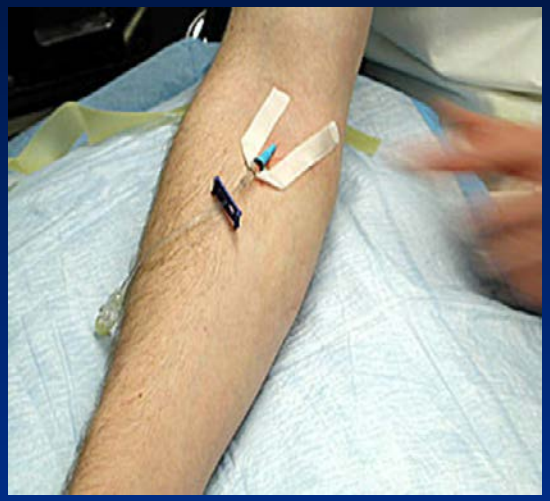
Prevention Strategies for Device-Related Infections



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Objectives

1. To understand the principles and need for antimicrobial prophylaxis for implantable devices
2. To outline the preventive strategies for device associated infections
3. To be aware of the research gaps in the prevention of device-associated infections

Disclosures

- Clinical reviewer and co-investigator: CADTH (*C. difficile* and MRSA projects)
- Grants/Contracts: AI-HS, EuroAspire Program, NCCID, PHAC, Sanofi
- Speaker or Participant (last 3 years): Pfizer, BioMerieux, Merck
- Consultant: WHO (AGISAR, GIPC Network)

Case presentation

- An 84 year old female admitted from Pacemaker Clinic to FMC Aug 2012 with pain and swelling over the pacemaker site
  - Background of osteoporosis, atrial fibrillation and anticoagulation, hypertension with LVH and LV diastolic dysfunction, moderate AI, moderate pulmonary hypertension, mild CAD
  - Pacemaker inserted for AF with slow ventricular response and syncope FMC June 2011 ; minor complication of proximal perforation of cephalic vein otherwise unremarkable
  - Meds: ASA, Bisoprolol, Enalapril, Furosemide, Levothyroxine, Nortriptyline, Warfarin, Nitropatch

Case presentation

- Previous admission RGH ICU Apr 2012 for fever, rigors and hypotension and found to have MSSA bacteremia ; all investigations negative for source including TTE ; treated parenteral cloxacillin
- Readmitted RGH MTU late May 2012 with lassitude and malaise ; blood cultures + MSSA ; full workup for source including TEE , nuclear medicine scans all negative
- Referred to HPTP for 6 weeks cloxacillin

Case presentation

- Physical findings of dusky erythema , warmth and bogginess over the pacermaker site
- Infectious diseases consulted and recommended aspiration
- US revealed complex fluid mass
- Small amount fluid obtained – many PMNs and scant g + cocci with growth *S. aureus*
- OR Aug 17 and pacemaker capsule, pacemaker and lead tip all + MSSA
- New VVI pacemaker on August 24 and cloxacillin for 6 weeks ; remained well 1 year

Types of Device-Related Infections

- Intravenous catheter associated (peripheral, midline, central, umbilical, tunneled and non tunneled, ports)
- Implantable cardiac devices (pacemakers, defibrillators, assist devices)
- Urinary tract catheters (upper and lower)
- Chest devices (ETTs, chest tubes, pleurocaths)
- GI tract (stents) and CNS devices (shunts and deep brain stimulators)
- Orthopedic implants

Guidelines

- CDC/HICPAC
- Compendium of Strategies to Prevent HAI(SHEA/IDSA/APIC/SIS/SHM/others)
- PHAC
- IHI 5 Million Lives from Harm
- Others
  - AHA: CV Implantable Electronic Device Infections
  - Hydrocephalus Clinical Research Network
  - Surgical Infection Prevention Project

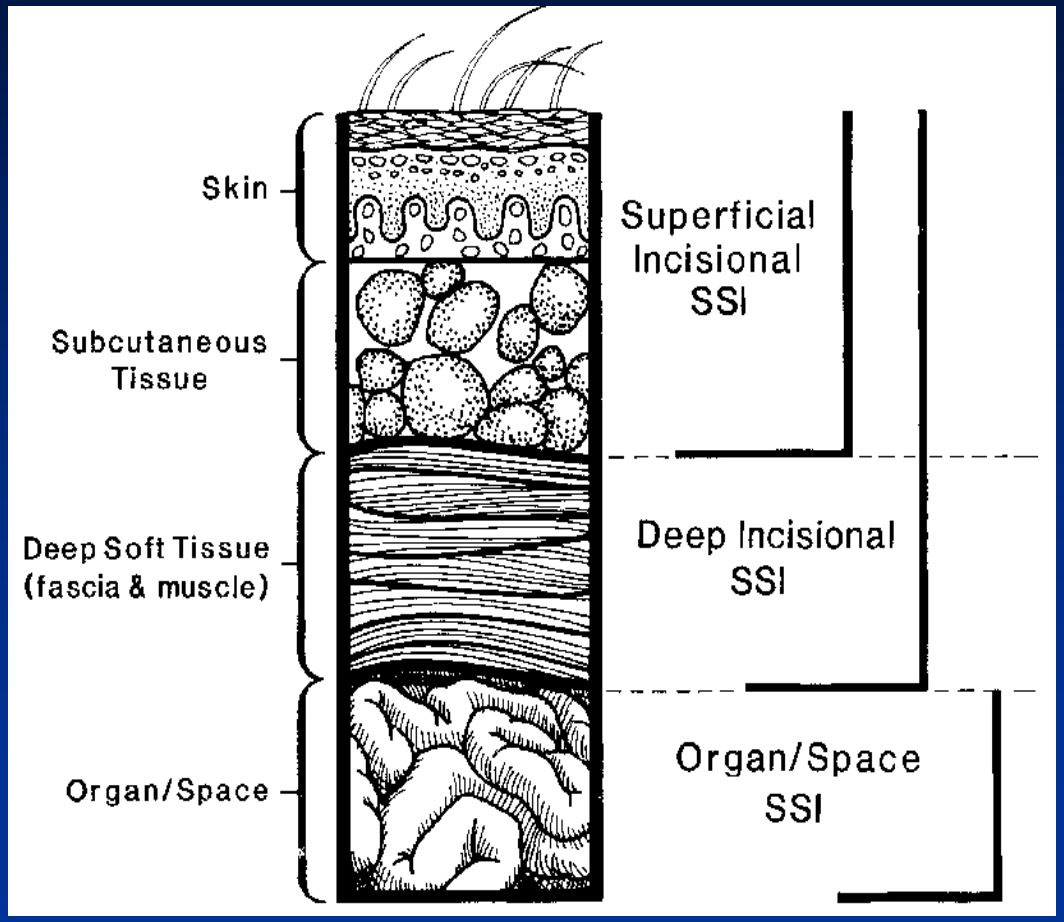
http://www.shea-online.org/PriorityTopics/CompendiumofStrategiestoPreventHAIs.aspx
http://www.ihi.org/engage/initiatives/Pages/default.aspx
http://phac-aspc.gc.ca/dpg-eng.php#infection
http://www.cdc.gov/hicpac/pubs.html

Pathogenesis of SSI

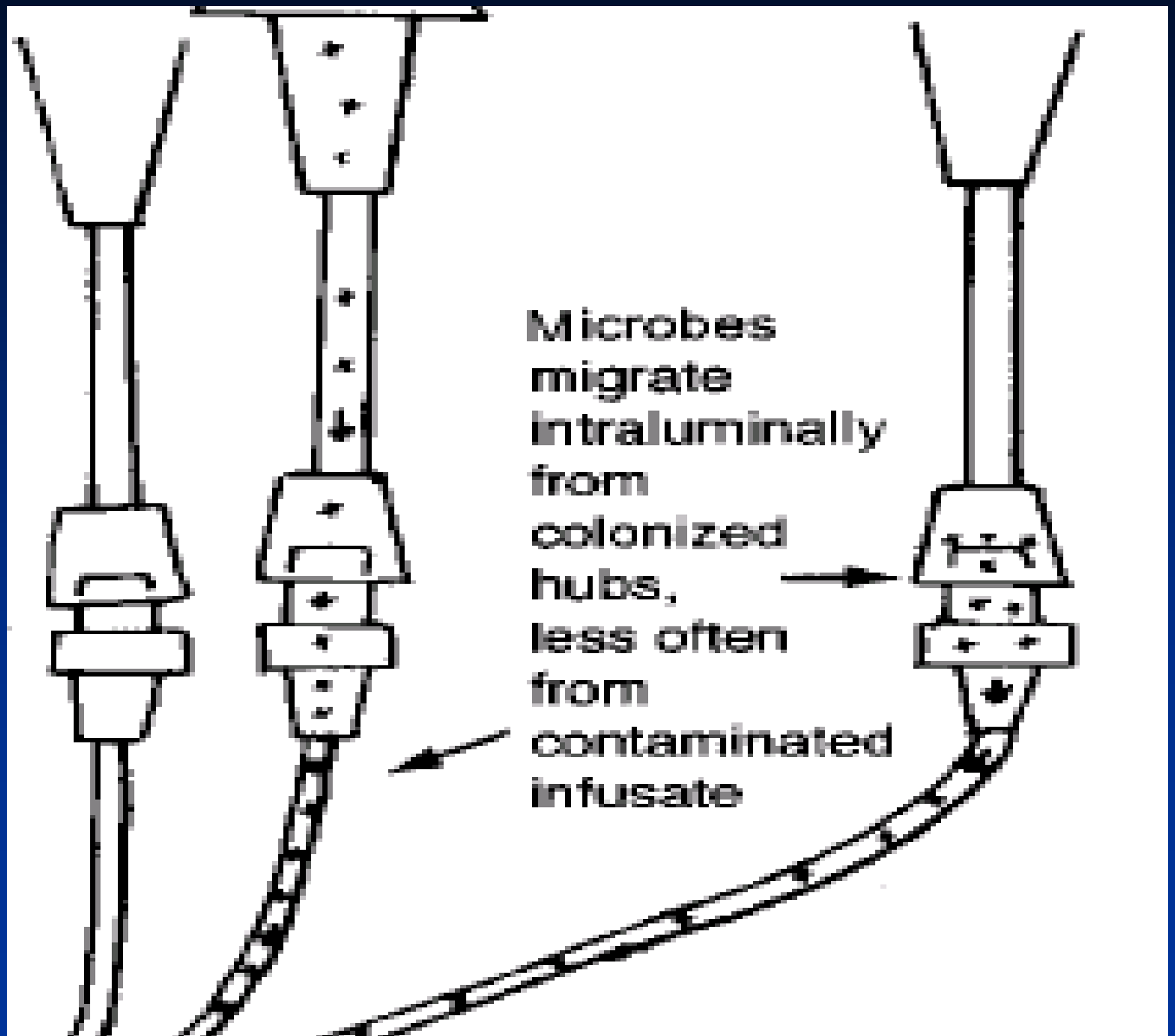
- $\frac{\text{Inoculum of bacteria } x \text{ Virulence}}{\text{Resistance of the host}}$ = SSI Risk
- Primary source of SSI pathogens: endogenous flora (skin, mucous membranes, hollow viscera)
- Exogenous sources of SSI pathogens
  - Operating room environment
  - Surgical personnel (mainly surgical team)
  - Tools, instruments, materials

Adapted from CDC

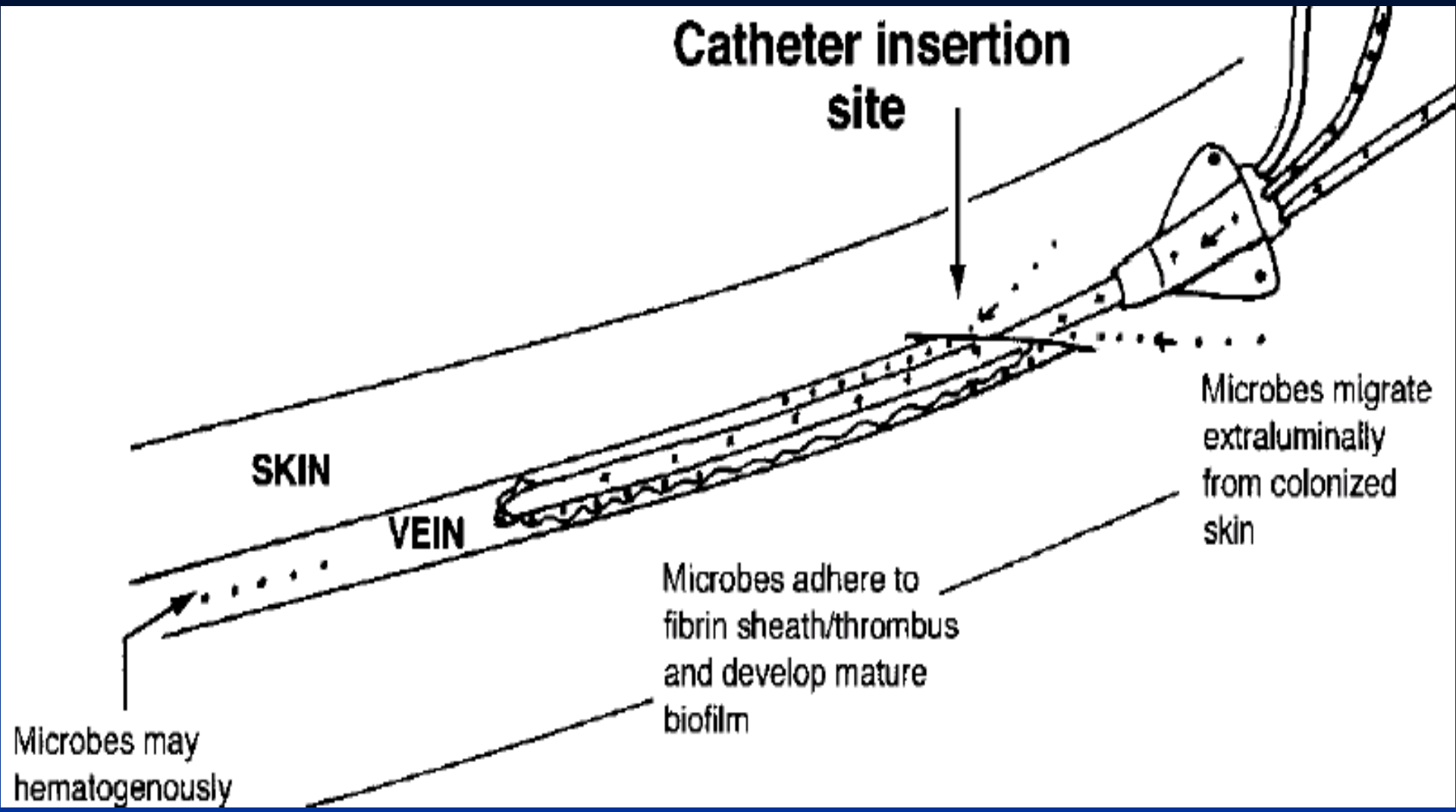
Cross Section of Abdominal Wall Depicting CDC Classification of SSI



Pathogenesis of CRI



Pathogenesis of CRI

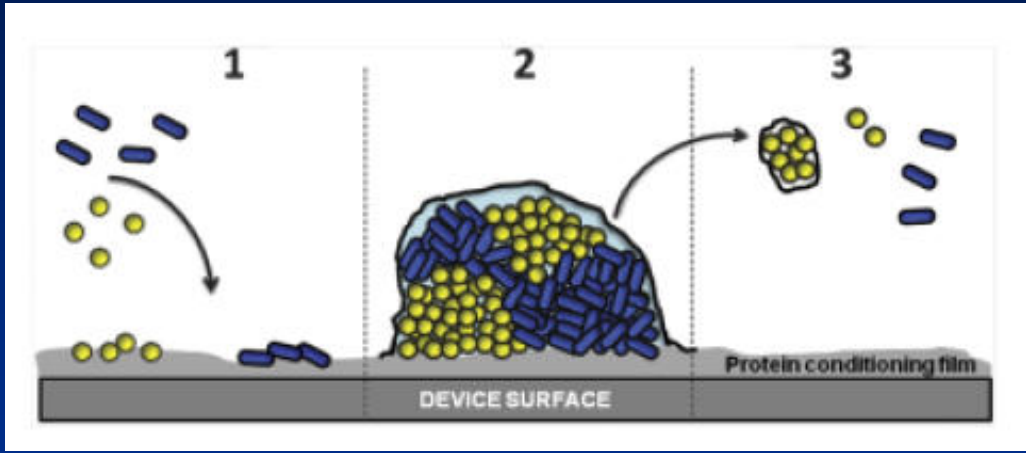


Pathophysiology of Device-Related Infection (SSI or CRI)

- Microbe related factors
- Host related factors
- Operative/insertion risk factors (includes device related)

Microbe Related Factors

- Inherent virulence
- Adherence properties
- Production of biofilms
- Innate immunity defences



Francolini I, Donelli G FEMS Immunol Med Microbiol 59 (2010) 227–238

Host Risk Factors

- Extremes of ages(age < 1 year or > 60 years)
- Poor nutritional status/obesity
- Co-morbidities and severity underlying illness
- Systemic steroids/chemotherapy/radiotherapy
- Coincident remote site infection
- Length of stay
- Perioperative transfusion of blood products
- Loss skin integrity (more for line-related)

Operative/Insertion Risk Factors

- Duration of scrub
- Pre-op shaving and skin antisepsis
- Duration of surgery/procedure
- Prophylaxis and its timing
- OR ventilation
- Sterilization of instruments
- Foreign material in site/presence drains
- Surgical technique

Device-Related Risk Factors

- Type of device material
- Frequency of surface irregularities
- Thrombogenecity of device materials
- Use of antibiotic or antiseptic impregnated devices
- Duration of use (longer duration > risk)
- Type and site of placement (cutdown > percutaneous; emergent > elective)

Preventing Device-Related SSIs

Preoperative

- Administer antimicrobial prophylaxis according to evidence-based standards and guidelines (I)
  - Begin administration within 1 hour before incision
  - Select agents based on the procedure and the most common pathogens
  - Discontinue agent within 24 hours
- Do not remove hair at the operative site unless necessary and no razor use (II)
- Use alcohol-containing preoperative skin prep if no contraindication exists (I)
  - Alcoholic chlorhexidine may be preferred

Deverick J. et al . Strategies to Prevent Surgical Site Infections in Acute Care Hospitals: 2014 Update. Infection Control, 35, pp 605-627 doi:10.1086/591064

http://journals.cambridge.org/abstract_S0195941700093267

Principles of Antimicrobial Prophylaxis

- The operation should carry a significant risk of SSI and/or cause significant bacterial contamination or an SSI would be catastrophic
- Use an agent that is safe, inexpensive, and bactericidal for likely pathogens
- The shortest course of the most effective and least toxic antibiotic should be used
- The antibiotic chosen must achieve concentrations > than the MIC of the suspected pathogens in the wound site and be present at the time of incision

Prophylaxis: Agents, Timing

- 1st and 2nd generation cephalosporins most commonly used agents
- Avoid broad spectrum agents
- General consensus: Administer within 60 min before incision
  - Previously except C-section, after cord clamping but now before clamping (2010)
  - Except vancomycin, infusion time may take longer

Bratzler DW, Dellinger EP, Olsen KM, et al G, Clinical Practice Guidelines for Antimicrobial Prophylaxis in Surgery Am J Health-Syst Pharm. 2013; 70:195-283.

Preoperative

- Educate surgeons and perioperative personnel about SSI prevention(III)
  - Education on sterile technique and surgical scrubbing especially housestaff
- Educate patients and their families about SSI prevention (III)
- Implement policies/practices that align with evidence-based standards (II)

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Preoperative

- Implement policies/practices that align with evidence-based standards (II)
  - Optimal preparation and disinfection of the operative site and the hands of the surgical team members
  - Adherence to hand hygiene prior to application of skin prep in the OR
  - Reduce unnecessary traffic in the OR
  - Appropriate care and maintenance of operating rooms, including appropriate air handling and optimal cleaning and disinfection of equipment and the environment

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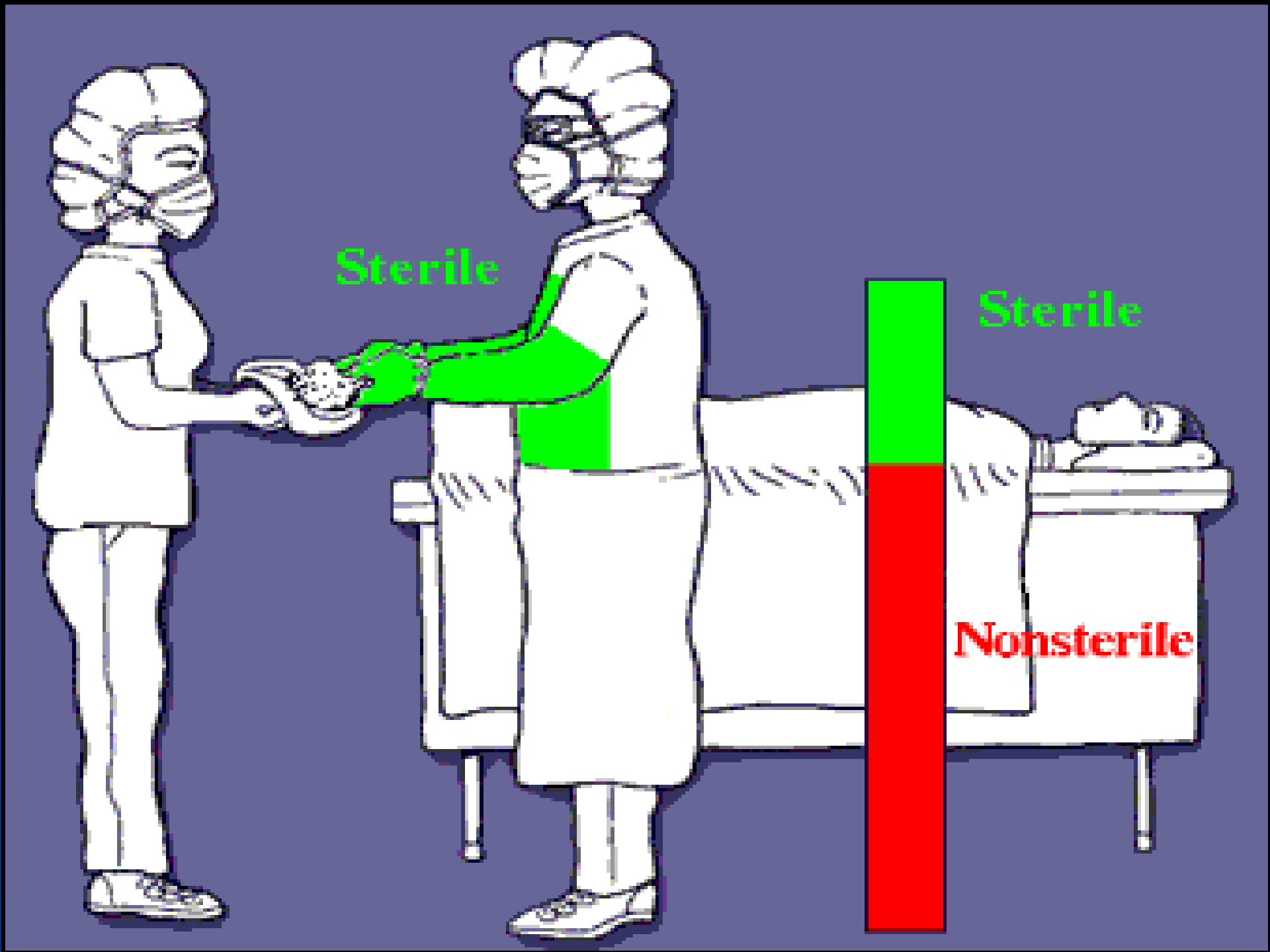
Sterile
Sterile
Nonsterile

Perioperative

- Maintain normothermia (temperature of 35.5^{o} C or more) during the perioperative period (I)
  - Mild hypothermia risk for SSI
  - Also reduces intraop blood loss
- Optimize tissue oxygenation by administering supplemental oxygen (I)

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Perioperative

- Use impervious plastic wound protectors for gastrointestinal and biliary tract surgery (I)
- Use a checklist (eg WHO) to ensure compliance with best practices (I)
- Implement policies/practices that align with evidence-based standards (II)
  - Reduce unnecessary traffic in the OR (maintain theatre discipline)
  - Appropriate care and maintenance of operating rooms

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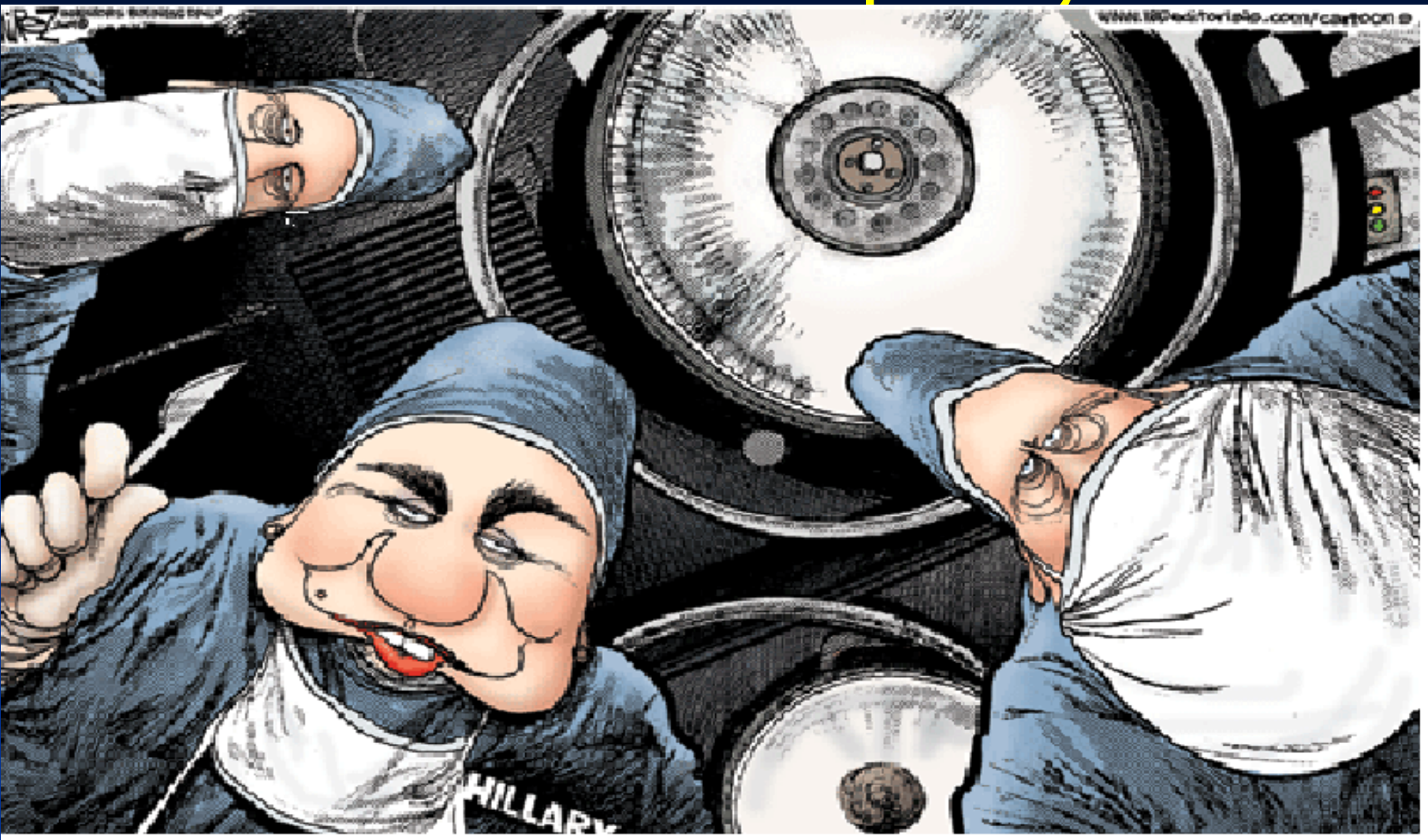
What is theatre discipline ?

- Poor theatre discipline[1,2]
  - Jewelry wearing and artificial nails
  - Open isolation gowns in theatre
  - No masks in theatre
  - Personal cameras in OR adjacent to incisions
  - Improper handling of medical devices
  - Too many personnel in the theatre
  - Freqent and unnecessary entry/exit from OR

[1]Recommended practices for preoperative patient skin antisepsis. In: Perioperative Standards and Recommended Practices. Denver, CO: AORN, Inc; 2013:75-90

[2]Crolla RMPH, van der Laan L, Veen EJ, Hendriks Y, van Schendel C, et al. (2012) Reduction of Surgical Site Infections after Implementation of a Bundle of Care. PLoS ONE 7(9): e44599. doi:10.1371/journal.pone.0044599

Dress code policy



Postoperative Factors

- Control blood glucose during the immediate postoperative period (I/II)
- Perform surveillance for SSI (I)
- Increase the efficiency of surveillance using automated data (II)
- Provide feedback of SSI rates (II)
- Provide feedback on rates of compliance with process measures (III)

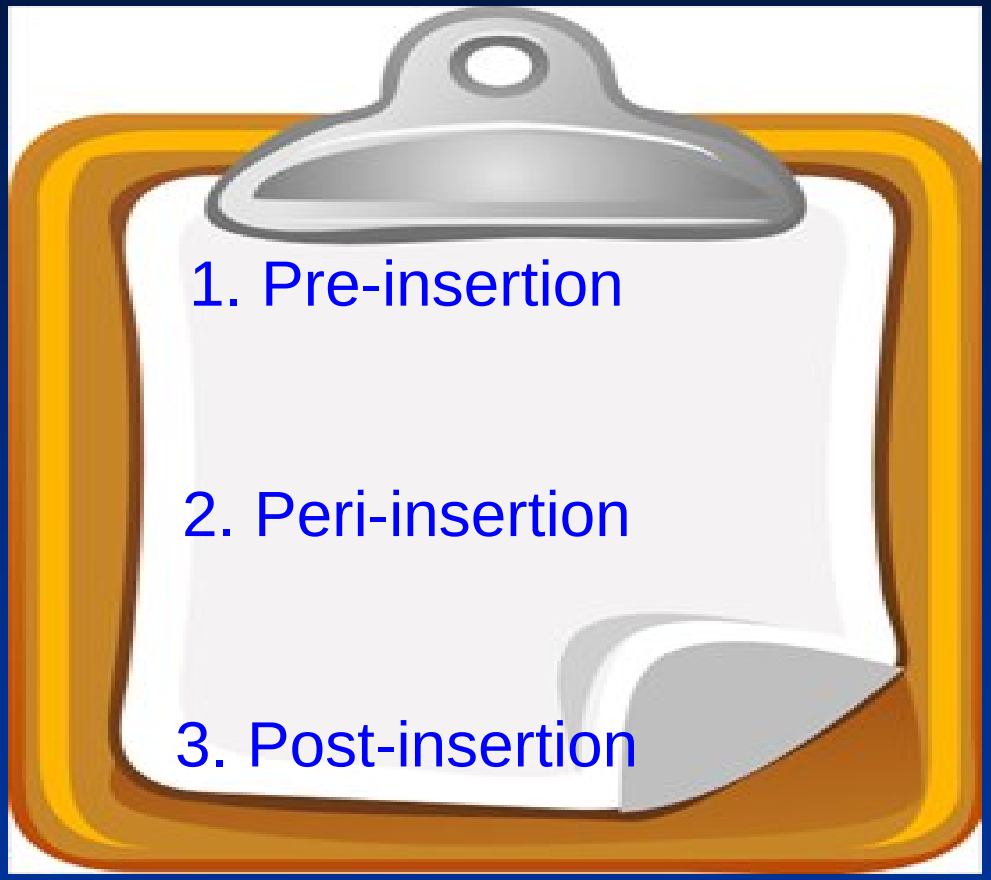
Unresolved Issues and Research Gaps

- No standard protocol for preoperative showers/baths with an antiseptic agent the night before surgery
- Admission screening *S. aureus*
- RCTs vs quasi-experimental and cohort studies on issues of theatre discipline - major ethical issues
- Optimal device materials to prevent infection

1Perl TM, Cullen JJ, Wenzel RP, et al Intranasal mupirocin to prevent postoperative Staphylococcus aureus infections. N Engl J Med. 2002 Jun 13;346(24):1871-7.

2Webster J, Osborne S. Preoperative bathing or showering with skin antiseptics to prevent surgical site infection Cochrane Database Syst Rev. 2012 Sep 12;9:CD004985. d10.1002/14651858.CD004985.pub4

Preventing Central Line - Related Infections



Pre-Insertion

- Minimize unnecessary CVC (III)
- Require education of HCEs involved in insertion, care, and maintenance of CVCs (II)
  - Complete educational program and renew at intervals
  - Credentialing
  - Use of simulation
- Bathe ICU patients over 2 months of age with a chlorhexidine preparation daily (I)
  - Role in non ICU patients unkwown
  - Unresolved issue in pediatric patients < 2 months

Marschall et al Strategies to Prevent Central Line–Associated Bloodstream Infections in Acute Care Hospitals: 2014 Update Infection Control / Volume 35 / Issue 07 / July 2014, pp 753 – 771 DOI: 10.1086/591059, Published online: 02 January 2015

Peri-Insertion

- Process in place to ensure adherence to infection prevention practices at the time of CVC insertion (II)
  - Document adherence to aseptic technique (checklist or direct observation)
- Hand hygiene prior to insertion (II)
- Avoid femoral site (I)
- Use of pre-loaded cart for supplies (II)
- Use US guidance for IJ (II)
- Maximal barrier precautions (II)
- Alcoholic chlorhexidine antiseptic for skin preparation (I)

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Post-Insertion

- Ensure appropriate nurse-to-patient ratio and limit the use of float nurses in ICUs (I)
- Disinfect catheter hubs, needleless connectors, and
- injection ports before accessing the catheter (II)
  - Use CHG or alcohol or PI
  - Friction for no < 5 sec
  - Monitor compliance
- Remove nonessential catheters (II)
- For non-T CVCs ∆transparent dressings and perform site care with a GHG antiseptic q5-7d; gauze q2d; immediately if soiled, loose, or wet (II)

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Post-Insertion

- Replace administration sets not used for blood, blood products, or lipids at intervals no > 96h (I)
- Use antimicrobial ointments for hemodialysis catheter-insertion sites (I)
  - PT triple or PI prefered
  - Do not use mupirocin ungt
- Perform surveillance for CLABSI in ICU and non-ICU settings (I)
  - Measure the unit-specific incidence of CLABSI (CLABSIs per 1,000 catheter-days) and report regularly
  - Benchmark internally and externally

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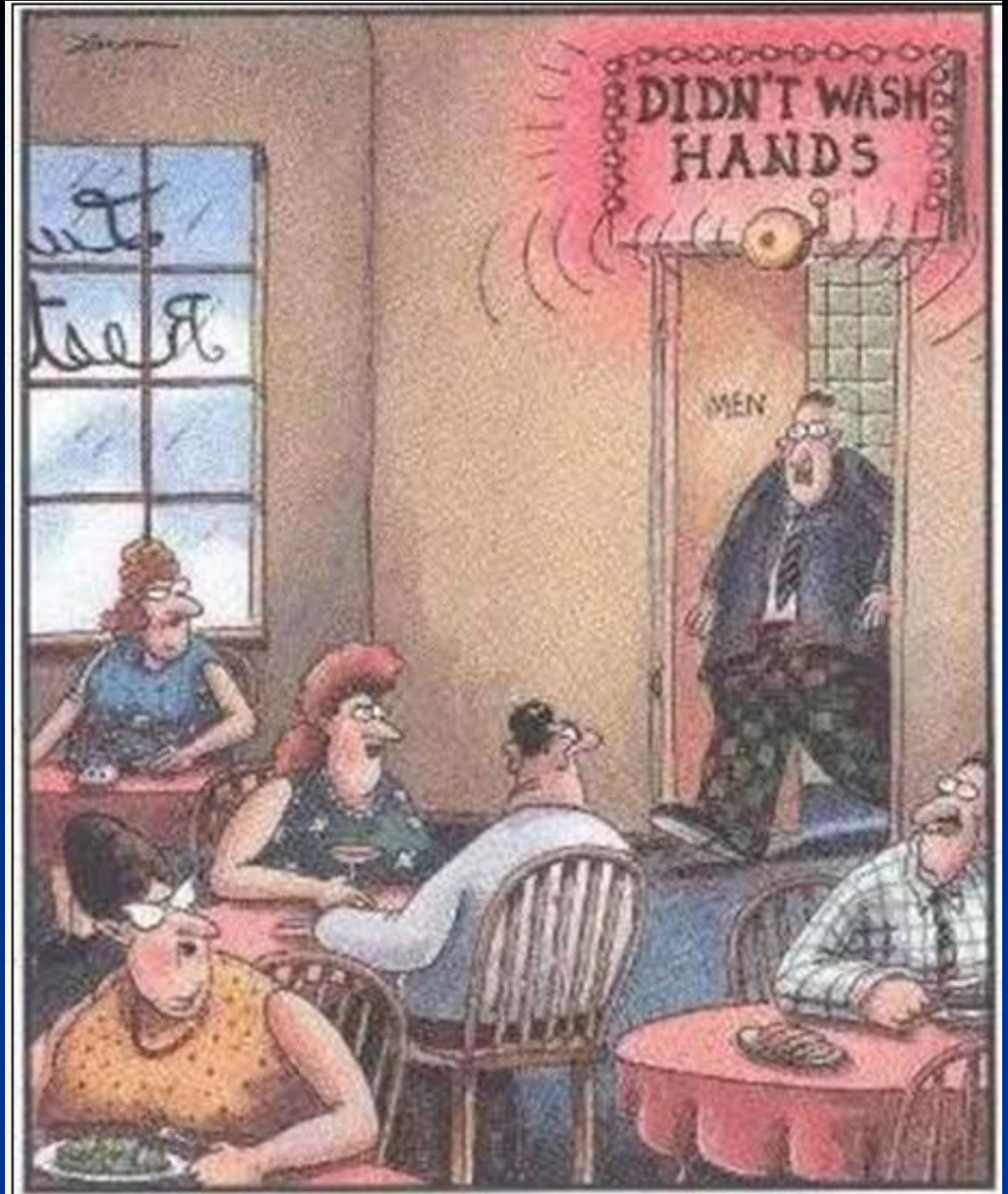
Unresolved Issues and Research Gaps

- Recognition of limitations of the data
- Use of antiseptic and antimicrobial impregnated catheters/hubs and risk of resistance
- Use of antiseptic impregnated dressings if CHG washes used
- Extent of use of antibiotic locks for CVCs
- Routine use needleless connectors to reduce infection risk
- Use of teams for CVL insertion
- Transparent vs dry gauze dressings
- Rise of chlorhexidene and silver resistance


DIDN'T WASH HANDS
MEN