

Some things old, Some things new, Some things borrowed, and some things flu – Infectious Diseases issues in Occupational Health

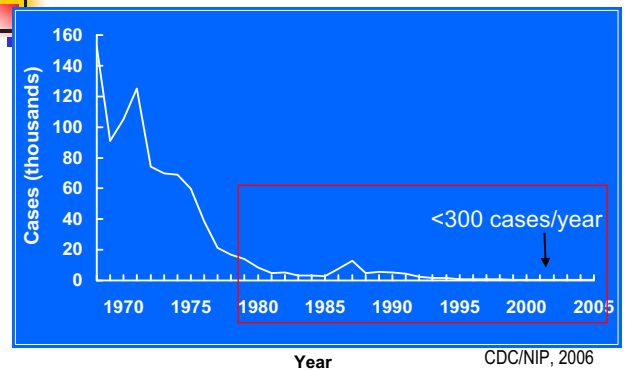
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November 2007

Infectious Disease and Occupational Health

- Some things old
 - Measles and mumps
- Some things new
 - Acellular pertussis vaccine
- Some things borrowed
 - Community acquired MRSA
- Some things flu
 - Annual influenza immunization

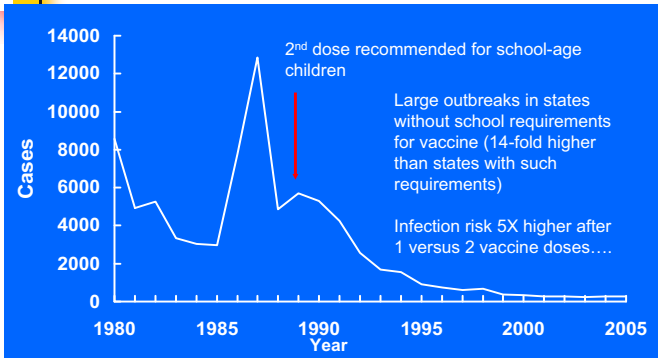


Mumps—United States, 1968-2005*
Vaccine introduced in 1967



Mumps resurgence, 1986-87*

Conclusion: 2 doses required

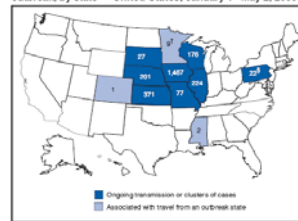


*2005 provisional total

Cochi SL, et al. AJDC 1988;142:499-507
Hersh, et al. J Pediatrics 1991;119:187-93

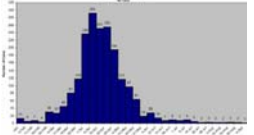
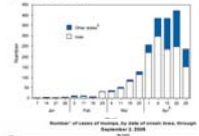
MUMPS OUTBREAK - 2006

FIGURE 1. Number of reported mumps cases linked to multistate outbreak, by state — United States, January 1–May 2, 2006



* N = 2,597.
† Three cases related to the outbreak.
‡ Twelve cases related to the outbreak.

FIGURE 2. Number of reported mumps cases linked to multistate outbreak, by week of onset* — United States, January 1–May 2, 2006



Mumps in Iowa

- Genotype G
- 1643 confirmed, 315 probable cases
- 22 yrs = median age
- IgM + 1419
- Cultures + 192
- PCR + 45
- Parotitis 69%
- Submandib/max swelling 49%
- Sore throat 52%
- Fever 35%
- Headache 34%
- Orchitis 8%
- Encephal .002%

New ACIP guidance for evidence of mumps immunity for Healthcare workers

- Documentation of adequate vaccination
 - Born during/after 1957: 2 doses MMR
 - Born before 1957: 1 dose MMR
- Serologic evidence of mumps immunity
- Documentation of physician- diagnosed mumps
- Outbreak settings:
 - Persons born before 1957 w/o other evidence of immunity: strongly consider recommending 2 doses of live mumps virus vaccine

MMWR 6/9/2006 55(22);629-30

....However, reviewing HCW immune status for mumps and providing vaccine during an outbreak might be impractical or inefficient. Therefore, facilities might consider reviewing the immune status of HCWs routinely and providing appropriate vaccinations, including a second dose of mumps vaccine...

<http://www.idph.state.ia.us/adper/mumps.asp>

Sneezles and Wheezles

Christopher Robin had sneezles and wheezles,
 They bundled him into his bed,
 They gave him what goes for a cold in the
 nose,
 And some more for a cold in the head.

When I was six. AA Milne

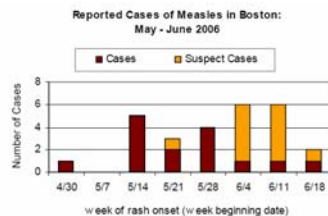
Measles

- Measles one of the most highly contagious human diseases (~76% of exposed susceptible individuals)
- Prodrome - fever, cough, coryza and conjunctivitis
- Maculopapular rash follows in 2-4 days
 - Begins on the face and spreads to the rest of the body
 - Koplik spots (white grains of sand on erythematous base) appear on the oral and/or buccal mucosa 1-2 days prior to rash onset and last a few days
- Atypical measles can occur in persons who received the killed vaccine which was available from 1963 through 1967
- Encephalitis occurs in 1 in 1,000 cases
- Death in 1-2 in 1,000



Measles – Massachusetts 2006

- May 2006 – a non-immunized computer programmer from India developed measles 9 days after arrival in US
- Subsequent illness appeared in co-workers, electrical contractor working in building, worker in adjacent building, local restaurant worker
- 8 of first 10 patients ranged in age from their early 30s to their late 40s
- The state distributed or ordered 23,000 doses of measles vaccine, at a cost of nearly \$400,000.
- Hundreds of people at three workplaces ordered to stay home until they proved they weren't susceptible or until they have passed the incubation period for the disease



Measles – Healthcare Facilities

- In past, Health care workers were the source of 5% to 10% of all cases of measles (Ann Intern Med 1996;125:826)
- Acceptable proof of immunity for Healthcare Workers in Massachusetts (2006):
 - For HCWs born in the United States on or after 1/1/1957 (or persons born outside the United States at any time) written documentation from a health care provider of two doses of vaccine given on or after the person's first birthday, with vaccine given on or after 1/1/1968
 - HCWs born in the United States prior to 1957 should have either one dose of MMR vaccine or serologic proof of immunity
 - Physician diagnosis is not acceptable documentation of immunity
- Non-immune staff who are exposed to a case of measles must be excluded from work from the 5th through the 21st day after exposure.

Massachusetts Department of Public Health Measles Alert - July 6, 2006

Measles Mumps Rubella Vaccine

- Live measles and mumps vaccine produced in chick embryo cells
- Live Rubella vaccine produced in human diploid cells
- Components: human albumin, neomycin, sorbitol, gelatin
- Adverse reactions:
 - Transient Arthralgias – 25% in post-pubertal women
 - Fever - 5%
 - Transient rash - 5%
 - Hypersensitivity - <1:1,000,000
 - Thrombocytopenia – 1:30,000 – 1:1,000,000
- Based on theoretical concerns vaccination should not be administered to women who are pregnant or intend to become pregnant within 28 days
- MMR-Varicella vaccine licensed but not approved for individuals >12 year of age

MMWR 1998;47 No. RR-8
MMWR 2001;50:1117

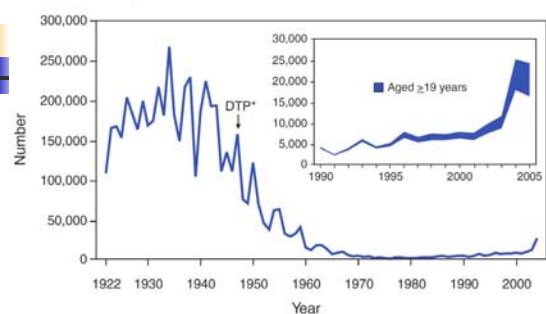
Pertussis (Whooping Cough)

- Pertussis - acute respiratory infection caused by *Bordetella pertussis*
- The organism elaborates toxins that damage respiratory epithelial tissue and have systemic effects
- Transmitted through large respiratory droplets
- Incubation period 7–10 days (range: 5–21 days)
- Patients most infectious during the catarrhal and early paroxysmal phases of illness and can remain infectious for >6 weeks

Pertussis (Whooping Cough)

- Classic pertussis three phase illness:
 - Catarrhal phase (1–2 weeks): coryza and intermittent cough; high fever is uncommon-
 - Paroxysmal phase (4–6 weeks): spasmodic cough, posttussive vomiting, and inspiratory whoop
 - Convalescent phase (2 weeks – months): recurrent bouts of paroxysmal cough

FIGURE. Number of reported pertussis cases, by year — United States, 1922–2005



* Introduction of universal pediatric diphtheria and tetanus toxoids and whole-cell pertussis vaccine.

SOURCE: 1950–2005, CDC, National Notifiable Diseases Surveillance System, and 1922–1949, passive reports to the Public Health Service

MMWR 2006;55:RR-17

Pertussis - Adults

TABLE 2. Clinical characteristics and complications in adults with pertussis

Feature	Proportion of adults with clinical feature						
	Massachusetts Aged ≥18 yrs 2001-2003 (n = 936) ^a	Massachusetts Aged ≥18 yrs 1996-2000 (n = 203) ^b	U.S. excluding Massachusetts Aged 19-64 yrs 1996-2004 (n = 18,243) ^c	U.S. excluding Massachusetts Aged ≥65 yrs 1996-2004 (n = 984) ^d	Sweden Aged ≥20 yrs 1976-1978 (n = 155) ^e	Quebec Aged ≥18 yrs 1986 (n = 384) ^f	Australia Aged ≥18 yrs 1967-1978 (n = 73) ^g
Paroxysmal cough	86%	84%	89%	86%	— ^h	90%	82%
Difficulty sleeping	—	84%	—	—	—	—	84%
Difficulty breathing	—	86%	—	—	—	—	—
Apnea	44%	—	32%	32%	—	85%	—
Fluorescent vomiting	47%	64%	49%	27%	50%	61%	62%
Weight loss	—	33%	—	—	—	—	33%
Whoop	41%	—	37%	33%	82%	70%	45%
Urinary incontinence	—	28%	—	—	—	(24% women aged ≥50 yrs)	—
Pneumonia	2%	5%	3% [§]	8% [§]	0.6%	5%	5%
Rib fracture	—	4%	—	—	1%	(4% in women)	—
Seizure	0.3%	—	0.6%	0.2%	0	0	0
Loss of consciousness	—	6%	—	—	0	3%	0
Hospitalization	3%	—	3%	12%	2%	2%	0

MMWR 2006;55:RR-17

Pertussis - Infants

TABLE 3. Hospitalizations and complications among infants aged <12 months with pertussis, 2000-2004^a

Complication	No.	(%) [†]
Hospitalization	6,114	(62.8)
Apnea	5,454	(55.8)
Pneumonia [§]	1,063	(12.7)
Seizures	146	(1.5)
Deaths	92	(0.8)
Total	12,174	(100)

^a Source: CDC, National Notifiable Diseases Surveillance System and Supplemental Pertussis Surveillance System, 2000-2004, Atlanta, GA: US Department of Health and Human Services, CDC, 2005.

[†] Percentages are based on total number with information. For 20% of infants with cases, no information was available on hospitalization, seizure, or apnea; for 30%, no information was available on pneumonia.

[§] Radiographically confirmed.

MMWR 2006;55:RR-17

Impact of Pertussis on a Tertiary Care Medical Center FY2004

- During 12 month period:
 - 20 primary and 3 secondary laboratory confirmed cases of *B. Pertussis* infections with 2 primary pertussis cases and 1 secondary case in healthcare workers
 - Outbreak investigations prompted screening of 353 medical center employees
 - Probable or definitive exposure was identified in 296 healthcare workers, and 287 subsequently underwent treatment or prophylaxis for *B. Pertussis* infection
 - Direct medical center costs included:
 - treatment and prophylaxis \$13,416
 - Personnel time \$19,500-\$31,190
 - Indirect costs (time lost from work) \$51,300-\$52,300
 - Total cost \$84,546 - \$97,656.

Acellular Pertussis Vaccines

- Adacel[®] – tetanus toxoid/diphtheria toxoid/acellular pertussis vaccine licensed for persons 11-64 years of age
- Boostrix[®] – tetanus toxoid/diphtheria toxoid/acellular pertussis vaccine licensed for adolescents 10-18 years of age

Adacel® (Tdap) vaccine

- Dosage 0.5 ml IM – one dose as an adult instead of Td booster immunization (for non-immunized adults – 2 doses Td and 1 Tdap)
- Normally should be administered > 5 yr after last Td immunization, but interval may be as short as 2 yr since last Td immunization
- Incidence of local and systemic reactions to Tdap comparable to that of Td
- Can be given concurrently with influenza and Hepatitis B vaccines – but may increase incidence of local tenderness slightly
- Vaccine has not been tested in pregnant women – it might be potentially given after an informed discussion with the woman
- Contraindications –
 - hypersensitivity reactions
 - history of encephalopathy within 7 days of a prior pertussis vaccine administration

MMWR 2006;55:RR-17 MMWR 2007;56 (Oct 19) Quickguide

Management of Healthcare Pertussis exposures

- “Studies are needed to evaluate the effectiveness of Tdap to prevent pertussis in vaccinated HCP, the duration of protection, and the effectiveness of Tdap in preventing infected vaccinated HCP from transmitting *B. pertussis* to patients and other HCP. Until studies define the optimal management of exposed vaccinated HCP or a consensus of experts is developed, health-care facilities should continue postexposure prophylaxis for vaccinated HCP who have unprotected exposure to pertussis.”

MMWR 2006;55:RR-17

Management of Healthcare Pertussis exposures

- Alternative approach:
 - Daily monitoring of pertussis-exposed HCP who have received Tdap might be a reasonable strategy for post-exposure management, because the incubation period of pertussis is up to 21 days and the minimal risk for transmission before the onset of signs and symptoms of pertussis

MMWR 2006;55:RR-17



EPIDEMIOLOGY OF MRSA - USA

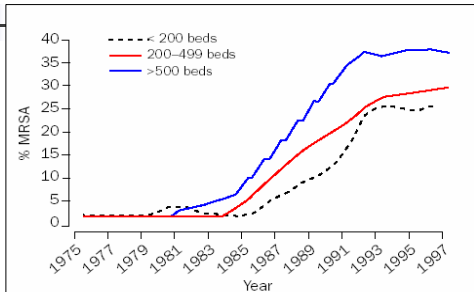
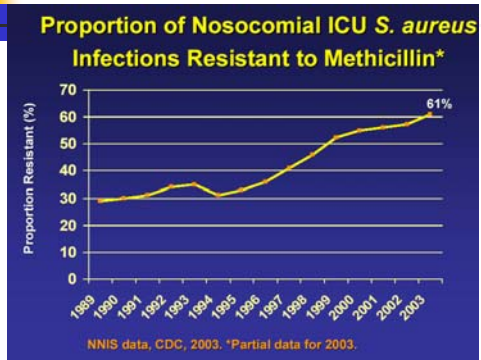


Figure 1. Proportion of *S aureus* resistant to methicillin among nosocomial infections by hospital bed size from 1975 to 1997. Adapted from National Nosocomial Infection Surveillance (NNIS) System.⁶

Current Situation



selected US Medical Centers

CDC August 20, 1999 / Vol. 48 / No. 32

MMWRTM MORBIDITY AND MORTALITY WEEKLY REPORT

- 705 Carbon Monoxide Poisoning Deaths Associated with Camping
- 707 Community-Acquired Methicillin-Resistant *Staphylococcus aureus*
- 710 Gastrointestinal Bacteriobolomycosis — Arizona
- 714 Iron Deficiency Anemia in Alaska Native Children — Hooper Bay
- 717 Potential Hepatitis A Exposure — North Carolina
- 717 Notices to Readers

Vol. 48 / No. 32

MMWR

707

Four Pediatric Deaths from Community-Acquired Methicillin-Resistant *Staphylococcus aureus* — Minnesota and North Dakota, 1997–1999

Methicillin-resistant *Staphylococcus aureus* (MRSA) is an emerging community-acquired pathogen among patients without established risk factors for MRSA infection (e.g., recent hospitalization, recent surgery, residence in a long-term-care facility [LTCF], or injecting-drug use [IDU]) (1). Since 1996, the Minnesota Department of Health (MDH) and the Indian Health Service (IHS) have investigated cases of community-acquired MRSA infection in patients without established risk factors. This report describes four fatal cases among children with community-acquired MRSA; the MRSA strains isolated from these patients appear to be different from typical nosocomial MRSA strains in antimicrobial susceptibility patterns and pulsed-field gel electrophoresis (PFGE) characteristics.

Methicillin-Resistant *S. aureus* Infections among Patients in US Emergency Departments – August 2004

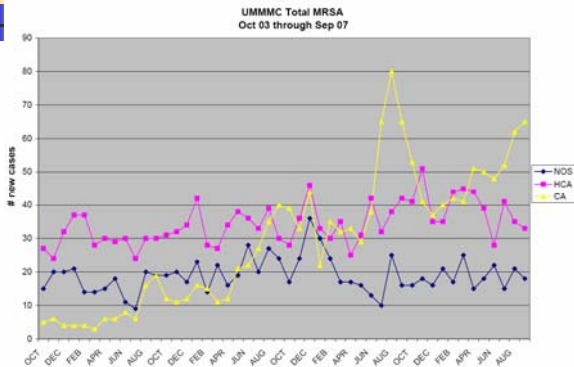
Table 1. Bacterial Isolates from Purulent Skin and Soft-Tissue Infections in 11 U.S. Emergency Departments.*

Site	No. of Patients Enrolled (N=422)	MRSA (N=249)†	MSSA (N=71)	Other Bacteria (N=64)‡	No Bacterial Growth (N=38)
Albuquerque	42	25 (60)	10 (24)	3 (7)	4 (10)
Atlanta	32	23 (72)	4 (12)	3 (9)	2 (6)
Charlotte, N.C.	25	17 (68)	0	4 (16)	4 (16)
Kansas City, Mo.	58	43 (74)	6 (10)	4 (7)	5 (9)
Los Angeles	47	24 (51)	6 (13)	8 (17)	9 (19)
Minneapolis	28	11 (39)	4 (14)	9 (32)	4 (14)
New Orleans	69	46 (67)	11 (16)	9 (13)	3 (4)
New York	20	3 (15)	8 (40)	5 (25)	4 (20)
Philadelphia	58	32 (55)	12 (21)	12 (21)	2 (3)
Phoenix, Ariz.	30	18 (60)	8 (27)	4 (13)	0
Portland, Oreg.	13	7 (54)	2 (15)	3 (23)	1 (8)

* A total of 31 cultures, including 10 cultures from which MRSA was isolated, were polymicrobial. Because of rounding, percentages may not total 100. MSSA denotes methicillin-resistant *Staphylococcus aureus*.
† P<0.001 for the test for homogeneity of MRSA prevalence across sites.
‡ Other bacteria isolated were as follows: MSSA (17 percent), streptococcus species (7 percent), coagulase-negative staphylococci (3 percent), and *Proteus mirabilis* (1 percent).

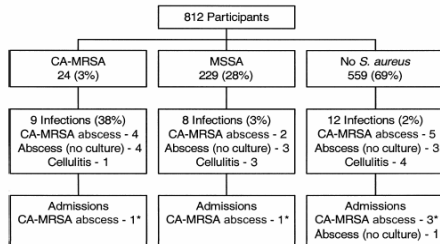
N Engl J Med 2006;355:666-74

INCIDENCE OF NEWLY IDENTIFIED CASES OF NOSOCOMIAL, HEALTHCARE ASSOCIATED, AND COMMUNITY ACQUIRED MRSA – UMASS MEMORIAL MEDICAL CENTER



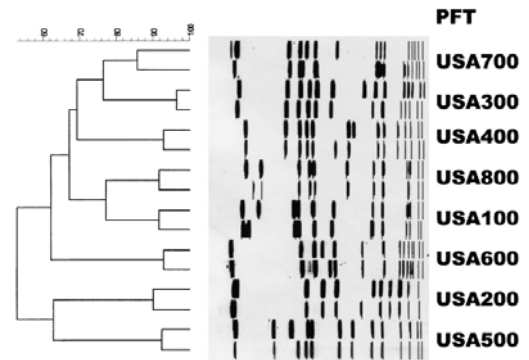
Natural History of CA-MRSA Colonization and Infection in Soldiers

812 military personnel followed for 8-10 weeks during training program in Fall 2003 at Fort Sam Houston. All participants had baseline nasal culture



Ellis MW et al. Clin Infect Dis 2004; 39:971-9

Molecular typing of MRSA



CA-MRSA USA300

- Whole genome sequence reported Feb 28, 2006
- Contains PVL toxin, *SCCmec* type IV, and two pyrogenic toxin superantigens

Lancet 2006;367:731-740

CA-MRSA USA300

- Contains a unique 30.9 kb pathogenicity island previously identified in *S. epidermidis*
 - Includes 6 genes that encode arginine deaminase pathway (ACME)
- Arginine deaminase is virulence factor for group A streptococci
 - inhibits peripheral blood monocyte proliferation
 - Inhibits nitric oxide production
 - Induces ammonia production and thereby may promote bacterial colonization in acidic environment of human skin (pH 4.2-5.9)

Lancet 2006;367:731-740

MRSA in Health Care Workers

Epidemiology of Community-Acquired Methicillin-Resistant *Staphylococcus aureus* Skin Infections Among Healthcare Workers in an Outpatient Clinic

Cecilia P. Johnston, MD, MHS; Lisa Cooper, RN;
William Ruby, DO; Karen C. Carroll, MD;
Sara E. Cosgrove, MD, MS; Trish M. Perl, MD, MSc

We describe an investigation of soft-tissue infections caused by community-acquired methicillin-resistant *Staphylococcus aureus* (CA-MRSA) strains in 2 healthcare workers employed in an outpatient clinic for patients with human immunodeficiency virus infection. Cultures of environmental samples from multiple surfaces in the clinic grew toxin-producing CA-MRSA strains, suggesting fomites may play a role in the transmission of these strains of MRSA.

Infect Control Hosp Epidemiol 2006; 27:1133-1136

CA-MRSA and Healthcare Workers

INFECTION CONTROL AND HOSPITAL EPIDEMIOLOGY JUNE 2006, VOL. 27, NO. 6

ORIGINAL ARTICLE

Outbreak of Methicillin-Resistant *Staphylococcus aureus* Colonization and Infection in a Neonatal Intensive Care Unit Epidemiologically Linked to a Healthcare Worker With Chronic Otitis

Surgical Management

- Prospective observational study of 69 children with CA-MRSA cutaneous abscesses seen Children's Medical Center Dallas 2002-2003
 - 96% underwent surgical drainage
 - Only 5 received appropriate antibiotic therapy as outpatients
 - At follow up at 1 to 6 days; only 4 required hospitalization
 - Abscess > 5 cm was predictor for hospitalization (P = 0.004) but not inappropriate antibiotic therapy (P=1)

Pediatric Inf Dis J 2004;23:123-7

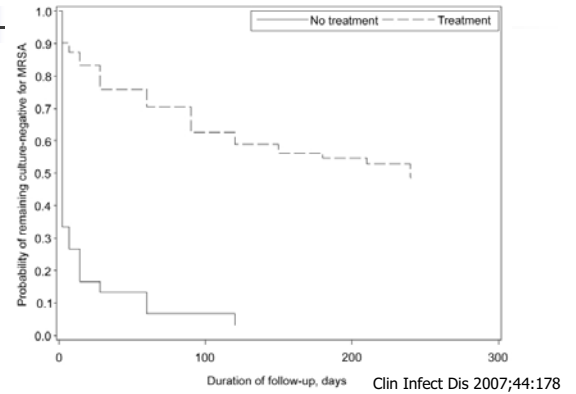
Medical Management

- Intravenous Therapy
 - Vancomycin
 - Linezolid
 - Daptomycin
- Oral Therapy
 - Trimethoprim-sulfamethoxazole
 - Minocycline/Doxycycline
 - Clindamycin
 - Linezolid

Decolonization?

- Purpose – to reduce risk of future infections by reducing colonization
 - In individuals who have already experienced recurrences or
 - In HCW's who may be transmitters
- Many regimens studied
 - Limited evidence on efficacy

Randomized Controlled Trial of 7 day regimen 2% Chlorhexidine wash, topical mupirocin, oral doxycycline and oral rifampin for MRSA decolonization (146 patients)



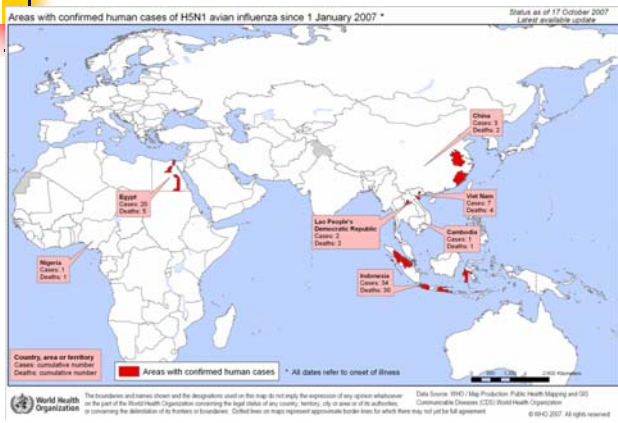
Decolonization

- Other approaches
 - Oral treatment with clindamycin or TMP-SMX plus rifampin
- Treat all family members when clustering observed
- Concurrently wash bed linens, clothing

Bird Flu hits Florida



H5N1 Influenza - 2007

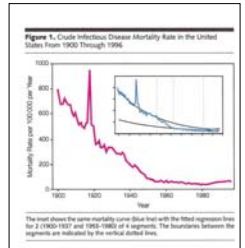


Influenza Pandemics

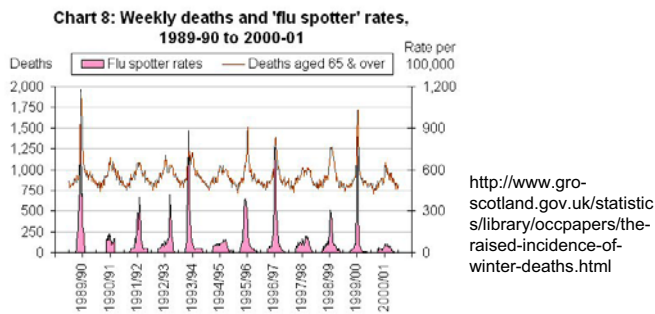
Table 1. Historically recognized pandemics attributed to influenza^a

Years of occurrence	HA subtype	No. of years since last pandemic
1729–33	—	?
1781–82	—	49
1830–33	—	48
1889–91	H3 ^b	55
1918–20	H1	27
1957–58	H2	37
1968–69	H3	10
1977 ^c	H1	9

^a Modified from Potter (2).
^b Determined through retrospective serological studies (seroarchaeology).
^c No excess mortality.



Seasonal Influenza



The Seven Truths of Influenza Vaccination for HCWs

- Influenza is a serious illness
- Influenza infected HCWs can transmit influenza to their patients
- Influenza vaccination of HCWs saves money for employers and prevents workplace disruption
- Influenza vaccination of HCWs is already recommended by the CDC and is the standard of care
- Immunization requirements are effective and work in increasing vaccination rates
- HCWs and health care systems have an ethical and moral duty to protect vulnerable patients from transmissible diseases
- The health care system will either lead or be lambasted

Poland GA et al. Vaccine 2005;23:2251-5.
www.health.state.mn.us/divs/idepc/diseases/flu/hcp/hcwfluvaxfull.ppt

New York Times – October 21, 2007

Op-Ed Contributor Inoculate Thyself

By JANE R. ZUCKER
Published: October 21, 2007

DID you know that many doctors and nurses don't bother to get flu shots? I know it sounds absurd, especially since influenza complications hospitalize more than 200,000 people and kill 36,000 in the United States every year. ...

Virginia Mason Health System Mandatory Vaccination Campaign

- 336-bed tertiary care hospital in Seattle
- Multi-specialty group practice
 - 480 physicians
 - 5000 FTEs
- Instituted mandatory influenza vaccination campaign in 2005
- Staff can request an accommodation on religious or medical grounds.
- If approved, staff wear a mask at work during the influenza season.
- Requests for accommodation are evaluated on a case-by-case basis in consultation with Employee Health, Human Resources and the medical director of the VM Infectious Disease Department

CDC. 2007 National Influenza Vaccine Summit

Virginia Mason Health System Mandatory Vaccination Campaign

- Provided multipronged promotional campaign:
 - Participation of Seattle Seahawks
 - Flumist campaign
 - Roaming flu immunization teams
 - Educational videos
 - Drive through flu clinics for patients and staff
 - "Double shot" promotion with local coffee company
 - Provided compassionate and evidence based accommodations for staff who chose not to receive vaccinations
 - Allergy screening developed a process for allergy screening with the Allergy department that was free to employees
- ~ 98% employee immunization rate last 2 seasons

CDC. 2007 National Influenza Vaccine Summit

Virginia Mason Health System Mandatory Vaccination Campaign

- Nursing unit filed grievance against mandatory component of immunization campaign
 - Currently under review
- Infection Control Requirement: Unfair Labor Practice Charge filed
 - NLRB Judge rules that hospital could require nurses to wear masks as part of the infection control policy. Judge determines that this is a matter within employer's rights and not a required subject of bargaining

CDC. 2007 National Influenza Vaccine Summit



Massachusetts Department of Public Health

- Expert Panel for Prevention and Control of Healthcare-Associated Infections in Massachusetts of the Betsy Lehman Center for Patient Safety and Medical Error Reduction has recommended that acute care hospitals in Massachusetts publicly report on the annual influenza vaccination of healthcare workers
- Public reporting anticipated for 2008-2009 influenza season



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