Influenza Policy: The Impact of Epidemiology 2012

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Disclosures

- Research support: VA and CDC (influenza prevention study), Merck, Sage
- Advisory Boards: Pfizer, Hospira

MMWR 2012; 61; 414
Overview

• Epidemiology & Disease Burden
• Impact on specific settings
  – Workforce
  – Healthcare setting
• Options for prevention, control, & treatment,
  – Vaccination
  – Non-pharmacologic measures
• Use of policy to impact vaccination in healthcare—rationale and issues
Influenza

- Acute respiratory illness - abrupt onset of symptoms
  - Spectrum of illness from asymptomatic to severe illness

- Incidence: 5% to 20% of population, mortality 22,000-36,000 annually

- 23% HCW w/ serologic evidence of influenza
  - 59% recalled influenza like illness
  - 28% recalled respiratory infection

- Nosocomial outbreaks documented and lead to morbidity for patients & staff, increased costs for institution
  - Attack rates of up to 54% reported
  - Mortality in NICUs up to 25%
  - HCWs are the primary vectors

Vectors for transmission include staff, visitors, patients

Influenza Virus

- Orthomyxovirus
  - Single stranded RNA virus (segmented genome)
    - Type A:
      - humans, animals, birds, more severe in the elderly
    - Type B:
      - humans only, more common in children
    - Type C:
      - uncommon in humans
      - 2 surface glycoproteins
        - Hemagglutinin (HA)
          - attachment & entry
        - Neuraminidase (NA)
          - release
Influenza Transmission to Humans

Avian virus

Avian virus

Avian virus

Reassortment in swine

Reassortment in humans

Human virus

Avian virus
Epidemics, Pandemics & Antigenic Changes

- Influenza viruses cause epidemics & pandemics
  - Size & relative impact result of
    - Antigenic variation, amount of immunity in populations & relative virulence
- Antigenic variation result of changes in genes encoding for HA & NA
  - Drift – point mutations (both A & B)
    - Minor changes, same subtype
      - Associated with epidemics
  - Shift – genetic reassortment (A)
    - Major change, new subtype
      - Associated with pandemics
Influenza Subtype Emergence

Influenza A HA and NA subtypes

H1, H2, H3, H4, H5, H6, H7, H8, H9, H10, H11, H12, H13, H14, H15

N1, N2, N3, N4, N5, N6, N7, N8, N9
Influenza Pandemics

- 1918-19 Spanish Flu (H1N1)
  - 20 million worldwide/
  - >550,000 U.S. deaths
  - 2 Mutations from
  - Avian Virus; H+++N+++ 

- 1957-58 Asian Flu (H2N2)
  - 1 million worldwide/
  - 70,000 U.S. deaths
  - Reassortment 3 Avian Virus
    Segments, H+++N+++ 

- 1968-69 Hong Kong Flu (H3N2)
  - 1 million worldwide/
  - 40,000 U.S. deaths
  - Reassortment 2 Segments
    from Avian Virus, H+++N-

- 2009-10 Swine Flu (H1N1)
  - 18,000 worldwide/
  - 3,443 U.S. deaths
  - Reassortment 4 Segments
    from Avian Virus, H+++N-
## Complications Are Common in Low Risk Groups

<table>
<thead>
<tr>
<th>Group &amp; Complication</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young children -- Otitis media</td>
<td>30% - 45%</td>
</tr>
<tr>
<td>Healthy adolescents &amp; adults</td>
<td></td>
</tr>
<tr>
<td>Resp w/ antibiotics</td>
<td>17%</td>
</tr>
<tr>
<td>URI:</td>
<td>8%</td>
</tr>
<tr>
<td>LRI:</td>
<td>9%</td>
</tr>
<tr>
<td>Any LRI</td>
<td>5.3%</td>
</tr>
</tbody>
</table>

Influenza: Complications

Pulmonary

• Primary viral pneumonia
• Secondary bacterial pneumonia
• Croup
• Bronchitis
• Exacerbation of chronic pulmonary disease

Non pulmonary complications

• Myositis
• Cardiac
• Toxic shock syndrome
• Central nervous system complications
• Reye syndrome
<table>
<thead>
<tr>
<th>Condition</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Restricted activity</td>
<td>5 – 6 days</td>
</tr>
<tr>
<td></td>
<td>10% to 20%</td>
</tr>
<tr>
<td></td>
<td>10 + days</td>
</tr>
<tr>
<td>Bed Disability</td>
<td>3 – 4 days</td>
</tr>
<tr>
<td>Absenteeism</td>
<td>3 days</td>
</tr>
<tr>
<td>Medical care</td>
<td>50%</td>
</tr>
</tbody>
</table>
Deaths from Influenza

Influenza Transmission Within Households

395 Index Cases (flu A pos)

817 Household Contacts

313 (38%) Secondary Cases

178 (57%) w/ HC Visit

56% of households had at least 1 secondary case

Who Gets Influenza?

- 78/600 (13%) of household contacts developed ILI
- In 21% 2ndary ILI developed in 1 household member and in 6% ILI developed in more than 1 contact.
- Contacts < 18 were 1.96 times more susceptible than those over 50 (CI 1.05-3.78, p<0.005) and those > 50 were less susceptible than contacts age 19-50 (OR 0.17; CI 0.02-0.92, p<0.03)
- Mean onset was 2.6 days (CI 2.2-3.5)

Chauchemez et al. NEJM 2009:361:27
Influenza

- 23% HCW w/ serologic evidence of influenza
  - 59% recalled influenza like illness
  - 28% recalled respiratory infection
- Vectors for transmission include staff, visitors, patients
- 76.6% HCW work while ill with influenza like illness (ILI) a mean **2.5 days** while ill with ILI
- Economic cost in the US: $71-167 billion per year.

Stott, Occup. Med. 2002; Talbot, ICHE 2005; Elder, BMJ 1996; Lester, ICHE 2003; Maltezou Scan Infect Dis 2010 online 1-9
Who Gets Influenza in Healthcare Settings?

- 6093 HCWs surveyed pre vaccination (spring 2009, H1N1 circulating)
- 123 confirmed cases of H1N1
- Risk of acquiring H1N1 was greatest in ED and among providers
- 49% of illness occurred in less than 20% of HCWs

Santos et al. Dis Med Pub Health Prep 2010:4:47
23 bed AIDS/ID ward in Spain

Outbreak during a 16-day period in February 2001

No community-based influenza activity at this same time
Options for Preventing & Controlling Influenza

- Surveillance
- **Immunization**
- Hand hygiene
- Respiratory hygiene / cough etiquette
- Contact avoidance including barrier precautions and isolation
- Antivirals
Influenza Vaccine Efficacy

- Efficacy ~50-90% (higher in children)
- Efficacy decreases when vaccine strains do not match circulating strains ~48-60%

↓ the risk of
- death 73-79% from major vascular events
- Allograft loss and death in SOT (ideally 3 months post transplant)
- Pneumonia and hospitalization in the elderly and those in LTCF
- Febrile illness

Influenza Vaccine and Herd Immunity

Cluster RCT; 947 children received flu vaccine and 2326 Hutterite members did not

- 83% received flu and 79% received hepatitis A vaccine
- Influenza rate in unvaccinated 10.6%, 4.5% in vaccinated

Loeb et al. JAMA. 2010;303:943.
A Mass Vaccination Program in Japan

Excess Deaths From All Causes (per 100,000 population)

- 1957: Asian influenza epidemic claims 8,000 lives
- 1962: Program to vaccinate schoolchildren begins
- 1977: Influenza vaccination becomes mandatory
- 1987: Parents allowed to refuse vaccination
- 1994: Program is discontinued

Excess Deaths Attributed to Pneumonia and Influenza (per 100,000 population)

Summary: Influenza in healthcare workers

- **Influenza Infection**: 88%
- **Sick Days Due to Respiratory Infection**: 28%
- **Days Lost from Work**: 41
- **Patient Mortality**: 41
- **Patient Mortality**: 39

*Sources:
Talbot, ICHE 2005.
Feery, JID 1979.
Saxen, PIDJ 1999.
Wilde, JAMA 1999.
Potter, JID 1997.*
Is Herd Immunity Important?

Salgado CD et al. ICHE 2004;25:923
Does Hand Hygiene Reduce Respiratory Disease?

Aiello et al. AJPH 2008;98:1372-81

[Diagram showing statistical analysis of different interventions on hand hygiene and respiratory disease]
Which Prevention Strategies Are Most Important?

Comparison 1. Case control studies

<table>
<thead>
<tr>
<th>Outcome or subgroup title</th>
<th>No. of studies</th>
<th>No. of participants</th>
<th>Statistical method</th>
<th>Effect size</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Thorough disinfection of living quarters</td>
<td>1</td>
<td>990</td>
<td>Odds Ratio (M-H, Fixed, 95% CI)</td>
<td>0.30 [0.23, 0.39]</td>
</tr>
<tr>
<td>2 Frequent handwashing</td>
<td>6</td>
<td>2077</td>
<td>Odds Ratio (M-H, Fixed, 95% CI)</td>
<td>0.45 [0.36, 0.57]</td>
</tr>
<tr>
<td>3 Wearing mask</td>
<td>5</td>
<td>1991</td>
<td>Odds Ratio (M-H, Fixed, 95% CI)</td>
<td>0.32 [0.25, 0.40]</td>
</tr>
<tr>
<td>4 Wearing N95 mask</td>
<td>2</td>
<td>340</td>
<td>Odds Ratio (M-H, Fixed, 95% CI)</td>
<td>0.09 [0.03, 0.30]</td>
</tr>
<tr>
<td>5 Wearing gloves</td>
<td>4</td>
<td>712</td>
<td>Odds Ratio (M-H, Fixed, 95% CI)</td>
<td>0.43 [0.29, 0.65]</td>
</tr>
<tr>
<td>6 Wearing gowns</td>
<td>4</td>
<td>712</td>
<td>Odds Ratio (M-H, Fixed, 95% CI)</td>
<td>0.23 [0.14, 0.37]</td>
</tr>
<tr>
<td>7 All interventions</td>
<td>2</td>
<td>369</td>
<td>Odds Ratio (M-H, Fixed, 95% CI)</td>
<td>0.09 [0.02, 0.35]</td>
</tr>
</tbody>
</table>
### Why do HCWs Decline Vaccination?

<table>
<thead>
<tr>
<th>Reason</th>
<th>OR; 95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dislike injections</td>
<td>1.03, 0.6-1.76</td>
</tr>
<tr>
<td>Not protective</td>
<td>0.63, 0.4-1</td>
</tr>
<tr>
<td>Side effects</td>
<td>0.47, 0.3-0.72</td>
</tr>
<tr>
<td>Ill after previous flu shot</td>
<td>0.47, 0.13-1.69</td>
</tr>
<tr>
<td>Thought vaccine protective</td>
<td>29.7, 13.3-66.1</td>
</tr>
<tr>
<td>Risk of contracting flu</td>
<td>2.5, 1.55-4.06</td>
</tr>
<tr>
<td>Concern about side effects of flu</td>
<td>1.4, 0.89-2.16</td>
</tr>
<tr>
<td>Already had the flu</td>
<td>1.17, 0.6-2.44</td>
</tr>
<tr>
<td>Never get the flu</td>
<td>0.6, 0.35-1.03</td>
</tr>
</tbody>
</table>

*Quershi et al Occ Med 2004;54:197-201*
# Impact of Various Strategies on HCW Vaccination Coverage

## Table 1. Relative Impact of Various Strategies on Health Care Worker Influenza Vaccination Coverage

<table>
<thead>
<tr>
<th>Intervention and study</th>
<th>Preintervention immunization rate, %</th>
<th>Postintervention immunization rate, %</th>
<th>Overall change in vaccination rate, %</th>
<th>Randomized, controlled trial of intervention</th>
<th>Implemented with other interventions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Declination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Polgreen et al [23]</td>
<td>54</td>
<td>65</td>
<td>+11</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Bartin et al [25]</td>
<td>38</td>
<td>55</td>
<td>+17</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Ribner et al [27]</td>
<td>43</td>
<td>65</td>
<td>+22</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Mandatory vaccination</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Virginia Mason [37]</td>
<td>30</td>
<td>98</td>
<td>+68</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>BJC HealthCare [39]</td>
<td>71</td>
<td>99</td>
<td>+28</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Education and promotion</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harbarth et al [31]</td>
<td>13</td>
<td>37</td>
<td>+24</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Thomas et al [32]</td>
<td>8</td>
<td>46</td>
<td>+38</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Mobile cart</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sartor et al [29]</td>
<td>7</td>
<td>32</td>
<td>+25</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Cooper et al [30]</td>
<td>8</td>
<td>49</td>
<td>+41</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Incentives (raffle) [35]</td>
<td>38*</td>
<td>42</td>
<td>NS</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Educational letter from leadership [36]</td>
<td>38*</td>
<td>39</td>
<td>NS</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>On-site expert education [33]</td>
<td>21*</td>
<td>22</td>
<td>NS</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**NOTE.** NS, nonsignificant.

* Rate from nonintervention arm of concurrent randomized trial of intervention.
BJC and Washington University Experience

On quality scorecard; Declination statements

Babcock et al CID 2010:50; online
Pandemic and Seasonal Influenza Principles for U.S. Action

National Foundation for Infectious Diseases Applauds Society for Healthcare Epidemiology of America for Efforts to Improve Influenza Immunization Rates Among Nation’s Health Care Workers

* FOR IMMEDIATE RELEASE *

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Office: 202-667-5200
Mobile: 202
dlove@ap

APIC BOARD ENDORSES
MANDATORY FLU VACCINATION FOR HEALTHCARE WORKERS

Washington, DC, November 15, 2005—Recognizing the dramatic effect health immunization has on reducing influenza outbreaks and associated complications, the APIC Board of Directors today endorsed mandatory flu vaccination for healthcare workers.

Influenza Vaccination of Healthcare Workers and Vaccine Allocation for Healthcare Workers During Vaccine Shortages

Thomas R. Talbot, MD, MPH; Suzanne F. Bradley, MD; Sara E. Cosgrove, MD, MS; Christian Ruff, MD; Jane D. Siegel, MD; David J. Weber, MD, MPH
Rationale for Vaccinating HCWs

- Highly effective
- “First do no harm” -- reduce the risk for nosocomial transmission from staff to patient
- Reduce staff absenteeism and preserve health care capacity
  - May be cost saving for the health care org
- Personal benefits to HCWs
- (? Increase awareness & likelihood of HCWs vaccinating patients)
Influenza Prevention and Control: Immuno & Chemoprophylaxis

**Immunoprophylaxis**

- 2012–13 trivalent influenza vaccine
  - A/California/7/2009-like (pH1N1)
  - A/Victoria/361/2011-like (H3N2)
  - B/Wisconsin/1/2010-like (B/Yamagata lineage)

**Chemoprophylaxis**

- Amantadine
- Rimantadine
- Neuraminidase inhibitors
Take Home Messages

• Influenza in common in all of us including HCW
• The complications and mortality of influenza are significant
• The vaccine is safe and effective
• Epidemiologic data has influenced policy in recent years
• Mandatory vaccination, while controversial, does markedly increase vaccination coverage
• Intentions and principles do not protect patients; results are needed
Control strategies during healthcare based outbreaks

- Enforce hand hygiene.
- Cohort patients with flu-like symptoms.
- Isolate patients with respiratory sx’s (contact with mask).
- Document etiology of illness.
- Vaccinate all patients and HCW’s.
- Administer antiviral agent to at risk persons (patients and HCW’s) for at least 2 weeks. Persons who cannot receive the vaccine should receive an antiviral agent for 5-6 weeks or the duration of the outbreak.
- Screen incoming patients. Isolate those with symptoms or if the outbreak is several all patients until documented influenza free.
- Screen HCW’s and visitors. Furlough ill employees.
AH
AH
AH

CHOO!

THANK YOU FOR SHARING THAT
AND THANK YOU FOR BEING THERE
Conclusions

- **Epidemiology & Disease Burden**
  - Influenza is common, miserable, and often serious illness

- **Impact on specific settings**
  - Influenza has a substantial impact in the workplace and in healthcare settings

- **Options for prevention & control**
  - Vaccination
    - Vaccination is the mainstay for influenza prevention & control
  - Antivirals
    - Important, complementary role, for preventing and treating influenza
The Framers of the Constitution

  
  “It behooves every man who values liberty of conscience for himself, to resist invasions of it in the case of others.”

- James Madison (1751-1836): 4th US president, the constitution’s principle author & writer of the 1st 10 amendments.
  
  “In Republics, the great danger is, that the majority may not sufficiently respect the rights of the minority.”
Jean Jacques Rousseau (1712-1778): philosopher whose theories influenced the French Revolution. Rousseau argued that nature was a primitive condition without law or morality, which humans left for the benefits and necessity of cooperation. As society developed, division of labor and private property required humans to adopt institutions of law. By joining together into civil society through the social contract and abandoning their claims of natural right, individuals can both preserve themselves and remain free.
Personal Choice and Politics

- Mandatory vaccination violates the 14th amendment and deprives me of liberty without due process
- 1809: MA passed first law
  - Required smallpox vaccination of population
  - 1802-1840: Vaccination became widely accepted and the incidence of smallpox decreased
- 1905: Jacobson vs. Commonwealth of Massachusetts
  - Supreme court upheld right to require vaccination (exercise of state’s police power under the 10th amendment which allows the government to impose restrictions on private rights for the sake of public good.)
Personal choice and politics

• 1922: Zucht vs. King
  – Supreme Court upheld school entry vaccination laws
  – Do not require epidemic conditions exist to compel vaccination
  – Opponents maintain that the requirements are improper on the grounds that they amount to illegal search and seizure under the 4th Amendment (no state shall…. deny to any person within its jurisdiction the equal protection of lay….)
School-Entry Requirements

• Task Force on Community Preventive Services:
  – Vaccination requirements for childcare, school, and college recommended on basis of scientific evidence that
    ▪ Effective in reducing preventable disease
    ▪ Effective in improving coverage
    ▪ Effective in all relevant populations

• 50 states w/ medical exemptions
• 48 states w/ religious exemptions
• 21 states w/ philosophical/personal belief exemptions
Mandating Vaccination: School Entry Requirements

- Hepatitis A & child care attendees (AZ):
  - Marked decline in Hep A rates and shift in risk factors after mandating vaccination

- Measles vaccination:
  - Req. for 2nd vaccine dose at either primary or secondary school entrance effective in lowering measles incidence
  - Areas with low measles incidence differed from area of high incidence in detail and enforcement of school entry laws
Mandates and Healthcare Workers

PPD (taken from dead TB bacteria) is injected into the area.
Conditions for Employment in Healthcare

• Conditions for employment in place at many facilities
  – MMR or evidence of immunity
  – Varicella vaccine if no evidence of immunity
  – *Hepatitis B vaccine series, evidence of immunity, or signed declination*
  – Annual tuberculin skin testing

• Ingrained into training/schools
Hepatitis B Vaccination of HCWs

• OSHA Bloodborne Pathogens Standard
  – Passed 12/6/1991
  – Enacted March 6, 1992

• Required:
  – Work practice controls and PPE
  – Disposal of infectious waste
  – Post-exposure follow-up
  – Hepatitis B vaccination (with declination)
Since hepatitis B vaccine became available in 1982, the annual incidence of occupational Hep B infections has decreased 95%. 
Seasonal Influenza: Components

- 2012–13 trivalent influenza vaccine
  - A/California/7/2009-like (pH1N1)
  - A/Victoria/361/2011-like (H3N2)
  - B/Wisconsin/1/2010-like (B/Yamagata lineage).

- The components (influenza A (H3N2) and influenza B) have changed from the 2011-2012 vaccine.
## Trivalent Inactivated (TIV) and Live Attenuated Influenza Virus (LAIV) Vaccines

<table>
<thead>
<tr>
<th>Category</th>
<th>TIV</th>
<th>LAIV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration &amp; immune response</td>
<td>IM → Serum antibodies</td>
<td>Intranasal → Mucosal immunity</td>
</tr>
<tr>
<td>Formulation</td>
<td>Inactivated</td>
<td>Live attenuated</td>
</tr>
<tr>
<td>Efficacy children</td>
<td>50%–90%</td>
<td>70%–90%</td>
</tr>
<tr>
<td>Efficacy adults &lt;65 y</td>
<td>70%–90%</td>
<td>70%–90%</td>
</tr>
<tr>
<td>Safety (side effects)</td>
<td>Sore arm</td>
<td>Runny nose</td>
</tr>
<tr>
<td>Growth medium</td>
<td>Chick embryos</td>
<td>Chick cells</td>
</tr>
<tr>
<td>Storage</td>
<td>Refrigerated</td>
<td>Frozen</td>
</tr>
<tr>
<td>Indication</td>
<td>≥6 mo (healthy &amp; HR)</td>
<td>6 mo–49 yrs (healthy)</td>
</tr>
</tbody>
</table>

*MMWR 2005; 54 (RR-8)*
Surveillance: CDC

http://gis.cdc.gov/grasp/fluview/fluportaldashboard.html