

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

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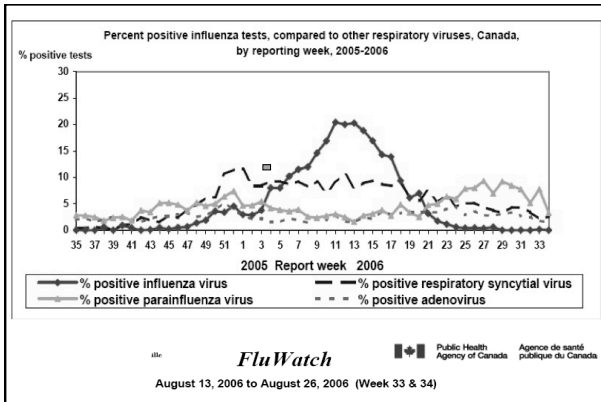
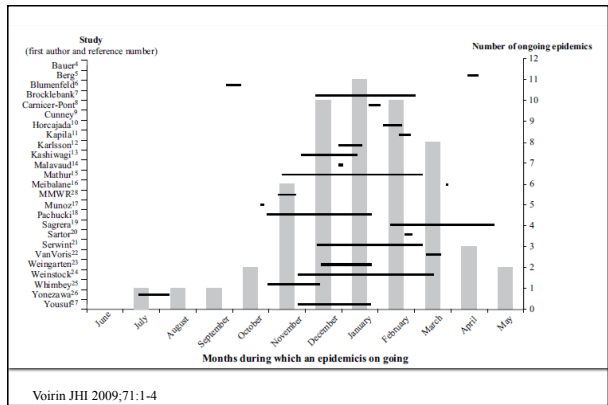
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Paul Webber
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Outline

- 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?



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

Pathogen	No. (%) of isolates
Respiratory syncytial virus	38 (38)
Influenza A	9 (9)
Influenza B	8 (8)
Parainfluenza	11 (11)
Adenovirus	6 (6)
<i>Staphylococcus aureus</i> ^a	7 (7)
<i>Haemophilus influenzae</i>	4 (4)
<i>Moraxella catarrhalis</i>	4 (4)
<i>Streptococcus pneumoniae</i>	3 (3)
<i>Pseudomonas aeruginosa</i>	3 (3)
<i>Enterobacter cloacae</i> ^b	2 (2)
Other bacteria	6 (6)

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

	CA MD visit rate	CA hospitalization rate	Nosocomial rate
Forster, 2004	7700	1117	10600
Macartney 2000	-	-	35600
Vayalumkal 2009	-	-	14000

Macartney Ped 2000;106:520; Forster EJP 2004;163:709; Vayalumkal ICHE 2009

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

Weingarten S. Arch Intern Med. 1988;148:113-116
 Glezen WP. Can J Infect Control. 1991;6:65-67
 Adal KA. Infect Control Hosp Epidemiol. 1996;17:641-648
 Weinstock DM. Infect Control Hosp Epidemiol. 2000;21:730-732
 Babcock HM. personal communication

Why worry about hospital-acquired RVIs?

- 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)

Nosocomial influenza

Incidence	3/1000 admissions 8/1000 admissions 6/1000 admissions	California, 87 Virginia, 88-94 Houston, 88
Case fatality rate	7% (14/213)	Multiple
Costs	\$4,050/case \$3,622/case	S. Dakota, 93 US, 2000

Risk of acute viral illness after ED visits Canada, 2006-8

- 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

Season	No (%) cluster associated
2004/5	25 (45%)
2005/6	12 (60%)
2006/7	19 (54%)

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

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
- 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

Fernanda C. Lessa,¹ Phillip L. Gould,^{2,3} Neil Pascoe,⁴ Dean D. Erdman,⁵ Xiaoyan Lu,⁶ Michel L. Bunning,⁷ Vincent C. Marconi,⁸ Lisa Lot,⁹ Marc-Alain Widdowson,¹⁰ Larry J. Anderson,¹¹ and Arjun Srinivasan¹

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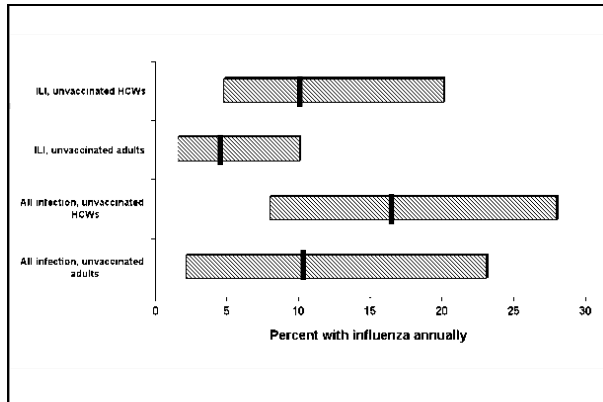
Table 1. Attack Rate of Adenovirus Serotype 14 (Ad14) Infection by Health Care Occupation—Texas, June 2007

Occupation	No of Ad14 infection cases (n = 35)	No of HCP tested (n = 218)	Attack rate, %
Respiratory therapist	6	17	35
Resident/fellow	5	22	23
Nurses (RN/LPN)	14	100	14
Medical technician	5	35	14
Housekeeper	4	30	13
Attending physician	0	9	0
Clerical staff	1	5	20

NOTE. LPN, licensed practical nurse; RN, registered nurse; HCP, health care personnel.

Are HCWs at increased risk of influenza?

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**Surveillance for influenza among staff
International Medical Centre, Japan
2003/4-2005/6**

Occupational group	Number (%) influenza infections		
	2003-04	2004-05	2005-06
Nurses (N=585)	25 (4.3%)	68 (12%)	35 (6.0%)
Physicians (N=155)	14 (9.0%)	29 (19%)	8 (5.2%)
Lab tech/pharmacists (N=100)	4 (4.0%)	8 (8%)	6 (6.0%)
Administrative personnel (N=80)	0	8 (10%)	0

**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)

Williams BMCID 2010;Jan12

**Risk of influenza in healthcare workers
Berlin, 2006/7**

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

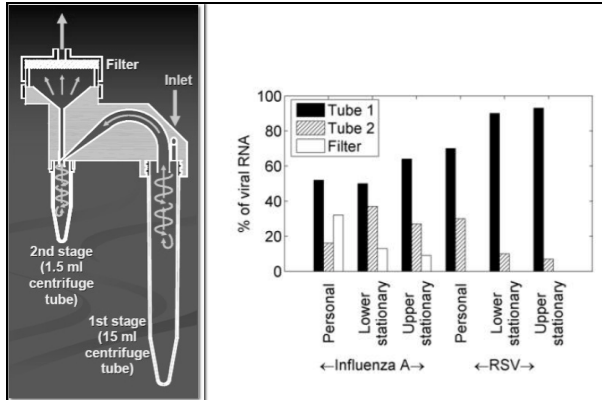
**So, how do we protect patients and health
care workers from influenza?**

- 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 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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What is the problem with droplet contact precautions for patients with influenza?

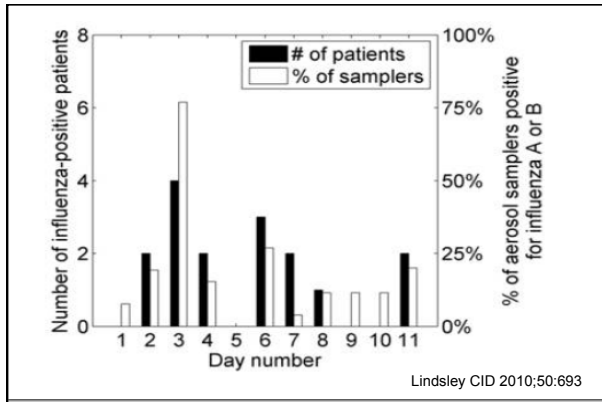
Not All ILI Patients Have Influenza

- 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

Blumenfeld HL. J Clin Invest. 1959;38:199-212
 J Nursing. 1982;32:1836-1838
 Intern Med. 1982;96:153-158
 Weingarten S. Arch Intern Med. 1988;148:113-116
 Pachucki CT. Arch Intern Med. 1989;149:77-80
 Van Voris LP. Ann Intern Med. 1991;6:65-67
 Glezen WP. Can J Infect Control. 1991;6:65-67

Hospital acquired pH1N1 Toronto, 2009

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



Not All Influenza Patients Have an ILI

- 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

Babcock HM. Infect Control Hosp Epidemiol 2006;27:266-270
 Kuster E. JCMID 2010 in press

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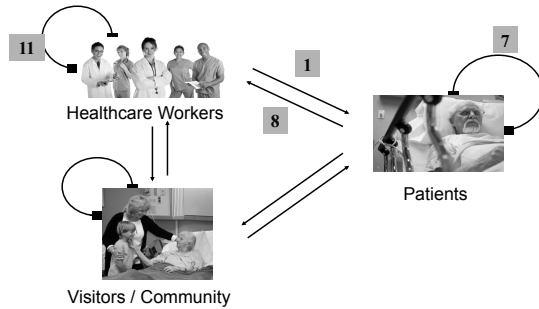
Case A – January 10, 2010

- 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

- In ED
 - T37.8C, HR 185, BP 131/85, O2 sat 89% (2L)
 - On exam
 - Confused and agitated
 - JVP increased
 - Lungs: crackles both bases, bilateral wheezing
 - Pedal edema
 - ECG – rapid atrial fib
 - CXR – cardiomegaly, perihilar haze/opacities
- Hb 143, WBC 5.1, Plat 169
- Lytes/BUN/Creat/LFT/CPK normal

- Admitting diagnosis: CHF

Influenza - Routes of Spread



**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

Greer ICHE 2009;30:1084

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

Hayward BMJ 2006

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)

What can we do?

- Introduce administrative policies to support vaccination
 - Up to and including “mandatory” immunization

“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

“Mandatory immunization” - influenza

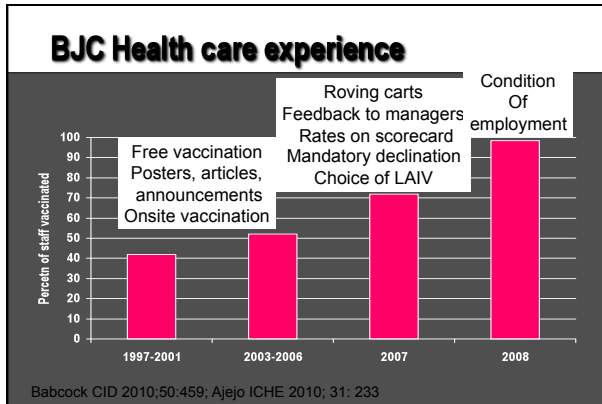
- Ontario
 - 12/38 public health units
 - 1 acute care hospital (NBGH)
- Range
 - Mandatory private consultation with PH nurse before refusal
 - Vaccine or antiviral during season
 - Vaccine/antiviral/work restriction during season
 - Vaccine as requirement for employment

Mandatory influenza immunization US healthcare workers

	Reported policy	Vaccinated
Seasonal vaccine		
Required	11%	98%
Recommended	65%	65%
Neither	23%	24%
pH1N1 vaccine		
Required	8%	87%
Recommended	62%	43%
Neither	30%	11%

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- In summary**
- Influenza is regularly transmitted in hospitals
 - Transmission occurs between patients, staff, volunteers and visitors
 - There are many gaps in our knowledge about the transmission of influenza and other respiratory viruses
 - The biggest and most important gap in our practice is in use of influenza vaccine

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 Rutala, 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 <i>Broadcast live from the 2010 CHICA-Canada conference</i> Speaker: Gail Meara, Alberta Health Services
2 June 10	(Free Teleclass) Going Green vs. Best Practices: Busting The Myth

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