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Emerging, Re-Emerging Pathogens and “Superbugs”...
Patient Management in the Perioperative Environment

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Objectives

• Discuss a variety of emerging, re-emerging pathogens and “super bugs”
• Understand patient management of the relevant pathogens in the perioperative environment
• Discuss the role of the perioperative staff in Preventing Transmission
What are they?

- Emergence of new infectious diseases:
  - Outbreaks of previously unknown diseases or known diseases whose incidence in humans has significantly increased in the past two decades.
  - Changes in human demographics, behavior, land use, and other factors changing transmission dynamics to bring people into closer and more frequent contact with pathogens.

- Re-emergence of old infectious diseases:
  - Known diseases that have reappeared after a significant decline.
  - Genetic variations, recombination, and adaptations allow new strains of known pathogens to appear.

Where are they from?

General Considerations

Prevention Strategies in the OR
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General Requirements for the OR - Ventilation

• 20-25 ach/hour (minimum)
• Airflow
  – Positive
• Temperature
  – 68°F – 75°F (20°C – 24°C)
• Relative Humidity
  – 20% - 60%

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General Requirements for the OR – Environmental Cleaning

• Between Cases - High touch / high risk surfaces
  – Cleaned after each surgical or invasive procedure
  – EPA registered germicide with a lint free or microfiber cloth
  – OR bed and attachments, positioning devices, overhead lights, booms, patient monitors, straps, anaesthesia cart, machines and equipment, switches, knobs, panels, etc.
  – Floors mopped (ensure inspection under and around the bed after procedures; if soiled (splashes, spatter, sprays) with blood, body fluids or other potentially infectious material
  – Contaminated laundry

• Terminal Cleaning
  – Daily for procedure rooms and scrub/utility areas
  – All external surfaces of items in room, wheels, casters, disinfected daily when room is used
  – Entire floor mopped or vacuumed
  – Wall cleaned at least weekly


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General Requirements for the OR – Environmental Cleaning

• Extraordinary measures or closure of OR following procedures classes as contaminated or dirty
• Enforce clearing and disinfection for patients infected or colonized with multi-drug resistant organisms (MDROs)
  – Use Contact Precautions and proper personal protective equipment
  – Use a EPA registered bleach-based disinfectant for patients with Clostridium difficile
• Tuberculosis
  – Restrict access to room until 99.9% air exchange completed
• Exceptions
  – Suspected or confirmed Creutzfeld Jakob Disease (CJD)

After the Resistance: The Alamo Today


Multi-drug Resistant Organisms (MDRO)

... the Rods and the Staph... they discomfort me.

Multi-Drug Resistant Organisms (MDRO)

• Definition
  Bacteria (excluding M. tuberculosis) resistant to one or more classes of antimicrobial agents and usually are resistant to all but one or two commercially available antimicrobial agents (e.g., MRSA, VRE, extended spectrum beta-lactamase [ESBL] producing or intrinsically resistant Gram-negative bacilli)
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**Antibiotic Resistance**

- Estimated minimum number of illnesses and deaths caused by antibiotic resistance (including bacteria and fungi):
  - At least 2,049,442 illnesses
  - 23,000 deaths
- High-Risk Patients
- Cancer Chemotherapy
- Complex Surgery (CABG, joint replacements, etc.)
- Rheumatoid Arthritis
- Dialysis – ESRD
- Organ and Bone Marrow Transplants


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**Urgent Threats**

- *Clostridium difficile*
- Carbapenem-resistant Enterobacteriaceae (CRE)
- Drug-resistant Neisseria gonorrhoeae


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**Serious Threat Level**

- Multidrug-resistant Acinetobacter
- Drug-resistant Campylobacter
- Fluconazole-resistant Candida (a fungus)
- Extended spectrum β-lactamase producing Enterobacteriaceae (ESBLs)
- Vancomycin-resistant Enterococcus (VRE)
- Multidrug-resistant Pseudomonas aeruginosa
- Drug-resistant Non-typhoidal Salmonella
- Drug-resistant Salmonella Typhi
- Drug-resistant Shigella
- Methicillin-resistant Staphylococcus aureus (MRSA)
- Drug-resistant Streptococcus pneumoniae
- Drug-resistant tuberculosis

Concerning Threat Level

- Vancomycin-resistant Staphylococcus aureus (VRSA)
- Erythromycin-resistant Group A Streptococcus
- Clindamycin-resistant Group B Streptococcus


“SUPERBUGS” - ESKAPE

- Enterococci (VRE)
- Staphylococci (MRSA, VISA, VRSA)
- Klebsiella (KPC)
- Acinetobacter
- Pseudomonas
- Enterobacter (CRE)
Carbapenem Resistant Enterobacteriaceae

- Immediate public health threat that requires urgent and aggressive action.
- 9,000 drug-resistant infections/year.
- 600 deaths.
- Carbapenem-resistant:
  - K. pneumoniae – 7,900
  - E. coli – 1,400


Multidrug-Resistant Acinetobacter

- 7,300 infections.
- 500 deaths.
- 12,000 infections/year.
- Resistant to 3 different classes of antibiotics.
  - No longer cure infections.


Extended Spectrum Beta Lactamase (ESBL) Producing Enterobacteriaceae

- 26,000 (19%) drug resistant infections.
- 1,700 deaths.
- 140,000 infections/year.
- $40,000 in excess medical costs/year for each infection.

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**Vancomycin Resistant Enterococci (VRE)**

- 20,000 drug resistant infections
- 1,300 deaths
- 66,000 enterococcus infections/year
- Few or no treatment options

*Antibiotic Resistance Threats in the United States, 2013. U. S. Department of Health and Human Services, CDC*

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**Methicillin Resistant Staphylococcus aureus (MRSA)**

- 80,461 severe MRSA infections/year
- 11,285 deaths/year
- Staphylococcus is the leading cause of healthcare-associated infections (HAIs)

*Antibiotic Resistance Threats in the United States, 2013. U. S. Department of Health and Human Services, CDC*

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**Patient Management**

- Standard Precautions
  - Hand hygiene
  - Isolation precautions (respiratory, contact, or droplet)
  - Personal protective equipment (PPE)
  - Environmental control
- Contact Precautions
  - Known or suspected patients known to be colonized or infected with multidrug-resistant (MDR) organisms
  - Use of PPE on entry to and exit from patient’s room
  - Hand hygiene

*Perioperative Standards and Recommended Practices For Inpatient and Ambulatory Settings, 2014 Edition*
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**Clostridium difficile Infection (CDI)**

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**Background: Pathogenesis of CDI**

1. Ingestion of spores transmitted from other patients via the hands of healthcare personnel and environment
2. Germination into growing (vegetative) form
3. Altered lower intestine flora (due to antimicrobial use) allows proliferation of *Clostridium difficile* in colon
4. Toxin A & B Production leads to colon damage +/- pseudomembrane

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**Risk Factors**

- Antimicrobial exposure
- Acquisition of *C. difficile*
- Advanced age
- Underlying illness
- Immunosuppression
- Tube feeds
- ? Gastric acid suppression

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*Main modifiable risk factors*


http://www.idph.state.il.us/patientsafety/AM_session-Carling_Carterville_Spfd.pdf
Clostridium difficile

- Estimated minimum number of illnesses and death due to Clostridium difficile (C. difficile), a unique bacterial infection that, although not significantly resistant to the drugs used to treat it, is directly related to antibiotic use and resistance:
  - At least 250,000 illnesses
  - 14,000 deaths
  - Excess medical costs - $1,000,000,000 in excess of


Control Measures

- Standard Precautions
- Personal Protective Equipment to prevent nosocomial transmission of C. difficile
- Handwashing with soap and water important
- Alcohol hand gel products are not sporicidal and efficacy against C. difficile is questioned
- Cleaning and disinfecting environmental surfaces
- Thorough cleaning, disinfection and/or sterilization of equipment and instruments (commodes, bed pans, GI endoscopes)

Summary of Prevention Measures

Core Measures
- Contact Precautions for duration of illness
- Hand hygiene in compliance with CDC/VHA
- Cleaning and disinfection of equipment and environment
- Laboratory-based alert system
- CDI surveillance
- Education

Supplemental Measures
- Prolonged duration of Contact Precautions
- Presumptive isolation
- Evaluation w/eg gastrointestinal testing
- Soap and water for HH upon exiting CDI room
- Universal glove use on units with high CDI rates
- Breastfeeding recommendations
- Antimicrobial stewardship program

* Not included in CDC/HICPAC 2007 Guideline for Isolation Precautions
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Captain Consumption and the Collector of Souls

- Alice Neel (1900–1984)
- T.B. Harlem (1940)
- Oil on canvas

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TB Transmission

- TB is caused by Mycobacterium tuberculosis (M. tb)
- Transmission occurs from person with infection
- Spread through airborne droplet nuclei by coughing, sneezing, speaking, singing
- More easily transmitted in closed air spaces
- Close contacts at highest risk of becoming infected
- Cannot be transmitted off surfaces

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TB Infectivity

- Infectivity of person with TB
- Environment in which exposure occurred
- Duration of exposure
- Viability of the organism

- Patients considered infectious if they:
  - are coughing
  - are undergoing cough-inducing or aerosol-generating procedures
  - have sputum smears positive for acid-fast bacilli
  - are not receiving therapy
  - have just started therapy
  - have poor clinical response to therapy
Management of TB Patients

- Elective surgery: postponed until adequate therapy and is no longer considered infectious
- Bronchoscopies: airborne infection isolation room (negative pressure isolation room)
- Emergency surgery:
  - last case of the day to provide maximum time (~28 mins) for air changes (Per IE ACH)
  - transport patient directly to the OR (patient should wear surgical mask if tolerated or staff where N95 respirator)
  - in OR, staff wear N95 respirator
  - keep all doors closed
  - keep staff to a minimum
  - recover in OR or in patient’s room; send to the PACU, if negative pressure room

Use of N95 Respirator

- Half-face air-purifying respirator
- Fits over the nose and mouth for use against certain particles
- Reduces airborne exposure 10-fold
- Appropriate ventilation is not available and the patient’s signs and symptoms suggest a high potential for infectivity
- Patient is potentially infectious and is undergoing a procedure that is likely to produce bursts of aerosolized infectious particles or result in copious coughing or sputum production regardless of ventilation

How to Don a Particulate Respirator

- Select a fit tested respirator
- Place over nose, mouth and chin
- Fit flexible nose piece over nose bridge
- Secure on head with elastic
- Adjust to fit
  - Inhale: respirator should collapse
  - Exhale: check for leakage around face
TB Environmental Decontamination

- Not acquired from environmental surfaces
- Same cleaning process as for other rooms
- No PPE is required, except under Standard Precautions, if the room has been ventilated for the appropriate amount of time.

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Health and the Myrmidons

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Viruses, Viruses ...

- Influenza Virus
- Ebola Virus
- Bird Flu
**Ebola Virus**

- **Total Cases (Majority Liberia and Sierra Leone)**
- **As of:** September 14, 2014
- **Suspected and Confirmed Case Count:** 5347
- **Suspected Case Deaths:** 2630
- **Laboratory Confirmed Cases:** 3095

http://www.cdc.gov/vhf/ebola/

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**Transmission**
- Blood or body fluids (urine, saliva, feces, vomit and semen)
- Contaminated objects infected with body fluids
- Infected wildlife

**Risk of Exposure**
- Close contact of a confirmed case of Ebola
- Lack of proper PPE
- Travel to disease endemic areas

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**Precautions**

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Precautions

- Standard, Contact and Droplet Precautions
  - Hand Hygiene (before and after)
  - Gown (fluid resistant or impermeable)
  - Gloves
  - Facemask
  - Eye protection (face shield or goggles)

- Additional PPE
  - Double gloving
  - Disposable shoe covers
  - Leg coverings

- Aerosol generating procedures
  - N-95 respirator
  - Powered Air Purifying Respirator (PAPR)

- Environmental Controls
  - Proper cleaning of patient care equipment
  - EPA approved disinfectant
  - Avoid contamination of reusable patient care items


Influenza Pandemics / Outbreaks

- 1918 – 1920 "Spanish" flu – H1N1
- 1968 – 1969 "Hong Kong" flu – H3N2
- 2003 – 2004 – H5N1
- 2009 – 2010 Swine Flu - H1N1/09

Influenza Epidemiology

- Spread by aerosols and occasionally by fomites
- Transmission is very efficient, usually 3-9 new infections per clinical case
- Seasonal epidemic trends (temperate climates)
- Peak of infectivity 1-2 days before and 4-5 days after the clinical signs.
- Epidemics usually last from 3-6 weeks and the highest attack rates are for 5-19 years old

Prevention

- Standard and Droplet precautions
  - Surgical mask to cover nose and mouth
  - Respiratory/Cough Etiquette
  - Hand hygiene
  - Work exclusion
- Influenza vaccine

Bloodborne Pathogens
Bloodborne Pathogens (BBP)

- Hepatitis B – 6% - 30%
  - Single needlestick or a cut exposure to infected blood
  - Depends on the hepatitis B antigen (HBcAg) status of the source individual
  - Hepatitis B surface antigen (HBsAg) positive and HBcAg positive
  - Higher risk of infection

- Hepatitis C – 1.8% - 3%
  - Estimated risk for infection after a needlestick or cut to infected blood

- HIV – 0.3%
  - 99.7% of needlestick/cut exposures to HIV-contaminated blood do not lead to infection

What does it take?

<table>
<thead>
<tr>
<th>Bloodborne Pathogens (B)</th>
<th>10^11</th>
<th>10^10</th>
<th>10^9</th>
<th>10^8</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBV</td>
<td>13,000</td>
<td>1,000</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>HCV</td>
<td>1-100,000</td>
<td>10-10,000</td>
<td>1-100</td>
<td>0.1-10</td>
</tr>
<tr>
<td>HIV</td>
<td>0.7</td>
<td>0.07</td>
<td>0.007</td>
<td>0.0007</td>
</tr>
</tbody>
</table>

NOTE 1: Assumes 10^11 to 10^10 for HCV, 10^11 for HIV, and 10^10 for HBV.

NOTE 2: Assumes 10^11 to 10^10 for HCV, 10^11 for HIV, and 10^10 for HBV.

Prevention of Exposures

**Before Procedure**
- Organize equipment
- Remove unnecessary sharps
- Establish a neutral zone
- Point sharps away from user
- Standardize sterile field set up

**During Procedure**
- Do not hand pass
- Alert passing of sharps
- Activate safety device feature
- Maintain proper lighting and space

**During clean up**
- Check procedure trays, waste materials and linen for sharps
- Keep hands behind sharps containers
- Maintain control of sharps and sharps during disposal
- Do not overfill sharps containers


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Prevention of Exposures

- Report all sharps injuries
- Ensure team adheres to safe work practices

**Standard Precautions**
- Proper hand hygiene (soap and water if visibly soiled; alcohol-based hand rubs if visibly clean)
- Use of personal protective equipment (PPE)
- Hepatitis B vaccine

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I rhyme / To see myself, to set the darkness echoing

Gerard van Kuijl, Dutch painter active in Rome (1604–1673) Narcissus (c. 1645) Oil on canvas

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I rhyme / To see myself, to set the darkness echoing

EMERGING INFECTIOUS DISEASES

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Fifteen people in three states now have been warned that they may have been exposed to a rare and fatal brain disease through potentially contaminated surgical equipment, health officials said Friday.

In addition to eight patients in New Hampshire, five in Massachusetts and two in Connecticut have received the news that they may have shared tainted equipment with a patient who died from apparent Creutzfeldt-Jakob Disease. Hospitals frequently share high-cost neurosurgery equipment on a fee-for-use or rental basis.

The problem arose because standard hospital sterilization techniques cannot eradicate the prion that causes CJD. Hospitals need to analyze equipment for any potential risk of contamination before it is shared with other patients. 

15 patients in 3 states possibly exposed to fatal brain disease

Prion Diseases - Etiology

- Prions (proteinaceous infectious agent)
- No agent-specific nucleic acid
- Host protein (PrPc) converts to pathologic isoform (PrPsc)
- Mutation in this gene may trigger transformation
- Accumulates in neural cells, disrupts function
- Resistant to conventional disinfectant and sterilization procedures
Prion Diseases of Humans

- Kuru
- Gertsmann-Straussler-Scheinker (GSS)
- Fatal Familial Insomnia (FFI)
- Creutzfeldt-Jakob Disease (CJD)
  - Sporadic CJD
  - Iatrogenic CJD
- Variant CJD (vCJD), 1994 (March 2002, 115 cases)

Iatrogenic CJD

- Transmission of abnormal prion protein during medical procedures
  - Contact with contaminated reusable surgical instruments
  - Use of allografts from infected donors
  - Therapeutic use of infected blood components and hormonal extracts

Transmission not associated with ...

- Casual contact
- Environmental contamination
- Person–person by skin contact, droplet or airborne
- Non-critical patient care items and surfaces
**Epidemiology of CJD in the US**

- Degenerative neurologic disorder
- Incidence
  - One death/million population
  - No seasonal distribution, no geographic aggregation
  - Both genders equally affected
  - Age range 50-80+ years, average 67
- Long incubation period (years)
- Rapid disease progression after onset (death within 6 months to a year)

**Clinical Features of CJD**

- Progressive dementia (memory, intellect, personality)
- Progressive motor deterioration
  - Unsteadiness and clumsiness
  - Visual deterioration
  - Muscle twitching
  - Severe dementia, mute, immobile
- Death (<1 year)

**Risk of CJD Transmission**

<table>
<thead>
<tr>
<th>Risk of Infection</th>
<th>Tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>Brain (including dura mater), spinal cord, and eyes (cornea) from high-risk patient</td>
</tr>
<tr>
<td>Low</td>
<td>CJD, liver, lymph node, kidney, lung, spleen, placenta, olfactory epithelium from high-risk patient</td>
</tr>
<tr>
<td>No Detectable Risk</td>
<td>Peripheral nerve, intestine, bone marrow, whole blood, leukocytes, serum, thyroid gland, adrenal gland, sweat, intestinal fluid, adipose tissue, gingiva, prostate, bladder, teeth, nasal mucosa, saliva, sputum, urine, feces, semen, vaginal secretions, and milk</td>
</tr>
</tbody>
</table>

- No detectable risk for transmission to inoculation animal models.
**CJD and Patient Management**

**Pre-operative**
- Schedule case to end of the day
- Remove unnecessary equipment and supplies from room or cover with impervious drape
- Cover mattress, headrest and other exposed surfaces with impervious, disposable drapes
- Use disposable sterile and non-sterile supplies; drapes and linen, when possible
- Use disposable instruments when possible
- Disposable brain biopsy needles, instruments
- Manual saw and drills
- Avoid instruments to be reprocessed by low temperature sterilization technology

**Intraoperative**
- Personnel to wear face shield, impervious gowns, disposable hats, masks; double gloves and shoe covers
- Anaesthesia to wear mask, protective eyewear, gown and gloves
- Careful handling of sharps and instruments
- Use neutral zone for passing sharps
- One-way flow of instruments
- Restrict traffic to essential personnel

**Post-operative**
- All disposables into biohazardous waste container labeled for incineration
- All sharps into puncture resistant container labeled for incineration
- Separate instruments used on high, low and no detectable risk and kept moist sprayed to prevent drying of organic material
- Place instruments in leak proof container, labeled CJD, and placed in closed case cart
- Reprocess as soon as possible
- Discard difficult to clean instruments

**Environmental**
- Personnel to wear gloves, mask with face shield or goggles, shoe covers
- Disinfect contaminated surfaces with 1:10 dilution of bleach or 1N-2N sodium hydroxide (contact time of one hour)
- Terminal cleaning with routine procedure
- Routing cleaning of floors, walls, other flat surface outside surgical field

**Specimen Handling**
- Safe handling of brain tissue, CSF, lymph nodes and tonsil specimen
- Place in impervious bag labeled as “suspected CJD”
- Notify laboratory personnel before transport
- Hand transport to the laboratory
- Dispose body fluids, regulated medical waste as per waste management policy and procedure
- Reusable laundry placed in linen bag and managed per OSHA bloodborne pathogen regulation
- Disinfect supplies, equipment, surfaces should be disinfected
- Disinfect work areas
Instrument Management

- Disposable instrumentation
  - discarded
- Reusable
  - quarantine until diagnosis in ascertained
- Do not use Immediate Use Steam Sterilization (IUSS)
- Use terminal steam sterilization methods
- Do not use low temperature technologies

History of Medicine

- 2000 B.C. – Here, eat this root.
- 1000 A.D. – That root is heathen. Here say this prayer.
- 1850 A.D. – That prayer is superstition. Here, drink this potion.
- 1920 A.D. – That potion is snake oil. Here, swallow this pill.
- 1945 A.D. – That pill is ineffective. Here, take this penicillin.
- 1955 A.D. – Oops…bugs mutated. Here take this tetracycline.
- 1960-1999 – 39 more “oops”… Here, take this more powerful antibiotic.
- 2000 A.D. – The bugs have won! Here, eat this root.

WHO, 2000
Anonymous

Thank You!
 References


2. Guidance for the Selection and Use of Personal Protective Equipment (PPE) in Healthcare Settings


