

# Infection Control: Preventing the Spread of Infectious Diseases

Mount Sinai Hospital



MOUNT SINAI  
SCHOOL OF  
MEDICINE



# Healthcare-Associated Infections

- ~2 million hospital-acquired infections per year
  - These infections affect ~5-10% of patients.
- ~88,000 deaths related to those infections.
- At least 1/3 of those infections are preventable.

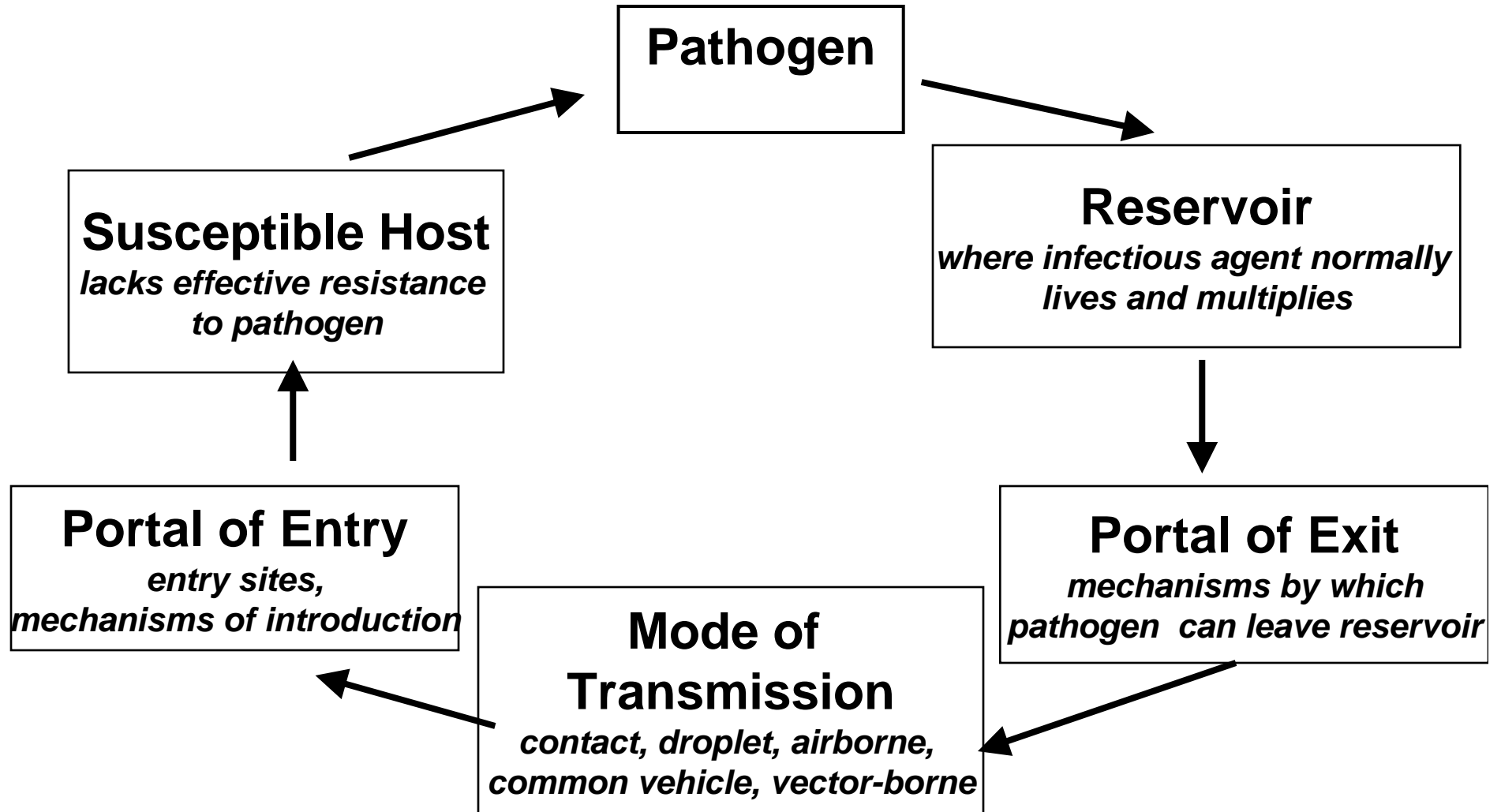
# Healthcare-Associated Infections (HAI)

- The most common HAI are:
  - Urinary tract infections (35%)
  - Surgical site infections (20%)
  - Bloodstream infections (15%)
  - Pneumonia (15%)
- Often associated with multidrug-resistant pathogens: MRSA, VRE, *C. difficile*, GNR (*Klebsiella*, *Acinetobacter*, etc.).

# Risk Factors for Healthcare-Associated Infections

- Severity of underlying illness
- Invasive devices and procedures
- Antimicrobial therapy
- **Poor infection prevention practices**
  - Healthcare worker hand hygiene
  - Environmental cleaning
  - Equipment disinfection and sterilization

# The Chain of Infection



# Topics to be Covered

- Blood and Body Fluid Exposures (BBFE)
  - Definitions
  - Risk
  - Prevention
  - Post-exposure management
- Regulated Medical Waste
- Standard Precautions
  - Hand hygiene
  - Personal protective equipment
- Transmission-Based Precautions

# Bloodborne Pathogens

- Hepatitis B
- Hepatitis C
- Human Immunodeficiency Virus (HIV)

# Case 1

- You are on your first rotation as a third year medical student. You want to be helpful to the nursing staff so you offer to empty Mr. Jones' urinal. Unfortunately, you drop the urinal and your leg is splashed with clear, yellow urine.



## Case 2

- You are now a seasoned fourth year student and you are performing phlebotomy on a 36 year old man admitted to the hospital with pneumonia. While the needle is in the patient's vein, he coughs and moves his arm. You feel (and see) the needle puncture the tip of your index finger.

**Were you exposed to a potentially  
infectious body fluid?**

# What Defines a Potential Exposure to Bloodborne Pathogens?

## ■ Potentially infectious body fluid/material:

- Blood
- Cerebrospinal fluid
- Pleural fluid
- Pericardial fluid
- Peritoneal fluid
- Amniotic fluid
- Synovial fluid
- Semen
- Vaginal secretions
- Any visibly bloody fluid
- Unfixed tissue

## ■ Route of exposure that can lead to infection:

- Parenteral (needlestick, cut, abrasion, bite)
- Mucous membrane (e.g., nose, eyes, mouth)
- Non-intact skin

Vomit, Saliva, Tears, Sweat, Urine and Feces are **not** considered infectious unless visibly contaminated with blood.

# Back to the Cases

- Case 1: Non-bloody urine onto intact skin
  - Not a bloodborne pathogen exposure
  
- Case 2: Percutaneous needlestick injury
  - Possible bloodborne pathogen exposure
  - Must be reported and further evaluated

# After a Blood or Body Fluid Exposure:

- **Wash** the area with soap and water immediately. If a mucous membrane was exposed, flush with water.
- **Report the exposure** to your supervisor. Supervisor will notify the “needle-stick coordinator” (pager #4118) and refer you for further evaluation:
  - Students: Jack Martin Fund Clinic (M-F 9-17, ED at all other times)

# After a Bloodborne Pathogen Exposure:

- Evaluation will determine the need for post-exposure prophylaxis for Hepatitis B and/or HIV based on:
  - Type and severity of exposure
  - Source patient's medical history and risk factors for Hepatitis B&C and HIV (if known)
  - Source patient's Hepatitis B&C and HIV status (if available)
  - Exposed worker's Hepatitis B immune status
- Testing of the exposed worker for HIV, HCV, and HBV (if not known to be immune) is recommended at baseline and at 6, 12, and 24 weeks.

# Bloodborne Pathogen Risks

- The risk of a non-immune worker acquiring HBV from an infected patient is about 30% following a needlestick injury (if no prophylaxis is provided).
  - Sharps injury is probably the most efficient mode of transmission.
  - Transmission through contact with contaminated environmental surfaces has been reported.
- The risk of acquiring HCV from an infected patient is about 3% following a needlestick injury.
  - HCV is most easily transmitted by blood, but other body fluids may present some risk.

# Bloodborne Pathogen Risks

- The risk of acquiring HIV from an infected patient is ~0.3% (about 1:300) following a needlestick injury.
  - The risk is 0.09% (about 1:1000) after a mucous membrane exposure.
- Highest risk injuries are those that involve:
  - A large-bore, hollow needle
  - A deep puncture
  - A needle used in a patient's artery or vein
  - A device visibly contaminated with blood
  - A source patient with advanced HIV disease (e.g., high viral load)



# Occupational Acquisition of HIV

(United States, 1981 - 2001)

## ■ 57 documented cases

- 50 had percutaneous injuries (e.g., needlestick)
- 6 had mucocutaneous exposures
- 1 had an unknown route of exposure (a lab employee who worked with concentrated HIV)

## ■ 138 possible cases

- Cases with no other risk factor for HIV and a history of occupational exposure to blood/body fluids/laboratory specimens but time and source of HIV infection could not be documented.

# Reducing the Risk of Occupational HBV Infection

- Vaccination of all susceptible HCW
  - Produces immunity in >90% of vaccine recipients
  - Lower response rates (50 - 85%) are seen in individuals >40 years of age and in those with underlying liver or kidney disease or immune deficiency
- Avoid exposure
  - Use of personal protective equipment
  - Implementation of safe work practices
- Post-exposure prophylaxis
  - Administration of HBV immune globulin and HBV vaccine to susceptible HCW after exposure provides  $\geq 75\%$  protection from infection.

# Reducing the Risk of Occupational HCV Infection

- Avoid exposure
  - Use of personal protective equipment
  - Implementation of safe work practices
- Post-exposure prophylaxis is not recommended.
- Treatment of acute HCV infection may prevent development of chronic HCV infection.
  - Important to report all exposures so that appropriate follow-up can be arranged.

# Reducing the Risk of Occupational HIV Infection

- Avoid exposure
  - Use of personal protective equipment
  - Implementation of safe work practices
- Post-exposure prophylaxis (PEP):
  - Reduces the risk of transmission by up to 80%
  - Is most likely to be effective when taken shortly after exposure.

**The goal is to receive first dose within 2 hours of the exposure.**

# Sharps Safety

- “Engineering controls” isolate or remove the bloodborne pathogens hazard from the workplace to eliminate or minimize employee exposure. Examples include:
  - Sharps disposal containers
  - Self-sheathing or self-blunting needles
  - Scalpels with blade protection devices
  - Needleless IV systems
  - Other sharps with sharps injury protections
- A variety of sharps containers, safety sharps, & needle-less devices are widely available at Mount Sinai.

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# Sharps

- Needles
- Scalpel blades
- Blood vials, test tubes, cover slips
- Broken or unbroken glassware and other sharps
- Lancets
- Inoculating needles and loops
- Pasteur pipettes, plastic pipettes

# Sharps Containers

- For discarding all sharp devices whether used or unused, clean or dirty





# Safer Sharp Devices

- Safety devices must be used properly in order for them to provide protection.
  - If you don't know how to use a device, ASK!
- Do not attempt to remove the safety mechanism from the device.
- Report problems or device malfunction to your supervisor.

# Regulated Medical Waste

- Handling and disposal of medical waste is regulated by the New York State Department of Health and the New York City Department of Sanitation.
- The OSHA Bloodborne Pathogen Standard also applies to Regulated Medical Waste.



# Regulated Waste

- Disposed in containers labeled “Regulated Waste” (a.k.a. Red Bag containers)
  - Blood and other potentially infectious body fluids
  - Items dripping with blood except for tampons and sanitary napkins
  - All blood bags and blood tubing
  - All rigid containers (e.g., pleurovacs, hemovacs) regardless of fluid amount
  - Drained urinary bags/catheters with visible blood
  - All waste resulting from the care of patients with “highly communicable” diseases (e.g., SARS, smallpox)
  - Dressings with saturated or dried body fluids



# Non-Regulated Medical Waste (Regular Trash)

- Disposed in standard (clear) trash bags
  - Drained urinary bags / tubing / urinary catheters (without visible blood)
  - IV tubing and/or bags without visible blood
  - Any material with drops of blood
  - Glucose meter strips
  - Sanitary napkins or tampons

## Case 3

- You are in the Emergency Department and have been asked to help drain a large (3 x 4 cm), bulging abscess on the left buttock of a 54 year old man. As the resident prepares to incise the pus-filled abscess cavity, you say to yourself:

“What can I do to protect myself from exposure to infectious diseases during my work as a healthcare provider?”

# Standard Precautions

- Reduce the risk of transmission of microorganisms from recognized and unrecognized sources.
- Apply to (1) blood; (2) all body fluids, secretions, and excretions except sweat; (3) non-intact skin; and, (4) mucous membranes.
- Apply to **ALL** patients **ALL** the time regardless of diagnosis, symptoms, or test results.

Garner, JS. Guideline for isolation precautions in hospitals. AJIC: Am J Infect Control 1996;24: 24-52

# Components of Standard Precautions

## ■ Hand hygiene

## ■ Gloves:

- Used when you expect your hands to have contact with any body fluid or non-intact skin or mucous membrane

## ■ Gowns:

- Used when you could expect to have any body fluid, non-intact skin, or mucous membrane make contact with your body/clothing

## ■ Mask, eye protection, face shield:

- Used when you could expect to have any body fluid spray or splash toward your eyes, nose, and/or mouth



# Maternal Mortality Rates Allgemeines Krankenhaus, Vienna

<u>Year</u>	<u>Ward 1</u>	<u>Ward 2</u>
1846	11.4%	2.7%
1847	Calcium hypochlorite washings begun	
1848	1.3%	1.3%

# Importance of Hand Hygiene

- Hand contamination is a major cause of transmission of infection in healthcare facilities.
- Improved hand hygiene is associated with:
  - Lower rates of nosocomial infection.
  - Reduced rates of transmission of MRSA.
- Hand hygiene is the most important infection control intervention.<sup>CDC</sup>

# HCW Hand Contamination: Patient Contact

- Hand cultures positive in **59%** of HCW caring for *C. difficile* patients.
- **Two-thirds** of routine examinations of VRE-colonized patients result in contamination of the hands, clothes, and/or stethoscope of the examiner.

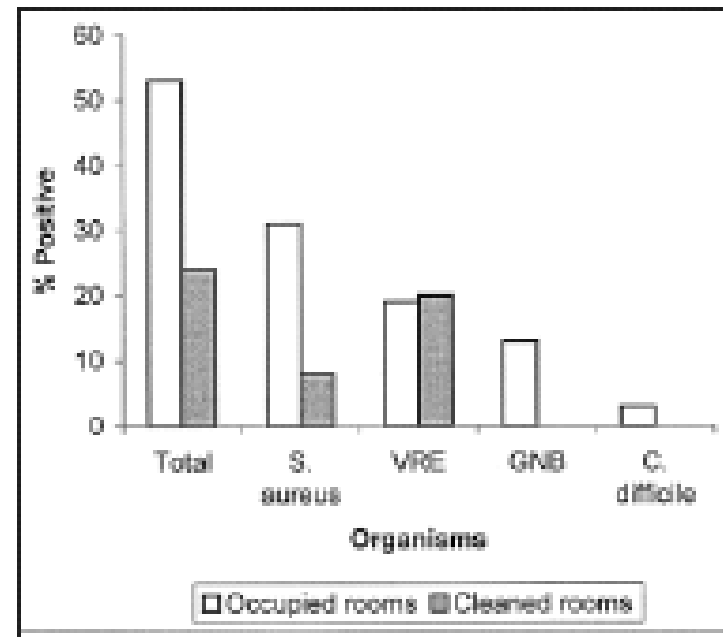


McFarland. New Engl J Med 1989; 320(4):204

Zachary KC. Infect Control Hosp Epidemiol 2001; 22:560-4

# HCW Hand Contamination: Environmental Contact

- Hand imprint cultures after 5 second contact with bedrail and bedside table were positive in:
  - 34/64 (53%) occupied rooms
  - 6/25 (24%) “clean” rooms



# HCW Hand Contamination



Photo source:

<http://app1.unmc.edu/publicaffairs/todaysite/Images/SiteImages/agarhand.jpg>

# Hand Hygiene

- Among HCW, the average rate of adherence to recommended hand hygiene practices is only ~40%.
- Factors associated with poor hand hygiene compliance include: being a physician, being male, working in an ICU, and wearing gown and gloves.
- Factors associated with improved hand hygiene compliance include: reminders, observations with feedback, role models.

# Indications for Hand Hygiene during Patient Care Activities

- **Before patient contact**
- Before donning gloves
- When moving from a contaminated to a non-contaminated body site during patient care
- **After patient contact**
- After removing gloves
- **After touching inanimate objects (e.g., surfaces, equipment) in the patient's immediate vicinity**
- Before preparing or administering medications or food

# Ask Us If We Cleaned Our Hands



## Pregúntenos Sí Nos Lavamos las Manos

Hand cleaning by healthcare workers and patients is the most effective way to prevent the spread of infection in hospitals.

It's Okay to Remind Us





# Hand Hygiene

- Hand washing is preferred in certain situations:
  - When hands are visibly dirty or soiled
  - Before eating
  - After using the restroom
  - After suspected or proven exposure to *B. anthracis* (anthrax). (Hand washing is also preferred during outbreaks of *C. difficile*.)
- Alcohol-based hand sanitizers are preferred in all other clinical situations.

CDC. Guideline for hand hygiene in health-care settings. MMWR 2002; 51(RR-16):1-44

# How to Wash Hands

- Wet hands with warm water.
- Apply soap and vigorously rub hands together for at least **15 seconds**, covering all surfaces of hands and fingers.
- Rinse hands thoroughly with water.
- Dry hands with paper towel(s).
- Use the paper towel to turn off the faucet.



# How to Use an Alcohol Based Antiseptic Hand Sanitizer

- Apply sanitizer to hands.
- Rub with friction all over hands, between fingers, backs of hands, up to wrists until hands are dry (usually takes about 15 seconds).



# Gloves

- Clean, non-sterile disposable exam gloves are adequate for routine patient care activities.
  - Sterile gloves are used for invasive procedures, manipulation of indwelling vascular catheters, etc.
- Gloves must be changed between tasks/patients.
- Gloves must be removed promptly after use and before touching non-contaminated items or environmental surfaces such as telephones and computer keyboards.
- Clean your hands after removing gloves.

# Gowns

- Clean, non-sterile gowns are adequate for routine patient care activities.
- A gown must be worn for only a single patient encounter.
- When removing a gown, be sure not to contaminate your clothing.
- Always clean your hands after removing a gown.



# Face Protection

- Face protection can consist of:
  - A standard surgical face mask PLUS goggles or other protective eyewear
  - A surgical face mask with a built-in plastic face shield
- Standard eyeglasses do **not** provide sufficient protection of the eyes.
- The mask must cover the mouth AND nose.
- Surgical masks are used for a single patient encounter only.





# Donning and Removing PPE

## ■ Donning

1. Gown
2. Mask/respirator
3. Goggles/face shield
4. Gloves

## ■ Removing

1. Gloves
2. Goggles/face shield
3. Gown
4. Mask/respirator

# Other Tips to Protect Yourself

- No food or drinks in patient care areas, including nursing stations.
- Disinfect your stethoscope and other medical shared medical equipment after every use.
- Don't take patient charts into patient rooms.

# Transmission-Based Precautions

- Used for patients known or suspected to be infected with highly transmissible or epidemiologically important pathogens.
- Involve the use of practices beyond those of Standard Precautions in order to interrupt germ transmission.
- Types of Transmission-Based Precautions
  - Droplet Precautions
  - Contact Precautions
  - Airborne Precautions
  - *Varicella-Zoster Precautions*

Garner JS. Guideline for isolation precautions in hospitals. Am J Infect Control 1996;24: 24-52

# CONTACT PRECAUTIONS

Visitors must report to Nurses' Station for instructions before entering room.



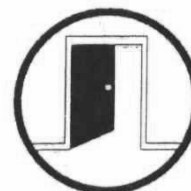
**HANDS** must be washed before and after patient contact.



**GLOVES** if contact with patient or environment.



**GOWN** if contact with patient or environment.



**DOOR** may be left open.

## Case 4

- It is now January and you are on the General Medicine inpatient service. You are called to the ED to admit a 74 year old female with 2 days of fever, malaise, headache, severe myalgias, and cough. Her chest x-ray is normal. You are told that several residents at the nursing facility where she lives have similar illnesses.
- What is your diagnosis and how do you protect other patients and staff?

# Droplet Precautions

- Used for microorganisms that are transmitted by large-particle droplets that can be generated by the patient during coughing, sneezing, talking, or the performance of procedures.
- Examples of microorganisms requiring Droplet Precautions include:
  - Influenza
  - *N. meningitidis*
  - Pertussis (“whooping cough”)
  - Meningitis of unknown cause

# Components of Droplet Precautions

- Single room
  - If a single room is unavailable, cohorting patients actively infected with the same organism can be considered.
- Use of a surgical face mask when within 3 feet of the patient.
- During transport, the patient should wear a surgical mask (if possible).





# Influenza Vaccination of HCW

- Provided free to HCW annually.
- Protect yourself and your patients.
  - High morbidity and mortality rates among hospital patients who acquire influenza infection while hospitalized.

**Get vaccinated every year!**



## Case 5

- You are on your surgery rotation. A patient is admitted with a ruptured, gangrenous appendix. He undergoes an emergent appendectomy and is treated with broad-spectrum antibiotics for peritonitis. He is recovering well but on his fifth hospital day he develops profuse green-brown diarrhea.
- What is the likely diagnosis? What do you do to protect others?

# Contact Precautions

- Used for microorganisms that can be transmitted by direct contact with the patient or indirect contact (touching) with environmental surfaces or patient-care items.
- Examples of microorganisms requiring Contact Precautions include:
  - *C. difficile*
  - Vancomycin-resistant *Enterococcus* (VRE)
  - Methicillin-resistant *S. aureus* (MRSA)
  - Multidrug-resistant gram-negative bacteria

# Components of Contact Precautions

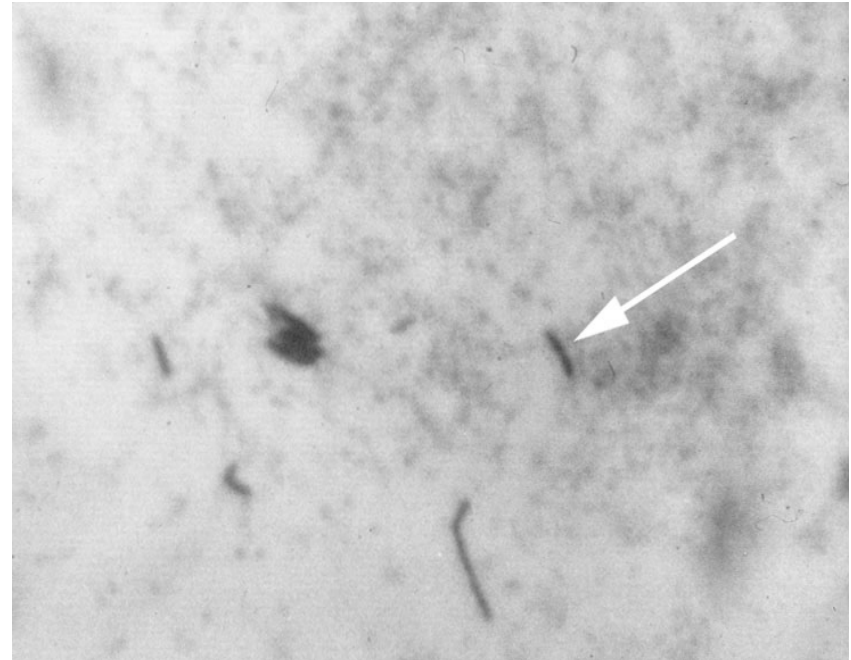
- Single room
  - If a single room is unavailable, cohorting patients infected or colonized with the same organism can be considered.
- Use of gowns & gloves when entering the patient's room.
- Use of dedicated (non-shared) patient care equipment (e.g., stethoscope, blood pressure cuff).
  - If items must be shared with other patients, these items must be cleaned and disinfected prior to use with another patient.

# Efficacy of Contact Precautions

- Use of Contact Precautions during the care of patients with MRSA is associated with a 16-fold decreased risk of MRSA transmission.

## Case 6

- It is the last rotation of the year! You admit a 43 year old female who has a 4 week history of cough (and a few episodes of hemoptysis), fever, night sweats, and 10 lb weight loss. She was treated with cefpodixime for 10 days but her symptoms continue. Her chest x-ray shows a right upper lobe cavitory lesion and a sputum specimen demonstrates acid-fast bacilli (AFB).



What is the most likely diagnosis?

What precautions do you take to protect yourself and others while you are establishing a definitive diagnosis?

# Airborne Precautions

- Used for microorganisms transmitted by airborne droplet nuclei that remain suspended in the air and that can be dispersed by air currents within a room or over a long distance.
- Examples of microorganisms requiring Airborne Precautions include:
  - Pulmonary tuberculosis (TB)-documented or suspected
  - Varicella (chickenpox)
  - Measles



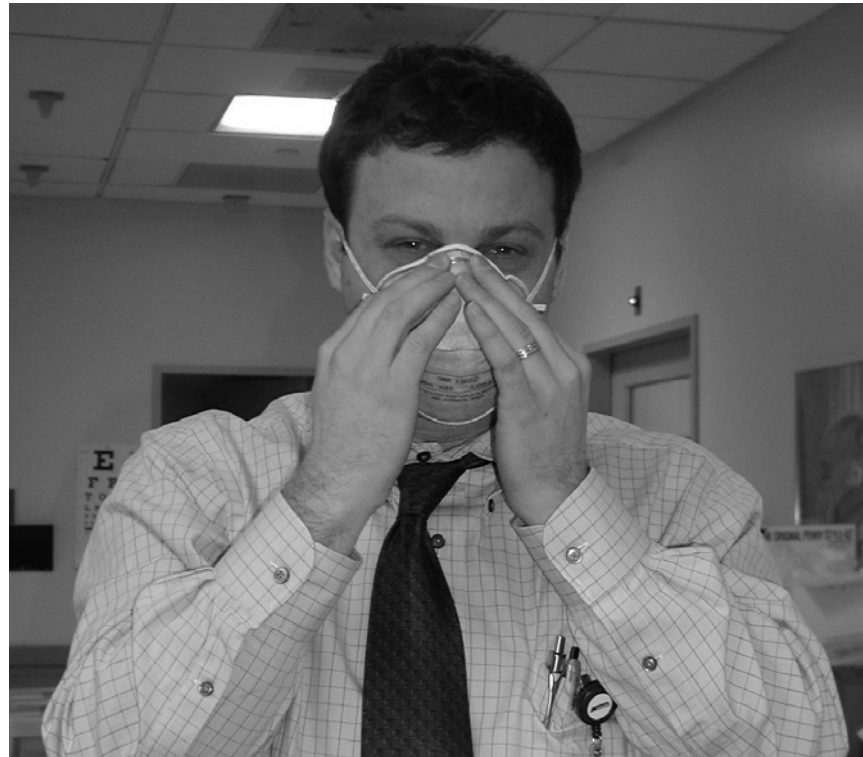
# Components of Airborne Precautions

- Single, “negative pressure” room (i.e., air pressure inside the room is negative relative to that in surrounding areas)
- Door must remain closed
- Limit patient movement outside of the negative pressure room
  - If patient must leave the room, he/she should wear a surgical mask if at all possible.

# Components of Airborne Precautions

- Use of respiratory protection by those entering the room.
- N-95 Respirators
  - Available on infection control carts.
  - Workers must receive training and fit testing prior to using an N-95 respirator.
- PAPR (Powered Air-Purifying Respirator)
  - A PAPR is used if adequate fit cannot be obtained with an N-95 respirator (e.g., worker failed fit testing or has facial hair).
  - Use of a PAPR requires special training.

# N95 Respirator: “Fit Check”



# Powered Air Purifying Respirator (PAPR)



# TB Control in the Hospital

- Hospital outbreaks of TB occur when cases of TB are not quickly recognized and when appropriate precautions are not taken.
  - Failure to implement Airborne Precautions for a patient with TB resulted in:
    - 5 secondary cases of TB (4 patients and 1 HCW)
    - Skin test conversion in 56 (11%) exposed HCW
    - Skin test conversion in 39 (23%) exposed patients

# Infection Control Resources

- Infection Control Office: 8-9450
- Infection Control Practitioner
- Mount Sinai intranet
  - Select “Infection Control” from the menu on the left.
- Blood and Body Fluid Exposures
  - Needlestick Coordinator (M-F 9-5): Pager 4118
  - Nursing Administrator (nights, weekends, holidays)

# Dear Medical Student

Please print this page, sign and submit to:

Ms. Jeanneth Persaud  
Department of Medical Education  
Annenberg 13-30

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Print Name

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Signature

Note: Please print in black and white