

ElderHealth Resources Inc Conference for Foot Care Nurses

The Dirt Behind Cleaning & Disinfection

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Chicago Tribune (2000)

- 75% of an estimated 103 000 patient deaths linked to HAIs
- Due to unsanitary facilities, unwashed hands & dirty instruments
- Found that hospital cleaning staff were inadequately trained & cuts cleaning budgets

Chicago Tribune

Legal Issues in Patient Safety

- 2003: Cdn hospitals notified >900 patients that improper sterilization of equipment may have exposed them to HIV, Hepatitis and other diseases. \$150M class action lawsuit filed alleging negligence in failing to meet adequate sterilization standards.
- Government ordered a province-wide audit of hospital infection-control practices

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Legal Issues in Patient Safety

- 2004: Class action lawsuit filed on behalf of patients who contracted SARS in hospitals during the second wave of the outbreak. Claim alleges that public health officials failed to maintain sufficiently rigorous infection-control precautions.
- In context of nosocomial infection, patients may claim harm simply from exposure to a risk of infection & need not establish that they did, in fact, acquire an infection

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Patient Disclosure

- Canadian law clearly establishes a positive duty on care providers to inform patients of errors that occur during their care
- When care providers realize that patients may have been exposed to infection from equipment, other patients or healthcare workers, a legal obligation may arise to contact patients to warn them of the risk and provide advice regarding appropriate follow-up testing and care.

Effects of Germicides on Microorganisms

- HCWs take for granted the action of disinfectants without fully understanding mechanism of action
- Differences in the action of antimicrobial ingredients
- Differences depending on concentration of chemical used

Infection Control Today
Cleaning & Disinfecting: The Effects of Germicides on Microorganisms
Feb 2004

Basic Facts

- Disinfectants are the backbone of Infection Control
- >8000 Products registered in the U.S. & Canada
- 50% of which are used for Healthcare Infection Control
- There are 300 different active chemistries
 - 14 are in 95% of the disinfectant products

On the Same Page

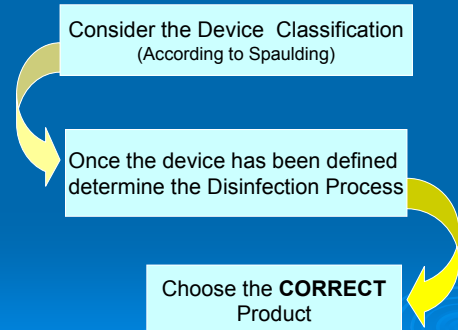
Terminology, Definitions,
Common Words, Guidelines

Major Groups Of Microbes

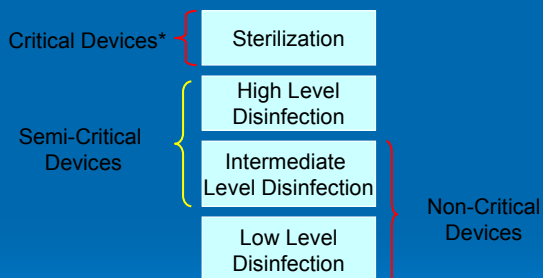
- Viruses (enveloped)
- Bacteria (*Gram +ve* & *Gram -ve*)
- Fungi
- Viruses (non-enveloped)
- Mycobacteria
- Protozoa
- Bacterial Spores



Process for Choosing a Disinfectant

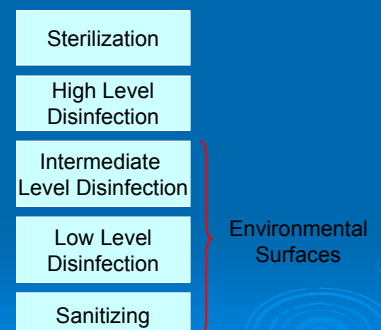


Process for Choosing a Disinfectant



*Foot Care Instruments defined as critical according to CDR Vol. 23S8 (Dec 1997) Infection Control Guidelines: Foot Care by Health Care Providers

Process for Choosing a Disinfectant



Cleaning

- The removal of adherent visible soil, blood, protein substances (tissue) and other debris from surfaces by mechanical or manual process
- Generally accomplished with water and detergents
- Removes or eliminates the reservoirs of potential pathogenic organisms



Criteria for Low Level Disinfection

- Bactericidal: effective against Vegetative bacteria: > 6 Log₁₀ reduction
 - *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Salmonella choleraesuis*
- General Virucide: effective against the Sabin strain of Polio virus Type 1 (Hydrophilic virus), criterion is > 3 Log₁₀ reduction
- Virucidal: effective against targeted viruses (enveloped or non-enveloped), criterion is > 3 Log₁₀ reduction
- Fungicidal: effective against criterion is > 5 Log₁₀
 - *Trichophyton mentagrophytes*

Criteria for Intermediate Level Disinfection

- Bactericidal: criterion is > 6 Log₁₀ reduction
- General Virucide: criterion is > 3 Log₁₀ reduction against Polio
- Virucidal: criterion is > 3 Log₁₀ reduction against specific viruses
- Fungicidal: effective against *Trichophyton mentagrophytes*, criterion is > 5 Log₁₀
- Tuberculocidal: effective against *Mycobacteria terrae*, criterion is > 4 Log₁₀

Criteria for High Level Disinfection & Sterilization

- Fungicidal: effective against *Trichophyton mentagrophytes*, criterion is > 5 Log₁₀
- Tuberculocidal: effective against *Mycobacteria terrae*, criterion is > 6 Log₁₀
- Sporocidal: effective against *Bacillus subtilis* & *Clostridium sporogenes*, criterion is > 6 Log₁₀

Foot Care by Health Care Providers

- Overall goal of infection prevention practices for foot care is to eliminate the risk of transmission of pathogens between clients and between clients and the health care worker
 - All foot care equipment for re-use must be capable of being cleaned
 - Single-use items should be discarded after every use (or dedicated to patient)
 - **All instruments used in foot care must be sterile** before use on a client
 - Recommended methods of sterilization include: dry heat, autoclave or chemosterilization
 - Handwashing is the single most important procedure for preventing infections

Foot Care by Health Care Providers

- Non-sterile gloves should be worn throughout procedures
- Gloves must be changed for each patient
- If a foot basin is used it should be washed & dried (and disinfected) between clients
- Blades must not be re-used between clients

PIDAC Best Practices for Cleaning, Disinfection and Sterilization in All Health Care Settings

- It is strongly recommended that reprocessing should be performed in a centralized area that complies with the physical & human resource requirements for reprocessing:
 - Clear separation between soiled & clean areas
 - Easy access to hand hygiene facilities
 - Easy access to emergency supplies
 - Area for donning/doffing PPE
 - Reprocessing area is routinely cleaned
 - Adequate ventilation, temperature & humidity requirements must be met
 - Water used in processing area should be tested & free of contaminants

Disinfectants: Desired Traits & Limiting Factors



Marketplace overview

- Existing Technologies *"FAIL"* in one or more of the key decision making criteria when selecting a cleaner/disinfectant.
 - **Cleaning Efficacy**
 - **Disinfection Capability**
 - **Personal Health & Safety**
 - **Environmental Responsibility**

Registration

- Government registered by Health Canada (DIN)
- Easy to Use with clear label instructions

Microbiological

- Broad-Spectrum Germicidal Activity
- Fast Acting
- Not Readily Neutralized in Organic or Inorganic Matter
- Microorganism Resistance will not develop

Chemical

- Safe to Transport
- Long Shelf Life
 - Improper or prolonged storage of disinfectants may lead to growth of bacteria in them
- Safe & Easy to Store
 - Improper storage of disinfectants may lead to explosions or fires
- Non-Corrosive & Material Compatible
 - Using the wrong type or level of disinfectant may cause corrosion or other damage to expensive items such as flexible endoscopes

Toxicological

- Non-Toxic to humans & animals
- Non-Allergenic & non-sensitizing
- Non-Hormone disruption
 - Certain microbicidal chemicals or their breakdown products can disrupt hormone function in humans & animals
- Safe for the User and Patient
 - Exposure to cleaner & disinfectant vapours may cause respiratory sensitization
 - Improperly rinsed endoscopes or other devices may release residues of disinfectants into body cavity

Environmental

- Environmentally sound (Biodegradable)
 - Environmentally-stable sanitizers & disinfectants can contaminate food or water (groundwater & surface water)
- No Active Residual Chemistry
- Good Air Quality
 - Free of any pungent smell
 - No Volatile Organic Compounds (VOCs)
 - Use of gaseous or volatile products may negatively affect indoor air quality
 - Fragrance Free

Factors Affecting Disinfectants

- Prior cleaning of a surface or device
 - Cleaning MUST precede disinfection & sterilization procedures
 - Cleaning residues can interfere with the activity of some disinfectants
 - Chemical sterilants can be relied on to produce sterility only if adequate cleaning occurs
- Organic load on the surface or device
 - Soil can provide a protection barrier for microbes
 - Soil can neutralize many of the disinfectant chemistries

Factors Affecting Disinfectants

- Type & level of microbial load on the surface or device
 - Mechanism of action differs for each chemistry (surface actives, cell components)
- Water Quality
 - Many chemistries can be neutralized when diluted with hard water
- Concentration of the chemical
 - Improper dilution can lead to a false sense of security

Factors Affecting Disinfectants

- Exposure time of the surface or device to the chemical
 - Contact time must be adhered to in order to achieve desired level of disinfection
 - Surface or device must remain wet
- Physical configuration of the object (crevices, hinges etc)
 - Difficult to remove debris or ensure disinfectant comes in contact with all areas of a surface or device

Factors Affecting Disinfectants

- Temperature
 - Effectiveness is enhanced or hindered by various temperature levels
 - Higher temperatures can accelerate the evaporation of volatiles which can reduce the concentration & effectiveness
- pH
 - Some products need to be activated prior to use
 - Changes to pH can decrease (neutralize) some chemistries
- Storage & Shelf-life
 - Must consider how products are stored (too cold or hot)
 - Efficacy of product decreases once diluted

The Chemistries



NAME THAT CHEMISTRY!?!

What Do the following chemicals have in common?

- N-Alkyl (40% C12, 50% C14, 10% C16) dimethyl benzyl ammonium chloride
- 3-(trimethoxysilyl) propyldimethyloctadecyl ammonium chloride
- N-Alkyl (68% C12, 32% C14) dimethyl ethylbenzyl ammonium chloride
- Benzalkonium chloride

They are all **QUATERNARY AMMONIUM COMPOUNDS!**

Next Slide

Quaternary Ammonium Compounds

Advantages:

- Bactericidal, Fungicidal, Virucidal (enveloped) with a minimum contact time of 10 minutes
- Generally non-irritating to hands & non-corrosive to surfaces
- Usually has detergent properties
- Low Toxicity profile
- Stable in concentrate and use dilution
- Newer generations are relatively stable in the presence of organic matter

Quaternary Ammonium Compounds

Disadvantages:

- Not sporicidal, generally not tuberculocidal or virucidal against non-enveloped viruses
- Not effective against Biofilms
- DO NOT use to disinfect Instruments
- Leaves Residual Active Chemistry on Environmental Surfaces

Quaternary Ammonium Compounds

Disadvantages:

- Repeated uses increase residue build up on surfaces which may lead to increase resistance to susceptibility to antimicrobials inside health settings
- Formulations may contain APEs or NPEs (hormone disrupting chemicals)
- Non-Biodegradable

NAME THAT CHEMISTRY!?!

What do the following chemicals have in common?

- Ethanol
- Isopropanol
- Methanol
- Alcohol Anhydrous

They are all **ALCOHOLS**

Next Slide

Alcohols

Advantages:

- Broad-spectrum effectiveness: bactericidal, tuberculocidal, fungicidal and virucidal
- Contact time for Ethanol is 1 to 3 minutes
- Contact time for Isopropanol is 5 to 10 minutes (generally added to Quats)
- No Active Chemical Residue
- Non Staining

Alcohols

Disadvantages:

- Evaporation may diminish concentration therefore contact time is difficult to achieve unless items are immersed
- Inactivated by organic material
- Poor cleaners, not appropriate for use on Environmental Surfaces
- Not sporicidal

Alcohols

Disadvantages:

- Volatile, flammable and must be stored in well-ventilated area
- Use in the OR is contraindicated
- Prolonged exposure may cause dry skin & skin irritation
- Compatibility issues with glues & plastics
- May affect indoor air quality due to VOCs

NAME THAT CHEMISTRY!?!

What do the following chemicals have in common?

- Chlorophene
- Chloroxylenol
- P-tert-amylphenol Potassium salt
- O-phenylphenol
- O-benzyl-p-chlorophenol

They are all PHENOLS / PHENOLICS

Next Slide

Phenols & Phenolics

Advantages:

- Commercially available with added detergents to provide cleaning & disinfecting
- Broad-Spectrum antimicrobial (bactericidal, tuberculocidal, fungicidal & virucidal) with a 5 to 10 minute contact time
- Stable in both concentrate and use dilutions
- Tolerance for organic load and hard water will depend on formulation
- Generally regarded as biodegradable

Phenols & Phenolics

Disadvantages:

- Poor cleaning efficacy
- Not Sporicidal
- Contraindicated for use around children
- Not recommended for use on Food Contact Surfaces
- Residual disinfectant may cause tissue irritation
- Pungent Odour (Volatile)

Phenols & Phenolics

Disadvantages:

- High Toxicity (listed on the Canadian Toxic Substance List & the EPA National Priority Lists)
- Phenols have limited use in Educational & Food Preparation settings because of their restrictions due to the toxicity
- Potential toxicity (skin, brain, kidneys, liver & lungs) from o-phenylphenol (listed as a carcinogen), o-benzyl-p-chlorophenol & ethylene glycol (anti-freeze, listed as a teratogen)

NAME THAT CHEMISTRY!?!

What do the following chemicals have in common?

- Calcium Hypochlorite
- Sodium Hypochlorite
- Chlorine Dioxide
- Sodium Chlorite

They are all **CHLORINE COMPOUNDS!**

Next Slide

Chlorine & Chlorine Compounds

Advantages:

- Low cost, readily available, Multi-purpose
- Relatively Fast Acting (average contact time of 10 minutes)
- Broad-Spectrum Antimicrobial (bacteria, viruses, fungi, protozoa, spores)
- Effective in removing biofilms (does not kill)
- Readily available in liquid or solid
- Use for disinfection Environmental surfaces, toys, sports equipment

Chlorine & Chlorine Compounds

Disadvantages:

- Instable, Corrosive & pH dependant
- Inactivated (neutralized) by Organic Matter
- No detergent properties
- Irritant to skin & mucous membranes
- Compatibility issue with metals, rubber & material

Chlorine & Chlorine Compounds

Disadvantages:

- Use in well-ventilated areas
- High Toxicity, kills all forms of aquatic life
- Chlorine disinfection by-products cause adverse developmental & reproductive effects including spontaneous abortion

NAME THAT CHEMISTRY!?!

What do the following chemicals have in common?

- Dihydrogen dioxide
- Hydrogen dioxide
- Dioxidane

They are all synonymous for **Hydrogen Peroxide!**

Next Slide

Hydrogen Peroxide

Advantages:

- Environmentally safe
- Broad-spectrum antimicrobial (bacteria, viruses, mycobacteria, fungi, spores)
- Effective against biofilms
- Stable in presence of organic matter
- Non-staining
- No Active Chemical Residue

Hydrogen Peroxide

Disadvantages:

- Can be corrosive to soft metals aluminum, copper, brass, zinc, mild & galvanized steel
- High concentration has strong pungent odour (>20%)
- High concentration may cause chemical burns
- Can be explosive at high concentrations

Accelerated Hydrogen Peroxide

Advantages:

- Fast acting broad-spectrum antimicrobial (bacteria, viruses, mycobacteria, fungi, spores)
- Contact times ranging from 30 seconds to 20 minutes depending on level of disinfection
- Effective against biofilms
- Excellent cleaning efficacy
- Excellent Health & Safety profile

Accelerated Hydrogen Peroxide

Advantages:

- Stable in presence of organic matter
- No active chemical residuals
- Low foam & non-staining
- Stable in concentrate form
- VOC free
- Environmentally friendly (Inherently Biodegradability, Low Aquatic Toxicity)
- Not manufactured using APEs (ie NPEs)

Accelerated Hydrogen Peroxide

Disadvantages:

- Prolonged exposure should be avoided to soft metals aluminum, copper, brass, zinc, mild & galvanized steel

NAME THAT CHEMISTRY!?!

What do the following chemicals have in common?

- Glutaral
- 1,5-pentanedial
- Ortho-phthalaldehyde
- Formalin

They are all ALDEHYDES!

Next Slide

Ortho-phthalaldehyde

Advantages:

- High level disinfectant in 5 - 12 mins
- No activation required
- Non-corrosive to metals
- Non-flammable
- Excellent material compatibility, can be used on lensed instruments and flexible endoscopes

Ortho-phthalaldehyde

Disadvantages:

- Slow sporicidal activity
- Stains skin, mucous membranes, clothing and environmental surfaces
- Eye irritation with contact
- Not enough information on Toxicity
- Potential material incompatibility (anodize aluminum coating dulls)

Ortho-phthalaldehyde

Disadvantages:

- Restrictions to disposal (dependant on municipality)
- Instruments must be well rinsed to ensure removal of all chemical residues
- Contraindication for use on urological instruments due to anaphylaxis

Glutaraldehydes

Advantages:

- Chemical sterilants in 6 - 12 hrs
- High level disinfectant in 10 - 60 mins
- Non-corrosive to metals
- Non-flammable
- Active in presence of Organic Matter
- Excellent material compatibility, can be used on lensed instruments and flexible endoscopes

Glutaraldehydes

Disadvantages:

- Not suitable or safe for use as a surface disinfectant
- Pre-cleaning is essential (fixative)
- May corrode or stain high-carbon steel & leave residues on metals
- Germicidal activity is affected by pH & dilution
- Questionable ability to kill / remove Biofilms

Glutaraldehydes

Disadvantages:

- Extremely irritating to skin & mucous membranes (pungent odour)
- Special ventilation is required
- Liquid & vapour are recognized as toxic can cause dermatitis (skin), conjunctivitis (eyes), rhinitis & sinusitis (lungs)
- Glutaraldehyde is a suspected mutagen & carcinogen

Conclusions

Disinfectant Selection

Consider:

- Efficacy
- Spectrum
- Versatility
- Ease of use
- Safety profile
- Cost



Disinfectant Selection

Remember:

- Match Product with Protocol
 - Surfaces vs Instruments
- Cleaning = 1st step
- Disinfection = 2nd step
- Contact Time is **MANDATORY!**



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Germicide Type	Active Residuals	Volatiles	Organic Compounds	Toxic Irritant	Substrate Impact	Poor Cleaning	Environmental Issues	Narrow-Spectrum Germicide	Organic Neutralization	Restrictions In Use
Quats										
Alcohols										
Phenolics										
Chlorine										
Gluteraldehyde										
AHP										

Virox Technologies Inc.

Engineering
Revolutionary
Disinfectants for the
War Against
Microbes

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