Antiseptics and sterilization methods

By Stephanie Saridakis, DO, and Morgan Amigo, MD

<table>
<thead>
<tr>
<th>Antiseptics</th>
<th>Agent</th>
<th>Mechanism</th>
<th>Onset</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Residual activity</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcohol (isopropyl and ethanol) 70%=optimal strength</td>
<td>Denatures proteins (bacterial cell walls)</td>
<td>Fastest (Skin must remain wet for 2 min for max effect)</td>
<td>Broad antimicrobial coverage: G(+), G(-), mycobacteria, fungi, and many viruses</td>
<td>Inactive against spores and some nonenveloped viruses. Not effective for soiled hands.</td>
<td>None, dissipates upon evaporation</td>
<td>• Inexpensive, but flammable!</td>
<td></td>
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<tr>
<td>Chlorhexidine (2-4%)</td>
<td>Disrupts cell membranes</td>
<td>Fast</td>
<td>Broad antimicrobial coverage: G(+), G(-), mycobacteria, fungi, and viruses. Blood/sputum do not inactivate.</td>
<td>Inactive against spores; Risk of ototoxicity and keratitis/ conjunctivitis. Risk of contact urticaria, ICD, and ACD. Anaphylaxis rare.</td>
<td>#1 overall (&gt;6 h, even when wiped from field; binds to stratum corneum)</td>
<td>• Longest acting</td>
<td></td>
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<tr>
<td>Chlorhexidine-isopropyl alcohol combination (Typically, 2% CHG and 70% isopropyl alcohol)</td>
<td>Denatures cell walls, disrupts cell membranes</td>
<td>Fast</td>
<td>Improved broad-spectrum coverage: G(+), G(-), mycobacteria, fungi, and viruses</td>
<td>Inactive against spores; otopedic and ocular toxicity risk (CHG). Supplied as single-use applicator.</td>
<td>48 h</td>
<td>• Provides both short- and long-term effects • More effective than povidone-iodine</td>
<td></td>
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<tr>
<td>Chloroxynol (PCMX)</td>
<td>Deactivates enzymes, alters cell walls</td>
<td>Intermediate</td>
<td>Fairly broad-spectrum: G(+), G(-), mycobacteria, fungi, and viruses</td>
<td>Decreased efficacy in presence of organic materials.</td>
<td>Several hours; still not as long-lasting as CHG</td>
<td>• Ineffective against Pseudomonas unless combined with chelating agent like EDTA</td>
<td></td>
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<tr>
<td>Hexachlorophene</td>
<td>Inactivates enzymes</td>
<td>Slow</td>
<td>Strong effect against G(+) cocci</td>
<td>Ineffective against G(-), fungi and mycobacteria. Neurotoxic in infants; teratogen.</td>
<td>Modest</td>
<td>• No longer in use • High skin absorption</td>
<td></td>
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<tr>
<td>Iodine and Iodophors (e.g., Povidone-iodine)</td>
<td>Oxidation leads to disruption of protein synthesis and cell membranes</td>
<td>Fast (Must wait for it to dry to be effective)</td>
<td>Very broad coverage: G(+), G(-), bacterial spores, mycobacteria, fungi, and viruses</td>
<td>Skin irritation and discoloration. Inactivated by blood and sputum. ACD/ICD risk. Chronic maternal use → risk of neonatal hypothyroidism</td>
<td>Minimal, especially if wiped from skin</td>
<td>• May cross-react with iodine in radiocounter media and iodides in medications • Stains fabrics</td>
<td></td>
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<tr>
<td>Quaternary ammonium compounds (e.g., Benzalkonium)</td>
<td>Induces leaks in cytoplasmic membranes</td>
<td>Slow</td>
<td>G (+) and lipophilic viruses</td>
<td>Ineffective against G(-), mycobacteria and fungi; inactivated by organic materials and cotton gauze. ACD risk &gt; ICD</td>
<td>Good</td>
<td>• Also found in cosmetics and ophthalmic solutions</td>
<td></td>
</tr>
<tr>
<td>Triclosan</td>
<td>Alters cytoplasmic membrane and synthesis of RNA, fatty acids, and proteins</td>
<td>Fast</td>
<td>Broad coverage: G (+), mycobacteria, and candida; not inactivated by organic material</td>
<td>Ineffective against G(+) and filamentous fungi</td>
<td>Good</td>
<td>• FDA banned use in certain OTC antiseptic products for use in health care setting</td>
<td></td>
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<tr>
<td>Soap and water</td>
<td>Detergent; removes dirt, organic substances; disinfects.</td>
<td>Very rapid</td>
<td>Highly effective against C. Difficile and Norwalk virus</td>
<td>Skin irritation</td>
<td>None</td>
<td>• Most appropriate for soiled hands</td>
<td></td>
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Additional Considerations:
- Antiseptic solutions may become contaminated and support bacterial growth (e.g., Serratia colonizing chlorhexidine bottles) leading to infection
- Do not shave prior to procedures, it is best to use clippers and/or chemical depilatories right before procedure. However, lowest risk of infection when hair is left intact within the surgical field.
- Hand hygiene: alcohol or alcohol plus chlorhexidine reduces bacterial counts the most.

Abbreviations:
- ACD = Allergic contact dermatitis
- h = Hours
- CHG = Chlorhexidine gluconate
- OTC = Over-the-counter
- G (+) = Gram positive
- G (-) = Gram negative
- ICD = Irritant contact dermatitis
- PCMX = Parachlorometaxylenol

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<th>Sterilization methods:</th>
<th>Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
<th>Settings</th>
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</table>
|                        | Steam autoclave | • Most popular in office setting  
• Easiest/safest | • Corrosive → may dull sharp instruments | • Specific settings required (20-30 min at 2atm pressure & 121°C) |
|                        | Chemiclave | • Lower humidity than steam, therefore less damage to sharp instruments  
• PPE & ventilation, cannot be used in small spaces | | • Special chemical required (mixture of formaldehyde, methyl ethyl ketone, acetone, and alcohols) |
|                        | Dry heat (oven) | • Inexpensive  
• No risk to instruments | • Cannot use cloth, paper, or plastic | • High temperature, longer duration (1h at 171°C; 6h at 121°C) |
|                        | Gas sterilization | • Mostly used in hospitals since better for large volumes  
• Effective for heat and moisture-sensitive instruments | • Expensive equipment  
• Toxic and mutagenic gas | • Longer durations (1 day for paper, 7 days for polyvinyl chloride) |
|                        | Cold sterilization (glutaraldehyde or ortho-phthalaldehyde solutions) | • Simple and inexpensive  
• Used for heat-sensitive equipment | • ACD risk due to glutaraldehyde  
• Not recommended as only method; instruments must be used immediately, cannot be wrapped  
• Not always effective against bacterial spores (ortho-phthalaldehyde has greater sporicidal activity) or hepatitis B virus | |

References: