Validation and Statistical Assessment of Heat Syndromic Data

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New York City, NY
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Presentation Overview

• Chicago & Illinois experience and response
  – Historic
  – Infrastructure
• Stakeholders
  – Emergency Preparedness
  – Climate change
• Analysis
  – System comparison
  – Definition comparison
  – Broad risk assessment
• Next Steps
  – New data
  – New methods
Chicago Heat Wave, 1995

- 5 days: July 12-16th
  - Max Heat Index = 120
  - High night temps
  - Urban heat island effect
  - Power failures
  - Hospitals on bypass
- 700+ deaths
- Over 1000 HRI hospitalizations
- At risk:
  - Elderly
  - Male
  - African Americans
  - Poor - without AC
- Common factor: isolation

http://www.isws.illinois.edu/atmos/statecli/general/1995chicago.htm
Landscape - then

- Debate: “really real”
  - Cook County Medical Examiners Office
    - 465 deaths /3 days
  - City officials “It’s hot...not blow this out of proportion”

- “I still remember the back and forth debates on TV about the ‘correct numbers of heat related deaths’ between the Mayor’s office and the Cook County Medical Examiner’s Office.” (T.Shen)
- “The situation got out of hand quickly. Dead bodies piled up in commentaries and because so many were not claimed by any relatives (an evidence of living alone was a risk factor), mass burials were conducted” (T. Shen)

*Interview with Eric Kinkenberg.  
http://www.press.uchicago.edu/Misc/Chicago/443213in.html

** Tiefu Shen – comments from the EIS experience in Chicago in 1995
Perspectives & Study Findings

• Was 1995, weather-related?
  – “Climate”-related: Political, economic, social
  – Climate models: failed to detect relationships b/w weather & mortality that would explain what happened in July 1995 in Chicago (Whitman, AJPH 1997)

• Challenge: difficult to assess true risk of HRI
  – Deaths even with the broad heat-related fatality definition used by the Cook County medical examiner compared with excess all-cause mortality was underestimate [19 vs. 24-25 per 100,000] (Shen, AJFMP, 1998)
Landscape – recent years

• Hospital Reporting HRI in ED
  – Conducted in the hospital bypass system (HBS)
  – Limited to Chicago region
  – Manual entry by hospital staff
  – Implemented intermittently on as needed daily basis
    • Dependent of heat advisories, watches and warnings

• Resources
  – Warnings and messaging aligned with NWS
  – Cooling centers
  – Transportation
  – Social service and police checks on elderly

• Expanded monitoring
  – Manual 2x daily entry into HBS June-September
  – Alternative: utilize automated, statewide syndromic surveillance data
Study: System Comparison
ESSENCE with Hospital Bypass, 2013

- Correlation higher with bypass
- System consideration
  - Representativeness
  - Historic trends
  - Automated/manual
  - Different users
  - Different definitions
  - Different collection
  - Different queries
  - Timeliness

Bahena, Fabien. Comparison of 2 Syndromic Surveillance Systems Over 3 Year Period During Extreme Heat Events in Chicago 12/5/13
Stakeholders for Heat-Related Illness

• Immediate Response
  – Health Departments: State & local
  – Emergency Preparedness
  – Other government agencies (i.e. police, park districts, schools)
  – Organizations
    • Red Cross
    • Salvation Arm

• Long-term planning
  – BRACE (Building Resilience Against Climate Effects) Grantee
    • Collaboration with University of Illinois at Chicago & IDPH
    • Working on a long-term climate response plan
  – Midwest BRACE Group
    • Collaboration of grantees
  – Climate and Health Syndromic Surveillance Workgroup
  – Region 5 workshop
    • May 2013, use case for data sharing workshop / discussion
HHS Regional Collaboration for Syndromic Surveillance

- ISDS Data Sharing Workshop-Region 5
  - May 2013
  - Use Case: Heat-related illness

- Challenges:
  - No standard definition for syndrome classifiers
  - Comparison of results is difficult across regions
    - Different systems
    - Different definitions
    - Variations in data quality
  - Local customization is optimal

- Metadata tool in development

- Active discussion with neighboring jurisdictions (WI)
Study: Definition Comparison
Heat-Related Illness, 2013

Objective: To determine differences in case detection using different syndrome definitions for heat effects
# Results

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>CC (local) N (%)</th>
<th>DD (local) N (%)</th>
<th>ESSENCE-defined N (%)</th>
<th>BioSense 2.0-defined N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>417 (91.2)</td>
<td>338 (98.5)</td>
<td>305 (99.0)</td>
<td>616 (89.8)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>36 (7.9)</td>
<td>5 (1.5)</td>
<td>0 (0)</td>
<td>45 (6.6)</td>
</tr>
<tr>
<td>Likely</td>
<td>4 (0.9)</td>
<td>0 (0)</td>
<td>3 (1.0)</td>
<td>25 (3.6)</td>
</tr>
<tr>
<td>Total</td>
<td>457</td>
<td>343</td>
<td>308</td>
<td>686</td>
</tr>
</tbody>
</table>

141 matched by CC
77 matched CC & DD
207 matched by DD

**Application of Final Definition**

Heat Related Emergency Visits, Northern IL, Jun - Aug 2013

<table>
<thead>
<tr>
<th>Accuracy</th>
<th>CC N (%)</th>
<th>DD N (%)</th>
<th>CC &amp; DD N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Correct</td>
<td>222 (99.6)</td>
<td>193 (98.8)</td>
<td>368 (99.2)</td>
</tr>
<tr>
<td>Incorrect</td>
<td>1 (0.4)</td>
<td>2 (1.0)</td>
<td>3 (.8)</td>
</tr>
<tr>
<td>Likely</td>
<td>0 (0)</td>
<td>0 (0)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>Total</td>
<td>223</td>
<td>195</td>
<td>371</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age Group</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>00-01</td>
<td>9 (2.4)</td>
</tr>
<tr>
<td>02-04</td>
<td>8 (2.2)</td>
</tr>
<tr>
<td>05-17</td>
<td>65 (0.2)</td>
</tr>
<tr>
<td>18-44</td>
<td>144 (38.4)</td>
</tr>
<tr>
<td>45-64</td>
<td>90 (24.3)</td>
</tr>
<tr>
<td>65+</td>
<td>55 (14.9)</td>
</tr>
<tr>
<td>Total</td>
<td>371</td>
</tr>
</tbody>
</table>
Illinois Infrastructure

• Illinois
  – State-wide syndromic surveillance implementation, 2012
  – Representation is 75% of ED visits captured, 125 hospitals (N=185)
  – Mandate for 100% reporting by end 2014
  – Use National Syndromic Surveillance Program to store / process data
  – 9,500 visits/day
  – 1 M messages/month
  – HL7 and Meaningful Use
  – Data and facility management – standard DQ

• Cook County
  – 45 facilities in Northeastern Illinois
  – 10+ years of data
  – Use ESSENCE
Strategy
Routing of Public Health Messages

IGA with IDPH
DUA with IDPH (agent of state)

Health Information Exchange

2014 CCHIT certified software
Surveillance in Illinois, 2014

Illinois Heat-Related Illness Report

Exposure to high temperatures can cause heat-related illness (HRI) or death which, with proper precautions, can be prevented. The Illinois Department of Public Health (IDPH) tracks emergency department (ED) visits in BioSense and provisional mortality data from medical examiners and coroners in the electronic Illinois Vital Records System (IVRS). Numbers in this report may be updated as additional data are reported.

The following websites have tips and resources for preventing HRI and staying cool during hot weather:

- Keep Cool Illinois: http://www2.illinois.gov/keepcool/pages/default.aspx

IDPH has seen an increase in heat-related illness from August 21-25, 2014, associated with the increase in temperatures. The following data represents ED visits during this time period.

<table>
<thead>
<tr>
<th>Visit Date</th>
<th>Number of HRI Visits</th>
<th>Percent of HRI Visits</th>
<th>Number of All Reported Visits</th>
<th>Number of Facilities Reporting ED Visits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug. 21-25, 2014</td>
<td>117</td>
<td>0.26</td>
<td>2</td>
<td>41,157</td>
</tr>
<tr>
<td>Aug. 20, 2014</td>
<td>77</td>
<td>0.04</td>
<td>1</td>
<td>180,330</td>
</tr>
<tr>
<td>July 1-15, 2014</td>
<td>131</td>
<td>0.05</td>
<td>2</td>
<td>285,082</td>
</tr>
<tr>
<td>June 1-15, 2014</td>
<td>338</td>
<td>0.07</td>
<td>2</td>
<td>264,605</td>
</tr>
<tr>
<td>Total</td>
<td>543</td>
<td>0.07</td>
<td>7</td>
<td>781,685</td>
</tr>
</tbody>
</table>

*HRI ED visits were identified by searching chief complaint data for the terms “heat,” “overheat,” or “too hot” and excluding the terms “faint” and “heat.” Discharge diagnosis data were searched for “heat,” or “D00” or “952” and excluding “992” and “heat” and “sew.” Heat-related deaths were identified using the search terms “heat” or “hyperthermia” or “sustained” with spelling variations included or excluded based on biological plausibility.

Number of Heat-Related ED visits by Age Group and Gender

- Number of HRI: 736
  - Age: 0-4: 30
  - Age: 5-14: 45
  - Age: 15-54: 153
  - Age: 55-64: 24
  - Age: 65+: 80
- Gender: Male: 23
- Female: 513

- Number of HRI (ED visits) by Race/Ethnicity
  - White, NH: 392
  - Black, NH: 48
  - Hispanic: 16
  - Other/Ethnicity: 16
  - Total: 560

- Demographics

Mortality 2010-2013

- Number of Heat-Related Deaths by Month and Year
  - May: 5
  - June: 4
  - July: 3
  - August: 2
  - September: 1
  - December: 1

- Number of Heat-Related Deaths, 2010-2013
  - Age: 0-4: 3
  - Age: 5-14: 10
  - Age: 15-54: 32
  - Age: 55-64: 37
  - Age: 65+: 42
  - Total: 187

*Heat-related deaths were identified by searching provisional cause of death coding and/or including immediate cause of death and death certificate and other medical conditions including “hyperthermia” or “heat stroke” or “sustained.”

Date of Report: 8/26/14
Research – Broad Definitions

- Limited studies of non-fatal HRI
- Hospital Discharge data (Semenza)
  - Primary diagnoses: Dehydration, heat stroke, heat exhaustion, acute renal failure,
  - Co-morbidities associated with HRI: CVD, diabetes, renal disease, nervous system disorders (65+ pop)
- ED visits (Knowlton) – CA – 2006
  - Increase in ED visits not hospitalization
  - Stratified by age, race/ethnicity, region, condition
  - Case-crossover
  - Increase acute renal failure, CVD (Hispanic), diabetes, electrolyte imbalance (<5), nephritis
- Hospital admissions in elderly (Bobb)-1999-2010
  - 283 primary diagnosis categories
  - Increases electrolyte /fluid disorders, renal failure, urinary tract infections, septicemia, and heat stroke
Study: Illinois Cause-Specific Risk Analysis, 2015

- Identify causes of ED visits during heat, measure risk (Patel. M, et. al.)
- Daily counts
- Defined coronary disease, MI, stroke, diabetes, acute renal disease, nephritis, electrolyte disorders, heat stress (2009-2014)
- Poisson regression, matched baseline
- Heat days: two or more days w/daily $T_{\text{max}} > 97, 98, 99$ percentile
- Increased risk electrolyte disorders, nephritis, acute renal disease.

Impact of heat events on ED visits _pending APHA abstract._
Solution Requirements:
How to count things right?

- Accurately characterizing weather-related illness
  - Broad vs. narrow case/syndrome definitions
  - All-cause excess morbidity
  - Cause-specific risk ratio
  - Stratified by (age, gender, race/ethnicity)

- Visualization / Dashboard

- New Methods
  - Dan Neil
    - Asyndromic –text patterns undefined by syndrome
    - Pre-syndromic –known health-related exposure** (heat)
    - Multiple data stream analysis
  - ISDS Technical Conventions Committee use case
Broader Solution Applications

• Cold-related illness
• Effect on mental illness & violence
• Floods & other natural events
  – Hurricanes-displacement
• Large event / mass-casualty
• Targeted interventions
Final Thoughts

• Tiefu Shen, December 2014

  “Now if we think about it, we can’t help but wonder how much time was wasted by questioning and confirming numbers, and how many lives could have been saved if the door-to-door visit were organized earlier and cooling centers were opened earlier.”
References


