

Pediatric Disaster Preparedness in the Wake of Katrina: Lessons to be Learned

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Hurricane Katrina exposed numerous gaps in disaster preparedness when it struck the Gulf Coast on August 29, 2005. Lack of coordination, communication failures and delays in the recovery responses of local, State and Federal disaster authorities resulted in increased morbidity and mortality for both children and adults. This paper focuses on some of the longstanding pediatric disaster preparedness issues that were exposed in the recent experience with Hurricane Katrina, the important lessons to be learned, and offers a series of recommendations towards improving pediatric disaster readiness.

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Many gaps in disaster preparedness were exposed when Hurricane Katrina struck the Gulf Coast of the United States on August 29, 2005. The city of New Orleans was especially hard hit by the hurricane and the devastating flooding caused by the failure of the levee system. Role confusion, lack of coordination, communication failures, and delays in the recovery responses of local, state, and federal disaster authorities resulted in increased morbidity and mortality for both children and adults. These issues have and will be addressed by Congress, the Federal Emergency Management Agency, state and local governments, professional organizations, and other investigative bodies [1]. The enormity of the disaster impact, combined with the overall perception of a global failure in disaster response and recovery, makes it unlikely that these investigative processes will specifically examine or assess the pediatric care issues that were

manifested during the disaster. This paper focuses on some of the longstanding pediatric disaster preparedness issues that were exposed in the recent experience with Hurricane Katrina and the lessons to be learned.

Pediatric Disaster Readiness Issues Exposed by Katrina

Despite several days of warning of an impending category 4 or 5 storm, an examination of the disaster response and recovery after Hurricane Katrina revealed several key deficiencies related to pediatric readiness.

Inadequate Disaster Planning at the Federal, State and Local Government Level to Support Structurally Intact Hospitals and Other Care Facilities Through Extended Periods Without Adequate Power, Water, Food, Supplies, and Security

The Children's Hospital in New Orleans, although it had sufficient supplies for a week, was forced to begin evacuations after 2 days when their water pump broke, and they were unable to obtain a replacement. This pump failure resulted in a loss of air conditioning and running water, incapacitating the hospital. Staff at some hospitals

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without power were required to hand-ventilate critically ill patients for days until they could be evacuated. In some hospitals, staff resorted to replenishing themselves with intravenous hydration to continue their efforts [2,3]. Other hospitals reported significant security concerns including looting, sniper fire, and violence, with some being forced to evacuate intact areas of their facility because of concerns for their inability to protect patients and staff. Requests for emergency utility and security support by many hospitals were largely unmet.

Inadequate Federal, State, and Local Government Agency Planning for the Care and Evacuation of Hospitalized Children, Infants, and Premature Newborns

Affected hospitals had to make their own arrangements within the medical community nationwide to evacuate their pediatric patients when it became evident that these hospitals were no longer able to provide care (R. K. Minkes, MD, FACS, personal communication). Tulane's corporate partner, the Hospital Corporation of America system, coordinated the evacuation of the Tulane University Hospital [4-6]. Three hospitals that executed extensive rescues of pediatric inpatients, especially at the beginning of the crisis, were Texas Children's Hospital in Houston, the University of Alabama-Birmingham (UAB) Hospital, and Arkansas Children's Hospital in Little Rock. The Texas Children's transport program has 2 fixed-wing aircraft but no helicopters. The hospital's evacuation teams were flown into Baton Rouge and Houma, La, a small town near New Orleans. From there, they connected with helicopter services arranged by Texas Children's or by Tulane or New Orleans Children's Hospital, neither of which had their own helicopter. The UAB Hospital airlifted babies from the neonatal intensive care unit at the Ochsner Clinic Foundation Hospital as well as neonates and adult inpatients from hospitals in Lafayette and Monroe, La, and Biloxi, Miss. In addition to a fixed-wing jet, UAB did have its own helicopter service, as did Arkansas Children's, which they coordinated with ambulance services on the ground in New Orleans and in nearby Slidell. Critically ill pediatric cancer patients were airlifted to St. Jude Children's Hospital in Memphis [7].

Without the timely support of these out-of-state 'private' pediatric transport services, many critically ill newborns and children may not have survived. These evacuation efforts were not coordinated through federal, state, or local disaster agencies, and in many cases were largely unsupported by local public safety authorities. This further complicated efforts to coordinate with local helicopter and ground transport resources. The absence of public safety support also created safety concerns for these transport programs, as some transport efforts were threatened by sniper fire and other random acts of violence.

Inadequate Strategies for the Evacuation of Children With Their Parents, Families, or Caretakers

During and after the hurricane, scores of children were found wandering alone in search of lost adults [8]. Some children later described swimming past bloated human and animal corpses and lacerating their legs on unseen objects in the water below in efforts to find their parents [9]. Some parents reported that during the evacuation, they placed their children on earlier buses in the mistaken belief that when the adults got seats on a later bus, the whole family would end up in the same place. In some cases, the children who were found were too young to give their names or too traumatized to speak, even if they were of age to talk. In other cases, investigators had no photographs of the children to circulate because the pictures were left behind in the floods.

In the Houston Astrodome, a center was set up where volunteers worked to reunite children with their parents [10]. Digital photographs were taken of each child. The photos and any information obtained were placed in the database of the National Center for Missing and Exploited Children. The volunteers also had a very long list of children who had been reported missing by a parent.

Inadequate Strategies for the Reunification of Children With Their Parents/Caretakers, Especially Infants and Preverbal Toddlers

This is a long-standing problem in disasters where children are involved. School-aged children can recognize their parents, making reliable reunification possible. This is not the case for infants and preverbal toddlers. After the 2004 tsunami, a highly publicized example of this occurred when an infant boy in Sri Lanka was claimed by 9 sets of desperate parents [11]. His true identity and true parentage was eventually confirmed by DNA testing, and he was eventually reunited with his parents. In the high technology world of egg donors and artificial insemination for conception, or had that child been adopted, this outcome would not have been possible. As of January 2006, several hundred children separated from their families after Katrina have not been reunited.

After Hurricane Katrina, the Center for Missing and Exploited Children posted photos and names of missing children on its website as they were received from evacuation shelters [12]. This is a good first step but does not completely resolve the problem of accurate reunification of infants and nonverbal toddlers with their caretakers in the event a child is claimed by more than one adult or if the correct parent is not a genetic parent. Parents and family are the single most important source of security for children. These children who have already

endured the trauma of a natural disaster now have the additional trauma of being without the support of their families and caregivers for extended periods.

Inadequate Preparations for Culturally and Developmentally Appropriate Critical Incident Mental Health Interventions for Children Affected by the Disaster

Thousands of children were among the 25,000 people crowded into the New Orleans Superdome and the New Orleans Convention Center for protection from Katrina and the subsequent flooding. Refugees within these centers reported excessive heat, crowding, acts of violence, poor sanitation, inadequate fluids and food, and the overt presence of medically ill and dead persons [13,14]. For many reasons, including interagency delays and confusion, relief personnel were unable to access these refugees with basic essentials, including mental health services. Evacuation of the refugees from these centers did not begin for 2 days after the hurricane was over. Mental health services, including play therapy and art therapy for the children, did not begin until well after the evacuations and certainly did not include all of the affected children or all shelters. In one instance, women residing in the neighborhood near one of these shelters were the ones to finally provide crayons and paper for the evacuated children so that these children could finally begin to express the experiences they had been through [15].

Inadequate Resources for Non-English-Speaking Children

In the aftermath of the hurricane, many families were disrupted as they moved from shelter to shelter and city to city. Six weeks after the hurricane, The Center for Missing and Exploited Children reported that there were still more than 2500 children who were separated from their families [16]. Many of these children were from in flux family situations and/or from families with questionable immigration status, intimidated by public safety agencies, yet in great need of assistance. The Center reported that many of the displaced were adolescents younger than 21 and Spanish-speaking. Many shelters did not have sufficient translation support for Spanish-speaking victims.

Increased Risk of Morbidity and Mortality for Children With Special Healthcare Needs During and After the Disaster

Children with special healthcare needs (CSHCN), particularly the subset of technology-dependent children, experienced increased morbidity and mortality because of inadequate planning to provide for backup electricity to run essential life-sustaining equipment, such as suction,

ventilators, and nebulizers. Local emergency medical services (EMS) agencies were generally unaware of the technology-dependent children in their catchment areas who needed immediate evacuation to centers with electricity and medical personnel and were therefore unable to provide such assistance. The press contained accounts of CSHCN being evacuated in private vehicles on interstate highways with essential equipment, such as respirators, running out of battery power [9]. Although the American Academy of Pediatrics (AAP) and American College of Emergency Physicians (ACEP) Emergency Information Form (EIF) [17,18], which was designed to assist in the short-term care for CSHCN, is increasingly being used by primary care providers, subspecialists, and emergency departments (EDs), it has not been widely disseminated to EMS agencies.

Discussion

Disasters may be caused by natural (floods, hurricanes, earthquakes, tsunamis) or manmade (industrial, chemical, radiological, terrorism) events. The most vulnerable groups in disasters are those subpopulations that are particularly prone to illness and malnutrition such as infants, pregnant and lactating women, the elderly, and the handicapped. Worldwide, half of the individuals affected by disasters are children; more than 15 million children were affected annually by disasters in the past 5 years alone [19].

After the events of September 11, 2001, our country's approach to security has forever changed. The intensity of federal agency responsiveness has increased and billions of dollars have been spent on terrorism and disaster preparedness. Al Qaeda and other terrorist organizations have made specific threats that they plan to target America's children. The school bombing in Beslan, Russia, in July 2004 demonstrated what can happen when children are specifically targeted by an act of terrorism. The tsunami of December 2004 killed more than 50,000 children and illustrated what can happen when large numbers of children are involved in a natural disaster. Hurricane Katrina revealed that despite prior experiences and recent efforts to improve emergency preparedness, our children are still quite vulnerable and in many cases may have been overlooked in disaster planning.

Children have special needs during disasters. Because of their small size and high metabolic rate, they develop dehydration, malnutrition, and fatigue more rapidly than adults do. Because of their immature immune systems and hygiene practices, they are more susceptible to infectious diseases, which can be especially severe in infants and young children. Children may be attending school or daycare during a disaster and their caretakers may be unable to reach them. Children may become orphaned if their parents do not survive. Children may also be lost or become separated from parents during

evacuation. Sadly, children may also be abandoned by their caretakers.

Unaccompanied children have no one to provide basic requirements or protection and are at risk for exploitation or injury. Family is the most important support group and source of security for children. The separation of children from their parents and caretakers during and after a disaster is terrifying and may have profound and long-standing sequelae. Numerous studies following disasters have shown the psychological consequences of disasters on children, including the posttraumatic stress disorder (PTSD). PTSD is caused by high levels of stress hormones that, in young children, may eventually produce permanent structural and functional brain changes. These changes are associated with unhealthy behaviors including depression, substance abuse, risk taking, and abusive relationships, which may last into adolescence and adulthood [20-26]. Providing children with timely, developmentally, and culturally appropriate means to express themselves and their feelings about what has happened to them (including play therapy and art therapy) seems to provide psychological relief and may promote effective coping and resilience [27,28]. Fairbrother et al [29] reported that only 27% of children from New York City with severe or very severe PTSD reactions after the World Trade Center attacks received any counseling. This was actually greater than the number of symptomatic children in Oklahoma City who received counseling after the Murrow Federal Building bombing [30].

Loss of pets during a disaster is also stressful for children. Most disaster planning does not include planning for evacuation of family pets. The presence of a pet can adversely influence the evacuation decision made by a family, placing them all in great danger [31]. The entire family unit is under great stress and without its usual support systems during a disaster. Some studies have demonstrated an increase in suicide in all age groups and in child abuse in families affected by disasters [32-34].

Injuries or illnesses sustained by children will vary with the disaster type [35-38]. Although the types of injuries are not significantly different from those occurring in adults under the same circumstances, comprehensive pediatric disaster planning must address the unique anatomical, physiological, and psychological differences of newborns, infants, children, and adolescents. In England, a Delphi study carefully examined the special needs of children in disasters and developed recommendations calling for specialized pediatric disaster teams to respond to disasters involving children [39,40].

Disasters involving children frequently require creativity and innovative planning because they cannot be treated like "little adults." A dramatic example of this challenge was the sudden arrival of 1600 Vietnamese orphans in San Francisco in 1975 requiring the rapid development of a coordinated disaster plan [41]. As one

third of the orphans were under 6 months of age, conventional nursery resources were insufficient, and a "warehouse" model was implemented. Because of the unusual problems presented by infants and small children, the authors recommended that all cities carefully evaluate their disaster planning with special reference to the needs of children. Currently, there are no federal requirements for specific pediatric disaster drills.

Children spend most of their awake time either in a school or in a daycare; hence, most children may be in a daycare or school setting when a disaster occurs, separated from their parents and caregivers. Although there may be increasing awareness of the need for school-based disaster preparedness, scant attention has been paid to disaster readiness in daycare settings [42,43]. What is typically missing in school or daycare planning is a preplanned collaboration between local EMS, the school/daycare, and families in case of a disaster, including strategies for rapid and accurate reunification.

Special attention is necessary to anticipate the needs of CSHCN, especially for children on oxygen or on electrically powered life support equipment. Preplanning is necessary for CSHCN, their caregivers, and EMS to assure a seamless activation of appropriate emergency services including evacuation and access to an emergency power supply if necessary in case of a disaster. Local EMS agencies must be aware of technology-dependent children and other CSHCN in their jurisdiction so that they can effectively orchestrate access to back-up utilities and specialized services, preferably without saturating ED resources. One report after the massive 8-state power failure of August 2003 suggested that during extended power outages, community-based technology-dependent patients are at great risk and may overwhelm the EMS system and hospital EDs [44].

Other resources have been developed that can be used in pediatric disaster planning. The Emergency Medical Services for Children (EMSC) program sponsored the development of the EIF by the AAP and ACEP [18]. The EIF has proven to be an excellent resource for hospital EDs and subspecialists in caring for CSHCN. Primary care physicians should assure that their local EMS agencies also have access to this information. In addition, EMSC supported development of the Special Children's Outreach and Education course [45,46], which educates EMS personnel about CSHCN in their catchment area, encouraging them to visit the homes, school, or daycare settings for these children, to become familiar with their families, equipment, and care routines before an emergency occurs.

Pediatric disaster preparedness resources focusing on bioterrorism and family readiness have been developed and are available on the AAP website (www.aap.org). Relatively little training materials exist that target pediatricians and primary care practitioners. Pediatric disaster life support courses, such as Pediatric Disaster

Life Support [47] and JumpStart, [48] are excellent resources but are directed toward the EMS community.

In a project funded by the Agency for Healthcare Research and Quality, the AAP in partnership with the New York University School of Medicine recently completed the development of the Pediatric Terrorism and Disaster Preparedness Resource [49]. The Pediatric Terrorism and Disaster Preparedness Resource is a comprehensive reference on pediatric disaster preparedness with a primary focus toward manmade events. This resource includes slides, handouts, and lecture outlines covering clinical guidelines and policy issues. Although this resource may focus on terrorism, many components are obviously applicable to any disaster type. This recently released resource was also updated to include a reflection of the experience related to Katrina.

The AAP and the International Pediatric Association have endorsed a resource handbook, *“Helping the Children: A Practical Handbook for Complex Humanitarian Emergencies,”* focusing on the special needs of children in disasters [19]. The handbook accompanies a course designed by the authors for local physicians and healthcare professionals entitled, *“The Management of Complex Humanitarian Disasters: Focus on Children and Families.”* A related domestic course, *“Disaster Management: Helping Ohio’s Children”* was also developed to train healthcare providers, school administrators, and emergency responders [50].

Local problems demand local expertise and solutions. Disaster readiness likewise should include local pediatricians and primary care practitioners. These care providers have historically been an untapped resource in federal disaster planning. Local primary care physicians, nurse practitioners, and medical and surgical subspecialists are obviously the most knowledgeable source regarding the at-risk patients and culturally diverse children in their communities. They are the “medical home” for these children. These healthcare providers are also the most familiar with local resources for evacuation, recovery, and ongoing care for children and are the best advocates for these patients in disasters [51].

Pediatric disaster preparedness in the United States has clearly been hindered by the absence of a well-defined, clear, and informed voice speaking proactively on behalf of pediatric care issues in all sectors and at the highest levels of government. Gaps in pediatric disaster preparedness exist because of inadequate awareness of unique pediatric care needs within federal and state agencies involved in disaster readiness policy development. Likewise, there has been insufficient input pertaining to pediatric readiness by pediatric care experts and advocates. These factors have resulted in the following:

- Inadequate pediatric input into the Health Resources and Services Administration (HRSA) and Center

for Disease Control and Prevention (CDC) guidelines for disaster preparedness.

- Children being described as one of the “special populations” in the federal guidelines instead of “Pediatrics” as they were previously [52]. Such designation dilutes the emphasis on unique pediatric differences and requirements in natural disasters and bioterrorism.
- HRSA and CDC being unable to make significant alterations in guidelines to better protect children once the guidelines have been established by the Department of Health and Human Services.
- No requirement in HRSA or CDC guidelines for pediatric input at the state disaster planning level when key decisions are made and resources are allocated; pediatric expertise is currently required only as an advisory function.
- No requirements for pediatric-specific national, state, or local disaster drills.
- No mandate for pediatric disaster life support training for emergency responders in disasters.
- No mandate for education regarding the specialized needs of children in disasters, focusing on nutrition, infectious disease, and mental health.
- No requirements for pediatric benchmarks except for surge capacity.
- No requirements for states to assess, report on, and improve the disaster preparedness of schools or daycare facilities.
- No requirement that states demonstrate an evacuation plan for hospitalized children, infants, and premature newborns.
- No requirements for hospitals to demonstrate abilities to continue services for ventilated newborns and children for sustained periods without power, food, or supplies.
- No requirements that states and localities demonstrate plans to evacuate technology-dependent community patients in the event of prolonged power failures.
- No requirements that states demonstrate linkages between schools or daycare facilities and local EMS for disaster preparedness.
- No requirement that states collaborate with existing expertise in pediatric bioterrorism or disaster preparedness locally, regionally, or nationally to prevent “reinventing the wheel” and misuse of valuable resources in disaster preparation.
- No requirement that states collaborate with pediatricians, pediatric subspecialists, and primary care physicians locally or use the AAP/ACEP EIF or EMSC’s Special Children’s Outreach and Education course so that local EMS agencies are more aware of technology-dependent infants and children and other CSHCN in their catchment areas.

Summary and Recommendations

Despite billions of dollars spent on homeland security since September 11, 2001, pediatric-specific preparations have lagged behind, resulting in deficient disaster readiness for children. It is important to realize that children make up nearly 30% of the population, but nearly 100% if a school or daycare is struck. Hurricane Katrina should be the urgent wake up call for the pediatric community and its leadership, and a call for action.

The following recommendations are offered for improving pediatric disaster readiness.

1. A summit conference should be convened to conduct a pediatric disaster readiness needs assessment. This conference should be attended by pediatric care experts and child health advocates, including key stakeholder professional organizations (such as AAP, ACEP, American Academy of Family Physicians, Emergency Nurses Association, and so on), the HRSA/MCHB EMSC program, the leadership of EMS and public safety agencies, and relevant state and federal government authorities. This summit should examine the issues in pediatric disaster response and recovery exposed by Hurricane Katrina, the adverse outcomes caused by these deficiencies, and set an agenda for improving pediatric readiness. The conference should involve a critical examination of existing federal and state guidelines for pediatric disaster preparedness and the deficiencies identified, including the following:
 - (a) Strategies to support hospitals and other healthcare facilities through extended periods without adequate power, water, food, supplies, and security
 - (b) Strategies for the timely evacuation and ongoing care of hospitalized patients, including critically ill and injured children
 - (c) Strategies that support the intact evacuation and care of children and their families
 - (d) Strategies for the accurate identification and reunification of children with their parents/caretakers
 - (e) Strategies to provide culturally and developmentally appropriate mental health interventions for children affected by the disaster with sufficient translation resources
 - (f) Strategies to identify and provide necessary care services for CSHCN before, during, and after a disaster
 - (g) Strategies to increase awareness and participation of pediatric care providers in local, state, and federal disaster planning.
2. An Office for Pediatric Disaster Preparedness should be created with the full participation and support of the leadership of pediatric, emergency medicine, and other healthcare provider professional organizations caring for children, the EMSC stakeholder community, federal policymakers, and other disaster relief organizations. This office would be responsible for the following activities:
 - (a) Development and maintenance of a proactive domestic pediatric disaster preparedness plan inclusive of both natural and manmade events
 - (b) Development of requirements and benchmarks for specific pediatric care concerns within federal, state, and local disaster response and recovery plans—to include direct participation by pediatric care experts
 - (c) Development of requirements for pediatric life support training for emergency responders in disasters, including CSHCN
 - (d) Development of pediatric disaster preparedness curricula for pediatricians and primary care practitioners, school administrators and teachers, daycare providers, and EMS responders
 - (e) Development of requirements for the demonstration of disaster preparedness of schools/daycare facilities and linkages between schools/daycare facilities and local EMS
 - (f) Development of requirements for pediatric-specific national, state, or local disaster drills.
3. Existing resources on disaster preparedness should be reviewed and revised as necessary in the light of the most recent disasters and the deficiencies observed in disaster response and recovery efforts.
4. The Office of Disaster Preparedness should work with federal policy makers to involve state pediatric chapters, local healthcare professional societies, and pediatric primary and specialty care providers proactively in disaster preparedness.
5. Healthcare profession organizations and institutions caring for children should consider adding pediatric disaster preparedness curricula to their continuing education requirements.
6. Healthcare profession organizations caring for children should initiate discussions with their residency review committees, specialty boards and/or licensing bodies to include pediatric disaster preparedness in training program curricula to assure that trainees are prepared for their public health and advocacy role in pediat-

tric disaster preparedness for their patients and families.

7. Healthcare profession organizations caring for children must work more directly and effectively with federal (eg, Department of Health and Human Services, HRSA, CDC) and state policy makers in the area of pediatric disaster readiness. Future HRSA and CDC disaster preparedness guidelines should have direct input from pediatric care experts as they are being written, not after the fact.
8. Federal and state policy makers should dedicate research funding for the development of redundant strategies for implementation in states to assure timely reunification of infants, toddlers, and children and with their correct parents and caregivers.

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