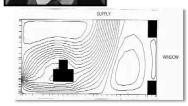
Establishing an Infection Control Program for Acute Respiratory Infections
Prof. Wing Hong Seto, Queen Mary Hospital, Hong Kong
Sponsored by WHO Clean Care is Safer Care (www.who.int/gpsc/en)

Establishing an Infection Control Program for Acute Respiratory Infections and Ensuring Pandemic Preparedness



WH Seto
Queen Mary Hospital
Hong Kong

Hosted by Philip Russo
National Project Manager
Hand Hygiene Australia

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WHO Patient Safety Challenge
Clean Care is Safer Care

www.webbertraining.com June 21, 2011

The problem of

over reaction on

the wrong thing

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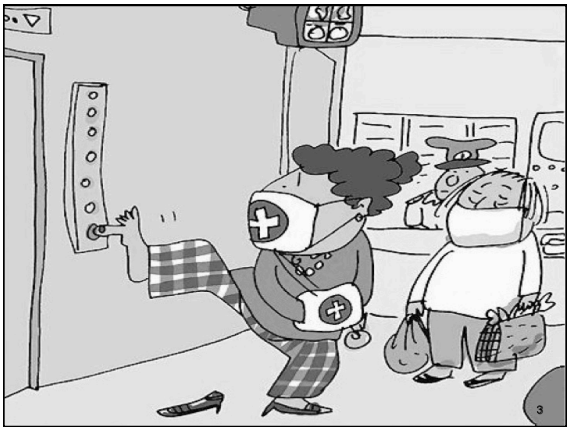

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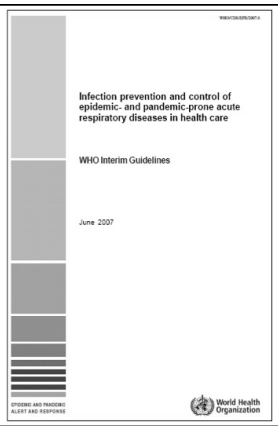
WHO PPP Tools
(Global Pandemic Plan + Checklist)

> 40 guidelines
Epidemic and Pandemic Alert and Response
http://www.who.int/csr/disease/avian_influenza/guidelines

World Health Organization



6

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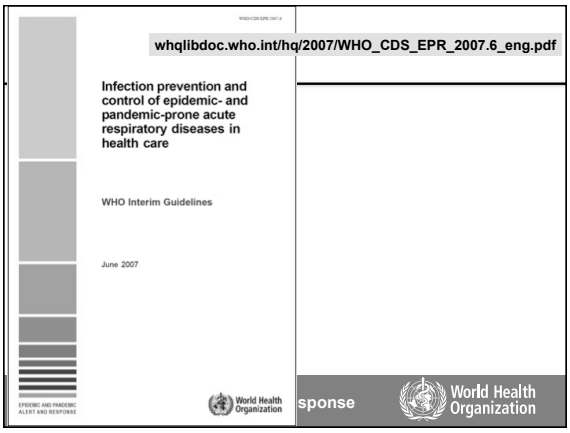

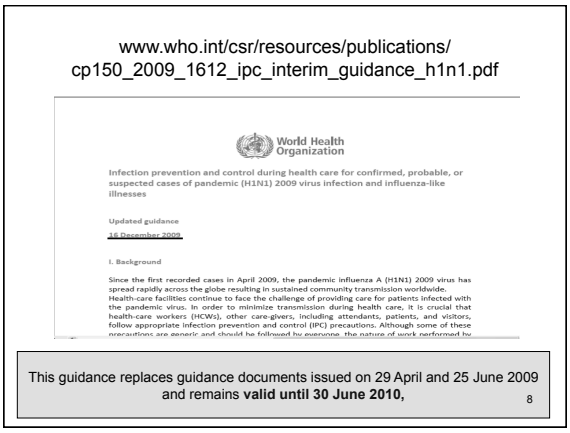

Contents

- Introduction
- Infection prevention and control recommendations
- Environmental ventilation for respiratory infections
- Preparedness planning for ARD epidemics
- Annexes

9

Key Features:

1. Standard precautions with cough etiquette
2. ARD of public health emergency and international concern: SARS, new influenza virus, novel ARD
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10

Modes of transmission

	General	Specific – isolation rooms
Airborne	• Barrier precautions when needed • Meticulous hand hygiene • Good environmental hygiene	**Ventilation Management with –ve pressure rooms** **N95 mask**
Droplets		**Good surgical masks – 3'**
Contact		**Gowning & gloves on contact**
Bloodborne		**Prevention of needle stick**

Standard Precautions

11

Table 4: Standard Precautions in all Healthcare Settings

COMPONENT	RECOMMENDATIONS
Hand hygiene	After touching blood, body fluids, secretions, excretions, contaminated items; immediately after removing gloves; patient contacts.
Personal protective equipment (PPE)	
Gloves	For touching blood, body fluids, secretions, excretions, contaminated items; for touching mucous membranes and nonintact skin
Gown	During procedures and patient-care activities when cont clothing/exposed skin with blood/body fluids, secretions excretions is anticipated..
Mask, eye protection (goggles), face shield*	During procedures and patient-care activities likely to g splashes or sprays of blood, body fluids, secretions, es suctioning, endotracheal intubation
Soiled patient-care equipment	Handle in a manner that prevents transfer of mic others and to the environment; wear gloves if vis contaminated; perform hand hygiene.
Environmental control	Develop proceedures for routine care, cleaning, d environmental surfaces, especially frequently to patient-care areas.
Textiles and laundry	Handle in a manner that prevents transfer of mic others and to the environment
Needles and other sharps	Do not recap, bend, break, or hand-manipulate u recapping is required, use a one-handed scoop t use safety features when available; place used s puncture-resistant container
Patient resuscitation	Use mouthpiece, resuscitation bag, other ventila prevent contact with mouth and oral secretions
Patient placement	Prioritize for single-patient room if patient is at in transmission, is likely to contaminate the environ maintain appropriate hygiene, or is at increased infection or developing adverse outcome followi
Respiratory hygiene/cough etiquette (source containment of infectious respiratory secretions in symptomatic patients, beginning at initial point of encounter e.g., triage and reception areas in emergency departments and physician offices)	Instruct symptomatic persons to cover mouth/no sneezing/coughing; use tissues and dispose in n receptacle; observe hand hygiene after soiling o respiratory secretions; wear surgical mask if tole spatial separation, >3 feet if possible.

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13

Definitions

- Acute respiratory diseases (ARD)
  - Infective causes
- Acute respiratory disease of potential concern
  - ARD with public impact
  - International Health Regulation (2005)
    - SARS
    - New influenza subtype
    - New organisms causing large-scale outbreaks and outbreaks with high morbidity and mortality
    - *Plague*

14

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Must first understand what is airborne infection

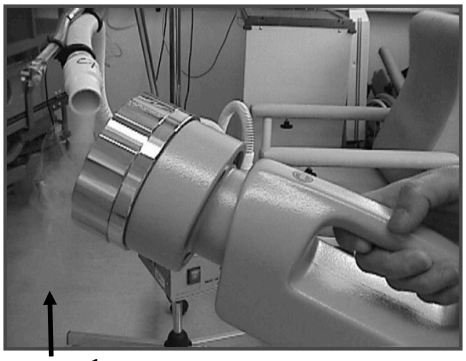
Bacteria That Cause Airborne Nosocomial Infections

- Group A Streptococcus
- Staph. aureus
- Neisseria meningitidis
- Bordetella pertusis
- MTB
- Acinetobacter
- Legionellae
- Clostridia
- Pseudomonas
- Nocardia

Viruses Implicated in Airborne Nosocomial Infections

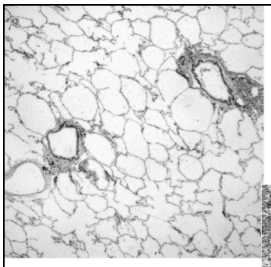
- Rinoviruses
- Influenza and
- Parainfluenza viruses
- Respiratory Syncytial Virus
- Adenovirus
- Varicella Zoster Virus
- Measles
- Rubella
- Smallpox
- Certain enteroviruses

Adapted from Schaal, 1985



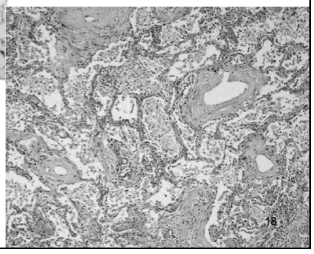
aerosol

17



Normal alveolar

Pneumonia



Courtesy: Dr Gavin Chan, Department of Pathology
Queen Mary Hospital

18

19

Transmission Based Precaution

Airborne	**Nuclei of < 5µm**	**Pulm. TB Measles Varicella Zoster**
Droplet	**Nuclei of > 5µm**	**Influenza Meningococcal Pertussis**
Contact	**Transmission by direct or indirect contact**	**MR organisms Enteric RSV**
Blood	**Exposure to blood inoculation**	**HIV, HBV**

20

Is Influenza Airborne?

21

Transmission of influenza A in human beings

Brankston et al. **Lancet ID 2007(7):257-65**

Search of 2012 citations

"We are able to conclude that transmission occurs at close range rather then over long distance, suggesting that airborne transmission, traditional defined, is unlikely to be of significance in most clinical setting."

22

Artificial generated aerosol can infect man and animals

Artificial aerosols: <10% are larger 8 μm
Natural coughing: 99.9% are larger then 8 μm

"We question whether these studies are relevant to natural route of human transmission"

"No published evidence of human infection resulting from the ambient air"

23

Alaskan Airline: Non functional ventilation system 72% infected **(Am J Epidemiol 1979:110:1-6)** Free movement of passengers

Naval base aircraft (**Am J Epidemiol 1989:129:341-48)**
Klontz reported outbreaks (56%) in functional ventilation planes

Influenza lower with UV lights (Am Rev Resp Dis 1961:83:36)
Infection related to ventilation systems in 4 buildings (J Am Ger 1996:18:811)

- Many confounders not accounted:
  eg. number of index patients, bed layout, length of stay, hand hygiene, immunization status.
  One study even confirmed that lowest rate has more space allocated
- Air exchange rate is not reported
- 2nd study even reported equal rates in next season.

24

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Recent classification for airborne transmission

Obligate airborne: initiate solely through aerosols: TB

Preferential airborne: initiate through multiple routes but predominately by aerosols: Chicken pox and measles

Opportunistic airborne: typically through other routes but by aerosols in favorable conditions (as high-risk procedures such as intubation): Influenza and SARS

25

WHO systemic review - 2008

Table 1. The scope and definitions of three transmission models

Mode of transmission	Definition	Examples of the agents
Airborne	Transmission of disease caused by dissemination of droplet nuclei that remain infectious when suspended in air over long distance (> 1m) and time. Airborne transmission can be further categorized into obligate or preferential airborne transmission. • ***Obligate airborne*** *transmission* refers to pathogens that are transmitted only by deposition of droplet nuclei under natural conditions. • *Preferential airborne transmission* refers to pathogens that can initiate infection by multiple routes, but are predominantly transmitted by droplet nuclei.	pulmonary tuberculosis measles chickenpox

26

Opportunistic airborne	Transmission of droplet nuclei at short range during special circumstances, such as the performance of aerosol-generating procedures associated with pathogen transmission.	SARS CoV Influenza
Droplet	Droplets are generated from an infected (source) person primarily during coughing, sneezing, and talking. Transmission occurs when these droplets containing microorganisms are propelled a short distance (usually ≤ 1m) through the air and deposited on the conjunctivae, mouth, nasal, throat or pharynx mucosa of another person.	Adenovirus Respiratory Syncytial Virus Influenza SARS CoV

27

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28

Research letters

Is SARS airborne?

Effectiveness of precautions against droplets and contact in prevention of nosocomial transmission of severe acute respiratory syndrome (SARS)

W H Seto, D Tsang, R W H Yung, T Y Ching, T K Ng, M Ho, L M Ho, J S M Peiris, and Advisors of Expert SARS group of Hospital Authority *Members listed at end of report*

We did a case-control study in five Hong Kong hospitals, with 241 non-infected and 13 infected staff with documented exposures to 11 index patients with severe acute respiratory syndrome (SARS) during patient care. All participants were surveyed about use of mask, gloves, gowns, and hand-washing, as recommended under droplets and contact precautions when caring for index patients with SARS. 69 staff who reported use of all four measures were not infected, whereas all infected staff had omitted at least one measure (p=0·0224). Fewer staff who wore masks (p=0·0001), gowns (p=0·006), and washed their hands (p=0·047) became infected compared with those who didn't, but stepwise logistic regression was significant only for masks (p=0·011). Practice of droplets precaution and contact precaution is adequate in significantly reducing the risk of infection after exposures to patients with SARS. The protective role of the mask suggests that in hospitals, infection is transmitted by droplets.

SARS 2–7 days after exposure, with no exposure to cases outside the hospital.

For this study, index patients were selected only when there was documented clustering, indicating recent spread of infection. We could identify infected staff because since early February, notification of staff with SARS was mandatory in hospital-authority hospitals. We tested sera taken from index patients and infected hospital staff during the acute phase of the infection and during convalescence for antibodies to the corona-like virus[1] associated with SARS using an indirect immunoflourescence test.[2]

We excluded one hospital that had a large nosocomial outbreak because a drug nebuliser was used on an index patient with SARS for longer than 10 days. Droplets precautions have never been recognised as an effective infection control measure for such aerosol-generating

+ HICPAC WHO/SHEA	Medical Masks	Gloves	Gowns	Eye Protection	N95
Droplets all cases	Yes	-	-	-	-
Standard Precautions	Yes	Yes	Yes	Yes	-
Aerosol Generating		Yes	Yes	Yes	Yes
Resp swabs	Yes	Yes	Yes	Yes	-
Collecting blood	Yes	Yes	-	-	-
CDC (13th May) Standard & Contact + IOM		Yes	Yes	Yes	Yes
Enter Isolation room - all HCWs					Yes

30

23rd July 2009

(http://www.cdc.gov/ncidod/dhqp/hicpac_transcript-07-23.html).

Healthcare Infection Control Practices Advisory Committee (HICPAC)

"No studies to date have demonstrated human infection occurring from naturally aerosolized influenza or human infection occurring by inhalation of artificially aerosolized influenza in ambient rather then directed air."

"**confirm the presence of airborne influenza virus in various clinic locations**"
Blachere et al (CID 2009 48 (4):438)

Finally a recent study focused on air sampling in a busy hospital emergency room during influenza's seasonal activity ….. detected in the air fraction was in small particles 1 to 4 micrometers in size.
PCR detection, rather then viral culture and assessment of viability, was utilized in this study, so the significance of these findings needs further investigation.

31

CDC website

HICPIC advisory committee
23rd July to vote on the latest recommendation

(http://www.cdc.gov/ncidod/dhqp/hicpac_transcript-07-23.html).

"endorse the use of surgical masks for the routine care of patients with confirmed or suspected, novel influenza A (H1N1)"

"it is appropriate at this time to recommend the use of N95 or higher respiratory protection for procedures that are likely to generate small particle aerosols." The procedures are then listed to include "bronchoscopy, intubation under controlled or emergent situations, cardiopulmonary resuscitation, open airway suctioning and airway induction."

32

Comment on Blachere et al: PCR positive is not the same as culture positive

1st September 2009

Institute of Medicine

- HCWs (including non-hospital settings) in close contact with individuals with nH1N1 or ILIs should use fit-tested N95 respirators.
- Endorse current CDC guidelines.

Page 17 : "confirm the presence of airborne influenza virus in various clinic locations"
Blachere et al (CID 2009 48 (4):438)

Also based on the Macintyre study done in China
Claims N95 statistically significant more protective then controls.
but surgical masks had no efficacy for any outcome

33

But there is a study not considered by IOM showing that surgical masks is as effective as N95…….

Surgical Mask vs N95 Respirator for Preventing Influenza Among Health Care Workers: A Randomized Trail.
Mark Loeb et al, JAMA,, 2009;302(17), October 1 online

A randomized controlled trail of 446 nurses in 8 tertiary care hospitals – Ontario

	Surgical masks	N95
n =	225	221
Influenza infected =	50 (23.6%)	48 (22.9%)

p = 0.086 (meet criteria for non-inferiority)

34

35

SHEA The Society for Healthcare Epidemiology of America · IDSA · APIC Spreading knowledge. Preventing infection.

November 5, 2009

President Barack Obama
The White House
1600 Pennsylvania Avenue, NW
Washington D.C. 20500

Dear President Obama:

During this state of national emergency due to the 2009 H1N1 influenza pandemic, it is imperative that healthcare professionals and facilities receive clear, practical, and evidence-based federal guidance to ensure patient and healthcare worker safety. With this in mind, the Society for Healthcare Epidemiology of America (SHEA), Infectious Diseases Society of America (IDSA), and Association of Professionals in Infection Control and Epidemiology (APIC) write to express significant concern with the federal guidance, developed by your Administration in cooperation with several agencies and recently issued by the Centers for Disease Control and Prevention (CDC), and Occupational Safety and Health Administration (OSHA) requirements concerning the use of personal protective equipment (PPE) by healthcare workers in treating suspected or confirmed cases of H1N1 influenza.

36

CDC change in June 2010.

"In a change from previous pandemic H1N1 recommendations, the CDC advises that healthcare workers wear face masks [ie. the surgical masks] when entering the room of a patient who has confirmed or suspected flu. Earlier recommendations suggested that staff wear N-95 respirators during all contact with flu patients; however, the new guidance recommends N-95s or higher levels of protection during risky procedures such as aerosol-generating procedures."

37

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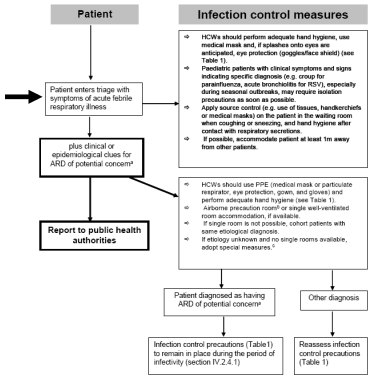
38

Figure 1 Decision tree for infection control measures for patients known or suspected to be infected with an acute infectious respiratory disease



39

Implementation of WHO ARD guideline

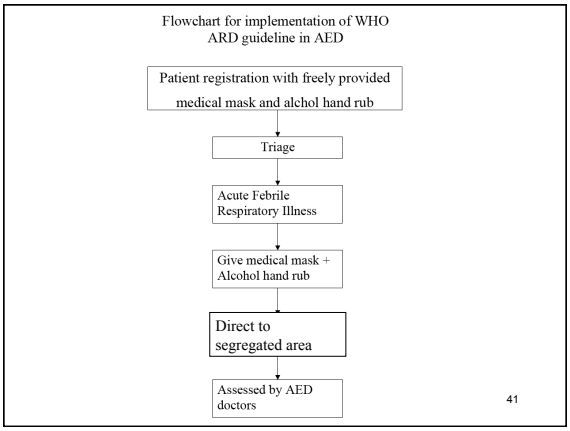
- AED

Facilities required:
- Medical/ surgical masks
- Alcohol hand rub
- Tissue papers
- Segregation of ILIs

- General medical units

Facilities required:
- ARD cubicles (beds separated by 1 m apart, with no extra/camp beds)
- Sufficient supply of PPEs
- Hand hygiene facilities (alcohol hand rub, sinks, etc.)
- Suction for NPA (viral TM)

40



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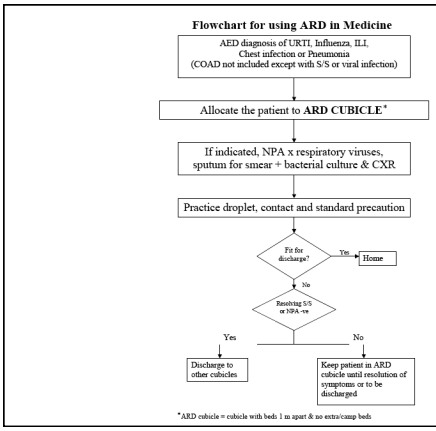
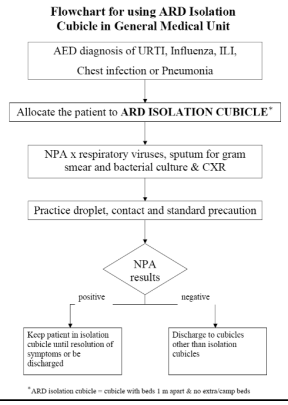


42

COPDs

1. Diagnosis of excerbation can be made in at least about 70% of the time
2. Most are due to bacteria.
3. Viral may account for about 10%
4. They usually have added features like coryza, sore-throat, myalgia, joint pains, high fever.
5. NPA should not be routinely done but only when indicated.

43



COAD not included unless clear evidence of URTI

44

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45

Special droplet precautions for Pediatric Patients

1. Beds are 1m apart
2. Patients are not to leave bed without permission
3. No sharing of non-essential medical equipments
4. Patient records are not placed by the bedside
5. No common play area
6. Once diagnosis made, relevant isolations may be needed

46

Cubicle with beds 3 feet apart. Children not allowed to mix and play. Visitor (in purple gown) stays at the bedside.

47

Individual stethoscope and bedside clipboard with pens. Whole set cleaned upon discharge of patient.

48

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Note sensor for door and alcohol rub.

49

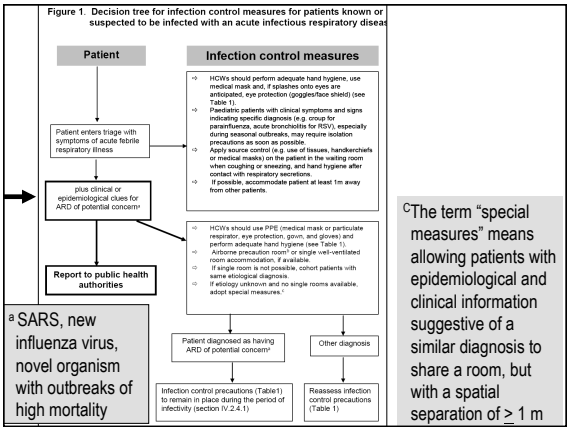
Nurses station is a clean zone. Medical charts stay here. No gowns or gloves allowed. Mask not really needed if not going in to see patients.

Visitor's policy

- 3 visitors named on admission
  - Only 1 visitor at bedside at any one time
  - 24 hour visit allowed
  - Visitors gown and mask

51

52



[a] SARS, new influenza virus, novel organism with outbreaks of high mortality

[c] The term "special measures" means allowing patients with epidemiological and clinical information suggestive of a similar diagnosis to share a room, but with a spatial separation of ≥ 1 m

Clinical and epidemiological clues

- *Clinical clues*
  - Unexplained severe acute febrile respiratory illness
  - Unexplained illnesses
  - Exposure history within incubation period
- *Epidemiological clues*
  - **T**ravel history
  - **O**ccupation
  - **C**ontact
  - **C**luster

54

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Table 1. Infection control precautions for HCWs and caregivers providing care for patients with ARDs according to a sample of pathogens

Precaution		No pathogen identified, no risk factor for ARD of potential concern (e.g. influenza-like illness without risk factor for ARD of potential concern)	Pathogen					
			Bacterial ARD[a]	Parainfluenza RSV & adenovirus	Influenza virus with sustained human-to-human transmission (e.g. seasonal influenza, pandemic influenza)	New influenza virus with no sustained human-to-human transmission (e.g. avian influenza)	SARS	Novel organisms causing ARD[b]
Hand hygiene[a]		Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gloves		Risk assessment[d]	Risk assessment[d]	Yes	Risk assessment[d]	Yes	Yes	Yes
Gown[a]		Risk assessment[d]	Risk assessment[d]	Yes	Risk assessment[d]	Yes	Yes	Yes
Eye protection		Risk assessment[f]	Risk assessment[f]	Risk assessment[f]	Risk assessment[f]	Yes	Yes	Yes
Medical mask on HCWs and caregivers		Yes	Risk assessment[f]	Yes	Yes	Yes[g]	Yes[h]	Not routinely[g]
Particulate respirator on HCWs and caregivers	for room entry	No	No	No	No	Not routinely[g]	Not routinely[g]	Yes
	within 1m of patient	No	No	No	No	Not routinely[g]	Not routinely[g]	Yes
	for aerosol-generating procedures[e]	Yes	Not routinely[j]	Not routinely[j]	Yes	Yes	Yes	Yes
Medical mask on patient when outside isolation areas[k]		Yes	Yes	Yes[j]	Yes	Yes	Yes	Yes
Single room		Yes, if available[m]	No	Yes, if available[m]	Yes, if available[m]	Yes	Yes	Not routinely[g]
Airborne Precaution room[n]		No	No	No	No	Not routinely[o]	Not routinely[o]	Yes
Summary of infection control precautions for routine patient care, excluding aerosol-generating procedures[e]		Standard plus Droplet Precautions	Standard Precautions	Standard plus Droplet plus Contact Precautions	Standard plus Droplet Precautions	Standard plus Droplet plus Contact Precautions	Standard plus Droplet plus Contact Precautions	Standard plus Airborne plus Contact Precautions

55

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Eye protection		Risk assessment[f]	Risk assessment[f]	Risk assessment[f]	Risk assessment[f]	Yes	Yes	Yes
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	for aerosol-generating procedures[e]	Yes	Not routinely[j]	Not routinely[j]	Yes	Yes	Yes	Yes
Medical mask on patient when outside isolation areas[k]		Yes	Yes	Yes[j]	Yes	Yes	Yes	Yes
Single room		Yes, if available[m]	No	Yes, if available[m]	Yes, if available[m]	Yes	Yes	Not routinely[g]
Airborne Precaution room[n]		No	No	No	No	Not routinely[o]	Not routinely[o]	Yes
Summary of infection control precautions for routine patient care, excluding aerosol-generating procedures[e]		Standard plus Droplet Precautions	Standard Precautions	Standard plus Droplet plus Contact Precautions	Standard plus Droplet Precautions	Standard plus Droplet plus Contact Precautions	Standard plus Droplet plus Contact Precautions	Standard plus Airborne plus Contact Precautions

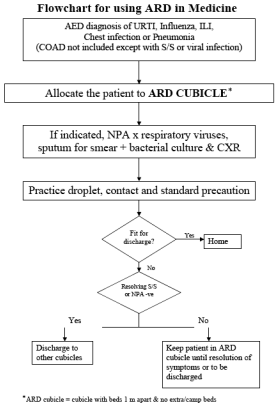
57

Fix the procedures (pp22)

For all ARDs

- ⇨ Cohorting refers to placing patients infected or colonized with the same pathogens in the same designated unit (same space and staff in the unit). Whenever possible, cohorting should be used for implementation of isolation precautions when single rooms are not available (*64*).
- ⇨ If the etiological diagnosis is not laboratory-confirmed, cohorting, as described above, is not possible. Because of the transmission risk, patients should be housed in single rooms, whenever possible.
- ⇨ However, if sufficient single rooms are not available, apply special measures. Only allow patients with epidemiological and clinical information suggestive of a similar diagnosis to share rooms, and with a spatial separation of at least 1 m from one another.
- ⇨ Avoid sharing of equipment, but if unavoidable, ensure that reusable equipment is appropriately disinfected between patients (*64*).
- ⇨ Ensure regular cleaning and proper disinfection of common areas (*66*), and adequate hand hygiene by patients, visitors and caregivers (*67, 68*).

"In Paediatric patients with ARDs.....Contact, Standard and Droplet Precautions should be implemented whenever possible." pp11



59

Key Features:

1. Standard precautions with cough etiquette
2. ARD of public health emergency and international concern: SARS, new influenza virus, novel ARD
3. Measures before diagnosis is made (Figure 1)
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7. Handling high risk procedures
8. Isolation rooms and when it is no enough
9. Use of PPEs and managing surge capacity
10. Infection Control in special situations

60

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Aerosol-generating procedures

Table 6 . Risk of transmission of respiratory pathogens during aerosol-generating procedures

Procedure		Type of study
Documented increase in risk of respiratory pathogen transmission		
○ Intubation, cardiopulmonary resuscitation and related procedures (e.g. manual ventilation, suction)		Epidemiological studies on tuberculosis and SARS
○ Bronchoscopy		Epidemiological studies on tuberculosis
○ Autopsy/surgery		Epidemiological studies on tuberculosis
Controversial/possible increase in risk of respiratory pathogen transmission		
○ Non-invasive positive-pressure ventilation and bilevel positive airway pressure		Epidemiological studies on SARS
○ High-frequency oscillating ventilation		Epidemiological studies on SARS
○ Nebulization		Epidemiological studies on SARS

61

1.1. When working in direct contact with patients, Standard[6] and Droplet Precautions[7] should always be applied.

62

www.who.int/csr/resources/publications/cp150_2009_1612_ipc_interim_guidance_h1n1.pdf

World Health Organization

Infection prevention and control during health care for confirmed, probable, or suspected cases of pandemic (H1N1) 2009 virus infection and influenza-like illnesses

Updated guidance
16 December 2009

I. Background

Since the first recorded cases in April 2009, the pandemic influenza A (H1N1) 2009 virus has spread rapidly across the globe resulting in sustained community transmission worldwide. Health-care facilities continue to face the challenge of providing care for patients infected with the pandemic virus. In order to minimize transmission during health care, it is crucial that health-care workers (HCWs), other care-givers, including attendants, patients, and visitors, follow appropriate infection prevention and control (IPC) precautions. Although some of these

This guidance replaces guidance documents issued on 29th April and 25th June 2009 and remains **valid until 30th June 2010,**

63

WHO guideline

1.2. When performing aerosol-generating procedures associated with an increased risk of infection transmission (e.g. aspiration or open suctioning of the respiratory tract, including for the collection of lower respiratory tract specimens, intubation, resuscitation, bronchoscopy, autopsy, etc.), IPC precautions should include the following:

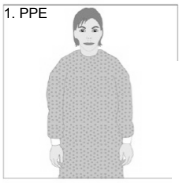
- Wear a particulate respirator (e.g. FFP2; see[9] for listing), eye protection (i.e., goggles or a face shield); a clean, non-sterile, long-sleeved gown; and gloves (some of these procedures require sterile gloves).
- Perform procedures in an adequately ventilated room; e.g. minimum of 6 to 12 air changes per hour in facilities with a mechanically ventilated room and at least 60 liters/second/patient in facilities with natural ventilation).[10]
- Limit individuals in the room only to those required for the patient's care and support.
- Perform hand hygiene before and after patient contact and after PPE removal.

- Non-invasive ventilation (NIV) (i.e., BiPAP, CPAP):[12] Standard and Droplet Precautions unless indicated otherwise by new evidence of increased transmission risk.[13]

- Nebulization: Standard and Droplet Precautions. Nebulizer treatment should be performed in an area that is physically separated from other patients (e.g. treatment room, screened enclosure).[14]

64

1. PPE



Gown

Aerosol generating procedures

N95 and eye protection

Gloves

2. Ventilation

6-12 ACH

3. Hand hygiene

65

Aerosol-generating high risk procedures.

Both WHO/CDC: Intubation, bronchoscopy, autopsies, cardiopulmonary resuscitation, open suction of airways.

CDC only: extubation, sputum induction;

WHO only: collection of lower respiratory tract specimens.

66

About Sputum Induction

Sputum induction is used to obtain sputum for diagnostic purposes when patients are unable to spontaneously expectorate a specimen. The procedure uses sterile water or hypertonic saline to irritate the airway, increase secretions, promote coughing, and produce a specimen. The CDC and OSHA both classify sputum induction as a high-risk procedure when performed on a person with suspected or known infectious TB

67

WHO guideline

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68

Nebulizers

Emerging Infectious Diseases • www.cdc.gov/eid • Vol. 10, No. 2, February 2004

Cluster of SARS among Medical Students Exposed to Single Patient, Hong Kong

Tze-wai Wong,* Chin-kei Lee,† Wilson Tam,* Joseph Tak-fai Lau,* Tak-sun Yu,* Siu-fai Lui,‡ Paul K.S. Chan,* Yuguo Li,§ Joseph S. Bresee,¶ Joseph J.Y. Sung,* and Umesh D. Parashar,¶ for the Outbreak Study Group*†

69

At the time this investigation was begun, jet nebulizer therapy given to the index patient was widely believed to have facilitated transmission. However, our findings demonstrate efficient transmission even before nebulizer therapy was begun on the afternoon of March 6.

Table 3. Time schedule of the clinical assessment of 19 medical students[a]

Time		Ill/total
6 March 2003	10:00–10:40 a.m.	0/3
	10:40–11:20 a.m.	2/3
	11:30 a.m.–12:00 p.m.	3/3
	12:00–12:40 p.m.	1/1
7 March 2003	10:00–10:40 a.m.	1/2
	10:40–11:20 a.m.	0/3
	11:30 a.m.–12:00 p.m.	0/3
	12:00–12:40 p.m.	0/1

[a]Excluding the student-patient whose illness had a long incubation period.

70

Lastly, for the students with SARS who were present on the ward for reasons other than the bedside assessment, no association was observed between their stay in the ward at the specific periods when the nebulizer was used and the development of SARS.

71

A Large-Volume Nebulizer Would Not Be an Infectious Source for Severe Acute Respiratory Syndrome

Gwo-Hwa Wan, PhD; Ying-Huang Tsai, MD; Yao-Kuang Wu, MD; Kuo-Chien Tsao, MSc

ABSTRACT

We attempted to detect the presence of airborne SARS-coronavirus (CoV) in a healthcare setting when a patient with SARS used a humidifier or a large-volume nebulizer (LVN). All of the air samples from the humidifier and LVN were found to have negative SARS-CoV–specific DNA products (*Infect Control Hosp Epidemiol* 2004;25:1113-1115).

72

Establishing an Infection Control Program for Acute Respiratory Infections
Prof. Wing Hong Seto, Queen Mary Hospital, Hong Kong
Sponsored by WHO Clean Care is Safer Care (www.who.int/gpsc/en)

NIVs

Am J Respir Crit Care Med Vol 169. pp 1198–1202, 2004

Transmission of Severe Acute Respiratory Syndrome during Intubation and Mechanical Ventilation

Robert A. Fowler, Cameron B. Guest, Stephen E. Lapinsky, William J. Sibbald, Marie Louie, Patrick Tang, Andrew E. Simor, and Thomas E. Stewart

TABLE 2. ASSOCIATION OF ENDOTRACHEAL INTUBATION WITH THE DEVELOPMENT OF SEVERE ACUTE RESPIRATORY SYNDROME AMONG PHYSICIANS AND NURSES

Any Involvement with Intubation	n	Developed SARS	RR	95% Confidence Interval	p Value
All healthcare workers					
Yes	14	6	13.29	2.99–59.04	0.003
No	62	2			
For nurses					
Yes	4	3	21.38	4.89–93.37	0.001
No	57	2			
For physicians					
Yes	10	3	3.82	0.23–62.24	0.5
No	5	0			

Definition of abbreviations: RR = relative risk; SARS = severe acute respiratory syndrome.

TABLE 3. ASSOCIATION OF VENTILATION STRATEGIES WITH THE DEVELOPMENT OF SEVERE ACUTE RESPIRATORY SYNDROME AMONG HEALTHCARE WORKERS

Ventilation Mode	n	Developed SARS	RR	95% Confidence Interval	p Value
Patient treated with NIPPV					
Yes	6	1	2.33	0.25 to 21.76	0.5
No*	28	2			
Patient treated with HFO					
Yes	38	2	0.74	0.11 to 4.92	0.6
No*	28	2			

Definition of abbreviations: HFO = high-frequency oscillatory; NIPPV = noninvasive positive-pressure ventilation; RR = relative risk; SARS = severe acute respiratory syndrome.
* Conventional ventilation is the reference, with an odds ratio of developing SARS = 1.

73

Clinical Infectious Diseases 2007; 44:1017–25

Why Did Outbreaks of Severe Acute Respiratory Syndrome Occur in Some Hospital Wards but Not in Others?

Ignatius T. Yu,[1,2] Zhan Hong Xie,[4] Kelvin K. Tsoi,[1] Yuk Lan Chiu,[1] Siu Wai Lok,[1] Xiao Ping Tang,[5] David S. Hui,[3] Nelson Lee,[3] Yi Min Li,[4] Zhi Tong Huang,[4] Tao Liu,[2] Tze Wai Wong,[2] Nan Shan Zhong,[4] and Joseph J. Sung[1,3]

[1]Centre for Emerging Infectious Diseases and Departments of [2]Community and Family Medicine and [3]Medicine and Therapeutics, The Chinese University of Hong Kong, Hong Kong, and [4]Guangzhou Institute of Respiratory Diseases, Guangzhou Medical College, [5]Guangzhou No. 8 People's Hospital, [6]Second Affiliated Hospital, Zhongshan University, and [7]Guangdong Provincial Hospital of Traditional Chinese Medicine, Guangzhou, China

Eighty-six wards in 21 hospitals in Guangzhou and 38 wards in 5 hospitals in Hong Kong were included in the study.

We defined a superspreading event as the development of 3 new cases of SARS in a ward during the period from 2 to 10 days

Results. Eighty-six wards in 21 hospitals in Guangzhou and 38 wards in 5 hospitals in Hong Kong were included in the study. Six risk factors were significant in the final multiple-logistic regression model: minimum distance between beds of ≤1 m (odds ratio [OR], 6.94; 95% confidence interval [CI], 1.68–28.75), availability of washing or changing facilities for staff (OR, 0.12; 95% CI, 0.02–0.97), whether resuscitation was ever performed in the ward (OR, 3.81; 95% CI, 1.04–13.87), whether staff members worked while experiencing symptoms (OR, 10.55; 95% CI, 2.28–48.87), whether any host patients (index patient or the first patient with SARS admitted to a ward) required oxygen therapy (OR, 4.30; 95% CI, 1.00–18.43), and whether any host patients required bi-level positive airway pressure ventilation (OR, 11.82; 95% CI, 1.97–70.80).

74

Nosocomial Transmission of Severe Acute Respiratory Syndrome: Better Quality of Evidence Is Needed

Stéphane Hugonnet,[1] Dominique Legros,[2] Cathy Roth,[1] and Carmem Lucia Pessoa-Silva[2]

[1]Infection Control Program, University of Geneva Hospitals, and [2]Department of Epidemic and Pandemic Alert and Response, World Health Organization, Geneva, Switzerland

First, the definition of a superspreading event is questionable. The authors made the strong assumption that the clustered cases were all secondary to a single identified (or unknown) index case and that transmissions occurred within the ward.

Second, the measure of the exposures suffers from very important limitations. Data collection was performed 1–3 years after the events, leading to an important recall bias.

Some exposures were of ecological nature (applying similarly to all patients in the ward at a given time), thus making it impossible to be sure that a given patient was really exposed to the risk factor under consideration.

procedure. Because transmission was more intense at the beginning of the outbreak of severe acute respiratory syndrome, a selection bias may have played a role, resulting in most of the case wards being selected at the beginning of the outbreak and most of the control wards being selected towards the end of the outbreak and, therefore, jeopardizing any comparisons.

resources. Although there is little doubt that some procedures may increase transmission [2], the risk associated with several respiratory support techniques observed in the study by Yu et al. [1], in addition to the aforementioned limitations, cannot be interpreted without information about individual compliance with standard infection-control measures and use of personal protective equipment

75

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10. Infection Control in special situations

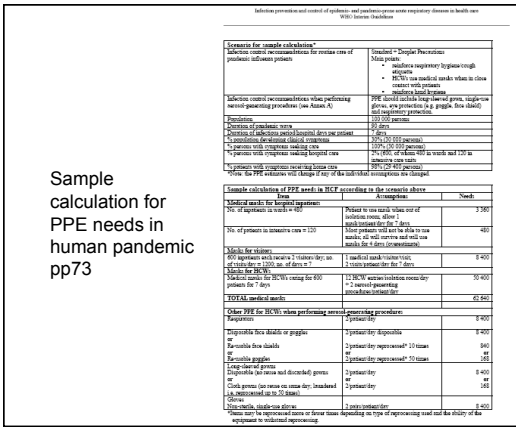
First do this

76

Page 40

77

Sample calculation for PPE needs in human pandemic pp73



78

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Special situations

1. Care of the diseased (pp 31)
2. Environmental cleaning and disinfection (pp 55)
3. Cleaning and disinfection of respiratory equipments (pp 74)
4. Waste management (pp 56)
5. Needle stick injury prevention (pp 57)
6. Infection control across continuum of care (pp 76)
7. Respiratory protection (pp 44)
   - Important of seal check every time
   - Stated that fit test does not have evidence

79

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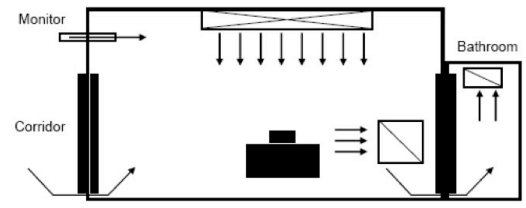
80

Figure 3. Example of negative-pressure room control for airborne infection isolation (AII)* + §¶



* Stacked black boxes represent patient's bed. Long open box with cross-hatch represents supply air. Open boxes with single, diagonal slashes represent air exhaust registers. Arrows indicate direction of air flow.
+ Possible uses include treatment or procedure rooms, bronchoscopy rooms, and autopsy.
§ Negative-pressure room engineering features include
- negative pressure (greater exhaust than supply air volume);
- pressure differential of 2.5 Pa (0.01-in. water gauge);
- air flow volume differential >125-cfm exhaust versus supply;
- sealed room, approximately 0.5-sq. ft. leakage;
- clean to dirty air flow;
- monitoring;
- ≥12 air changes per hour (ACH) new or renovation, 6 ACH existing; and
- exhaust to outside or HEPA-filtered if recirculated.

81

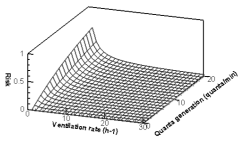
Figure 3. Example of negative-pressure room control for airborne infection isolation (AII)* + §¶

Airborne transmission isolation room:

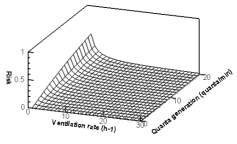
- **Single room or cohorting**
- **Negative pressure** (-2.5 Pa)
- **12 air changes per hour for new renovations**
- **Exhaust air outside or recirculated**
  HEPA filters

- sealed room, approximately 0.5-sq. ft. leakage;
- clean to dirty air flow;
- monitoring;
- ≥12 air changes per hour (ACH) new or renovation, 6 ACH existing; and
- exhaust to outside or HEPA-filtered if recirculated.

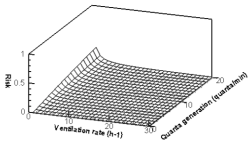
82



(a) 15 minutes exposure time



(b) 10 minutes exposure time



(c) 5 minutes exposure time

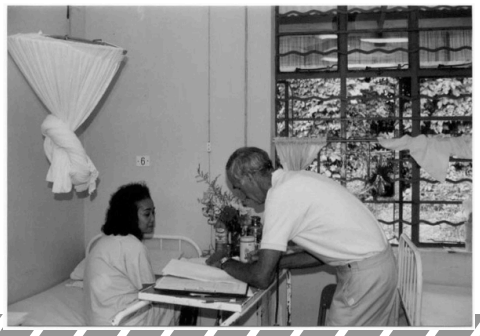
Graphs constructed by Wells-Riley equation to express the relationship between infection risk over ventilation rate, quanta generation rate and exposure time.

83

Measurements in Grantham Chest Hospital Hong Kong (tests in 4 rooms)

Windows open (100%), Doors open (100%)	= 45.4 ACH
Windows open (100%), doors close	= 20.2 ACH
Windows open (50%), doors close	= 15.5 ACH
Windows close , doors close	= 0.6 ACH
Windows close, doors open	= 3 .4 ACH

84



85

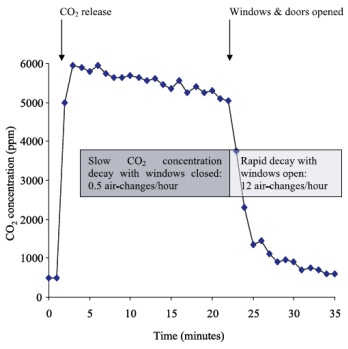
Journal of TB and Lung Diseases; Oct 2005

AR Escombe et al:
Supervise by Imperial College and John Hopkins

65 rooms in 8 hospitals in Lima, Peru

Old Facilities: Median 37 ACH
Modern Facilities: Median 18 ACH

86



87

TB incidence in Grantham and HA hospitals
1996-2005

Mean Incidence (per 100,000 pat year)

HA hospitals: (257 cases) 60.4

GH: (5 cases) 65.2

p = 0.9

88

A study comparing clinical and non-clinical staff

under the condition of mandatory reporting

Seto et al: CID (in press)

89

Comparison of Non-clinical and Clinical Staff Infected by pH1N1

	Non-clinical	Clinical	Statistical significance (p)
Total number of staff (n)	18759	40511	
Number infected			
A. During mandatory reporting for all staff	119 (0.63%)	249 (0.62%)	0.82 RR: 0.98 (95% CI 0.78-1.2)
B. Data during the entire pandemic period	NA	1039 (2.6%)	HK – 3.6% for same age group (Cowling et al – accepted CID)
For Infected staff (n)	**119**	**1039**	
Demographic data			
M	36 (30.3%)	253 (24.4%)	0.19
F	83 (70%)	786 (75.6%)	
Mean age	38.6	37	0.45

Marion A. Kainer MD, MPH, FRACP
Medical Epidemiologist/ Infectious Diseases Physician
Director, Hospital Infections and Antimicrobial Resistance Program Tennessee Dept. of Health

Dr Seto,

I really enjoyed your insightful presentation yesterday... I am sorry you had to skip through so many of the slides in the interests of time.

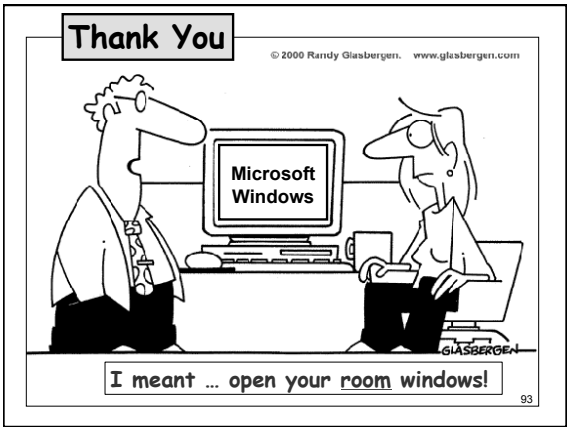
I did my infectious disease training in Australia at Fairfield hospital... a stand-alone infectious diseases hospital that saw/treated most of the TB patients in Victoria-- we had single rooms,]all of which opened up to a private balcony... we used lots of open air ventilation, high ACH and none of our staff converted their TSTs.

91

Opening your windows,

The key to natural ventilation..

92



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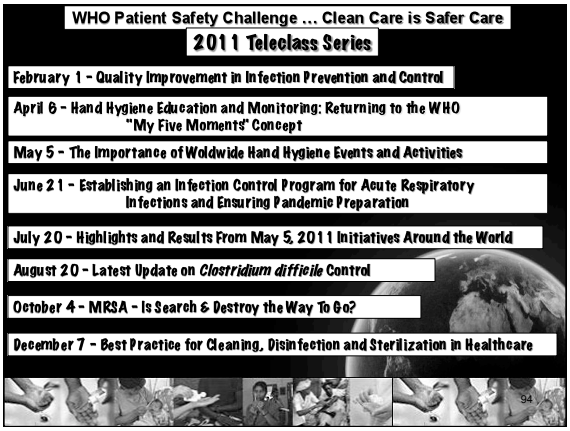

94