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Creation and Implementation of a Mobile Pediatric Emergency Response Team: Regionalized Caring for Displaced Children After a Disaster

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PREPARATION: LONG-TERM RESCUE AND DISASTER-RELIEF STRATEGIES: Located only 50 miles from the Gulf Coast and Galveston, Houston, Texas, is familiar with the challenges posed by hurricanes, tropical storms, and flooding. The hospitals of Houston and Harris County are no strangers to the aftermath of such natural disasters, themselves being victims of massive damage in 2001, when the entire Houston downtown area and Texas Medical Center complex, as well as a great portion of the city, were severely damaged by unexpected and unprecedented flooding in the wake of Tropical Storm Allison. City, county, and hospital officials are ever mindful of the need to learn lessons from the past and to have disaster-relief plans in effect. Texas Children's Hospital (TCH), in particular, has participated in numerous citywide disaster drills and is well prepared to deal with many types of disasters that may occur within its region. Indeed, the TCH emergency center (TCHEC) alone evaluates more than 80 000 children per year and serves a large populous and a large geographic area. Hence, it is poised for participation in any large disaster-relief effort.

Beginning on Friday, August 26, 2005, area officials and rescue and disaster-relief mechanisms were about to be tested. In the aftermath of Hurricane Katrina, Houston was faced with the sudden arrival of thousands of people, many in need of medical care. Although officials had prepared in advance for this event, a lack of pediatric provider involvement was associated with woefully inadequate strategies for providing emergency medical care for thousands of children and adolescents.

AUGUST 29: LANDFALL

The eye of Hurricane Katrina made landfall at 6:10 AM and crossed the wetlands/barrier islands between New Orleans, Louisiana, and the Gulf of Mexico. By 9:00 AM, officials learned that the lower Ninth Ward levee had failed to restrain the rising water of Lake Pontchartrain and that water was flowing unimpeded into the city. After the 17th Street levee was breached, more than 80% of the city experienced rising flood waters that reached heights of 20 feet in some areas.

AUGUST 30: 1 DAY AFTER LANDFALL

Within 24 hours, an estimated 50 000 to 100 000 persons were reportedly trapped in the attics and on the roofs of their homes, in the Louisiana Superdome, and in the Ernest N. Morial Convention Center. Early that morning, executives at the Tulane University Medical Center (TUMC) contacted TCH officials to request assistance, and a command center was opened to begin coordinating transports of patients. Initially, Children's

Key Words: Hurricane Katrina, emergency response, disaster planning, disaster relief

Abbreviations: TCH, Texas Children's Hospital; TCHEC, Texas Children's Hospital emergency center; TUMC, Tulane University Medical Center; CHNO, Children's Hospital of New Orleans; ED, emergency department; HCHD, Harris County hospital district; BCM, Baylor College of Medicine; HFD, Houston Fire Department; EMS, emergency medical services; MPERT, mobile pediatric emergency response team; IV, intravenous; CN, charge nurse

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Hospital of New Orleans (CHNO) sent communication stating that it had water, staff, equipment, supplies, and emergency power. Soon thereafter, however, all of the city's hospitals were frantically making efforts to find placement for their patients. For TCH, what had started as a controlled, methodically orchestrated transport of only a select group of pediatric patients from TUMC soon developed into a mass evacuation of all patients from the ICUs of TUMC and CHNO. During the next 72 hours, the faculty and staff of TUMC, CHNO, and TCH, along with other institutions around the country, worked tirelessly to evacuate all pediatric patients and their families from both New Orleans hospitals and to safer facilities in and out of state (see "Preparing, Improvising, and Caring for Children During Mass Transport After a Disaster," pp S421–S427; "Closing and Reopening of a Children's Hospital During a Disaster," pp S381–S385; "Disaster Preparation and Lessons Learned at the Ochsner Foundation Hospital," pp S375–S380; "Interstate Transfer of Pediatric Patients During Hurricane Katrina," pp S416–S420; and "Caring for Displaced Neonates: Intrastate," pp S389–S395).

AUGUST 31: 2 DAYS AFTER LANDFALL

In Houston, Mayor Bill White announced that the Reliant Astrodome was vacant and would be made available to provide shelter for evacuees from the Superdome. Buses finally arrived at the Superdome, and a slow exodus began as the first of nearly 25 000 refugees left that football stadium complex for the 350-mile trip to the Astrodome in Houston.

After watching news reports from New Orleans, members of Houston's medical community realized that

the overall number of evacuees seeking emergent medical care would be considerably higher than anticipated originally. Unless alternative locations for providing that care were created, the most likely destination for evacuees seeking medical care would be the local hospital emergency departments (EDs), many of which already were near capacity and unlikely to manage a surge. Preparing for the arrival of those patients would require every facet of the regional medical establishment to be involved.

Officials from the city of Houston and Harris County met to implement disaster plans, which included using the Reliant Park complex as the primary facility for providing shelter and medical care for evacuees. Reliant Park is a 350-acre complex that houses not only the Astrodome but also the Reliant Center, Reliant Stadium, and Reliant Arena (Fig 1). A 100 000-square-foot space in the Reliant Arena usually used for trade shows was designated for the Katrina clinic. The clinic was constructed in a 12-hour period using available display curtains and poles and Red Cross cots in place of examination tables. The Harris County hospital district (HCHD) was assigned to manage the administrative concerns and medical care at the Reliant Park facilities using volunteers and nurses from the HCHD. Staffing was organized through the Baylor College of Medicine (BCM) department of family and community medicine as well as the departments of pediatrics, internal medicine, radiology, obstetrics and gynecology, and other specialties. Calls for volunteers were issued from the BCM and TCH administrative offices (author R.D.F.).

While city and county plans were being finalized and the Reliant Park facilities were being prepared for what

FIGURE 1
A diagram of the Reliant Park facilities, where evacuees were housed. The Reliant Arena is where the Katrina clinic was situated.



would amount to the largest disaster-relief effort ever experienced on American soil, misinformation began coming from both reliable and unreliable sources. An example of such an event occurred at about 7:00 PM. The TCH command center received word that 3 C-130 aircraft were en route to Ellington Air Force Base (15 miles from TCH), each carrying possibly as many as 150 pediatric hospital patients. The first plane reportedly was 30 minutes out, and the second one was following by approximately 30 minutes. The TCHEC immediately began to prepare for the influx of patients. More than 50 non-emergent patients were discharged quickly from TCHEC while TCH faculty, staff, and administrative personnel waited for the first plane to arrive. Hours passed, and nothing happened. Other hospitals around the country reported that they were receiving the same communications. Hours later, planes carrying almost exclusively adult patients from New Orleans area hospitals, including the Veteran's Hospital, finally did arrive at Ellington. In fact, planes continued to arrive for several days, transporting healthy, ill, and injured adult evacuees and forcing many area hospital EDs to surpass their surge capacity. The 3 rumored C-130s carrying several hundred previously hospitalized pediatric patients never arrived in Houston; rather, 2 C-130s arrived in Kansas City, Missouri, with >30 children from CHNO (see "Interstate Transfer of Pediatric Patients During Hurricane Katrina," pp S416–S420; and "Closing and Reopening of a Children's Hospital During a Disaster," pp S381–S385). This unfortunate incident was only the first of numerous such instances in a plethora of misinformation that TCH faculty, staff, and administrators would receive during the next several days, which emphasized the need for better communications networks.

SEPTEMBER 1: 3 DAYS AFTER LANDFALL

Early in the morning, evacuees (healthy, ill, and injured) from the Superdome began arriving by bus at Reliant Park in Houston. Several physicians from BCM, 1 physician from the National Aeronautics Space Agency, and 1 physician and numerous prehospital personnel from the Houston Fire Department (HFD) were present at the arrival site when the first buses arrived. Medical staff, many of whom were prehospital emergency medical services (EMS) and/or emergency medicine-trained personnel were assigned to bus triage and entered the buses to assess the evacuees.

Reliant Astrodome Triage

Many healthy evacuees exited the buses without triage. Most of the evacuees in need of medical attention remained on their buses and continued to wait to be triaged. Medical personnel who entered the buses attempted to triage each evacuee as quickly as possible to 1 of 3 locations.

1. Well evacuees came to the Astrodome entrance (residential area), which would be their home for the next several weeks and where they were registered formally. Within a very short period of time, long lines of evacuees began to form outside the entrance to the Astrodome because they could not be processed as quickly as they arrived.
2. Evacuees needing urgent but not emergent medical attention were sent to the Astrodome first aid station, which was set up to handle minor medical issues and if needed, to triage patients to the Katrina clinic, which was located in the Reliant Arena.
3. The last group, evacuees requiring emergent care, was transported by waiting ambulances to area hospitals designated by the dispatch personnel.

Hospital Transport

For the first 48 hours of the relief effort in Reliant Park, ambulances from numerous private and volunteer agencies from all over the country appeared at the bus triage site prepared to transport patients to area hospitals on request. Two main dispatches were operating within the city during the Katrina response: the HFD EMS and Enterprise EMS. A previous agreement among Houston, Harris County, Reliant Park, and Enterprise EMS predetermined the role that each EMS system played during the Katrina response: the HFD dispatch managed all calls outside Reliant Park, whereas Enterprise EMS dispatch handled all calls from within the park. Those requests could come from anywhere within the Reliant Park facilities, including bus triage, the Astrodome, or the Reliant Arena itself, including the Katrina clinic. Although medical personnel from every level of the HFD performed a variety of assigned duties within the Reliant Park facilities, all dispatch and transport calls were handled by Enterprise EMS. Because notification of transports of pediatric patients was outside routine transport channels, the initial communication of the stability of these patients being transported to hospital EDs was limited.

SEPTEMBER 2: 4 DAYS AFTER LANDFALL

The Reliant Arena Katrina Clinic

The first 2 pediatric emergency physicians from TCH (including one of the authors [P.E.S.]) arrived on the scene at 1:30 AM on this fourth day after Katrina's landfall. They came in response to a call from a TCH administrative assistant who was watching the details of the crisis unfold on television, where local media were pleading for medical assistance to come to Reliant Park. Both pediatricians had spent most of the previous 2 nights assisting with transfers from New Orleans area hospitals and were getting rest, unaware that the ru-

mored buses had started arriving. Immediately after receiving the call, they headed to the Reliant Park area.

When they arrived, 1 of them went directly to bus triage and began performing triage on adult and pediatric patients, and the other one went to the newly created Katrina clinic, which was located in the southeast entrance of Reliant Arena. In addition to the Katrina clinic (which encompassed all of the adult, pediatric, and subspecialty clinics), Reliant Arena housed the pharmacy, medical control command center, central supply, food services, and, initially, residential facilities for 400 evacuees.

Inside the entrance to Reliant Arena was the clinic triage area, where people of all ages were lined up as far as the eye could see. Initially, the well-meaning medical and nonmedical staff members at the scene were outnumbered, and their supplies were insufficient to manage the pediatric population adequately. Fortunately, as a result of pleas from the media for medical volunteers, several community pediatricians, some of whom had retired years earlier, arrived to help manage the ever-growing number of pediatric patients. In addition, contact was made with the American Academy of Pediatrics in an effort to raise national awareness of the need for pediatricians at Houston's Katrina-relief effort. Within hours, pediatricians from all over the country were contacting TCH to volunteer their time at the clinic.

Initial Pediatric Space

During the first several hours of clinic operation, pediatric patients were "plucked" from the triage area, where county officials required every patient to be processed at a patient-registration desk. This registration requirement proved to be impractical during the early phase of the relief effort and was quickly ignored because of the necessity to provide hydration and other emergent care. These pediatric patients were examined wherever space was available, with or without accompanying paperwork.

At this phase of the relief effort, the pediatric clinic consisted of only 2 beds within the adult "general care" clinic space. The 2 beds eventually were replaced by 8 chairs that, although woefully inadequate, allowed pediatric staff to better evaluate and manage an estimated 100 pediatric patients during the next 8 hours. The most common complaints during this initial period were injuries, asthma, rashes, and psychological problems. Numerous personal stories involved falls from helicopters during rescue attempts, puncture wounds from roofing nails, and traumatic separations of children from their parents. In fact, early in the relief effort, most of the children arrived unaccompanied by family members.

The children with chronic diseases that required more aggressive treatment regimens and those who required more complex social or psychological support were

transported from the clinic to the TCHEC. Because of the limited space available on ambulances, EMS personnel often were forced to separate parents from their children when transporting the evacuees in need of additional medical attention to area hospitals. Fortunately, social workers were present on site early in the relief effort and helped immensely with the disposition of these children.

An immunization station was set up early in the relief effort and continued to operate in one form or another during the first week. Unfortunately, it was plagued with problems, including confusion over immunization status of children who arrived with no records, a shortage of staff to administer immunizations, and a limited supply of vaccines. County administrators from HCHD were positioned throughout Reliant Arena to oversee specific areas.

By 8:00 AM, more physicians and nurses began to arrive, and the need for more space for the pediatric clinic became obvious. The county's medical director (T.G.) of the relief effort at Reliant Park had more clinical space adjoining the initial area constructed, which enabled the TCH physicians to begin the process of creating a pediatric clinic fashioned after TCHEC. The pediatric clinic was not only facilities, staff, and space but also administration, communications, processes, and procedures, and we named it the "mobile pediatric emergency response team" (MPERT).

One of the distinct advantages of the MPERT was the relief it provided for the TCHEC and other hospital EDs that care for children. An important note is that children from New Orleans who arrived in Houston by private conveyances were seeking care independently at the TCHEC. The impact on the TCHEC (~45 non-MPERT patients per day) was greatest on days 4 through 7. As the MPERT evolved to meet the demands of the increasing number of pediatric evacuees arriving at the Astrodome, the impact of patients being transported from the MPERT to the TCHEC became almost negligible.

Creation of a Pediatric Pharmacy

During the first 24 hours of the effort at Reliant Park (3 days after landfall), the Harris County Health Department set up pharmacy services and filled more than 2400 prescriptions. However, each prescription required at least a 12-hour turnaround time, which hindered the movement of pediatric patients through the MPERT, particularly those children with asthma. Other problems specific to the pediatric demands also surfaced: many medications needed to treat the pediatric population were not available at Reliant Arena, thus slowing patient flow. Many children needed special pharmaceutical agents that could not be obtained easily. Although general medical supplies were delivered, urgently needed pediatric specialty items such as aero chambers and intravenous (IV) line start kits, did not arrive. To provide

for the special needs in the pediatric area, volunteer staff began accessing supplies from the TCHEC.

Within hours, when the need for a better system was recognized, the director of pharmacy at TCH (K.D.G.) was contacted and asked to create a pediatric pharmacy on site at the MPERT. Two hours later, members of the TCH pharmacy arrived at Reliant Arena with several boxes of medications and supplies and assessed the situation to determine the best place to set up an on-site pediatric pharmacy. Two needs were identified: (a) a protected environment with limited access and (b) accessibility to the pharmacy from 1 direction only. The director of pharmacy also determined a need to establish services for both “in-clinic” doses and “take-home” prescriptions.

In the initial area that was home to the MPERT, no space or furniture was available to establish a pharmacy. Initially, the medications were placed in white bags and labeled with the medication names so that they could be organized alphabetically for easy access. This arrangement changed once the MPERT moved into its expanded space. Ultimately, the entire south wall of the clinic was designated as the MPERT pharmacy and central supply (Fig 2).

After medication dispensing was initiated, the need for an expanded formulary was recognized, and medications were ordered and delivered by TCH pharmacy staff. An initial discussion was held, and a list of medications appropriate for the types of patients and illnesses being treated was compiled. Medications for chronic illnesses (primarily respiratory) and topical medications for patients who had waded in polluted water were those needed most critically. Several considerations were made when choosing the medications that would be included on the “formulary.” Because families sheltered in the Astrodome did not have access to refrigerators, measuring systems, or adequate storage for their



FIGURE 2
The MPERT pharmacy that was created, stocked, and staffed entirely by TCH.

prescriptions, medications and supplies had to be secured. Pharmaceutical provisions are shown in Table 1. A similar supplies list was created also and is shown in Table 2.

By day 6, the MPERT pharmacy/central supply area was fully stocked, including a fully supplied crash cart, and staff coverage was provided by TCH. This pharmacy supplied the needs of the MPERT and eliminated the use of and drains on supplies and resources at TCHEC.

SEPTEMBER 3: 5 DAYS AFTER LANDFALL

Getting through the main Katrina triage and registration areas continued to be a problem. Once the pediatric patients came to the MPERT, they were placed in a room, evaluated, treated, discharged from Reliant Arena, and returned to their home in the Astrodome. The process of patient flow improved hourly. The success of this process was the result of the synergy of effort that developed among team members. One very important team player who arrived at the clinic on that was an emergency medicine charge nurse (CN) from California. After hearing of the Katrina effort via the media, she flew to Houston to lend a helping hand. She was instrumental in maintaining patient flow.

TABLE 1 Example of Formulary for the MPERT

Antibiotics
Amoxicillin
Amoxicillin/clavulanate
Azithromycin
Ciprofloxacin
Clindamycin
Metronidazole
Steroids
Prednisone, oral
Prednisolone
Inhalers
Albuterol
Fluticasone
Antinausea/antidiarrhea agents
Promethazine
Ondansetron
Immodium
Topical agents
Desitin
Hydrocortisone cream
Lubriderm lotion
Neosporin ointment
Other
Insulin
Epi-pen
Solumedrol
Diphenhydramine
Ibuprofen
Tylenol
IV fluids
1/2 normal saline
D5 1/2 normal saline
D5 1/4 normal saline
Normal saline

TABLE 2 Examples of Supplies for the MPERT Pharmacy

Coolers and ice packs for refrigerated medications
Plastic bag
Paper bags
Empty prescription bottles
Oral syringes
Pens, notepads, Sharpies
Blank prescription pads
Prescription tape
Hard-copy formulary
Antiseptic hand wash
Alcohol/gauze pads
Latex gloves and protective garb as needed
Telephone lists

By this time, the TCH physician on site, who by default had assumed the role of medical director of the MPERT (P.E.S.), was asked formally to assume that role by the Harris County Command, which had assumed overall responsibility for Reliant Center operations. Part of his responsibility was to join other medical and administrative directors for twice-daily meetings at the command center, located in the Reliant Center. These meetings proved to be very useful and essential to the success of the Katrina clinic. Numerous issues that arose throughout the life of the clinic were addressed and, in most cases, resolved as a result of the discussions held at these meetings.

The Red Cross was invited to help deal with the evacuee-identification problem. Representatives from the Centers for Disease Control and Prevention were invited to attend several meetings to discuss the prevention of communicable diseases as well as immunization issues. Local, regional, and national political leaders, as well as designated representatives from the Department of Health and Human Services, also attended some of the meetings.

MPERT Staffing

Within the first 24 hours of the arrival of the pediatric emergency medicine physicians 4 days after landfall, the consensus was reached that guaranteed separate staffing for children was a priority for the success of the MPERT. Harris County orchestrated medical staffing for the main Katrina clinic. TCH was asked to guarantee that the MPERT had around-the-clock coverage of pediatric-trained physicians, nurses, and, eventually, ancillary personnel (ie, clerks and environmental services). By morning time 7 days after landfall, the MPERT had consistent, 24/7 coverage of personnel.

The strategic placement of physicians and nurses trained in pediatric emergency medicine also was a priority of the medical director of the MPERT. One pediatric emergency medicine-trained physician was assigned to the bus triage site, and one was assigned to manage the MPERT 24 hours per day. In addition, 4 physicians,

mostly general pediatricians, were assigned to direct patient care in the clinic. The nurse staffing mirrored the physician staffing. One pediatric emergency medicine-trained CN was assigned to manage the MPERT, and 4 other nurses worked in the clinic alongside the physicians.

TCH stayed in constant communication with the county staffing office. This daily communication allowed the county to distribute their staff to various other clinics in need of coverage. Any staff designated to the MPERT clinic by the county were additional personnel, because coverage was guaranteed already by TCH.

Formal Credentials

During the first week of the Katrina-relief effort, rogue clinics appeared everywhere, adding to the frustration of county officials. At one point, an entire clinic that was set up by a well-meaning area hospital was operating without county permission and was performing abdominal ultrasounds on pregnant evacuees. Identification and credentialing of staff was at the center of the problem.

The goal of the command structure at the Reliant Arena Katrina clinic was to identify and credential thousands of staff in a timely manner without creating an unnecessary burden on the process. All medical personnel were required to be credentialed formally through the HCHD. That process worked well for medical professionals who were employed in Texas, but many of the physicians and nurses who assisted in the relief efforts were from out of state. Ultimately, the clinic closed before an ideal process was identified. By the end of the relief effort, each of the clinic medical directors had stories to tell of nonphysicians who were practicing medicine without a license; fortunately, no identifiable harm came to any patient.

Most of the MPERT physicians and nurses were able to bypass the HCHD credentialing process because they were credentialed already by TCH and/or HCHD. The State of Texas also created a fast pathway for obtaining temporary licensure for those out-of-state physicians who wanted to participate in the Katrina-relief efforts. TCH made every effort to help out-of-state pediatricians, especially those from New Orleans, practice at the clinic. Several of the out-of-state physicians and nurses who worked in the MPERT were themselves displaced evacuees from New Orleans who wanted to do their part in the relief effort.

SEPTEMBER 4: 6 DAYS AFTER LANDFALL

When the first case of diarrhea was noted in the main Katrina clinic remains unclear, but on this day it was on the rise in the MPERT. The CN kept a tally of all patients presenting to the clinic with viral, respiratory, or diarrhea complaints and then provided that information to

the physician-in-chief (R.D.F.) at TCH every morning. Stool cultures were forwarded to TCH for laboratory analysis. County leadership also responded to the rise in the number of cases of diarrhea, and every effort was made to prevent the development of an epidemic of diarrheal disease.

The MPERT was given an additional 4 beds to triage, isolate, evaluate, and treat all patients presenting with gastrointestinal complaints. Unfortunately, this space was not sufficient, and in a very short time clinic outflow came to a complete halt. As a result, a 25-bed isolation/observation area reserved for patients receiving IV fluids was constructed next to the MPERT. For those evacuees with diarrhea but not requiring medical attention, a larger (400-bed) isolation area was created within Reliant Arena. Once the isolation areas were established, the MPERT was able to decompress and flow resumed.

Toilet and hand-washing facilities for medical staff were separated from those being used by the evacuees. All evacuees were provided showers and fresh clothing. The only stool pathogen identified was Norovirus; polymerase chain reaction analyses revealed that more than half of the specimens were positive for this agent. To everyone's relief, this crisis with diarrhea eventually resolved.

At no point, from when the evacuees were first picked up in New Orleans to when they arrived in Houston, was a sustained, organized attempt made at decontamination. Many of the evacuees who made their way to the MPERT were dressed in their original clothes and were covered with mud and fecal debris. Some evacuees attempted to clean themselves in restroom sinks located throughout the Reliant Center facilities, but those facilities rapidly became unsanitary and eventually were closed to all traffic. Not until later in the relief effort were Katrina evacuees given access to fresh clothing and shower facilities.

SEPTEMBER 5 THROUGH SEPTEMBER 11: 7 TO 13 DAYS AFTER LANDFALL

Seven days after landfall (only 3 days after the TCH EMS directors had received that first telephone call), the pediatric MPERT was fully operational (Fig 3) and staffed 24 hours per day by physicians and nurses; a pharmacy was in place; and children and adolescents were receiving medical care that was similar to or better than (as they reported) they had received in their lifetimes.

Children with special needs began to present to the clinic in greater numbers. Most of the medical leadership noted this trend and determined that it likely was because of the fact that most of these children were not acutely ill and their conditions were well controlled for the short-term. However, once the family's concerns over food, water, safety, and rest were resolved, concern over their child's special health care needs became a

priority. It is notable that no patients with special needs presented to the MPERT with his/her chronic medications or prescriptions. Like most of their possessions, they were lost in the flood. As a result, physicians in the Katrina clinic found themselves writing prescriptions for children with chronic conditions such as sickle cell disease, asthma, and diabetes.

Many anxious parents who presented to the clinic requested refills of their children's medications for attention-deficit disorder, possibly because their conditions were exacerbated by the close confines in the Astrodome. In an effort to provide prescriptions expeditiously to evacuees who had lost their medications during the flood, the State of Texas temporarily waived the regulation that restricted prescription writing to physicians and allowed designated pharmacists to fill certain prescriptions for Louisiana residents without obtaining the approval of a physician.

Arranging for follow-up care for children with special needs, as well as children who were seen previously in the clinic, was another dilemma that faced the MPERT. Patients could return to the MPERT for follow-up care, and many did, but this solution was not the best one long-term. TCH leadership met with all of the ambulatory clinic directors on the main campus and created a mechanism for all pediatric evacuees with chronic illnesses to obtain subspecialty follow-up care, within 24 hours if needed. The Harris County Health Department also approved a plan that provided follow-up care at various county clinics throughout the city.

During the course of this second week, procedures for identifying staff improved. Access to the clinic and parking, which had posed yet another set of problems, also improved, and the numbers of patients began to decline incrementally. By the end of the week, the MPERT was evaluating fewer than 100 patients per day, down from the high of 400. The TCH EMS director began to develop an exit strategy. He recruited an HCHD pediatrician with experience in medical direction and, with permission from the county medical control, asked her to assume his role. He continued to have oversight of the clinic until 14 after landfall, at which time he relinquished control to her.

SEPTEMBER 12 THROUGH SEPTEMBER 15: 14 TO 17 DAYS AFTER LANDFALL

Fourteen days after landfall, with the number of pediatric patients presenting to the clinic drastically lower, the clinic hours were shortened from "around the clock" to 8:00 AM to 8:00 PM. TCH began removing supplies and equipment. Physician staffing was turned over to the county officially 15 days after landfall, nursing coverage was turned over the following day, and the day after that the MPERT formally closed patient care. Any pediatric patient who required medical evaluation and treatment that could not be provided in one of the other general

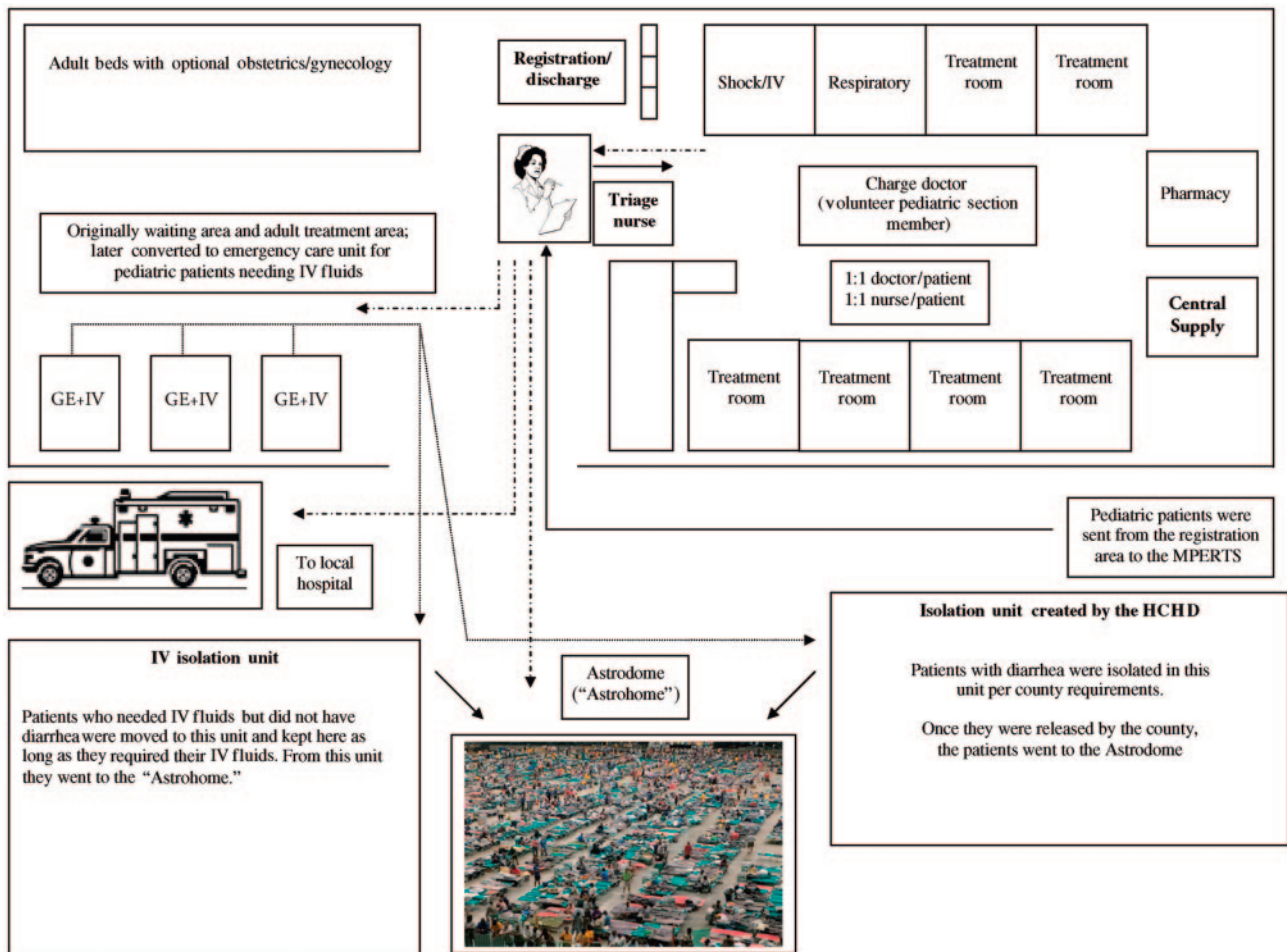


FIGURE 3
 Shown is a diagram of the final triage operations (including those used during the outbreak of cases of diarrhea) that were in place and ran smoothly with the teamwork that characterized MPERT. GE indicates gastroenteritis.

medicine clinics located throughout the Reliant Park facilities was transported to an area hospital. In just 13 days, the MPERT triaged, evaluated, and managed more than 3500 pediatric evacuees. During that time, fewer than 50 patients were transported to area hospitals, and there were no patient deaths.

LESSONS LEARNED

Although the evolution of the MPERT was an unexpected and unplanned concept, it proved to be a resounding success. Many lessons were gained from this experience, and a few of them are described below.

- Physicians and nurses trained and experienced in the emergency care of children always should be included in planning for and responding to a disaster. County medical officials did not include such available pediatric expertise in their initial response plan.
- Access to local or regional tertiary pediatric care resources should be arranged in advance, and the tertiary care provider supplying those resources must

control their distribution. The tertiary care center providing the resources must be responsible for and control the organization, preparation, training, deployment, and operation of the MPERT. One of the advantages of the MPERT model is the availability of local or regional specialty care resources (in this case, pediatric emergency medicine). If managed appropriately, minimal resources are needed to carry out this effort.

- Early identification of evacuees is essential during an evacuee crisis. Identification is paramount when separation of families is unavoidable, as in the case of Katrina. In theory, the identification of evacuees could have been done while they were en route to the Reliant Park facilities. In some cases, the bus ride took more than 16 hours, which was more than sufficient time to have allowed for properly identifying evacuees, providing medical evaluations, and possibly even treating minor emergencies. Future disaster and response planning can include such provision, which

would largely preclude having the large number of minors who presented to the MPERT without accompanying guardians during the Katrina response.

- Proper identification and thorough investigation of credentials is essential in any disaster-relief effort. Rogue clinics and medical staff proved to be a problem during the Katrina-relief effort. Early in the Katrina-relief effort, volunteers could bypass check-in through a back entrance, check in at other locations within Reliant Park, or check in at the appropriate staffing area located at the entrance to Reliant Arena. Every attempt was made to ensure single-site check-in, but success was limited. Finding innovative ways to identify and credential thousands of staff in a timely manner without creating an unnecessary burden on the process is important.
- Although volunteerism is essential in the event of mass casualties, guaranteed staffing of the MPERT should be a priority. Local and out-of-state volunteers play important roles in the disaster response. Out-of-town physicians are very useful in a crisis, and most states will relax credentialing requirements once a state of emergency has been declared. All volunteers should be organized from the outset with a single-site check-in point and nonreproducible means of identification to minimize the incidence of often well-meaning but generally unwanted rogue clinics and clinicians. In addition, an orientation manual should be created, and mandatory review of that document should be required of all volunteers before they enter the clinic to practice. Although volunteerism should be embraced and supported, the clinic should not depend on volunteers to meet its staffing obligation. The clinic should be staffed around the clock, at least initially, by the local or regional resources (eg, the tertiary pediatric care hospital staff). The staffing schedule should be handled by managers normally charged with that task on a day-to-day basis. Allocation of physician and nursing resources should be based on experience, subspecialty training, and the inherent, recognizable expertise for disaster management. In addition to the medical staff, other essential personnel such as environmental services, unit clerks, office managers or administrators, laboratory technicians, and runners also should be scheduled on a daily basis. For all practical purposes, the MPERT can and should operate like the local tertiary pediatric care ED.
- Ideally, the physician and nursing directors of the MPERT will be trained and experienced in pediatric emergency medicine. A disaster requires decisiveness from experienced leaders. The physicians and nurses who manage the clinic must be comfortable with providing pediatric emergency care.
- At a minimum, the medical director of the MPERT should be knowledgeable in prehospital medicine and, ideally, should be associated with the local EMS system and be aware of their policies and protocols. The medical director for the Katrina MPERT (P.E.S.) is also an assistant physician director of the City of Houston EMS. Most of the physicians performing bus triage early in the crisis were either EMS-trained or experienced in EMS. The combined knowledge of prehospital medicine, policies and protocols, and disaster medicine and the ability to work within a variety of EMS modalities was essential to the success of the Katrina-response effort. Centralizing care responsibilities and decisions for resource use will minimize the impact to the associated pediatric hospital ED's resources.
- The efforts of the medical personnel assigned to triage proved to be critical in managing overcrowding at the main Katrina clinic. Triage and management of minor medical needs at the epicenter of the disaster relief (bus triage) was instrumental in controlling the influx of patients at the main site for medical management, which was the Katrina clinic. Critically ill patients were transported rapidly to area hospitals via waiting ambulances, and the remaining less acutely ill or injured evacuees were triaged to appropriate residential or clinic areas on site.
- The appropriate allocation of physician and nursing resources is vitally important to patient flow in the MPERT clinic, as it is in the ED. Early in the disaster response to Katrina, MPERT physicians trained and experienced in pediatric emergency medicine were placed strategically at the main triage area and as charge physicians at the MPERT. Both roles are well suited for emergency medicine physicians. The clinic depended greatly on generalist pediatricians for direct patient care and relied heavily on the pediatric emergency-trained physicians for triage and medical direction. Pediatricians with other subspecialty training were not required on site but were accessible readily at the referral hospital if needed for either their special or general pediatric expertise.
- An experienced CN is essential for optimal patient flow. Special planning must go into finding the best CN and back-up CN when developing an MPERT. Except on a supervisory level, he or she should not be assigned to patient care. The main priority of the CN is process management. The clinic must flow, and it should be made clear to all of those involved that the CN is responsible for that flow. The CN should have the autonomy and authority necessary to make spontaneous executive decisions.
- Psychiatry and social services must be made available to the evacuee population early. Children are especially vulnerable to emotional trauma. The earlier ap-

appropriate counseling is made available to the child, the better he or she will be able to cope with the event. During the Katrina response, psychiatric and social services were welcomed by everyone and present on site early during the crisis.

- MPERT must be able to mobilize rapidly. If the resource is local, it can be accomplished with relative ease. The Katrina MPERT mobilized in less than 24 hours. If the expectation is more regional, planning for relocation must be rehearsed and fine-tuned in advance of any disaster. Facilities and access to those facilities must be predetermined so that both the staff and the supplies can reach their destination in a timely and safe manner.
- Choosing the appropriate venue for the staging of the disaster response is critical. Local officials should not skimp where clinic space is concerned. At the Reliant Arena Katrina clinic, the MPERT was slow to acquire much-needed space. Providing enough room initially to create a scaled-down version of an ED, including an area for observation and isolation, might have been the better solution. Eventually, the Katrina MPERT could comfortably care for 22 patients at any 1 time (1 shock room, 1 asthma room, 6 treatment rooms, and 3 rooms for IV insertion and the evaluation of isolation patients). In addition, the team shared 25 additional rooms for isolation patients with IVs and one 400-bed space (for the isolation of patients not requiring medical oversight) with the adult patient population. Diarrhea was a concern in the Katrina response and, as a result, isolation took precedence. Ideally, an MPERT would evolve depending on its needs. For example, if mass casualties were a concern, more shock rooms could be made available.
- Cooperation with command is essential. Few people would question the importance of having an intact, well-organized command structure during a disaster response. However, finding the appropriate balance between allowing for risky, innovative decisions while maintaining a strict command structure is not easy. This is especially true when private, nonprofit, local, state, and federal agencies all are charged with the same mission and each considers its solution to the problem at hand to be the best. Although it is uncommon for bureaucracy to promote teamwork, it can be accomplished; to do so, individual egos must be put aside. The Katrina medical command on site welcomed and recognized the benefit of TCH's involvement early on in the disaster response.
- A centrally located functional communication device with a means to access essential staff and services is crucial to the successful implementation of a good disaster-management plan. At the Katrina MPERT, this device was a cellular phone, permanently at-

tached to the triage desk (so that it could not be removed) and located next to a telephone list of essential staff and supplies. On the receiving end of the telephone was the tertiary pediatric care hospital command center, operating around the clock to carry out, among other things, field requests from the clinic. Of course, depending on the specific type of disaster, the cell phone may not be the best option for all communications. No single method is failsafe and, ultimately, several alternative forms of communication should be made available to meet the needs of every possible scenario. This line of communication should include personnel designated at all of the departments impacted by such an MPERT clinic at the home institution (eg, the distributor of resources, the physicians accepting transport patients, representatives from the higher acuity units) to effectively manage the response to activities by the MPERT.

- The EMS systems on site must be able to communicate and work well with each other as well as the other various medical and nonmedical personnel present during a disaster response. With few exceptions, this was the case during the Katrina effort.
- Always plan an exit strategy. Once the cost of running the clinic exceeds the cost of referring those patients to the hospital ED, the clinic should be closed.

CONCLUSIONS

The success of the Katrina MPERT can be attributed to the following factors: (1) county disaster planners shared and participated in the same agenda as that of the local tertiary pediatric care hospital leadership; (2) TCH was willing and able to provide whatever resources were needed to set up and operate the clinic; and (3) the medical control of the clinic was delegated to the experts in pediatric emergency care. What evolved from this cooperation was an altruistic and synergistic partnership between the county and TCH that allowed for the out-of-hospital triage, evaluation, management, and disposition of more than 3000 pediatric patients.

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RESOURCES

Pan American Health Organization. Disasters and humanitarian assistance. September 2005. Available at: www.paho.org/disasters

CNN.com. New Orleans braces for monster hurricane: Crescent City under evacuation; storm may overwhelm levees. August 29,

2005. Available at: www.cnn.com/2005/WEATHER/08/28/hurricane.katrina

MSNBC.com. New Orleans mayor orders looting crackdown: thousands feared dead from Katrina's wrath; stadium evacuation begins. September 1, 2005. Available at: <http://www.msnbc.msn.com/id/9063708>

Caring for Evacuated Children Housed in the Astrodome: Creation and Implementation of a Mobile Pediatric Emergency Response Team: Regionalized Caring for Displaced Children After a Disaster

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