Basics of Cleaning, Disinfection & Sterilization for Health Care

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A Webber Training Teleclass

Basic Principles of Cleaning, Disinfection, and Sterilization in Health Care

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Disclaimer

The findings and conclusions in this presentation are those of the author and her information resources and do not necessarily represent any determination or policy of the Centers for Disease Control and Prevention (CDC).

Bluebonnets in Central Texas

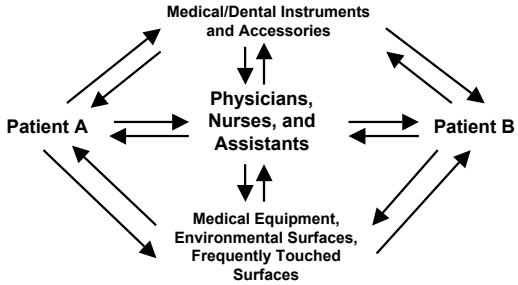
Topics for Today

- Basic infection control considerations
- Levels of disinfection
- Introduction to the Spaulding Classification
- Sterilization
- Cleaning and disinfection of environmental surfaces

Chain of Infection

- Virulent pathogen
- Sufficient number of the pathogen (infectious dose)
- Susceptible host
- Mode of transmission
- Correct portal of entry

From Point A to Point B



So Why All the Fuss About Hand Hygiene?

- *Most common mode of transferral of pathogens is via the hands!*
- Infections acquired in healthcare
- Spread of resistant microorganisms

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Evidence of Relationship Between Hand Hygiene and Healthcare-Associated Infections

- Substantial evidence that hand hygiene reduces the incidence of infections
- Historical study: Semmelweis
- More recent studies: rates lower when antiseptic handwashing was performed

Guideline for Hand Hygiene in Health-care Settings. *MMWR 2002*; vol. 51, no. RR-16.

Cleaning

A process that:

- Renders a surface or device safe to handle
- Reduces the natural bioburden on devices and environmental surfaces
- Removes organic / inorganic contaminants
- Reduces the challenge load posed to a sterilizing or disinfecting process

Disinfection

- By definition, disinfection differs from sterilization by its lack of sporicidal power
- Levels of disinfection:
  - High
  - Intermediate
  - Low
- Environmental surfaces need only low- to intermediate level disinfection

Low-Level Disinfection

- **Kills most vegetative bacteria, some viruses, and some fungi, but NOT mycobacteria**
  - **Hospital-type germicides used primarily for housekeeping**
    - **quaternary ammonium compounds ("quats")**
    - **some phenolics**
    - **some iodophors**

Intermediate-Level Disinfection

- **Kills resistant mycobacteria (*MTB* var. *bovis* or *M. terrae)* and all other vegetative bacteria, fungi, and most viruses**
  - **"Tuberculocidal" chemicals**
    - **phenolics**
    - **iodophors**
    - **chlorine compounds**
    - **alcohols**

High-Level Disinfection

- **Kills all microorganisms except HIGH numbers of bacterial spores**
  - **Liquid chemical sterilizing agents (sporicides), minimum 10-20 minutes exposure time**
    - **aldehydes**
    - **hydrogen peroxide**
    - **peracetic acid**

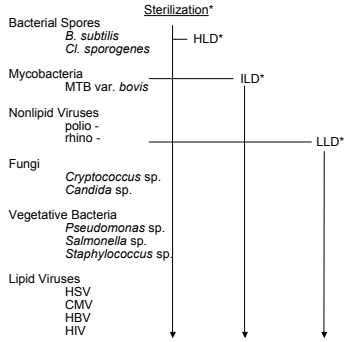
What is Sterility?

- Sterile – free from living microorganisms
- In practical terms, this is expressed as a probability function, such as the probability of a surviving microorganism on an item as being 1 in 1 million
- Sterility Assurance Level (SAL) – the predictor of the efficacy of the sterilization process

Sterilization

- **Kills all microorganisms, including HIGH numbers of bacterial spores**
  - **Heat (moist or dry)**
  - **Chemical gas or vapor**
  - **Radiation**
  - **Liquid chemical sterilizing agents (sporicides); 6-10 hours exposure time**
    - **aldehydes**
    - **hydrogen peroxide**
    - **peracetic acid**

Relative Microbial Resistance and Germicide Levels*



Spaulding Classification and Instrument Reprocessing

Spaulding Classification of Instruments and Devices

- Medical instruments and devices:
  - Critical
  - Semicritical
  - Noncritical
- CDC modification; Environmental
  - Housekeeping
  - Frequently touched, clinical touch

Critical Instruments

- **Critical – penetrates mucous membranes; makes contact with bone, the bloodstream, or other normally sterile tissues**
- **Examples:**
  - **Surgical instruments, scalpel blades**
  - **Surgical dental burs**
  - **Orthopedic drill bits, saws**

Semicritical Instruments

- **Semicritical – contacts mucous membranes, but does not not make contact with the bloodstream, bone, normally sterile tissues, or penetrate soft tissue**
- **Examples:**
  - **Dental mouth mirror**
  - **Speculum**
  - **Ultrasonic probe tips**

Noncritical Instruments and Devices

- **Noncritical – contacts intact skin**
- **Examples:**
  - **Blood pressure cuff**
  - **Stethoscope**
  - **Pulse oximeter**

Levels of Reprocessing

- Critical – sterilization
- Semicritical – sterilization, high-level disinfection
- Noncritical – low- to intermediate-level disinfection (depending on the type and degree of contamination)
- Environmental – low- to intermediate-level disinfection (depending on the type and degree of contamination)

The most important step in instrument reprocessing or surface management is….

Cleaning!!

Decontamination and Cleaning

- Decontamination or cleaning helps to ensure the success of the terminal reprocessing step (e.g., sterilization)
- Manual scrubbing or automated process
- Keep instrument surfaces moist to prevent organic matter from drying
- DO NOT USE HIGH-LEVEL DISINFECTANTS AS HOLDING SOLUTIONS!!

Reusable Medical Devices: Effect of Cleaning on Bioburden

(1) Nyström - instrument washer
- **>78% of the instruments had $<10^1$ CFU/device**
- **96% had $<10^2$; 100% had $<10^3$**

(2) Rutala - standard cleaning procedure
- **72% of the instruments had $<10^1$ CFU/device**
- **86% had $<10^2$; 94% had $<3 \times 10^2$**

(3) McAllister, *et al.* - standard cleaning procedure
- **88% of the instruments had $<10^2$ CFU/device**
- **100% had $<10^3$**

(1) J. Hosp. Infect. 1981, **2:** 363-368 (2) Amer. J. Infect. Cont. 1997. **25:** 185.
(3) Amer. J. Infect. Cont. 1997. **25:** 156.

Flexible Fiberoptic Endoscopes: Effect Cleaning on Bioburden

(1) Colonoscope insertion tube:
- **After clinical use - 1.3 x 10^7 - 2.0 x 10^{10} cfu/device**
- **After manual cleaning - 1.3 x 10^5 - 4.5 x 10^5 cfu/device**

(2) Five studies showed that cleaning alone provided a mean 4.0 $\log_{10}$ reduction in microbial contamination

(1) Chu, NS *er al.* 1997. Am. J. Infect. Cont. **25:** 186.
(2) Rutala, WA & DJ Weber. 1995. Infect. Cont. Hosp. Epidemiol. **16:** 231-235.

Factors Affecting Sterilization or Disinfection

- **AMOUNT OF ORGANIC MATERIAL**
- **Number of microorganisms**
- **Type of microorganisms (resistance levels)**
- **Type of germicidal agent**
- **Concentration of germicidal agent**
- **Exposure time to germicidal agent**
- **Temperature of exposure**
- **pH of solution**
- **Presence or absence of moisture**

Sterilization

Instrument Factors

- **Lumens**
- **Mated surfaces**
- **Acute angles**
- **Absorbent surfaces**
- **Springs / valves**
- **Rough / pitted surfaces**
- **Inaccessible areas**
- **Heat-sensitive materials**
- **Faulty "cleaning" devices**

Attributes of the Ideal Sterilant*

- **Highly efficacious**
  - **Bacteriocidal, sporicidal, tuberculocidal, fungicidal, virucidal**
- **Rapid activity**
  - **Achieves sterilization quickly**
- **Strong permeability**
  - **Penetrates packaging materials and device lumens**
- **Materials compatibility**
  - **Negligible changes in either appearance or function of processed items**

Attributes of the Ideal Sterilant*

- **Non-toxic**
  - **Poses no health hazards to the operator, patient, or the environment**
- **Organic material resistance**
  - **Withstands reasonable organic challenge without loss of efficacy**
- **Adaptability**
- **Monitoring capability**
  - **Physical, chemical, or biological indicators**
- **Cost effective**

*** Source: Schneider, PM. Low-temperature sterilization in the 1990's. 1994. Tappi Journal 77: 115-121.**

Effective Sterilization: Controlled Conditions

- **For all physical processes:**
  - **Time, temperature, relative humidity**
- **For liquid chemical processes:**
  - **Time, temperature, pH, concentration**
- **For gas or plasma processes:**
  - **Time, temperature, gas concentration, relative humidity, wrapping**

Moist Heat Sterilization

- All moist heat sterilization processes consist of four phases in their cycles:
  - Heating phase
  - Sterilization phase
  - Evacuation and cooling phase
  - Drying phase

Sterilization via Saturated Steam: Air Removal Mechanisms

- Air interferes with the ability of steam to make contact with items to be sterilized. Air is removed by:
- Gravity displacement: incoming steam forces air to the bottom of the chamber for removal
- Pre-vacuum (porous load): air is pumped out of the chamber mechanically in one or multiple cycles before steam enters

"Flash" Sterilization

- In hospitals, unwrapped item(s) are run through a sterilization cycle using a higher temperature and a shorter exposure time
- Items used immediately after cool-down
- Do not use flash sterilization for implanted devices
- Avoid using flash sterilization if possible
- Have adequate instrument inventory

Flash Sterilization

- None of the new processes are approved for flash sterilization
- Items must be thoroughly cleaned
- AAMI, AORN recommendations:
  - Non-porous loads, unwrapped: 3 minutes $\geq$132ºC in either gravity-displacement or prevacuum units
  - Porous loads: at $\geq$132ºC , 10 minutes in gravity-displacement units, or 4 minutes in prevacuum units

Liquid Chemical Sterilants and Low-Temperature Processes

- Use of liquid chemical sterilants or low-temperature sterilization processes is intended for the reprocessing of heat-sensitive instruments and devices
- NOTE: The vast majority of instruments in medicine and dentistry are heat-stable

Liquid Chemical Sterilants and Low-Temperature Processes

- Liquid chemical sterilants
  - Powerful, toxic chemical used for immersion
  - Safety concerns; follow instructions carefully
  - Use of these chemicals is discouraged
- Low-temperature sterilization processes
  - Ethylene oxide (EO)
  - Gas-plasma (e.g., hydrogen peroxide plasma)
  - Chemical systems

Advice From an Indoor Environmental Microbiologist

"The proper method of reprocessing a heat-stable device is to AUTOCLAVE it! You COOK it!

You don't gas it, you don't dunk it, YOU COOK IT!!!"

W.W. Bond, MS
CDC Microbiologist (Retired)

Biological Indicators

- A standardized preparation of bacterial spores on or in a carrier
- Serves to demonstrate whether sterilizing conditions have been met
- BI must be placed in the most difficult site for sterilant penetration
- A positive BI indicates a process failure

Types of Biological Indicators

- *Bacillus stearothermophilis*
  - Moist-heat systems
  - *Geobacillus stearothermophilis*
- *Bacillus subtilis*
  - EO, dry heat systems
  - *Bacillus atropheus*
- *Bacillus pumilus*
  - Radiation-based systems

Chemical Indicators

- Measure key parameters of the sterilization process
- Visual change when the desired parameter has been achieved (e.g., color change with temperature)
- Single parameter indicators, multi-parameter indicators

Physical Indicators

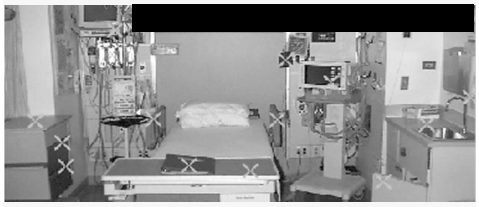
- Equipment monitors that are engineered to detect any of these parameters:
  - Temperature, time
  - Pressure, gas concentration
  - Relative humidity
  - Steam purity
  - Delivered dose of sterilant

General Points to Consider

- Cleaning:
  - Was this done, automated or manual, what cleaning chemical, use conditions
- Rinsing:
  - Use of tap water, removal of residuals, water quality
- Sterilization/disinfection:
  - Label instructions, contact time, factors affecting the operation of equipment, water quality, inappropriate use/misuse of disinfectants, drying of the instrument
- Equipment use during medical procedures:
  - Use of tap water, reuse of single-use devices, multi-dose vials, examine all instruments/devices available for use
- Documentation:
  - Instrument identification noted in charts, processes used, instrument trace back

Disinfection

The Inanimate Environment Can Facilitate Transmission



~ Contaminated surfaces increase cross-transmission ~

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

Environmentally Transmitted Infections

- Healthcare workers and patients can be infected directly or indirectly from environmental sources
  - Sources can be air, fomites, instruments, or aerosols
- Environmental surfaces (e.g., walls, floors) are not directly involved in infectious disease transmission

Fomite: An inanimate object or substance capable of carrying infectious organisms and hence transferring them from one individual to another

Choosing a Disinfectant

- Clean first!
- Nature and use of the item to be disinfected
  - Disinfection level
- Sufficient potency for disinfection
  - Intrinsic resistance of microbes
  - Chemical class of disinfectant, use conditions
- Materials compatibility
- Safety concerns: hazards with use?
  - Aerosols, residuals, chemical sensitivities

Choosing a Disinfectant Procedure

- Nature of the item to be disinfected
- Concentration of microorganisms present
- Innate resistance of those microorganisms
- Amount of organic soil
- Type and concentration of germicide used
- Duration and temperature of germicide contact
- Other factors if using a proprietary product

EPA Lists of Registered Germicides

- List A – sterilants
- List B – tuberculocides
- List C – HIV-1
- List D – HIV-1, hepatitis B virus (HBV)
- List E – HIV-1, HBV, and *Mycobacterium tuberculosis*
- List F – hepatitis C virus (HCV)
- List G – norovirus
- List H – MRSA, VRE (*E. faecalis* or *E. faecium*)
- List J – medical waste treatment

What is a "Hospital Disinfectant?"

- An EPA category for disinfectants
- Demonstrated potency against:
  - *Pseudomonas aeruginosa*
  - *Staphylococcus aureus*
  - *Salmonella choleraesuis*
- Low-level disinfectant
- Intermediate-level disinfectant if the chemical is tuberculocidal

"Tuberculocidal" Germicides

- Use of these products will NOT prevent the spread of TB because TB is not acquired from environmental surfaces
- Measure of potency
- Mycobacteria have the highest intrinsic level of resistance among the vegetative bacteria, viruses, and fungi
- Broad spectrum antimicrobial capability

Do NOT use high-level disinfectants/chemical sterilants (e.g., glutaraldehyde, formaldehyde) to disinfect medical equipment surfaces or housekeeping surfaces!!

Cleaning and Disinfecting of Medical Equipment

- FOLLOW THE MANUFACTURER'S INSTRUCTIONS!!!
- In the absence of instructions, clean and follow with low- to intermediate-level disinfection depending on the degree of contamination
- Consider covering those surfaces that are frequently touched during delivery of care

Cleaning and Disinfecting of the Housekeeping Surfaces

- **Clean on a regular basis to remove soil and dust**
- **Physical removal of microorganisms and organic soil is as important as the antimicrobial effect of the disinfecting agent**
- **Surfaces not touched frequently by hand (i.e., floors) in general care areas are cleaned and disinfected**
- ***This is controversial – routine disinfection of floors is not supported by epidemiology; lack of consensus among infection control staff and hospital epidemiologists***

Microorganism Removal with Microfiber

Cleaning Solution	Cleaning System	Dry Time (mins)	Mean % Reduction CFU ± SD
QUAT	Cotton string mop/standard bucket with wringer	2:48	94.84 ± 4.8
QUAT	Microfiber mop/standard bucket with wringer	2:13	87.94 ± 17.2
QUAT	Microfiber mop/microfiber bucket	7:04	95.31 ± 5.7
Detergent	Cotton string mop/standard bucket with wringer	2:48	67.75 ± 31.6
Detergent	Microfiber mop/standard bucket with wringer	2:23	79.74 ± 24.8
Detergent	Microfiber mop/microfiber bucket	8:03	94.50 ± 4.6

- QUAT = 1:128 dilution of product containing 5.15% didecyl dimethyl ammonium chloride, 3.43% dimethyl benzyl ammonium chloride. Detergent was a neutral cleaner with no germicidal properties
- RODAC plates with D/E Neutralizing agar; CFU compared before and after cleaning

Source: Rutala WA, Gergen MF, Weber DJ. Microbiologic evaluation of microfiber mops for surface disinfection. *Am J Infect Control* 2007; 35: 569-73.

Cleaning and Disinfecting of the Housekeeping Surfaces

- Follow manufacturer's instructions if using proprietary cleaners or disinfectants
  - Use conditions (e.g., concentration, contact time)
- Clean and disinfect surfaces that are touched by hand on a frequent and regular basis
  - Door knobs, light switches, bed rails
  - Surfaces around the toilet

Minimize Glove "Misuse"

- Failure to remove or change contaminated gloves
- 18.3% (4/22) samples showed potential transferral of microorganisms [a = from patient, b = from gloves]

Source: Girou E, Chai SHT, Oppein F, et al. *J Hosp Infect* 2004; 57: 162-9

	Glove Cultures		Environmental Cultures		
No. of Contacts Before Sampling	Bacterial Counts (CFU)	Pathogenic Bacteria	Sampled Surfaces	Bacterial Counts (CFU)	Pathogenic Bacteria
6	4,500	*P. aeruginosa* (a), *Serratia marcescens* (a)	Bed barrier (rail)	85	*P. aeruginosa, Serratia marcescens* (a, b)
10	>30,000	*P. aeruginosa*	Bedside table	2	*P. aeruginosa*
10	>30,000	*P. aeruginosa*	Bedside table	>300	*P. Aeruginosa* (a)
17	>30,000	*P. aeruginosa*	Weighing machine	169	*P. aeruginosa* (b)

Environmental Cleaning Study: VRE in RUMC MICU

- 4 periods of time over 9 months:
  - Period 1: baseline, current procedures
  - Period 2: enhanced environmental cleaning
    - Virex (cleaner / quat disinfectant)
    - 20 – 25 mins/room, 2X per day
    - "Bucket method for the floors, 8 – 12 cloths for touched surfaces
  - Period 3: "washout" (no continued emphasis)
  - Period 4: hand hygiene campaign
- Rectal swabs for patients; environmental swabs; hand cultures for HCWs
- VRE acquisition rates:
  - Period 1: 33.47 cases per 1000 patient-days at risk
  - Period 2: 16.84
  - Period 3: 12.09
  - Period 4: 10.40
- Limitations to the study and unanswered questions:
  - No reported use of neutralizer for the disinfectant
  - Little or no details on the housekeeping procedures

- Hayden MK, Bonten MJM, Blom DW, Lyle EA, van de Vijver DAMC, Weinstein RA. Reduction in acquisition of vancomycin-resistant Enterococcus after enforcement of routine environmental cleaning measures *Clin Infect Dis* 2006; 42: 1552-60

An Example on Why Instructions are so Important

- EPA-registered products labeled as "cleaner/disinfectants:"
  - Label clearly distinguishes between use of the product as a cleaner OR as a disinfectant
  - Level of soil, precleaned surface
  - Contact time
  - Surface is to remain WET for the full contact time

Should Environmental Sampling Be Done?

- NO, not routinely
- Environmental sampling may be useful:
  - To verify the effectiveness of a new cleaning and disinfecting process
  - To identify environmental reservoirs during outbreak situations
  - Coordinate sampling with the laboratory

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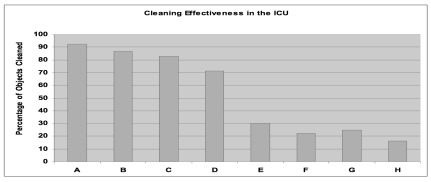
Cleaning in the ICU: The Most and the Least



A = Sink B = Tray Table C = Toilet Seat D = Bedside Table
E = Room Door Knobs F = Bathroom Door Knobs G = Bedpan Cleaner
H = Bathroom Light Switch
Adapted From: Carling PC, et al. *J Hosp Infect* 2008; 68: 39-44

Environmental Infection Control: Bacterial Spores

- Anthrax spore abatement; management of *Clostridium difficile* outbreaks
- The Big Dilemma!
  - HLDs are not routinely recommended for use on environmental surfaces
  - ILDs are not EPA-registered as sporicides
  - Safe, yet effective decontamination of affected areas

Hydrogen Peroxide Vapor

- Vapor-phase hydrogen peroxide VHP has been shown to be sporicidal at concentrations ranging from 0.5 < 10mg/L; optimal range of 2.4 mg/L with a contact time of 1 hr
- Break down products are non toxic (water and oxygen)
- Can adsorb to some plastics
- Requires low RH ≤ 30%
- Two commercial companies slightly different technologies
- Has been used for laboratories, Building Decontamination following Anthrax releases from intentionally contaminated mail, glove boxes, aerosol chambers, patient wards and rooms in healthcare facilities

Disinfectants are Pesticides!!


Impact on Staff and Patients

- **Staff:**
  - **Irritant and allergic contact dermatitis on hands and forearms**
  - **Occupational asthma on the increase**
  - **20% are eye and skin burns (chemical exposures)**
  - **Muscular/skeletal injuries (ergonomics)**

- **Patients:**
  - Many exposed to chemicals 24/7
  - Chemical sensitivities

How to Determine if Cleaning Products Are Hazardous or Contain Hazardous Substances

Review ingredients on material safety data sheet (MSDS). You can check products or ingredients against the following databases or lists.

- IARC – International Agency for Research on Cancer: www.iarc.fr
- NTP – National Toxicology Program; http://ntp-server.niehs.nih.gov
- OSHA – Occupational Safety and Health Administration: www.osha.gov
- IRIS – EPA Integrated Risk Information System: www.epa.gov/iris
- NIOSH – National Institute of Occupational Health and Safety: www.cdc.gov/niosh
- ACGIH – American Conference of Governmental Industrial Hygienists: www.acgih.org
- CleanGredients Database – Green Blue Institute: www.greenblue.org
- Green Seal: www.greenseal.org
- EPA DfE - EPA Design for the Environment: www.epa.gov/dfe/pubs/projects/formulat/index.htm
- IRCHS - Indiana Relative Chemical Hazard Score: www.ecn.purdue.edu/CMTI/IRCHS/
- **TURI –** Toxic Use Reduction Institute: www.cleanersolutions.org

Strategies to Enhance the Safety and Efficacy of Cleaning and Disinfecting

- Be familiar with the product's MSDS and instructions for proper and safe application
- Look for opportunities to prevent surface contamination from occurring
- Look for opportunities to reduce the amounts of chemicals used

Safety Assessment of Cleaning and Disinfectant Products

- How is the product diluted and how frequently is it being used?
- What is the product's intended use?
- What is the likelihood it will be misused?
- What is the experience level of users?
- What are the hazard ratings for the product?
- What does the MSDS say about the product safety?
- Does the product present an acceptable level of risk?
- What do others report about the product safety?

EPA and FDA Information

- EPA information about registered germicides:

http://www.epa.gov/oppad001/chemregindex.htm

- FDA information about LCS/HLD:

http://www.fda.gov/cdrh/ode/germlab.html

- FDA MAUDE database:

http://www.accessdata.fda.gov/cdrh/cfdocs/cfMAUDE/search.CFM

Source: U.S. Dept. of the Interior, National Park Service: Grand Teton National Park

Thank You!

Division of Healthcare Quality Promotion
Centers for Disease Control and Prevention

"Protect patients, protect health-care personnel, and promote safety, quality, and value in the health-care delivery system"

Bonus Material

Use and Interpretation of Sterilizer BI Indicators

Biological Spill Management

Emerging Pathogens, Antimicrobial Resistance

Use and Interpretation of Indicators

- Use on each sterilizer periodically (e.g., at least weekly)
- Use on each load of implantable devices
- Use control BI's (not processed) for comparison purposes
- In-office culture services vs. mail-in services:
  - No significant influence on results if delayed during mailing

Use and Interpretation of Indicators

- Check the mechanical parametric readings (e.g., time, pressure) and internal/external chemical indicators (e.g., temperature) first
- When these suggest that the sterilizer is functioning properly, a single positive BI may not indicate process failure
- Take sterilizer out of service, review process of operation to determine possible error

Use and Interpretation of Indicators

- Repeat BI testing with controls on three consecutive sterilization cycles, empty chamber
- If all processed BI's are negative, return the unit to service
- If any of the processed BI's are positive:
  - Recall the processed items from that unit, rewrap, and re-sterilize these items
  - Have the equipment repaired and repeat the BI challenge series

Basic Principles of Biological Spill Management

- Know and understand the Chain of Infection
- Aerosol production and control
  - Is the agent an airborne organism?
  - Does the spill management activity produce aerosols?
- Low- to intermediate-level disinfection
- Do not let the pathogenicity of the agent override the science of its inactivation!

Biological Spill Management

- Contain the spill's organic material with disinfectant-soaked absorbent toweling
- Intermediate-level disinfectant
  - Hospital disinfectant with tuberculocidal property
  - Sodium hypochlorite solutions
- Remove organic material, clean
- Apply fresh disinfectant at proper use conditions

Sodium Hypochlorite Solutions

- Intermediate-level germicide, tuberculocidal properties
- When using generic or reagent grade formulations: 5000-6000 ppm or 500-600 ppm working solutions
- Manufacturer's instructions for proprietary, EPA-registered formulations

More About Spill Management

- DO NOT use liquid sterilants to disinfect environmental surfaces!
  - Not cleared for this purpose; respiratory hazard
- DO NOT use environmental surface disinfectants to wash exposed skin!
  - Use antiseptic solutions for this purpose
- DO NOT use alcohol to "neutralize" chlorine residuals on surfaces!

Antimicrobial Resistance And Emerging Pathogens

- Newly discovered pathogens or organisms that acquire antimicrobial resistance are usually erroneously assigned extraordinary resistance to commonly used disinfection and sterilization procedures
- Examples: SARsCo-V, HIV, HBV, Ebola virus, Hantavirus, MDR-Tb, VRE, MRSA, VRSA

Antimicrobial Resistance

- In general, antibiotic resistance is a trait independent of an organism's innate susceptibility or resistance to a disinfectant's properties.
- Environmental infection control of major antibiotic-resistant bacteria (e.g., MRSA, VRSA, VRE) is similar to that for antibiotic-sensitive organisms

Drug Resistant Pathogens

- No correlation to drug resistance and resistance to disinfection
- Some organisms may develop tolerance at concentrations hundreds to thousand folds below use dilution
- Current protocols do not have to be altered; use products per manufacturer's label or per laboratory protocols

Antimicrobial Resistance

- Resistance may be apparently "increased" because of physical factors
  - Thicker cell walls
  - Biofilms
  - Release into the environment as a cell-associated agent
  - Other organic matter

Antibiotic-Resistant Gram-Positive Cocci: MRSA, VRE

- Antibiotic resistance does not confer increased resistance to chemical germicides
- Hand transferral is considered to be the primary means of spreading these bacteria to patients, workers, and other surfaces
- Control measures:
  - HANDWASHING!
  - Follow the hands – what is touched with gloved hands during care?
  - Appropriate barrier precautions
  - Patient isolation measures
  - Standard cleaning and disinfection of surfaces
  - Terminal cleaning and disinfection of the patient's room may be intensified if environmental reservoirs of the MDRO persist

Staphylococcus aureus and MRSA: Infection Control Issues

- People are the source:
  - Carriage, infection
  - Shed into the general environment
  - Transmit to other people
- Small numbers of staph can initiate infection
- Staph contaminates the environment
  - Person to environment to person
  - Staph can survive for long periods of time
- Cleaning can reduce staph and MRSA in the environment
- Cleaning can reduce staph / MRSA infection rates

Adapted from: Dancer SJ. *The Lancet Infectious Disease*; epub 10/31/07

MDROs and Environmental Infection Control

- V.A.6. Environmental Measures
  - a. Clean and disinfect surfaces and equipment that may be contaminated, including those in close proximity to the patient and frequently touched surfaces in the patient care environment on a more frequent schedule compared to that for minimal touch surfaces. Category IB
  - b. Dedicate noncritical medical items when patients are known to be infected or colonized with MDROs. Category IB
  - c. Prioritize room cleaning of patients on Contact Precautions. Focus on cleaning and disinfecting frequently touched surfaces and equipment in the immediate vicinity of the patient. Category IB

Management of Multi-Drug Resistant Organisms in Healthcare Settings, 2006. HICPAC guideline available at: www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf

Environmental Sites Positive for MRSA in Endemic and Outbreak Situations

Item or Surface	Mean %	Range %
Floor	34.5	9.0 – 60.0
Patient Gown	40.5	34.0 – 53.0
Bed Rails	27.0	1.0 – 60.0
Bed Linens	41.0	34.0 – 54.0
Overbed Table	40.0	18.0 – 67.0
Bathroom Door Knob	14.0	8.0 – 24.0
Room Door Knob	21.5	4.0 – 59.0
Furniture	27.0	11.0 – 59.0
Flat Surfaces	21.5	7.0 – 38.0
Sink Taps	23.5	14.0 – 33.0
Infusion Pump Button	19.0	7.0 – 30.0

Adapted from: Dancer SJ. The Lancet Infectious Diseases: epub 10/31/07

MDROs: When All Else Fails…

- V.B.8 Enhanced Environmental Measures
  - a. Use patient-dedicated or single-use noncritical equipment and devices. Category IB
  - b. Intensify training of environmental staff to achieve consistency of proper environmental cleaning and disinfection services. Category IB
  - c. Monitor cleaning performance to ensure consistent cleaning and disinfection of surfaces in close proximity to the patient and those likely to be touched by the patient and HCP

Management of Multi-Drug Resistant Organisms in Healthcare Settings, 2006. HICPAC guideline available at: www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf

MDROs: When All Else Fails…

- V.B.8 Enhanced Environmental Measures
  - d. Obtain environmental cultures when there is epidemiologic evidence that an environmental source is associated with ongoing transmission. Category IB
  - e. Vacate units for environmental assessment and intensive cleaning when previous efforts to eliminate environmental reservoirs have failed. Category II

Management of Multi-Drug Resistant Organisms in Healthcare Settings, 2006. HICPAC guideline available at: www.cdc.gov/ncidod/dhqp/pdf/ar/mdroGuideline2006.pdf

Environmental Control of Avian Influenza Virus

- Basic biophysical and biochemical properties of avian influenza virus have not changed
- Sensitivity to disinfectants predicted to be equivalent to that for human influenza viruses
- Infection control strategy for environmental surfaces will be similar to current protocols (e.g., focus on clinical touch surfaces, LLD)

Basics of Cleaning, Disinfection & Sterilization for Health Care

Dr. Lynne Sehulster, CDC

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