Infection Control in the OR: Perspectives from Anesthesia and ID

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Scope of Healthcare Associated Infections (HAI)

- On any given day, 1 in 25 hospital patients has at least one HAI

<table>
<thead>
<tr>
<th>Site of Infection</th>
<th>Estimated Number</th>
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<tbody>
<tr>
<td>Pneumonia</td>
<td>157,500</td>
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<td>GI illness</td>
<td>123,100</td>
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<tr>
<td>Urinary tract infection</td>
<td>93,300</td>
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<tr>
<td>Bloodstream infection</td>
<td>71,900</td>
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<tr>
<td>Surgical site infection</td>
<td>157,700</td>
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<tr>
<td>Other types of infections</td>
<td>118,500</td>
</tr>
<tr>
<td>Total number</td>
<td>721,800</td>
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</tbody>
</table>

http://www.cdc.gov/HAI/surveillance/index.html

Scope of Healthcare Associated Infections (HAI)

- Annual cost of 5 major infections in U.S. estimated at $9.8 billion
  - Surgical site infections largest contributor to overall costs – 34% of total
  - Per case cost:
    - Central line associated bloodstream infection $45,814
    - Ventilator associated pneumonia $40,144
    - Surgical site infection $20,785
    - Clostridium difficile infection $11.285
    - Catheter-associated urinary tract infection $896

Zimlichman et al, JAMA Intern Med 2013

Disclosures

Robin Stackhouse: No disclosures
Lisa Winston: No disclosures
ASA Recommendations for Infection Control (3rd Edition)

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Prevention of Healthcare-Associated Infection in Patients

- Hand Hygiene
- Preventing Contamination of Medications
- Prevention of Surgical Site Infection
- Prevention of Intravascular Catheter-Related Infection
- Prevention of Ventilator-Associated Pneumonia in the ICU
- Prevention of Infection Associated with Neuraxial Procedures
- Prevention of Transmission of Multi-drug–Resistant Organisms
- Pediatric Considerations
- Disinfection of Equipment

http://www.asahq.org/For-Members/~/media/For%20Members/About%20ASA/ASA%20Committees/Recommendations%20for%20Infection%20Control%20for%20the%20Practice%20of%20Anesthesiology.ashx

ASA Recommendations for Infection Control (3rd Edition)

Prevention of Occupational Transmission of Infection to Anesthesiologists

- Needlestick/Sharps Safety
- Transmission-based Precautions
- Bloodborne Pathogens (hepatitis B virus, hepatitis C virus, human immunodeficiency virus)
- Tuberculosis (TB)
- Emerging Infectious Diseases/Pandemic Influenza
- PPE: Respirators for the Care of Patients With Virulent Respiratory Pathogens
### Infection prevention in anesthesia practice: A tool to assess risk and compliance

**Hand Hygiene & Gloves**

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Date</th>
<th>F compliant</th>
<th>M compliant</th>
<th>NA not applicable</th>
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<tbody>
<tr>
<td>Wash hands before wearing gloves</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wash hands after removing gloves</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wash hands before and after contact with patient</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wash hands before and after touching equipment</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wash hands before and after patient contact</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use alcohol-based hand rub</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use disposable gloves</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Hand contamination of anesthesia providers is an important risk factor for intraoperative bacterial transmission

- 164 patients (82 1st case, 2nd case pairs)
- All providers with access to hand sanitizer on anesthesia cart and in room
- 89% contamination of anesthesia environment
  - 12% from anesthesia team
- 11.5% bacterial transmission to IV stopcock
  - 47% from anesthesia team
- 1 case of horizontal transmission


Video observation to map hand contact and bacterial transmission in operating rooms

- HH compliance 2.9%
- Inverse correlation between HH compliance and magnitude of surface contamination
- Organisms cultured:
  - S aureus
  - Enterococcus
  - “Plethora” of gram negative organisms
  - Coag negative Staph
  - Micrococcus
  - Corynebacterium
- Average # HH opportunities: 149/hr

Loftus et al. AJIC 42(2014)698-701

Indications for Hand Hygiene (HH) (CDC)

- When hands are visibly soiled
- Before direct contact with patients
- Before donning sterile gloves
- Before inserting indwelling urinary catheters, peripheral vascular catheters, or other invasive devices
- After contact with patient’s intact skin
- If moving from a contaminated-body site to a clean-body site
- After contact with inanimate objects in the immediate vicinity of the patient
- After removing gloves
- Before eating and after using a restroom

Hand Hygiene Algorithm

From: ASA Recommendations for Infection Control, 3rd Ed.
Artificial nails in the OR

- Outbreaks of healthcare associated infections linked to artificial and long nails
- CDC and WHO recommend nail length less than 0.25 inch (6.35 mm)
- Polish considered acceptable
- No evidence based guidelines for shellac (gel) or nail art
  - Conservative approach: treat as artificial nails

Ellingson et al. Infect Control Hosp Epidemiol 2014

Artificial nails – linked to infection

- 7 cardiovascular surgery patients developed post-operative infections with Serratia marcescens; one died
- All exposed to one scrub nurse with artificial nails
- Available isolates same by molecular typing
- Cardiac surgery suspended
- Distribution of infections by day of surgery


Artificial nails – linked to infection

- Culture of exfoliant cream from scrub nurse’s home grew same S. marcescens
- No other hospital or home environmental cultures grew S. marcescens
- Nurse used cream only on weekends, usually Sundays
- Exfoliant cream was discarded; nurse removed nails
- No other infections identified after surgery resumed


Injection safety headlines

- 5,700 may be at risk for hepatitis C in Colorado due to medical tech
- A former technician may have exposed patients at Bexar Medical Center and a San Antonio surgery facility.

Pittsburgh Tribune-Review

- Syringes reused at Children’s clinic

San Pedro Clinic Patients Told To Check For Hepatitis, HIV

Las Vegas Review-Journal

- Lawyers: 100 fear infection
Viral Hepatitis Outbreaks (n=16) in Outpatient Settings due to Unsafe Injection Practices, 2001-2010 (CDC)

<table>
<thead>
<tr>
<th>State</th>
<th>Setting</th>
<th>Year</th>
<th>Type</th>
</tr>
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<tbody>
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<td>NY</td>
<td>Private MD office</td>
<td>2001</td>
<td>HCV</td>
</tr>
<tr>
<td>NY</td>
<td>Private MD office</td>
<td>2001</td>
<td>HBV</td>
</tr>
<tr>
<td>NE</td>
<td>Oncology clinic</td>
<td>2002</td>
<td>HCV</td>
</tr>
<tr>
<td>OK</td>
<td>Pain remediation clinic</td>
<td>2002</td>
<td>HBV+HCV</td>
</tr>
<tr>
<td>NY</td>
<td>Endoscopy clinic</td>
<td>2002</td>
<td>HCV</td>
</tr>
<tr>
<td>CA</td>
<td>Pain remediation clinic</td>
<td>2003</td>
<td>HCV</td>
</tr>
<tr>
<td>MD</td>
<td>Nuclear imaging</td>
<td>2004</td>
<td>HCV</td>
</tr>
<tr>
<td>FL</td>
<td>Alternative medicine clinic</td>
<td>2005</td>
<td>HBV</td>
</tr>
<tr>
<td>CA</td>
<td>Alternative medicine clinic</td>
<td>2005</td>
<td>HCV</td>
</tr>
<tr>
<td>NY</td>
<td>Endoscopy/surgery clinics</td>
<td>2006</td>
<td>HBV+HCV</td>
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<tr>
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<td>2007</td>
<td>HCV</td>
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<tr>
<td>NV</td>
<td>Endoscopy clinic</td>
<td>2008</td>
<td>HCV</td>
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<tr>
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<td>HBV</td>
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<tr>
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<td>2009</td>
<td>HCV</td>
</tr>
<tr>
<td>CA</td>
<td>Pain remediation clinic</td>
<td>2010</td>
<td>HCV+HBV</td>
</tr>
</tbody>
</table>

How much can we see?

- Asymptomatic infection
- Under-reporting of cases
- Under-recognition of healthcare as risk
- Difficulty identifying single healthcare exposure
- Barriers to investigation
- Resource constraints

Medication - Infusion/Injection Safety Scenario

- First case of the day (weekend)
- Anesthesiologist meets patient in pre-op
- Pt brought to OR with IV pump/fluid (connected to the pump, capped off) that was at bedside
- End of case, anesthesiologist connects the old IV fluid and takes patient to PACU
- PACU nurse notes that IV is labeled for a different patient.

Scenario

- Anesthesia personnel: anesthesia faculty, CRNA, CRNA student
- CRNA and CRNA student sign out their first patient in the PACU
- OR is readied for second case
- Next patient evaluated and premedicated with versed 2 mg and fentanyl 50 mcg
- CRNA student gives CRNA fentanyl syringe (4 ml left)
- Patient brought to OR for combined epidural and GA
- Attending anesthesiologist monitoring patient and supervising placement of epidural by CRNA and student
- Patient needs more sedation, CRNA gives fentanyl syringe to attending
- Epidural completed, CRNA notes that there are 2 syringes of fentanyl. One missing 2 ml, one missing 1 ml
Infection Control Assessment of Ambulatory Surgical Centers

- 67.6% had at least 1 lapse in infection control practices
- 17.6% had lapses in 3 or more of the 5 infection control categories
  - Lapses:
    - Single dose vial used for more than 1 patient (28%)
    - HH adherence (19%)
    - PPE use
    - Failure to adhere to recommenced practices for equipment reprocessing (28%)
    - Failed environmental cleaning (19%)
    - Lapses in handling of glucose monitoring equipment (30% contaminated, HBV viable 7 days in dried blood, HCV viable 16hrs) (46%)

Schaefer et al, JAMA 2010;303(22):2273-2279

Survey Finds ‘Discouraging’ Injection Habits Among Anesthesiologists

- 49% - same vial for > 1 patient
- 31% - use Propofol on > 1 patient
- ~25% don’t always use a new needle or syringe when drawing from a vial
- ~25% use an open vial w/o knowing who accessed it previously
- Reused syringes on different patients
  - 8% residents
  - 2% anesthesiologists


Issue: Using Propofol syringe for multiple pts and changing the microbore tubing between pts.

Contamination can occur:

- Handling
- Fluid splatter
- Retrograde flow
  - Specific gravity Blood > IV solutions so passive backflow against forward flowing fluid possible.
- Lack of visible blood
  - Blood contamination found in 3.3% of tubing injection sites
    - Only 33% visible to naked eye

Greene ES. ASA Newsletter. 2002;66(12):22-23

“Did you just double dip that chip?” Timmy asks incredulously. “That’s like putting your whole mouth right in the dip!”
Safe Injection Practices: What CMS Surveyors Are Looking For

Unless otherwise indicated, a “No” response to any question below will be cited as a deficient practice.

- Needles are used for only one patient
- Syringes are used for only one patient
- Medication vials are always entered with a new needle
- Medication vials are always entered with a new syringe
- Medications that are pre-drawn are labeled with the time of draw, initials of the person drawing, medication name, strength and expiration date or time
- Single dose (single-use) medication vials are used for only one patient
- Multi-dose medications, used for more than one patient, are not stored or accessed in the immediate areas where direct patient contact occurs

CDC guidelines

- Minimize contamination risk by scrubbing the access port with an appropriate antiseptic (chlorhexidine, povidone iodine, an iodophor, or 70% alcohol) and accessing the port only with sterile devices [189, 192, 194–196]. Category IA

O’Grady et al, 2011 Guidelines for the Prevention of Intravascular Catheter Related infections
Scrubbing the hub

- Disinfect catheter hubs, needleless connectors, and injection ports before accessing (moderate evidence)
  - Apply mechanical friction for at least 5 seconds
  - Use an alcohol chlorhexidine preparation, 70% alcohol, or povidone iodine
  - Benefit most convincing for catheter colonization

  Marschall et al. Infect Control Hosp Epidemiol 2014

Antiseptic hub cap or port protector?

- Several products commercially available
  - Contain either 70% isopropyl alcohol (examples below) or chlorhexidine + isopropyl alcohol
  - Few clinical studies
    - Isopropyl alcohol impregnated devices associated with decreased risk of catheter colonization and CLABSI
  - Consider use as a “special approach”

  CUROS
  Marschall et al. Infect Control Hosp Epidemiol 2014

Stopcocks

- Closed catheter access systems are associated with fewer CRBSIs than open systems and should be used preferentially
  - Stopcocks represent a potential portal of entry for microorganisms into vascular access catheters and IV fluids. Aseptic technique warranted.
  - For stopcocks not in use
    - Sterile cap or syringe


Central Line Insertion Practices (CLIP)

- 31 states required by state law to report data on healthcare-associated infections through CDC’s National Healthcare Safety Network (NHSN)
  - Can report CLIP data
  - Started with Keystone project in Michigan ICUs
  - Results reported 2006
  - “Checklist”
    - Median rate central line associated bloodstream infection (CLABSI) decreased from 2.7 to 0 per 1000 catheter days; mean rate decreased from 7.7 to 1.4 per 1000 catheter days

NHSN CLIP Bundle requires “yes” to all

- Hand hygiene performed
- Appropriate skin prep
  - Chlorhexidine gluconate (CHG) if at least 60 days old
- Skin prep dry before insertion
- All 5 maximal sterile barriers used
  - Sterile gloves
  - Sterile gown
  - Cap worn
  - Mask worn
  - Large sterile drape covers patient’s entire body

Does CLIP bundle work?

- Central line associated bloodstream infection (CLABSI) rates reported to NHSN continue to decline
  - Data for ICUs reported since 1970s
- Experimental and observational data consistent regarding effect from CLIP improvement
- Given decline in rates, estimated that between 104,000 and 198,000 CLABSI avoided in non-neonatal critical care areas from 1990 - 2010

  Wise et al, Infect Control Hosp Epidemiol 2013

Neuraxial Procedures

- What is the recommended PPE to be worn by anesthesia when performing Neuraxial procedures (e.g. spinal anesthesia)?

Bacterial Meningitis After Intrapartum Spinal Anesthesia --- New York and Ohio, 2008--2009

- 5 cases of bacteria meningitis
  - Post partum women (13-22 hr following SAB or CSE)
  - 4 w/ CSF - *Streptococcus salivarius*
  - 1 death
- Hospital A
  - 3 patients, one anesthesiologist who routinely wore a mask, others in room did not
  - Indistinguishable PFGE in 2 of the pts
- Hospital B
  - 2 patients, one anesthesiologist who did not routinely wear a mask
  - PCR positive for *Strep. Salivarius* (culture neg, had received abx prophylaxis)
- Droplet Transmission most likely

  MMWR January 29, 2010;59(03):65-69
**Practice Advisory - Neuraxial**

- Aseptic techniques during preparation of equipment and the placement of neuraxial needles and catheters
  - removal of jewelry (rings, watches, etc)
  - hand washing
  - Wear cap, mask (covering mouth and nose)
    - Consider changing before each new case
  - sterile gloves
  - individual packets of antiseptics
  - sterile draping
  - sterile occlusive dressing

*Practice Advisory for the Prevention, Diagnosis, and Management of Infectious Complications Associated with Neuraxial Techniques* Anesthesiology 2010;112:530-545

**Multistate Outbreak Fungal Meningitis**

- 751 cases and 64 deaths reported from 20 states beginning September 2012 into 2013
- Caused by contaminated methylprednisolone acetate from the New England Compounding Center
  - *Exserohilium rostratum*
- Visible black particulate matter was seen in some recalled vials
- Other products compounded by NECC found to be contaminated with other organisms

*Possible actions for clinicians*

- Careful assessment of risks and benefits of invasive procedure
  - Informed consent
- Inspection of sterile products
Ebola 2014 (CDC)

- Filoviridae family (filovirus), Genus Ebolavirus
- Transmission: direct contact
  - broken skin or mucous membranes
  - blood and body fluids (urine, feces, saliva, vomit, and semen)
- Signs and symptoms:
  - fever (greater than 38.6 °C or 101.5 °F)
  - severe headache, muscle pain, vomiting, diarrhea, stomach pain, or unexplained bleeding or bruising.
  - appear anywhere from 2 to 21 days after exposure, 8 to 10 days most common.

<table>
<thead>
<tr>
<th>Country</th>
<th>Suspect</th>
<th>Confirmed</th>
<th>Deaths</th>
<th>Mortality (%)</th>
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<tr>
<td>Guinea</td>
<td>8/31/14</td>
<td>771</td>
<td>579</td>
<td>494</td>
</tr>
<tr>
<td></td>
<td>9/18/14</td>
<td>942</td>
<td>750</td>
<td>601</td>
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<tr>
<td>Liberia</td>
<td>8/31/14</td>
<td>1698</td>
<td>871</td>
<td>403</td>
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<td></td>
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<td>812</td>
<td>1459</td>
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<td>8</td>
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<td>5347</td>
<td>3095</td>
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Personal Protective Equipment (PPE)
- All persons entering the patient room should wear at least:
  - Gloves
  - Gown (fluid resistant or impermeable)
  - Eye protection (goggles or face shield)
  - Facemask
- Additional PPE (copious blood, body fluids, vomit, or feces)
  - Double gloving
  - Disposable shoe covers
  - Leg coverings
  - Aerosol generating procedures: N95 respirator or higher
If double gloving, don first pair of gloves (long) before gown.

**Sequence for removing personal protective equipment (PPE):**

1. **GOWN**
   - Fully cover torso from neck to knees, arms to end of wrists, and wrap around the back.
   - Fasten in back of neck and waist.

2. **MASK OR RESPIRATOR**
   - Secure ties or elastic bands at middle of head and neck.
   - Fit flexible band to nose bridge.
   - Fit snug to face and below chin.
   - Fit cheek respirator.

3. **GOOGLES OR FACE SHIELD**
   - Place over nose and eyes and adjust to fit.

4. **GLOVES**
   - Extend to cover wrist of isolation gown.

**Glove removal:**

- Grasp outside edge near wrist.
- Peel away from hand, turning glove inside-out.
- Hold in opposite gloved hand.
- Slide ungloved finger under the wrist of the remaining glove.
- Peel off from inside, creating a bag for both gloves.
- Discard.
- Perform hand hygiene.

- Double gloves: use this method for each pair.
- If using other PPE, remove gloves first.

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