Hurricane Sandy Research and its Implications for Mental Health Policy and Operation (Panel Session 1)

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What Happened to Our Environment and Mental Health as a Result of Hurricane Sandy?

**Aim 1:** To quantify the short- & long-term health effects of Hurricane Sandy on morbidity in the impacted population

**Aim 2:** To identify & evaluate whether weather/environment, socio-demographics, community characteristics, & social vulnerability, interacted with Sandy-morbidity association

**Aim 3:** To evaluate health impacts of home cleaning, determine what risk factors may be modified & what existing surveillance programs may be used to reduce health impacts in impacted populations & build evidence-based preparedness programs
Project Importance

• Filled knowledge gaps by evaluating the short-/long-term effects of Sandy on **multiple outcomes** and addressing **critical barriers** in healthcare facilities

• Enhanced recovery efforts by understanding how **individual, community, environment** and health care facility mediated/modified health impacts from Sandy

• Identified **sensitive diseases, high risk areas, and population vulnerability** after disaster

• **Developed tools**, including vulnerable/resilience index and predictive model for emergency preparedness
Study Methods

- **Affected areas**: Evacuation zones or Hurricane storm surge zones: NYC (Bronx, Queens, Kings, Richmond, NY), Nassau, Suffolk, Westchester
- **Retrospective cohort study and trend analysis**:
  - **Two references**:
    - Affected and non-affected (control) area comparison
      - Control for time-varying variables such as year, day of week
    - Time trend analysis (pre-Sandy periods as references)
      - Pre-/Post-Sandy: 2001-2011 averages vs. post-Sandy periods
        - During Sandy, 3 months, 1 year after Sandy
        - Controls for demographics since each area is compared to itself
  - **Health outcomes**: Mental health, injury, asthma, CVD, CO poisoning, dialysis, WB/FB diseases, diabetes from admission, ED visits, prescriptions
  - **Control diseases**: Appendicitis, cirrhosis
<table>
<thead>
<tr>
<th>County</th>
<th>All types</th>
<th>Anxiety</th>
<th>Adjustment Disorder</th>
<th>Psychosis</th>
<th>Mood disorder</th>
<th>Substance Abuse</th>
<th>Suicide</th>
</tr>
</thead>
<tbody>
<tr>
<td>All counties</td>
<td>4.95</td>
<td>0.51</td>
<td>0.58</td>
<td>0.57</td>
<td>0.70</td>
<td>2.54</td>
<td>0.07</td>
</tr>
<tr>
<td>Bronx</td>
<td>7.15</td>
<td>0.55</td>
<td>0.67</td>
<td>1.08</td>
<td>1.19</td>
<td>3.52</td>
<td>0.14</td>
</tr>
<tr>
<td>Kings</td>
<td>6.44</td>
<td>0.57</td>
<td>0.97</td>
<td>0.73</td>
<td>0.82</td>
<td>3.30</td>
<td>0.05</td>
</tr>
<tr>
<td>Nassau</td>
<td>2.45</td>
<td>0.52</td>
<td>0.28</td>
<td>0.22</td>
<td>0.38</td>
<td>1.01</td>
<td>0.04</td>
</tr>
<tr>
<td>New York</td>
<td>6.38</td>
<td>0.38</td>
<td>0.90</td>
<td>0.27</td>
<td>0.80</td>
<td>3.99</td>
<td>0.05</td>
</tr>
<tr>
<td>Queens</td>
<td>4.16</td>
<td>0.44</td>
<td>0.41</td>
<td>0.47</td>
<td>0.63</td>
<td>2.13</td>
<td>0.09</td>
</tr>
<tr>
<td>Richmond</td>
<td>4.05</td>
<td>0.53</td>
<td>0.46</td>
<td>0.27</td>
<td>0.48</td>
<td>2.28</td>
<td>0.04</td>
</tr>
<tr>
<td>Suffolk</td>
<td>3.13</td>
<td>0.57</td>
<td>0.27</td>
<td>0.23</td>
<td>0.44</td>
<td>1.56</td>
<td>0.06</td>
</tr>
<tr>
<td>Westchester</td>
<td>3.24</td>
<td>0.53</td>
<td>0.20</td>
<td>0.39</td>
<td>0.61</td>
<td>1.44</td>
<td>0.07</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>County</th>
<th>PRs</th>
<th>95% CIs</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>All counties</td>
<td>0.995</td>
<td>0.83, 1.20</td>
<td>0.96</td>
</tr>
<tr>
<td>Bronx</td>
<td><strong>8.82</strong></td>
<td>1.27, 61.42</td>
<td><strong>0.03</strong></td>
</tr>
<tr>
<td>Kings</td>
<td>2.14</td>
<td>0.33, 13.71</td>
<td>0.42</td>
</tr>
<tr>
<td>Nassau</td>
<td>0.88</td>
<td>0.47, 1.65</td>
<td>0.70</td>
</tr>
<tr>
<td>New York</td>
<td>0.81</td>
<td>0.57, 1.16</td>
<td>0.25</td>
</tr>
<tr>
<td>Queens</td>
<td><strong>2.47</strong></td>
<td>1.05, 5.82</td>
<td><strong>0.04</strong></td>
</tr>
<tr>
<td>Richmond</td>
<td>0.87</td>
<td>0.46, 1.64</td>
<td>0.66</td>
</tr>
<tr>
<td>Suffolk</td>
<td>0.91</td>
<td>0.62, 1.35</td>
<td>0.64</td>
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<td>0.88</td>
<td>0.47, 1.65</td>
<td>0.70</td>
</tr>
</tbody>
</table>

*Adjusted for day of the week, patient county.
## Comparison of mental health outpatient (ED) and inpatient hospital visits in 7 affected NY state counties in 3 time periods

<table>
<thead>
<tr>
<th>Overall Sex</th>
<th>Overall</th>
<th>3 months</th>
<th>1 year</th>
</tr>
</thead>
<tbody>
<tr>
<td>More Affected</td>
<td>PR (95% CI)</td>
<td>More Affected</td>
<td>PR (95% CI)</td>
</tr>
<tr>
<td>Less Affected</td>
<td>PR (95% CI)</td>
<td>Less Affected</td>
<td>PR (95% CI)</td>
</tr>
</tbody>
</table>

### Adjustments

<table>
<thead>
<tr>
<th>Adjustment disorder</th>
<th>13 Days</th>
<th>3 Months</th>
<th>1 Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>More Affected</td>
<td>RR (95%CI)</td>
<td>RR (95%CI)</td>
<td>RR (95%CI)</td>
</tr>
<tr>
<td>Less Affected</td>
<td>RR (95%CI)</td>
<td>RR (95%CI)</td>
<td>RR (95%CI)</td>
</tr>
</tbody>
</table>

- **Overall**
  - 0.94 (0.81 - 1.09) 0.92 (0.88 - 0.96)
  - 0.92 (0.87 - 0.97) 0.95 (0.91 - 0.99)
  - 0.92 (0.90 - 0.94) 0.95 (0.92 - 0.97)

- **Sex**
  - **Female**
    - 0.98 (0.83 - 1.16) 0.87 (0.81 - 0.94)
    - 0.95 (0.89 - 1.01) 0.93 (0.88 - 0.99)
    - 0.93 (0.90 - 0.96) 0.91 (0.89 - 0.94)
  - **Male**
    - 0.92 (0.78 - 1.08) 0.94 (0.90 - 0.99)
    - 0.91 (0.85 - 0.98) 0.96 (0.92 - 1.01)
    - 0.92 (0.89 - 0.95) 0.96 (0.91 - 1.01)

- **Age**
  - Age 5-19
    - 0.64 (0.51 - 0.81) 0.66 (0.58 - 0.74)
    - 0.89 (0.82 - 0.96) 0.94 (0.88 - 1.00)
    - 0.91 (0.88 - 0.95) 0.96 (0.92 - 0.99)
  - Age 20-64
    - 0.95 (0.82 - 1.10) 0.93 (0.89 - 0.98)
    - 0.92 (0.87 - 0.98) 0.95 (0.91 - 0.98)
    - 0.92 (0.90 - 0.95) 0.94 (0.90 - 0.97)
  - Age 65+
    - 1.71 (1.08 - 2.68) 1.36 (1.03 - 1.80)
    - 1.29 (0.99 - 1.68) 1.16 (0.93 - 1.45)
    - 1.15 (0.87 - 1.51) 1.10 (0.96 - 1.25)

- **Race**
  - **White**
    - 0.99 (0.73 - 1.32) 0.88 (0.83 - 0.94)
    - 0.86 (0.76 - 0.96) 0.90 (0.83 - 0.97)
    - 0.86 (0.81 - 0.91) 0.90 (0.83 - 0.99)
  - **Black**
    - 0.86 (0.81 - 0.91) 0.90 (0.83 - 0.99)
    - 0.91 (0.81 - 1.03) 0.88 (0.78 - 1.00)
    - 0.93 (0.84 - 1.02) 0.90 (0.83 - 0.98)
  - **Other Race**
    - 0.90 (0.65 - 1.24) 0.97 (0.90 - 1.04)
    - 0.96 (0.70 - 1.31) 1.05 (0.92 - 1.20)
    - 0.98 (0.80 - 1.19) 0.99 (0.87 - 1.14)

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## Comparison of mental health hospital visits in 7 affected NY state counties in 3 time periods

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<th>Adjustments</th>
<th>13 Days</th>
<th>3 Months</th>
<th>1 Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>More Affected</td>
<td>RR (95%CI)</td>
<td>RR (95%CI)</td>
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</tr>
<tr>
<td>Less Affected</td>
<td>RR (95%CI)</td>
<td>RR (95%CI)</td>
<td>RR (95%CI)</td>
</tr>
</tbody>
</table>

- **Adjustment disorder**
  - 0.95 (0.77 - 1.16) 0.99 (0.78 - 1.26)
  - 1.00 (0.85 - 1.18) 1.03 (0.92 - 1.15)
  - 1.06 (0.97 - 1.16) 1.02 (0.96 - 1.08)

- **Anxiety**
  - 1.30 (1.07 - 1.57)
  - 1.08 (0.95 - 1.23)
  - 0.96 (0.88 - 1.05)
  - 0.96 (0.91 - 1.01)
  - 0.92 (0.86 - 0.99)
  - 0.91 (0.87 - 0.95)

- **Mood disorder**
  - 0.84 (0.80 - 0.89)
  - 0.80 (0.70 - 0.91)
  - 1.01 (0.92 - 1.11)
  - 0.95 (0.87 - 1.04)
  - 0.99 (0.93 - 1.06)
  - 0.94 (0.89 - 0.99)

- **Psychosis**
  - 1.02 (0.84 - 1.24)
  - 1.09 (0.85 - 1.41)
  - 1.11 (0.89 - 1.38)
  - 1.10 (0.88 - 1.37)
  - 1.08 (0.86 - 1.37)
  - 1.06 (0.90 - 1.25)

- **Substance abuse**
  - 0.92 (0.69 - 1.22)
  - 0.92 (0.87 - 0.98)
  - 0.86 (0.76 - 0.97)
  - 0.93 (0.86 - 1.00)
  - 0.87 (0.81 - 0.93)
  - 0.92 (0.83 - 1.02)

- **Suicide**
  - 0.79 (0.49 - 1.27)
  - 1.00 (0.66 - 1.51)
  - 1.05 (0.94 - 1.18)
  - 1.14 (1.02 - 1.27)
  - 1.03 (0.99 - 1.08)
  - 1.06 (0.97 - 1.15)
<table>
<thead>
<tr>
<th></th>
<th>Mental Health ED from Medicaid</th>
<th>Mental Health ED from Medicare</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>RR</td>
<td>Low Limit</td>
</tr>
<tr>
<td>County</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Counties</td>
<td>1.348</td>
<td>1.341</td>
</tr>
<tr>
<td>Rest of Counties</td>
<td>1.000 (ref)</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.794</td>
<td>1.785</td>
</tr>
<tr>
<td>Male</td>
<td>1.000 (ref)</td>
<td></td>
</tr>
<tr>
<td>Period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandy Period</td>
<td>2.093</td>
<td>2.082</td>
</tr>
<tr>
<td>Non-Sandy Period</td>
<td>1.000 (ref)</td>
<td></td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>0.252</td>
<td>0.250</td>
</tr>
<tr>
<td>Hispanic</td>
<td>0.040</td>
<td>0.040</td>
</tr>
<tr>
<td>Other</td>
<td>0.062</td>
<td>0.062</td>
</tr>
<tr>
<td>White</td>
<td>1.000 (ref)</td>
<td></td>
</tr>
</tbody>
</table>
Community Vulnerability Index for Mental Health after Sandy
Practical Applications from the Environmental Findings

• **Findings:** Multiple environmental hazards occurred during Hurricane Sandy, e.g., flooding – blackout, fire, snow/cold – air / water quality, might intensify the disaster impact

• **Impacts:**
  1) Assist environmental officials to identify co-environmental hazards for improving response
  2) The substantial health impacts of power outages provide target direction for governments
Practical Applications from the Mental Health Findings after Sandy

• **Findings:** 1) Anxiety ED visits significantly increased during Sandy; 2) Suicide was the most common problem; 3) Length of stay (LOS) and hospital cost for MHED increased after Sandy; 4) MHED traveled 0.41 miles more for care in the affected area than those in control areas; 5) 17% more comorbidity (alcohol, opioid abuse) during Sandy; 6) affected both affected/ unaffected areas

• **Impacts:**
  1) Helped state and county officials and hospital managers learn diseases burden, specific MHED types, LOS/cost increase, comorbidity after Sandy for disaster preparation
  2) Benefited clinical facilities in case management and displacement during disaster
Practical Applications by Developing Vulnerability and Resilience Index

• **Findings:** 1) Blacks and Hispanics had lower risks than Whites after Sandy in both Medicaid and Medicare populations; 2) Females, elderly, and those living in mobile homes showed increased risks.

• **Impacts:**
  1) The different population vulnerability during Sandy will provide important insight to policy makers on future disaster response planning.
  2) Developing vulnerability/resilience index and predictive model will help disaster preparedness.
Project Team & Acknowledgements

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