Epidemiology of Influenza in the Hospital Setting

Keith F. Woeltje, MD, PhD
Associate Professor of Medicine
Washington University School of Medicine
Medical Director, Infection Control
BJC HealthCare
St. Louis, MO
Nosocomial Influenza - Definitions

- **Disease definitions**
  - CDC: “Influenza-like Illness” (ILI)
    - Temp $\geq 37.8^\circ C$
    - Cough or sore throat (or both)
    - No other documented cause of illness
  - Other clinical definitions
  - Laboratory confirmed cases
    - Culture
    - Serologic tests
    - Others: DFA, rapid antigen tests, PCR

- **Timing definitions**
  - $\geq 72$ hours after admission
  - $\geq 48$ hours after admission
Not All ILI Patients Have Influenza

- Blumenfeld: 22/30 nosocomial ILI with positive convalescent titers
- Weingarten: 2/4 nosocomial ILI with positive cultures
- Pachucki: 15/38 submitted specimens (patients and HCW) with positive cultures
- Rivera: 16/21 nosocomial ILI patients with positive convalescent titers
- Van Voris: 18/29 nosocomial ILI patients with either positive culture or positive convalescent titers (1/11 non-positive with confirmed RSV)
- Glezen: 6/17 nosocomial ILI patients with positive culture

Blumenfeld HL. J Clin Invest. 1959;38:199-212
Rivera M. Am J Nursing. 1982;82:1836-1838
Pachucki CT. Arch Intern Med. 1989;149:77-80
Not All Influenza Patients Have an ILI

<table>
<thead>
<tr>
<th>ILI Symptom</th>
<th>No. (%) of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature $\geq 37.8^\circ C$</td>
<td>124 (60)</td>
</tr>
<tr>
<td>Temperature $\geq 37.8^\circ C$ and cough</td>
<td>106 (51)</td>
</tr>
<tr>
<td>Temperature $\geq 37.8^\circ C$ and sore throat</td>
<td>25 (12)</td>
</tr>
<tr>
<td>Temperature $\geq 37.8^\circ C$ and either cough or sore throat$^a$</td>
<td>106 (51)</td>
</tr>
</tbody>
</table>

$^a$ Centers for Disease Control and Prevention definition of ILI.
Estimates of Nosocomial Influenza

- Weingarten: 0.3 cases / 100 hospital admissions (2/663)
- Glezen: 0.6 cases / 100 hospital admissions
- Weinstock: 0.73 - 2.62 / 10,000 patient days (cancer center)
- Adal: 0.01 – 0.14 / 100 admissions (overall 0.08)
- Babcock: 0 / 335 participating patients

Adal KA. Infect Control Hosp Epidemiol. 1996;17:641-648
Babcock HM. personal communication
Outbreak - 1957 Pandemic

• 1957 “Asian Flu” H2N2
  – SW China February
  – US cases starting in May, slow during summer, epidemics Sept-Dec
• Ward H5 at New York Hospital - Cornell Medical Center
  – 29 patients, 33 healthcare workers
  – 22 HCW vaccinated with monovalent vaccine

Blumenfeld HL. *J Clin Invest.* 1959;38:199-212
patient attack rate 15/29 (52%)

HCW attack rate 15/33 (45%)
Epidemiology of 12 Nosocomial Acute-Care Influenza Outbreaks

- Strains: A (11; mostly H3N2), B (2)
- Years: 1960s (1), 1970s (4), 1980s (2), 1990s (3), 2000s (2)
- Outbreak durations: 2-69 days (median 7)
- Attack rates: Patients – 3-50% (affected wards)
  - 0.7-20% (hospital-wide)
  HCWs – 11-59% (flu caregivers)
- Patient mortality: 0% (5); 10-67% (7)

Review of 17 Reports of Nosocomial Influenza

- 5 reports also in Salgado et al.
- Years: 1950s (1), 1960s (1), 1970s (3), 1980s (6), 1990s (1)
- Strains: A (10), B (1), A & B (1)
- Patient mortality: 0% (6), 6-33% (6)
- In most reports fewer than 1/3 of HCW vaccinated

Special Populations - HIV

• Outbreak at residential AIDS facility in NYC 1996
  – 34/65 (52%) residents with ILI
  – 19/68 (28%) employees with ILI
  – 20/31 (65%) ILI patients had laboratory confirmed influenza
  – 2/41 (5%) of participants w/o ILI who were tested had (+) serologies (both were residents)
Influenza Attack Rates

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>All persons (n = 133)</th>
<th>Residents (n = 65)</th>
<th>Employees (n = 68)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. (%)</td>
<td>RR</td>
<td>P</td>
</tr>
<tr>
<td>AIDS</td>
<td>37 (52.9)</td>
<td>2.1</td>
<td>.001</td>
</tr>
<tr>
<td>No AIDS</td>
<td>16 (25.4)</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>HIV infection</td>
<td>38 (52.1)</td>
<td>2.1</td>
<td>.002</td>
</tr>
<tr>
<td>No HIV infection</td>
<td>15 (25.0)</td>
<td>0</td>
<td>—</td>
</tr>
<tr>
<td>Vaccinated^a</td>
<td>26 (32.5)</td>
<td>0.7</td>
<td>.063</td>
</tr>
<tr>
<td>Unvaccinated</td>
<td>24 (49.0)</td>
<td>17 (65.4)</td>
<td>1.4</td>
</tr>
<tr>
<td>Other chronic illness^b</td>
<td>16 (50.0)</td>
<td>13 (68.4)</td>
<td>1.5</td>
</tr>
<tr>
<td>No other chronic illness</td>
<td>35 (36.5)</td>
<td>21 (45.7)</td>
<td>1.6</td>
</tr>
<tr>
<td>Current smoker</td>
<td>39 (54.2)</td>
<td>33 (57.9)</td>
<td>4.6</td>
</tr>
<tr>
<td>Nonsmoker</td>
<td>14 (23.0)</td>
<td>1 (12.5)</td>
<td>—</td>
</tr>
</tbody>
</table>

On multivariate analysis, current smoking status was strongest predictor of influenza, followed by vaccination status. HIV/AIDS status was not strongly predictive.

Special Populations - Transplant

• BMT unit, 1998
  – Source: BMT patient admitted with ILI but not isolated
  – Patient attack rate: 7/27 (26%)
  – 5 staff with ILI

• Solid organ transplant unit, 2000
  – Patient attack rate: 4/12 (33%)
  – Source: nurse with ILI. 2/26 (8%) other HCW developed ILI

Malavaud S. Transplantation. 2001;72:535-537
Control of Influenza in the Hospital Setting
Influenza - Routes of Spread

Healthcare Workers

Visitors / Community

Patients
Measures Used to Control Outbreaks

- Isolating or cohorting patients with ILI
  - Restricting group activities
- Having staff wear masks
- Closing ward to new admissions
- Limiting or prohibiting visitors
- Having ill HCW stay home
- Antiviral prophylaxis

- Vaccinating patients/HCW
Key Unanswered Questions

• What is the true incidence of nosocomial influenza, and how do we prevent it?
  – How common is clustering, really?
  – Which patients and HCW had what levels of exposure?
  – What factors are associated with transmission?
    • patient factors
    • HCW factors
    • visitor factors
    • hospital factors
    • process factors
  – How can influenza patients best be identified early?
  – What interventions prevent nosocomial influenza?
Key Unanswered Questions

• Healthcare worker beliefs, knowledge and behaviors
  – How do we motivate HCW to stay home if ill?
  – How do we motivate them to come to work if well?
  – How do we influence adherence to infection control measures?
    • administrative controls (e.g., initiating isolation)
    • personal protective equipment
    • vaccine acceptance