CIC Review Course
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Day 1 Outline
• Identification of Infectious Disease Processes
• Surveillance and Epidemiologic Investigation
• Employee/Occupational Health
• Preventing/Controlling the Transmission of Infectious Agents
Identification of Infectious Disease Processes
Kathleen McMullen, MPH, CIC®, FAPIC®

CBIC Outline
- Identification of Infectious Disease Processes (22 items)
  - Interpret the relevance of diagnostic and laboratory reports
  - Identify appropriate practices for specimen collection, transportation, handling, and storage
  - Correlate clinical signs and symptoms with infectious disease process
  - Differentiate between colonization infection and contamination
  - Differentiate between prophylactic empiric and therapeutic uses of antimicrobials

Education Outline
- Microbiology
- Chain of Infection
- Antimicrobials and Resistance
- Organisms of Interest
Microbiology basics

- Bacteria
- Fungi
- Yeast
- Virus

Types of Bacteria

- Aerobe
  - Requires oxygen to grow
- Obligate anaerobe
  - Requires no oxygen to live (poisoned by oxygen)
- Facultative anaerobe
  - Can live with or without oxygen
- Microaerophilic
  - Requires a lower concentration of oxygen to grow
Direct Examination

• **Gram stain**
  • Detects peptidoglycan in the cell wall of bacteria
  • Gram-positive organisms will appear dark violet or purple
  • Gram-negative organisms will appear red or pink

• **Wet mount - fresh clinical specimens (smears)**
  • Sputum
  • Stool
  • CSF
  • Vaginal secretions

Direct Examination

• **Antigen Detection**
  • Direct method for testing for antigens
  • Agglutination tests
  • Immunofluorescence
  • Enzyme-linked immunosorbent assay (ELISA)

• **Molecular Diagnostic Testing**
  • Polymerase chain reaction (PCR)
    • first test that uses nucleic acid amplification
    • Risk of false-positives

Direct Examination

• **Toxin Production Testing**
  • Exotoxins
    • Proteins secreted by Gram-negative and Gram-positive bacteria
      • Detection includes EIA and high-pressure liquid chromatography (HPLC)
  • Endotoxins
    • Lipid A section of the lipopolysaccharides - Gram-negative bacteria
      • Limulus amebocyte lysate (LAL) test used in dialysis
  • Weil-Felix agglutinin
    • Detect and differentiate rickettsia
Specimen Collection and Transport – Do’s

• Collect aseptically
• Place in a sterile container
• Transport to lab ASAP
• Properly label
• Leak-proof containers and sealed plastic bag
• Some specimens may be placed directly into culture media

Specimen Collection and Transport – Don’ts

• Refrigerate
  • Especially bad for spinal fluid, genital, eye and ear specimens
• Leave sharp used to collect specimen attached
• Delayed transport more than 2 hours
• Improperly selected, collected or transported specimens
  • Generate misleading data that may result in inappropriate patient management
  • Specimen rejection

Micro Lab – Your Partner for Prevention

• Quick communication about organisms that require isolation
• Notification about organisms with new or unusual resistance patterns
Biofilms

- Biofilms are microbial masses attached to surfaces that are immersed in liquids.
- Bacteria within biofilms are up to 1,000 times more resistant to antimicrobials than the same bacteria in suspension.
- Can be found:
  - Hemodialysis systems
  - Urinary catheters
  - Central venous catheters

Chain of Infection

Colonization vs Infection

- Colonization means the organism can be found on the body but it is not causing any symptoms or disease.
  - Colonizing strains can cause infections later
  - Transmission can occur
- Infections are usually associated with symptoms, which vary based on the site that is infected
  - Transmission can occur
The Chain of Infection

Infectious Agent

- There are several characteristics that influence the transmissibility of an organism and its ability to cause disease:
  - Invasive enough to enter tissue (pathogenicity)
  - Virulent enough to cause disease
  - High amount of the agent present (infectious dose, inoculum)
  - Ability to cause disease in more than just humans
  - Ability to adapt to challenges (antibiotic resistance, antigenic variation in Influenza)

Reservoir

- All organisms have a place where they can exist and reproduce that facilitates their transmission. These include:
  - Humans
  - Animals
  - Insects
  - Food
  - Environment
  - External
Portal of Exit

- Path by which the infectious agent leaves the reservoir
  - Respiratory tract
  - Genitourinary tract
  - Gastrointestinal tract
  - Skin
  - Mucous membrane
  - Blood

Mode of Transmission

- Method by which the organism reaches a susceptible host
  - Contact: either direct (person-to-person) or indirect (person to fomite)
  - Droplet and airborne transmission: infectious agent is suspended in particles in the air by the reservoir then inhaled by a healthy individual
  - Vehicles or vectors: contaminated food or water

Portal of Entry

- Opening that allows the infectious agent to enter the patient’s body
- Generally the same as the portals of exit
- Epidemiologically significant examples include:
  - Indwelling urinary catheters
  - Intravascular devices
  - Ventilators
  - Surgical procedures performed within or outside the operative suites
  - Contaminated food
Susceptible Host

• Factors that affect agents ability to enter the host
  • Age
  • Sex
  • Medical History (cancer, diabetes)
  • Lifestyle
  • Heredity
  • Occupation
  • Nutritional Status

The Immunocompromised Host

• Individual who has one or more defects in the body's normal defense mechanisms that predisposes him or her to infections.
  • Examples:
    • Traumatic injuries
    • Surgical incision
    • Cancer
    • Human immunodeficiency virus (HIV) infection
    • Chemotherapy

Chain of Infection Example: Tuberculosis

• Causative agent
  • Mycobacterium tuberculosis
• Reservoir
  • Humans
• Portal of exit
  • Respiratory tract – coughing
Chain of Infection Example: Tuberculosis

- Mode of Transmission
  - Airborne spread
- Portal of Entry
  - Respiratory Tract
- Susceptible Host
  - Immunocompromise

Antimicrobials and Resistance

Antibiotics

- Penicillins
  - Penicillin G
- Cephalosporins
  - Cefazolin, cefotaxime, ceftriaxone
- Miscellaneous β-Lactams
  - Imipenem, Aztreonam, Zosyn
- Fluoroquinolones
  - Ciprofloxacin, moxifloxacin
- Macrolides
  - Azithromycin
- Lincosamides
  - Clindamycin
- Aminoglycosides
  - Gentamicin
Antivirals, Antifungal & Antiparasitics

- Antivirals
  - Acyclovir
- Antifungal
  - Fluconazole
- Antiparasitics
  - Chloroquine

Indication for Antimicrobial Use

- Pathogen-Directed Therapy
  - Based on the microbial pathogen result
  - Use of narrowest spectrum antimicrobials
- Empirical Therapy
  - Microbial pathogen is unknown
  - Broader spectrum therapy is used
- Prophylaxis
  - Prevent infection
  - Antimicrobials are chosen based on the mostly likely infection to occur

Factors That Affect Outcome

- Prompt institution of an appropriate antimicrobial
- Virulence and susceptibility of the infecting organism
- Activity of the antimicrobial at a particular site of infection
- Underlying condition and immunocompetence of the patient
- Infections at certain body sites are inherently more difficult to treat for a variety of reasons
Antibiogram

• Summary of an institution’s organisms and antimicrobial resistance to monitor trends emerging in drug resistance
• Each organism has a row, each antibiotic has a column
• One number shows the % of all organisms at that institution’s resistant to each antimicrobial option
• Help answer questions in two main areas:
  • Clinical care – which antimicrobial would be best to use in this hospital for this pathogen
  • Infection prevention strategies – trend of antimicrobial susceptibility changing

Antimicrobial Resistance

• Major mechanisms of antimicrobial resistance include
  • Drug inactivation
  • Alteration in target site
  • Decreased permeability or efflux
  • Bypass of a metabolic pathway

Antimicrobial Susceptibility Testing

• Identifies if a microbe is resistant to certain antibiotics
  • Disk diffusion (Kirby-Bauer Method)
  • Broth dilution
  • E-test
  • Beta-lactamase test
Antimicrobial Stewardship

- Surveillance
  - Laboratory and infection prevention should watch for possible emergence of sentinel resistance patterns

- Antimicrobial Management Team
  - Multidisciplinary Team
    - ID physician
    - Clinical pharmacists
    - Clinical Lab
    - IP

Organisms of Interest

Bacteria

*Bordetella pertussis*

- Aerobic, Gram-negative pleomorphic bacillus.
- Paroxysms of coughing, inspiratory “whoop,” or vomiting without other apparent cause
- The incubation period of pertussis in non-immunocompromised patients is usually 7 to 10 days, with a range of 6 to 11 days
**Bordetella pertussis**

- **Diagnosis**
  - The gold standard methodology for the laboratory diagnosis of pertussis is culture, utilizing either fresh Bordet-Gengou or Regan-Lowe media
  - Nasopharyngeal aspirate or swab
- **Prevention**
  - Droplet precautions for suspected or known infected patients
  - Provide post-exposure prophylaxis for all asymptomatic exposed employees, patients, and visitors regardless of immunization history

**Clostridium difficile**

- **Gram-positive, spore forming anaerobillus**
  - Spore phase is resistant to antibiotics and many environmental disinfectants
  - Produces two exotoxins A&B
- **Symptoms**
  - Watery diarrhea
  - Fever
  - Nausea
  - Abdominal pain
- **Patients at increase risk**
  - Antibiotic exposure
  - Proton pump inhibitors
  - Long stay in health care settings

**Clostridium difficile**

- **Colonization**
  - Patient exhibits NO clinical symptoms
  - Patient tests positive for Clostridium difficile organism and/or its toxin
  - More common than Clostridium difficile infection
- **Infection**
  - Patient exhibits clinical symptoms
  - Patient tests positive for the Clostridium difficile organism and/or its toxin
**Clostridium difficile**

- **Diagnosis**
  - Stool culture
  - Cell Cytotoxicity Assay
  - Enzyme Immunoassay for toxins A and B
  - Colon endoscopy

- **Prevention**
  - Isolation patients on contact precautions
  - Hand hygiene
  - Environmental cleaning with sporicidal agents
    - Spores can live on surfaces for extended periods of time
    - 1:10 dilution of bleach

**Enterobacteriaceae**

- **Gram-negative, short, cocobacillary, or straight, non-spore-forming bacilli**
  - *Escherichia coli*
  - *Enterobacter cloacae*
  - *Klebsiella pneumoniae*

- **Emerging Carbapenemase-producing Enterobacteriaceae (CRE)**
  - Carbapenemase enzymes have broad spectrum hydrolyzing activity, thereby rendering all penicillins, cephalosporins, and carbapenems ineffective.

- **Prevention Measures**
  - Hand Hygiene
  - Contract isolation – if drug resistant
  - Environmental cleaning
  - Proper maintenance of equipment

**Acinetobacter**

- **Encapsulated, non-motile, aerobic Gram-negative bacilli**
  - Water loving
  - Persist in the environment

- **Clinical Manifestation**
  - UTIs, respiratory tract infections, wound infection

- **Diagnosis**
  - MacConkey agar

- **Prevention**
  - Hand hygiene
  - Environmental cleaning
Multi-drug Resistant Gram Negatives

- Variety of mechanisms of resistant
  - Plasma (gene) mediated
  - Random gene mutations
- CRE, ESBL, KPC
- Risk factors
  - Prior antibiotics
  - Hospitalization >5 days
  - Immunosuppression

Enterococci

- Gram-positive, catalase-negative, nonspore-forming cocci that can exist singly, in pairs, or in chains
- Facultative anaerobic
  - E. faecalis
  - E. faecium
- Colonize the human gastrointestinal tract
- Vancomycin-resistant Enterococci (VRE)

Group A Streptococcus (GAS)

- GAS are Gram-positive cocci occurring in pairs or short chains
  - Transmission through direct person-to-person contact.
- Clinical Manifestation
  - Shock, bacteremia, and multiorgan failure
- Diagnosis
  - Throat culture remains the gold standard
- Prevention and Control
  - Respiratory etiquette
  - Hand hygiene
Staphylococcus

- Gram-positive coccus
- S. aureus – clinically pathogenic, with or without methicillin resistance (MRSA)
- Coagulase negative Staphylococcus – normal skin colonizers but can cause disease
- Colonize many skin sites including nares, axilla, groin

Legionella Pneumophila

- Aerobic Gram-negative
  - Waterborne
- Clinical Manifestation
  - Pneumonia (Legionnaires’ disease) and Pontiac fever, a flulike illness
  - Incubation period 2 to 10 days
- Diagnosis
  - Organism may be detected with the direct fluorescent-antibody (DFA) stain examined under an ultraviolet microscopic for same-day results
  - Urinary antigen is now the most commonly used test

Neisseria Meningitidis

- Gram-negative cocci
- Clinical Manifestation
  - Bacteremia without sepsis
  - Meningococemia without meningitis
  - Meningitis with or without meningococccemia
  - Meningococcal meningoencephalitis
  - Meningococcal pneumonia
- Prevention
  - Droplet Precautions based on suspicion of meningococcal disease, appropriate antibiotic therapy of the patient
  - Vaccine
Chlamydia trachomatis

- Chlamydiae are obligate intracellular bacteria with a biphasic life cycle
- Incubation period
  - 7 to 14 days or longer
- Clinical Manifestation
  - Urethritis, epididymitis, cervicitis, acute salpingitis, or other pelvic symptoms
  - Dysuria and urethral discharge
- Sexually transmitted disease
- Diagnosis
  - Urine or endocervical or vaginal specimen swab

Neisseria Gonorrhoeae

- Nonmotile, nonspore forming, gram-negative diplococcus
- Incubation period is generally 2 to 5 days but ranges from 1 to 10 days or longer
- Clinical manifestations
  - 90 percent of men have no symptoms with urethritis as the predominant manifestation
  - Many women have no or only minor symptoms
  - Cervicitis, occasional urethritis, increased vaginal discharge, and intermenstrual bleeding
- Diagnosis
  - Culture, nucleic acid hybridization, or NAATs can be used for the diagnosis of genital infection
- Sexually transmitted disease

Skin and Soft Tissue Infections

- Impetigo
  - The skin lesion, or group of lesions, is typically characterized by erythema, or blisters, without crusting that later progress to lesions that ooze and form yellow or honey-colored crusts surrounded by an erythematous margin
  - Bullous impetigo is generally associated with S. aureus infection
  - Nonscrotal impetigo is usually associated with group A streptococcal infection
- Folliculitis
  - Infection process originating in hair follicles
  - Commonly caused by S. aureus
  - The initial lesions appear papulo-urticarial, usually within 48 hours of exposure, with evolution to pustular folliculitis
- Cellulitis
  - It is not raised and is indistinctly demarcated from adjacent uninvolved skin
  - Painful and tender
  - Most often on the legs, usually below the knee.
Tuberculosis (TB)

- Caused by Mycobacterium tuberculosis
- Two forms: TB infection and TB disease
  - TB infection (aka latent TB, LTBI)
    - Occurs when a susceptible person inhales droplets containing TB, which become established in the body
    - TB is spreading in your body, but is not making you sick; you are not contagious
    - Can be found with a TB skin test or a blood test (IGRA, Tspot, Quantiferon Gold)

TB Skin Test

- TB skin test – diagnostic for LTBI, not necessarily disease
  - Inject 0.1 ml of tuberculin purified protein derivative (PPD) into the inner surface of the forearm
  - Injection should produce a pale elevation of the skin (a wheal) 6 to 10 mm in diameter
  - Read between 48 and 72 hours after administration
    - Replace another test if not read by 72 hours
  - Diameter of the indurated area (palpable, raised, hardened area or swelling) should be measured across the forearm
  - Do not measure redness or irritation
  - Positive
    - >15 mm induration in any person
    - >10 mm induration in high risk (healthcare worker, recent immigrants from high risk countries, illness puts at risk for disease)
    - >5 mm induration in immunocompromised (HIV, organ transplant)

TB Skin Test

- History of BCG vaccination
  - BCG is the most commonly used vaccine in the world
  - BCG might cause a positive TST (i.e., false-positive) result initially; however, tuberculin reactivity caused by BCG vaccination typically wanes after 5 years
  - Tuberculin reactivity caused by BCG vaccination can be boosted by subsequent TST
  - No reliable skin test method has been developed to distinguish tuberculin reactions caused by BCG from reactions caused by natural mycobacterial infections
  - TST reactions of >20 mm of induration are not usually caused by BCG
  - if an employee with history of BCG has a positive TB skin test, recommend using IGRA
Interferon Gamma Release Assay (IGRA)

- Blood test to measure immune system reaction to the TB bacteria (Quantiferon Gold or TB Spot)
- Requires a single patient visit to conduct the test
- Results can be available within 24 hours
- Does not boost responses measured by subsequent tests (no 2-step testing required)
- Prior BCG (bacille Calmette-Guérin) vaccination does not cause a false-positive IGRA test result
- Collection and transport requirements should be strictly followed
- Expensive

TB Disease (Active TB)

- The stage where TB is causing symptoms of disease in your body
  - Unexplained weight loss
  - Loss of appetite
  - Night sweats
  - Fever
  - Fatigue
- Two types: pulmonary (lungs) and extrapulmonary (any other body site)
  - Pulmonary disease is most common and contagious
    - TB is spread by tiny airborne droplets that are generated when a person with active pulmonary TB disease coughs, sneezes or speaks
- Diagnosis:
  - Chest Xray – many forms of abnormalities could be seen
  - Microbiologic detection – Acid fast bacilli (AFB) smear (quick), culture (slow growth, up to 8 weeks)
    - For sputum, three sputums obtained, at least one should be early morning specimen
- Requires treatment with multiple drugs for a long course (generally 3-4 antibiotics/vitamins over 6-12 months) to cure patients
- Non-compliance with treatment leads to multi-drug resistant TB
  - This is uncommon in the US because the health department will require that patients are observed taking their medication – a process called directly observed therapy (DOT)
TB Transmission

- TB transmission depends on:
  - Infectiousness of the person with TB
  - How many infectious particles they are expelling
  - The environment of the exposure
  - A confined space or high-risk facility vs. large room or outdoors
  - The duration of exposure
  - How long a healthy person is breathing contaminated air

TB prevention

- Airborne Infection Isolation
  - Negative pressure ventilation
  - N-95 respirator
- Annual TB infection assessment
  - Requires facility complete a risk assessment
  - Medium risk facilities are required to test employees annually

Organisms of Interest

Fungus
Candida

- Yeasts are unicellular organisms that reproduce by budding and typically
- Candida is the most common isolated yeast
  - Normal commensal of the GI tract and female genital tract
- Clinical Manifestation
  - Varies with the organ system involved
  - Thrush, yeast infection or invasive candidiasis
- Diagnosis
- Prevention
  - Hand hygiene
  - Judicious use of antibiotics

Aspergillus

- Ubiquitous molds found in decaying organic matter
- The route of acquisition of Aspergillus is typically via inhalation of conidia (spores)
- Clinical manifestation
  - Sinusitis, hemoptysis, aspergillomas, pneumonia
- Diagnosis
  - Histology and positive culture is the gold standard
- Prevention
  - Hand hygiene
  - Appropriate barriers during construction
  - Hega filtration

Organisms of Interest

Viruses
Measles

- Ribonucleic acid (RNA)-containing paramyxovirus with one serotype
  - Highly contagious febrile exanthema
  - Airborne
- Clinical Manifestation
  - Illness usually begins 8 to 12 days after exposure
  - Starts with fever/malaise then 2 to 4 days later the rash
- Diagnosis
  - Immunofluorescence or polymerase chain reaction (PCR)
- Prevention
  - Vaccine
  - Airborne

Mumps

- Rubulavirus within the family Paramyxoviridae
  - Incubation period ranges 12 to 25 days
  - Communicability
    - 1 to 2 days before symptoms through 9 days after
- Clinical Manifestation
  - Transmission through droplets
  - Inflammation in affected glands
  - Parotitis
- Prevention
  - Vaccine
  - Droplet precautions

Rubella (German Measles)

- Rubivirus in the Togaviridae family
  - "Rubella" comes from the Latin for "little red"
- Incubation period of 14 days (range 12 to 23 days)
- Clinical Manifestations
  - Rash
- Prevention
  - Vaccine
  - Droplet precautions
Noroviruses

- Most common cause of sporadic cases of diarrhea in the community
- Transmission
  - Fecal-oral spread, or aerosol formation
  - The virus is highly infectious
- Clinical Manifestations
  - Incubation period of the virus is 12 to 48 hours, with gradual or abrupt development of symptoms.
  - Abdominal cramps with or without nausea, vomiting, and diarrhea (together or alone).
- Diagnosis
  - Real-time reverse transcriptase-polymerase chain reaction (RT-qPCR)
- Prevention
  - Hand Hygiene
  - Wash and cook food
  - Environmental cleaning

Herpes Virus

- Humans are the only natural reservoir for HSV-1 and HSV-2
  - Human-to-human contact with infected material, usually from mucous membranes or skin
- Clinical Manifestation
  - HSV-1 is usually an oral infection
  - HSV-2 is usually a genital infection
- Diagnosis
  - Viral culture, Polymerase chain reaction (PCR)

Varicella-Zoster Virus

- VZV is the third of the alpha-herpesviruses
- Clinical Manifestation
  - Vesicular rash often associated with prodromal malaise, pharyngitis, rhinitis, and abdominal pain
- Diagnosis
  - The rash appears 15 days after VZV exposure
  - Vesicular eruption on skin emerges in successive crops during the first 3 to 4 days of illness
- Prevention
  - Isolation Airborne without N95 and contact
  - Direct transmission only (human to human)
  - VZV vaccine
Herpes Zoster (Shingles)

- VZV infection reactivates in cranial or spinal nerve ganglia, spreads to the cutaneous nerves, and infects the skin in the exact distribution of the nerve (dermatome)
- Clinical Manifestations
  - Pain and vesicular eruptions along a dermatome
- Diagnosis
  - Direct immunofluorescent stain of a skin scraping
- Prevention
  - Disseminated and immunocompromised patients should be in Airborne without N95 and contact
  - Localized in an immunocompetent patients is standard precautions

Hepatitis A

- Hepatovirus, in the family Picornaviridae.
- Transmitted principally by the fecal-oral route
  - Highest level of virus in the feces found in the 2 weeks prior to onset of jaundice or liver enzyme increase
- Clinical Manifestations
  - Jaundice, malaise, fatigue, anorexia, nausea, vomiting, abdominal discomfort, arthralgia, myalgia and fever
- Prevention
  - Standard precautions
  - Hand hygiene
  - Vaccine

Hepatitis B

- HBV is a small DNA virus in the family Hepadnaviridae
- Transmitted through blood or blood products and sexual contact
- Clinical Manifestations
  - Incubation period ranges from 30 to 180 days
  - Urticarial rash, arthritis and fever
- Prevention
  - Standard precautions
  - Vaccine
Hepatitis C

- HCV is a single-stranded RNA virus in its own genus in the family Flaviviridae
- Transmitted parenterally by blood injection (injecting drug users), organ transplantation, or transfusion of HCV infected blood or blood products

Clinical Manifestations
- The incubation period ranges between 15 and 160 days (2-26 weeks (mean, 36-49 days))

Prevention
- Standard precautions
- Following sharp safety
- Co-infection with Hep B or HIV

HIV/AIDS

- Double-stranded ribonucleic acid (RNA) virus
- Transmitted as free virus in secretions
  - Blood, semen, breast milk

Stages of HIV Infection
- Incubation period
- Acute retroviral syndrome
- Asymptomatic HIV infection
- Symptomatic HIV infection
- AIDS
- Advanced HIV infection

HIV Diagnosis

- Standard serologic antibody tests
  - Enzyme-linked immunosorbent assay (ELISA) followed by a confirmatory Western blot (WB)
- Rapid HIV tests
  - Variety of antibody tests on blood or oral secretions
  - Can be done in the home
  - Result in 15 minutes
  - Confirmation with Western blot is needed
- Viral Load
  - Quantitative HIV RNA (viral load)
Infections in Immunocompromised Pts

- Most common opportunistic bacteria associated with cell-mediated immunity dysfunction
  - Listeria
  - Salmonella
  - Mycobacterium
  - Nocardia
  - Legionella
  - Pneumocystis

Influenza

- Clinical Manifestations
  - Upper respiratory symptoms, fever, headache, and myalgia, most often with acute onset
  - Viral shedding
    - Start 24 to 48 hours after infection
    - 24 hours before the onset of symptoms
- Diagnosis
  - Rapid influenza diagnostic tests (RIDTs)
  - RT-PCR has become the gold standard for the diagnosis of influenza.
- Prevention
  - Vaccine
  - Droplet Precautions
  - Respiratory Etiquette

Respiratory Syncytial Virus

- RNA virus and a member of the Paramyxovirus family. Two serotypes: A and B
  - Transmission by droplets
  - Incubation period ranges from 2 to 8 days
- Clinical Manifestation
  - Upper respiratory tract infection which progresses bronchiolitis, tracheobronchitis and pneumonia
- Diagnosis
  - Antigen detection, culture and amplified nucleic acid methods
Viral Hemorrhagic Fevers

- Enveloped RNA viruses
- Disease range mild febrile illness to the multisystem hemorrhagic syndrome
- No cure or treatment
- Transmission generally related to contact with blood or body fluids
- Families:
  - Flaviviridae: YFV, dengue fever, dengue hemorrhagic fever (DHF), Omsk hemorrhagic fever (OHF), and Kyasanur Forest disease (KFD)
  - Bunyaviridae: Congo-Crimin hemorrhagic fever (CCHF), HPS, hemorrhagic fever with renal syndrome (HFRS), and Rift Valley fever (RVF)
  - Filoviridae: Marburg and Ebola
  - Arenaviridae: Lassa fever and new world arenaviruses, including guanarito, sabia, junin, and machuca.

Organisms of Interest

Creutzfeldt-Jakob Disease

- Occurs as a rapid and progressive dementia with several distinctive clinical manifestations, including ataxia, myoclonic seizures, visual or sensory deficits, abnormal psychiatric behavior, and coordination deficits.
- Prion (misfolded protein) disease
  - Sporadically in nature
  - Familial transmission (gene mutation)
  - Exposure to contaminated tissue (injection or medical treatment)
- Diagnosis
  - Definitive diagnosis of CJD is made by direct examination of the brain tissue
  - The observation of neuronal loss, reactive gliosis and neuronal vacuolation (spongiform appearance) with an absence of inflammatory cells is consistent with the diagnosis of CJD
CJD Prevention

- Prions are highly resistant to routine sterilization/disinfection methods
  - Chemical or increased temperature/extended cycle sterilization or a combination of both
- Prion diseases are not spread person to person, and in general patients with prion diseases can be cared for by health care personnel and family members without risk of transmission of infectious particles
- Infectiousness of body tissues
  - Highly infectious: brain, dura mater, pituitary tissue, spinal cord and eye
  - Minimally infectious: lung, liver, kidney, spleen, lymph nodes and CSF
- Caution – not to be confused with JCV (John Cunningham virus)

Lyme Disease (Borrelia Burgdorferi)

- Lyme disease is caused by a coiled spirochete
  - Transmitted by a tick bite
  - Most common in Northern, heavily wooded parts of the US
- Clinical Manifestation
  - Early localized
  - Early disseminated
  - Late disseminated
- Diagnosis
  - Western blots
  - Lymphocyte transformation tests
  - Borreliacidal antibody assay
  - Immune complex disruption
  - T-cell proliferative response

Lyme Disease

- Treatment
  - Tetracyclines
  - Most penicillins
  - Second- and third-generation cephalosporins
  - Macrolides
- Prevention
  - Tick bite prevention - Protective clothing, tick repellent
Scabies - *Sarcoptes Scabiei*

- Female mite burrows under the skin to deposit eggs
  - Itching and pimple-like rash
  - Symptoms may take as long as 4-6 weeks to begin for the first time
  - Repeat infections can appear 1-4 days after exposure
- Norwegian scabies (crusted)
  - Immunocompromised patients are at risk
  - Debilitating pain and skin breakdown
  - Crusts contain large numbers of mites and eggs – very contagious
- Diagnosis
  - Skin scraping
  - Appearance and distribution of rash
- Transmission
  - Person-to-person contact (generally prolonged or close contact)
  - Contact with clothing, towels, or linens (usually with crusted only)

Helicobacter pylori

- Gram-negative, microaerophilic bacterium usually found in the stomach
- Associated with peptic ulcer disease and gastric cancers

Foodborne Illnesses

- Clinical Manifestations
  - Upset stomach
  - Stomach cramps
  - Nausea
  - Vomiting
  - Diarrhea
  - Fever
- Illness caused by a variety of organisms (Bacterial, viral and parasitic)
  - Top causes: Norovirus, Salmonella, C. perfringens, Campylobacter, S. aureus
Foodborne Illnesses

- **Bacterial agents**
  - *S. aureus* – 30 min-6 hours
  - Clostridium perfringens – 8-12 hours (begins suddenly, lasts less than 24 hours)
  - Salmonella spp. – 12-72 hours
  - Clostridium tetani – 18-36 hours
  - Campylobacter – 2-5 days
  - E. coli – 3-4 days
  - Listeria – 1-4 weeks

- **Viral agents**
  - Norovirus – 12-48 hours
  - Hepatitis A – 2-6 weeks

- **Parasitic agents**
  - *Giardia* lamblia – 1-14 days
  - Cryptosporidium – 1-12 days
  - Cyclospora – 1 week

**Resources**

- APIC Text of Infection Control and Epidemiology 2014
- Kulich P, Taylor D, eds. The Infection Preventionist’s Guide to the Lab

**Break Time!!**

Don’t forget to return...we’re just getting started!
Part 1 – Surveillance and Epidemiologic Investigation

Kate Gase, MBA, MPH, CIC®, FAPIC®
Surveillance and Epidemiology

- Key Concepts: Surveillance...
  - Is essential for an effective IP Program
  - Should support the identification of risk factors for infection, the implementation of interventions, and the assessment of those interventions
  - Is critical to identifying outbreaks, emerging diseases, and important trends of resistant organisms or infections of interest, so IP measures can be instituted

- Key Concepts: Epidemiology...
  - Is the study of the frequency, distribution, cause and control of disease in populations
  - Provides background for interventions to reduce the transmission of infecting organisms and the number of HAIs, while also protecting health care workers
  - Is used to understand the relationship of host, environment and organism
  - Aids IPs designing studies to determine the cause of HAIs and to design/implement interventions

Design of Surveillance Systems

- Develop a surveillance plan based on the population served, services provided, and regulatory or other requirements
- Periodically evaluate the effectiveness of the surveillance plan and modify as necessary
- Identify appropriate critical/significant lab results and implement a notification system
- Determine data needed to calculate specific rates
- Integrate surveillance activities within health care settings
- Establish mechanisms for identifying individuals with communicable disease who require follow-up and/or isolation
Surveillance

You are an IP at an outpatient surgery center. You are developing the surveillance plan for the center. Which of the following should you take into consideration?

1. The state laws regarding required SSI reporting
2. The risks associated with the specialized population your center serves
3. The concerns brought to you regarding the prepping technique of one of the operative nurses
4. The risks associated with the new surgical technique one of your surgeons is using

Surveillance

You included HPRO SSI in your 2016 surveillance plan. In March, you learn that the Chief of the Orthopedic Service is leaving in May and taking half of the department with her.

1. Do you need to do anything differently with your surveillance plan?
2. WWKD?
Surveillance

You included HPRO SSI in your 2016 surveillance plan. In March, you learn that the Chief of the Orthopedic Service is leaving in May and taking half of the department with her. Here’s what I would do:

1. Contact hospital leadership
   • Is there a plan to replace the departing surgeons?
   • How do they anticipate this affecting surgical volumes, specifically HPRO?

2. Scenario 1 – Surgeons being replaced and the program is planning to expand, doubling HPRO volume
   • Assess how that will affect IP’s ability to continue fulfilling surveillance plan
   • Plan for additional rounding in the OR during the orientation of the new surgical staff

3. Scenario 2 – Ortho program is being phased out completely and those ORs are going to be renovated to accommodate a new Women and Infants Program that is expected to have capacity for 1,500 births/year and will include 4 C-Section ORs.
   • Revise entire surveillance plan
   • Plan for construction-related surveillance; consider C-Section surveillance in the future

Surveillance

• A comprehensive method of measuring outcomes and related processes of care, analyzing the data, and providing information to members of the health care team to assist in improving those outcomes.

Written Surveillance Plan

• Type of health care setting, services, population served
• Program purpose, goals, objectives
• Results of risk assessment
• Events monitored, criteria used
• Justification for selections
• Methodology: case identification, data collection, analysis
• Description of federal, state, local reporting requirements
• Reports generated, who receives them
• Process and frequency for evaluating surveillance plan
Surveillance and Risk Assessment

- Surveillance plans should be informed by your facility risk assessment
- Identify what data you need to successfully complete surveillance

- Outcomes
  - Numerators
    - SSI, CAUTI, CLABSI…
  - Denominators
    - Procedures, urinary catheter days, central line days…
- Benchmarks
  - National, local
  - Goals
    - Quality
    - Improved

- Processes
  - Compliance with surgical attire policy, scrub technique, pre-operative antibiotic administration, normothermia, glucose control…
  - Aseptic urinary catheter insertion, compliance with maintenance bundles…
  - Insertion checklist for central line insertion, sterile dressing changes, technological solutions…

II. Collection and Compilation of Surveillance Data

- Use standardized definitions for identification of outcomes and processes
- Use a systematic approach to record surveillance data
- Determine numerators, denominators, and constants for calculations of rates for outcomes and processes
- Organize and manage data in preparation for analysis
- Determine the incidence or prevalence of infections
- Calculate specific infection rates
- Calculate risk-stratified rates
- Incorporate post-discharge surveillance findings into calculation of rates

Surveillance Data

You are preparing to present HPRO SSI information form last year to a group of orthopedic surgeons. Your data includes the following:

- # HPRO SSI = 8
- # HPRO Procedures = 212
- NHSN Pooled SSI Mean = 1.44%

What is the SIR?
Standardized Infection Ratio

\[ SIR = \frac{\text{Observed Infections}}{\text{Predicted Infections}} \]

Observed = 8
Predicted = 212 (procedures) \times 0.0144 (SSI rate) = 3.05
SIR = 8/3.05 = 2.62

What does that mean?

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Standardized Definitions

- You can't compare a dataset to another dataset unless they were defined and collected in the same way
- Outcome Measure Definitions: National Healthcare Safety Network (NHSN)
- Process Measure Definitions: Not always so easy
  - Hand Hygiene – WHO 5 Moments vs. In/Out; Hawthorne Effect; Observer Bias
- Risk Factors: Age, DM, BMI, etc...

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Interpretation of Surveillance Data

- Generate, analyze and validate surveillance data
- Use basic statistical techniques to describe data
- Recognize statistical significance of surveillance data
- Monitor and interpret antibiotic resistance patterns
- Recognize the need for an epidemiologic study to investigate a problem
- Compare surveillance results to published data or other benchmarks
- Prepare and report findings of surveillance using analyzed data as appropriate
- Develop and implement corrective action plans based on surveillance findings
Statistics

- Statistics ≠ Scary
- Involves collecting, organizing and analyzing data in order to draw a conclusion about the meaning of the data
- Statistics = A very powerful tool
  - Aid in organizing and summarizing data
  - Communicate findings clearly and meaningfully
  - Make inferences about data
  - Cannot prove association or causality;
  - Can suggest that an association exists
  - Strength of the association between cause and effect is determined using statistics

Some Definitions

- Descriptive statistics uses numbers to describe characteristics of a dataset
  - Discrete data
    - Whole numbers and are mutually exclusive
  - Continuous data
    - Measured on a scale and can have numeric values between the min and max values
    - Require measuring rather than counting
- Inferential statistics make an assumption about a population based on a sample
  - Calculates strength of association between cause and effect

Descriptive Statistics: Scales

- Nominal is the simplest level of measurement
  - Categories are used to classify observations into mutually exclusive groups
  - No order is implied among classifications
  - Example of nominal data: Disease state, 1 = ill, 2 = not ill
- Ordinal ranks each distinct category and defines a relationship
  - Example of ordinal data: ASA score, 1-5
  - When the exact distance between any two observations in an ordinal dataset is known, it is called interval data
Descriptive Statistics: Frequency Measures

Measures of Central Tendency

• Mean: Average
  • Add all the observations together and divide by the total number of observations
  • Misleading if there are outliers in your dataset

• Median: Middle
  • Sort your data from lowest to highest, identify what number has 50 percent of the values above and 50 percent of the values below
  • If dataset has an even number of values, find the two middle values and the mean of those two numbers is the median
  • Ispins extreme outliers
  • Useful when the distribution is skewed

• Mode: Most Frequent
  • Determines the height and shape of the curve
  • Least stable of the measures of central tendency
  • Nonmodal, unimodal, bimodal, multimodal

Descriptive Statistics: Quantiles and Percentiles

• Quantiles: Quantifiable groupings useful for a detailed study of a distribution
  • Groups values in ascending order

• Quartiles: Four groups that each have 25 percent of the observations
  • 1st quartile: lowest 25 percent of observations
  • 4th quartile: highest 25 percent of observations

• Deciles: Ten groups that each have 10 percent of the observations

• Percentiles: Value of having x percent of the measurements below it and (100 – x) percent above it
  • Tenth (10th) percentile = 90 percent of the measurements were better; this measurement is in the bottom 10 percent of group

Descriptive Statistics – Measures of Variability

• Range: Difference between highest and lowest values
  • Least stable measure of dispersion

• Deviation: Spread of each individual value from the mean
  • Negative, positive or no deviation
  • Sum of deviations must always be zero

• Standard Deviation: Measure of dispersion that reflects the variability in values around the mean
  • Used to indicate the “spread” among observations
  • Small value indicates all the values are close to the mean; large value indicates the values are not close to the mean
  • Only valid with normally distributed data
  • One standard deviation from the mean should include 68% of the results

• Variance: Square of the standard deviation
Descriptive Statistics: Skew and Kurtosis

- **Skew** indicates the direction that extreme values fall from the mean
  - Positive: Mean is greater than the median (right skew)
  - Negative: Mean is less than the median (left skew)

- **Kurtosis** refers to how flat or peaked a curve is
  - **Mesokurtic** is: Typical bell curve (Kurtosis = 0)
  - **Leptokurtic** is: Peak curve (Kurtosis > 0)
  - **Platykurtic** is: Flatter curve (Kurtosis < 0)

Descriptive Statistics – Rates

- **Rate** measures the probability of occurrence in a population of a particular event
  - Summarize the experience of a population over time
  - Provides a way of comparing the occurrence of an event in one population to similar populations by adjusting for differences in population sizes
  - Choice of the appropriate denominator is key
    - Include only those at risk for the particular event
  - Basic formula: Number of events (numerator)/Population (denominator) x Constant
  - Persons in the denominator must reflect the same population from which the numerator was taken
  - Counts in the numerator and denominator should cover the same time period
  - Persons in the denominator should have been at risk of the event

Descriptive Statistics: Rates

- **Incidence Rate**: Measures the frequency an event occurs in a population over a specified time period
  - Number of new cases/Population at risk x Constant

- **Prevalence Rate**: Proportion of persons in a population with a particular disease at a specific point in time
  - Incidence + Prevalence
  - Number of existing cases/Population at risk x Constant

- **Attack Rate**: Not a really a rate, but a proportion of persons at risk who become infected over an entire period of exposure
  - Measure of the probability of becoming a case
  - Number of new cases/Population at risk x 100

- **Incidence Density**: Incidence rate that incorporates time into the denominator
  - Number of new cases/Total time observed x Constant

- **Mortality Rate**: Measures the frequency of death in a defined population during a specified time
  - Crude Mortality Rate measures the proportion of the population dying each year from all causes
  - Cause-Specific Mortality Rate measures death from a specified cause for a population
Descriptive Statistics – SIR

- Standardized Infection Ratio: Summary measure that compares HAI rates over time among one or more groups of patients to that of a standard population
  - For NHSN, the SIR is used to compare how a single facility’s infection rates differ from a national standard
    - SIR = 1: Facility’s rates are the same as the benchmark
    - SIR > 1: Facility’s rates are higher than the benchmark
    - SIR < 1: Facility’s rates are lower than the benchmark

Descriptive Statistics: Measures of Association

- Relative Risk: Probability of developing a disease in the risk factor is present divided by the probability of developing disease if the risk factor is not present
  - RR = 1: No significant association
  - RR > 1: Positive association (worse outcome)
  - RR < 1: Negative association (protective)

- Odds Ratio: Probability of having a particular risk factor if a disease is present divided by the probability of having the risk factor if the disease is not present
- Calculates the direction and magnitude of a relationship between two variables
  - Range from 0 to ∞; the closer to 1, the stronger the relationship
  - Positive correlation: as one variable increases, so does the other
  - Negative correlation: as one variable increases, the other decreases
  - A value of 0 indicates no correlation

- Correlation: Calculates the direction and magnitude of a relationship between two variables
  - Ranges from +1 to -1; the closer to ±1, the stronger the relationship.
  - Positive correlation: as one variable increases, so does the other
  - Negative correlation: as one variable increases, the other decreases
  - A value of 0 indicates no correlation

- Regression: Assesses the influence of one or more variables on another
  - If there is only one independent variable, the relationship is represented in a straight line (linear regression)
- Confounding Variable: Variable with an important effect on the result of a regression or correlation can suggest a false relationship between variable, or it can hide a relationship that exists

Inferential Statistics

- Makes an assumption about a population based on a small sample size and is used to show an association between cause and effect
- Population: Set of all observations of interest; total from which the sample is selected
- Sample: Group of observations selected from the population and chosen to represent the population whole
  - The larger the sample, the stronger the inference
- Power: Ability to detect a specified difference
  - Consideration of risk factor frequency, disease frequency, and desired degree of sensitivity
Inferential Statistics: Things You Need to Know

• Confidence Intervals: Range of possible values the population mean might take, compensating for margin of error
  • Reported as 95% CI (x, y)
• Statistical Significance: If p ≤ 0.05, a result is significant
• Sensitivity: Probability that a test correctly identifies patients who have the disease as positive
  • TP/(TP + FN)
• Specificity: Probability that a test correctly identifies patients without disease as negative
  • TN/(TN + FP)
• Positive Predictive Value: Proportion of individuals with a positive test who have the disease
  • TP/(TP + FP)
• Negative Predictive Value: Proportion of patients without disease who test negative
  • TN/(TN + FN)

Outbreak Investigation

• Verify existence of outbreak
• Collaborate with appropriate persons to establish the case definition, period of investigation and case-finding methods
• Define the problem using time, place, person and risk factors
• Formulate hypothesis on source and mode of transmission
• Implement and evaluate control measures, including ongoing surveillance
• Prepare and disseminate reports

Verify and Alert

• Outbreaks are defined as an increase over the expected occurrence of an event
  • Confirm that what is being reported represents an increase in the outcome
  • Surveillance and microbiology data
  • If no comparative data, may need to rely on subject matter experts
• Alert key partners
  • Administration, risk management, Micro lab, Public health officials
Literature Review, Case Definition and Finding

- Literature reviews are useful to help identify possible sources and develop a balanced case definition
  - Narrow enough to focus investigative efforts
  - Common pathogens, more frequent events
  - Broad enough to capture the majority of cases
  - Rare pathogens
- Case finding methodology will be dependent on case definition
  - Lab results
  - Clinical symptoms
  - Paper charts vs. EHR
  - Inpatient vs. other
  - Infection and colonization
  - Discussions with HCW

Collecting the Information

- Time, place, person, risk factors
  - Line list: Patient demographics, signs/symptoms, medications, procedures, locations, contacts, exposures, and on and on and on...
  - Epidemic curve: cases are plotted according to time of onset of illness (histogram)
    - Determine whether the source is common, propagated or both
    - Identify probable time of exposure and incubation
    - Determine if the problem is ongoing

Epi Curve Interpretation

- Common Source: All cases have the same origin; exposure may be continuous or intermittent
- Propagated Source: Infections transmitted from person to person and can’t be attributed to a single source
  - Occur over a longer period of time
  - If secondary and tertiary cases occur, intervals between peaks usually approximate average incubation period
Observations and Environmental Sampling

- Initial observations can (should?) be done without a detailed observation form
- Engage HCW and stress collaboration
- Focus on practice patterns and workflow that deviate from good IP practices and policies
- Identify teachable moments
- Inform the development of the detailed observation form, if needed
- If environmental cultures are going to be obtained:
  - Focus on items most likely to be implicated
  - Possible vectors of transmission
  - Make sense as a likely reservoir
  - Determine whether the lab can process the cultures and identify optimal method of collecting

Control Measures

- Implement IP measures throughout the investigation
- Measures driven by findings from line list and observations
- Reinforce education on general IP recommendations
- Develop a plan to ensure compliance and review regularly
- Critically assess if/when measures can be removed – very important for time-consuming and resource intensive measures

Further Study and Reports

- Further analytical studies – generally case control – are not always required, necessary, or beneficial, but should be considered
- Guide further investigations or future outbreaks
- Suggest new avenues for exploration
- Useful in convincing clinicians that proposed source/cause is correct
- Powerful teaching tools
- When investigation is controlled, final summary reports should be sent to all stakeholders
A urine specimen collected from an indwelling urinary catheter was sent to the laboratory for culture and sensitivity. Culture results reported a colony count of 50,000/mL of *Escherichia coli*. Sensitivity testing reported resistance to cephalosporin and sensitivity to ciprofloxacin. This organism is an example of:

A. Methicillin resistance  
B. Aminoglycoside resistance  
C. Extended spectrum beta-lactam resistance  
D. Quinolone resistance
ID of ID

- The validity of a culture report is dependent on the quality of the specimen sent. To determine if an expectorated specimen was sputum and not saliva, the Gram stain should show:
  A. Fewer than 10 epithelial cells per low-power field
  B. More than 10 epithelial cells per low-power field and moderate to abundant polys
  C. More than 10 epithelial cells per low-power field and abundant *Pseudomonas aeruginosa* in pure culture
  D. Many WBCs and organisms on low-power field

ID of ID

- To increase recovery of AFB from expectorated or induced sputum, specimens should be collected:
  A. Once a week for 3 consecutive weeks
  B. Every day for a week
  C. First morning specimen for 3 consecutive days
  D. Three specimens 1 hour apart on the same day

ID of ID

- A patient has a nasal swab positive for MRSA. This is an example of:
  A. Normal flora
  B. Colonization
  C. Asymptomatic infection
  D. Symptomatic infection
A 27 year old man is admitted with symptoms suggestive of meningitis. The patient has a history of head trauma from a motor vehicle collision. The laboratory calls to report that a gram-positive organism is noted in the CSF. What is your next action?
A. Have the charge nurse compile a list of exposed staff
B. Notify employee health that several employees will need prophylaxis
C. Tell the staff that no one should be treated until the culture report is final
D. Ensure that employees understand which organisms are treated and which are not

The type of isolation or precautions to be followed when providing direct care to the patient mentioned in the previous question would be:
A. Droplet
B. Airborne
C. Standard
D. Respiratory etiquette

Which of the following is not a mechanical barrier to infection?
A. Intact skin
B. Mucous membranes
C. Secretions
D. Normal bacterial flora
Patients with cell-mediated immunity dysfunction are susceptible to infections attributed to pathogenic intracellular bacteria. Examples of these organisms include:

1. Salmonella typhi
2. Bacteroides fragilis
3. Listeria monocytogenes
4. Staphylococcus aureus

A. 2, 3
B. 1, 3
C. 1, 2
D. 3, 4

What is the name for a substance that prevents water-soluble elements such as antibiotics and disinfectants from reaching pathogens?

A. Cell wall
B. Biofilm
C. Sludge
D. Biocarbon

Gram stains easily classify an organism as gram-positive or gram-negative. The determinant factors for Gram stains are cell wall components of:

A. Peptidoglycans
B. Lipids
C. Polysaccharides
D. Mycolic acids
Part 2 – Surveillance and Epidemiologic Investigation
Kate Gase, MBA, MPH, CIC®, FAPIC®

Let’s Practice!
Supplemental Materials Sent via E-mail

Employee/ Occupational Health
Kathleen McMullen, MPH, CIC®, FAPIC®
CBIC Outline

- Employee/Occupational Health (11 items)
  - Review and/or develop screening and immunization programs
  - Collaborate regarding counseling, follow up, and work restriction recommendations related to communicable diseases and/or exposures
  - Collaborate with occupational health to evaluate infection prevention related data and provide recommendations
  - Collaborate with occupational health to recognize healthcare personnel who may represent a transmission risk to patients, coworkers, and communities
  - Assess risk of occupational exposure to infectious diseases (e.g., Mycobacterium tuberculosis, bloodborne pathogens)

Educational Outline

- Immunizations and Employment Requirements
- Body Substance Exposures
- Organisms of interest: TB, N. meningitis, Influenza, Pertussis, VZV
- Special Considerations: Volunteers, Work Restrictions, Pregnancy

Immunizations and Employment Requirements
Components of an Employee Health Program

- Pre-employment
  - Documentation of history of infectious disease or immunizations:
    - Measles, mumps, rubella
    - Varicella zoster (chicken pox)
    - Hepatitis A
    - Hepatitis B (immunization optional)
    - TB skin testing/evaluation

Immunity

- Active Immunization
  - Development of antibodies or cellular immune response following administration of a vaccine or toxoid

- Passive Immunization
  - Temporary immunity that follows exogenous antibody administration

Immunoglobulins/Antibodies

- Large, Y-shaped protein produced mainly by plasma cells that is used by the immune system to neutralize pathogens such as pathogenic bacteria and viruses
- IgM – eliminates pathogens in the early stages of infection
- IgG – important for immunity later in infection stage
- IgE – allergies and parasitic worms
- IgA – saliva, tears, breast milk
- IgD

[Graph]
Immunosuppression

- HIV with CD4 count >200
- Leukemia or lymphoma
- Neutropenia with ANC <500
- Splenectomy
- Early post-transplant
- Cytotoxic chemotherapy
- High dose steroids

Determination of Immunity

- Measles, Mumps, Rubella:
  - Documented receipt of 2 doses of MMR or combination of vaccines OR
  - Laboratory evidence (titer drawn) of immunity or confirmation of disease OR
  - Birth before year 1957 generally considered acceptable evidence of immunity, but consider vaccination if no proof or memory of disease

- Varicella zoster (Chicken pox):
  - Documentation of two doses of varicella vaccine given at least 28 days apart OR
  - Physician diagnosis of varicella or herpes zoster OR
  - Laboratory evidence (titers drawn) of immunity or confirmation of disease

Pictures compliments of CDC picture library
Hepatitis Vaccination

- Hepatitis A
  - First dose of the two dose series generally required OR
  - Proof of previous vaccination
- Hepatitis B
  - If no previous vaccination, immunization offered and first dose administered
  - Employee can decline, need to sign a declination statement

TB testing

- TBST: Two step testing required for all new employees unless:
  - Prior positive IGRA or TBST
    - Requires chest X-ray and/or annual symptom screening
  - Prior treatment for latent TB infection or TB disease
  - Documentation of a negative TBST in the past 12 months (then only one TBST may be required)
- IGRA: Single test required for new employees unless:
  - Past positive IGRA or TBST, with or without treatment
    - Requires chest X-ray and/or annual symptom screening

Pre-employment

- Additional testing/vaccination to consider
  - Respiratory medical evaluation for fit-testing an N95 mask
  - Latex allergy questionnaire
  - Tdap vaccine – based on work assignment
  - Influenza vaccine – during flu season
  - Meningococcal vaccine – laboratory employees
Facility Orientation

- Orientation should include the following:
  - Infection prevention policies and procedures
  - Modes of infection transmission
  - Bloodborne pathogen exposure prevention
  - TB information
  - Hand hygiene
  - Other state or local regulatory requirements
  - Processes for reporting of unsafe situations, including recognized breaches in infection prevention processes

Components of an Employee Health Program

- Post employment
  - Annual vaccinations/testing
  - Work Restrictions (including pregnancy)
  - Exposure Follow-up
    - Bloodborne pathogens
    - Infectious diseases

Annual vaccinations/testing

- Influenza vaccination
  - Inactivated IM or intradermal OR
  - Live attenuated nasal (not if provide care for severely immunocompromised pts)
  - Consider requiring a declination statement that confirms education about the vaccine was received
Annual vaccinations/testing

- LTBI testing – based on risk assessment
  - One step testing (TBST or IGRA)
  - Further evaluation of conversions includes chest X-ray and decision to treat as latent TB infection or TB disease
  - Symptoms screening for those with previously positive testing
  - Ensure only trained personnel are reading TBST

Body Substance Exposures

Occupational Exposures to Bloodborne Pathogens

- Prevention of occupational blood exposures is the primary way to reduce transmission
  - Hepatitis B virus
  - Hepatitis C virus
  - Human immunodeficiency virus (HIV)

- Health care organizations and facilities should set up programs to
  - Manage cases of exposure
  - Prevent future exposures to bloodborne pathogens
Infection Risk per Exposure

- Risk depends on source, host, & injury factors
- Most infections occur after percutaneous exposures
  - Few after mucous membrane contacts
  - Cutaneous contacts pose very small risk
- Risk depends on viral load
- Increased blood transfer = increased risk
  - Larger needles, hollow-bore needles, & deeper penetration

Management of Exposures: Factors

- Type of Exposure
  - Percutaneous, mucous membrane, nonintact skin, intact skin
- Type and amount of fluid/tissue
  - Blood
  - Visibly bloody fluid
  - Other potentially infectious fluid or tissue (semen, vaginal secretions; and cerebrospinal, synovial, pleural, pericardial, and amniotic fluids)

Management of Exposures: Factors (cont’d)

- Infectious Status of Source
  - Hepatitis B (V surface antigen)
  - Hepatitis C (V HCV antibody)
  - HIV (V HIV antibody)
- Susceptibility of exposed person
  - Hepatitis B vaccine history and vaccine response status
Source Testing

- **Known source**
  - If all testing is negative, no further action is necessary for the exposed person
  - If unavailable for testing, use medical history, symptoms and history of risky behaviors to evaluate risk
  - Do not test discarded needles for BBP

- **Unknown source**
  - Evaluate the likelihood of source having high risk of infection

High Risk Source Patient

- Person with identified BBP infection
- Victim of violent trauma
- Person with homosexual, bisexual, or multiple heterosexual contacts
- IV drug user
- Person requiring multiple blood products
- Recipient of blood products before 1985

BBP Fluid Concentrations (virions/ml)

<table>
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<th>HCV</th>
<th>HIV</th>
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HBV Post-exposure Management

- If vaccinated/adequate response,
  - No monitoring/follow-up
- If unvaccinated,
  - HBIG (within 7 days) + vaccination series (1st dose ASAP)
  - v HBV surface antibody (HBsAb) 1-2 months after last dose of vaccine
- If inadequate response,
  - v HBV surface antibody (HBsAb) 1-2 months after booster dose of vaccine
  - If still inadequate, complete series and recheck

HCV Post-exposure Management

- Monitor
  - HCV RNA (viral load; PCR) and ALT at 4-6 weeks,
  - HCV Ab at baseline and 6 months (ELISA)
- At present, there is no indication for PEP for occupational exposure to HCV because:
  - No evidence of efficacy
  - Risk of acute infection is low; and spontaneous clearance may occur
  - Therapy for acute HCV is promising
  - Treatment side effects are high

HIV Post-Exposure Management

- HIV(+): source: Obtain viral load & treatment history
- Initiate PEP promptly
- Follow-up testing at 6 weeks, 3 and 6 months (or with symptoms)
- Counsel exposed worker about
  - Importance of post-exposure prophylaxis (PEP)
  - Support for physical and emotional side effects of exposure and meds
  - No blood donation (6-12 months)
  - Safer sex practices, no breastfeeding
Report/Documentation

- Date/time exposure
- Details of procedure being performed (where, when, sharp device involved)
- Details of exposure (type and amount of fluid or material, severity of exposure, description of area exposed)
- Details of exposure source and exposed person
- Details about counseling, PEP offered and follow-up

Minimizing Exposure to Blood and Body Fluids

- Development of sharps engineering controls and safer medical devices
  - Evaluation, selection, and implementation
- Injury prevention teams to evaluate sharps injuries
  - Identify trends with sharp injuries – Location, Device, Action
- Administrative controls
  - Policies and policy compliance monitoring
- Healthcare worker education
  - Standard and transmission-based isolation
  - Personal protective equipment (PPE)

BSE trending

- Rate per employees working or employee working time
- Benchmark to Bureau of Labor Statistics (BLS) or National Institute for Occupational Safety and Health (NIOSH)
Organisms of Interest – Occupational Exposures

Tuberculosis

- Generally evaluate exposed personnel only after TB has been confirmed
  - TB is relatively rare
  - No time-sensitive treatment is necessary
  - Personnel with any length of time in the presence of TB patient, unless patient is wearing a surgical mask or personnel are wearing an N95 mask, are considered exposed

Post exposure workup:

- Employee with previously positive TBST or IGRA:
  - Screening for active disease
- Employee with previously negative TBST or IGRA:
  - Immediate testing to establish baseline; if negative, place another TBST 8-12 weeks after exposure
  - If either is positive, move to screening for active disease

Meningococcal Meningitis

- Clinical presentation: Fever, stiff neck with or without purpuric rash on extremities, mental status changes
- Spread via droplet transmission, surgical mask prevents exposure
- Pts are only contagious until 24 hours of effective therapy
  - Many antibiotics are effective but generally want to use Ceftriaxone

Indications of bacterial meningitis in CSF:

- Protein is normal or elevated, WBC elevated (poly >90%), glucose low
- Gram stain: Gram negative diplococci - consistent with N. meningitidis
Meningococcal Meningitis Exposure

- Treatment is very time sensitive, evaluate and offer prophylaxis as quickly as possible
- If there is indication of viral meningitis or a differing bacterial cause, exposure workgroup usually not warranted
- Caution! Not every healthcare worker who walked past the room needs PEP
  - PEP recommended for HCW only if there has been close intimate/mucosal contact with respiratory secretions (e.g., intubating a patient without a wearing a mask, mouth-to-mouth resuscitation, direct coughing into unmasked face)

Prophylaxis is recommended for all household, daycare & intimate contacts (decisions regarding community prophylaxis should be made by public health authorities)

- Adults (one of the following choices)
  - Ciprofloxacin 500mg PO x1 (>18 yrs)
  - Rifampin 600mg bid PO x 2d
  - Ceftriaxone 250mg IM x1 (recommended for pregnant women)

- Children (one of the following choices)
  - Greater than or equal to 1 mo: Rifampin 10mg/kg po bid x 2 days (max600mg)
  - Less than or equal to 1 mo: Rifampin 5mg/kg po bid x 2 days
  - Less than or equal to 12 yrs: IM Ceftriaxone 125mg x 1
  - Greater than 12yrs: IM Ceftriaxone 250mg x 1

Influenza Exposure

- Spread via droplet transmission, surgical mask prevents exposure
- Patients are contagious 1 day prior to symptom onset
- HCW exposures (regardless of immunization status):
  - Unmasked direct exposure to respiratory, oral or nasal secretions from a symptomatic patient
  - Unmasked close contact with a symptomatic patient
    - close face-to-face interaction within 6 feet of the patient/without
    - presence in confined space, unmasked, for ≥10 minutes

- If exposed, offer treatment and screen for symptoms (with furlough as necessary)
Pertussis Exposure

• Spread via droplet transmission, surgical mask prevents exposure
• Healthcare workers exposed if:
  • Unmasked direct exposure to respiratory secretions
  • Face to face contact, unmasked, for a total of 10 minutes
• If exposed:
  • Antibiotics should be offered, regardless of vaccination status
  • Symptomatic employees should be screened for pertussis and should not work until 5 days of therapy

Varicella Zoster

• Spread via airborne transmission
• Contagious patient:
  • Chicken pox
  • Disseminated shingles
  (lesions in more than one dermatome; if lesions in only one dermatome, cover, use standard precautions, do not treat exposures)

Varicella Zoster

• Exposed healthcare provider
  • >10 minutes of intermittent or continuous exposure to the source case within 48 hours before the rash appeared or during the rash episode
  • Furloughed from work day 8 through 21 after exposure
  • Vaccine or immune globulin administration
• Criteria for receipt of varicella zoster immune globulin (non-immune health care providers)
  • people on medications that suppress the immune system, such as high-dose systemic steroids or chemotherapeutic agents
  • people with cellular immune deficiencies or other immune system problems
  • pregnant women
• Else, the provider should offer the vaccine, preferably between 3-5 days post exposure
Special Considerations

Volunteers, Contract Workers and Nonemployees

• Must understand the transmission and prevention of disease
• Must comply to requests for prescreening health records
• Nonemployee individuals who have more sustained contact with patients may require more intensive training in exposure prevention
• Evaluate risk of their activity
• Ensure the competency

Work Restrictions

• Conjunctivitis (Pink Eye)
  • May not return to food service or patient care until free of drainage and appropriately treated
• Draining wounds
  • May not return to food service or patient care until wound is no longer draining
• Scabies and Lice
  • Must be appropriately treated prior to return
• Diarrhea
  • Non-outbreak situation, may not return until free of diarrhea
Work Restrictions

- Rubella (active)
  - Exclude from duty until 7 days after the rash appears
- Chicken Pox
  - Exclude from duty until all lesions dry and crust
- Shingles
  - Localized – Cover, restrict from caring for high risk patients until all lesions dry and crusted
  - Disseminated – Exclude from duty until all lesions dry and crusted

- Hepatitis A
  - May return 7 days after onset of illness
- Hepatitis B
  - If performing exposure-prone invasive procedures need expert panel review
- Measles (active)
  - Exclude from duty until 4 days after rash appears
- Mumps (active)
  - Exclude from duty until 5 days after onset of parotitis

- TB
  - Exclude from duty until determined not to be infectious
- Pertussis
  - Exclude from duty until 5 days after start of effective antimicrobial therapy
- Influenza
  - Exclude from duty for 7 days and until afebrile after 24 hours off antipyretics
The pregnant employee

- Reassignments necessary
  - Parvovirus: reassignment for patients in aplastic crisis or with chronic parvoviral infection
  - RSV and other viral infections: reassignment only if patient is under treatment with ribavirin
  - Rubella: reassignment if the healthcare worker is not immune

Vaccine Storage

- Do not block air vents
- Leave several inches between the vaccines and fridge/freezer walls to allow air movement
- Monitor and document current temp as well as min and max temps since last evaluated (when available)

Necessary Policies

- TB risk assessment
- Bloodborne pathogen exposure control plan
References

- Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Settings, 2005: http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5417a1.htm

Break Time!!
Hang in there…you're almost finished with Day 1!

Preventing/Controlling the Transmission of Infectious Agents
Tania Bubb, PhD, RN, CIC®, FAPIC®
Kate Gase, MBA, MPH, CIC®, FAPIC®
CBIC Outline

• Preventing/Controlling the Transmission of Infectious Agents (25 items)
  • Identify and implement infection prevention and control policies and procedures
  • Develop evidence-based/informed infection prevention and control policies and procedures
  • Collaborate with relevant groups and agencies in planning community/facility responses to biologic threats and disasters (e.g., public health, emergency, emergency agencies)
  • Identify and implement infection prevention and control policies and procedures
  • Develop evidence-based/informed infection prevention and control policies and procedures
  • Collabo
Responsibility Assignment Matrix (RACI)

- **Responsible**
  - The person who actually carries out the process or task as assigned.
  - Responsible to get the job done.

- **Accountable**
  - The person who is ultimately accountable for process or task being completed appropriately.
  - Responsible for ensuring accountability to the person.

- **Consulted**
  - People who are not directly involved with carrying out the task, but who are consulted.
  - May be stakeholders or subject matter experts.

- **Informed**
  - Those who receive output from the process or task, or who have a need to stay informed.

Core IPC Policies and Procedures
- IPC Program Scope
- IPC Program Mandate
- IPC Risk Assessment
- IPC Surveillance Plan
- IPC Tuberculosis Risk Assessment
- Exposure Control Plan
- BBF
- Low-level Disinfection
  - Who cleans, what item, when and, with what?
- High-level Disinfection
- Sterilization Assurance
- Standard Precautions
- Hand Hygiene
- Transmission-based Precautions
- Construction and Renovation
- Occupational Health
- Prevention of Waterborne Infectious Diseases (Legionella)
- Creutzfeldt-Jakob Disease (CJD)
- Top Cleaning
- Ambulatory Services
- Dental Services
- Rehabilitation Services
- Behavioral Health Services
- Long-term Care Services
- Specialty
  - IBD
  - PTSD
  - Dialysis
  - HSCT
  - SOT
  - Peds
  - Dialysis

Collaborate with Relevant Groups/Agencies
- Public Health
  - Department of Health and Human Services (HHS)
  - Centers for Disease Control and Prevention (CDC)
  - Division of Healthcare Quality Promotion (DHQP)
    - National Healthcare Safety Network (NHSN)
    - Healthcare Infection Control Practices Advisory Committee (HICPAC)
  - National Institute for Occupational Safety and Health (NIOSH)
  - Agency for Healthcare Research and Quality (AHRQ)
  - National Institutes of Health (NIH)
  - Center for Medicare & Medicaid Services (CMS)
Public Health Agencies

- State and local
  - State: Establish laws, rules, and regulations for health care facilities – professional licensure, certificate of need, environmental regulations
  - Local: Reportable communicable diseases, construction codes, water quality, fire marshal regulations

Collaborate with Relevant Groups/Agencies

- Regulatory/Accrediting
  - Occupational Safety and Health Administration (OSHA)
  - Healthcare Facility Accreditation Organizations
    - The Joint Commission (TJC)
    - Healthcare Facilities Accreditation Program (HFAP)
    - DNV – GL
    - National Committee for Quality Assurance (NCQA)
    - American Medical Accreditation Program (AMAP)
    - American Accreditation Healthcare Commission/Utilization Review Accreditation Commission (AAHC/URAC)
    - Accreditation Association for Ambulatory HealthCare (AAAHC)
    - Foundation for Accountability (FACT)
    - Centers for Medicare and Medicaid Services (CMS)

- Oversight – Guidelines
  - Centers for Disease Control and Prevention (CDC)
  - World Health Organization (WHO)
  - Association for Professionals In Infection Control and Epidemiology (APIC)
  - Society for Healthcare Epidemiology of America (SHEA)
  - Facility Guidelines Institute (FGI)
  - Association of peri-Operative Registered Nurses (AORN)
  - Association for the Advancement of Medical Instrumentation (AAMI)
  - Society for Gastroenterology Nurses and Associates (SGNA)
Identify and Implement IPC Strategies

- Standard Precautions and Hand hygiene
- Cleaning, disinfection and sterilization
- Specific direct and indirect care settings
- Infection risks associated with therapeutic and diagnostic procedures and devices
- Recall of potentially contaminated equipment and supplies
- Initiation and discontinuation of isolation/barrier precautions when indicated
- Patient placement, transfer and discharge
- Environmental hazards
- Use of patient care products and medical equipment
- Immunization programs for patients
- Construction and renovation in patient care settings
- Influx of patients with communicable diseases
- Antimicrobial Stewardship

Standard Precautions and Hand Hygiene

- Standard Precautions
    - "Universal precautions is an approach to infection control to treat all human blood and certain human body fluids as if they were known to be infectious for HIV, HBV and other bloodborne pathogens."
    - "If it is wet and it is not yours, put a barrier between you and it."
  - Sandra Hardy, retired IP

- Hand Hygiene
  - Contaminated hands pose a significant risk for transmission of infection
    - Hands with breakdown are more susceptible to becoming colonized with microorganisms
    - HCWs need to be educated, monitored and given feedback
  - Interventions to improve HH should be multimodal
  - Improved compliance has been associated with HAI reduction
  - Alcohol-based hand rubs vs. soap and water
  - Involving patients and giving them an opportunity to perform hand hygiene
  - TJC National Safety Patient Goal and the WHO 5 Moments

Cleaning, Disinfection and Sterilization

- Cleaning: Reduces the bioburden and removes foreign material
  - Normally accomplished using water with detergents or enzymatic products and is completed manually
  - Effective in reducing the number of microorganisms present on contaminated surfaces and equipment

- Disinfection: Eliminating many or all microorganisms, except bacterial spores, on an object

- Sterilization: Destroys or eliminates all forms of microbial life
Cleaning, Disinfection and Sterilization

- **Critical Items**: Objects that enter sterile tissue or the vascular system thus there is a high risk of transmitting infection if contaminated with any microorganism
  - Must be sterile prior to use
  - Sterilization process: Steam, ethylene oxide, hydrogen peroxide, liquid chemical sterilants

- **Semi-critical Items**: Objects that come in contact with mucous membranes or non-intact skin
  - Should be free of all microorganisms but a small number of bacterial spores may be present
  - High level disinfection process: Chemical disinfectants (glutaraldehyde, hydrogen peroxide, peroxyacetic acid, chlorine-based products)

- **Non-critical Items**: Objects that contact intact skin, but not mucous membranes
  - Reusable items may be decontaminated (cleaned and/or disinfected) where they are used

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Direct and Indirect Care Settings

- All health care settings should be considered, some key areas include:
  - Ambulatory care/Surgery centers
  - Behavioral health facilities
  - Dental services
  - Emergency department
  - Home care
  - Imaging services
  - Intensive care
  - Interventional radiology
  - Long term care/Rehabilitation services
  - Respiratory care services
  - Dialysis providers
  - Endoscopy

- IPC efforts/approaches must be risk stratified to the specific location of care
Risk of Therapeutic and Diagnostic Procedures and Devices

• Any interventional procedure or indwelling device increases the risk of a patient developing an infection, some key patient populations include:
  • Surgical (procedure-specific)
  • Burns
  • Dialysis
  • Geriatrics
  • Neonates
  • Pediatrics
  • Oncology and immunocompromised
  • Transplant
  • Intensive care

Recall of Equipment and Supplies

• Well-defined process is needed
  • IP is generally consultative
  • Delineate responsibility
  • Chain of command/decision-making
    • Removing a product from the shelf
    • Approving future use of a recalled product
    • Contact tracing required?

Isolation/Barrier Precautions

• Infections can be transmitted from patient to patient via HCW, visitor, shared environment, or medical equipment and devices
• Isolation precautions are a key part of a comprehensive IP Program
  • Standard precautions
    • Unidentified colonized or infected patients represent a risk
  • Transmission-based precautions
    • Droplet: 3–6 feet
    • Airborne: respirator fit test (annually), PAPRs, negative pressure rooms
    • Contact
    • Enteric: Contact, sporicidal, soap and water
    • Protective Environment
Isolation/Barrier Precautions

Standard Precautions
- **All patients, all settings, all the time**
  - Treat all blood/body fluid as if they are infectious
  - Hand hygiene
  - Gloves, gown, mask, eye protection, face shield dependent on anticipated exposure
  - Safe injection practices
  - One and only: Lancauge, 1 needle, 1 syringe, 1 time
  - Mask during lumbar puncture procedures
  - Respiratory hygiene/cough etiquette
    - Cover mouth and nose during coughing and sneezing
    - Offer a surgical mask to coughing patient
  - Hand hygiene
  - Appropriate signage
  - Educate HCW, patients, visitors

Transmission-Based Precautions: Recommended to contain highly transmissible and/or epidemiologically important agents and are based on the mode of transmission of the specific pathogen; implemented in addition to Standard Precautions.
- **Contact**: Protection against diseases transmitted by contact with the patient or the patient’s environment
  - Gown, gloves, Single room preferred
- **Droplet**: Protection against diseases transmitted by large respiratory droplets generated by coughing, sneezing, or talking
  - Mask, Single room preferred
- **Airborne**: Protection against diseases transmitted by infectious organisms that remain suspended in the air and can travel great distances due to their small size
  - NIOSH-approved N-95 or higher level respirator
  - Airborne infection isolation room (AIR) with negative pressure (6-12 air exchanges/hour directly exhausted to the outside)
- **Protective Environment**: Recommended for allogenic hematopoietic stem cell transplant recipients, primarily based on a daily absolute neutrophil count
  - Minimize dust
  - N-95 for patient during transport in the presence of active construction
  - HEPA filtration with positive pressure (12 air exchanges/hour)

Patient Placement, Transfer and Discharge
- **Patient placement**
  - Semi-private
    - Standard precautions
    - Cohorted transmission-based precautions, if like organisms
    - Shared bathroom, commode
  - Private
    - Priority for patients that have conditions that may foster transmission
- **Transfer and transport**
  - Limit transport to medically necessary purposes
  - Communication/documentation to receiving department/facility
  - Cover/contain potentially infectious body fluids
- **Discharge (to other than home)**
  - Patients on transmission-based precautions are often dealt with on a case by case basis
    - Infection risk to others
Environmental Hazards

Environment of Care (EOC)
- Patient care furniture and equipment
- Clean, free of tears
- Clean supply/storage
- Restricted, clean, no dirty/washed items
- Dirty supply/utility
  - Restricted, appropriate containers, nothing overflowing, no clean items
- Linens
  - Covered, dry, clean and dirty separate
- Sharps
  - Secured, accessible, covered
- Staff workspace
  - No food, uncovered drinks (covered drinks only in OSHA clean space)

Environmental Hazards
- Legionella (Legionnaires disease, Pontiac fever)
  - Water maintenance program
    - Hyper-heating
    - Chlorination
    - Copper-silver ionization
    - Flushing
    - Cooling towers
    - Dead legs in plumbing
- Aspergillus (Invasive Aspergillus Infections)
  - HVAC
  - Construction, dust control
  - Mold
  - Air counts/cultures
  - Severely immunocompromised

Patient Care Products and Equipment
- Identify responsible parties for all equipment and products, particularly, who are responsible for cleaning:
  - Linens
  - Trash
  - IV poles
  - Computers/electronics
  - Crash cart
  - Other mobile medical equipment
Immunizations for Patients

- Certain immunizations are required to be offered to inpatients
  - Influenza
  - Pneumococcal
- Based on State requirements

Construction and Renovation

- Infection control risk assessment and mitigation recommendations are important components of an IP Program
- IP should have knowledge of most current guidelines for design and construction
  - American Society for Healthcare Engineering (ASHE)
  - Facility Guidelines Institute/American Institute of Architects
- IP leaderships is essential in planning, construction, and acceptance phases to protect HCW, patients, visitors
- Policies and procedures addressing the expectations and responsibilities of IP, facilities, plant operations, contractors, and affected areas are important when planning and implementing projects

Construction and Renovation

- Familiarize architectural plans
- “Construction speak”
- ICRA Matrix
- Spot checks
Influx of Patients

• Incidents may be the result of nature, emerging infections, or man-made events
  • Advanced planning and practicing management plans are essential
  • Communication and coordination among organizations and individuals
• IP often called on for unique skill set that enables them to better prepare and respond
  • Basic principles of emergency management; Response interventions may vary to address specific situation
  • Includes development of a plan, education of responders, practicing, and evaluating the facility’s level of preparedness
• Should be a part of annual risk plan

Antimicrobial Stewardship

• Core Elements
  • Leadership Commitment: dedicating necessary human, financial, and information technology resources
  • Accountability: appointing a single leader responsible for program outcomes. Experience with successful programs show that a physician leader is effective
  • Drug Expertise: appointing a single pharmacist leader responsible for working to improve antibiotic use
  • Action: implementing at least one recommended action, such as systematic evaluation of ongoing treatment need after a set period of initial treatment (i.e. “antibiotic time out” after 48 hours)
  • Tracking: monitoring antibiotic prescribing and resistance patterns
  • Reporting: regular reporting information on antibiotic use and resistance to doctors, nurses, and relevant staff
  • Education: educating clinicians about resistance and optimal prescribing

A Few Quick Review Questions

And some instructions for tomorrow... then you can go unwind!!
Prevent & Control

- It is November and the IP has seen the first few cases of Influenza A in the hospital. Mrs. Senna, an 86 year old CHF patient, and Mrs. Bright, a 68 year old COPD patient were admitted to the same room on November 4th. Mrs. Bright had her Influenza swab come back positive on November 6th. What should you do?
  A. Keep the patients together on Droplet Precautions since they were both exposed to Influenza
  B. Transfer Mrs. Bright to a private room on Droplet Precautions. Assess Mrs. Senna for signs and symptoms of Influenza and notify her physician to possibly give an antiviral as prophylaxis
  C. Transfer Mrs. Bright to a private room on Droplet Precautions. Begin assessing Mrs. Senna for signs and symptoms of Influenza on November 13th
  D. Transfer Mrs. Bright to a private room on Airborne Precautions. If Mrs. Bright is given an antiviral, discontinue her precautions 24 hours after beginning the treatment

- During Influenza season, a patient comes into the ER with flu symptoms – fever, muscle aches, cough. The symptoms came on suddenly. The patient needs to be admitted to the floor. A rapid influenza test done in the ER is negative. What is the next step?
  A. Isolate the patient in Droplet Precautions and repeat the rapid test
  B. Admit the patient to the floor using only Standard Precautions. Initiate additional testing to determine the patient’s diagnosis other than influenza
  C. Isolate the patient in Droplet Precautions and obtain an order for an Influenza PCR
  D. Admit the patient to the floor using only Standard Precautions and obtain an order for an Influenza PCR

- Your facility is beginning a new procedure that has many infection prevention implications. The department asks for your assistance in developing a policy. After gathering information from the department about the procedure, your action is:
  1. Perform a literature review on the procedure
  2. Ask for input for the IP Medical Director
  3. Look for national guidelines that address the procedure
  4. Write a policy according to how the staff performs the procedure
  A. 1, 1
  B. 1, 4
  C. 1, 2, 3
  D. 2 only
Prevent & Control

- Infection Prevention and Control priorities in a disaster include all of the following except:
  A. Drinking water for employees and victims
  B. Sterilization of instruments and disinfection of equipment
  C. Maintaining ability to prepare food for employees and victims
  D. Obtaining medication from vendors not affected by disaster

Prevent & Control

- The IP is evaluating products to use for surgical hand scrubs on the OR. Which of the following characteristics are most important to evaluate?
  A. Log reduction of microorganisms, fast acting, persistence, non-irritating antimicrobial preparation, broad spectrum
  B. Log reduction of microorganisms, fast acting, lathering action, non-irritating antimicrobial preparation, broad spectrum
  C. Log reduction of microorganisms, cost effectiveness, persistence, broad spectrum
  D. Log reduction of microorganisms, fast acting, cost effectiveness, persistence

Prevent & Control

- A laryngoscope blade is an example of a:
  A. Critical item needing sterilization
  B. Semi-critical item needing HLD
  C. Semi-critical item needing intermediate level disinfection
  D. Non-critical item needing low level disinfection
Prevent & Control

• You are evaluating a new outpatient radiology facility for adherence to IP practices. What are you most interested in knowing more about?
  A. Screening patients for MDROs
  B. Processing of vaginal ultrasound probes between patients
  C. History of flooding in the building
  D. Number of pregnant HCWs who work in the facility

Prevent & Control

• To facilitate drying and to reduce microbial contamination and proliferation in an endoscope, you should:
  A. Blow dry with compressed air, rinse with tap water and hang vertically to dry
  B. Rinse with 70% ethyl or isopropyl alcohol and blow compressed air through the channel
  C. Rinse with tap water and blow compressed air through the channel
  D. Rinse with alcohol, hang vertically to dry and store in case to keep clean

Prevent & Control

• CSPD calls the IP because a new tech working in the area mistakenly released instrument trays after they had gone through a sterilizer that was malfunctioning. The error involved 26 trays that went to various operating rooms. After determining that all trays were either used or have been returned to CSPD, the first issue that needs attention is:
  A. Malfunctioning sterilizer
  B. Lack of checking trays before releasing
  C. Lack of an instrument tracking system
  D. Inadequate supervision of a new worker
Prevent & Control

• CDC has issued a Health Alert for a recall of contaminated medication compounded at a certain facility. The IP should view this Health Alert as:
  A. The highest level of importance; warrants immediate action or attention
  B. Important information; may not require immediate action
  C. Updated information; unlikely to require immediate action
  D. General information; not emergent in nature

Occupational Health

• A patient has been on the general medicine unit for 10 days. The nurse on the night shift on 9/10 notes new skin rash, consistent with shingles on the patient’s right arm and left leg. The nurse who cared for the patient on 9/7 has no immunity documented and is undergoing treatment with chemotherapy. What would you recommend?
  A. No exposure
  B. Furlough – 9/14– 9/27, administer Varicella zoster vaccine
  C. Furlough – 9/14–9/27, administer Varicella zoster immune globulin

Occupational Health

• Which of the following does not require reassignment of a pregnant healthcare worker?
  A. CMV PCR positive from CSF
  B. Pt with Parvovirus in aplastic crisis
  C. Treatment with ribavirin
  D. Rubella if HCW is not immune
Occupational Health

Which of the following statements about meningitis is false?
A. PEP is warranted for an employee who performs a lumbar puncture without a surgical mask
B. You should wait until the lab confirms Neisseria meningitidis is growing from the CSF to consider PEP
C. If the patient was on ceftriaxone for more than 24 hours, healthcare workers who contact them should not be considered exposed
D. Healthcare workers are required to wear N95 masks to care for these patients

A 93 year old woman is admitted for hip fracture. 10 days into her hospital stay, cough is documented. Four days later, a respiratory pathogen PCR is positive for pertussis. Which healthcare worker should not be given antibiotics?
A. MD who intubated her on day 12 who did not have a recent vaccine
B. MD who intubated her on day 12 that had a recent vaccine
C. The dietary worker who delivered her tray on the morning of day 13

All of the following are reasons to not complete two step TB skin testing on a new employees except:
A. Prior positive TST
B. Prior treatment for latent TB infection or TB disease
C. Documentation of a negative TST in the past 12 months
D. BCG vaccination history
Surveillance & Epi

The probability that patients with a negative test truly do not have the disease is called:
A. Sensitivity
B. Specificity
C. Positive predictive value
D. Negative predictive value

Surveillance & Epi

The IP is notified by the Nurse Manager of the Med Surg floor. The manager is upset and feels that they might need to close the 20-bed floor because all the patients have Clostridium difficile, and she feels there has been transmission from one patient to another and that the whole environment is contaminated. You:
A. Ask for a list of patients that she feels have C. diff and review the charts and lab results
B. Go to the floor and observe nursing practices
C. Close the floor
D. Arrange for each patient on the floor to have a stool specimen tested for C. diff
E. Bleach all the rooms on the floor

Surveillance & Epi

During an outbreak investigation, you want to determine whether the course is common or propagated. To do this, you would use:
A. Control chart
B. Comparison of attack rate
C. Epicurve
D. Line list
Surveillance & Epi

- Staff in Med Sur ICU is trying to follow their CLABSI rates. The ICU's SIR for CLABSI is 1.00. The Medical Director has told everyone about his ICU's low CLABSI rate. You meet with him to discuss. You tell him:
  A. Your CLABSI rate is 1 CLABSI per 1000 line days
  B. Your CLABSI rate is very low and we should publish the data
  C. Your CLABSI rate is even with the national benchmark for CLABSI. We should try to lower the rate to decrease our SIR
  D. Your CLABSI rate is even with the national benchmark for CLABSI. We should try to lower the rate to increase our SIR

Surveillance & Epi

- You're an IP at a 78-bed hospital. Your services include dialysis, cardiac cath lab, a 6-bed pediatric ward, a surgery floor, a medicine floor, one ICU, and a dermatology clinic. Surgeries performed at your hospital are: spinal surgeries (40/year), colon surgeries (190/year), and pacemakers. You have only enough resources to do surveillance for 3 indicators. You have electronic surgical denominators, but all others must be hand collected. Which two of the following indicators are the least important to be included in your surveillance plan?
  A. CAUTI in the pediatric ward
  B. CLABSI in the ICU
  C. Skin infection in the derm clinic
  D. Colon surgery SSIs
  E. Spinal surgery SSIs

End of Day 1!

Thank you for your attention and participation!! See you in the morning.
Welcome back!! How are you doing?

Day 2 Outline

- Review & Practice
- Management and Communication
- Education and Research
- Environment of Care
- Cleaning, Disinfection, Sterilization, Asepsis

Practice Questions
Occupational Health

- During an inservice program on hepatitis B vaccine, the IP is asked why some healthcare workers who received the Hep B vaccine soon after its release did not develop antibody. What is the most likely explanation for why this occurred?
  A. The vaccine may have been injected into the buttocks rather than the deltoid
  B. Healthcare workers tend to be less responsive to Hep B vaccine because of environmental exposure to blood
  C. The vaccine has been reformulated several times in the past decade, causing it to improve in its effectiveness
  D. Antibody levels wane with time

Occupational Health

- The employee health team has asked the IP to assist with personnel TB skin testing. Which of the following represents a known TB skin test conversion in a HCW?
  A. Prior tuberculin test results are not available, but current result is 16mm after 48 hours
  B. Tuberculin skin test reaction 1 year ago was 9mm, and the current results are 13mm
  C. A prior tuberculin reaction was not measured but the employee states it was dime sized. The current result is 11mm
  D. Tuberculin reaction 1 year ago was 3mm and the current result is 18mm

Occupational Health

- Which of the following diseases are preventable by immunization?
  1. Diphtheria
  2. Varicella
  3. Pertussis
  4. Cytomegalovirus
  A. 1,2,3
  B. 2,3,4
  C. 1,3,4
  D. 1,2,3,4
Prevent & Control
• Your ICU nurse manager has purchased 4 touch screen electronic tablets in which patients can use to watch movies or receive patient teaching in their beds. The manufacturer of the tablets recommends cleaning the tablets only with a dry cloth. She asks if this is ok with you. Your response is:
  A. Yes, we can follow the manufacturer’s recommendations
  B. Ask the manufacturer for other products to use on the tablets
  C. No, the tablets require disinfections between patients. Use a quaternary ammonium product to clean the tablets
  D. No, provide a clear barrier such as a plastic bag, to use for each patient when he/she uses the tablet

Prevent & Control
• You are investigating a Pertussis case at your hospital’s child care center. A 3 year old day care participant attended the center for the first time on May 2nd and 3rd. She was diagnosed with Pertussis May 4th. She has been coughing for the past week. She was only with her 3 year old class and had no interaction with other children when she was sat the center for those 2 days. What group of children should be considered for prophylaxis with immunization?
  A. Only those under 6 months. Children over 6 months would already be immunized
  B. All children in the childcare center should have their immunization status reviewed. Any child who is not up to date or whose last immunization was >2 months ago should receive immunization
  C. Children in the 3 year old class need to immunization status reviewed. Any child not up to date should be immunized, but no supplemental immunizations should be given
  D. Children and adult caregivers in the 3 year old room should receive supplemental immunization as long as it has been 4 months since their last immunization

Prevent & Control
• Temporary negative pressure rooms/areas can be developed in all of the following ways except:
  A. Choose an area as far from others as possible or use a naturally segregated area
  B. Choose an area that has no windows
  C. If walls do not enclose the isolation room/area, erect some type of enclosure
  D. Exhaust air from the isolation room/area to make it negative pressure compared to the surrounding areas
The causative organism of Creutzfeldt-Jakob disease is a:
A. Helminth
B. Rickettsia
C. Spirochete
D. Prion

Which of the following viral diseases has the shortest incubation period?
A. Rubella
B. Influenza
C. Hepatitis A
D. Hepatitis B

An emaciated homeless person is admitted with suspicion of TB. He has an upper lobe cavitary lesion and a positive PPD skin test measuring 10mm. He is placed on Airborne Precautions with negative pressure. Laboratory reports 3 positive AFB smears. The result indicates:
A. Confirmed diagnosis of TB
B. Presumptive mycobacterial infection
C. Presumptive diagnosis of TB
D. No conclusion is possible from this report
Prevent & Control

• The ER Medical Director notifies you that they have a patient with a vesicular rash that is suspect for smallpox, but it could turn out to be monkeypox or chickenpox. The patient is in a bay and has only been seen by the physician. What precautions should be taken immediately?

A. Contact and Airborne with N-95 and no one non-immune to chickenpox should go into the room. The patient needs to be in negative pressure.
B. Contact
C. Droplet
D. Airborne with N-95

Prevent & Control

• Mrs. Holzman, a 72 year old female with a sacral decubitus culture positive for VRE, is admitted to the medical surgical floor, but no private rooms are available. Which is the best roommate to cohort with Mrs. Holzman?

A. A 32 year old patient recovering from chemotherapy
B. An 86 year old patient with a new colostomy
C. A 42 year old patient with localized shingles
D. A 62 year old renal diabetic patient with a new dialysis fistula

Prevent & Control

• An ER nurse was involved in the care of a trauma patient and has blood stains on her scrub pants. The ER manager gave her a fresh pair of scrub pants to wear and asks the IP if she needs a special bag to take the pants home. Your response is:

A. The hospital has specific blood-borne pathogen bags for transporting textiles contaminated with blood or other potentially infectious materials
B. The nurse can take the pants home in a regular patient laundry bag
C. The hospital will launder the pants
D. The pants are contaminated and should be disposed of in a biohazard bag. The nurse is eligible for reimbursement for the pants by OSHA regulations
Management and Communication

Kate Gaze, MBA, MPH, CIC®, FAPIC®

CBIC Outline

- Management and Communication (13 items)
  - Key Concepts: (Effective) Management and communication:
    - Is essential to preventing and controlling HAIs
    - Involves managing structures and systems that change organizational culture and individual behaviors
    - Support sustainable improvements, encompassing responsibility, collaboration, consultation, and a broad vision to assess risks and resources
    - Fully integrates IP into the structure, systems, metrics and culture of the health care organization
Planning

• Conduct an infection risk assessment of the organization
• Develop, evaluate, and revise a mission and vision statement, goals, measureable objectives, and action plans for the IP and Control Program
• Recommend specific equipment, personnel, and resources for the IP and Control Program
• Participate in cost benefit assessments, efficacy studies and product evaluations
• Recommend changes in practice based on clinical outcomes and financial implications

Conduct Risk Assessment

• Serves as the basis for developing goals and measurable objectives
  • Crucial task
  • Foundation of your IP Plan
  • Prioritize risks
  • Effectively use resources

Mission and Vision Statements

• Vision statement – What your organization believes is the ideal
  • Understood and shared by all
  • Broad, inspiring, uplifting, easy to communicate
• Mission statement – Describes how your organization will achieve your vision
  • Concise, outcome-oriented, inclusive
Goals, Objectives and Action Plans

• Be SMART
  • Specific: Who, what, where, when, which, why
  • Measurable: Concrete criteria
  • Attainable: Realistic
  • Realistic: Willing and able
  • Timely: Grounded within a timeframe

• Take action
  • Create detailed action plans
  • Next steps
  • Responsible person/group

Equipment, Personnel and Resources

“Do you have everything you need to succeed today?”
  • Right people
  • Right equipment
  • Right support
  • Evaluate regularly

Cost Benefit Analysis, Efficacy Studies and Product Evaluations

Make the case
  • Cost savings
  • Cost avoidance
  • Reputation
  • Data-driven evaluations
Recommend Changes

- Be smart
- Be brief
- Be gone

Communication and Feedback

- Provide IP and Control findings, recommendations, annual reports, and policies and procedures to appropriate individuals, committees, departments and units
- Communicate with internal and external customers
- Collaborate with risk management/quality management in the identification and review of adverse and sentinel events
- Evaluate accreditation/regulatory issues and facilitate compliance

Provide Findings, Reports and Recommendations

- IP Committee Meetings
- Unit/Department-Specific Feedback
- Leadership Briefs

- Don’t expect them to know what a report means
  - Be sure to interpret and explain the findings
Internal and External Customers

- Who’s more important? Why?
  - Internal customers (stakeholders)
  - External customers

Collaborate with Risk and Quality

- DUH!

Accreditation and Regulatory Issues

- The Joint Commission
- Healthcare Facilities Accreditation Program
- State and local health departments
Quality/Performance Improvement and Patient Safety

- Participate in quality/performance improvement and patient safety activities related to IP and Control
- Demonstrate quality/performance improvement projects through the use of graphic tools

Participate in QI/PI activities

- Interdisciplinary teams to deploy changes and improvement
- IP is a key component to a quality-focused culture
  - Value knowledge, skills, and expertise of HCW
  - Use innovation, scientific methods, and change management
- Continuous cycle that focuses on patient clinical outcomes, customer satisfaction and service

Use Graphic Tools to Demonstrate QI/PI Projects

- Tools for your quality toolbox:
  - SWOT analysis
  - Gap analysis
  - Failure mode effects analysis
  - Ishikawa diagrams
  - Control charts
  - Pareto
  - Checklists
- Determine effectiveness and efficiency
  - Proactive approaches and retrospective analysis can further improve program quality
Stakeholder Assessment

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Strength</th>
<th>Noticeable</th>
<th>Moderate</th>
<th>Neutral</th>
<th>Weaker</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

WHAT: A tool to identify stakeholder level of current and needed support

WHY: Helps establish “landscape” of existing level of support, where the main gaps are and who might influence whom

HOW:
1. Identify stakeholders for your project. Now identify and prioritize who are the top 10-12 key stakeholders.
2. Assess current level of support with regard to desired change (+ = current, - = need to change)
3. Assess desired level of support (+ = desired) in order to successfully accomplish desired change. Identify gaps between current and desired.
4. Draw boxes indicating influence links using an arrow (→) to indicate who influences whom.
5. Use Engagement Strategy to formulate plan to close the gaps.

Engagement Strategy

<table>
<thead>
<tr>
<th>Stakeholder</th>
<th>Concerns / Interests / Wishes</th>
<th>What will be a success for them?</th>
<th>Strategy</th>
<th>Who will talk to them?</th>
<th>What will influence their thinking?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

WHAT: A tool to identify stakeholder interests and wins and subsequent Engagement Strategy

WHY: Effective influence requires that we view the situation from their perspective

HOW:
1. For each key stakeholder, determine what their concerns, interests and potential “wins” are. What are the underlying reasons they support or resist the change? What might be a benefit for them?
2. Discuss and agree on a strategy to successfully influence these stakeholders. The strategy includes who will talk to them and what they will influence their thinking.

Break Time!!

Don’t get lost...still lots of fun to have!
CBIC Outline

• Education and Research (11 items)
  • Education
    • Assess needs, develop goals and measurable objectives for preparing educational offerings
    • Prepare, present, or coordinate educational content that is appropriate for the audience
    • Provide immediate feedback, education, and/or training when lapses in practice are observed
    • Evaluate the effectiveness of education and learner outcomes (e.g., observation of practice, process measures)
    • Facilitate effective education of patients, families, and others regarding prevention and control measures
    • Implement strategies that engage the patient, family, and others in activities aimed at preventing infection
  • Research
    • Conduct a literature review
    • Critically appraise the literature
    • Facilitate incorporation of applicable research findings into practice

Key Concepts: Education and Research

• Education and Research
  • Should have a basic goal of improving job skills and competence
  • Self and learner
  • Are necessary due to health care’s complexity and rapid changes
  • Must address issues of literacy, diversity, cultural competency, cross-training and technical advances
  • Should be informed by learning theories and the educational needs of the learner, institution, and the community
  • Must be flexible and creative, when possible
Education

- Assess needs, develop goals and measurable objectives, and prepare lesson plans for educational offerings
- Apply principles of adult learning to educational strategies and delivery of educational sessions
- Prepare, present, or coordinate educational workshops, lectures, discussions, or one-on-one instruction on a variety of IPC topics
- Evaluate the effectiveness of education and learner outcomes
- Instruct patients, families and other visitors about methods to prevent and control infections

Assess Needs, Develop Goals and Measurable Objectives, and Prepare...

- Similar to IP risk assessment, program plan and goals
- Promote motivation and independent learning
- Diversity of healthcare personnel
  - Age, cultural background, ethnicity, education, learning styles
- Preparation is a key factor to success

Assess Needs, Develop Goals and Measurable Objectives, and Prepare...

- Overall educational goals for the learning program
  - General overview of what the program is intended to achieve
  - Helps you to stay focused
- Goals should:
  - Describe overall outcomes
  - Be stated in terms of learner outcomes
  - Be realistically attainable by the completion of the curriculum
  - Be stated in terms of learner knowledge, behavior, and attitudes
  - Describe real world behaviors to be used by the learner
- Example
  - The goal of this presentation is to reinforce basic infection prevention and control knowledge of the participants.
Assess Needs, Develop Goals and Measurable Objectives, and Prepare...

- Objectives are the intended results of the instructional process or activity
  - They communicate the expected results in terms of outcomes
  - Typically the basis for items within evaluation instruments
- Key words to use when developing objectives:
  - Recall: Name, define, recognize, list, identify, describe, etc.
  - Analysis: Compare, separate, design, differentiate, classify, etc.
  - Synthesis: Propose, compose, solve, organize, relate, predict, etc.
  - Application: Apply, employ, illustrate, interpret, etc.
- Example
  - By the end of this presentation, the learner will be able to:
    - Define what goals and objectives are (in relation to educational presentations)
    - Give examples of goals and objectives
    - Develop goals and objectives specific to the educational content they wish to present

Goals vs Objectives

<table>
<thead>
<tr>
<th>Goals</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>General, big picture</td>
<td>Focused</td>
</tr>
<tr>
<td>Broad</td>
<td>Specific</td>
</tr>
<tr>
<td>Teacher focused</td>
<td>Learner centered</td>
</tr>
<tr>
<td>Where we want to be</td>
<td>Steps needed to get there</td>
</tr>
<tr>
<td>Not measurable</td>
<td>Measureable</td>
</tr>
</tbody>
</table>

Adult Learning Strategies

Adult learners
- Autonomous and self-directed
- Have a foundation of life experiences and knowledge
- Goal-oriented
- Relevance-oriented
- Practical
- Show relevance to their job
- Provide immediate feedback
- Reinforce appropriate/expected behavior
- Desire respect
- Golden Rule
Variety of Learning Styles

Variety of Presentation Styles

Evaluate the Effectiveness of education and learner outcomes

- Pre/Post Evaluations
- Discussion/feedback during session
- Quiz
- Survey
- Return demonstration
- Simulation
- Observation
Instruct Patients, Family and Visitors

- Active participants in their care
- Signage
- Consistent communication
- Educational hand-outs
- Less likely to experience an adverse event

Research

- Apply critical appraisal skills to evaluate research findings
- Incorporate research findings into practice through education and consultation

Evaluate Research Findings

- Validity
  - Results obtained using sound scientific methods
  - Factors that impact the accuracy of the study
  - Study participant selection, assignment, inclusion/exclusion criteria, appropriateness of statistical tests used
  - Confounding variables appropriately controlled (e.g., age, gender, type of diet)
- Reliability
  - Findings repeatable
  - Probability of similar results if study was repeated using the same methods in a similar patient population
- Applicability
  - Results appropriate for your particular practice setting
  - Address an important topic in IP practice
- Critical Appraisal of Scientific Articles (du Preul, 2009)
Incorporate Research Findings

• Implementation Science – promoting the uptake of research findings into routine health care in clinical, organizational, and policy contexts
  • Start small
  • Get support and buy in
  • Use the evidence
  • Innovation and flexibility

Environment of Care
Kathleen McMullen, MPH, CIC®, FAPIC

CBIC Outline

• Environment of Care (14 items)
  • Recognize and monitor elements important for a safe care environment (e.g., Heating-Ventilation-Air Conditioning, water standards, construction)
  • Assess infection risks of design, construction, and renovation that impact patient care settings
  • Provide recommendations to reduce the risk of infection as part of the design, construction, and renovation process
  • Collaborate on the evaluation and monitoring of environmental cleaning and disinfection practices and technologies
  • Collaborate with others to select and evaluate environmental disinfectant products
Educational Outline

- Construction and Renovation
- Environmental Services
- Laundry, Linens, etc
- Waste Management
- Maintenance, Engineering and HVAC
- Water and Legionella

IP Role in Project Design Phase

- Involvement with facility management staff during the beginning design phase is key to identifying necessary support structures required to prevent HAI
- Review current and future patient populations and care delivery systems
- Determination of impact on infection prevention and control program aspects based on scope of project
- Determination of environmental monitoring needs and budgeting for appropriate consultants
- Determination of type and methods of educational provisions for internal and external contractors
Surfaces and Furnishings

- Floor coverings
  - Durable
  - Avoid carpeting in patient care areas
- Wipeable/washable surfaces
  - Walls
  - Furniture
  - Horizontal surfaces
  - Consider antimicrobial such as copper?
- Textiles
  - Easy to change
- Number and location of Airborne Isolation Rooms

IP Role in Construction/Renovation Phase

- Project teams provide ongoing planning and monitoring during area preparation
  - Demolition
  - Construction
  - Cleanup
  - Preparation for return to service
  - Final project review
- Focus should be on isolating the construction/renovation area

Infection Control Risk Assessment (ICRA)

- An ICRA must guide a strategic, proactive design to mitigate environmental sources of microbes and to prevent infectious hazards through architectural design
- Committee includes representatives from:
  - Infection control
  - Direct patient care
  - Risk management
  - Facility design
  - Construction
  - Ventilation
  - Safety
Infection Control Risk Assessment

• Risk Assessments need to be done with each project
  • Identify the type of job and duration of project
  • Identify the location and patient populations involved
  • Determine which infection prevention measures are necessary to manage risk
• Many different version of ICRA are available

Identify Type of Job, Duration of Project

<table>
<thead>
<tr>
<th>Work Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work Type A</td>
<td>Inspection and non-invasive activities, involving no dust, including but is not limited to:</td>
</tr>
<tr>
<td></td>
<td>· Painting (but not sanding)</td>
</tr>
<tr>
<td></td>
<td>· Electrical trim work and activities which do not generate dust or require cutting of walls or access to ceiling for visual inspection</td>
</tr>
<tr>
<td>Work Type B</td>
<td>Small scale, short duration activities which create minimal dust, including but not limited to:</td>
</tr>
<tr>
<td></td>
<td>· Minor plumbing</td>
</tr>
<tr>
<td></td>
<td>· Removal of ceiling tiles for visual inspection</td>
</tr>
<tr>
<td></td>
<td>· Installation of telephone and computer cabling using existing “J” hooks or wire trays</td>
</tr>
<tr>
<td></td>
<td>· Removal of ≤ 5 floor tiles or carpet squares</td>
</tr>
<tr>
<td></td>
<td>· Access to chase spaces</td>
</tr>
<tr>
<td></td>
<td>· Cutting a small area of a wall where dust migration can be controlled such as within a closed chase space or use of a hepa vac while cutting</td>
</tr>
<tr>
<td>Work Type C</td>
<td>Typically large scale, longer duration activity (e.g. &gt; one work shift) that generates a moderate to high level of dust, requires demolition or removal of any fixed building components, including but not limited to:</td>
</tr>
<tr>
<td></td>
<td>· Sanding walls</td>
</tr>
<tr>
<td></td>
<td>· Removal &gt; 5 floor tiles or carpet squares or removal of casework</td>
</tr>
<tr>
<td></td>
<td>· Any work above ceilings including J Hook or wire tray installation</td>
</tr>
<tr>
<td></td>
<td>· Major cabling activities</td>
</tr>
<tr>
<td></td>
<td>· Major demolition</td>
</tr>
<tr>
<td></td>
<td>· Wall covering or cove base removal</td>
</tr>
<tr>
<td></td>
<td>· New construction</td>
</tr>
</tbody>
</table>

Identify Location and Patients Involved

<table>
<thead>
<tr>
<th>Patient/Location Group 1</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Admitting</td>
<td></td>
</tr>
<tr>
<td>Main lobby areas, common hallways</td>
<td></td>
</tr>
<tr>
<td>Radiation oncology</td>
<td></td>
</tr>
<tr>
<td>Respiratory Therapy</td>
<td></td>
</tr>
<tr>
<td>Therapy Services</td>
<td></td>
</tr>
<tr>
<td>Pharmacy, main and all satellites</td>
<td></td>
</tr>
<tr>
<td>Wound center</td>
<td></td>
</tr>
<tr>
<td>Ultrasound</td>
<td></td>
</tr>
<tr>
<td>Special Care Nurseries (level 2 or &gt;)</td>
<td></td>
</tr>
<tr>
<td>Kitchen, cafeteria</td>
<td></td>
</tr>
<tr>
<td>Pre and post op areas</td>
<td></td>
</tr>
<tr>
<td>Operating Room (including C-section rooms)</td>
<td></td>
</tr>
<tr>
<td>Radiology/MRI, CT</td>
<td></td>
</tr>
<tr>
<td>Pain Management Clinic</td>
<td></td>
</tr>
<tr>
<td>Cancer clinics, including chemo centers, transplant</td>
<td></td>
</tr>
<tr>
<td>Outpatient clinics, offices</td>
<td></td>
</tr>
<tr>
<td>Well baby nurseries</td>
<td></td>
</tr>
<tr>
<td>Dialysis Units</td>
<td></td>
</tr>
<tr>
<td>Pulmonary function transplant clinics</td>
<td></td>
</tr>
<tr>
<td>Pediatrics</td>
<td></td>
</tr>
<tr>
<td>Inpatient Oncology area</td>
<td></td>
</tr>
<tr>
<td>Endoscopy suites</td>
<td></td>
</tr>
<tr>
<td>Emergency Department</td>
<td></td>
</tr>
<tr>
<td>Interventional Radiology/Cardiac Cath Lab</td>
<td></td>
</tr>
<tr>
<td>Nuclear Medicine</td>
<td></td>
</tr>
<tr>
<td>Labor and Delivery</td>
<td></td>
</tr>
<tr>
<td>Central Sterile Processing</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Patient/Location Group 2</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiology</td>
<td></td>
</tr>
<tr>
<td>All inpatient areas EXCEPT adult &amp; pediatric oncology, and bone marrow transplant units</td>
<td></td>
</tr>
<tr>
<td>Radiation oncology</td>
<td></td>
</tr>
<tr>
<td>Echocardiography</td>
<td></td>
</tr>
<tr>
<td>Intensive Care Units</td>
<td></td>
</tr>
<tr>
<td>Pain Management Clinic</td>
<td></td>
</tr>
<tr>
<td>Cancer clinics, including chemo centers, transplant</td>
<td></td>
</tr>
<tr>
<td>Outpatient clinics, offices</td>
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</tr>
<tr>
<td>Well baby nurseries</td>
<td></td>
</tr>
<tr>
<td>Dialysis Units</td>
<td></td>
</tr>
<tr>
<td>Pulmonary function transplant clinics</td>
<td></td>
</tr>
</tbody>
</table>
Risk Management – Low Risk Projects

• Close doors to patient rooms or offices near work
• Doors closed to supply areas or cover clean supplies tightly; store supplies away from where work is performed
• Linen carts covered or moved away from where work is performed
• Cover office furniture, counters and equipment with plastic; protect personal belongings as appropriate

Risk Management – Medium Risk Projects

• Infection Prevention Specialist consulted well ahead of start of project
• Project superintendent to check in with department leader at the beginning of each shift
• Use methods to minimize migration of dust, other contaminants and or aerosolization of water:
  • Working within a cube; misting of ceiling surface with water (with or without bleach), appropriate plastic barrier, use of Hepa vac, while cutting, etc
  • Mist carpet tiles before removal
• No patients present in active work area
• Debris removed in covered containers via designated route
• Ceiling tiles replaced ASAP and must be closed if unattended
• Walk off sticky mats.
• Clean work site at end of workday

Risk Management – High Risk Projects

• Barriers constructed and inspected by IP prior to beginning work
• Masks for short projects, hard hats for longer projects
• Maintain negative air flow within construction site
• Cap off air supply if necessary to achieve negative pressure
• Check air flow and/or cap off air supply to maintain negative pressure (at least daily or more frequently if necessary)
• Site and equipment for negative pressure
• Check air flow and/or cap off air supply to maintain negative pressure
• Return air vents blocked or sealed before beginning work
• Workers to remove dust from clothing prior to entering any hospital areas; e.g. sticky mats, wet mats, vacuum clothing, don clean clothing or remove coveralls and shoe coverings
• Keep work area clean e.g. wet mop or Hepa vac frequently
• Assess location of air intakes for outdoor projects and/or projects where work is being done < 75 ft from intakes
• Partner with EH&S to determine if air sampling (e.g. particle counts) is required during the project
Monitor Compliance with ICRA

- Routine visual observations
  - Multidisciplinary group at routine, arranged times
  - Random drop-ins

Environmental Services
Cleaning Principles

• Routine cleaning is necessary to decrease bioburden
• High-touch surfaces most frequent
  • Medical equipment knobs or handles
  • Blood pressure cuffs
  • Bedrails
  • Handheld television controls
• Establish written policies and procedures
  • Include a multidisciplinary team
• Develop performance improvement activities to measure the effectiveness of cleaning program

Typical Environmental Cleaning Agents

• Quaternary ammonium compounds (quats)
• Bleach
• Hydrogen peroxide solutions
• Phenolics

Quaternary ammonium compounds

• Most frequently selected for cleaning environmental surfaces
• Active against most bacteria
  • Not sporcidal
  • Not tuberculocidal
  • Not virucidal against hydrophilic (nonenveloped) viruses
• Inexpensive
• Gentle to most surfaces
• Can be combined with alcohol for quicker kill times
Bleach/Chloride

- Active against most bacteria, including spores
- Cons
  - Irritant to eyes and mucous membranes
  - Corrosive to metals and some plastics
  - Discoloration
- Generally used for C. difficile and norovirus cleaning
  - 1:10 dilution of household bleach to clean units with high endemic rates of CDI and during outbreaks of CDI
  - For norovirus, high-touch surfaces cleaned and disinfected at least three times per day and that low-touch surfaces be cleaned at least twice a day

Other cleaners

- Hydrogen peroxide solutions
  - Great germicidal activity against wide variety of organisms
  - Quick acting - bactericidal and virucidal within 30 to 60 seconds
  - Non-toxic
  - Unstable, short shelf life without stabilization
- Phenolics
  - Originally used by Joseph Lister
  - Similar effectiveness to quats
  - Fallen out of favor due to association with hyperbilirubinemia in newborns

Other Comments about Cleaners

- Mycobacterium tuberculosis - innately more resistant to disinfectants than most microorganisms
  - EPA registered tuberculocidal disinfectant may require 5- to 10-minute contact time to be effective
  - Although contact transmission isn’t typical spread, TB kill time is considered effective for all organisms (typical quoted kill time)
- Multidrug-resistant organisms
  - MDROs have not developed resistance to disinfectants, so no single disinfectant has been specified for use on MDROs
- Floors
  - Neutral cleaners or detergents are frequently used for flooring
Inpatient Rooms

- **Cleaning Schedules**
  - Facilities should develop written cleaning schedules to meet the needs of each area being serviced.

- **Cleaning to be performed and when the patient is discharged includes:**
  - High dusting
  - Spot cleaning of walls, windows and doors
  - Close attention should be paid to cleaning frequently handled medical equipment

- **The same daily cleaning procedures should be followed for isolation and non-isolation rooms**
  - After use in an isolation room, cleaning equipment (water and bucket, cleaning cloths, mop head) should be discarded or disinfected before use in another room
  - Only clean equipment should be used in rooms of patients who are immunocompromised

Operating Rooms/ASC

- The operating room suite should have dedicated cleaning tools
  - EVS staff should use disinfectants that are EPA-registered as effective against HBV and HIV
  - Sodium hypochlorite is not recommended for routine use because it can cause pitting of metal and some other surfaces
  - Alcohol is not recommended for damp dusting large environmental surfaces because it dries too quickly

- There are three distinct cleaning times for operating rooms:
  - Before the first case of the day
  - Between cases
  - End of the day

Procedure Rooms

- Procedure rooms are cleaned and disinfected in a similar manner to operating rooms
- After each case, all horizontal surfaces and shields should be cleaned and disinfected
- Floors may be spot cleaned unless more extensive decontamination is necessary
- At the end of each day, all surfaces and the floor should be thoroughly cleaned and disinfected
- Walls should be cleaned on a routine schedule and as needed
Examination Rooms

• After each patient
  • Linen or paper on the examination table must be changed or discarded
  • Wipe down with disinfectant
  • Patient care equipment such as blood pressure cuffs
  • Horizontal surfaces must be wiped with a disinfectant
  • Walls and floors should be spot cleaned as needed
• At the end of each day
  • Horizontal surfaces and the entire floor must be thoroughly cleaned and disinfected
  • Waste containers must be emptied

Specialty Areas

• Nurseries
  • Focus on bassinets, incubators, scales and other specialized equipment
  • Avoid phenolics
• Dialysis
  • Pay critical attention to machine cleaning
  • Environmental surfaces follow procedure room guidelines
• Clinical laboratories
  • Countertops must be decontaminated after each shift and whenever spills occur.
  • Both biohazardous and non-biohazardous wastes must be collected at least daily
  • Floors must be cleaned and disinfected daily

Blood and Body fluid Clean Up

• Nonporous surface: 1:100 dilution of household bleach (one part household bleach plus 99 parts tap water or ¼ cup of bleach in a gallon of water) is a highly effective disinfectant and is the least expensive
• Porous surface: 1:10 dilution of household bleach (one part household bleach plus nine parts water or 1 ½ cups of bleach in a gallon of water) is required
Bed Bugs

- Indications of bed bugs include
  - Bites on the individual (some individuals do not react to the bites)
  - Fecal stains (rusty-colored blood spots due to blood-filled fecal excretions)
- Bed bugs can survive for a year without feeding
- If bed bugs are suspected
  - Personal belongings should be placed in plastic bags that are tied securely closed or in other sealed containers
  - HCP should wear protective gowns and gloves while providing care and when decontaminating infested areas
- When notified about bed bugs, EVS may assist with containment procedures and will contact the facility exterminator
  - Apply insecticide
  - Treat the room with high heat (118°F or 48°C for one hour)
  - Specially trained dogs may also be used to detect infested areas

Evaluating Effectiveness of Cleaning

- Visual Inspection
  - EVS personnel and their supervisors should inspect their completed work to ensure that visible evidence verifies that basic cleaning has been done
- ATP Bioluminescence Test
  - In this method, swabs of environmental surfaces are placed in reagent and the amount of light is read by the bioluminometer
  - If the fluorescent mark is visible under a UV light after the surface is cleaned, the surface requires recleaning
- Fluorescent Markers
- Cultures
  - Quantitative environmental cultures (swabs, Rodac plates) have been used as markers of thorough cleaning; less than 2.5 cfu/cm² is considered acceptable
  - Most reliable and most expensive method of evaluation

Laundry, Linens, etc
Healthcare Textiles

- Patient bed linens
  - Bed sheets
  - Pillowcases
  - Blankets
- Patient use linens
  - Towels
  - Washcloths
- Surgical Scrubs

Soiled Health Care Textiles

- Handling, Collection, and Transportation must be in accordance with OSHA regulations and federal guidelines
- Soiled health care textiles must be assumed to be contaminated
- Soiled textiles must not be sorted or rinsed in patient-care areas
- Containers must be leak-proof, capable of being closed securely to prevent textiles from falling out and not tear when loaded to capacity
- Bags or other containers must be color-coded or labeled
- Functional separation of clean from soiled textiles in carts
- Standard precautions must be observed while moving, loading and unloading soiled textiles

Laundry Facility Environment

- Negative air pressure in soiled areas
- Working surfaces must be kept clean of visible soil, dust and lint
- Must be free of vermin, cardboard and without obvious moisture contamination
- Hand hygiene resources must be available
- Safety of environment
  - Emergency eyewash/shower equipment
  - Safety features (e.g., emergency lighting, signage, fire alarms, door accessibility and egress, safety perimeter for robotics, equipment guards) must be evident and operational
  - A written regulated medical waste management plan
Washing, Extraction and Drying

- Three basic types of washing equipment for processing of health care textiles:
  - Washers
  - Washer/extractors
  - Continuous batch washers
- The load size (weight) for each classification of soil shall be established by the facility and recorded for each load processed
- Cycle time: prewash, wash, rinse and final rinse times
- Water levels/usage (total water usage and/or water levels)
- Temperature (wash cycle, bleach cycle and rinse cycle temperatures)
- Chemical usage (chemical types and usage levels for each step in the wash process)
- The wash cycle shall comply with all applicable state and local requirements for health care textile processing

The Laundering Process

- Antimicrobial action of the laundering process results from a combination of mechanical, thermal and chemical factors
  - Substantial numbers of microorganisms removed through the process of dilution and agitation
  - Soaps and detergents function to suspend soil and exert microbiocidal properties
  - Hot water also provides an effective means of destroying organisms
  - A temperature of at least 160°F (71°C) for a minimum of 25 minutes is recommended for hot-water washing
  - Low-temperature washing at 71°F to 77°F (22°C to 25°C) plus a 125-part-per-million (ppm) chlorine bleach rinse has been found to be effective, comparable to high-temperature wash cycles

Packaging and Clean Storage

- While unwrapped
  - Stored in traffic-controlled clean room
  - Limit access to room
  - Door should remain closed
  - During packaging, textiles handled as little as possible to prevent soiling or contamination
  - Reprocess any textiles that become contaminated during packaging
- Small bundles
  - Wrapped into fluid-resistant
  - Can be stored on open racks
- Large amounts/carts or hampers
  - Items can be unwrapped if fluid-resistant cover on carts or hampers
  - Cart should have a solid bottom
- Remain covered at all times until delivered
Infectious Waste Categories

• Contaminated Sharps
  • Properly placed into appropriate rigid, puncture-resistant containers, the environmental risk they pose is negligible

• Blood and Blood Products
  • Small amounts of these materials dried on dressings represent an insignificant hazard once they are properly contained
  • Bulk blood, blood-tinged suctioned fluids, excretions and secretions
    • These fluids may be carefully poured down a drain connected to a sanitary sewer that is designed for the disposal of human waste
    • Personnel must follow universal/standard precautions

• Pathology Wastes
  • Pathology wastes include human tissues and body parts that are collected at autopsy or during surgery
  • Incineration or grinding and discharging into a sanitary sewer are the common acceptable methods of treating this waste

“Infectious Waste” Management Plan

• Designation
• Segregation
• Packaging
• Storage
• Transport
• Treatment
• Contingency Planning
• Training
Maintenance, Engineering and HVAC

Responsibilities of the Department

- Equipment repair and maintenance
- System maintenance and repair
- Heating, ventilation and air conditioning (HVAC) systems
- Utility systems management
- Medical gas systems including oxygen, medical air, nitrogen and medical vacuum, as well as piped anesthesia gases
- Potable water and wastewater systems
- Boiler, steam and hot water systems
- Pager and communication systems
- Facility infrastructure maintenance and repair
- Grounds and landscaping
- Building renovations and alterations

Surface and Finish Risks

- Deterioration and damage to surfaces and finishes
  - Replace or repair damaged structural surfaces
  - Ensure surfaces, materials and furnishings used for new construction and renovation projects is durable and repairable
Plumbing Supply and Drainage Systems Risks

• Nonfunctional or improperly functioning hand-washing facilities
• Drainage pipes (clogs, etc)
  • Backflow, flooding or backsplash may cause environmental contamination of surfaces, supplies or equipment
• Ensure effective clean-up of floods or water leaks
  • Use a moisture meter for objective evaluation of wet materials
  • Replace/repair wet ceiling tiles, drywall or other surfaces that cannot be dried within 72 hours
  • Replace all materials that have been wetted with unclean (gray or brown) water

Steam Supply System Risks

• Inadequate functioning of steam sterilizers resulting in insufficient sterilization of medical instruments and devices
  • Monitor pressure of supplied steam
  • Develop communication protocols with affected departments for problems
  • Schedule regular maintenance of equipment, document preventive maintenance and document repairs
• Incomplete sanitation of cookware, dinnerware, utensils
• Faulty humidification systems can cause spraying of condensate or steam on filters, leading to compromised filtration efficacy
• Faulty pressure relief can cause leaking from steam debris that can create ideal conditions for mold growth

HVAC Systems

• Guidelines, recommendations, and standards related to HVAC systems include:
  • American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE)
  • The CDC and its federal research agency, the National Institute for Occupational Safety and Health (NIOSH)
  • National Fire Protection Association (NFPA)
  • The Centers for Medicare & Medicaid Services (CMS) Conditions of Participation for Medicare and Medicaid (CoP)
  • State authorities having jurisdiction (AHJs)
  • Occupational Safety and Health Administration (OSHA)
  • Environmental Protection Agency (EPA)
  • Voluntary accreditation agencies: for example, TJC, American Osteopathic Association (AOA), and the National Committee for Quality Assurance (NCQA)
Air Pressurization and Balancing

- Pressure relationships with respect to the surrounding area or corridor is dependent on the patient care or processes in the area
  - Positive (excess air supply in the room) – used in procedural areas, to protect extremely immunocompromised patients
  - Negative (air drawn into the room) – used for certain infectious disease isolation (such as TB), for soiled processing
  - Neutral – used for most general patient care areas

Air Pressure Testing

- Air pressure testing includes
  - Qualitative tests (e.g., smoke trails, electronic meters, tissue test)
  - Visual observation of movement
  - Quantitative methods (Built-in pressure manometers)
    - Differential pressure should be a minimum of 0.01 inch water gauge or 2.5 Pascals (Pa)
- Frequency of monitoring
  - In general, monthly checks of rooms is sufficient
  - NPV for tuberculosis: OSHA directives require facilities follow CDC TB Guidelines which specify
    - Daily verification and documentation in use
    - Monthly checks of rooms when not in use

Airborne Isolation Rooms

- Must have
  - Dedicated for negative pressure only (older construction may have rooms that switch back and forth)
  - Exhaust to the outside (preferably in a very short manner)
  - 12 air exchanges per hour
- Nice to have
  - Audible alarm when not negative
  - Anteroom
Air Filtration

• Pre-filters are used before fans to remove gross particulate matter (minimum efficiency 30 percent)
• Filters that are 85 to 90 percent efficient are placed downstream of the fans after the pre-filters. This combination typically provides an overall filtration of 95 percent efficiency
• HEPA filtration is defined as filtration with efficiency of 99.97 percent in removing particles 0.3 micron or more in size
  • Airborne infectious microorganisms fall into a range of 0.3 to 5.0 microns
• Filters that are 90 percent efficient as measured by industry standards remove sufficient particulate matter to meet minimum OR standards

Distribution and Diffusion of Air

• Airflow supply and exhaust should be controlled to ensure movement of air from “clean” to “less clean” areas, especially in critical areas
• Cleaned, filtered air (supply) is typically distributed by directing airflow into the room from ceiling outlets near the center of the work area and moving to the periphery
• Return air (exhaust) should be near floor level
• Laminar airflow (LAF) refers to a directional flow of air with little to no turbulence
  • Vertically
  • Horizontally

System for Rating Filters

• Based on the size of particle or contaminant to be filtered
• This measure of “minimum efficiency reporting values” (MERV) uses a scale of 1 through 16
  • 30 percent efficient filter equates to MERV 8
  • 80 percent is equivalent to MERV 13
  • 90 to 95 percent equates to MERV 14
  • 95 percent equals MERV 15
Air Source

- Fresh air intakes should be located at least 25 feet (7.62 meters) from exhaust outlets of ventilation systems.
- The bottom of outdoor air intakes serving central systems should be as high as practical but at least 6 feet (1.83 meters) above ground level or, if above the roof, 3 feet (91 cm) above the roof level.
- Exhaust outlets from contaminated areas should be above the roof level and arranged to minimize recirculation of exhausted air back into the building.
- New construction and major renovation:
  - Air supply for operating and delivery rooms should be from ceiling outlets near the center of the work area.
  - Returns (at least two, and as far apart as feasible) should be near the floor level.
  - Supply for nurseries, labor/delivery/recovery/postpartum (LDRP) rooms, as well as rooms used for invasive procedures, should also be near the ceiling, with returns near the floor level.
  - Exhaust grills (returns) for anesthesia evacuation or special applications may be installed in the ceiling.

HVAC Systems Risks

- Airborne transmission of potentially infectious organisms such as fungal spores.
- Ensure appropriate filter maintenance and changes.
- Out of range temperature and/or humidity levels.
- Provide systems for monitoring of critical elements related to HVAC control.
- Inappropriate pressure relationships.
- Schedule preventive maintenance to include regular cleaning of air intakes, supply/exhaust/return vents, ducts and cooling towers.

Interventions

- Evaluate HVAC and local area exhaust systems.
- Procedures are established and followed.
- Schedule preventive maintenance.
Environmental Sources of Water-Associated Infectious Agents

- Important water reservoirs for these organisms include:
  - Potable water systems
  - Cooling towers
  - Flush sinks
  - Faucet aerators
  - Hoppers
  - Toilets
  - Eyewash
  - Drench shower stations
  - Chests/ice machines
  - Water baths used to thaw or warm blood products and other liquid
  - Whirlpool or spa-like baths

Water Distribution Systems, Cooling Towers and Environmental Surfaces

- Sources of aerosolized water, especially cooling towers, can promote the growth and dispersion of Legionella
- Excessive moisture around pipes and insulation, condensation in drain pans and flooding from broken pipes can lead to extensive environmental fungal contamination
- Static (stagnant) water systems can serve as reservoirs of organisms in the healthcare environment by supporting bacterial growth
Water Distribution Systems, Cooling Towers and Environmental Surfaces

- Decorative Water Fountains, Water Walls
  - Aerosolize waterborne pathogens
  - Include filtration and/or water treatment, don’t have areas where water stagnates

- Sinks, Flushing Rim Sinks, Hoppers and Toilets
  - Splashing contaminated water onto patients, supplies, equipment
  - Locate them away from patient, locate items away from sink, increase sink depth
  - Aerators are not recommended

- Stationary and Portable Eyewash/Drench Shower Stations
  - Eyewash/shower stations may go unused for months and pose a possibility of contamination
  - OSHA recommends flushing the system for a 3-minute period each week

- Ice Storage Chests and Ice Machines
  - Contaminated ice and ice machines have been implicated as sources of infection, though such reports are not common

- Water Baths and Related Devices
  - Water baths and related devices are used to warm blood or blood products (e.g., cryoprecipitate, fresh frozen plasma) and other liquids, such as intravenous solutions or peritoneal dialysect

- Pools, whirlpools, hot tubs and physiotherapy tanks
  - Microbial contamination may involve the drains and agitators

Potable Water Supply System

- Water delivery systems should be designed to supply water at sufficient pressure to operate all fixtures and equipment during maximum demand
- Water-service mains, branch mains and other main waterlines should have stop (isolation) valves for each fixture
- Vacuum breakers should be installed on faucets
- Approved backflow preventers (i.e., anti-siphon devices) protect water supply systems from contamination in high-risk areas such as dialysis units
- Floor drains should be avoided as much as possible and specifically should not be in operating or delivery rooms, with the exception of dedicated cystoscopic rooms
- Drainage piping should not be installed in ceilings or exposed in operating and delivery rooms, nurseries or other sensitive areas
Water Temperature Specifications

• Temperature measured at the point of use or inlet to the equipment
• Eater temperature for showers and bathing should be appropriate for comfortable use
  • 2010 FGI Guidelines temperature range between 105°F (41°C) and 120°F (49°C).
  • The CDC recommends temperatures at 124°F (51°C) or higher and cold water temperatures at 68°F (20°C) to control Legionella
    • Legionella prefer to grow between 77.5°F and 100°F.
    • Concerns with scalding move many building codes to limit hot water temperature to 120°F (as with the FGI Guidelines).

References

• APIC Text of Infection Control and Epidemiology 2014
• Guidelines for Preventing the Transmission of Mycobacterium tuberculosis in Health-Care Settings, 2005: http://www.cdc.gov/mmwr/preview/mmwrhtml/rr5417a1.htm?pdf=r5417a1_e

Lunch Time!!
Nourish the soul!
Cleaning, Sterilization, Disinfection, Asepsis

Tania Bubb, PhD, RN, CIC®, FAAPIC

CBIC Outline

• Cleaning, Sterilization, Disinfection, Asepsis (15 items)
  • Identify and evaluate appropriate cleaning, sterilization and disinfection practices
  • Collaborate with others to assess products under evaluation for their ability to be reprocessed
  • Identify and evaluate critical steps of cleaning, high level disinfection, and sterilization

Identify and evaluate critical steps of cleaning, disinfection and sterilization practices
Spaulding’s Classification

**Critical**
- Items that enter sterile tissue or the vascular system
  - Surgical instruments
  - Cardiac and urinary catheters
  - Implants
  - Ostomy devices used in sterile body cavities

**Semicritical**
- Items in contact with mucous membranes or non-intact skin
  - Respiratory therapy and anesthesia equipment
    - Bronchoscopes, laryngoscopes, esophageal manometry probes
    - Vaginal and rectal probes
- Require high level disinfection - chemical disinfectants
  - Respiratory therapy and anesthesia equipment
    - Bronchoscopes, laryngoscopes, esophageal manometry probes
    - Vaginal and rectal probes

**Noncritical**
- Items used on intact skin - bedpans, blood pressure cuffs, crutches, bed rails, linen, bedside tables, patient furniture, floors
- Between patient cleaning
- Items in contact with mucous membranes or non-intact skin
  - Gastrointestinal endoscopes, bronchoscopes, laryngoscopes
  - Esophageal manometry probes
  - Prostate biopsy probes
- Require high level disinfection - high-level sterilants
  - Gastrointestinal endoscopes, bronchoscopes, laryngoscopes
  - Esophageal manometry probes
  - Prostate biopsy probes
- Items that enter sterile tissue or the vascular system
  - Surgical instruments
  - Cardiac and urinary catheters
  - Implants

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**Types of Disinfectants/Sterilants**

<table>
<thead>
<tr>
<th>Low/intermediate-level</th>
<th>High-level*</th>
<th>Sterilants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quaternary-ammonium compound</td>
<td>Glutaraldehyde</td>
<td>Steam sterilization</td>
</tr>
<tr>
<td>Hydrogen peroxide</td>
<td>Hydrogen peroxide</td>
<td>Ethylene oxide (ETO)</td>
</tr>
<tr>
<td>Bleach</td>
<td>Ortho-phthalaldehyde</td>
<td>Hydrogen peroxide gas plasma</td>
</tr>
<tr>
<td>Peroxycetic acid with hydrogen peroxide</td>
<td>Ozone</td>
<td></td>
</tr>
<tr>
<td>Improved hydrogen peroxide</td>
<td>Vaporized hydrogen peroxide</td>
<td></td>
</tr>
<tr>
<td>Chlorine-based products</td>
<td>Liquid chemical sterilants</td>
<td></td>
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</tbody>
</table>

*The exposure time for most high-level disinfectants varies from eight to 45 minutes at 20° to 25°C.

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**Clean**
- Minimize the transmission of microorganisms using:
  - Sterile gloves, gowns, drapes
  - Masks
  - Surgical aseptic practices that use clean and disinfected or sterile equipment and supplies to reduce the numbers of microorganisms and minimize the risk of transmission from personnel or the environment to the patient.

**Aseptic**
- Hand hygiene, skin antisepsis, appropriate use of sterile or clean devices, supplies and equipment, and environmental cleaning and disinfection.

**Sterile**
- Ventilation, temperature, humidity controls sterile environments.

**Surgical Aseptic**
- Operative physical barriers such as screens
  - Proper ventilation/temperature and humidity control
  - Controlled/restricted access
  - Appropriate attire
  - Use OR or procedure room if possible
  - Limit personnel, traffic and other activity
  - Doors closed during procedures
  - Eliminate patient housing.
Attire

- Appropriate attire is based on the risk of the procedure and the area of the hospital where the procedure is performed
  - Scrubs are not considered personal protective equipment (PPE)
  - Face and eye protection should be worn if there is a potential for splashing or exposure to body fluids
  - Sterile gowns are required for procedures such as insertion of central lines
  - Freshly laundered scrubs
  - Head and facial hair covering and clean shoes
  - Masks should be worn in restricted areas when open sterile supplies and equipment are present

Hand Hygiene

- Hand decontamination
- Surgical scrub
  - Long natural fingernails, artificial fingernails or any fingernail enhancements should not be worn

Identify and evaluate appropriate cleaning, sterilization and disinfection practices

- Cleaning
  - Removal of foreign material
  - Required before high-level disinfection and sterilization
  - Dried or baked foreign material on instruments makes disinfection or sterilization process become less effective or ineffective
  - IMPORTANT to Presoak!
    - Enzymatic cleaners
Identify and evaluate appropriate cleaning, sterilization and disinfection practices

- High-level Disinfection
  - The Joint Commission Booster Pak, https://www.jointcommission.org/assets/1/6/TJC_HLD_BoosterPak.pdf
  
  1. Pre-cleaning
  2. Manual Cleaning
  3. Rinse
  4. Disinfectant
  5. Rinse
  6. Drying
  7. Storage
  - Follow manufacturer’s recommendations!

Flexible Scope Cleaning Overview

- Mechanically clean internal and external surfaces, including brushing internal channels and flushing each internal channel with water and an enzymatic cleaner

- Immerse endoscope in high-level disinfectant (or chemical sterilant) and perfuse (eliminates air pockets and ensures contact of the germicide with the internal channels) disinfectant into all accessible channels such as the suction/biopsy channel and air/water channel and expose for a time recommended for specific products.

- Rinse the endoscope and all channels with sterile water, filtered water (commonly used with automated endoscope reprocessors) or tap water

- Rinse the insertion tube and inner channels with alcohol and dry with forced air after disinfection and before storage

- Store the endoscope in a way that prevents recontamination and promotes drying (e.g., hanging vertically)

Ultrasonic Cleaners

- High-frequency sound waves to remove particles

- Fine cleaning
  - Used only after gross soil has been removed
  - Cleaning solution should be changed before it becomes heavily soiled

- Thorough rinsing follows to dislodge particles
Automatic Endoscope Reprocessors (AER)

- This equipment is designed to clean and chemically disinfect the scope.
- Not all units have a washing cycle and it should be determined if manual cleaning is required before use.
- Scopes should be rinsed with isopropyl alcohol, dried with air under pressure and hung in a storage cabinet so the tip does not touch the bottom of the cabinet.
- The minimum recommended concentration (MRC) or minimum effective concentration (MEC) of the chemical disinfectant should be tested before each use to ensure that the concentration of the active ingredient is adequate.
- Printout should be checked at the beginning and end of the cycle to verify that cycle parameters were met, and the printout should be initialed.

Washer-Disinfectors and Decontaminators

- Used for cleaning and intermediate-level disinfection.
- Dispense an enzyme and detergent.
  - Water temperature up to 180 degrees F for washing.
  - Lubricant.
  - Thermal pure-water rinse up to 194 degrees F.
  - Drying phase.
- The correct cycle for the load contents must be selected and the items must be loaded as required.

Washer/Pasteurizer

- Not a sterilization procedure.
- Pasteurization is an acceptable cleaning and high-level disinfection alternative for respiratory therapy and anesthesia equipment.
- Following a precleaning:
  - Hot water (150°F to 170°F or 65°C to 77°C).
  - At least 30 minutes.
- The temperature of the final rinse should be monitored with an irreversible thermometer or a remote sensing device.
Single-use Devices, Equipment and Supplies

- Ensure an intact seal and confirm that sterilization indicators with expiration date are verified
  - Inspect for
    - Damage
    - Moisture
    - Tears
    - Discoloration
    - Expiration date
- Reprocessing
  - Facility protocol

Steps of Sterilization

Sterile Processing Team

- Sterile processing team is responsible and accountable for reprocessing contaminated instruments and medical devices, especially surgical instruments and equipment
  - Handling
  - Collecting
  - Sorting
  - Disassembling
  - Cleaning
  - Inspecting
  - Disinfecting
  - Packaging
  - Sterilizing
  - Storing
  - Distributing reprocessed items
Manufacturers’ Written Instructions For Use (IFU)

- These instructions provide the information necessary to safely use, monitor the efficacy, and conduct preventive maintenance to ensure quality and process reliability.
- Reference IFUs for the following:
  - Chemical solutions
  - Cleaning tools
  - Disinfectants
  - Packaging
  - Cleaning
  - Sterilization monitors

Post Procedure

- Point of Use
  - Remove gross soil and debris and rinse immediately post procedure
  - Lumens should be flushed with water (not saline, as salt is corrosive to most instruments)
  - Instrument or equipment surfaces need to stay moist until they can be cleaned to facilitate the removal of soil
    - Enzymatic foam or gel cleaner
    - Using wet towels (water, not saline) placed within the set of used instruments
    - Presoaking used items in water or cleaning solution are all potential options

Transportation

- Containers need to be puncture-resistant leak-proof and sealable
- Labeled as biohazardous
- The selection of the container
- The liquids in the containers should be discarded while wearing PPE
- If off-site transportation is required, follow department of transportation, state regulations and OSHA requirements
Physical Design of the Area

- Physical barrier must separate decontamination area from the other work areas
- Floors and walls
  - Must withstand wet vacuuming and washing
- Ceiling
  - Nonparticulate/nonfibrous material
- The work surfaces
  - Nonporous and can withstand frequent cleaning
- The ventilation of the area should have negative air pressure
  - 10 air exchanges/hour and all air exhausted to the outside atmosphere.
- Hand hygiene facilities should be easily accessible to staff
- There should be eyewash stations as identified by OSHA regulation, and safety data sheets (SDSs) for each chemical used within 10 seconds of travel

Personal Protective Equipment

- Safety goggles or full-length face shields
- Hair should be covered with a surgical cap
- Fluid-resistant face mask should cover the nose and the mouth at all times
- A liquid-resistant covering with sleeves should be worn and should cover the arms and clothing
- Gloves should be worn
  - General purpose utility gloves that are heavy duty and waterproof should be worn
  - Should be cuffed and long enough to completely cover the exposed hand, arms and part of the gown
- Liquid-resistant shoe covers
Disinfecting Work Areas

- Routine cleaning of the work environment is essential
- At Least Daily
  - Work stations
  - Countertops
  - Other high-touch horizontal surfaces
  - Floors
- After Each Use
  - Case carts
  - Storage containers
  - Transportation
- Regular Scheduled Basis
  - Walls
  - Air-intake and return ducts
  - Storage shelves
  - Storage areas

Manual Cleaning Method

- Manual cleaning is done when the use area does not have a mechanical unit (e.g., ultrasonic cleaner or washer-disinfector) or for fragile or difficult-to-clean instruments
- Two essential components
  - Friction
  - Fluidics
- Recommended for:
  - Delicate
  - Complex medical devices
  - Devices that can not be submerged
- Brushes of the appropriate type, size (diameter and length), and bristle type and material should be used, and the instrument manufacturer should provide this information in writing
- Brushes can be single-use disposable or reusable

Mechanical Cleaning Methods

- Mechanical cleaning equipment removes soil and microorganisms using an automated cleaning and rinsing process and sometimes incorporates a thermal disinfection or chemical disinfectant process
- This equipment should be located in the decontamination department
Inspection of Instruments

- When cleaning and disinfecting have been completed and devices are safe for handling, reprocessed items need to be inspected
- Inspected for proper function and defects, as well as to ensure that all soil has been removed
  - The cleaning of orthopedic and neurosurgical instruments pose a significant challenge to SP personnel
  - The sharpness of cutting surfaces should be checked
  - Lighted magnifying glasses should be available at workstations to assist with detailed inspections
  - Sterilization containers must also be inspected to verify integrity, correct for proper functioning and replace parts of rigid containers, such as the filters and valves

Area Design

- Requires positive airflow
- The linen sorting and folding process should be in an enclosed space separate from the remainder of the preparation area to reduce the accumulation of lint
- The airflow should be a downdraft type
  - 10 air exchanges per hour
- Housekeeping procedures should be the same as those used to clean operating rooms and delivery rooms

Packaging Material

- Packaging should allow the sterilizing agent to enter and exit the set/pack
- Durability of the packaging is critical, especially when loading and unloading the sterilizing cart
- Packaging materials should repel moisture and water
- Packaging must be made of low-lint material
- Ignition resistance is a consideration
Prepared Sets or Trays

- The SP staff usually places items into predetermined sets or trays
- Implants require a Bi process challenge device (Bi PCD) in the load
- The arrangement is critical to the sterilization process
- When assembling sets or trays assess the following:
  - Size
  - Weight
  - Design
  - Density of instruments
  - Distribution of mass
  - Composition of the set
  - Instrument sets should not weigh more than 25 pounds

Product Identification and Traceability

- Each package should be labeled
  - Lot control identifier that lists the sterilizer identification number, the date of sterilization and the cycle number
  - The lot control identifier date can be used for stock rotation
  - Patient to device
  - Each package should also be labeled with an expiration statement such as “Contents sterile unless package is opened or damaged. Please check before using.”

Area Design

- Sterilizers are located on the “clean” side, away from the decontamination area
  - 10 Air Exchanges/hour
  - Positive Airflow
  - Temp 68 – 73 degrees F
  - Humidity 30 – 60 percent
Loading the Sterilizer

• Steam sterilizer mixed-load
  • Rigid containers and wrapped instrument sets trays should always be placed flat to allow for:
    • Air removal
    • Sterilant penetration
    • Condensate drainage
    • Drying
  • Containers from different manufacturers should not be stacked because the configurations for air removal and steam penetration may not match
  • Peel pouches so they are placed on edge, not flat, with the paper side facing in one direction

Unloading of the Sterilizer and Sterile Storage

• Time is required to cool down any heat-sterilized items to prevent condensation
• Cooling time will vary with the load, temperature-sensing devices are available to determine the internal temperature of the package before removing items from the sterilizer rack to storage
• EO sterilized items require aeration time in the sterilizer to remove traces of the gas before they are unloaded
• During removal from the cart, items should be visually inspected for torn or wet packaging and for external CIs that suggest inadequate processing

Quality Control

• Sterilization process monitoring
  • Physical monitors
  • Chemical and biological indicators
  • Documentation of these results
• The sterilization parameters that affect the efficacy of the sterilization process
  • Temperature
  • Exposure times
  • Pressure
  • Vacuum levels
  • Moisture conditions
  • Relative humidity
  • Chemical concentrations
  • Adequate air removal
• The SP staff should verify the information provided on the digital printouts, recording charts, displays, or gauges at the end of the cycle by reading and initialing the ‘receipt’
Chemical Indicators (CI)

- A CI is a device that monitors the presence of one or more of the parameters required for an effective sterilization process or to monitor the sterilizer equipment.
- The device is designed to respond with a characteristic chemical or physical change to one or more of the physical conditions within the sterilizing chamber.
- CIs are intended to detect potential sterilization process failures that could result from incorrect packaging, incorrect loading of the sterilizer, or malfunctions of the sterilizer.
- The “pass” response of a CI does not prove that the item accompanied by the indicator is necessarily sterile.

Six classes of CIs:

- **Class 1 (process indicators)**
  - External: Sterilization indicator tape
- **Class 2 (Bowie-Dick tests)**
  - Test for air removal
- **Class 3 (single-variable indicators)**
  - Internal CI for pack control monitoring
- **Class 4 (multivariable indicators)**
  - Internal paper strips with color change CI
- **Class 5 (integrating indicators)**
  - Internal: Reacts to all critical process variables
- **Class 6 (emulating indicators)**
  - Internal: Cycle specific

Biological Indicators (BI)

- Bios directly monitor the effectiveness of a given sterilization process.
- Cannot be replaced by the use of either Class 5 or Class 6 CIs.
- Spores used to monitor a sterilization process have demonstrated resistance to the sterilizing agent and are more resistant than the bioburden found on medical devices or instruments.
- Bacillus stearothermophilus spores are used to monitor steam sterilization, hydrogen peroxide with or without gas plasma, and ozone sterilization processes.
- **Monitoring includes:**
  - Use of the positive control
  - Record of the incubation temperatures
  - Readout time
Storage of Sterile Items

- 18 inches below the ceiling or the sprinkler head or according to the fire code
- Eight to 10 inches from the floor
- At least two inches from an outside wall
- Away from sprinklers and air vents
- Open rack storage should have a solid bottom
- Position packages so they are not crushed, bent, compressed or punctured
- Store heavy trays/containers on middle shelves but not stacked
- In areas of limited traffic

Storage of Sterile Items

- Clean workroom or clean holding area(s):
  - Airflow positive pressure
  - Minimum of four air exchanges per hour
  - Temperature and humidity (approximately 24°C [75°F], relative humidity not to exceed 70 percent)
- Soiled workroom or soiled holding area(s):
  - Airflow must be negative pressure
  - Minimum of 10 air exchanges per hour

Transportation

- Avoid dragging, sliding, crushing, bending, compressing or puncturing the packaging or otherwise compromising the sterility of the contents
- Transferred in covered or enclosed carts with solid bottoms to prevent or reduce environmental
- Carts and reusable covers should be cleaned, disinfected and thoroughly dried after each use
- No outside shipping containers or corrugated cardboard
- Off-site transporting of sterile items should be closely monitored
Documentation/Recordkeeping

- Records must be kept of the sterilization cycles.
  - Each item or package should be labeled with a lot control identifier
  - Sterilizer identification number or code
  - Date of sterilization
  - Cycle number
  - SP staff should document
    - Lot number
    - Date
    - Time
    - Contents of load
    - Specific description of the items
    - Exposure time
    - Temperature
    - Operator’s initials on machine
    - Results of BI testing and thermocouple testing
    - Results of aseptic load and B-D testing
    - Action taken or comment with BI test results found in the load
    - Action taken would be included for EO processed loads.

Immediate-Use Steam Sterilization

- IUSS (formerly called flash sterilization) is a sterilization process designed for the cleaning, steam sterilization, and delivery of patient care items for immediate use
- AAMI, the AORN, and TJC do not recommend the use of IUSS because IUSS may be associated with increased risk of infection to patients
- Only time saved is elimination or shortening of the dry cycle
- IUSS should not be used as a substitute for sufficient instrument inventory

Managing Items Contaminated with Prions

- Surgical and SP staff need to be knowledgeable about proper procedures for handling, cleaning, decontaminating, storing and disposing of used surgical instruments, as well as how to manage the contaminated environment
- Determining the best method for handling a suspected or known TSE or CJD case should be based on the infectivity level of the tissue and the items used
- Instruments contaminated with cerebrospinal fluid need to be treated as highly infectious items
Toxic Anterior Segment Syndrome (TASS)

- Acute inflammation of the anterior chamber, or segment, of the eye following cataract surgery
- Can be caused by impurities of autoclave steam, heat stable endotoxin, and irritants on the surfaces of intraocular surgical instruments

Collaborate...to assess products...for their ability to be reprocessed

- Product Evaluation Committee
- Multidisciplinary team evaluates new products and technology for the all areas in the hospital
  - Investigate the new product
  - Analysis of costs
  - Review literature
  - Seek out information from other users at other facilities
  - Identify any infection prevention/safety issues
  - Develop, conduct and evaluate product trial
  - Final decision based on information gathers during the process

Reasons for Introducing New Products

- Cost
- Contract expirations
- Product failures or recalls
- Superior product created
- Vendor recommendations
- New or revised regulations, standards, or guidelines
- New procedures
- Custom products
Break Time!!
Get some caffeine for our final review!

Final Review Questions
Time to show us how much you learned!!

Thank you!!
Good luck on your certification exam!!!!