EHR Surveillance for Seasonal and Pandemic Influenza in Primary Care Settings

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Acute Respiratory Infections are Common in Primary Care Practice

2007 / 2008

8.1%
Influenza hides within the constellation of Acute Respiratory Infections (ARI)

- CDC Definition of ARI
  - Two or more of the following:
    - Fever
    - Cough
    - Sore Throat
    - Rhinorrhea
    - Nasal Congestion

- CDC definition of Influenza-Like Illness (ILI)
  - Age ≥ 2 years: fever and (cough or sore throat)
  - Age < 2 years: fever and any respiratory symptom
Influenza Surveillance

- P+I mortality Index
- Virological Surveillance
- Assessment of State and Territorial Epidemiologists
- ILI–Net (Sentinel Surveillance)
  - Primary care sentinels through the US
  - Weekly reporting of ILI cases in 4 age groups
  - Weekly reporting of all patient seen
Objective:

- Determine whether a simple EMR algorithm can reliably identify influenza outbreaks in a primary care population

Background

- Experience in monitoring ARI from the UW-DFM Clinical Data Warehouse
- Combining EMR data with ILI-Net data from Wisconsin provided evidence that ILI/ARI may be a good signal
Combining data produced some interesting and strong signals...

2007 / 2008
Methods

Data Period
- July 1, 2006 through April 10, 2010
  - 3 seasonal influenza epidemics
  - 2 waves of pandemic influenza

Electronic Data
- UW Dept. of Family Medicine Clinical Data Warehouse
- Extensive universe of primary care data
  - Approximately 176,624 unique patients
  - 3.2% of Wisconsin’s total population
    - Demographic information
    - ICD-9 codes
    - CPT codes
    - EPIC EMR Data
- Approximately 16,500 patient encounters per week
Methods

- Assess the percentage of visits per week
  - “all-cause” Acute Respiratory Infections (ARI)
    - ICD-9: 381-382.9: “nonsuppurative otitis media and eustachian tube disorders” and “suppurative and unspecified otitis media”
    - ICD-9: 460-466.99: “acute respiratory infections”
    - ICD-9: 480-488.1: “pneumonia”, “influenza”, and “H1N1”
  - Influenza-like Illness (ILI)
    - ARI diagnosis code and measured temperature \( \geq 100^\circ \text{F} \)

- Calculate the ratio ILI to ARI (\%)
Methods

- Compare ILI/ARI signal to an external measure of influenza prevalence
  - Wisconsin State Laboratory of Hygiene
  - Public Health Surveillance of influenza
    - Culture
    - Rapid testing network
    - PCR
- Calculate sensitivity, specificity, PPV and NPV
  - Peak influenza weeks
  - Outbreak weeks
WSLH data

- Weekly data
  - Culture
  - Rapid testing
  - PCR

- Available at:
  - www.slh.wisc.edu
## Influenza Activity in Wisconsin

<table>
<thead>
<tr>
<th>Outbreak</th>
<th>Start</th>
<th>End</th>
<th>Weeks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seasonal #1</td>
<td>2/04/2007</td>
<td>3/24/2007</td>
<td>7</td>
</tr>
<tr>
<td>Seasonal #2</td>
<td>1/27/2008</td>
<td>3/29/2008</td>
<td>9</td>
</tr>
<tr>
<td>Seasonal #3</td>
<td>2/08/2009</td>
<td>4/04/2009</td>
<td>8</td>
</tr>
</tbody>
</table>
ILI / ARI ratio
Proposed 5% ILI/ARI ratio

- Based on occurrence of five definite peaks
- Threshold level
- Simplicity
ILI / ARI ratio

- Ratio
- 3pt Moving Average
- Outbreaks

## Performance

<table>
<thead>
<tr>
<th></th>
<th>Outbreak (+)</th>
<th>Outbreak (-)</th>
</tr>
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<tbody>
<tr>
<td>( \geq 5% \text{ ILI/ARI} )</td>
<td>31 weeks</td>
<td>0 weeks</td>
</tr>
<tr>
<td>&lt; 5% ILI/ARI</td>
<td>3 weeks</td>
<td>162 weeks</td>
</tr>
<tr>
<td>(using 3-pt MA)</td>
<td>34 weeks</td>
<td>162 weeks</td>
</tr>
<tr>
<td></td>
<td></td>
<td>196 weeks</td>
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- **Sensitivity**
  - \( \frac{31}{34} = 91.2\% \)

- **Specificity**
  - \( \frac{162}{162} = 100\% \)

- **PPV**
  - \( \frac{31}{31} = 100\% \)

- **NPV**
  - \( \frac{162}{165} = 98.2\% \)
An increase in the ILI/ARI ratio of 2% over 3 weeks also predicts outbreaks
Validity of Results

- **Strengths**
  - Primary care based data
  - Large population size
  - Wide inclusion of “umbrella” diagnoses
  - Simplicity

- **Limitations**
  - Lack of “a priori” hypothesis
  - No clear definition of influenza outbreak
    - Lack of definite “gold standard”
  - Nuances of practice, EMR and practice style
Conclusions

- Influenza outbreaks can be reliably detected by EMR data
- A very simple algorithm performs well
  - unselected ARI cases compared to cases filtered using a 100°F criteria
  - Use of a 3-point moving average would delay outbreak detection by one week
  - A marked rise in ILI/ARI ratio may provide additional support for outbreak occurrence
- Additional evaluations are warranted