Now that we are SMART about Influenza Outbreaks —

What's the Next Opportunity?

- What are next steps for flu tracking w/ SMART?
  - Third season reliability/ validity vs. ILI
- Use by public and/or public health practitioners?
  - Marketing to practitioners:
    - Visits to CDC
    - International Soc. Disease Surveillance Abstract
    - Other Meetings?  American Public Health Assoc.?
    - Emails to Flu stakeholders – Vaccine Manufactures?
- Feedback/Improvement - Link inviting user to:
  - Send email ? Take Survey ?
  - "User Forum / Chat room with staff feedback?"
Rationale for City ILI Focus

-- “all public health is local”

• Other Fly Systems at national & state level
  • Google Flu Trends national, regional city?
  • FluNearYou --- uses crowdsourcing – state reports local maps

• Detecting an outbreak at the city/county level could make impact in reducing disease transmission or treatment
  ▪ Neighboring cities could focus on prevention
  ▪ Could guide resource allocation decisions
    • Anti-viral drugs
    • Hospital staffing, Elective admissions suspended
What other Diseases or Health Issues to Track?

- Problem--
  - Fit problem to tool (twitter)
  - Fit tool to the problem (health condition)

- Finding Problems and Public Health Priorities
  - What are “needs of the market?”
    - Systematic reviews (1)
    - Policy/ Priority Documents (old)
    - White Papers / Plans ?
    - Expert Opinion Surveys ?
    - Governmental / Non-Governmental Organizations ?
    - Not too much Found --- yet
Public Health … big problems
Look at gaps in reportable diseases?

- Foodborne Illness -- “tip of the iceberg”
  - Several Innovative Interactive Systems
    - See tweet on possible Foodborne illness
    - Health Dept Staff sends link to official case report website.
    - Health dept follow-up

- Sustainability issues
Public Health Surveillance

- **Definition:** ongoing, systematic collection, analysis, and interpretation of data on specific health events
- **Collection of Data**
  - Pertinent, regular, frequent, prompt, timely
- **Consolidation and Interpretation of Data**
  - Orderly, descriptive, evaluative, prompt, timely
- **Dissemination of Information**
  - Prompt, timely, all who need to know
- **Action to**
  - prevent disease, control epidemics, improve health
Velasco et al. (2014). "Social Media and Internet-Based Data in Global Systems for Public Health Surveillance: A Systematic Review."

**TABLE 2**

List of Event-Based Systems Identified

<table>
<thead>
<tr>
<th>No.</th>
<th>System Name (literature reference)</th>
<th>Category</th>
<th>Country</th>
<th>Year Started</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.1</td>
<td>Argus&lt;sup&gt;43,51&lt;/sup&gt;</td>
<td>Moderated</td>
<td>USA</td>
<td>2004</td>
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<tr>
<td>3.2</td>
<td>BioCaster&lt;sup&gt;52&lt;/sup&gt;</td>
<td>Automatic</td>
<td>Japan</td>
<td>2006</td>
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<tr>
<td>3.3</td>
<td>EpiSPIDER&lt;sup&gt;34,53&lt;/sup&gt;</td>
<td>Automatic</td>
<td>USA</td>
<td>2006</td>
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<tr>
<td>3.4</td>
<td>EWRS&lt;sup&gt;54&lt;/sup&gt;</td>
<td>Moderated</td>
<td>EU</td>
<td>1998</td>
</tr>
<tr>
<td>3.5</td>
<td>GOARN&lt;sup&gt;55&lt;/sup&gt;</td>
<td>Moderated</td>
<td>Multiple&lt;sup&gt;a&lt;/sup&gt;</td>
<td>2000</td>
</tr>
<tr>
<td>3.6</td>
<td>GODSN&lt;sup&gt;56&lt;/sup&gt;</td>
<td>Automatic</td>
<td>USA</td>
<td>2006</td>
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<tr>
<td>3.7</td>
<td>GPHIN&lt;sup&gt;26,57&lt;/sup&gt;</td>
<td>Moderated</td>
<td>Canada</td>
<td>1997</td>
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<tr>
<td>3.8</td>
<td>HealthMap&lt;sup&gt;58-62&lt;/sup&gt;</td>
<td>Automatic</td>
<td>USA</td>
<td>2006</td>
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<tr>
<td>3.9</td>
<td>InSTEDD&lt;sup&gt;63&lt;/sup&gt;</td>
<td>Moderated</td>
<td>USA</td>
<td>2006</td>
</tr>
<tr>
<td>3.10</td>
<td>MedISys and PULS&lt;sup&gt;64,65&lt;/sup&gt;</td>
<td>Automatic</td>
<td>EU</td>
<td>2004</td>
</tr>
<tr>
<td>3.11</td>
<td>MiTAP&lt;sup&gt;66&lt;/sup&gt;</td>
<td>Automatic</td>
<td>USA</td>
<td>2001</td>
</tr>
<tr>
<td>3.12</td>
<td>ProMED-mail&lt;sup&gt;13,67-69&lt;/sup&gt;</td>
<td>Moderated</td>
<td>USA</td>
<td>1994</td>
</tr>
<tr>
<td>3.13</td>
<td>Proteus-BIO&lt;sup&gt;11&lt;/sup&gt;</td>
<td>Automatic</td>
<td>USA</td>
<td>2000</td>
</tr>
</tbody>
</table>

<sup>a</sup>GOARN is a WHO-coordinated network
Velasco et al. (2014). Finding & Conclusions

- No comprehensive evaluations that show systems have been integrated into actual epidemiological work during real-time health events.
- Acceptability of Internet and social media in public health surveillance programs is limited.
- **Circular challenge** willingness to integrate needs effectiveness studies but …. No structured evaluation of newer systems.
- Other non-technical issues are also barriers individual perceptions (epidemiologists)
- Dealing with personal health data and social media and other Internet data
Contingencies of Morbidity Reporting

Population
- Persons without symptoms of a particular disease
  - No complaints (ashamed, stoical afraid, etc.)
  - Complaints of symptoms
    - Consultation sought
      - Diagnosis suspected
        - Diagnosis not established (too early, too late, not confirmed)
      - Diagnosis established
        - Report of case
    - No consultation (no funds, do not believe in doctors, indifference)

Fox, Hall & Elvenbach,
Epidemiology

FIG. 13-2 Contingencies of morbidity reporting.
Wanted: systematic assessment of emerging surveillance systems

<table>
<thead>
<tr>
<th>Surveillance Methods</th>
<th>Approaches</th>
<th>Syndromic</th>
<th>Surveillance</th>
<th>Approaches</th>
<th>Or</th>
<th>systems</th>
<th>Traditional</th>
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</thead>
<tbody>
<tr>
<td>Social-Media</td>
<td>Web crawler</td>
<td>Crowd-sourcing with Interaction</td>
<td>Surveillance</td>
<td>Website and or email text analysis</td>
<td>Retail sales data bases</td>
<td>Event - based new systems</td>
<td>Insurance claims data</td>
</tr>
<tr>
<td>Example(s)</td>
<td>SUSD SMART website (San Diego State University 2014)</td>
<td>FluNear You (Flinear 2014)</td>
<td>Foodborne Chicago</td>
<td>Expert knowledge sourcing (Bemang-Ford &amp; Garton 2013)</td>
<td>New York Health Dept-Yelp.com Restaurant complaint review</td>
<td>This can be considered a form of “event” based data</td>
<td>Multiple established systems see review by: (Velasco, Agheneza et al. 2014)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>System Characteristics</th>
<th>Criteria for evaluation</th>
<th>...starter list...</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purpose of system</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current Status &amp; availability</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owner(s)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Customers or stakeholders</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access - public vs. private, membership</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Logistical Issues</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Development costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sustainability &amp; Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Innovative &amp; Novel Issues</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adaptable/useful with mobile technology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operator attention</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intensity &amp; type of expertise needed</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Privacy, confidentiality HIPPA concerns</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Big Picture --- Strategic &amp; Policy Issues</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Public health significance and or interest in disease or threat or issue</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Health or burden</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morbidity/Mortality etc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utility - Fills gap vs. improving existing info</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Public, Policymaker &amp; Other interest in disease or issue</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Surveillance Methods or Approaches - Partial listing

- State Mandated disease/condition reporting (Public Health)
- Sentinel or “expert” systems (e.g. ILI in selected cities)
- Retail sales databases
- Insurance Claims data
- Website and or email text analysis “Webcrawler”
- Electronic medical records & regional data exchanges
- Crowd-sourcing social media with Interaction
- Social Media “Twitter” tracking
- Active Crowd Sourcing -- Flu Near You
System Characteristics
Criteria for evaluation … starter list

General

- Purpose of system
- Current Status & availability
- Owner(s)
- Customers or stakeholders
- Access – public vs private, membership
• Logistical Issues

• Development costs
• Sustainability & Costs
• Innovation vs incremental improvement
• Adaptable/ useful with mobile technology
• Operator attention
• Intensity & type of expertise need
• Privacy, confidentiality HIPPA concerns
Big Picture -- Strategic & Policy & Political Issues

- Public health significance
  - Interest in disease or threat or issue
  - Health burden
    - Morbidity/Mortality
    - Costs: lost school, worker productivity
- Fills gap vs. improving existing info?
- Public, Policymaker & Funder interest in disease or issue
Surveillance (scientific)
Characteristics /Issues

• Acceptability & Use by professionals / organizations/ policy makers
• Locus of analysis --
  • Local vs. state vs. national? E.g. granularity of data & information
• Case definition precise vs. vague
• Timeliness –
• Leading or Lagging indicator
• Sensitivity vs Specificity
• Action-ability for disease control or other purposes
  • -- direct or needs more analysis?
• Action-ability for Policy or Planning – and other less immediate uses
Vaccine Information and Sentiment Over Space and Time

Anna C. Nagel, Ming-Hsiang Tsou, Li An, Jean Marc Gawron, Dipak K Gupta, Brian Spitzberg, Jiue-An Yang, Su Han, K. Michael Peddecord, Mark H. Sawyer, Suzanne Lindsay

Committee members;
- Dr. Suzanne Lindsay (Chair)
- Dr. Michael Peddecord
- Dr. Ming-Hsiang Tsou

Tweets Leading or Lagging ILI?  2012-13 Flu Season


<table>
<thead>
<tr>
<th>City</th>
<th>r</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seattle</td>
<td>0.75</td>
<td>14229</td>
</tr>
<tr>
<td>Portland</td>
<td>0.33</td>
<td>1074</td>
</tr>
<tr>
<td>San Diego</td>
<td>0.67</td>
<td>10586</td>
</tr>
<tr>
<td>Denver</td>
<td>0.67</td>
<td>8964</td>
</tr>
<tr>
<td>Chicago</td>
<td>0.29</td>
<td>26924</td>
</tr>
<tr>
<td>Cleveland</td>
<td>0.44</td>
<td>7434</td>
</tr>
<tr>
<td>New York</td>
<td>0.23</td>
<td>55455</td>
</tr>
<tr>
<td>Fort Worth</td>
<td>0.75</td>
<td>4820</td>
</tr>
<tr>
<td>Nashville-Davidson</td>
<td>0.53</td>
<td>8755</td>
</tr>
<tr>
<td>Jacksonville</td>
<td>0.67</td>
<td>3647</td>
</tr>
</tbody>
</table>

**Tweets Lead**

- Seattle
- Portland
- San Diego
- Denver

**Tweets Lag**

- Chicago
- Cleveland
- New York
- Fort Worth
- Nashville-Davidson
- Jacksonville

**Legend**

- Percent ILI
- Tweet Rate
- Data Missing

**Charts**

- Histograms showing percent ILI, tweet rate, and data missing for different cities.

Table 4. “Valid” Tweet Rates per 100,000 versus Sentinel Provided ILI Rates by City, 2013-14 Influenza Season

<table>
<thead>
<tr>
<th>City</th>
<th>r</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boston</td>
<td>0.10</td>
<td>3813</td>
</tr>
<tr>
<td>Chicago</td>
<td>0.64</td>
<td>5116</td>
</tr>
<tr>
<td>Cleveland</td>
<td>0.60</td>
<td>1497</td>
</tr>
<tr>
<td>Columbus</td>
<td>-0.24</td>
<td>1034</td>
</tr>
<tr>
<td>Denver</td>
<td>0.69</td>
<td>1942</td>
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<tr>
<td>Detroit</td>
<td>0.76</td>
<td>2195</td>
</tr>
<tr>
<td>Fort Worth</td>
<td>0.85</td>
<td>1236</td>
</tr>
<tr>
<td>Nashville-Davidson</td>
<td>0.83</td>
<td>1630</td>
</tr>
<tr>
<td>New York</td>
<td>0.55</td>
<td>12632</td>
</tr>
<tr>
<td>San Diego</td>
<td>0.88</td>
<td>1808</td>
</tr>
</tbody>
</table>
Anoshé A. Aslam, MPH Plan B Project: The Reliability of Tweets as a Supplementary Method of Seasonal Influenza Surveillance

Figure 1. Comparing weekly laboratory confirmed influenza cases (black line) and weekly flu tweeting rates (pink bars). Note: Total lab confirmed cases= 1808
Social Media Analysis & Research Testbed

About Human Dynamics Center, San Diego State University

Human Dynamics is a transdisciplinary research field focusing on the understanding of dynamic patterns, relationships, narratives, changes, and transitions of human activities, behaviors, and communications.

The Center for Human Dynamics in the Mobile Age (HDMA) is a new research institute at SDSU to focus on research questions and analytical software development for human dynamics problems, such as disaster responses and disease outbreaks, urban problems, by monitoring information from mobile technologies and mobile devices (such as GIS, social media and GPS datasets).

Please select a topic

- Flu
- Whooping Cough
- Wildfire
- Drugs
- Aztecs
http://vision.sdsu.edu/hdma/smart/
Crowd Sourcing to Track Influenza Outbreaks

https://flunearyou.org

Flu Near You is a free, real-time ILI surveillance system
• Uses anonymous crowd-sourced symptom reporting
• Gives public health community & practitioners a new tool
• Early warning system that identifies outbreaks
• May aid targeting of disease prevention and treatment
• Better analysis and visualization disease spread
• Direct public engagement in combating communicable disease
• Possible insight into vaccine effectiveness

a project of HealthMap.org Boston
FluNearYou Weekly Report

Health Status Report

Thank you! Please report symptoms for Monday, September 01 2014 - Sunday, September 07 2014.

I experienced:

- Fever
- Cough
- Sore throat
- Shortness of breath
- Chills/night sweats
- Fatigue
- Nausea or vomiting
- Diarrhea
- Body aches
- Headache

- I did not have any of the listed symptoms

Did you receive the flu vaccine after July 31, 2014?

- Yes
- No
- Don't Know

Did you receive the flu vaccine last year (between July 31, 2013 - July 31, 2014)?

- Yes
- No
- Don't Know

Report
FluNearYou Android or iPhone App
FluNearYou  iPhone or Android App
Flu activity level

1 = No Report  2 = No Activity  3 = Sporadic  4 = Local  5 = Regional  6 = Widespread

Data supplied by CDC weekly flu reports
Thank you!

Questions?
Evolution of Health Surveillance

- Classical: Communicable Disease Reporting Cycle:
  - Providers >> Local >> State >> Federal >> Users

- Sentinel Surveillance
  - Selected organizations and providers

- Syndromic Surveillance
  - Mining of electronic data
    - Examples: Electronic Medical Records, Pharmacy sales

- Emerging concepts
  - Infodemiology - study of the distribution and causal factors using information in cyberspace
  - Infoveillance – monitoring online texts for surveillance
Previous works - Google Flu Trends

- Compared search queries with ILI
  - Mean correlation = .9
- Used 45 different search queries

Google Flu Trends last 6 seasons

We've found that certain search terms are good indicators of flu activity. Google Flu Trends uses aggregated Google search data to estimate flu activity. Learn more »
Google Flu Trends

States | Cities (Experimental) - Click on a city below to chart the flu trend above.

San Diego, CA
Flu activity: Low
Google Flu Trends  Cities

Addison, TX
Flu activity: High