



# Cleaning, Disinfection, and Sterilization



Basics of Infection Prevention  
2-Day Mini-Course  
2016

# Objectives

- Describe basic principles of cleaning, disinfection, sterilization
- Identify when to use cleaning, disinfection, or sterilization
- Describe how to monitor cleaning, disinfection and sterilization processes

# Terminology

- Cleaning
  - general removal of debris (dirt, food, feces, blood, saliva and other body secretions)
  - reduces amount of organic matter that contributes to proliferation of bacteria and viruses
- Disinfection
  - removes most organisms present on surfaces that can cause infection or disease
- Sterilization
  - the killing or removal of all organisms

# Cleaning, Disinfection and Sterilization in Healthcare Settings

- Practice standards are based on Spaulding's Classification system
- Healthcare devices and equipment designated as
  - Critical
  - Semi-critical
  - Non-critical
- Categories define level of reprocessing required

# Critical Items

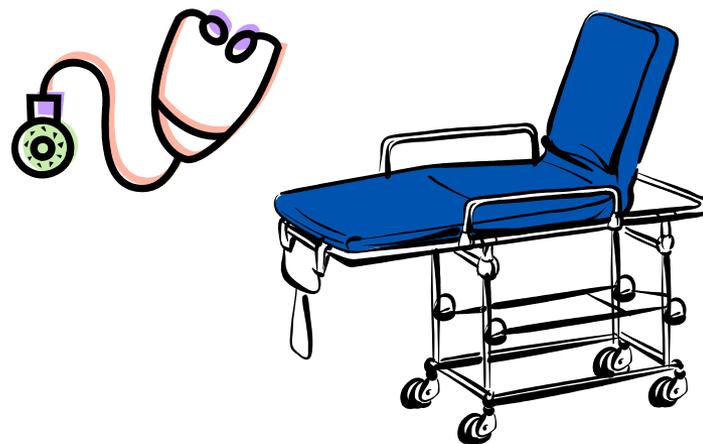
- Require sterilization
- Includes items that **enter sterile tissue or the vascular system**
- Examples include surgical instruments and accessories, biopsy forceps, cardiac and urinary catheters, implants, needles

# Semi-Critical Items

- Require minimum high level disinfection (or sterilization)
- Includes items in contact with **non-intact skin or mucous membranes**
- Examples include respiratory therapy equipment, anesthesia equipment, flexible and laryngoscopes, bronchoscopes, GI endoscopes, cystoscopes, vaginal ultrasonic probes
- Cleaning process must precede high-level disinfection

# Non-Critical Items

- Require intermediate-level or low-level disinfection
- Includes items in contact only with **intact skin**
- Examples include BP cuffs, stethoscopes, durable mobile patient equipment



# Environmental Cleaning

- Patient environment can facilitate transmission of bacteria and viruses
  - By direct contact
  - On hands of healthcare personnel
- Contaminated surfaces increase potential for transmission of bacteria and viruses between patients
- Items categorized as non-critical (intermediate or low disinfection) or require cleaning only



**X** represents VRE culture positive sites



Abstract: Risk of Hand and Glove Contamination after Contact with a VRE (+) Patient Environment. Hayden M, ICAAC, 2001, Chicago

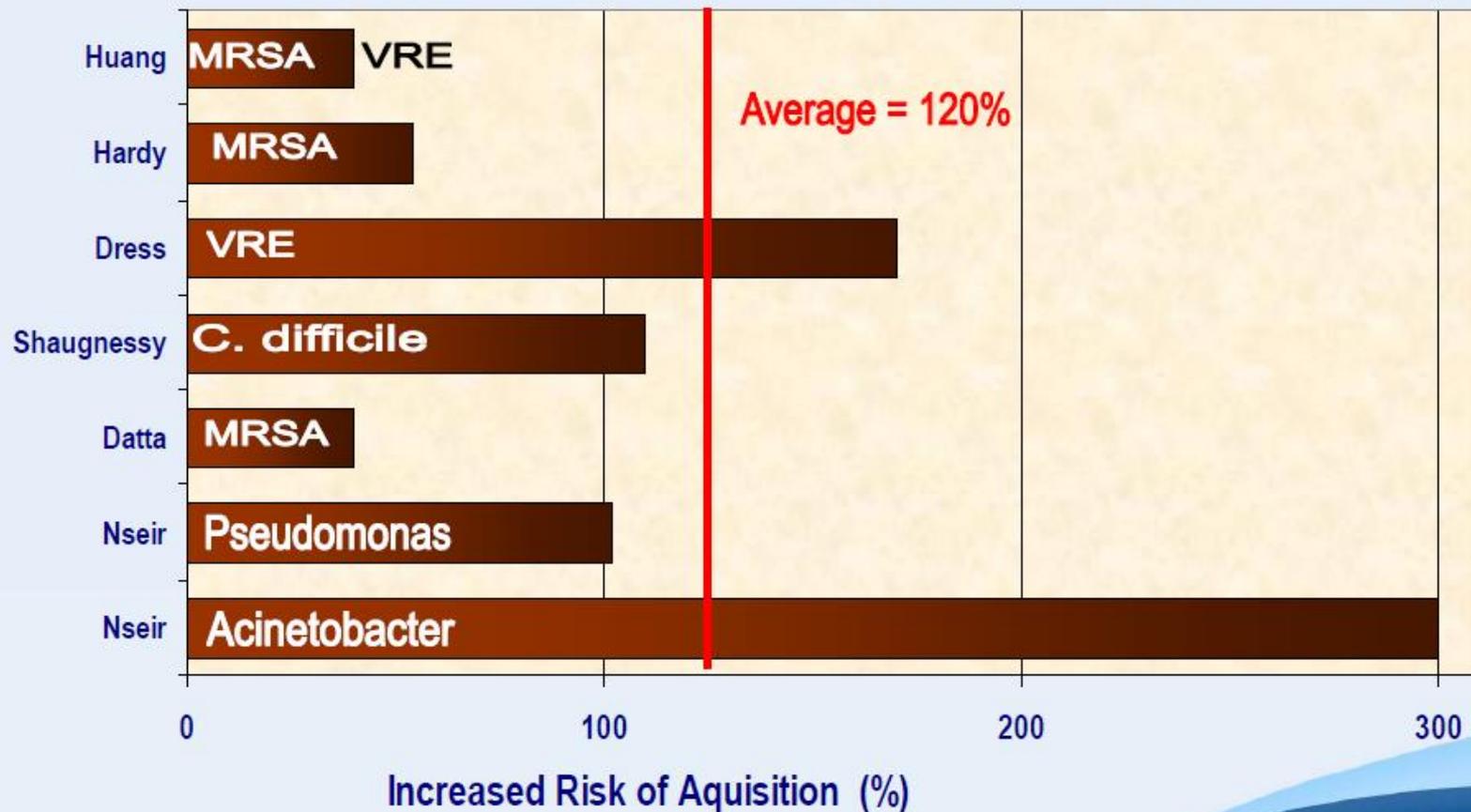
# Policy Considerations

- Include in policy all surfaces and equipment that can reasonably be expected to be contaminated by bacteria (high touch surfaces)
- Define responsibility and frequency for cleaning and disinfecting patient care equipment and surfaces
- Monitor compliance with policy
- Staff should be able to answer question “How do you know whether this item has been cleaned and/or disinfected?”
- Cleaned/disinfected items should be labeled (date/time)

# High Touch Surfaces in Patient Rooms

- Considered non-critical
- Must be cleaned *then* disinfected on a regular basis
- Examples include:
  - Bedrails
  - Call bell
  - Telephones
  - TV remote
  - IV pump
  - IV poles
  - Toilet, commode chair
  - Overbed table
  - Light switches
  - Doorknobs
  - Respiratory and other bedside equipment
  - Computer keyboard
  - Chairs

## Increased acquisition risk from prior room occupant 6 studies as of January 2011



-Carling PC, Bartley JM. Am J Infect Control 2010;38 S41-50.

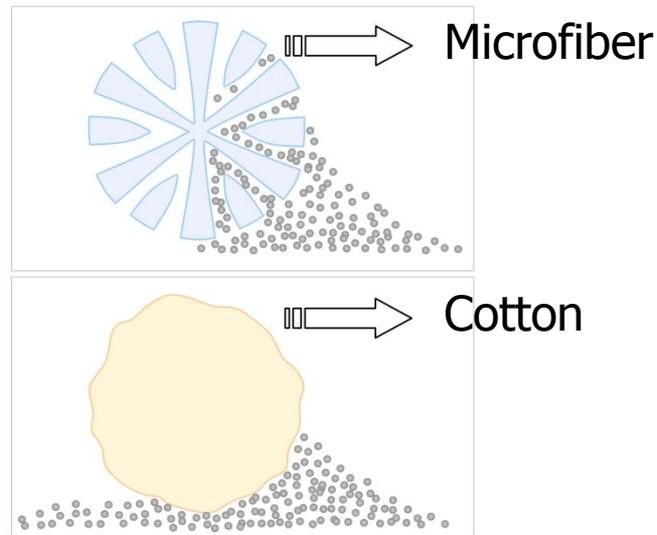
## Items Requiring *only* Cleaning

- Floors, walls, and windows
- Chairs and other furniture used by individuals who are clothed
- Private offices and other non-public, non-patient care areas
- Bed curtains should be changed when soiled and w/ terminal cleaning

Clarify in policy what needs to be cleaned and not necessarily disinfected

# Use Microfiber for Cleaning

- Densely constructed synthetic strands  $\sim 1/16^{\text{th}}$  the diameter of a human hair
- Attracts dust, cleans  $\sim 50\%$  better than comparable cotton
- Easier to use, lighter, designed for repeat usage



HICPAC Disinfection &  
Sterilization Guideline  
2008, Rutala

# Monitor Environmental Cleaning Processes

- Bioluminescence (outcome measure)
  - Monitors for light emissions produced if organism present
  - Results difficult to interpret because it is unknown whether organism remains viable and thus transmissible
  - Expensive
- Fluorescence (process measure)
  - Monitors for chemical markers that fluoresce with ultraviolet (black) light if not removed during cleaning
- Culturing
  - Should *not* be done except during some outbreak investigations
- Visual inspection
  - Make routine rounds and provide feedback to frontline staff



# Linens

- All linen handled as if contaminated with blood or body fluids (Standard Precautions)
  - Bag linen at point of use
  - Wear PPE when sorting and agitate minimally
- Laundry equipment must be maintained to prevent microbial contamination\*
- New laundry technologies allow linen washing without requirements for hot water and chlorine
  - Hot water - 160° F x 25 min
  - Cold water - 71-77° F with 125 ppm chlorine bleach rinse or equivalent detergent
  - Detergents not required to have stated anti-microbial claims\*



\*Manufacturer's instructions for use must be followed

# Cleaning, Disinfection, and Sterilization of Medical Instruments and Devices

-  You CANNOT achieve disinfection or sterilization without pre-cleaning
- As organic material dilutes disinfectants, bioburden must be reduced for processes to be effective

**Clean** all medical instruments and devices as a first step

- Remove visible soil
- May need to disconnect or separate instrument parts
- Avoid organic material drying on equipment by rinsing or soaking in an enzymatic solution

# Personal Protection

When cleaning soiled medical instruments, wear

- Long sleeved impervious gown
- Eyewear
- Mask or mask with face shield
- Gloves
- Cap
- Chemical goggles (when mixing or changing solution)



# Disinfection

- Eliminates or kills most bacteria, many virus types, some fungi (not prions)
- Cannot be accomplished without first cleaning
- Time-dependent process
- Levels of disinfection - high, intermediate, or low
- Hospitals must use EPA-approved product for desired level of disinfection
  - Has minimally a tuberculocidal label claim

## Disinfection - continued

- Follow manufacturer's recommendations to achieve disinfection and to avoid medical device damage method
  - Use correct dilution – more is not better!
  - Use correct contact time
  - Use correct temperature
- Understand employee and environmental safety issues
  - Do not exceed exposure limits
  - Know permissible exposure levels
  - Assess compatibility with gloves, basins, other products

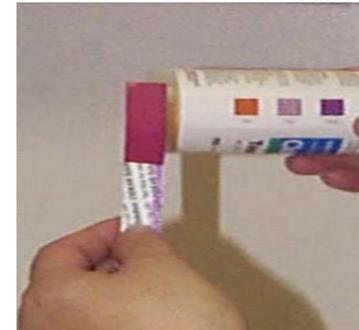
# EPA Registration of Disinfectants

- Labeled as high level vs. intermediate vs. low level
- May include degrees of approval
  - Limited approval, e.g. kills Hepatitis B and HIV but not approved for spores
- Select disinfectant based on what you are trying to accomplish
  - Environmental vs. medical device disinfection
- Search EPA website by product name

[www.epa.gov/oppad001/chemregindex.htm](http://www.epa.gov/oppad001/chemregindex.htm)

# High-level Disinfection

- EPA approved products include gluteraldehyde, ortho-phthaldehyde(OPA), peracetic acid & hydrogen peroxide
- Ensure achievement of temperature requirements
- Test product prior to each use
  - Can get diluted with frequent use
  - Follow facility policy
  - Test strips expire; monitor dates
- Change product as indicated by test and as manufacturer requires
- Maintain log records
- Ensure competency of staff



# Endoscopes/Bronchoscopes

- United States
  - An estimated 14.4 million gastrointestinal endoscopic procedures are performed annually in the US, including 500,000 ERCPs <sup>1</sup>
  - Since 2013, there have been 69 infections with CRE related to duodenoscopes; 13 deaths may have been partially attributable to the infection that developed after exposure to the scope <sup>2</sup>
- Professional organization guidelines require
  - Minimum high-level disinfection
  - Ensure competency of personnel performing process
- Outbreaks associated with failure to comply with guidelines for disinfection/sterilization



<sup>1</sup> ASGE, FDA, March 5, 2015

<sup>2</sup> CDC 2014, 2015 Communications

# Endoscopy/Bronchoscopy-Associated Infections

## Endoscopy

- More healthcare-associated outbreaks are associated with endoscopes than any other medical device
- Scopes acquire high levels of contamination with use (bioburden) due to high bacteria levels in areas explored

## Bronchoscopy

- Evidence of transmission of pathogens from inadequately processed bronchoscopes including
  - Mycobacteria – resistant to many disinfectants
  - Pseudomonas aeruginosa – problematic MDRO

Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008

[http://www.cdc.gov/hicpac/Disinfection\\_Sterilization/toc.html](http://www.cdc.gov/hicpac/Disinfection_Sterilization/toc.html)



# The 5 Steps of Endoscope Re-Processing

***Key concept: Perform steps in order. Do not skip steps!***

## 1. Clean

- Remove debris/tissue which can impede disinfection process, flush all lumens (water & enzymatic cleaner)

## 2. High Level Disinfection

- Perfuse through ALL channels with disinfectant

## 3. Rinse all channels

- Sterile or filtered water, follow with alcohol rinse

## 4. Dry: force air through all channels

## 5. Store

- Hang vertically in a closed cabinet to promote drying and avoid recontamination

# Factors Leading to Outbreaks from Endoscope/Bronchoscope Contamination

- Contaminated water supply
- Contaminated brushes for cleaning scope lumens
- Improper manual cleaning prior to disinfection
- Biofilm inside automatic washer
- Improper use of automatic washer
- Contaminated or expired disinfection reagent
- Inability or neglect to clean the suction channel
- Mechanical or design issues related to the endoscope/bronchoscope



Elevator shaft on a duodenoscope

# CDC Interim Guidelines for Reprocessing Duodenoscopes Used for Retrograde Cholangiopancreatography (ERCP) Procedures

- Inspect and manually clean the elevator mechanism
  - Perform in open/raised and closed/lowered positions
- Ensure that all channels of the scope and elevator mechanism are thoroughly dried before storage
- Use of ERCP scope culturing to ensure effectiveness of reprocessing
  - See CDC suggested algorithm
  - Take remedial action if a scope is culture-positive for high concern organisms or if unacceptable colony counts of low-concern organisms



# Environmental Disinfectants

- Phenolics
  - “Gold Standard” in healthcare
  - Toxicity concerns prohibit use in nurseries, NICU
  - Does not kill spores
- Quaternary ammonium compounds
  - Approved for specific pathogens (read the label!)
  - Affected by water hardness
  - Affected by bioburden
  - PPE use required (estrogen-like effect with contact, use gloves)

<https://www.federalregister.gov/articles/2007/09/06/E7-17634/residues-of-quaternary-ammonium-compounds-di-n-alkyl-c8#h-23>

Correct dilution and wet contact time is critical to effectiveness.

# Environmental Disinfectants - continued

- Iodophors
  - Can be used in food preparation areas
  - Inactivated by organic materials, e.g. blood
  - Can stain surfaces
- Chlorine (bleach)
  - Inactivated by organic materials, e.g. blood
  - Kills spores, e.g. *C. difficile*
  - Corrosive
  - Highly toxic (deadly) if combined with ammonia

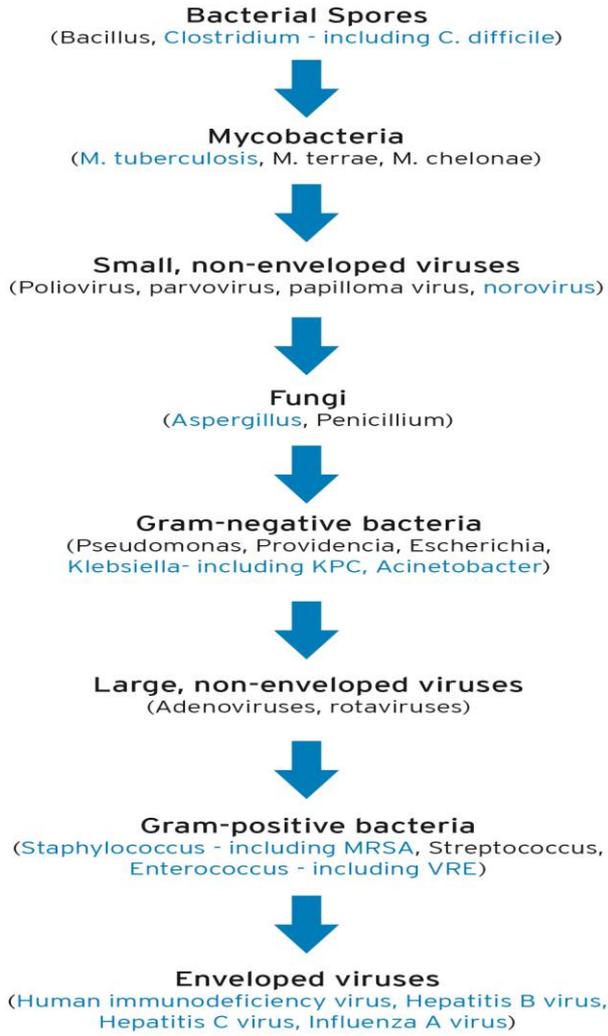
## Environmental Disinfectants - continued

- Disinfectant spray-fog techniques for antimicrobial control in hospital rooms
  - Unsatisfactory method of decontaminating air and surfaces
  - Not recommended for general infection control in routine patient-care areas
- Ultraviolet Radiation
  - Dependent on strength and duration of exposure to light, 'line of sight', how well microorganism can withstand UV
  - Limited to destruction of airborne organisms, inactivation of microorganisms on surfaces, and water purification



MORE RESISTANT

DESCENDING ORDER OF RESISTANCE OF MICROORGANISMS TO GERMICIDES



MOST SUSCEPTIBLE



Demonstrating the susceptibility of organisms to specific disinfectant types

Adapted from: McDonnell G. Antisepsis, disinfection and sterilization: types, action and resistance. Washington, DC: ASM Press 2007.  
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# Sterilization

Achieved by

- Steam
- Dry Heat
- Ethylene Oxide
- Peracetic Acid
- Plasma Gas (vaporized hydrogen peroxide)
- Glutaraldehyde (using higher concentrations and exposure times than for high-level disinfection)



# Steam Sterilization - Autoclave

- Achieves rapid heating and penetration
  - Short exposure times (<20 minutes) but temperature must be maintained throughout
  - No toxicity to workers
  - Inexpensive
  - Can damage delicate instruments
- Items to be sterilized must be
  - Clean and free of protein (blood) or other organic material
  - Packaged so that the steam can penetrate
- Autoclave must be loaded correctly

# Rapid Cycle or Flash Sterilization

- “Unwrapped” steam sterilization
- Should only be used when absolutely necessary
  - **Do not flash whole trays of instruments**
  - Items must be used immediately
  - Avoid flash sterilization by keeping adequate supply of frequently dropped items
- Maintain records or “flash logs”
  - Include all implants
  - Requires same monitoring processes as routine steam sterilization in hospital
  - Use to support need for additional instruments

# Monitoring Sterilization

- Mechanical Indicators
  - Gauges, displays, printouts
  - Indicates if device working properly
  - Not indicator of sterility
- Chemical Indicators
  - Change color with timed exposure to heat, steam
  - Not indicator of sterility
  - Used to show items have gone through sterilization process
- Biological Indicators
  - Indicator of sterility
  - Demonstrates bacterial spores on test strips or in vials/containers have all been killed
  - Results can be available in 1 hour



# Storage of Sterile Items

- Protect sterility until ready to use
  - Store to protect packages from dust, moisture, falling on floor
  - Transport only covered, dry packages
  - Handle to protect package integrity
    - Refrain from crushing packages or 'rubber-banding' them for storage
    - Wrap sharp points in gauze
- Rotate sterile items first in, first out
- Store and label for effective recall system
- Expiration date vs. Event-related sterilization
  - Needs a program flex from L&C



# IP Role in Cleaning, Disinfection, and Sterilization

- Know the processes; update the policies
- Know directors of environmental services, sterile processing, operating room, endoscope services
- Know where all sterilization and disinfection is being done
  - May include
    - Radiology
    - GI dept
    - Cardiac cath lab
    - Wound care center
    - Outpatient clinics
    - Emergency room
    - Same day procedures
    - Ambulatory surgery
- Ensure staff know and follow contact times for products
  - Per manufacturer guidelines; on labels

# Questions?

For more information, please contact any  
HAI Liaison Team member

Thank you

