The Vertical Evacuation of a Neonatal ICU During a Disaster

Lessons Learned at NYULMC during Hurricane Sandy

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NYULMC NICU: Evacuation Experience(s)

- **2011**
  - Hurricane/Tropical Storm Irene
  - Controlled, Pre-emptive Evacuation

- **2012**
  - Hurricane Sandy
  - Urgent Evacuation under Disaster Conditions
NYULMC NICU: Background

- Level IIIc Neonatal Intensive Care Unit
  - 25 beds
  - Average Census: 20

- NICU Staff
  - 1 Attending (7 full-time)
  - 1 Fellow (6 total)
  - 8 to 12 Nurses
  - 4-5 Residents + NNP/PA
NYC Flood Zones
Evacuation Experience Prior to Sandy: 
Tropical Storm Irene

- **August 26, 2011:**
  - 4 Hospitals in Flood Zone A ordered to Evacuate
  - NYULMC NICU Evacuation
    - 19 neonates evacuated
      - 3 mechanically ventilated (1 on High Frequency Oscillator)
  - 6 Receiving Hospitals
    - Cornell, Columbia, Hackensack, LICH, Maimonides, Mt. Sinai, St. Luke’s, Westchester
  - Completed in 16 hours
Hurricane Irene: Valuable Experiences

- **Finding beds at other facilities**
  - Navigating the process of finding alternate hospital beds
  - Familiarized with regional NICU’s staff, organization, and capabilities
  - Prioritizing infants for transfer
Hurricane Irene: Valuable Experiences

- Practical aspects of inter-hospital transport
  - *Equipment* and *personnel* can be a rate-limiting step in evacuation
  - Infant can be held by an adult secured to gurney

- Clear organization and cooperation between medical, nursing, and support staff
Hurricane Sandy
Hurricane Sandy Response: 3 Phases

1. Pre-Landfall Preparation
2. Power Outage/Immediate Response
3. Vertical Evacuation
Hurricane Sandy: Preparation

• Preparations at different levels
  – Regional
  – Hospital
  – Unit
10/27-29: Pre-Landfall

- Preparations for two scenarios:
  1. Shelter in place
  2. Evacuation
Preparation: Hospital

Hospital

- Hospital Incident Command System/Command Center established
- All staff on alert
- Briefings
- Dormitories and provisions to allow adequate personnel through the weekend
Preparation: NICU

Decreased Census

- However, few infants ready for discharge in the NICU
  - Critically ill
  - Underweight
- Maternal Transfers
  - Labor & Delivery transferred one mother at <28 weeks gestation
Preparation: NICU

Ensure Adequate Staffing

- Attendings, fellows, nurses, residents
  - Faculty on alert through weekend
  - Many nurses and fellows stayed in house
Preparation: NICU

Equipment and Power Check

- Ventilators
- IV Pumps
- Flashlights
- Batteries
- Red (Emergency) Power Outlets
Preparation: NICU

Anticipating Possibility of Patient Transfer

- Medical Records/Discharge/Patient summaries updated
- Pre-arrangements with other NICUs to accept each patient
  - More than half were to be accepted by Maimonides
October 29

- **Census: 21 infants**
  - Two patients on mechanical ventilation
    - 1 SIMV
    - 1 HFOV
  - Four patients on NCPAP
  - Remainder on NC or room air

- **Four infants with congenital heart disease**
- One infant with **NEC** with perforation who had gone to the OR that day
October 29: Landfall

7:00 PM First signs of power loss

- Lights flickered off then on
- Computers/monitors rebooted

Immediate preparations for complete power loss

- Handheld radios distributed
- Infant on High Frequency Oscillator switched to Conventional Ventilator
- Pharmacy unlocked all electronically controlled medication lock boxes
October 29: Landfall

8:30 PM Loss of Power

- Affected:
  - Lights
  - Computers (EMR)
  - Ventilators
  - Medication Lock Boxes

- Monitors
- Elevators
- Telephones
- Doors
Immediate Response

1. Patient Safety
2. Equipment and Supplies
3. Communication
4. Additional Personnel
5. Continued Patient Care
Immediate Response

1. Patient Assessments
   - Rapid assessments and stabilization by MDs, RNs, RTs.
   - Vital signs and status of each infant
Immediate Response

2. Checking Equipment and Supplies
   - Respiratory support and oxygen supply
   - IV Pumps
   - Monitors
   - Batteries
   - Medications/Fluids
Immediate Response

3. Establishing Communication & Situational Awareness
   - Handheld radios
   - Personal cell phones

4. Alerting Additional Personnel
   - Neonatal Faculty
   - Fellows, residents, and nurses staying in-house
Rapid Formation of a Command Structure and Delegation of Tasks

Hospital Incident Command Center

Chair of Pediatrics
Vice-Chair of Pediatrics

Neonatology Chief
Clinical Commander

Faculty
Housestaff
Nursing
Respiratory/Other Support Staff
Immediate Response

5. Coordinating Continuation of Clinical Care

- Feedings
- Thermo-regulation
- Monitoring vital signs
- Medication schedules

- Labor & Delivery Coverage
  - Residents called to one delivery during evacuation
9pm: Evacuation Order Given

Three Main Challenges/Goals
1. Prioritizing patients & finding alternate hospital beds
2. Transfer of medical information
3. Preparation patients for safe vertical and inter-hospital transport
Evacuation: Prioritizing Patients

Evacuation Whiteboard

- Patients prioritized
  - Acuity
  - Respiratory support
  - Equipment battery life
Evacuation: Finding Beds

- **Challenges**
  - Pre-landfall assignment list discarded due to closure of bridges/tunnels
  - Telephones disabled
  - Institutions varied in acceptance process
    - Decision by accepting on-call neonatologist/NICU director
    - Deferred to accepting hospital administration/command center
    - Dependent on receiving hospital staffing
Evacuation: Finding Beds

- Faculty made calls to regional NICUs using personal cell phones
  - Personal contacts
  - Directory of Regional NICUs

- Each patient accepted to one of 6 hospitals
  - NYP-Cornell
  - NYP-Columbia
  - Mt. Sinai
  - St. Luke’s
  - Lenox Hill
  - Montefiore
Evacuation: Transfer of Medical Information

- **Challenges:**
  - EMR inaccessible
  - Telephones
  - Patient summaries had been updated but not printed

- Residents used their **paper hand-off worksheets** for detailed information
- **Verbal sign-out** via cellular phone
- **Handwritten** patient transfer summaries
Evacuation: Preparing Patients for Safe Transport

- How to vertically transport critically ill infants without elevators?
  - NICU Situated on 9th Floor
  - Precluded use of transport Isolettes
  - Only available route was via unlighted stairwells
Evacuation: Preparing Patients for Safe Transport
Evacuation: Mode of Transport

• Isolettes
• Vests
• Basinettes
• Med Sled
• Hand Carry
Evacuation: Preparing Patients for Safe Transport

- Safe Mode of Transport
- Thermoregulation
- Oxygen Delivery/Ventilation
- Medication Delivery
- Monitoring

- Hand-carried by nurse
- Warming packs/Swaddling
- Portable Neopuff Devices or Ambu-bag with O2 tank
- Portable IV pumps and monitors
Evacuation: Vertical Evacuation
Evacuation: Vertical Evacuation

- Individually carried slowly down stairs
- Accompanied by at least 3 to 6 staff
  - 2 RNs holding the infant, swaddled and with warming pack, IV pumps or monitor
  - 1 MD monitoring vital signs, hand-bagging, keeping ET tube secure
  - Additional RNs/RTs carrying medications, O2 tanks, other equipment
- NYPD/FDNY
Evacuation: Inter-Hospital Transport

- Patient information and receiving hospital recorded when leaving the NICU and when departing from ground floor staging area

- Patient and teams assigned to one of >60 waiting ambulances contracted by FEMA

- Each accompanied by a NICU nurse and physician with nurse secured to gurney
  - Face to Face sign-out at receiving hospital
Evacuation: Inter-Hospital Transport
NYU NICU Evacuation: Timeline

7pm First Signs of Loss of Electricity

830pm Loss of Electricity

945pm First Infant Leaves

100am Last Infant Leaves
Evacuation: Inter-Hospital Transport

- All 21 infants safely transferred to other facilities in less than 6 hours from loss of power

- There were no fatalities or adverse consequences to transfer
Post-Evacuation: What We Have Learned

• Many challenges were similar to other others’ experiences

• Main impediments to speedy evacuation
  – Length of time finding accepting hospitals
  – Transportation deficits
  – Communication difficulties and situational awareness


Elements of an Effective and Speedy NICU Evacuation

1. Familiarity with an evacuation plan, including triage strategies
2. Awareness of and (advance) determination of appropriate receiving hospitals
3. (Advance) Determination of transportation resources
4. Medical record transfer and patient tracking
5. Communication with Parents

Adapted from Downey EL et al. (2013)
What We’ve Learned?

1. The Importance of Back-ups
2. Clear Organization and Command Structure
3. Communication and Situational Awareness
4. Regional Co-ordination
5. Flexibility
Power Outage Checklist

☐ Ensure all necessary equipment is plugged into emergency (red) outlet
☐ Obtain flashlights and extra batteries
☐ Charge batteries
☐ Locate additional back-up ventilators and pumps
☐ Check function of all ventilators, portable monitors, and pumps
☐ Attach End Tidal CO2 monitors to all ventilated patients
☐ Locate non-electronic order forms
☐ Draw up bolus doses of appropriate drips in case of pump failure
☐ Ensure resuscitation medications in medication storage areas are still accessible
☐ Locate medication storage cart key
☐ Ensure accessibility to all areas with code or ID card access via alternative methods
☐ Print hospital course summaries and patient demographic information

NYU Langone Medical Center

Department of Pediatrics

Lessons Learned from Hurricane Sandy: Jennifer Gillen, MD; Payal Patel, MD; Laura Monahan, MD, MPH; Paul Kim, MD; Mayer Sagy, MD
Preparedness

• Preparing for continuing care through an emergency/power outage
  • Personnel
  • Equipment
  • Communication
    • Including Parental Contact Information
  • Back-ups for computer dependent systems
    • EMR
    • Meds
    • Orders
Evacuation Checklist

☐ Triage high priority patients to be transported first
☐ Contact outside facilities to arrange admission and communicate patient care information with receiving teams
☐ Contact ambulances to transport patients
☐ Discuss consent for transport with families
☐ Determine best method for patient transport to ambulances
☐ Ensure secure positioning of all medical equipment attached to patients
☐ Arrange transport team (MD, nurse, respiratory therapist, etc.)
☐ Place patient on portable monitor if necessary
☐ Arrange for continued management of airway, breathing, and circulation during transport
☐ Gather necessary paperwork including hospital course summary, demographic information, medication reconciliation form, transfer form

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Preparedness

• Preparing for vertical evacuation and transfer
  • Knowledge of regional NICU’s surge capacities and key contacts
  • Communication
    • Parents’ phone numbers
  • Awareness of a safe route of evacuation
  • Determining a safe method of evacuation
    • Sleds
    • Baskets
• Personnel
• Equipment/Supplies
  • Transport Isolettes on ground floor
Once outside babies can remain in the Evacu-B
Regional Cooperation is Key
ST LUKE’S-ROOSEVELT HOSPITAL CENTER
ROOSEVELT HOSPITAL
1000 Tenth Avenue • New York, New York 10035 • Main Phone B: 212-523-4000

NICU Director name: Farrokh Shahrivar, MD

NICU phone number: 212-523-7953

Number of full time Neonatologists: 6

Number of part time Neonatologists: 0

Fellowship program: No

Fellows per year: 4

Full time Perinatologists: 0

Part time Perinatologists: 0

NICU Level NYS DOH criteria (Definitions in appendix 1): 3

NICU Level National criteria (Definitions in appendix 1): 3b

Number of staffed and equipped beds in NICU: 28

Special Services:

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Does unit have Transport Services: Yes

Including ability to transport with high frequency ventilation No

Including ability to transport with iNO No

Able to transmit medical records and images: Electronically (images)/ Paper

Newborn Nursery: Yes

Number of Labor and Delivery beds at NICU hospital: 28

NYC Pediatric Disaster Coalition
Sponsored by the Bureau of Health Care System Readiness

NYC Health

NYC NICU Resource Directory
August 2013
Updates to Our Evacuation Plans

• NICU specific Evacuation and Surge Plans have been formalized
  – Formalized Local Incident Command Structure
  – Placing transport Isolettes on ground floor during emergencies
  – Designation of the Social Worker as Family Liaison/Point Person

• NICU specific Power Failure and Evacuation checklists

• Easily located infant specific evacuation equipment
BREAKING NEWS
EVACUATIONS UNDERWAY AT NYU LANGONE MEDICAL CENTER
Post-Evacuation: What We Have Learned

- A rapid NICU evacuation can be accomplished safely during a disaster

- Preparedness, communication, coordination, and situational awareness are key.
Thank You