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## Caring for and Transporting Very Low Birth Weight Infants During a Disaster

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The author has indicated he has no financial relationships relevant to this article to disclose.

**A**UGUST 29: HURRICANE KATRINA LANDFALL: I am a neonatologist in private practice and had been at the hospital for >24 hours along with 40 other physicians. I had volunteered to take care of the patients at Memorial Medical Center (MMC) during Hurricane Katrina. There were 16 infants in the NICU, ~260 patients in total at the hospital, 500 essential employees, and >1200 family members of the patients and employees with their pets taking refuge from the storm. An additional 50 patients were in an acute care ward for adults with chronic conditions run by LifeCare within the hospital premises.

Like most people, I thought Katrina would be just like other hurricanes that had threatened the city in the last few years. We would be at the hospital for a few days, and then we would return home. I had no idea what we were about to encounter.

As Katrina approached New Orleans, Louisiana, the NICU staff moved the infants to an inside room because of the many windows that could endanger their safety. When Katrina made landfall in the early morning, the strong 125-mph winds did blow in several of the hospital's windows, including some in the NICU. As soon as the electrical power was lost, the backup generators started and restored the emergency electrical services.

After enduring several hours of severe winds and rain, there was a general feeling of relief because the storm was over. Many windows were shattered, there was glass and water in many places, but apparently there was little structural damage to the main hospital building.

In the ensuing hours we heard that the storm surge had breached the levee system, and the waters from Lake Pontchartrain were flooding the city. Still, we had no awareness of the impending severity of the situation.

It soon became ominous as the floodwater reached the hospital and started rising all too rapidly.

### AUGUST 30: 1 DAY AFTER LANDFALL

It was midmorning when the evacuation order was given by the CEO of MMC. Now we needed to figure out where and how to evacuate the infants. One of our neonatologists was able to secure placement for the 16 infants at the Woman's Hospital NICU in Baton Rouge, Louisiana, ~80 miles northwest of New Orleans (see "Caring for Displaced Neonates: Intrastate," pp S389–S395). It was decided that the best option was to evacuate by helicopter. Workers at MMC cleared an abandoned landing pad located on the roof of the hospital's 8-floor garage building and made it functional.

Then, the really hard times began.

Multiple calls were made to emergency transport services, but they failed to respond promptly or gave conflicting reports. Everything seemed to be chaotic, telephone communications were poor, telephones were dying, and trying to identify who was in charge of the airlift was difficult. Eventually, the helicopter transport appeared to be underway.

The next task was to bring the incubators with the infants to the heliport, which proved to be quite an ordeal. Because the basement of the hospital was

**Key Words:** Hurricane Katrina, very low birth weight infants, neonatology, neonatal transport

**Abbreviation:** MMC, Memorial Medical Center

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flooded, the only way to access the parking garage was through a 35 by 45-inch hatch. The first transport incubator had to be carried by hand 8 floors to the top of the garage, because a truck flatbed was too high to negotiate the ceilings of the parking lot. Later, a different truck was successful in delivering the other incubators. Because the elevator to the heliport was not working, they had to be carried by hand up 3 flights of stairs to the landing pad (Fig 1).

Once at the holding area of the heliport, hours passed, with many choppers flying overhead. The few that landed had contracted with LifeCare for their patients. Incredibly, at least 2 helicopters tried to land on our parking garage to drop off evacuees with medical needs! The sun was now setting, and neither the Coast Guard nor National Guard helicopters that were supposed to carry the infants had shown up. Furthermore, there was no lighting in place for the helicopters to land after dark.

The transport incubators were still functioning because the backup generators were providing power to the holding area; however, there was concern that the rising water would flood the location of the back up generators, which would shut the power off.

Somebody was able to attract the attention of the pilot of one of the passing helicopters who took the first group of infants. A bit later, we were able to convince the pilot of a small, nonmedical, 3-seat chopper that was dropping supplies to carry 2 critical tiny infants with one of the nurses and me. Both were very low birth weight infants who required mechanical ventilation. One of them was infant boy S, a 6-week-old infant born at 24 weeks' gestation with severe bronchopulmonary dysplasia. He still weighed less than 1 kilogram and needed high respiratory support. The other infant had respiratory distress but was on low ventilator settings. The pilot told us that there was not enough space in the chopper for the transport incubator, so we wrapped the 2 infants

in blankets, placed them close to our bodies, and proceeded to ventilate them with hand-compression bags (Fig 2). We were able to bring intravenous pumps and several oxygen cylinders on the helicopter with us.

Although the trip was supposed to last about 30 to 45 minutes, it took much longer because after only a few minutes into the flight, the pilot had to land and wait for quite a while (what seemed like an eternity to me) to refuel. The night was very dark, and there were no lights at the heliport, but we did see 2 Army helicopters. Given the critical stage of the infants, I expressed my concern to the pilot about the delay. He looked at me and remarked that the Army helicopters were ahead of us refueling (first come, first served) and what they were doing was also extremely important because they were picking up people from their rooftops who could die if they were not rescued promptly.

I felt bad for my shortsightedness and apologized.

As we finished refueling, I checked my infant's oxygen tank and found that it was almost empty; with some difficulty, I switched to a new oxygen tank. If that prob-



FIGURE 1  
Taking an Isolette up to the landing pad.



FIGURE 2  
Dr Gershanik bagging a very low birth weight infant on a helicopter.

lem had occurred while in the air, it would have been almost impossible to switch tanks because of the lack of light and space. The refueling delay may have been instrumental in saving the infant's life.

To say that the transport was suboptimal is an understatement. Cold air was gushing through the windows, and there was no way to improve the situation. I tried to shield the infant with my body and kept him as close to me as possible, "pseudo-kangaroo," while bagging with high (undetermined) peak pressures and a fast rate to comply with his high ventilator-support requirements. There were no monitors to check the infant's heart rate, respiration, or oxygen saturation; the loud noises inside of the chopper and the lack of light (only a useless penlight was available) made it practically impossible to ascertain the condition of the infant while in flight, and only the movement of the infant's leg after pinching his extremity convinced me that he was still alive.

Finally, the lights of Baton Rouge appeared, and we landed at Woman's Hospital (see "Caring for Displaced Neonates: Intrastate," pp S389–S395), where a receiving team was waiting to take care of the infants. Both infants were placed in transport incubators, hooked to the ventilators, and brought to the NICU. Fortunately (and unexpectedly), the temperature and blood gases of infant boy S after the transport were similar to the ones before we left the NICU at MMC!

Military helicopters completed the evacuation of the remaining infants after workers at MMC strung together extension cords from the generator to the landing pad and shined lights to guide the pilots after dark.

After several attempts to follow-up on the status of the infants, we found that all 16 infants survived! In fact, they did as well during the transport as they were doing in the NICU. Some of them required a second transport to another NICU for different reasons (overcrowding, moving closer to where their families evacuated, etc).

Some parents left New Orleans before the storm; others stayed at MMC during Katrina, requiring evacuation mostly by boat, and eventually were reunited with their infants. No parents were transported with the infants. It took several days before infant boy S and his mother saw each other. He was eventually moved from Baton Rouge to Galveston, Texas, to where his mother had been evacuated. The infant was discharged at about 4 months of age in good condition with a home monitor and supplemental oxygen with feedings, which was discontinued shortly after discharge.

There is no way to accurately describe the dedication of the professional staff of the NICU at MMC and the incredible cooperation of their family members, who along with some of the patients' relatives did so much to achieve the best outcome for our tiny infants. We are so grateful for the help of employees at MMC and the kindness and professionalism shown by the doctors and



FIGURE 3  
Infant boy S at 5 months.

nurses at Women's Hospital, which contributed to the success of our endeavor.

### LESSONS LEARNED

There has to be a system in which the referring neonatologist and staff will be able to receive temporary hospital privileges and continue to take care of his or her patients in the receiving NICU. Many neonatologists were displaced to the same communities in which his or her patients were transported. The extra number of patients in at least one of the receiving NICUs generated a request from its responsible professional corporation to seek volunteers among their contract neonatologists nationwide to cover the additional medical help needed.

Systems that are activated at the local or regional level may prove more efficient than dependence on national or otherwise highly bureaucratic entities.

During the hurricane season (and other disasters), preparations for the worst scenario are a must. Emergency plans must include the possibility of catastrophic flooding in any potential trouble spot.

There is need for a local or regional central commander unit that can be activated during appropriate

times and match referring and receiving units. It would require an improved system of communications and the ability to follow the course and location of all the transfers.

Having the architectural design of critical care units and hospitals to prevent failure of the electrical and other vital systems is obvious, including locating backup emergency services where they cannot be affected by floods or other threats.

Another aspect of these disasters is the disruption/interruption of the clinical practice of the affected physicians. There is a heavy personal and financial toll that

develops, because physicians are unable to continue to practice and face a sudden interruption of income, sometimes for prolonged periods of time.

We need ways for families to find out promptly (such as via a telephone hotline) where their infants have been transported to and set up programs that could address the special needs of particular populations because of language limitations (eg, the Latino, Vietnamese, etc) or other barriers.

By the way, infant boy S (Fig 3) and his family will be back home soon. And, New Orleans will be back, better and stronger than ever!

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