Patient Outcomes, Inpatient Costs, and Hospital Performance During a Disaster: Implications for the Nurse Licensure Compact

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EMORY

Background

- The U.S has seen an increase in the number of life-threatening storms possibly due to climate change

- 2020: 25 named storms and six major hurricanes, more than double the 1981-2010 averages

- Severe storms disrupt activities of daily living across communities and age groups

- Little is known about storms and other natural disasters and their impact on the delivery of health care services

Hurricane Sandy Timeline

- 10/22: Sandy begins as a tropical storm in the Caribbean Sea.

- 10/24: Sandy Category 1 hurricane hits Jamaica - winds of 80 mph.

- 10/25: Sandy Category 2 hits Cuba w 105 mph winds, then Haiti and Bahamas, killing 54 in Haiti, 11 in the DR, and two in Bahamas.

- 10/26-27: Sandy alternates between Category 1 hurricane and a tropical storm, then returns to Category 1.

- 10/28: Category 1, Sandy moves parallel to GA, SC, and NC.

- 10/29: Sandy approaches the East Coast of U.S. as Category 2, then weakens to post-tropical cyclone.

October 29th 2012

Hurricane Sandy
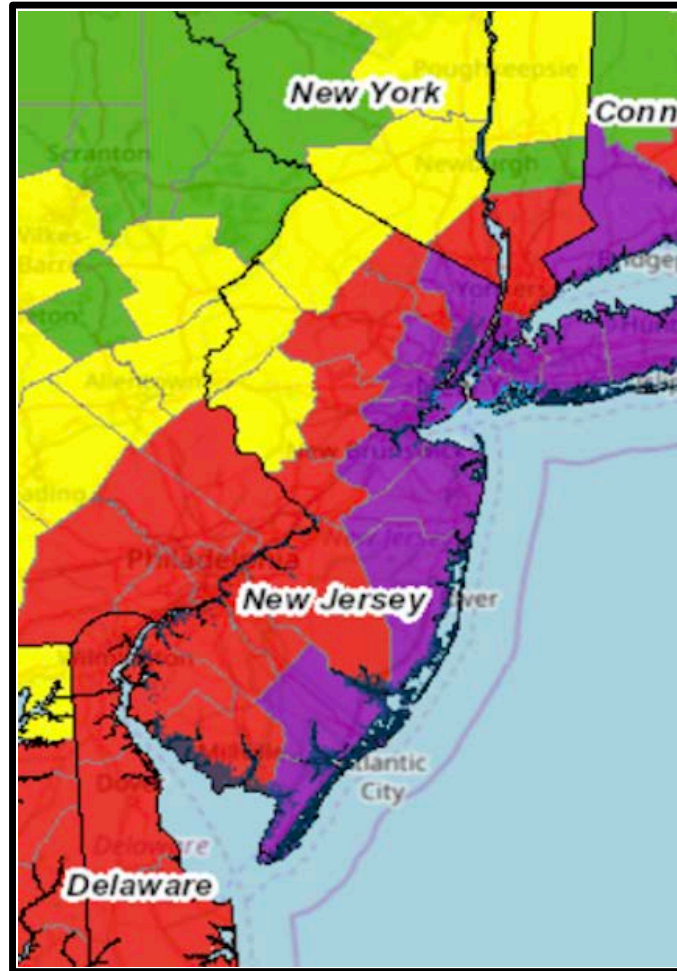
Hurricane Sandy Timeline

- 2:30 p.m.: Sandy w high winds rain from D.C., northward.

- 8 p.m.: Sandy comes ashore Atlantic City, NJ, w hurricane-force winds of 90 mph. In combination with a full moon and high tide, a 14-foot wave surge in NY Harbor tops the seawall in lower Manhattan and floods parts of NY subway system and a crucial tunnel.

Storm Severity*	County
Very High Areas: >10,000 people exposed to surge	Atlantic, Ocean, Monmouth, Middlesex, Union, Essex, Bergen, Hudson, Cape May
High Areas: 5000-10,000 people exposed to surge; or >$100 million in wind damage; or > 8" of rain	Cumberland, Salem, Gloucester, Camden, Burlington, Mercer, Somerset, Morris, Passaic
Moderate Areas: 100-500 people exposed to surge; or $10-100 million in wind damage; or 4-8" of rain	Sussex, Warren, Hunterdon,

*adapted from the Federal Emergency Management Agency Hurricane Sandy Impact Analysis

Study Aims

- Determine if supply of nurses in the hospitals of NJ were able to meet patient needs during Hurricane Sandy; and

- Determine if patient outcomes could have been improved if additional nurses from other states were able to practice in storm surge areas.

Methods

- **Design**: Cross-sectional analysis of secondary data
- **Data 4th quarter of 2011 and 2012**:
    - HCUP/AHRQ State Inpatient Databases
        - Patient characteristics
    - American Hospital Association Annual Survey
        - Hospital characteristics
    - New Jersey Department of Health
        - Nurse staffing
- **Sample**:
    - 66/72 NJ acute care hospitals w sufficient data on nurse staffing

Variables and Measures

- Hospital characteristics (n = 66)
  - Bed size, teaching status, high-technology, Magnet, safety-net
- Nurse staffing: FTEs and patient to nurse ratio
- Unit types: ICU and non-ICU
- Patients (n = 87,701)
  - Demographics, comorbidities, admit unit type, admission & discharge month
- Patient outcomes
  - Transfer status, mortality, readmission, length of stay

Statistical Analysis

- Descriptive
  - Means and standard deviations, numbers and percentages

- Inferential statistics
  - Univariate and multivariate linear and logistic regression

- Projected nurse staffing
  - Observed – expected FTEs*

*Based on the work of Spetz (2015). Forecasts of the Registered Nurse Workforce in California

Hospital Characteristics by Storm Impact Area (n = 72)

	Very High Area (n = 39)	High Area (n = 23)	Moderate Area (n = 4)
Bed size			
<100	0 (0.0%)	2 (9%)	0 (0%)
101-250	13 (33%)	7 (30%)	4 (100%)
>=251	26 (67%)	14 (61%)	0 (0%)
Teaching hospital	24 (62%)	14 (61%)	2 (50%)
High technology	18 (85%)	18 (78%)	3 (75%)
Safety-net	11 (28%)	7 (30%)	0 (0%)
Magnet hospital	17 (44%)	8 (35%)	1 (25%)

Patient Characteristics (n = 87,701)

Age at admission (years)	50 (28)
Sex	
Female	50184 (57%)
Male	37517 (43%)
Race	
White	53518 (62%)
African American	14997 (17%)
Other	17786 (21%)
Ethnicity	
Hispanic	10811 (13%)
Non-Hispanic	75490 (87%)
Median household Income:	
Quartile 1: 0 - 25th	11608 (13%)
Quartile 2: 26th – 50th	11903 (14%)
Quartile 3: 51st – 75th	19796 (23%)
Quartile 4: 76th – 100th	43552 (50%)

Nurse Staffing by Unit Type and Quarter 2012

|	Quarter 3		Quarter 4		Differences	
	Mean	Range	Mean	Range	Mean	*p*-value
Intensive care	1.93	1.2 – 2.6	2.02	1.3 – 4.7	-0.08	0.17
Intermediate	3.49	1.4 – 6.0	4.00	0.8 – 6.0	-0.01	0.97
Medical-Surgical	4.44	2.6 – 8.3	4.40	2.0 – 6.4	0.03	0.85
Overall	3.26	2.3 – 5.0	3.28	2.3 – 4.8	-0.02	0.83

Length of stay	4.9 (5.6)
Readmission	3381 (6%)
Died	1755 (2%)

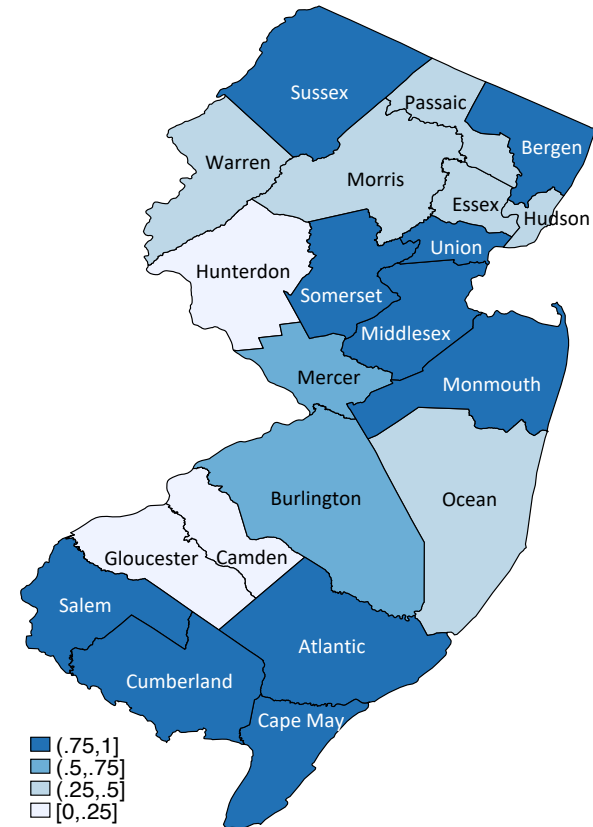Multivariate Analyses Nurse Workload and Patient Outcomes, 4th Quarter 2012 (n = 84,431)

	Transferred out	Mortality	Readmission	Length of Stay
Intensive care	0.18**	-0.18	-1.60***	-0.36
Intermediate	0.07***	-0.05	-0.73***	0.07**
Medical-surgical	-0.03*	-0.02	-0.19***	-0.02
Composite	0.05	-0.07	-0.57***	0.02

*<0.05, **= 0.00, *** = <0.0001

Estimated Shortage of RN FTEs by County: NJ 4th Quarter 2012
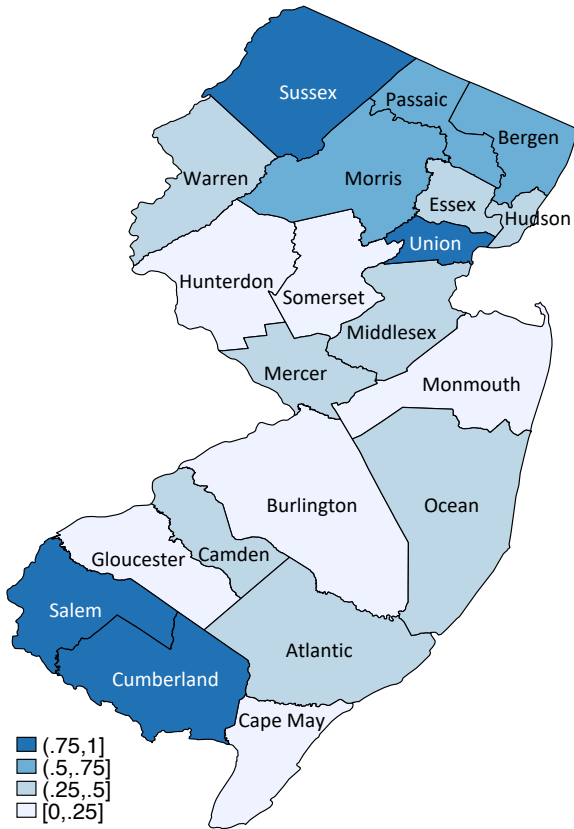
Intensive Care Units

Non-Intensive Care Units

20% increase of RN FTEs was estimated to alleviate the shortage

Limitations

- Nurse data are based on monthly staffing levels and reported quarterly; and we acknowledge that data at a more granular level such as monthly, weekly, or daily might have been more informative

- Nurse data were reported as number of patients per RN and lacked details on nurse employment status (FT, PT, per-diem, supplemental)

- Our findings might not be generalizable to hospitals in other states or during other disasters

Conclusion

- Our estimates show that the supply of NJ RNs was not sufficient to meet the demand for patient care during Hurricane Sandy.

- Significant association between RN staffing and patient outcomes

- States need to be proactive in an effort to ensure an adequate and flexible nurse workforce

- The nurse licensure compact is a model that should be adopted by states nationwide to ensure a sufficient supply of nurses during a disaster.

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