Disinfection and Sterilization in Healthcare
An Overview

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Disinfection and Sterilization
Overview

- Provide overview
- Discuss processes and products
- Emerging pathogens and prions
- Special instrument reprocessing issues
Efficacy of Disinfection/Sterilization
Influencing Factors

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

EH Spaulding believed that how an object will be disinfected depended on the object’s intended use.

CRITICAL - objects which enter normally sterile tissue or the vascular system or through which blood flows should be **sterile**.

SEMICRITICAL - objects that touch mucous membranes or skin that is not intact require a disinfection process (**high-level disinfection [HLD]**) that kills all microorganisms but high numbers of bacterial spores.

NONCRITICAL - objects that touch only intact skin require **low-level disinfection**.
**Processing “Critical” Patient Care Objects**

- **Classification:** Critical objects enter normally sterile tissue or vascular system, or through which blood flows.
- **Object:** Sterility.
- **Level germicidal action:** Kill all microorganisms, including bacterial spores.
- **Examples:** Surgical instruments and devices; cardiac catheters; implants; etc.
- **Method:** Steam, gas, hydrogen peroxide plasma or chemical sterilization.
## Critical Objects

- Surgical instruments
- Cardiac catheters
- Implants

## Chemical Sterilization of “Critical Objects”

<table>
<thead>
<tr>
<th>Chemicals</th>
<th>Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glutaraldehyde (≥ 2.0%)</td>
<td></td>
</tr>
<tr>
<td>Hydrogen peroxide-HP (7.5%)</td>
<td></td>
</tr>
<tr>
<td>Peracetic acid-PA (0.2%)</td>
<td></td>
</tr>
<tr>
<td>HP (1.0%) and PA (0.08%)</td>
<td></td>
</tr>
<tr>
<td>HP (7.5%) and PA (0.23%)</td>
<td></td>
</tr>
<tr>
<td>Glut (1.12%) and Phenol/phenate (1.93%)</td>
<td></td>
</tr>
</tbody>
</table>

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Exposure time per manufacturers’ recommendations
Processing “Semicritical” Patient Care Objects

| Classification: Semicritical objects come in contact with mucous membranes or skin that is not intact. |
| Object: Free of all microorganisms except high numbers of bacterial spores. |
| Level germicidal action: Kills all microorganisms except high numbers of bacterial spores. |
| Examples: Respiratory therapy and anesthesia equipment, GI endoscopes, thermometer, etc. |
| Method: High-level disinfection |
Semicritical Items

- Endoscopes
- Respiratory therapy equipment
- Anesthesia equipment
- Endocavitary probes
- Tonometers
- Diaphragm fitting rings

High Level Disinfection of “Semicritical Objects”

Exposure Time > 12 m-30m, 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-phthalaldehyde (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
Classification: Noncritical objects will not come in contact with mucous membranes or skin that is not intact.

Object: Can be expected to be contaminated with some microorganisms.

Level germicidal action: Kill vegetative bacteria, fungi and lipid viruses.

Examples: Bedpans; crutches; bed rails; EKG leads; bedside tables; walls, floors and furniture.

Method: Low-level disinfection or detergent cleaning
Low-Level Disinfection for “Noncritical” Objects

Exposure time ≥ 1 min

<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>100ppm (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>
</tbody>
</table>

UD=Manufacturer’s recommended use dilution

Disinfection and Sterilization of Emerging Pathogens
Disinfection and Sterilization of Emerging Pathogens

- Hepatitis C virus
- *Clostridium difficile*
- *Cryptosporidium*
- *Helicobacter pylori*
- *E.coli 0157:H7*
- Antibiotic-resistant microbes (MDR-TB, VRE, MRSA)
- SARS Coronavirus, avian influenza, norovirus
- Bioterrorism agents (anthrax, plague, smallpox)

Standard disinfection and sterilization procedures for patient care equipment are adequate to sterilize or disinfect instruments or devices contaminated with blood and other body fluids from persons infected with emerging pathogens.
Creutzfeldt Jakob Disease (CJD): Disinfection and Sterilization

Decreasing Order of Resistance of Microorganisms to Disinfectants/Sterilants

- Prions
- Spores
- Mycobacteria
- Non-Enveloped Viruses
- Fungi
- Bacteria
- Enveloped Viruses
### CJD: Disinfection and Sterilization

#### Conclusions

- Critical/SC-cleaning with 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*
- Noncritical-four disinfectants (e.g., chlorine, Environ LpH) effective (4 log decrease in LD$_{50}$ within 1h)

*VHP reduced infectivity by 4.5 logs (Lancet 2004;364:521)

### Endoscopes/AERS
ENDOSCOPE DISINFECTION

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

- Ensure policies equivalent to guidelines from professional organizations (APIC, SGNA, ASGE);
  policies = practices
- Are the staff who reprocess the endoscope specifically trained in that job?
- Are the staff competency tested at least annually?
- Conduct IC rounds to ensure compliance with policy
Special Instrument Reprocessing Issues
**Endocavitary Probes**

- Probes—Transesophageal echocardiography probes, vaginal/rectal probes used in sonographic scanning
- Probes with contact with mucous membranes are semicritical
- Guideline recommends that a new condom/probe cover should be used to cover the probe for each patient and since covers may fail (1-80%), HLD (semicritical probes) should be performed

**Endocavitary Probe Covers**

- Sterile transvaginal probe covers had a very high rate of perforations before use (0%, 25%, 65% perforations from three suppliers)
- A very high rate of perforations in used endovaginal probe covers was found after oocyte retrieval use (75% and 81% from two suppliers) but other investigators found a lower rate of perforations after use of condoms (0.9-2.0%)
- Condoms superior to probe covers for ultrasound probe (1.7% condom, 8.3% leakage for probe covers)
Conclusions

- When properly used, disinfection and sterilization can ensure the safe use of invasive and non-invasive medical devices.
- Method of disinfection and sterilization depends on the intended use of the medical device.
- Cleaning should always precede high-level disinfection and sterilization.
- Current disinfection and sterilization guidelines must be strictly followed.

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Thank you
References

- Rutala WA. APIC guideline for selection and use of disinfectants. Am J Infect Control 1996;24:313