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The Mississippi Katrina Experience: Applying Lessons Learned to Augment Daily Operations in Disaster Preparation and Management

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Abstract: On August 29, 2005, Hurricane Katrina made landfall on the US Gulf Coast, causing catastrophic damage to communities and the medical infrastructure throughout the lower half of Mississippi. Substantial power outages, widespread communication failures, and a sustained medical surge of patients provided a unique challenge for the medical care delivery system in Mississippi for weeks after the hurricane. In the 7 years since Hurricane Katrina struck, many lessons have been learned in medical planning, preparation, and response to disasters that have affected Mississippi.

Key Words: communications, disaster preparedness, medical surge, patient transfer coordination

August 2012 marked 7 years since Mississippi's medical response and infrastructure were confronted with one of the greatest challenges since Hurricane Camille ravaged the Mississippi Gulf Coast in 1969. Daily emergency operations after Hurricane Katrina have been greatly enhanced through lessons learned by medical professionals and the public safety community. Although much has been written regarding the struggles of hospitals and medical providers in the greater New Orleans area, little has been published regarding the impact of Hurricane Katrina on the medical community and infrastructure where it made landfall. Two hundred thirty-eight people died in the storm, and there are no published statistics of the number of patients who were injured or whose chronic medical conditions were exacerbated after being displaced.¹ The secondary effects on the medical system from mass utility failures and the large number of people displaced inland from both

Mississippi and Louisiana proved to be one of the greatest stressors on the medical system. Approximately 800,000 homes lost power, some for weeks after the storm, distressing 31% of the population of Mississippi.^{2,3} More than one-third of the medical infrastructure in Mississippi was affected by wind or water damage, and cities as far north as Meridian, Jackson, and Vicksburg sustained direct and substantial damage, including primary power failures. All of Mississippi's 82 counties were declared federal disaster areas; 47 were declared major disaster areas.⁴ The stress on the healthcare system in Mississippi was enormous and lasted an unprecedented length of time. Hurricane Katrina had a profound impact on the University of Mississippi Medical Center (UMMC) in Jackson, the only academic medical center in the state. Since the storm, much attention has been placed on streamlining and focusing the medical system while enhancing the role of the UMMC to support local healthcare providers.

The lessons learned from Hurricane Katrina for medical providers have challenged hospitals to revisit disaster response plans and to be more involved in state and local disaster planning and response. Mississippi is endeavoring to design and operate an efficient daily emergency communication, coordination, and transfer system that is well rehearsed when disaster strikes. This philosophy has been validated in the state's medical response to disasters since Katrina in 2005.

Located more than 130 mi inland from where Katrina made landfall, UMMC had not previously engaged in disaster

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Key Points

- Physicians and medical providers should play a key role in disaster planning and response at the local, state, and regional levels.
- Healthcare facilities and providers should assess and improve communications interoperability with local emergency management and public safety officials.
- Healthcare facilities and providers should apply new assumptions to medical surge plans.
- Healthcare facilities and providers should develop coordinated medical evacuations plans that mirror daily transfer patterns and procedures.

response nor had it been involved in such planning and was not an active participant within Emergency Support Function-8 (ESF-8). ESF-8, as defined by the National Response Framework, published by the Federal Emergency Management Agency⁵ and reflected in the Mississippi Comprehensive Emergency Management Plan,⁶ is the primary mechanism that outlines the state and federal public health and medical response to a disaster. Collaborative efforts among various healthcare systems were promoted by the Mississippi State Department of Health and the Mississippi Hospital Association following the terrorist events of September 11, 2001. Before Hurricane Katrina, ESF-8 capabilities were focused on terrorism response; however, the collaborative relationships were quickly adapted to respond to the needs of Mississippians following Katrina. Combined efforts among the healthcare communities, including UMMC, across Mississippi provided substantial care and assistance to patients displaced by the storm and to hospitals directly affected in the southern half of the state. As a result of these improved collaborative efforts, planning and response for disasters changed greatly. Evidence of this change can be seen in the improved and coordinated response to disasters that have occurred in Mississippi since Hurricane Katrina.

Catastrophic Communications Failure

Hurricane Katrina devastated communications in the commercial, cellular, and public safety networks from the Gulf Coast to counties and cities south of the Interstate 20 corridor, leaving medical providers, hospitals, and those who wanted to provide assistance without the ability to determine the needs of medical care. Essentially all terrestrial-based communications systems (radio, telephone, and data) were either completely nonfunctional or only minimally functional in the immediate area, necessitating the need for runners to communicate medical needs from hospitals to those who were able to provide assistance. Overall, commercial communication networks were unable to meet the demands of the critical medical infrastructure in returning normal service to hospitals in the immediate postlandfall phase. More concerning was that the backup satellite communication equipment of few of the coastal hospitals survived the hurricane. Antennas were lost in the wind or became nonfunctional from water damage. Initial assessments of the storm's impact on healthcare systems along the Gulf Coast were relayed via portable satellite telephones to state command centers in Jackson. The decompression of hospitals that were uninhabitable either from primary damage or from secondary issues caused by failures of electricity, climate-controlled systems, or other critical utilities accentuated the needs in communication, coordination, and transport at a time when all of these assets were severely limited. In the days following Katrina making landfall, the most salient information came from emergency medical services crews that were returning from southern Mississippi, word of mouth, or a few agencies with

reliable satellite communications or individuals who found islands of cellular telephone or text messaging service.

In the 7 years since the storm, substantial changes have resulted in improved communications. Before Hurricane Katrina, many individuals in health care had never heard of *mission critical*, a term long used by public safety in designing, building, and supporting communications and utility channels to a standard that is more durable than the typical commercial network. The operators of healthcare plans in Mississippi had presumed that commercial carriers and networks were robust and would survive, an assumption that resulted in a false belief that those networks would survive a catastrophe and that the medical community would be one of the first entities to have services restored. With the complete loss of much of the infrastructure, the majority of the attention focused by commercial providers was on rebuilding its base and connecting public safety, leaving some of the healthcare system without communication capabilities.

One of the valuable lessons learned in the aftermath of Hurricane Katrina was that healthcare institutions should become active participants in mission critical communications and should allow enhanced interoperability of hospitals with local public safety officials. After Hurricane Katrina, the state of Mississippi, through federal grants and bond money, developed the Mississippi Wireless Information Network radio system. This network allows clear and secure communications for mission critical demands throughout the state and is dedicated to public safety, which now includes critical healthcare infrastructure. In 2011, UMMC, in cooperation with the Executive Office of the Governor, the Mississippi Wireless Commission, and Mississippi Information Technology Services, was able to secure a grant to provide Mississippi Wireless Information Network radios to every emergency department and 9-1-1 response ambulance in the state. This technology is a component of an enhanced interoperable communications system that has been developed, tested, and used on a daily basis by a broad range of public safety officials and medical professionals.

Sustained Surge

Before Hurricane Katrina, many hospitals, including UMMC, were working from assumptions and lessons learned from the events of September 11, 2001 that deal with surge capacity for hospitals. The suppositions were that there would be a large surge of mainly trauma patients presenting in traditional methods who would be triaged and cared for in a relatively short period of time. The experience in the Jackson metro area hospitals immediately before August 29, 2005 was that operations were at normal levels. Hospitals were operating at near-capacity censuses. Much of the central Mississippi emergency medical services reserve equipment and people were mobilized to the Gulf Coast as the numbers of evacuees continued to arrive from areas across the Gulf coasts of Louisiana and Mississippi. The Mississippi Gulf Coast had been largely evacuated well ahead

of the storm; many heeded the warning and comparison of Hurricane Katrina to Hurricane Camille. Additional surges of people came into the Jackson metropolitan area and other areas north of the Interstate 20 corridor as the power outages continued beyond the first few days. The first wave of patients was local trauma patients injured as a result of fallen debris. The second and sustained surge of patients was patients with chronic medical conditions who had run out of medications and/or needed specialty services (eg, dialysis, methadone, oxygen supply). Because communications and infrastructure returned slowly in the hardest hit areas, the partial evacuation, decompression, and evaluation continued for weeks until federal and out-of-state medical assets arrived. At that point, the transfer patterns changed to evaluation by the mobile field hospitals that eventually treated approximately 8000 patients in the months following Katrina.⁷ With the majority of federal assistance heading to the coast in the days after Katrina's landfall, much of the unnoticed and underreported stress was occurring in cities with limited medical infrastructure that was functioning near capacity before the storm that were now coping with a large increase in new residents. Medical surge in a large-scale disaster such as a hurricane can be sustained and complicated by patients who require not only surgical specialties but also medical and pediatric specialties and subspecialties or intensive medical resources.

Since 2005, hospital operations have become leaner in Mississippi, as they have in other parts of the country, making surge capacity even more of an issue not only for hospitals but also outpatient services. Many outpatient services and dialysis clinics in the affected areas were without power for weeks, leaving patients with limited options for medical care. Many hospitals and clinics have applied lessons learned from Katrina's sustained medical surge through developments of reinforced supply chain agreements, flexible staffing patterns and flexibility, and operational adaptability; however, the ability of large medical complexes and the Mississippi healthcare community to maintain a sustained surge capacity continues to be a challenge.

To meet this challenge, the Mississippi State Department of Health developed the State Medical Response System (SMRS). The SMRS is composed of various levels of teams designed to provide healthcare support to local responders based on the scope and scale of the incident. The SMRS has healthcare teams as small as two to four people for triage and shelter support to large mobile field hospitals with 50-bed capacity, capable of providing advanced medical care in an austere environment. The SMRS allows Mississippi to provide advanced medical care to patients affected by disaster without having to wait for the intervention of federal or out-of-state teams.

Patient Movement Coordination

When the magnitude of Katrina became apparent in the early-morning hours of August 30, 2005, UMMC was assigned by the Mississippi State Department of Health to help to

coordinate patients from the Mississippi Gulf Coast. The patients in this movement coordination included patients from affected coastal hospitals and inland hospitals that had lost power or needed decompression. To date, no data have been published that detail how many patients were transferred in the weeks following the hurricane. Information about patients transferred to UMMC was recorded on flipcharts in the emergency department. As reported in the Mississippi State Department of Health after-action review, disaster response ambulances and resources were deployed haphazardly, resulting at times in dozens of ambulances sent to areas with unclear direction.⁸ Although the response was functional because of the resourcefulness of local public safety providers, hospital staff, and emergency managers, the coordination of available healthcare resources was inadequate to match the various requests, which complicated the coordination of mass patient evacuation.

The key to successfully navigating a disaster is a functional and streamlined system that enhances early response and coordination. As a direct result of lessons learned from Hurricane Katrina and the effects it had on the medical delivery system in Mississippi, in 2008, UMMC, in partnership with the Mississippi State Department of Health and leveraging federal grant funding from the US Department of Health and Human Services Assistant Secretary for Preparedness and Response, developed a statewide medical communications center, Mississippi MED-COM, to provide a hub for patient coordination and movement during emergency incidents. Each year MED-COM assists in the movement and coordination of more than 30,000 emergency patients from Mississippi into hospitals that have required or desired services. The functional design provides streamlined daily transfer patterns, policies, and practices that provide a common, reliable, and familiar pathway for disaster response on the local, state, or regional level.

In 2011, Governor Haley Barbour named the UMMC as a primary agency under ESF-8 (Public Health and Medical Services).⁹ That an academic medical center would be actively engaged in community and statewide disaster planning, response, and recovery was a new role and the direct result of lessons learned from Hurricane Katrina. In 2005, UMMC had an academic department of emergency medicine with a mature residency and faculty possessing a wide range of interests and expertise, including prehospital care and other fields related to disaster management; however, the physicians, nurses, and prehospital providers had never applied their expertise on such a broad scale or contemplated being part of a statewide system. Involvement in statewide disaster assistance focuses on helping both in-hospital and prehospital local responders. UMMC's involvement has produced many partnerships such as that with the Mississippi Department of Transportation's Intelligent Traffic Management System.¹⁰ This collaboration, the first such partnership in the nation, links the statewide network of traffic cameras to Mississippi MED-COM to help coordinate the disaster response and the evacuation of patients. Additional affiliations with law enforcement, the Mississippi National

Guard, and local responders have created alliances and allowed for enhanced responses targeted at improving the delivery of medical care to Mississippians.

Conclusions

The impact of Hurricane Katrina revealed to hospitals and the greater medical community of Mississippi that some of the most basic assumptions that are made in disasters such as quick recovery of utilities' power, limited duration of patient surge, reliable communications systems, and effective disaster planning and readiness were severely flawed in catastrophes of Katrina's type and magnitude. Physical reminders of lessons learned were evident as hospitals designed and built self-contained fueling stations and water towers, enhanced employees' sheltering abilities, improved and hardened communications, and strengthened utility supply agreements with out-of-state suppliers. Since Katrina, UMMC has become an active, vital partner in statewide disaster planning, exercises, and response, offering the resources, personnel, and experienced clinical providers to enhance medical coverage in not only the hospital but also all areas of healthcare delivery in a disaster. Active engagement from tertiary referral hospitals and academic hospitals in disaster planning at local, state, and regional levels is vital to ensuring that medical response is coordinated and efficient. As seen in disasters in 2010 and 2011, the progressive approach of UMMC and the resourcefulness and spirit of service exhibited by so many medical professionals throughout Mississippi have improved response and built a stronger, more redundant medical response system.

The people of Mississippi and the state's medical community were tested by Hurricane Katrina in ways that likely will not be repeated for decades. The stark devastation affected not only the medical infrastructure and utility support but also healthcare providers working in extremely difficult

circumstances. The response from neighboring states and volunteer and partnering medical providers was critical to the restoration of the medical system in southern Mississippi. Their professionalism and spirit of service were noted and greatly appreciated. The active participation of the healthcare system in planning, response, and communication will markedly improve reaction to the next disaster.

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AQ1 = Pls provide page number(s) for article.

AQ2 = Additional information needed, It's not at all clear from text what this award has to do with the partnership between UMMC and the Mississippi Department of Transportation's Intelligent Traffic Management System. Delete reference?

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