Guidelines for the use of disinfectants in hospital settings

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Introduction

USA

- 46.5 million surgical procedures
- Even more invasive medical procedures
- 5 million gastrointestinal endoscopies

http://www.cdc.gov/ncidod/dhqp/disinfection.html
GUIDELINES

USA

1. U.S. Center for Disease Control and Prevention (CDC)

2. Association for Professionals in Infection Control (APIC)
Guideline for Selection and Use of Disinfectants, 1996
GUIDELINES

CANADA

1. Public Health Agency of Canada (PHAC)
   Handwashing, Cleaning, Disinfection and Sterilization in Health Care, 1998

2. Ontario, Ministry of Health and Long - Term Care
   Best practices for Cleaning, Disinfection, Sterilization in all Health Care Facilities, 2006
GUIDELINES

1. World Health Organization (WHO)
   Practical Guidelines for Infection Control in Health Care Facilities, 2004

2. Australia
   Department of Health and Ageing,
   Infection Control Guidelines for the Prevention of Transmission of Infectious Diseases in Health Care Settings, 2004
Endoscope Reprocessing: Current Status of Cleaning and Disinfection

Guidelines

- Centers for Diseases Control and Prevention, 2008
- Multi-Society Guidelines, 11 professional organizations, 2003
- Society of Gastroenterology Nurses and Associates, 2000
- European Society of Gastrointestinal Endoscopy, 2000
- British Society of Gastroenterology Endoscopy, 1998
- Gastroenterological Society of Australia, 1999
- Gastroenterological Nurses Society of Australia, 1999
- American Society for Gastrointestinal Endoscopy, 1996
- Association for Professional in Infection Control and Epidemiology, 2000
Definitions

- **Cleaning** the removal of visible soil from objects and surfaces.

- **Disinfection** the process that eliminates many or all the pathogenic microorganisms, except bacterial spores, on inanimate objects.

- **Sterilization** the process that destroys or eliminates all forms of microbial life.
Spaulding Classification of equipment

- Critical items
- Semi-critical items
- Non-critical items
  - non-critical patient care items
  - non-critical environmental surfaces
Spaulding Classification of equipment

- Critical items
  - confer high risk for infection if they are contaminated with any microorganism
  - objects which enter in sterile tissue or in the vascular system or through which blood flows should be sterile
Critical items

- Surgical instruments
- Cardiac, urinary catheters
- Implants
- Ultrasound probes used in sterile body cavities
### Processing “Critical” Patient Care Objects

<table>
<thead>
<tr>
<th>Classification</th>
<th>Objects which enter in sterile tissue or in the vascular system or through which blood flows should be sterile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object</td>
<td>Sterility</td>
</tr>
<tr>
<td>Level germicidal action</td>
<td>Kill all microorganisms, including bacterial spores</td>
</tr>
<tr>
<td>Examples</td>
<td>Surgical instruments and devices</td>
</tr>
<tr>
<td>Method</td>
<td>Steam, gas, hydrogen peroxide plasma or chemical sterilization</td>
</tr>
</tbody>
</table>
Chemical Sterilization of “Critical” Objects

- Glutaraldehyde (>2.0 %)
- Hydrogen Peroxide (7.5 %)
- Peracetic Acid (0.2 %)
- Hydrogen Peroxide (1.0 %) and Peracetic Acid (0.08 %)
- Hydrogen Peroxide (7.5 %) and Peracetic Acid (0.23 %)
- Glutaraldehyde (1.12 %) and Phenol/phenate (1.93 %)

Exposure time per manufacturers’ recommendations
Spaulding Classification of equipment

- Semi-critical items
  - contact mucous membranes or nonintact skin

  e.g.
  - Respiratory therapy and anesthesia equipment
  - Endoscopes
  - Cystoscopes

High-level Disinfection
## Processing “Semi-Critical” Patient Care Objects

<table>
<thead>
<tr>
<th>Classification</th>
<th>Come in contact with mucous membranes or skin that is not intact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object</td>
<td>Free of all microorganisms except high numbers of bacterial spores</td>
</tr>
<tr>
<td>Level germicidal action</td>
<td>Kill all microorganisms, except high numbers of bacterial spores</td>
</tr>
<tr>
<td>Examples</td>
<td>Respiratory therapy and anesthesia equipment, endoscopes, tonometers</td>
</tr>
<tr>
<td>Method</td>
<td>High-level disinfection</td>
</tr>
</tbody>
</table>
High Level Disinfection of “Semi-critical” Objects

Exposure time > 12 - 30 m, 20°C

<table>
<thead>
<tr>
<th>Germicide</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glutaraldehyde</td>
<td>&gt; 2.0 %</td>
</tr>
<tr>
<td>Ortho-phthaldehyde (12 m)</td>
<td>0.55 %</td>
</tr>
<tr>
<td>Hydrogen peroxide</td>
<td>7.5 %</td>
</tr>
<tr>
<td>Hydrogen peroxide and Peracetic acid</td>
<td>1.0 % - 0.08 %</td>
</tr>
<tr>
<td>Hydrogen peroxide and Peracetic acid</td>
<td>7.5 % - 0.23 %</td>
</tr>
<tr>
<td>Hypochlorite (free chlorine) *</td>
<td>650 - 675 ppm</td>
</tr>
<tr>
<td>Glut and phenol/phenate **</td>
<td>1.21 % - 1.93 %</td>
</tr>
</tbody>
</table>

* May cause cosmetic and functional damage
** Efficacy not verified
Spaulding Classification of equipment

• Non critical items
  - objects that come in contact with intact skin but not mucous membranes

Low-level Disinfection

non critical patient care items
  e.g. blood pressure cuffs

non critical environmental surfaces
  e.g. food utensils, bedside tables, patient furniture, floors
Non critical environmental surfaces
## Processing “Non - Critical” Patient Care Objects

<table>
<thead>
<tr>
<th>Classification</th>
<th>Will not come in contact with mucous membranes or skin that is not intact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object</td>
<td>Can be expected to be contaminated with some microorganisms</td>
</tr>
<tr>
<td>Level germicidal action</td>
<td>Kill vegetative bacteria, fungi and lipid viruses</td>
</tr>
<tr>
<td>Examples</td>
<td>Bedpans; bed rails; EKG leads; bedside tables; walls; floors; furniture</td>
</tr>
<tr>
<td>Method</td>
<td>Low - level disinfection (or detergent for housekeeping surfaces)</td>
</tr>
</tbody>
</table>
# Low - Level Disinfection of “Non - critical” Objects

**Exposure time > 1min**

<table>
<thead>
<tr>
<th>Germicide</th>
<th>Use concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethyl or isopropyl alcohol</td>
<td>70 - 90 %</td>
</tr>
<tr>
<td>Chlorine</td>
<td>100 ppm (1:500 dilution)</td>
</tr>
<tr>
<td>Phenolic</td>
<td>UD</td>
</tr>
<tr>
<td>Iodophor</td>
<td>UD</td>
</tr>
<tr>
<td>Quaternary ammonium</td>
<td>UD</td>
</tr>
<tr>
<td>Accelerated hydrogen peroxide</td>
<td>0.5 %</td>
</tr>
</tbody>
</table>

*UD = Manufacturer’s recommended use dilution*
Classification of Disinfection

- **High level** kill all the microorganisms and the bacterial spores
- **Intermediate level** kill mycobacteria and most bacteria, viruses, fungi but do not necessarily kill bacteria spores
- **Low level** may kill most vegetative bacteria, some fungi, some viruses
# Resistance of microorganisms and level of disinfection or sterilization

<table>
<thead>
<tr>
<th>Resistant</th>
<th>Level</th>
</tr>
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<tbody>
<tr>
<td>Prions (e.g. Creutzfeldt - Jacob Disease)</td>
<td>Prion reprocessing</td>
</tr>
<tr>
<td>Bacterial spores (<em>Bacillus subtilis</em>)</td>
<td>Sterilization</td>
</tr>
<tr>
<td><em>Coccidia</em> (<em>Cryptosporidium</em>)</td>
<td></td>
</tr>
<tr>
<td><em>Mycobacteria</em> (<em>M. tuberculosis</em>)</td>
<td>High Disinfection</td>
</tr>
<tr>
<td>Nonlipid or small viruses (Polio, coxsacie)</td>
<td>Intermediate disinfection</td>
</tr>
<tr>
<td><em>Fungi</em> (e.g. <em>Aspergillus</em>, <em>Candida</em>)</td>
<td></td>
</tr>
<tr>
<td>Vegetative bacteria (<em>S. aureus</em>, <em>P. aeruginosa</em>)</td>
<td>Low Disinfection</td>
</tr>
<tr>
<td>Lipid or medium size viruses (HIV, hepatitis B, Herpes)</td>
<td></td>
</tr>
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Efficacy of Disinfection Influencing Factors

- Cleaning of the object
- Organic and inorganic load present
- Type and level of microbial contamination
- Concentration of and exposure time to disinfectant
- Nature of object
- Temperature and relative humidity

Properties of an ideal disinfectant...

- Broad spectrum
- Fast acting
- Not affected by environmental factors
- Nontoxic
- Surface compatibility
- Residual effect on treated surfaces

- Easy to use
- Economical
- Solubility
- Stability
- Cleaner
- Environmentally friendly
Cleaning

- Manual
- Mechanical cleaning machines - automated equipment may increase productivity, improve cleaning effectiveness and decrease worker exposure
  - Utensil washer - sanitizer
  - Ultrasonic cleaner
  - Washer sterilizer
  - Dishwasher
  - Washer disinfecter
Disinfection: Challenges in the XXI Century

- Emerging pathogens
- Reprocessing complex medical instruments (endoscopes)
  1. Compliance and new Automatic Endoscope Reprocessors (AERs)
- Surfaces disinfection
- New technologies / Products
  1. Non-critical surfaces disinfection (microfiber, computer disinfection)
Disinfection: Challenges in the XXI Century

Emerging pathogens

1. *C. difficile* spores
2. CJD
3. Hepatitis C virus
4. Cryptosporidium
5. Helicobacter pylori
6. *E. coli* 0157 : H7
7. Antibiotic - resistant microbes (MRSA, VRE, MDR - TB)
8. SARS Coronavirus, avian influenza, norovirus
9. Bioterrorism agents (anthrax, plague, smallpox)
C. difficile
Control Measures

• Handwashing (soap and water), contact precautions, and meticulous environmental cleaning (disinfect all surfaces) with an authorized disinfectant should be effective in preventing the spread of the organism.


• In units with high endemic *C. difficile* infection rates or in an outbreak setting, use dilute solutions of 5.25-6.15% sodium hypochlorite (e.g., 1:10 dilution of bleach) for routine disinfection. (*Category II*)
C. difficile

Clean Hands... Better Job

Wash Your Hands
C. difficile
High - Level Disinfection

- 2% glutaraldehyde is effective against C. difficile at 20 minutes
- 0.55% ortho-phthalaldehyde is effective against C. difficile at 10 minutes
- 0.35 % peracetic acid is effective against C. difficile at 10 and 20 minutes

Alcohols do not inactivate Clostridium difficile spores !!!
Noroviruses (Adenovirus 8)  
A Common Cause of Epidemic Keratoconjunctivitis

• Adenovirus is extremely hardy when deposited on environmental surfaces and may be recovered from plastic and metal surfaces for more than 30 days

• Elimination of adenovirus from inanimate surfaces and ophthalmic instruments is essential in preventing outbreaks of epidemic keratoconjunctivitis

Rutala WA et al,  
Efficacy of hospital germicides against adenovirus 8, a common cause of epidemic keratoconjunctivitis in health care facilities  
Antimicrob Agents Chemother, 2006 April
CDC Guidelines

CDC, 1985

- Applanation tonometers—soap and water cleaning and then disinfected by soaking them for 5 to 10 minutes in a solution containing either:
  - 5000 ppm chlorine
  - 3% hydrogen peroxide
  - 70% ethyl alcohol
  - 70% isopropyl alcohol

CDC, 2008

- Wipe clean tonometer tips and then disinfect them by immersing for 5-10 minutes in either 5000 ppm chlorine or 70% ethyl alcohol. (Category II)
- These results emphasize the proper selection of disinfectants for use in disinfecting semicritical items (e.g., applanation tonometers)
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CJD: Disinfection and Sterilization

- Critical/Semicritical-devices contaminated with high-risk tissue, from high-risk patients requires special prion reprocessing
  - NaOH and steam sterilization
    (e.g., 1N NaOH 1h, 121°C 30 m)
  - 134°C for 18m (prevacuum)
  - 132°C for 60m (gravity)

- No low temperature sterilization technology effective

World Health Organization, 2000
Disinfection: Challenges in the XXI Century

- Emerging pathogens
- Reprocessing complex medical instruments (endoscopes)
  1. Compliance and new Automatic Endoscope Reprocessors (AERs)
- Surfaces disinfection
- New technologies / Products
  1. Non-critical surfaces disinfection (microfiber, computer disinfection)
Endoscope Disinfection

5 steps...

1. CLEAN - mechanically cleaned with water and enzymatic cleaner
2. HLD/STERILIZE - immerse scope and perfuse HLD/sterilant through all channels for at least 12 min
3. RINSE - scope and channels rinsed with sterile water, filtered water, or tap water followed by alcohol
4. DRY - use forced air to dry insertion tube and channels
5. STORE - prevent recontamination
Endoscope safety

- Ensure protocols equivalent to guidelines from professional organizations.
- Staff specifically trained to reprocess the endoscope.
- Staff competency tested at least annually.
- Ensure compliance with policy.
- Perform microbiologic testing of the endoscope or rinse water - no recommendation (unresolved issue).
Automatic Endoscope Reprocessors (AERs)

- Manual cleaning of endoscopes is prone to error.
- Advantages: automate and standardize reprocessing steps, reduce the risk of skipping any step, reduce personnel exposure to chemicals.
- Disadvantages: failure of AERs linked to outbreaks, does not eliminate precleaning, does not monitor HLD concentration.
- Must ensure exposure of internal surfaces with HLD/sterilant.
Disinfection: Challenges in the XXI Century

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Surface disinfectants or detergents on noncritical environmental surfaces

**Justification for Use of Disinfectants**

- Surfaces may contribute to transmission of epidemiologically important microbes (e.g. VRE, MRSA).
- Disinfectants are needed for surfaces contaminated by blood and other potentially infective material.
- Disinfectants are more effective than detergents in reducing microbial load on floors.
- Detergents become contaminated and result in seeding the patient’s environment with bacteria.
- Disinfection of noncritical equipment and surfaces is recommended for patients on isolation precautions by the CDC.
- Advantage of using a single product for decontamination of noncritical surfaces, both floors and equipment.
- Some newer disinfectants have persistent antimicrobial activity.

Rutala, Weber, HICPAC.

*CDC Guidelines for disinfection and sterilization in healthcare facilities, 2008*
Surface disinfectants or detergents on noncritical environmental surfaces

**Justification for Using a Detergent**

- Non critical surfaces contribute minimally to endemic healthcare-associated infections.
- No difference in healthcare-associated infection rates when floors are cleaned with detergent versus disinfectant.
- No environmental impact issues with disposal.
- No occupational health exposure issues.
- Lower costs.
- Use of antiseptics/disinfectants selects for antibiotic-resistant bacteria.
- More aesthetically pleasing floor.
Surfaces disinfection

- **Disinfecting Noncritical Patient - Care Items**
  
  ➔ Process noncritical patient - care equipment with an authorized disinfectant at the proper use dilution and a contact time of at least 1 min. *Category IB*

  ➔ Ensure that the frequency for disinfecting noncritical patient - care surfaces be done minimally when visibly soiled and on a regular basis (such as after each patient use or once daily or once weekly). *Category IB*
Surfaces disinfection

- Disinfecting Environmental Surfaces in Health Care Facilities
  - Disinfect (or clean) housekeeping surfaces (e.g., floors) on a regular basis (e.g., daily, three times per week), when spills occur and when these surfaces are visibly soiled. *Category IB*
  - Use disinfectant for housekeeping purpose where: uncertainly exists as to the nature of the soil on the surfaces (e.g., blood) or where uncertainly exists regarding the presence of multi-drug resistant organisms on such surfaces. *Category II*
Disinfection: Challenges in the XXI Century

Emerging pathogens
Surfaces disinfection
Reprocessing complex medical instruments (endoscopes)
  1. Compliance and new Automatic Endoscope Reprocessors (AERs)

New technologies / Products
  1. Non-critical surfaces disinfection (microfiber, computer disinfection)
Microfiber Cleaning

- Pads contain fibers (polyester and polyamide) that provide a cleaning surface times greater than conventional string mops.
- Advantages: reduce chemical use and disposal (disinfectant solution not changed after every third room, clean microfiber per room, light, ergonomic, reduce leaning times).
## Effectiveness of Microfiber Mop

<table>
<thead>
<tr>
<th>Product Configuration</th>
<th>Effectiveness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disinfectant - regular mop</td>
<td>95%</td>
</tr>
<tr>
<td>Disinfectant - microfiber system</td>
<td>95%</td>
</tr>
<tr>
<td>Disinfectant - microfiber system and regular mop basket</td>
<td>88%</td>
</tr>
<tr>
<td>Detergent - regular mop</td>
<td>68%</td>
</tr>
<tr>
<td>Detergent - microfiber system</td>
<td>95%</td>
</tr>
<tr>
<td>Detergent - microfiber system and regular mop basket</td>
<td>78%</td>
</tr>
</tbody>
</table>

Microfiber
Summary

- The microfiber system demonstrated superior microbial removal compared to cotton string mops when used with detergent cleaner.
- The use of disinfectant did not improve the microbial elimination demonstrated by the microfiber system.
- Use of a disinfectant did significantly improve microbial removal when a cotton string mop was used.
Computer Disinfection

Material and methods

- Disinfectants included:
  - 70% isopropyl alcohol
  - 3 Quaternary ammonium compounds
  - Chlorine 80 ppm
  - Phenolic

- Test pathogens
  Oxacillin-resistant *Staphylococcus aureus* (MRSA),
  *Pseudomonas aeruginosa*,

- Efficacy of disinfectants, cosmetic and functional effects of disinfectants on appearance of the letters or the keyboards

William A. Rutala et al,

*Bacterial Contamination of Keyboards: Efficacy and Functional Impact of Disinfectants*

*Infection Control and Hospital Epidemiology*, April 2006
Computer Disinfection

Results

All tested products were effective (> 95%) in removing and/or inactivating the test pathogens (MRSA, Pseudomonas aeruginosa)

No functional/cosmetic damage after 300 wipes

Recommended that keyboards be disinfected daily (for 5 sec) and when visibly

0 WIPES  300 WIPES
Computer Disinfection

Disinfectants are effective in removing / inactivating nosocomial pathogens from computers
Summary

Disinfection guidelines must be followed to prevent exposure to pathogens that may lead to infection.
http://www.cdc.gov/ncidod/dhqp/disinfection.html
http://www.apic.org
http://www.fda.gov/cdrh/ode/germlab.html
http://www.osha.gov/Publications/glutaraldehyde.pdf
http://www.disinfectionandsterilization.org
http://www.searo.who.int/EN/Section10/Section17/Section53/Section362_1113.htm