Nosocomial Transmission of Influenza: 
What do we really know?

Caroline Breese Hall
University of Rochester Medical Center
June 3, 2010
Importance of Nosocomial Viral Studies

- “Real World” outcome of transmission
- Relative importance of modes of spread on hospital wards
- Variability of modes of spread on wards
- Rationale for ICP and cost-benefit PPE use
Probability of Nosocomial Viral Spread

- High viral loads shed by young children:
  RSV and influenza: $3–7 \log_{10} TCID_{50}/ml$

- Often shed for long period. May be days before and after symptoms, when shedding is not suspected

- Asymptomatic influenza infection in about 30–50%
Influenza Shedding

Volunteer Challenge Studies:

56 studies with H1N1, H3N2, B

- Onset  1 day after challenge
- Peak d 2, mean duration 4.8 d
- Symptoms and shedding curves same, but onset of symptoms and peak are 1 day later

(Carrat 2008)
Natural Influenza Shedding in Adults

Influenza A and B shedding by RT-PCR

- 1–8% of shedding 1–2 days before symptoms
- Duration ~6 days, low titers after 3–4 days
- 14% had asymptomatic shedding
- Average 1.5–2 days between symptom onset and transmission to contacts (Lau 2010)

In Hospitalized Elderly with Comorbidities

- > 50% shed over 7 days
- Shedding unaffected by previous vaccination (Leekha 2007)
29 Flu-neg infants admitted in 1 mo.

- 14 (48%) got nosocomial H3N2

Ages 5 wk–21 mos; 42% <6 mos

Onset = fever, no respiratory signs

36% developed pneumonia

- Influenza H3N2 shed for 4–21 days
## Modes of Transmission of RSV

### 3 Groups of personnel:

<table>
<thead>
<tr>
<th>Group</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cuddlers:</strong></td>
<td>Wore gowns, but no masks; usual complete care of infant</td>
</tr>
<tr>
<td><strong>Touchers:</strong></td>
<td>Touched objects in room when infant was absent, then rubbed eyes and nose (proven inoculation routes) Surfaces then tested for virus</td>
</tr>
<tr>
<td><strong>Sitters:</strong></td>
<td>Sat reading &gt; 6 ft from infant Gowned, gloved, no mask</td>
</tr>
</tbody>
</table>
Acquisition of RSV

Cuddlers: 71% vs. Sitters (p<0.05)

Touchers: 40%

Sitters: None
Implications

- Close contact important
- Large particle aerosol spread may occur
- Short distance small particle spread could also occur
- Fomite transmission possible
Possibility of Fomite Spread

- RSV in infant secretions infectious on:
  - non-porous surfaces/gloves: hours
  - cloth, tissue: half to 1 hour
  - skin: 15 to 30 minutes

- Virus could be transferred to hands and from hand to hand
Survival of RSV in Infants’ Nasal Secretions on Hospital Ward

TITER (log$_{10}$ TCID$_{50}$/ml) vs. HOURS

- Countertop
- Paper Tissue
- Cloth
- Skin
- Gloves
**Influenza Spread by Fomites?**

Lab-grown Flu A, B survival on: *(Bean 1982)*
- Hand, non-porous surfaces: 24–48 hr.
- Cloth, paper, tissues: <8–12 hr.
- Steel to skin for 24 hr; on hands 5 min.

Flu A in Childrens’ Secretions on Ward:
- Hard surfaces: 12–24 hr; Gloves: 6–8 hr.
- Cloth, tissues: 3 to 6 hours
- Hands: 10 to 15 minutes
- Depended on humidity, drying time *(Hall)*
Nosocomial Influenza Infant Ward Study

- Influenza-naïve infants ≤ 11 months old
- Admitted during 2 seasons of A/H3N2
- ICP included vaccination of staff, screening, visitors limited, none <6 yrs, confined to room, nurses cared for respiratory or non-respiratory infants
- Ventilation: room and hall pressure equal; but varied with door movement
  Non-respiratory room doors often open
Two-thirds 1 bed room, one-third 2–3 bed rooms
Nosocomial Influenza Infant Ward Study

Methods:

- Viral testing on:
  - All admitted infants q 2d (nasal aspirates)
  - All personnel, family, and patients developing signs of illness

- Daily monitoring of patients’ locations, their movement, and roommates
Nosocomial Infant Flu Study: Results

- 199 infants admitted without respiratory illness and were negative for influenza
- 19 (9.5%) developed nosocomial influenza infection
- Personnel surveillance specimens were all negative for influenza
Risk Factors for Nosocomial Influenza

- Room with more than one bed \( (OR \ 3.9) \)
- Asymptomatic roommate who subsequently developed Flu \( (OR \ 36.1) \)
- Only known Flu exposure was close: 1–2 rooms vs. across ward \( (OR \ 2.4) \)

Suggests distance of contact important, and distant airborne spread not major mode
Nosocomial pH1N1 Studies

Only few reports of pH1N1 occurrence in healthcare workers, oncology units, and long-term care facilities.

Reports of nosocomial pH1N1 outbreaks examining mode of transmission scarce:

Pediatric Oncology Ward in Italy:
- 8 nosocomial pH1N1 cases
- 1 likely from healthcare worker

(Chironna 2010)
Nosocomial Influenza Spread: Summary

**Known**
- All 3 modes of spread are possible
- Close and prolonged contact augments transmission

**Unknown**
- Relative real world importance of each
- Is it required for nosocomial spread?
  - How long, how close?
# Nosocomial Influenza Spread: Summary

<table>
<thead>
<tr>
<th><strong>Known</strong></th>
<th><strong>Unknown</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Compliance with infection control procedures diminishes spread</td>
<td>Relative efficacy of PPE, ventilation, and education</td>
</tr>
<tr>
<td>Effectiveness of hand hygiene not shown</td>
<td>If fomite transmission occurs and results in nosocomial infection</td>
</tr>
</tbody>
</table>