Pandemic Influenza H1N1: Clinical and Epidemiologic Features and Public Health Surveillance

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How Flu Spreads

- Spread through coughing and sneezing
- Contact transmission also important
  - Hand to hand, contaminated surfaces
- Airborne transmission possible
Highly Efficient Transmission

• March 28–30, 2009: Virus identified
• April 26, 2009: US declares Public Health Emergency
• June 11, 2009: WHO declares phase 6 pandemic
Seasonal Flu is a Big Deal

- Affects 5–20% of US population each year
- 200,000 hospitalizations each year
- 36,000 deaths each year
  - More common in elderly
  - <100 pediatric deaths per year reported

Thompson, JAMA 2003; Thompson, JAMA 2004
Pandemic H1N1 vs. Seasonal Flu

- Similar transmissibility
- Affects younger populations
- Will infect more people than seasonal flu
  - More cases of severe illness
  - More deaths
### Pandemic H1N1 Confirmed and Probable Case Rates in the US, by Age Group

<table>
<thead>
<tr>
<th>Age Groups</th>
<th>Rate / 100,000 Pop by Age Group</th>
<th>Number of Cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4 Yrs</td>
<td>22.9</td>
<td>4,816</td>
</tr>
<tr>
<td>5-24 Yrs</td>
<td>26.7</td>
<td>22,080</td>
</tr>
<tr>
<td>25-49 Yrs</td>
<td>6.97</td>
<td>7,434</td>
</tr>
<tr>
<td>50-64 Yrs</td>
<td>3.92</td>
<td>2,187</td>
</tr>
<tr>
<td>≥65 Yrs</td>
<td>1.3</td>
<td>513</td>
</tr>
</tbody>
</table>

*Excludes 6,741 cases with missing ages.


www.cdc.gov/h1n1flu/surveillanceqa.htm
Pandemic H1N1 U.S. Hospitalization Rate in the US, by Age Group

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Hospitalizations per 100,000 Population in Age Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4 Yrs</td>
<td>4.5</td>
</tr>
<tr>
<td>5-24 Yrs</td>
<td>2.1</td>
</tr>
<tr>
<td>25-49 Yrs</td>
<td>1.1</td>
</tr>
<tr>
<td>50-64 Yrs</td>
<td>1.2</td>
</tr>
<tr>
<td>≥65 Yrs</td>
<td>1.7</td>
</tr>
</tbody>
</table>

*n=953*  
*n=1718*  
*n=1184*  
*n=658*  
*n=225*  

*Hospitalizations with unknown ages are not included (n=273)*  

www.cdc.gov/h1n1flu/surveillanceqa.htm
Pandemic H1N1: Clinical Features

• Similar severity to seasonal flu
  – Not “mild”

• Most cases uncomplicated, typical influenza-like illness (ILI)

• Diarrhea and vomiting more prominent than with seasonal flu

• Hospitalization and death rates difficult to assess
  – More total cases = more severe cases
### Clinical Features among NC Cases

<table>
<thead>
<tr>
<th>Condition</th>
<th>Count/Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>570/584</td>
<td>98%</td>
</tr>
<tr>
<td>Cough</td>
<td>506/551</td>
<td>92%</td>
</tr>
<tr>
<td>Myalgias</td>
<td>243/391</td>
<td>62%</td>
</tr>
<tr>
<td>Sore Throat</td>
<td>237/394</td>
<td>60%</td>
</tr>
<tr>
<td>Coryza</td>
<td>195/392</td>
<td>50%</td>
</tr>
<tr>
<td>Vomiting</td>
<td>114/493</td>
<td>26%</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>75/419</td>
<td>18%</td>
</tr>
</tbody>
</table>
Severe Illness

• 25% of admissions require ICU

• Lower respiratory illness
  – Diffuse alveolar damage
  – Hemorrhagic interstitial pneumonitis
  – ARDS

• Secondary bacterial pneumonia
  – Strep and staph

• High-risk conditions identified in >70% hospitalized cases, 80% deaths in US
Influenza Surveillance

• Not based on identifying every individual case
  – High numbers affected each year; more during pandemic
  – Most won’t seek care
  – Few will be tested
Influenza Surveillance

Relies on:
1. Tracking of influenza-like illness
   • Influenza-like Illness Network (ILINet)
   • Electronic emergency department surveillance
2. Systematic laboratory testing
3. Monitoring disease severity
   • Hospitalizations
   • Deaths
   • Severe illness among pregnant women
Flu Surveillance Goals

1. Identify and track mutations in viruses
   • Novel strains, match to vaccine, antiviral resistance
2. Detect the onset, duration and geographic spread of the epidemic/pandemic
3. Detect changes in severity
4. Identify severely affected populations
   ➢ Guide interventions
   ➢ Provide information to partners
Influenza-Like Illness Surveillance

- Influenza-like Illness Network (ILINet)
  - National program of volunteer providers
  - Report % of visits due to ILI
  - Submit specimens for testing
  - >95 volunteer providers across NC
Percentage of Visits for Influenza-like Illness (ILI) Reported by the U.S. Outpatient Influenza-like Illness Surveillance Network (ILINet), Weekly National Summary, October 1, 2006 – November 28, 2009
Flu Surveillance in NC

• **Influenza-like Illness Network (ILINet)**
  – National program
  – >95 volunteer providers across NC
  – Report % of visits due to ILI weekly
  – Submit specimens for testing

• **Emergency Department Surveillance: NC DETECT**
  – Electronic surveillance of all ED visits
  – Tracks visits/admissions for flu-like illness
Influenza-Like Illness Surveillance in North Carolina, 2009-2010

Week Ending Date

ED (NC DETECT)
Sentinel Provider Network (ILINet)
ED ILI Cases As A Percentage Of All Visits Grouped By the PHRSTs Region
2009-2010 Flu Season

Week Ending Date

*Start of 09-10 Influeza Season Week
40 = Week Ending 10/10/2009
Laboratory Surveillance

- NC State Laboratory of Public Health
  - Sample of patients from ILINet
  - Patients requiring ICU care
  - Deaths suspicious for influenza
  - Situations of public health significance
  - More than 5,700 specimens tested since April (!)

- Public Health Epidemiologist (PHE) Network
  - 11 largest healthcare systems in NC
  - Report positive tests for flu, other viruses
Influenza Positive Tests Reported by the N.C. State Laboratory of Public Health by Week

Week Ending Date

Seasonal A (H1)  Seasonal A (H3)  A unsubtypable  Seasonal B  Novel A (H1N1)  Percent Positive†

#Positive Specimens

0% 10% 20% 30% 40% 50% 60% 70% 80%
Laboratory Testing

• Negative rapid test does **NOT** rule out pandemic H1N1 infection
  – Sensitivity ranges 10–70% for novel H1N1
  – Negative rapid tests have led to treatment delay in fatal cases

• Treatment and control measures should be based on clinical and epidemiologic information; not on testing
Influenza-Associated Hospitalization Surveillance in NC

- NC DETECT
  - ED ILI visits resulting in admission
  - Does not include non-ED admissions
  - Includes ILI from any cause, not only influenza
Number of ED Visits for ILI and Percent Admitted

Source: NC DETECT
Influenza-Associated Hospitalization Surveillance in NC

• NC DETECT
  – ILI admissions from all EDs
  – Does not include non-ED admissions
  – Includes ILI from any cause, not only influenza

• Public Health Epidemiologist (PHE) Network
  – Admissions for febrile respiratory illness
  – Able to exclude those with “known cause other than influenza”
Influenza-Associated Death Surveillance

• “Influenza-associated” defined as
  – Clinically compatible illness
  – Influenza identified by laboratory or rapid test

• Pediatric influenza-associated deaths reportable since 2004

• Beginning October 1, NC physicians also required to report deaths in adults
251 since April; 210 confirmed H1N1
Influenza-Associated Deaths Reported in North Carolina, by Week of Death (n=74)

Week Ending Date

No. of Reported Deaths

<table>
<thead>
<tr>
<th>Week Ending Date</th>
<th>Adult Flu Deaths</th>
<th>Pediatric Flu Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>4/4/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4/18/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5/2/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5/16/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5/30/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6/13/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6/27/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7/11/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7/25/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8/8/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8/22/2009</td>
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<tr>
<td>9/5/2009</td>
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<td>0</td>
</tr>
<tr>
<td>9/19/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10/3/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10/17/2009</td>
<td>0</td>
<td>0</td>
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<tr>
<td>10/31/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11/14/2009</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>11/28/2009</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

All flu deaths made reportable
Influenza Associated Deaths by County of Residence

Confirmed influenza-associated deaths (N=74)
## Demographic Features

(n=74)

<table>
<thead>
<tr>
<th>Feature</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>Median 50, Range 5–87</td>
</tr>
<tr>
<td>Male</td>
<td>40 / 74 (54%)</td>
</tr>
<tr>
<td>Hispanic</td>
<td>8 / 56 (14%)</td>
</tr>
<tr>
<td>Race (n=68)</td>
<td></td>
</tr>
<tr>
<td>African American</td>
<td>23 (34%)</td>
</tr>
<tr>
<td>White</td>
<td>42 (62%)</td>
</tr>
<tr>
<td>Other</td>
<td>3 (4%)</td>
</tr>
</tbody>
</table>
Influenza-Associated Deaths Reported in North Carolina, by Age Group, April 1 - December 5, 2009
(n=74)

<table>
<thead>
<tr>
<th>Age Group</th>
<th>No. of Reported Deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-4</td>
<td>6</td>
</tr>
<tr>
<td>5-18</td>
<td>1</td>
</tr>
<tr>
<td>19-24</td>
<td>28</td>
</tr>
<tr>
<td>25-49</td>
<td>30</td>
</tr>
<tr>
<td>50-64</td>
<td>9</td>
</tr>
</tbody>
</table>
NC Influenza-Associated Death Rates
April 1, 2009 - December 5, 2009

Death Rate per 100,000 Population

- 5-18: 6
- 19-24: 1
- 25-49: 30
- 50-64: 1.72
- 65+: 9
- All Ages: 74
<table>
<thead>
<tr>
<th>Condition</th>
<th>Count/Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any</td>
<td>60/74</td>
<td>(81%)</td>
</tr>
<tr>
<td>Chronic Lung Disease</td>
<td>28/50</td>
<td>(56%)</td>
</tr>
<tr>
<td>COPD</td>
<td>16/28</td>
<td>(57%)</td>
</tr>
<tr>
<td>Asthma</td>
<td>8/28</td>
<td>(29%)</td>
</tr>
<tr>
<td>Heart Disease</td>
<td>23/47</td>
<td>(49%)</td>
</tr>
<tr>
<td>Diabetes</td>
<td>20/50</td>
<td>(40%)</td>
</tr>
<tr>
<td>Immunosuppressed</td>
<td>18/47</td>
<td>(38%)</td>
</tr>
</tbody>
</table>
## Complications

<table>
<thead>
<tr>
<th>Complication</th>
<th>Cases / Total</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pneumonia</td>
<td>53 / 60</td>
<td>88%</td>
</tr>
<tr>
<td>ARDS</td>
<td>38 / 55</td>
<td>69%</td>
</tr>
<tr>
<td>Sepsis</td>
<td>16 / 42</td>
<td>38%</td>
</tr>
<tr>
<td>Shock</td>
<td>13 / 45</td>
<td>29%</td>
</tr>
<tr>
<td>Encephalopathy</td>
<td>5 / 47</td>
<td>11%</td>
</tr>
<tr>
<td>Seizures</td>
<td>5 / 48</td>
<td>10%</td>
</tr>
</tbody>
</table>
Influenza-Associated Death Surveillance: Other Sources

- Public Health Epidemiologist network
  - Influenza deaths by age group

- Medical Examiner surveillance
  - Possible influenza deaths with no lab evidence

- 122 Cities Mortality Reporting System
  - Pneumonia and Influenza deaths
  - Covers 1/4 of all US deaths
Pneumonia and Influenza Mortality for 122 U.S. Cities
Week Ending 11/28/2009

% of All Deaths Due to P&I

Epidemic Threshold
Seasonal Baseline

Weeks

2005 2006 2007 2008 2009

40 50 40 30 20 10 0 10 20 30 40
<table>
<thead>
<tr>
<th></th>
<th>Point Estimate</th>
<th>(Range)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cases</strong></td>
<td>22 million</td>
<td>(14–34 million)</td>
</tr>
<tr>
<td><strong>Hospitalizations</strong></td>
<td>98,000</td>
<td>(63,000–153,000)</td>
</tr>
<tr>
<td><strong>Deaths</strong></td>
<td>3,900</td>
<td>(2,500–5,100)</td>
</tr>
<tr>
<td><strong>Child Deaths</strong></td>
<td>540</td>
<td>(300–800)</td>
</tr>
</tbody>
</table>
H1N1 Antiviral Resistance

- Universal resistance to adamantanes
- Sporadic oseltamivir resistance
  - 26 cases in US since April
  - 19 had exposure to oseltamivir
  - Majority immunosuppressed
- No zanamivir resistance to date
What’s Next?

• Continue enhanced surveillance, monitor for:
  – Increased activity during “normal flu season”?
  – Emergence of seasonal flu strains?
  – Changes in antiviral resistance?
  – Other?

• Stay tuned!
Public Health Resources

- www.flu.nc.gov
- www.cdc.gov/h1n1flu