Cleaning, Disinfection, and Sterilization

Basics of Infection Prevention
2-Day Mini-Course
2015

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

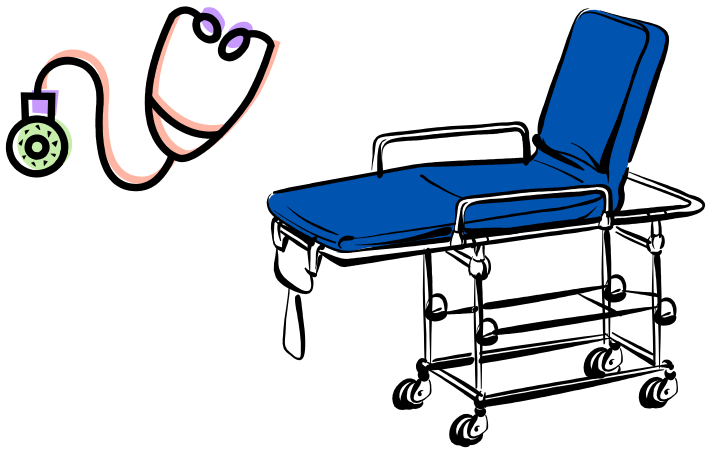
- Require sterilization
- Includes items that enter sterile tissue or the vascular system
- Examples include surgical instruments and accessories, biopsy forceps, cardiac and urinary catheters, implants, needles

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 larnygoscopes, bronchoscopes, GI endoscopes, cystocopes, 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

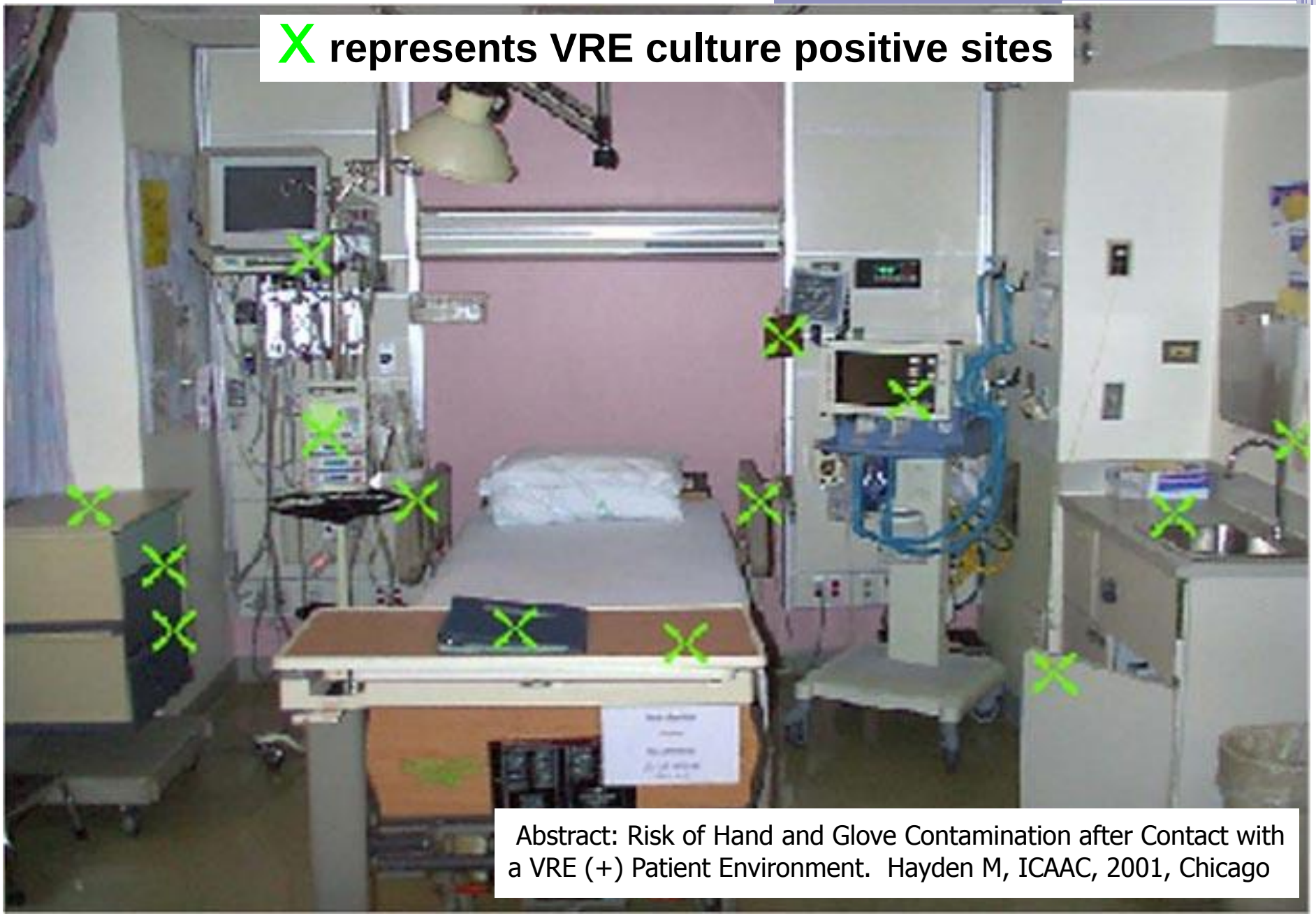


CDPH California Department of PublicHealth

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

CDPH California Department of PublicHealth



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)

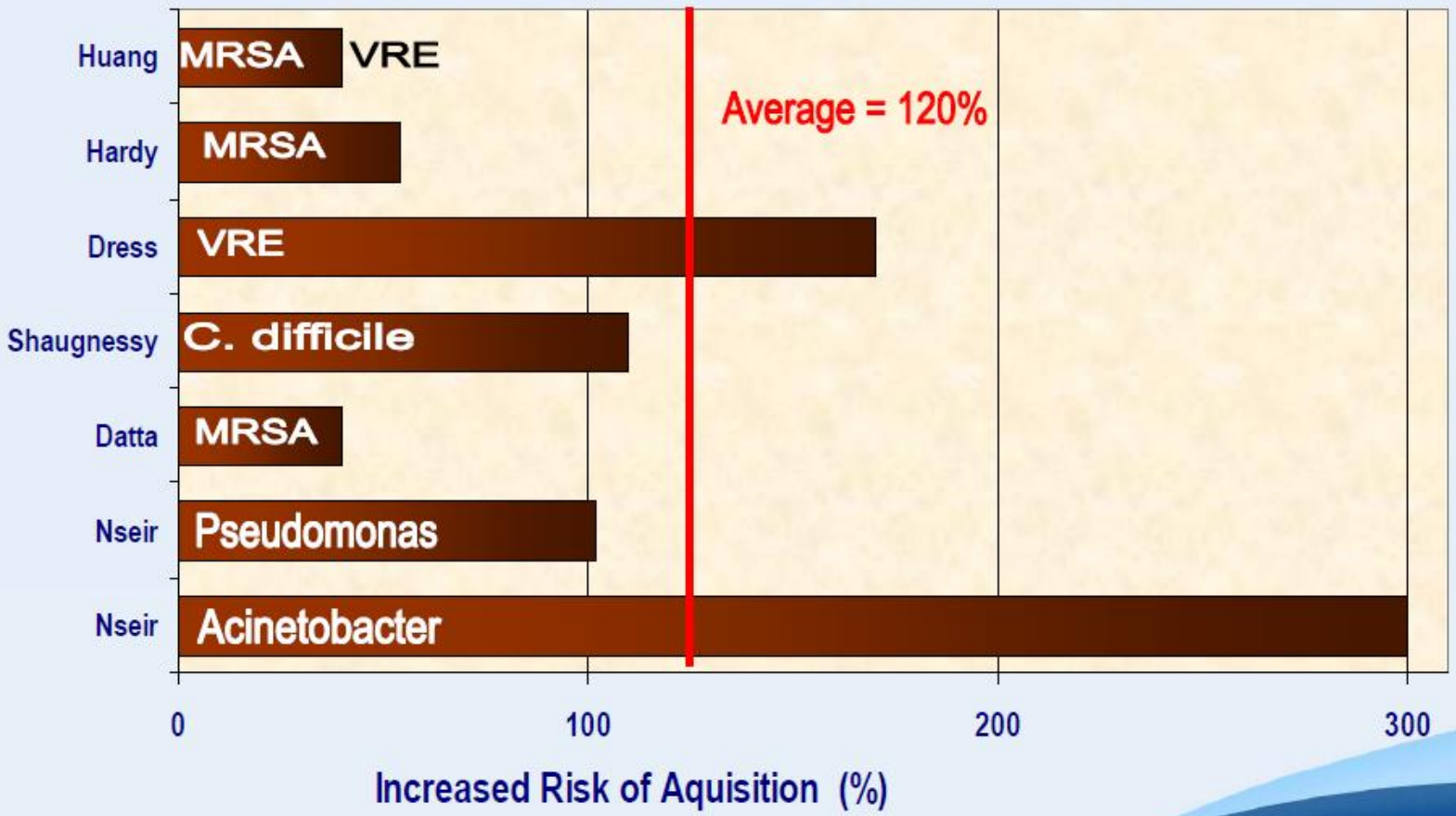
CDPH
California Department of
PublicHealth

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

CDPH California Department of PublicHealth

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.

SHEA The Society for Healthcare Epidemiology of America

Version 2.0 Copyright © SHEA, April 2011

Items Requiring *only* Cleaning

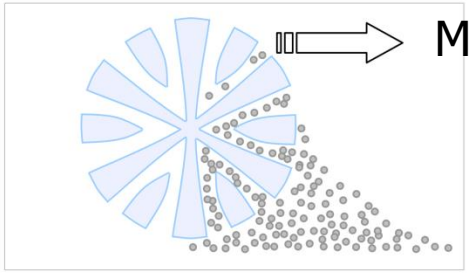
- Floors, walls, and windows
- Chairs and other furniture used by individuals who are clothed
- Private offices and other non-public, non-patient care areas
- Bed curtains should be changed when soiled and w/ terminal cleaning

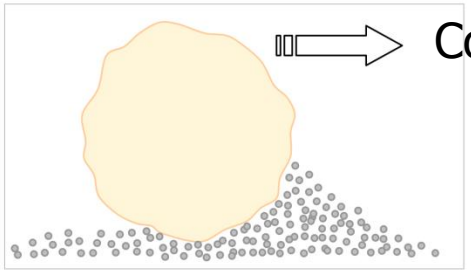
Clarify in policy what needs to be cleaned and not necessarily disinfected

CDPH California Department of PublicHealth

Use Microfiber for Cleaning

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





HICPAC Disinfection & Sterilization Guideline 2008, Rutala

CDPH California Department of PublicHealth

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

CDPH California Department of PublicHealth

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*

CDPH California Department of PublicHealth

*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

CDPH California Department of PublicHealth

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)

CDPH California Department of PublicHealth

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

CDPH California Department of PublicHealth

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

CDPH California Department of PublicHealth

EPA Registration of Disinfectants

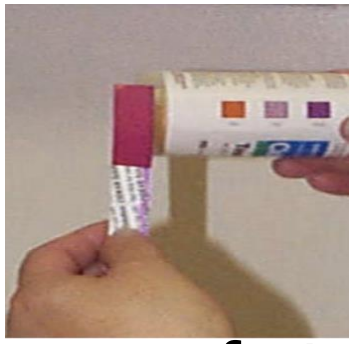
- Labeled as high level vs. intermediate vs. low level
- May include degrees of approval
  - Limited approval, e.g. kills Hepatitis B and HIV but not approved for spores
- Select disinfectant based on what you are trying to accomplish
  - Environmental vs. medical device disinfection
- Search EPA website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

www.**epa**.gov/oppad001/chem**reg**index.htm

CDPH California Department of PublicHealth

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

CDPH California Department of PublicHealth

Endoscopes/Bronchoscopes

- United States
  - An estimated 14.4 million gastrointestinal endoscopic procedures are performed annually in the US, including 500,000 ERCPs [1]
  - 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 [2]
  - 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

[1] ASGE, FDA, March 5, 2015
[2] CDC 2014, 2015 Communications

CDPH California Department of PublicHealth

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

CDPH California Department of PublicHealth

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

CDPH California Department of PublicHealth

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

CDPH California Department of PublicHealth

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

CDPH California Department of PublicHealth

http://www.cdc.gov/hai/pdfs/cre/interim-duodenoscope-surveillance-Protocol.pdf

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.

CDPH California Department of PublicHealth

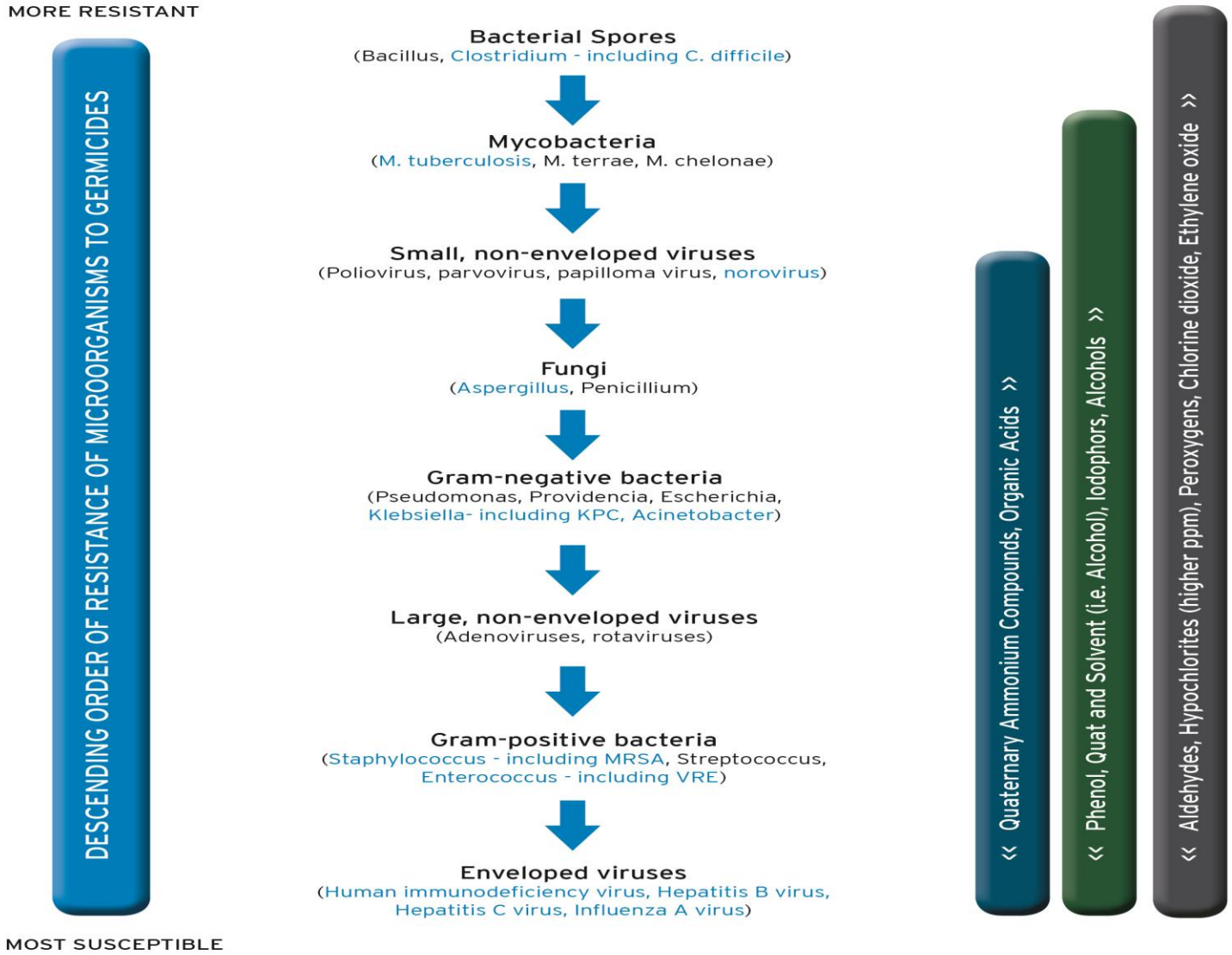
Environmental Disinfectants - continued

- 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

HICPAC Disinfection & Sterilization Guideline 2008



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.

©2011 Ecolab USA Inc. All rights reserved.

ECOLAB®
Everywhere It Matters.

Graphic used with permission from Ecolab- 2015

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

CDPH California Department of PublicHealth

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

CDPH California Department of PublicHealth

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

CDPH California Department of PublicHealth

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

CDPH California Department of PublicHealth

Questions?

For more information, please contact any HAI Liaison Team member

Thank you

CDPH
California Department of
PublicHealth