Influenza in the Hospital – Who Gets What From Whom?
Dr. Allison McGeer, University of Toronto
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Outline

- What is different about the epidemiology of nosocomial influenza and other nosocomial infections?
- What do we know about the epidemiology of nosocomial influenza?
- Can we prevent transmission in acute care hospitals? Can we prevent nosocomial acquisition of influenza?

Influenza in Hospitals
Who Gets What From Whom?

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April 22, 2010

Why worry about hospital-acquired RVIs?

- Incidence may be higher in hospitals than community

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Table 5: Distribution of 101 Pathogens Recovered From 88 Case Patients With Healthcare-Acquired Febrile Respiratory Infection, Canadian Nosocomial Infection Surveillance Program Surveillance, 2005

<table>
<thead>
<tr>
<th>Pathogen</th>
<th>No. (%) of isolates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory syncytial virus</td>
<td>38 (38)</td>
</tr>
<tr>
<td>Influenza A</td>
<td>9 (9)</td>
</tr>
<tr>
<td>Influenza B</td>
<td>8 (8)</td>
</tr>
<tr>
<td>Parainfluenza</td>
<td>11 (11)</td>
</tr>
<tr>
<td>Adenovirus</td>
<td>6 (6)</td>
</tr>
<tr>
<td>Staphylococcus aureus</td>
<td>7 (7)</td>
</tr>
<tr>
<td>Haemophilus influenza</td>
<td>4 (4)</td>
</tr>
<tr>
<td>M. catarrhalis</td>
<td>4 (4)</td>
</tr>
<tr>
<td>Streptococcus pneumonia</td>
<td>3 (3)</td>
</tr>
<tr>
<td>Pseudomonas aerogena</td>
<td>3 (3)</td>
</tr>
<tr>
<td>Enterobacter cloacae</td>
<td>2 (2)</td>
</tr>
<tr>
<td>Other bacteria</td>
<td>6 (6)</td>
</tr>
</tbody>
</table>

Annualized rate of RSV infection per 100,000 population, children <3 yrs

<table>
<thead>
<tr>
<th>CA MD visit rate</th>
<th>CA hospitalization rate</th>
<th>Nosocomial rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forster, 2004</td>
<td>7700</td>
<td>1117</td>
</tr>
<tr>
<td>Macartney 2000</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Vayalumkal 2009</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>


Estimates of Nosocomial Influenza

- Weingarten: 3 cases/1000 admissions
- Glezen: 6 cases/1000 admissions
- Farr: 8 cases per 1000 admissions
- Weinstock: 0.7-2.62/10,000 pt-days (cancer center)
- Babcock: 0 / 335 participating patients

Incidence may be higher in the hospital than in the community
Disease is more severe in hospitalized patients
- RSV: CFR noso 4.4%; CA 0.62 (Langley Ped 1997)
- Ad7h: 16% pediatric noso CFR (Larranaga JCV 2007)
- Influenza: 15% CFR (TIBDN, unpublished information)

Risk of acute viral illness after ED visits

- 393 NH residents with ED visits for non-resp, non-gi illness: 820 matched controls
- Followed for 5 days after return to nursing home for ARI and gastroenteritis
- Odds of ARI/gastro after ED visit: 5.3 (2.0, 14)

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**Why worry about hospital-acquired RVIs?**
- Incidence may be higher in the hospital than in the community
- Disease is more severe in hospitalized patients
- Outbreaks occur

**Proportion of nosocomial influenza that was outbreak associated, TIBDN, 2005-7**

<table>
<thead>
<tr>
<th>Season</th>
<th>No (%) cluster associated</th>
</tr>
</thead>
<tbody>
<tr>
<td>2004/5</td>
<td>25 (45%)</td>
</tr>
<tr>
<td>2005/6</td>
<td>12 (60%)</td>
</tr>
<tr>
<td>2006/7</td>
<td>19 (54%)</td>
</tr>
</tbody>
</table>

- 9/23 hospitals with clustered cases over 3 seasons
- Hospitals diagnosing more community acquired disease more likely to identify nosocomial cases

**Occupational disease occurs in staff**

**Health Care Transmission of a Newly Emergent Adenovirus Serotype in Health Care Personnel at a Military Hospital in Texas, 2007**

- Texas military hospital, 2007
- 15 recruits admitted
- 218/483 staff tested
- 28 confirmed cases
- 25 ill
- 16 febrile
- 14 febrile, and worked

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**Are HCWs at increased risk of influenza?**

**Table 1. Attack Rate of Adenovirus Serotype 14 (Ad14) Infection by Health Care Occupation—Texas, June 2007**

<table>
<thead>
<tr>
<th>Occupation</th>
<th>No of Ad14 infection cases</th>
<th>No of Ad14 infected (4/5)</th>
<th>Attack rate, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respiratory therapist</td>
<td>6</td>
<td>2</td>
<td>33</td>
</tr>
<tr>
<td>Medical assistant</td>
<td>5</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>Medical technician</td>
<td>5</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>Housekeeper</td>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Attending physician</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Clinical staff</td>
<td>1</td>
<td>1</td>
<td>100</td>
</tr>
</tbody>
</table>

NOTE: LPN, licensed practical nurse; RN, registered nurse; M/C, health care personnel.
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### Risk of influenza in healthcare workers
**Berlin, 2006/7**
- 250 acute care hospital HCWs, 486 non-HCWs.
- Outcomes:
  - Seroconversion to any one circulating influenza strain
  - ILI
  - ARI
- HCWs:
  - Younger, more likely to be female
  - Higher rates immunization, car ownership
  - Higher pre-season titer against A(H3N2)

### Exposure Odds ratio (95% CI) P value
- Immunization 0.50 (0.29,0.88) .02
- Household contacts
  - None Ref
  - Adults 2.0 (0.58,6.7) .28
  - 1-2 children 5.3 (1.3, 21) .02
  - >=3 children 14 (3.0, 64) .001
- No children in household, and owns a car 3.0 (1.2,7.3) .02

### What are hospital influenza reservoirs?
- Vanhems (ECCMID 2009)
  - 6 Pt-Pt, 7 Pt-HCW, 6 HCW-HCW
- Cheng (JHI 2009)
  - 1 Pt-Pt, 1 Pt-HCW, 2 HCW-HCW
- McGeer (unpublished)
  - 3 HCW-HCW, 1 HCW-Pt

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So, how do we protect patients and health care workers from influenza?
- Approaches to prevention
  - Engineering controls
    - Change humidity
    - Increase space between patients
    - Facilitate hand hygiene
  - Hand hygiene
  - Barrier when close to reservoir
    - Gowns, gloves, masks, N95 respirators.
What is the problem with droplet contact precautions for patients with influenza?

- Blumenfeld: 22/30 nosocomial ILI with influenza
- Weingarten: 2/4 nosocomial ILI with influenza
- Pachucki: 15/38 submitted specimens (patients and HCW)
- Rivera: 16/21 nosocomial ILI patients
- Van Voris: 18/29 nosocomial ILI patients
- Glezen: 6/17 nosocomial ILI patients

- 36 (3.9%) of hospitalized pH1N1 cases nosocomial
  - 7 (19%) required ICU admission
  - 5 (14%) died

- Babcock: 106 (50%) of hospitalized patients with influenza had ILI (fever and cough)
- Kuster: 94/268 (35%) of patients being admitted to the hospital with influenza had a fever

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Case A – January 10, 2010

- 67 yo female from residential care
  - PMHx
  - schizophrenia, COPD, type II DM, sleep apnea
  - atrial fibrillation, CHF, previous MS:
  - MI, 2006
  - Smoker
- Sudden onset SOB, presyncope

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Influenza - Routes of Spread

Healthcare Workers

Visitors / Community

Pertussis Simulation model of transmission in NICU

- Stochastic, agent-based simulation model based on HSC NICU
  - Modelled exposure of NICU to single symptomatic HCW
- Risk of transmission associated with
  - Vaccination rates in HCWs
    - 49% if none vaccinated, 2% if 95% vaccinated
  - Estimates of HCW-patient and HCW-HCW transmission
- NO association with vaccination of parents/visitors, or patient-HCW, family-patient transmission

Challenges

- Most adult patients with fever and respiratory symptoms don’t have a communicable disease
- Some patients without fever, do have a communicable disease
- Staff work with acute respiratory illnesses.

Healthcare worker vaccination Patient outcomes

- 4 RCTs in long term care facilities
  - Potter, J Infect Dis, 1997
    - 44% reduction in mortality (P<.01)
  - Carman, Lancet 2000
    - 42% reduction in mortality (P<.01)
  - Hayward, BMJ 2006
    - 27% reduction in mortality (P<.001)
  - Lemaitre, JAGS, 2009
    - 20% reduction in mortality (P=.02)
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**Hayward et al.**
- Pair matched, cluster randomized trial
  - 22 pairs of LTC facilities
  - Matched by region, size, dependence, mortality rate
- Intervention: policy to vaccinate staff
  - Lead nurses trained, letter to all staff
- Primary outcome: all cause mortality during 2 influenza seasons

**Conclusion**
- Death (all cause):
  - Number of HCWs you need to vaccinate to prevent one death: 8.2 (5.8, 20.4)
- Hospitalization:
  - Number of HCW you need to vaccinate to prevent one hospitalization: 20 (14, 102)

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**What can we do?**
- Introduce administrative policies to support vaccination
  - Up to and including ‘mandatory’ immunization

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**“Mandatory” immunization**
- University of Toronto, medical students and residents
  - Introduced 2003 – in first 2 years
    - Documentation of Hep B immunity increased from 81%-97%
    - Documentation of measles immunity increased from 88%-99%
  - CPSO – as of 2010, all physicians performing exposure prone procedures MUST be tested and report results to college

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**“Mandatory immunization” - influenza**
- Ontario
  - 12/38 public health units
  - 1 acute care hospital (NBGH)
- Range
  - Mandatory private consultation with PH nurse before refusal
  - Vaccine or antiviral during season
  - Vaccine/antiviral/work restriction during season
  - Vaccine as requirement for employment

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**Mandatory influenza immunization**

<table>
<thead>
<tr>
<th></th>
<th>Reported policy</th>
<th>Vaccinated</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>US healthcare workers</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seasonal vaccine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required</td>
<td>11%</td>
<td>98%</td>
</tr>
<tr>
<td>Recommended</td>
<td>65%</td>
<td>65%</td>
</tr>
<tr>
<td>Neither</td>
<td>23%</td>
<td>24%</td>
</tr>
<tr>
<td>pH1N1 vaccine</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Required</td>
<td>8%</td>
<td>87%</td>
</tr>
<tr>
<td>Recommended</td>
<td>62%</td>
<td>43%</td>
</tr>
<tr>
<td>Neither</td>
<td>30%</td>
<td>11%</td>
</tr>
</tbody>
</table>

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MMWR 59(12), April 2, 2010

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Roving carts
Feedback to managers
Rates on scorecard
Mandatory declination
Choice of LAIV
Free vaccination
Posters, articles, announcements
Onsite vaccination
Condition Of employment

The Next Few Teleclasses
29 Apr. 10  Simple Precautions – Simplifying Infection Control
Speaker: Dr. Jim Hutchinson, Health Care Corporation of St. John’s

6 May 10  Disinfection and Sterilization: Special Emphasis on Pediatric Issues
Speaker: Dr. William Rutka, University of North Carolina

13 May 10  Multi-Drug Resistant Organisms in a Behavioral Health Setting
Speaker: Gail Bennett, ICP Associates

20 May 10  Epidemiology of Healthcare Associated Infections in Limited Resource Settings
Speaker: Dr. Victor Rosenthal, Medical College of Buenos Aires

31 May 10  (Free Teleclass) Challenges in Reprocessing in Community Settings
Broadcast live from the 2010 CHCA-Canada conference
Speaker: Gail Meara, Alberta Health Services

2 June 10  (Free Teleclass) Going Green vs. Best Practice: Busting The Myth

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