's Hospital in the Garden District of New Orleans.
Post-Hurricane Gustav, September 2008.*

Since Hurricane Katrina, there have also been more opportunities for state and federal agencies and organizations to collaborate. For example, regional and statewide systems for patient tracking (e.g., EMSystem Resource Tracking) and census counts have been developed and implemented. Various programs at the local, state, and federal level intended to ensure collaboration and consistency in practice have been adopted (Berke et al., 2008). For example, the State of Louisiana, with funding support from the Health Resources Services Administration (HRSA) Hospital Bioterrorism Grant Program, has created an infrastructure to facilitate regional planning and provide training and resources needed to support “multi-tiered systems in which local health care entities are prepared to triage, treat, stabilize and refer multiple casualties to identified centers for care” (Louisiana Hospital Association, 2007, p. 3). The *Louisiana Hospital Emergency Preparedness and Response Plan* describes the infrastructure, including its relationship to the National Incident Management System, the state’s regional structures, and the interface between relevant state and federal agencies (Louisiana Hospital Association, 2007). Critical initiatives requiring collaboration include “communication, the patient movement process, the medical queue for mass evacuation, emergency codes, and special needs sheltering” (Louisiana Hospital Association, 2007, p. 2).

Outcomes: All hospital administrators interviewed emphasize the importance of the Metropolitan Hospital Council and the resultant collaboration between and among the region’s acute care hospitals. One of the collaborative initiatives referenced frequently and positively was the EMSystem Resource Tracking tool. This web-based interface allows hospitals to share real-time information on “the status of (their) operations (open, limited, or closed); the availability of beds by category (M/S, ICU, ped, psych, etc); and other resources that may be needed in an emergency (blood products, fuel, pharmaceuticals, personnel, etc.)” (Louisiana Hospital Association, 2007, p. 5).

All hospital administrators also note new systems for alerting hospitals throughout the state of individual hospitals’ plans to evacuate and the means available for so doing. Most interviewees indicated that pre-storm evacuations were successful, suggesting

that patients were able to evacuate safely and reach pre-determined destinations. Most also indicated that the system required changes in order to be more effective in the future. Pre-Gustav, not all hospitals were able to evacuate their patients when they wanted to do so, resulting in patients having to wait at the airport rather than at the hospital. Post-Gustav, there was some difficulty retrieving patients and the equipment that had accompanied them. The Louisiana Hospital Association (LHA) was instrumental in developing a patient tracking system that appeared to be adequate during Hurricane Gustav (Louisiana Hospital Association, 2007). This is an important improvement since Hurricane Katrina, when no formal, comprehensive system for tracking had been established beforehand, and LHA spontaneously created a tracking system.

Summary: Overall, the acute care hospitals in the New Orleans area did a commendable job of networking with other hospitals in the region and with state and federal agencies post-Hurricane Katrina. All of the administrators interviewed spoke positively of their collaborative experiences and reported that collaboration positively affected outcomes. Interviewees spoke more positively about partners as their physical proximity to those partners increased; the closer the distance of partners in the network, the more positive the evaluation. Administrators spoke most positively about the other hospitals in the region, followed by state, and finally, federal agencies. It seems highly likely that there is a strong association between the frequency of face-to-face meetings with different network partners and perceptions of the outcome of collaboration. The administrators had high praise for the Metropolitan Hospital Council, followed by somewhat less sanguine perceptions of state and federal agencies' involvement in pre-storm evacuation procedures and outcomes.

4. **Staffing.** Lesson from Hurricane Katrina: Hospitals should strive to hire staff members with disaster experience and be certain that these staff members are on site when needed.

Emergency Plan Revisions: Hospitals examined and revised emergency plans after Hurricane Katrina. One of the key areas evaluated was hospital staffing practices for hurricanes. First, hospitals clarified their policies for staff members' assignment to the "activation team" or "A team," the "recovery team" or "B team," or as non-essential staff who would resume work only when

the hurricane response period ended and a hospital re-opened for routine business. All of the interviewees described policies in which individuals annually volunteered to serve on the “A” or “B” teams, and all staff knew their team assignment in advance of hurricane season (June to November). Individuals serving on the “activation” teams were told during an annual orientation and in advance of a given hurricane when to report, items and supplies to bring (e.g., food, clothing, medicine, personal hygiene) and for how long they should plan to stay. Since Hurricane Katrina, a significant policy change involves the length of anticipated stay. In general, staff members were told during the annual orientation that they should plan to bring enough personal effects for at least a week, sometimes longer.

Likewise, individuals serving on “recovery” teams were told when they would need to report, and what they would need to do if their return was delayed. All staff were told to carry hospital employee identification with them, along with placards (new since Hurricane Katrina) declaring them emergency workers eligible to reenter the parish as soon as possible.

During Hurricane Katrina, most of the acute care hospitals in the region housed not only patients and staff members, but family members of patients and staff members as well. Several of the hospitals also housed individuals from an area’s fire and police departments and local government officials (e.g., politicians, parish staff members). Pets were also sheltered at most of the hospitals. The difficulties of evacuating so many people (and pets) after Hurricane Katrina challenged hospital administrators to rethink staffing policies. For example, LSU Interim Public Hospital did not allow staff members—under any circumstances—to bring any family members or pets to the hospital for sheltering (Figure 4-8). This hospital’s administrators decided that this policy would ensure that only the most committed and available staff members would volunteer to be on the “activation” team. “This made for a stronger A team,” stated one interviewee. Hospital administrators reported that in past experience, hospital staff with family members in the hospital during a mandatory city evacuation can feel burdened with their care or distracted by their presence and not perform their job at peak performance. Other hospitals severely limited the number of family members at the hospitals. For

example, in some hospitals, only single parents or individuals solely responsible for caring for aging parents were allowed to bring their family members to the hospital. Staff members at all of the hospitals were strongly encouraged to evacuate their family members rather than bring them to the hospital. Most did so. While some hospitals allowed family pets—one hospital even retained the services of a veterinarian to ensure the well-being of the pets beings sheltered—most urged hospital staff to find other shelter for pets. Hospital administrators that allowed pets had policies in place for pet care; for example, all pets were required to be brought in and remain in carriers and possess sufficient food.



Figure 4-8. LSU Interim Public Hospital (formerly, MCL/NO University Hospital) in the Central Business District of New Orleans. Post-Hurricane Gustav, September 2008.

Outcome: None of the hospitals reported significant problems with staffing. All or virtually all “activation” (A) team members reported on time; all or virtually all “recovery” (B) team members succeeded in returning to the parish and reporting to work on time. A small share of “activation” team members did not report and some hospital administrators disciplined such employees on a case-by-case basis. Some “Recovery” team members had difficulty reentering Orleans parish, even with their identification and placards. Apparently, there was confusion at the parish boundaries

as to who could reenter the parish and what identification would be required. In the end, hospital employees and residents in general were allowed to reenter Orleans parish at about the same time, rather than the planned staged reentry. The decision to allow everyone to enter at the same time and the resulting surface transportation congestion made it somewhat difficult for hospital workers to get to their homes and then to work as needed.

Most of the hospitals reported that “A” team members were assigned to 12 hours of duty followed by 12 hours off-duty; when not on duty, staff members were required to rest. Such staffing policies appear to have reduced staff members’ stress relative to the stress experienced by staff members during Katrina. Likewise, consistent availability of power and water during Gustav made it easier for staff members and patients to endure their confinement to the hospital. The ready availability of power and water during Gustav contrasted sharply to the lack of both during Katrina; without these necessities, hospital patients are more likely to suffer adverse consequences and staff members are more likely to be frustrated by their inability to provide the best of care.

The hospitals reported dramatically lower numbers of people sheltering within their facilities compared to the numbers who sheltered during Hurricane Katrina. Consequently, none of the hospitals had trouble feeding those present, and most of the hospitals provided three hot meals per day to everyone. Some hospitals reported an insufficient number of air mattresses and other comfort supplies, but no one suggested that such problems caused great inconveniences. All of the hospitals indicated that they would work to reduce their census counts and staffing loads even further in planning for future hurricanes. One obvious benefit of reducing the number of people sheltering-in-place is that less energy and fewer supplies are needed to sustain those present. In the worst-case scenario of a mandatory city evacuation, fewer people on site means fewer people to evacuate from the hospital.

The hospitals also reported a greater presence of on-site police officers, National Guard, and other individuals capable of providing security. These individuals were welcomed. Some were given separate quarters in the hospital for living and work. All of the administrators interviewed said that the additional security

presence helped staff members feel more secure in the hospital and confident that their safety and the safety of patients could be adequately maintained.

Summary: Overall, the acute care hospitals in the New Orleans area did a commendable job of ensuring adequate staffing and of reassuring staff members that they would be safe during and after a hurricane. Virtually all workers reported as needed, staff members complied with family member or pet policies, and staff members were generally satisfied with life inside the hospital during hurricane lockdown.

- 5. Communicating Emergency Plans Before Disaster Strikes.** Hurricane Katrina Lesson: Hospitals should plan for the worst and be certain that all staff members know their role in an emergency.

Emergency Plan Revisions: All of the acute care hospitals in the New Orleans area use some version of the Hospital Incident Command System (HICS) (formerly, the Hospital Emergency Incident Command System or HEICS), which establishes a hierarchy—of reporting relationships within a hospital’s administrative structure—for use in an emergency (Louisiana Hospital Association, 2007). In addition, several hospitals created pre-established Incident Command Centers (ICC), permanent locations that physically co-locate key decision makers with needed computers and communication equipment (Figure 4-9). Pre-established ICCs that are not used for other purposes can be maintained in advance of any emergency. Other hospitals have designated locations for their ICCs, but use the rooms for other purposes (e.g., conference rooms) in non-emergency times.



*Figure 4-9. Incident Command Center at a New Orleans hospital.
Post-Hurricane Gustav, September 2008.*

When asked who had been involved in creating and vetting their emergency preparedness, response, and recovery plans, most of the hospitals identified members of a top management team along with standing committees that included individuals from various departments and various managerial levels throughout the hospital. Physicians were a new addition to many of these committees—previously limited to staff—after Hurricane Katrina. These committees were responsible for identifying weaknesses in emergency planning after Hurricane Katrina and for proposing solutions. Solutions were implemented as budgets allowed. In several cases, administrators suggested that having direct access to the top management team was prerequisite to major hazard mitigation expenditures (e.g., drilling a well).

With respect to disaster training, all of the hospitals engaged their employees in annual discussions of hurricane planning, in May of each year during the lead up to hurricane season. Most administrators scheduled various exercise drills and training opportunities since Hurricane Katrina. The hospitals' emergency

plans were featured in new employees' orientation activities, and all hurricane planning information was made available on the hospitals' Intranet and/or Internet websites. Interviewees were confident that employees knew their roles and expectations in an emergency and how the hospital revised emergency plans to ensure their safety and the safety of patients. Hospitals publicized efforts to strengthen and enhance the hospitals' physical plants and power/water capability.

Outcome: All of the hospitals reported success using HICS. Incident Command Centers (ICC) were used to coordinate decision making within and between the region's hospitals. Only authorized personnel were permitted in the ICCs.

Hospital administrators interviewed were pleased with the reaction of staff and patients to the results of the hospitals' emergency planning. Including a wide range of hospital employees on emergency preparedness standing committees appears to have been successful, as engagement in the planning process may have increased participants' sense of ownership of emergency procedures.

In addition to having participated in disaster training, a fair number of the hospitals' employees, especially top management team members, experienced Hurricane Katrina first hand and therefore were confident in confronting Hurricane Gustav. While some who worked during Hurricane Katrina were unwilling to serve on the "Activation" team for the 2008 hurricanes, other staff members were glad to volunteer. Administrators speculated that these individuals may have volunteered because they felt they could improve upon the emergency response to Hurricane Katrina.

Summary: Overall, the acute care hospitals in the New Orleans area did a commendable job of communicating emergency plans before Hurricane Gustav. The ICCs operated as anticipated, and employees were able to carry out their roles as planned. Staff members were generally satisfied with how the hospitals planned for and dealt with Gustav, suggesting that they knew what to expect and that what they expected largely occurred.

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6. **Communicating in the Wake of Disaster.** Lesson from Hurricane Katrina: Hospitals should anticipate communication breakdowns within their facilities and with the outside world; emergency plans should include alternate plans for communication in emergencies.

Emergency Plan Revisions: The *Louisiana Hospital Emergency Preparedness and Response Plan* (Louisiana Hospital Association, 2007) includes communication as a critical initiative requiring collaboration within and across regions. During Hurricane Katrina, most New Orleans area hospitals indeed lost contact with the world outside the hospital. Once power was lost, customary forms of internal and external communication—e.g., intercom, public address, telephones, mobile phones, Internet, radio, television—were unavailable. Many hospitals used “runners” in the hospitals to communicate between floors. Newsletters were printed, sometimes every hour, updating employees about what was happening. Mobile phones with area codes outside the New Orleans area worked more reliably than those with the 504 New Orleans area code. Some hospitals had satellite phones, but for the most part, they did not work (or, no one knew how to use them). Hospitals that maintained their website on servers housed in New Orleans lost the ability to maintain or update their websites. Existing radio technology could not communicate with radio technology used by external emergency forces. The results of these communication breakdowns included miscommunication, rumor-mongering, and panic within the hospitals as people could not communicate reliably within the hospital or with anyone outside the hospital. Hospitals seeking outside help could not contact anyone to ask for it. Those outside the hospitals could not determine what was happening in the hospitals.

In the wake of these massive communication failures during Hurricane Katrina, all of the acute care hospitals in the New Orleans area aggressively took steps to maximize their ability to communicate both within their facilities and with the outside world. Hospitals bought satellite phones and computers that required little training or expertise, mobile phones with area codes outside the New Orleans area, and 800mh radios. Intranet and Internet information was housed on servers outside the New Orleans area. Employees outside the hospital had access to toll-free telephone numbers that they could call for updates (e.g., hospital status, when staff should return). Hospitals stayed in close touch

with each other and with their Designated Regional Coordinator by telephone and through the EMS system technology.

Outcomes: Hospital administrators interviewed were satisfied with communication within their facilities and with the outside world. None experienced any major breakdowns in communication. This was dramatically different from the Hurricane Katrina experience, when many hospitals experienced near complete communication shutdowns that lasted several days.

Summary: Overall, the acute care hospitals in the New Orleans area did a commendable job of communicating in the wake of Hurricane Gustav. Communication within hospital facilities and between the hospitals and external organizations was possible and perceived to be effective. Still, Hurricane Gustav was not a full test of the hospitals' communication systems, as none of the hospitals suffered significant power loss that disrupted communication. All had uninterrupted Internet access, for example, making communication between hospitals and between state and federal agencies straightforward.

7. **Leading Effectively.** Lesson from Hurricane Katrina: Having planned for the worst, hospital executives should be poised to lead.

Emergency Plan Revisions: Virtually everyone interviewed for the Hurricane Gustav research had been in New Orleans at the time of Hurricane Katrina and weathered the storm as hospital staff. Consequently, there was a tremendous amount of first-hand experience to inform emergency preparedness planning since Hurricane Katrina. This was viewed by hospital administrators as extremely valuable for confronting Hurricane Gustav. Since Hurricane Katrina, the region's hospitals collaborated on emergency planning through the Metropolitan Hospital Council, shared lessons learned, and revised hurricane plans and emergency procedures. Establishing new wells and new generators to lessen potential hurricane and flood damage were evidence that hospital administrators did not dismiss the threat of another storm as damaging as Hurricane Katrina. Importantly, most if not all of the acute care hospitals in the New Orleans area are financially "in the red," suggesting that they do not have access to funds that might be used to better mitigate facilities against hurricanes, flooding, and tornadoes (Zieger, 2009). Still, despite lacking resources that might

normally be used to fund such improvements, hospitals forged ahead and made the improvements anyway! In at least one hospital, many emergency preparedness expenses were not included in the regular capital budget, which typically considers projects and funds them over several years. Instead, at this hospital, many if not most emergency preparedness expenses were funded as operational expenses. If the argument was made that a given disaster-related expenditure was needed during the current fiscal year, such as the expense associated with drilling a well, the expenditure was made during the current fiscal year. Of course, doing so meant that some other operational expense (e.g., supplies, professional development, travel) could not be addressed during the current fiscal year.

During the hospital lockdown period during Hurricane Gustav, hospitals administrators made sure that they were visible and available to employees, making rounds during the storm period. Hospital administrators also sent important messages via e-mail and newsletters. They led “town hall” meetings once or more per day during which they updated staff members on events within the hospitals and fielded questions.

Outcomes: Administrators’ experience with Hurricane Katrina helped them to plan for and react to Hurricane Gustav. Many of the administrators appeared to be mindful of potential danger from a major hurricane including physical damage to facilities and emotional distress for patients and staff.

Based on interview findings, it appears that most—if not all—of the key administrators in New Orleans area acute care hospitals possessed the five qualities of mindfulness described by Weick and Sutcliffe (2001). First, they were preoccupied with failure. After Hurricane Katrina, administrators spent considerable time engaging a wide range of employees in discussions about what went wrong and what should be done differently in the future. In the two weeks after Hurricane Gustav, administrators had already begun the same debriefing process. Second, they were reluctant to simplify interpretations. In other words, they drew on a diversity of opinions, engaging staff members throughout the hospital in conversations about emergency preparedness, response, and recovery. Third, they were sensitive to operations. Information was

distributed widely. Flexibility was critical; while many hospitals' policies recommended against bringing family members to shelter at the hospital, exceptions were made as needed. Likewise, although the penalty for not appearing as scheduled for the "A" team or "B" team was termination at one hospital, exceptions were made if employees tried to reach the hospital and were unable to or if some other reasonable explanation was provided for their absence.

Fourth, administrators were committed to resilience. They allocated significant funds post-Hurricane Katrina to ensure that hospitals could survive another disaster. They actively learned about and implemented best practices from other hospitals. Even though physical facilities were largely not damaged by Hurricane Gustav, hospital administrators solicited ideas for improvement to facilities and emergency processes immediately after Hurricane Gustav had passed and the hospitals reopened for routine business. Finally, administrators deferred to expertise distributed within their organizations. Knowledgeable individuals were empowered to make critical decisions before, during, and after Hurricane Gustav.

Summary: Overall, administrators of the acute care hospitals in the New Orleans area did a commendable job of leading effectively. The administrators took actions before, during, and after Hurricane Gustav to make the hospitals' physical facilities and human assets more resilient. The generally positive outcomes—staff members who were present and able to perform their job, patients who survived, physical facilities that withstood hurricane winds, generators that provided power continuously—suggest that the leaders of New Orleans acute care hospitals learned Hurricane Katrina's lessons.

5.0 Conclusion

Three years after Hurricane Katrina, Hurricane Gustav struck southern Louisiana and threatened the New Orleans area. Given the devastating consequences of Hurricane Katrina, the individual and collective reaction to Hurricane Gustav was influenced by experience with Hurricane Katrina three years earlier. After all, Hurricane Katrina was responsible for 1,600 lives lost in Louisiana alone, along with more than \$81 billion in property losses (U.S. Department of Commerce, 2006). As of July 2008, the population of the greater New Orleans area was about 72 percent of its pre-Hurricane Katrina level, a level maintained since December 2007 (Greater New Orleans Community Data Center, 2008).

People generally understood the threat that Hurricane Gustav posed and they followed orders to evacuate the city. While 60,000 people were stranded in New Orleans after Hurricane Katrina (U.S. Governmental Accountability Office, 2006), during Hurricane Gustav more than 90 percent of the New Orleans-area population was estimated to have left in response to a mandatory evacuation order (Lawrence & Callebs, 2008; Nossiter & Dewan, 2008). As was the case during Hurricane Katrina, several acute care hospitals were once again the focus of media attention during Hurricane Gustav. This time, however, the attention was not directed at the number of patients, staff, and family members stranded by widespread flooding. Instead, the attention was directed at the positive outcomes of actions taken by hospital officials since Hurricane Katrina. An especially important decision made by the hospitals was to evacuate a large share of resident patients and minimize the number of patients, staff, and family members who sheltered in place (Sloane & Roesgen, 2008a). The decision to evacuate large numbers of patients in advance represents a significant departure from common practice (Rodriguez & Aguirre, 2006).

Although outcomes suggest the acute care hospitals in the New Orleans area performed satisfactory before, during, and after Hurricane Gustav, Hurricane Gustav was not a full test of whether the hospitals responded adequately to lessons that Hurricane Katrina offered. After all, New Orleans did not flood during Hurricane Gustav as it did during Hurricane Katrina. That meant that supplies and equipment on lower levels of buildings were not flooded. Staff members did not experience a flooded city after Hurricane Gustav. Surface transportation was available. Hospitals were not forced to evacuate post-storm by air. Widespread looting and violence did not occur. Hospitals had

ample security staff. The Internet remained available. Hospitals were able to stay in touch with the outside world. None of the larger hospitals closed.

While the physical damage caused by Hurricane Gustav in the New Orleans area was not as severe as the damage from Hurricane Katrina, hospital emergency plans were operationalized, hospital Incident Command Centers were established, and hospitals evacuated fragile patients pre-storm. When possible, patients were discharged. Elective surgeries were cancelled. Key staff members were called to duty and asked to work 12 hours of duty followed by 12 hours off-duty, until the “recovery” team could relieve them, about five days after “code gray”—signaling an impending storm— was established at hospitals.

From a fiscal perspective, Hurricane Gustav was a disaster for acute care hospitals in the New Orleans area, even though hospitals were not forced to close like they were during Hurricane Katrina. Having to pay salary to employees for 96 or more hours of work in a week’s time—some of that pay at overtime rates—represents an overwhelming cost. The additional supplies ordered and used, including the food provided at no cost to employees and others sheltering at the hospitals, were expenses that the hospitals would not incur in a typical week. On the revenue side, even though the hospitals reopened by Thursday, September 4, 2008, revenue-producing operations had not returned fully by the week of September 14, 2008. Community members returning to Jefferson and Orleans Parish were busy cleaning their property and homes rather than rescheduling elective surgeries originally scheduled before Hurricane Gustav.

A letter written by Louisiana Governor Bobby Jindal to U.S. Congressional leaders articulates the financial difficulties facing the hospitals:

The Louisiana Hospital Association estimates that the total financial and operational impact of Hurricane Gustav on Louisiana’s hospitals is as much as \$302 million. The hospitals, many of which were still struggling with post-Katrina and Rita losses, have sustained reported losses of net revenue, and have incurred costs for incremental salary and labor, sheltering and evacuation, facility damage and debris removal, and other non-ordinary costs attributable to the storm (Jindal, Landrieu urge Congress aid, 2008, para. 14).

Of course, closing a hospital is an extreme action because loss of revenue can be debilitating. While a hospital is closed, individuals who would have

sought services at that facility find a new one. Competition in the hospital industry is fierce; a hospital that fails to deliver a service when it is desired loses patients, referrals, and staff. Closed hospitals failing to earn revenue must still pay salary to employees. Even though most hospitals in the New Orleans area continued to pay employees several months after Hurricane Katrina closed their facilities, many employees eventually found new employers. Patients, like those who would have gone to Methodist Hospital in New Orleans East, find a new hospital for the services they need (Figure 5-1).



Figure 5-1. Methodist Hospital in New Orleans East, closed since Katrina. Post-Hurricane Gustav, September 2008.

The cost of closing a hospital is high, especially when patients and staff members are evacuated. Likewise, the cost of reopening a hospital is extraordinary. Hospitals closed under emergency conditions require intensive cleaning and rehabilitation before reopening, even if the facilities have not been under water for weeks, as some were after Hurricane Katrina (e.g., Charity Hospital, Chalmette Medical Center, Lindy Boggs Hospital,

Memorial, Tulane Hospital, VA Hospital). Hospital facilities and staff must be reviewed, approved, and re-certified for continuing operations by various agencies before reopening. When a hospital remains closed for a long period of time, key stakeholders such as the public, the government, and the facility's owners are likely to debate whether it makes economic, social, political, and even environmental sense to reopen. Such has been the case for Charity Hospital (Figure 5-2).



Figure 5-2. MCL/NO "Big Charity" in the Central Business District of New Orleans, closed since Hurricane Katrina. Post-Hurricane Gustav, September 2008.

To the extent that Hurricane Gustav represents a partial test of lessons learned from Hurricane Katrina, the evidence suggests that hospitals performed well, thanks to extensive emergency preparedness and response activities undertaken and executed in the three years since Hurricane Katrina. Acute care hospitals in the New Orleans area were prepared to be self-sufficient, in some cases for up to a month. At the same time, these hospitals

had developed and nurtured a regional perspective of emergency preparedness, response, and recovery in the three years since Hurricane Katrina. While everyone interviewed said that they were pleased, on balance, with how their hospitals coped with Hurricane Gustav, they also indicated that additional measures would be taken to further enhance their hospitals' ability to cope with future disasters.

6.0 References

6.1 Publications

- Anderson, E. (2008b). "Six Hospital Patients Die During Evacuation." *New Orleans Times-Picayune*. September 1.
- Arendt, L. A. and Hess, D. B. (2008). *Hurricane Gustav Reconnaissance: Lessons Learned by New Orleans Hospitals from Katrina to Gustav*. MCEER Response Brief. MCEER-08-SP07. Buffalo, New York: University at Buffalo, State University of New York.
- Arendt, L.A., & Hess, D.B. (2006). *Hospital Decision Making in the Wake of Katrina – The Case of New Orleans*. MCEER Special Report Series on Engineering and Organizational Issues Before, During and After Hurricane Katrina. MCEER-06-SP01. Buffalo, New York: University at Buffalo, State University of New York.
- Berke, P.R., Kartez, J. and Wenger, D. (2008). "Recovery After Disaster: Achieving Sustainable Development, Mitigation and Equity." *Disasters*. vol. 17. no. 2. pp. 93-109.
- Charatan, F. 2008. "New Orleans Hospitals Better Prepared for Hurricane Than Three Years Ago." *British Medical Journal*. 337; a1546.
- Corbacioglu, S. and Kapucu, N. (June 2006). Organisational learning and self-adaptation in dynamic disaster environments. *Disasters*, 30(2), 212-233.
- Glasser, B.G. and Strauss, A.L. (1967). *The discovery of grounded theory: Strategies for qualitative research*. Chicago, IL: Aldine.
- Hess, D.B. and Arendt, L.A. (2006). Critical care in crisis: Decision making in New Orleans' hospitals. *Learning from Catastrophe: Quick Response Research in the Wake of Hurricane Katrina*. Natural Hazards Center (Ed.). Boulder, Colorado: University of Colorado. 177-214.
- Louisiana Hospital Association. (2007). *Louisiana Hospital Emergency Preparedness and Response*. Baton Rouge, Louisiana: State of Louisiana.
- Maggi, L. (2008). "Hospitals Open and Readying for Returning Residents." *New Orleans Times-Picayune*. September 3.

Milhollon, M. (2008). "Hospital Patients May Have to Evacuation." *Advocate Capitol New Bureau*. September 2.

Neal, D.M. and Webb, G.R. (2006). Structural barriers to using the National Incident Management Systems. *Learning from Catastrophe: Quick Response Research in the Wake of Hurricane Katrina*. Natural Hazards Center (Ed.). Boulder, Colorado: University of Colorado. 263-282.

Nossiter, A. and Dewan, S. (2008). "Mayor Orders the Evacuation of New Orleans." *New York Times*. August 31, 2008; A1.

Pan American Health Organization. (1993). Mitigation of disasters in health facilities: Evaluation and reduction of physical and functional vulnerability. *Volume II: Administrative issues*. Washington, D.C.: Pan American Health Organization.

Quarantelli, E.L. (1985). *Needed innovation in emergency medical service in disasters of the future*. Preliminary Paper #95. Disaster Research Center, University of Delaware.

Rodriguez, H.R. and 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), 13-24.

Sternberg, E. (2003). Planning for resilience in internal hospital disasters. *Prehospital and Disaster Medicine*, 18(4), 291-299.

Sternberg, S. and Marcus, M. Brophy. (2008). "Big Easy Hospitals Prep for Gustav." *USAToday*. August 29.

Weick, K.E. and Sutcliffe, K.M. (2001). *Managing the unexpected: Assuring high performance in an age of complexity*. San Francisco, CA: Jossey-Bass.

6.2 Web Resources

Anderson, E. (August 31, 2008a). 1.9 million people evacuate south Louisiana. Retrieved September 30, 2008 from:
http://www.nola.com/hurricane/index.ssf/2008/08/11_million_people_evacuate_sou.html

Carver, A. (September 3, 2008). Hurricane Gustav: Thousands of patients, residents evacuated. Retrieved October 1, 2008 from:

http://www.efluxmedia.com/news_Hurricane_Gustav_Thousands_of_Patients_Residents_Evacuated_23533.html

Fink, S. (September 11, 2008). Lessons for hospitals from Hurricane Gustav. Retrieved October 2, 2008 from: http://www.huffingtonpost.com/sherifink/lessons-for-hospitals-fro_b_125785.html

Greater New Orleans Community Data Center. Population data retrieved September 6, 2008 from: <http://www.gnocdc.org/>

Jindal, Landrieu urge Congress aid. (2008). Jindal, Landrieu urge Congress aid For Hurricanes Gustav, Ike. Retrieved October 1, 2008 from: http://www.bayoubuzz.com/News/Louisiana/Government/Jindal_Landrieu_Urge_Congress_Aid_For_Hurricanes_Gustav_Ike___7523.asp

Lawrence, C. and Callebs, S. (August 31, 2008). Mandatory evacuations to begin Sunday morning in New Orleans. Retrieved September 6, 2008 from: <http://www.cnn.com/2008/US/weather/08/30/gustav.prepare/>

Life stands (March 23, 2009). Life Stands Still On New Orleans' Honeysuckle Lane. Retrieved March 30, 2009 from: <http://www.npr.org/templates/story/story.php?storyId=102250752>

Louisiana Economic Development. (September 18, 2008). LED releases Hurricane Gustav and Hurricane Ike economic impact assessment. Retrieved October 4, 2008 from: <http://www.louisianaforward.com/view-release.aspx?id=3937>

Moran, K. (November 25, 2008). LSU and VA to build joint medical campus in downtown New Orleans; VA expected to open by 2013. Retrieved March 30, 2009 from: http://www.nola.com/news/index.ssf/2008/11/lsvva_shared_hospital_site_is.html

National Hurricane Center Bulletin. (September 1, 2008). Hurricane Gustav Advisory Number 32. Retrieved October 1, 2008 from: <http://www.nhc.noaa.gov/archive/2008/al07/al072008.public.032.shtml>

NBC News. (August 31, 2008). Evacuation of New Orleans ordered for Sunday. Retrieved October 2, 2008 from: <http://www.msnbc.msn.com/id/26425142/>

Sloan, M. and Roesgen, S. (August 31, 2008a). Hospitals use lessons from Katrina to prep for Gustav. Retrieved August 31, 2008 from: <http://www.cnn.com/2008/HEALTH/08/31/gustav.medical/>

Sloane, M. and Roesgen, S. (September 1, 2008b). Hospitals use lessons from Katrina to prep for Gustav. Retrieved March 30, 2009 from:
<http://www.cnn.com/2008/HEALTH/08/31/gustav.medical/index.html>

St. Bernard (June 6, 2008). St. Bernard to get hospital by end of 2010. Retrieved March 30, 2009 from:
<http://www.wvltv.com/topstories/stories/wvltv060608tphsoptial.8ef722e.html>

U.S. Department of Commerce. (June 2006). Hurricane Katrina Service Assessment Report. Retrieved September 6, 2008 from:
<http://www.weather.gov/om/assessments/pdfs/Katrina.pdf>

U.S. Government Accountability Office. (July 2006). Coast Guard: Observations on the Preparation, Response, and Recovery Missions Related to Hurricane Katrina. Retrieved September 6, 2008 from:
<http://www.gao.gov/new.items/d06903.pdf>

Zieger, A. (March 2, 2009). SPOTLIGHT: New Orleans hospitals deep in the red. Retrieved March 30, 2009 from:
<http://www.fiercehealthcare.com/story/spotlight-new-orleans-hospitals-deep-red/2009-03-02>

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- NCEER-87-0001 "First-Year Program in Research, Education and Technology Transfer," 3/5/87, (PB88-134275, A04, MF-A01).
- NCEER-87-0002 "Experimental Evaluation of Instantaneous Optimal Algorithms for Structural Control," by R.C. Lin, T.T. Soong and A.M. Reinhorn, 4/20/87, (PB88-134341, A04, MF-A01).
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University at Buffalo, The State University of New York
Red Jacket Quadrangle ■ Buffalo, New York 14261
Phone: (716) 645-3391 ■ Fax: (716) 645-3399
E-mail: mceer@buffalo.edu ■ WWW Site <http://mceer.buffalo.edu>



University at Buffalo *The State University of New York*

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