

# **Training on Medical Waste Management**

**in Collaboration with  
Al-Essa Medical & Scientific Equipment Co. W.L.L**

## **Decontamination, Antisepsis and Sterilization**



**Kuwait University  
Health Science Center  
29 January – 1 February, 2012**

# Decontamination

## Encompasses:

- **Antisepsis, Disinfection, Decontamination, and Sterilization**
- **Antisepsis**
  - **Chemical applied to living tissue that will control or arrest the growth of a microorganism**
- **Decontamination**
  - **Disinfection or Sterilization of contaminated materials**

# Decontamination

## Disinfection

To free from infection, reduction of contaminant load to a safe level, does not imply total destruction of all microorganisms. Will not always destroy spores.

## Sterilization

The destruction of all forms of microbial life. Difficult to achieve (usually referred to a very low chance that a microbe survived).

# Disinfection in Healthcare

## High-Level Disinfection

- sporicidal/tuberculocidal (but used for shorter times than required for sterility). Equipment that will have invasive contact with patient.

## Intermediate

- tuberculocidal (equipment that will contact mucous membranes of patient)

## Low-Level (kills vegetative bacteria)

- for non-critical equipment (no invasive contact)

# Sterilants - Physical Methods

## Steam Autoclave

- steam under pressure --> moist heat
- 121 C/250 F @ 15 psi for 30 - 60 minutes

## Dry Heat

- 160 - 170 C/320 - 356 F for 2 - 4 hours

## Incineration

- 2 stage burn, 1400 & 1800 F

# Sterilants - Gases

## Formaldehyde Gas

- heat formalin to vaporize it (1 ml/ft<sup>3</sup>)
- heat paraformaldehyde (0.3 g/ft<sup>3</sup>)
- 2 hour exposure time required (8 hour or overnight contact period recommended)
- can neutralize HCHO (toxic, suspect carcinogen) with ammonium bicarbonate
- room temperature > 70 F, %RH - > 70%

# Sterilants - Gases

## Ethylene Oxide

- 400 - 800 mg/L
- 35 - 60 C temperature, 30 - 60% RH
- contact time up to 4 hours

## Hydrogen Peroxide

- vaporize from 30% H<sub>2</sub>O<sub>2</sub>

# Liquid Disinfectants

Surface treatment or to treat liquid waste

Inactivate by

- ❑ coagulation, denaturation, lysis, enzyme inactivation

Factors to consider:

- ❑ temperature, humidity, pH
- ❑ contact time, concentration
- ❑ penetrability
- ❑ presence of organic material



# Liquid Disinfectants

## Alcohol

- Ethanol, Isopropanol ( 70 - 85%)
  - requires presence of water for protein denaturation
- Bactericidal (vegetative bacteria)
- Virucidal (enveloped viruses)
- Not sporicidal
- Not as effective against non-enveloped viruses)
- Flammable
- Low BP, higher evaporation rate, difficult to get 10 minute contact time

# Liquid Disinfectants

## Glutaraldehyde

- ❑ stable in and stored in acid pH range
- ❑ activated by adding sodium bicarbonate to elevate pH to  $> 7.5$  (14 day shelf-life)
- ❑ contact time (10 - 180 minutes)
- ❑ sporicidal at longer contact times
  - sterility requires 6 - 10 hours
- ❑ non-corrosive
- ❑ effective in presence of organic material

# Liquid Disinfectants

## Formaldehyde (4 - 8 %)

- active in alkaline pH range, non-corrosive
- effective in presence of organic material
- diminished activity in colder temperatures
- 10 - 30 minute contact time required
- fixative (penetration rate of 8mm/24 hours in tissue specimens)
- wide spectrum disinfectant
- suspect carcinogen, toxic at low levels

# Liquid Disinfectants

## Phenol (0.2 - 3%)

- Not sporicidal, not effective against non-enveloped viruses
- Tuberculocidal, fungicidal, bactericidal
- not affected by presence of organic material
- hard water can affect effectiveness
- Toxic, can be absorbed through skin (large spills to skin can be fatal)

# Liquid Disinfectants

## Quaternary Ammonium Compounds (0.1 - 2%)

- cationic detergents, very good cleaning agents
- inactivated by organic material
- bactericidal, algicidal, fungicidal, will destroy enveloped viruses
- not tuberculocidal or sporicidal
- low-level disinfectant
- good for general surfaces and floors
- very toxic to eyes (a few drops can lead to blindness)

# Liquid Disinfectants

## Halogens - chlorine (0.01 - 5%)

- wide spectrum of activity
- acts rapidly at low concentrations (10 - 30 min.)
- inactivated by organic material (use more)
- will lose chlorine upon exposure to light/air
- more cidal at low pH, good at lower temps.
- very corrosive

# Liquid Disinfectants

## Halogens - Iodine (0.47%, 75 - 1600 PPM)

- inactivated by protein
- 1600 PPM inactivates wide spectrum of agents
- effective over wide pH range
- tuberculocidal, sporicidal
- corrosive, will stain, toxic, allergenic
- Dilution issue - must follow recommended dilutions for iodophors (or iodophor may not be as effective)

# Liquid Disinfectants

## Hydrogen Peroxide (3% - 25%)

- stable, non-toxic, fast acting
- 10 - 25% solutions are sporicidal
- inactivated by organisms that produce catalase



# Rank Order of Resistance to Disinfection

- Prions
- Protozoan cysts
- Bacterial spores
- Non-enveloped (hydrophilic) viruses
- Mycobacteria
- Fungal spores, fungi
- Vegetative bacteria
- Enveloped viruses (lipophilic)

# Verification of Decontamination

## Autoclave Tape

- time/temperature/date records on chart

## Chemical Indicators (diack melt pellets)

- fuse if temperature reached for at least 1 second

## Biological Spore Indicators

- *Geobacills stearothermophilus*
- *Bacillus atrophaeus*

## Manifest for Biomedical Waste (Incineration)

# Spill Decontamination

## Cover

- cover spill area with paper towels

## Disinfect

- slowly pour disinfectant around perimeter and into the center of spill area. 10-15 minute contact time.
- Clean/disinfect surrounding areas

## Clean

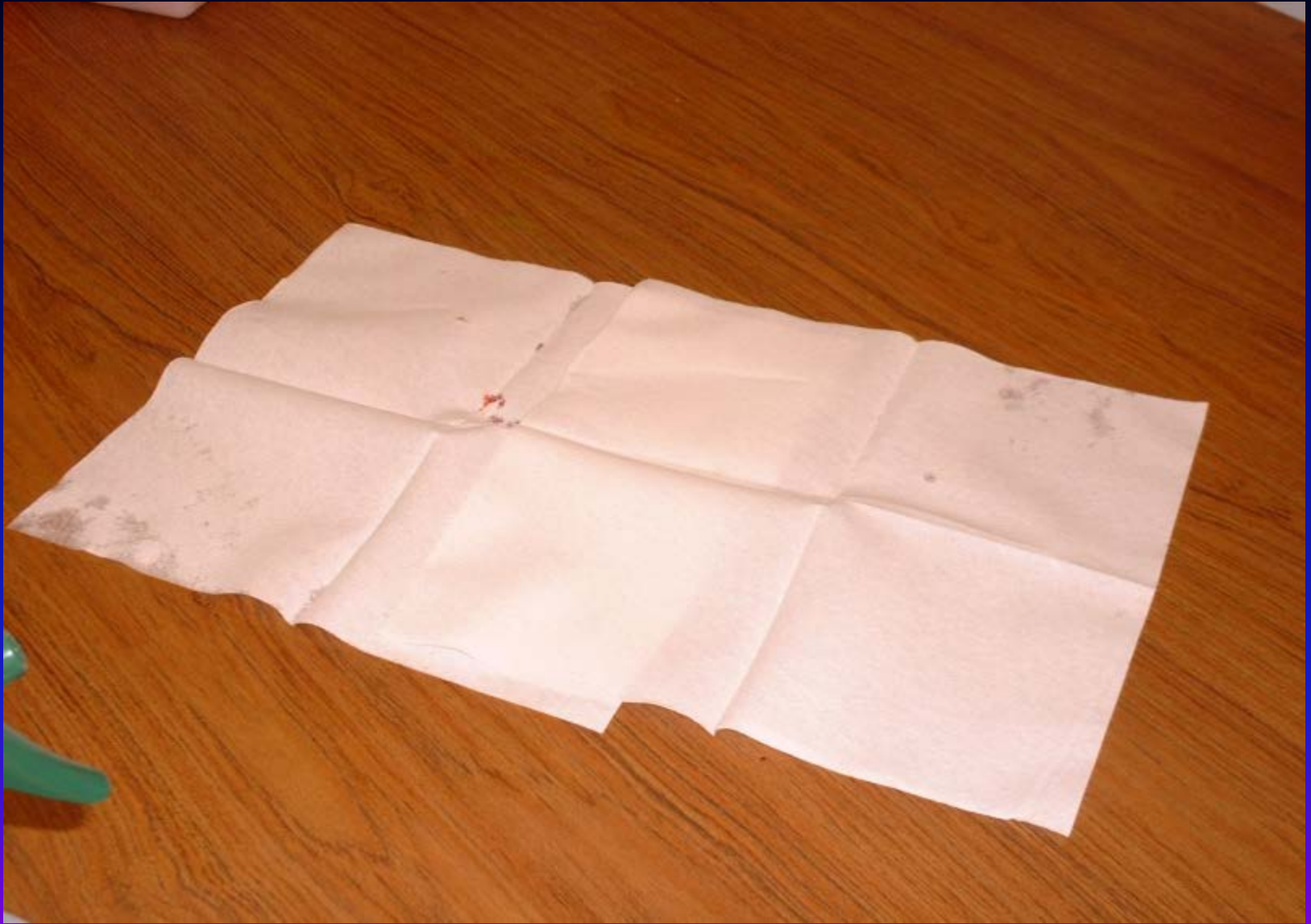
- absorb spill and paper towels and place in biohazard bag. Sharps placed in sharps container.

## Disinfect

- spray spill area with disinfectant, allow to air dry













The most important step in instrument reprocessing or surface management is....

**Cleaning!!**

# Cleaning and Disinfection

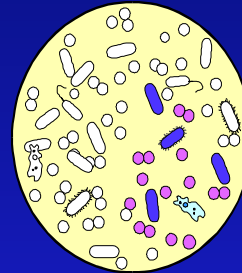
- ◆ **Cleaning: removal of soil, bioburden; safe to handle (decontamination)**
- ◆ **Disinfection differs from sterilization by lack of sporicidal power**
- ◆ **Levels of disinfection: high, intermediate, low**
- ◆ **Non-critical environmental surfaces: cleaning, low- to intermediate level disinfection as appropriate**
- ◆ **Cleaners don't disinfect, disinfectants don't clean!**

# Choosing a Disinfectant

- ◆ Clean first!
- ◆ Nature and use of the item to be disinfected
  - ◆ Disinfection level
- ◆ Sufficient potency for disinfection
  - ◆ Intrinsic resistance of microbes
  - ◆ Chemical class of disinfectant, use conditions
- ◆ Materials compatibility
- ◆ Safety concerns: hazards with use?
  - ◆ Aerosols, residuals, chemical sensitivities

# Chain of Infection

- Virulent pathogen
- Sufficient number of the pathogen (infectious dose)
- Susceptible host
- Mode of transmission
- Correct portal of entry



# Environmentally Transmitted Infections

Healthcare workers and patients can be infected directly or indirectly from environmental sources

- Sources can be air, fomites, instruments, or aerosols

**Fomite: An inanimate object or substance capable of carrying infectious organisms and hence transferring them from one individual to another**

# Environmental Sites Positive for MRSA in Endemic and Outbreak Situations

Item or Surface	Mean %	Range %
Floor	34.5	9.0 – 60.0
Patient Gown	40.5	34.0 – 53.0
Bed Rails	27.0	1.0 – 60.0
Bed Linens	41.0	34.0 – 54.0
Overbed Table	40.0	18.0 – 67.0
Bathroom Door Knob	14.0	8.0 – 24.0
Room Door Knob	21.5	4.0 – 59.0
Furniture	27.0	11.0 – 59.0
Flat Surfaces	21.5	7.0 – 38.0
Sink Taps	23.5	14.0 – 33.0
Infusion Pump Button	19.0	7.0 – 30.0

Adapted from: [Dancer SJ. The Lancet Infectious Diseases: epub 10/31/07](#)

# Antimicrobial Resistance and Emerging Pathogens

- Newly discovered pathogens or organisms that acquire antimicrobial resistance are usually erroneously assigned extraordinary resistance to commonly used disinfection and sterilization procedures
- Examples: SARS-Co-V, HIV, HBV, Ebola virus, Hantavirus, MDR-Tb, VRE, MRSA, VRSA

# Drug Resistant Pathogens

- No correlation to drug resistance and resistance to disinfection
- Some organisms may develop tolerance at concentrations hundreds to thousand folds below use dilution
- Current protocols do not have to be altered; use products per manufacturer's label or per laboratory protocols



# Cleaning and Disinfecting of the Housekeeping Surfaces

- ◆ Clean on a regular basis to remove soil and dust
- ◆ Physical removal of microorganisms and organic soil is as important as the antimicrobial effect of the disinfecting agent
- ◆ Surfaces not touched frequently by hand (i.e., floors) in general care areas are cleaned and disinfected
- ◆ This is controversial – routine disinfection of floors is not supported by epidemiology; lack of consensus among infection control staff and hospital epidemiologists

# **An Example on Why Instructions are so Important**

- **EPA-registered products labeled as  
“cleaner/disinfectants:”**
  - **Label clearly distinguishes between use of the  
product as a cleaner OR as a disinfectant**
  - **Level of soil, precleaned surface**
  - **Contact time**
  - **Surface is to remain WET for the full contact  
time**

# The Inanimate Environment Can Facilitate Transmission

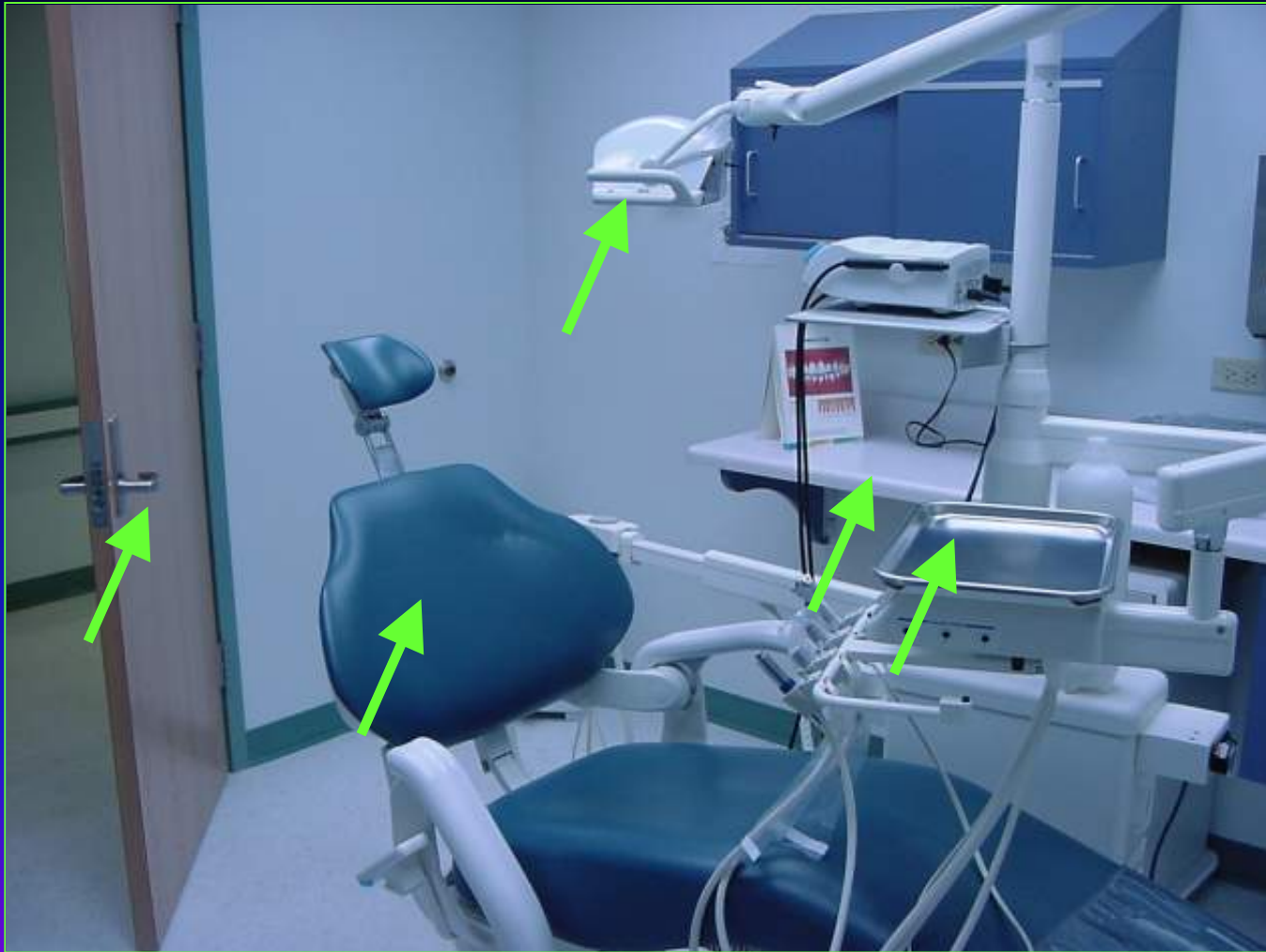
X represents VRE culture positive sites



~ Contaminated surfaces increase cross-transmission ~

Abstract: The Risk of Hand and Glove Contamination after Contact with a VRE (+) Patient Environment. Hayden M, ICAAC, 2001, Chicago, IL.

# Clinical Contact Surfaces



Dentistry

# Housekeeping Surfaces



# General Cleaning Recommendations

- Use barrier precautions (e.g., heavy-duty utility gloves, masks, protective eyewear) when cleaning and disinfecting environmental surfaces
- Physical removal of microorganisms by cleaning is as important as the disinfection process
- Follow manufacturer's instructions for proper use of EPA-registered hospital disinfectants
- Do not use sterilant/high-level disinfectants on environmental surfaces

# Cleaning Clinical Contact Surfaces

- Risk of transmitting infections greater than for housekeeping surfaces
- Surface barriers can be used and changed between patients



OR

- Clean then disinfect using an EPA-registered low- (HIV/HBV claim) to intermediate-level (tuberculocidal claim) hospital disinfectant









# Cleaning and Disinfecting of the Housekeeping Surfaces

- ◆ Follow manufacturer's instructions if using proprietary cleaners or disinfectants
  - ◆ Use conditions (e.g., concentration, contact time)
- ◆ Clean and disinfect surfaces that are touched by hand on a frequent and regular basis
  - ◆ Door knobs, light switches, bed rails
  - ◆ Surfaces around the toilet



# Minimize Glove “Misuse”

- Failure to remove or change contaminated gloves
- 18.3% (4/22) samples showed potential transferral of microorganisms [a = from patient, b = from gloves]

Source: Girou E, Chai SHT, Oppein F, et al. *J Hosp Infect* 2004; 57: 162-9

No. of Contacts Before Sampling	Glove Cultures		Environmental Cultures		
	Bacterial Counts (CFU)	Pathogenic Bacteria	Sampled Surfaces	Bacterial Counts (CFU)	Pathogenic Bacteria
6	4,500	<i>P. aeruginosa</i> (a), <i>Serratia marcescens</i> (a)	Bed barrier (rail)	85	<i>P. aeruginosa</i> , <i>Serratia marcescens</i> (a, b)
10	>30,000	<i>P. aeruginosa</i>	Bedside table	2	<i>P. aeruginosa</i>
10	>30,000	<i>P. aeruginosa</i>	Bedside table	>300	<i>P. Aeruginosa</i> (a)
17	>30,000	<i>P. aeruginosa</i>	Weighing machine	169	<i>P. aeruginosa</i> (b)

# So Why All the Fuss About Hand Hygiene?

- ◆ *Most common mode of transferral of pathogens is via the hands!*
- ◆ Infections acquired in healthcare
- ◆ Spread of resistant microorganisms



# Evidence of Relationship Between Hand Hygiene and Healthcare Associated Infections

- ◆ Substantial evidence that hand hygiene reduces the incidence of infections
- ◆ Historical study: Semmelweis
- ◆ More recent studies: rates lower when antiseptic handwashing was performed

Guideline for Hand Hygiene in Health-care Settings.  
MMWR 2002; Vol. 51, No. RR-16.

# How to Determine if Cleaning Products Are Hazardous or Contain Hazardous Substances

Review ingredients on material safety data sheet (MSDS). You can check products or ingredients against the following databases or lists.

- ♦ IARC – International Agency for Research on Cancer: [www.iarc.fr](http://www.iarc.fr)
- ♦ NTP – National Toxicology Program; <http://ntp-server.niehs.nih.gov>
- ♦ OSHA – Occupational Safety and Health Administration: [www.osha.gov](http://www.osha.gov)
- ♦ IRIS – EPA Integrated Risk Information System: [www.epa.gov/iris](http://www.epa.gov/iris)
- ♦ NIOSH – National Institute of Occupational Health and Safety: [www.cdc.gov/niosh](http://www.cdc.gov/niosh)
- ♦ ACGIH – American Conference of Governmental Industrial Hygienists: [www.acgih.org](http://www.acgih.org)
- ♦ CleanGredients Database – Green Blue Institute: [www.greenblue.org](http://www.greenblue.org)
- ♦ Green Seal: [www.greenseal.org](http://www.greenseal.org)
- ♦ EPA DfE - EPA Design for the Environment:  
[www.epa.gov/dfe/pubs/projects/formulat/index.htm](http://www.epa.gov/dfe/pubs/projects/formulat/index.htm)
- ♦ IRCHS - Indiana Relative Chemical Hazard Score: [www.ecn.purdue.edu/CMTI/IRCHS/](http://www.ecn.purdue.edu/CMTI/IRCHS/)
- ♦ TURI – Toxic Use Reduction Institute: [www.cleansolutions.org](http://www.cleansolutions.org)
- ♦ WHO – World Health Organisation [www.who.org](http://www.who.org)
- ♦ ECHA – European Chemicals Agency - <http://echa.europa.eu/>

# Safety Assessment of Cleaning and Disinfectant Products

- ◆ How is the product diluted and how frequently is it being used?
- ◆ What is the product's intended use?
- ◆ What is the likelihood it will be misused?
- ◆ What is the experience level of users?
- ◆ What are the hazard ratings for the product?
- ◆ What does the MSDS say about the product safety?
- ◆ Does the product present an acceptable level of risk?
- ◆ What do others report about the product safety?



# Cleaning and Disinfecting of Medical Equipment

- **FOLLOW THE MANUFACTURER'S INSTRUCTIONS !!!**
- **In the absence of instructions, clean and follow with low- to intermediate-level disinfection depending on the degree of contamination**
- **Consider covering those surfaces that are frequently touched during delivery of care**

# Strategies to Enhance the Safety and Efficacy of Cleaning and Disinfecting

- Be familiar with the product's MSDS and instructions for proper and safe application
- Look for opportunities to prevent surface contamination from occurring
- Look for opportunities to reduce the amounts of chemicals used

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- ✔ Results in 15 seconds
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- ✔ SURE-Trend analysis software (optional)

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Ultrasnap and Aquasnap are user-friendly,  
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**... Brings Back Fond Memories of  
the Response to SARS...**



# Final Points

- **Clean before you disinfect/sterilize**
- **Always wear Personal Protective Equipment**
- **Understand the products/equipment you are using whether they be a chemical or physical device**
- **Determine a way to evaluate your process**

Quiz time.....!!!!!!!

Name	Department	Position	Marks

Please write the answer in the Answer Column or tick the Option as applicable

No.	Question	Answer
1	What is the Colour of the Sharps Container used at HSC? A. Red B. Black C. Yellow	
2	Which Organization's name is abbreviated as 'WHO' ?	
3	Mercury and Mercury Compound Solutions are classified as A. Radioactive Waste B. Chemical Waste C. Cytotoxic Waste	
4	What is the Colour of the General Waste Bag? A. Red B. Black C. Yellow	
5	'MSDS' of a material contains a summary of the health hazards of the material and associated recommended safe work practices. Write the full form of the term 'MSDS'.	
6	The Equipment available in HSC for onsite treatment of Waste is an A. Autoclave B. Incubator C. Incinerator	
7	Gloves, Disposable Gowns, Shoe Covers etc. are classified as 'PPE'. Write the full form of the term 'PPE'.	
8	Write one Liquid Disinfectant that you use.	
9	Write any one Laboratory Hazard.	
10	Write any one Hazardous Waste generated in your Laboratory / Facility.	