Early Detection of the Flu Season Using the DC Department of Health’s Syndromic Surveillance System


APHA, Washington, November, 2007
Introduction

• Syndromic surveillance involves
  – Collection and monitoring of syndrome-related data
  – Application of statistical detection algorithms to detect a change or trend indicating
    • Bioterrorist attack
    • Beginning of seasonal flu, or pandemic

• Research questions
  – Regarding seasonal flu in Washington DC,
    • Which combinations of data in the DC ER SS system are most sensitive?
    • How quickly do they alert, compared to other sources of information?
**DC DOH’s ER SS System**

- Emergency Room Syndromic Surveillance System
  - Since 9/12/01, DC DOH has collected data on a daily basis from hospital ERs
  - Part of regional surveillance system including suburban Maryland and Northern Virginia
- Hospitals report number of patients with particular chief complaint
  - Respiratory — Neurological
  - Gastrointestinal — Sepsis
  - Unspecified infection — Death
  - Rash — Other
- Data for this presentation through June 2006
  - 7 hospitals with relatively complete data
**Detection algorithms**

- **CUSUM (CUMulative SUMmation)**
  \[- C_t = \max [C_{t-1} + (y_t - \mu) - k, 0] \quad \text{Alarm if } C_t > h\]

- **CUSUM EXPO (mean-adjusted)**
  - Exponentially Weighted Moving Average (EWMA)
    \[- z_t = \lambda y_t + (1-\lambda)z_{t-1} \]
    \[- C_t = \max [C_{t-1} + (y_t - z_t) - k, 0] \quad \text{Alarm if } C_t > h\]

- **Multivariate (MV) CUSUM** (Stoto et al., 2006)
Preliminary results

• Adjust false positive rates to account for multiple streams to >1 stream

• Fine-tuned CUSUM, CUSUM EXPO, and MV CUSUM algorithms using 2-pronged approach
  – Simulation studies
  – Compare to known outbreaks

• Results
  – In general, MV CUSUM performs better than CUSUM and CUSUM EXPO
  – In one setting (3 streams unspecified infection), CUSUM EXPO outperformed MV CUSUM
Winter 2002: Unspecified Infection

Red = Hospital A, Orange = Hospital H, Green = Hospital I
Winter 2002: Respiratory

Red = Hospital A, Green = Hospital B, Blue = Hospital C, Lt. Blue = Hospital D, Purple = Hospital E, Yellow = Hospital H, Black = Hospital I
Winter 2005: Children’s unspecified and respiratory and CDC sentinel physicians

Winter 2005: Children's Hospital Surveillance Systems (Black Symbols) vs. All Others (Red Symbols)
Winter 2004: Children’s unspecified and respiratory and CDC sentinel physicians

Winter 2004: Children's Hospital Surveillance Systems (Black Symbols) vs. All Others (Red Symbols)
# Early Detection of the Flu Season by DC ER Syndromic Surveillance

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<tbody>
<tr>
<td><strong>CDC sentinel physicians</strong></td>
<td>Jan 26 +26</td>
<td>Nov 22</td>
<td>Jan 22 +20</td>
<td>Feb 4</td>
</tr>
<tr>
<td><strong>Children’s Hospital</strong></td>
<td>Dec 31</td>
<td>Nov 24 +2</td>
<td>Jan 2</td>
<td>Feb 27 +23</td>
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<td><strong>All other hospitals</strong></td>
<td>Jan 4 +4</td>
<td>Dec 8 +14</td>
<td>Jan 4 +2</td>
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Conclusions

• In detecting the start of the influenza season using the DC ER SSS …

• “Unspecified infection” cases most effective
  – “Respiratory” cases provide information, but not beyond that in unspecified infection

• Children’s National Medical Center more sensitive than
  – Other hospitals alone
  – Multivariate analysis of 6 or 7 hospitals

• Analysis of unspecified infection cases from Children’s performs well compared to CDC sentinel physician surveillance