

Occupational Health and Safety Issues Related to Cleaners, Disinfectants, and Sterilants

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**Agenda**

1. Background
2. Routes of Exposure
3. Risk/Exposure Assessment
4. Hierarchy of Controls
5. Environmental Surfaces
  - Disinfectants (Low and Intermediate Level)
6. Reprocessing Reusable Items
  - Cleaning Agents
  - Disinfectants (High Level)
  - Sterilants

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1. Background

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# 1. Background

## Definitions

Decontamination is divided into three categories<sup>1</sup>:

- 1. **Cleaning:** physical means to remove many microorganisms with detergent.
- 2. **Disinfection:** the number of microorganisms are reduced to a level at which they are not harmful. Not all spores are destroyed.
- 3. **Sterilization:** all microorganisms, including spores are removed and destroyed.

- i. **High level:** kills all organisms, except high levels of bacterial spores.
- ii. **Intermediate level:** kills mycobacteria, most viruses, and bacteria.
- iii. **Low level:** kills some viruses and bacteria.

Guideline for Sterilization and Disinfection in Healthcare Facilities, 2008 Centers for Disease Control




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# 2. Routes of Exposure




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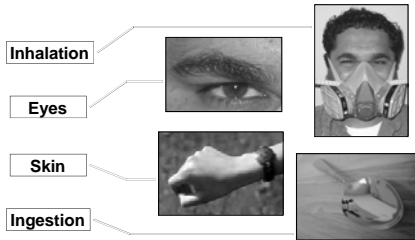
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# 2. Routes of Exposure

## Routes of Exposure




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### 3. Risk / Exposure Assessment





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### 3. Risk/Exposure Assessment

Product Risk

- Key ingredients and associated concentration
- Toxicology – acute and/or chronic
- Potential health effects

→ Most of this information can be found in the **Material Safety Data Sheet (MSDS)**


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### Sample MSDS – Virox 5

NATURAL SAFETY DATA SHEET

**11. TOXICOLOGICAL INFORMATION**



Acute toxicity: Corrosive to eyes. Oral LD50 estimated to be greater than 5000 mg/kg. Dermal LD50 estimated to be > 2000 mg/kg. See Section 3

Component Information: See Section 3

Chronic toxicity: None known

Specific effects:

- carcinogenic effects: None known
- Mutagenic effects: None known
- Reproductive toxicity: None known
- Target organ effects: None known


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### 3. Risk/Exposure Assessment

#### Exposure Considerations

- Dilution prior to use
- Method of application
- Environmental factors e.g. ventilation, size of room
- Duration
- Frequency



→ Airborne exposure may be assessed through exposure monitoring and comparison to occupational exposure limits, if applicable



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### 3. Risk/Exposure Assessment

#### Exposure Considerations – Best Practices

- If diluted, risk is reduced because agent is less concentrated
  - Method of dilution must be assessed
- Wherever possible, minimize spraying to prevent aerosolization
- The better the ventilation and/or the larger the room, the faster the decrease in airborne concentration of agent
- The shorter the duration of use, the shorter the exposure period
- When agent is less frequently used, exposure is minimized



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### 4. Hierarchy of Controls



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## 5. Environmental Surfaces

### Low and Intermediate Level Disinfectants

#### *Acute Health Effects*

- Corrosive
- Irritating to skin, eyes and respiratory tract

#### *Chronic Health Effects*

- Skin sensitization
- Occupational asthma



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## 5. Environmental Surfaces

### Low and Intermediate Level Disinfectants

#### Literature Findings

The odds of reported asthma among nurses were higher due to exposure to general building cleaning products and disinfectants (adjusted OR=1.72, 95% CI 1.00 to 2.94) (Arif et al., 2009)

A nearly 2X increase in likelihood of asthma was found after entry into a healthcare profession for tasks involving cleaning and disinfection as well as general cleaning products for indoor surfaces (Delclos et al., 2007)

Three case studies reporting link between quaternary ammonium exposure and occupational asthma (Purohit et al., 2000)



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## 6. Reprocessing Reusable Items



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## 6. Reprocessing Reusable Items

### Categories

- Cleaning Agents – Enzymatics
- High Level Disinfectants (HLD)
- Sterilants



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## 6. Reprocessing Reusable Items

### Enzymatics – Background

- Refers to a variety of groups of proteolytic enzymes derived from bacteria
- Subtilisins are one of most common types
- Used to assist with removal of organic material from instruments



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## 6. Reprocessing Reusable Items

### Enzymatics – Areas of Use

- Historically, mainly limited to Sterile Processing Departments
- Canadian Standards Association updated CSA 314.8-08 Decontamination of Reusable Medical Devices -- outlines specific requirements for the immediate application of products such as enzymatics to equipment*
- Increased use of enzymatics in departments such as Ambulatory Day Care, Emergency Departments, Medical Imaging, Operating Rooms, and community facilities



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## 6. Reprocessing Reusable Items

### Enzymatics – Potential Health Effects

Known respiratory and dermal irritants

Exposure may cause sore throat, nasal congestion, headache, persistent cough, wheezing, and dermal irritation (particularly in areas of high moisture content)

Inhalation exposure to certain enzymatics (e.g. subtilisins) may result in respiratory sensitization



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## 6. Reprocessing Reusable Items

### Enzymatics – Potential Airborne Exposure

ACGIH has set a Ceiling Occupational Exposure Limit (OEL) of 0.00006 mg/m<sup>3</sup> for *crystalline* subtilisins

Practical analytical methods not currently available

Research done in industrial dishwashing settings (high concentration enzymatic products) using worst case sampling and extended sampling periods <sup>1</sup>

Airborne levels measured during these industrial process assessments were very low and were well below occupational exposure limits

1. Human and Environmental Risk Assessment (HERA) of Ingredients of Household Cleaning Products February 2007 Edition 2.0



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## 6. Reprocessing Reusable Items

### Enzymatics – Control Methods

Minimize potential for aerosolization

Dispense under water

Water temperature should be as cool as allowable

Do not use compressed air

Safe work procedures required to ensure protection against airborne exposure

With the utilization of appropriate safe work procedures and practices, there is no need for local exhaust ventilation or respiratory protection



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## 6. Reprocessing Reusable Items

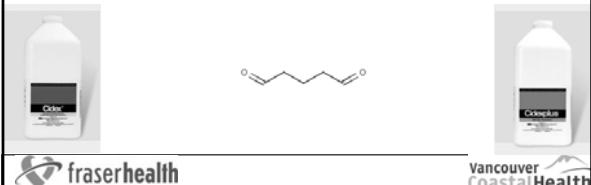
### HLD: Glutaraldehyde – Potential Health Effects

ACGIH has set a Ceiling Occupational Exposure Limit (OEL) of 0.05 ppm

Known skin and respiratory sensitizer

Can cause irritation of the nose, throat, skin, and eye, and headaches

Many facilities have stopped using in the last decade



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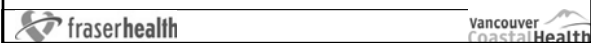
## 6. Reprocessing Reusable Items

### HLD: Glutaraldehyde

#### Literature Findings

A case study reported a healthcare worker experiencing nosebleeds while working with glutaraldehyde; symptom resolved when not at work (Wiggins et al., 1989)

Healthcare workers more than 8X more likely to be allergic to glutaraldehyde and experience contact dermatitis (Shaffer and Belsito, 2000)



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## 6. Reprocessing Reusable Items

### HLD: Glutaraldehyde – Controls

Must be accompanied with local exhaust ventilation



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## 6. Reprocessing Reusable Items

### HLD: Ortho-phthalaldehyde (OPA) – Potential Health Effects

Over the past decade, many hospitals switched from glutaraldehyde-based high level disinfectants to the OPA alternative (CIDEX OPA)

No occupational exposure limits

Known skin sensitizer and potential respiratory sensitizer

Irritating to skin and eyes



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## 6. Reprocessing Reusable Items

### HLD: Ortho-phthalaldehyde (OPA)

#### Literature Findings

Data is limited

Unpublished animal data suggests that it is non-sensitizing for skin; unknown if it is a respiratory sensitizer (Rideout et al., 2005)

A case of occupational bronchial asthma caused by OPA vapour during endoscope reprocessing has been reported (Fujita et al., 2006)

Animal studies suggest that OPA is an immunological adjuvant (Hasegawa et al., 2009)



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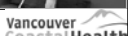
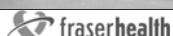
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## 6. Reprocessing Reusable Items

### HLD: Ortho-phthalaldehyde (OPA) – Airborne Exposure

Until recently no commercially available analytical method

2008 – Assay Technologies introduced a passive sampling badge



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## 6. Reprocessing Reusable Items

### Exposure Considerations – Best Practices

Summer of 2008 – airborne measurements collected in 3 SPDs and 2 ultrasound departments in Fraser Health

Used to assess effectiveness of controls in place

Area, short-term, and full-shift personal samples

Limits of Detection: 0.0006 ppm (8-hour sample); 0.02 ppm (15-minute sample)

Only one detectable measurement: 0.00025 ppm (area measurement averaged over 24-hours)



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## 6. Reprocessing Reusable Items

### HLD: Ortho-phthalaldehyde (OPA) – Controls

All processes utilized local exhaust ventilation

No measurements without any controls in place were conducted

However, based on the potential adverse health outcomes related to OPA, it is advisable to continue with appropriate local ventilation to ensure levels are maintained as low as reasonably achievable.



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## 6. Reprocessing Reusable Items

### HLD: Hydrogen Peroxide – Background

For use as a HLD, the percent of hydrogen peroxide in the product must be greater than 7%

Variety of hydrogen peroxide-based HLD manufacturers

Virox Technologies manufactures "accelerated hydrogen peroxide (AHP)" products where they state: "is a synergistic blend of commonly used, safe ingredients that when combined with low levels of hydrogen peroxide produce exceptional potency as germicide and performance as a cleaner."

Such "accelerated hydrogen peroxide" products contain hydrogen peroxide concentrations below the typical 7% requirement



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## 6. Reprocessing Reusable Items

### HLD: Hydrogen Peroxide – Potential Health Effects

ACGIH has set a time-weighted average exposure limit of 1 ppm  
Can cause irritation of the nose, throat, skin, and eye, and may also cause headaches



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## 6. Reprocessing Reusable Items

### HLD: Hydrogen Peroxide

#### Literature Findings

Two cases of subjects who developed cough, wheezing and shortness of breath following exposure to peracetic acid and hydrogen peroxide (Cristofari-Marquand et al., 2007)



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## 6. Reprocessing Reusable Items

### HLD: Hydrogen Peroxide – Airborne Exposure

In December 2008, an airborne exposure assessment of Sporox II was conducted in SPD. The product contains 7.5% hydrogen peroxide and 0.85% phosphoric acid.

Simulated worst case personal exposure

Used short-term colourimetric tubes

All measurements less than limit of detection (0.5 ppm)



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## 6. Reprocessing Reusable Items

### HLD: Hydrogen Peroxide – Controls

Of high level disinfectants, potential health effects generally less serious

Airborne exposure levels measured below established occupational exposure limits



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## 6. Reprocessing Reusable Items

### Sterilants - Background

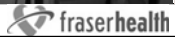
Ethylene oxide (e.g. 3M™ Steri-Vac™)

Hydrogen Peroxide Gas Plasma (e.g. Sterrad® 100S)

Peracetic Acid (e.g. Steris System 1E)

Steam (e.g. Steris Amsco Century, Getinge)

Ozone (e.g. TSO<sub>3</sub> STERIZONE)



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## 6. Reprocessing Reusable Items

### Sterilants – Potential Health Effects

#### Ethylene Oxide

Irritation of the eyes, skin, and mucous membranes; also affects brain and nervous system

Carcinogen

Possible reproductive effects

#### Hydrogen peroxide gas plasma

According to [disinfectionandsterilization.org](http://disinfectionandsterilization.org), safe for HCWs – leaves no toxic residue



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## 6. Reprocessing Reusable Items

### Sterilants – Potential Health Effects

#### Peracetic acid

- Adverse dermal effects and skin absorption
- Irritating to eyes, nose and throat

#### Steam

- Non toxic but may cause burns



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## 6. Reprocessing Reusable Items

### Sterilants

#### Controls

Sterilization generally completed in an enclosed chamber with associated local ventilation (engineering control), so risk is minimized

Ethylene oxide: *CSA Z314.1-09 Ethylene oxide sterilizers for health care facilities*



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### In General

#### Severity of health effects:

Sterilants > Disinfectants > Cleaners

However...

#### Risk of exposure:

Disinfectants > Cleaners > Sterilants



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Summary

There are documented adverse health effects associated with cleaners, disinfectants and sterilants

Ensure that you are familiar with the associated hazards

Exposure dependent on hazardous ingredients, concentration and application method

Ensure that you implement the hierarchy of controls to minimize exposure

Ensure workers are trained in safe work and handling policies/practices and that they are readily available for referral

Exercise hand hygiene after use with agents



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Acknowledgements

Kim McLeod MSc (UBC SOEH) *Assessment of Ortho-phthalaldehyde Exposure in Hospital Ultrasound and Sterile Processing Departments*

*Fraser Health Reprocessing for Patient Safety Project Team*

*Fraser Health Exposure Prevention Specialists*

*Environmental Cleaning Task Group - FH / VCH / PH*



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Questions?



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