What every person who works with animals needs to know
The Guide Says…

- Sanitation: The maintenance of conditions conducive to health
- No absolute minimal freq of bedding change (daily to weekly)
- Enclosures and accessories: at least every 2 weeks
- Monitoring of sanitation practices
  - Visual inspection
  - Water temp
  - Microbes
- Ideal pest control prevents entry of vermin into facility & eliminates harborage from the facility.

“There is No Silver Bullet”

- The magic chemical that...
  - kills all pathogens
  - noncorrosive to inanimate surfaces
  - non-toxic to human and animal tissue
  - nonallergenic
  - inexpensive
  - does not pollute
  - smells good

Resistance to Germicides

- Bacterial Spores (Bacillus subtilis)
- Mycobacteria (Mycobacteria tuberculosis)
- Nonlipid or small (non-enveloped) Viruses (polio, parvo)
- Fungi (Trichophyton spp)
- Vegetative Bacteria (Pseudomonas aeruginosa, Streptococcus pneumoniae)
- Lipid or medium-sized (enveloped) Viruses (herpes simplex, hepatitis B, HIV)

Sanitation Terminology

- Acid
  - Dissolves urine scale and removes hard water scale
  - Usually used in the prewash cycle or soak tank
  - Phosphoric acid (more corrosive) or citric acid (manual use)

- Antibiotic
  - An organically-derived chemical produced by microorganisms
  - Used in low concentrations to treat infections of plants and animals
  - Destroys or inhibits growth of bacteria and other microorganisms
Antiseptic

- Prevents or arrests the growth of microorganisms by destruction or inhibition
- Applied to living tissue, animate objects
- Alcohol is an antiseptic

Bactericide

- Kills bacteria, pathogenic and non-pathogenic
- Does not necessarily kill bacterial spores
- Used on living tissue and inanimate objects

Bacteriostat

- "-stat" from the Greek for "standstill"
- Prevents growth but does not necessarily kill
- Bacteria and their spores
- Usually a chemical

Biocide

- Kills all living organisms, pathogenic and non-pathogenic
- Kills spores, therefore is a sterilizing agent
- Destroys micro- and macro-organisms

Clean

- free from dirt, pollution or potential pathogens
- the first step in the sanitization process
- American Public Health Association definition of Cleaning:
  "The removal by scrubbing or washing, as with hot water, soap or suitable detergent, or by vacuum cleaning, of infectious agents and of organic matter from surfaces on which and in which infectious agents may find favorable conditions for surviving or multiplying."
- Failure to remove foreign matter from an object before disinfection or sterilization is likely to render the process ineffective.

Contamination

- made unfit for use through the introduction of or contact with dirt and potential pathogens
- introduction of microorganisms into tissues or sterile materials
### Decontamination
- The complete destruction of microbes by a nonsporicidal disinfectant when spores are absent
- Term used to distinguish between sterilization and the destruction of microbial contamination that is free of bacterial endospores
- Implies that items and devices treated as such are rendered safe to handle

### Detergent
- Mixture of compounds that acts as a cleaning agent by emulsifying grease and suspending particles of dirt

### Disinfectant
- Destroys 100% of disease bacteria vegetative forms or inactivates viruses; does not normally destroy spores
- Makes harmful organisms harmless by interfering with their metabolism
- Applied to inanimate objects and surfaces, not human or animal tissues
- May or may not require precleaning

### EPA Definition of ‘Disinfection’
- Antimicrobial pesticides identified by the term disinfectant are intended to provide a lower level of activity than sterilization.
- Disinfectants destroy or irreversibly inactivate specific viruses, bacteria, or pathogenic fungi, but not necessarily their spores, on inanimate surfaces.
- Most disinfectants, even with prolonged contact times, are not effective as sterilizers.
- To support effectiveness as a disinfectant, specific data relative to each bacteria, pathogenic fungus or virus against which a product is claimed to be effective must be submitted to EPA by the manufacturer or registrant.
- “…a hospital disinfectant is a product that must be shown to be effective against Pseudomonas aeruginosa, Staphylococcus aureus, and Salmonella choleraesuis.”

### Disinfection
- Factors affecting efficacy:
  - Nature/number of microbes
  - Concentration of chemical
  - Contact time
  - Organic matter
  - Temp, pH
  - Material surface

### Key Point
Remember cleaning is recommended prior to disinfection!
### Germicidal Activity Level

- **High:**
  - 2% Glutaraldehyde
  - 6% H2O2
  - 1% peracetic acid
  - Wet pasteurization
  - 5.2% bleach ≥20 min contact 1:50 dilution

- **Medium:**
  - 5.2% bleach ≤10 min contact 1:500 dilution
  - 0.5% iodine
  - 70-90% EtOH or isopropyl alcohol for 10 min
  - Phenolic detergent germicides

- **Low:**
  - Quats
  - Mercurials
  - Idophores
  - Phenols
  - 5.2% bleach ≤10 min contact 1:50 dilution

### Type of Product

- Chlorine & Chlorine compounds
- Iodine & Iodine compounds
- Phenols
- Alcohols
- Hydrogen peroxides & other oxidants
- Chlorhexidine
- Aldehydes
- Quaternary Ammonia compounds
- Other
  - Acid-anionic
  - Amphoteric
  - Heavy metals
  - Mercurials

### Type of Organism Affected

- Enveloped viruses
- Common, non-spore forming bacteria
- Fungi and molds
- Non-enveloped viruses
- Mycobacteria
- Bacterial spores
- Protozoan cysts and metazoan eggs

### Type of Tasks

- Pseudomonas
- Tuberculosis
- Clostridium piliforme
- Coxiella burnetti
- Viral inactivation
- Prions

### Selection Criteria

- **Label claims** (regulated by EPA / FIFRA)
- Broad spectrum activity
- Serum effectiveness
- Hard water effectiveness
- pH & use dilution stability
- Concentration required for effectiveness
- Contact time
- Temperature at which the agent works

### Germicide

- "-cide” from the Latin word for “killer”
- Destroys microorganisms, especially pathogens
- Does not necessarily destroy spores unless so stated
- Applies to use on living tissue and/or inanimate objects
- May refer to physical agents such as "germicidal lamps”
- May have “antiseptic” or “disinfectant” germicides
**Pasteurization**

- Heat treatment at a time and temperature combination that destroys many vegetative (active state) organisms
- Does not kill spores
- 145°F @ 30 min or 161°F @ 15 sec

Louis Pasteur (1822-1895)

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**Sanitizer**

- Reduces bacterial contaminant levels on inanimate objects
- Use on precleaned surfaces
- EPA definition: reduces vegetative bacteria by 99.9-99.999%

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**Soap**

- Lipophilic fatty acid: RCOO- Na/K+
- A cleansing agent made by combining alkali with fat
- Disadvantages: has a fixed chemical composition and reacts with minerals to form insoluble compounds (tub rings)
- Soaps emulsify lipoidal secretions of the skin and remove them along with most of the accompanying dirt, desquamated epithelium and bacteria

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**Sparkide**

- Destroys microbial spores
- Especially a chemical that destroys bacterial spores
- Generally applied to inanimate objects
- Would also be considered a sterilizing agent

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**Sterilization**

- Chemical or physical process
- An absolute state - destroys or eliminates all life forms
- A substance cannot be "partially sterilized"

For practical purposes however, because of possible limitations of detection, sterilization is defined as "the process by which living organisms are removed or killed to the extent that they are no longer detectable in standard culture media in which they have previously been found to proliferate."

- The process and the testing methods are equally important in defining sterilization

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**Chemical means**

- EtO
- Glutaraldehyde
- Formaldehyde
- H2O2
- Peracetic acid
**Sterilization**

- Physical means
  - steam autoclave
  - filtration
  - dry heat
  - radiation
  - boiling

**Methods to:**

- Disinfect
- Decontaminate
- Sterilize

**Alcohols**

- Features:
  - Broad spectrum, TB effective
  - No residue, evaporates readily

- Limitations:
  - Flammable
  - Not sporidal
  - Poor cleaner
  - Not EPA registered

**Chlorine Dioxide (ClO₂)**

- Clidox is a chlorine dioxide (ClO₂) based sterilant
- Clidox is a bactericide, fungicide, virucide, tuberculocide
- Kills both enveloped and non-enveloped viruses:
  - M. bovis: Killed in 5 minutes @ 20 C
  - H. simplex: Killed in 3 minutes @ 20 C
- Mix: Acid (hydroxyacetic acid) and Base (sodium chlorite)
  - Mix 1:18:1 (disinfectant) – stable for > 4 days
  - Vegetative bacteria
  - Mix 1:5:1 (high level disinfectant) – stable for ~ 24 hours
    - MHV, Sendai, PVM, LCM, etc.

**Chlorine Dioxide (ClO₂)**

- **Features:**
  - 2.6 times the oxidizing power of waterborne ClO₂
  - Costs about the same as other sanitizers
  - Does not have the strong odor or the corrosive properties
  - Economical: effective at concentrations as low as 5 ppm
  - Bacteria resistance to ClO₂ has not been demonstrated

- **Limitations:**
  - Flammable
  - Not sporidal
  - Poor cleaner
  - Not EPA registered

- **Chlorine Dioxide (ClO₂)**

  - CIP applications include dairy and beverage equipment, pasteurization equipment all types of tanks and enclosed pipe work
  - Food plant uses include fruit and vegetable processing; canning plants; meat, poultry and food production.
  - LAM facilities? Why not????
Sterilization at ambient temperatures
- Far quicker aeration than EtO (can literally be minutes)
- No need for a pressure rated vessel (lower cost for user)
- ClO₂ is non-flammable and non-explosive
- True gas leads to excellent distribution
- Does not condense out or breakdown during sterilization

Objects sensitive to temps > 60 C (plastics, optics, electrics)
- Generally performed between 30 C & 60 C & 30% RH
- Kills all known viruses, bacteria, fungi, and spores
- Can be flammable
- Post sterilization aeration is necessary
- Most common method for medical devices
- 2 options:
  - Gas Chamber (CFCs / CO₂)
  - Micro-dose (bag sterilization)

Heat between 121 to 134 degrees centigrade
- 15 minutes @ 121 C
- 3 minutes @ 134 C
- Steam will inactivate fungi, bacteria, viruses, and spores
- To inactivate prions - must use:
  - 2 hrs of NaOH + 60 minutes @ 121-132 C (270 F)
  - 18 minutes @ 134 C (273 F)

Dry heat is best for powders and metals
- Best to use forced air
  - 2 hours @ 160 C (320 F) ... or ...
  - 6 minutes @ 190 C (374 F) for unwrapped objects
  - 12 minutes @ 190 (374 F) for wrapped objects
- High concentration for spores
- Inactivated by heat and organic material
- Slow rate of kill

Features
- Broad spectrum activity (including spores)
- Stable
- Decomposes to oxygen and water
- Solution or vapor effective

Limitations
**Hydrogen Peroxide (Vapor)**

- VHP generator is located outside the room
- One hose to supply and one to:
  - Dehumidification
  - Conditioning
  - Decontamination
  - Aeration

**Features:**

- Used for area and room decontamination
- A safer alternative to EtO
- Solution is vaporized in a vacuum, then radio-frequency energy applied
- Vapor transformed to gas plasma state of biocidal free radicals
- Can't use for paper

**Limitations:**

- May stain
- Inactivated by exposure to light, heat, and organic matter
- May irritate mucous membranes

**Iodines**

- Features:
  - Broad spectrum
  - Not affected by hard water
  - Fair cleaner

- Limitations:
  - May stain
  - Inactivated by exposure to light, heat, and organic matter
  - May irritate mucous membranes

**Phenolics**

- Features:
  - EPA registered alkaline or acidic
  - TB effective and broad spectrum
  - Surfactants provide good cleaning ability
  - May be bacteriostatic

- Limitations:
  - Not sporidical
  - Disposal issues
  - Activity affected by other chemical agents
  - May not be appropriate for all animals

**Photoionization**

- Uses:
  - High intensity ultraviolet light rays, and
  - Ozone (produced locally)

**Effectiveness:**

- 99.9% surface microbial reduction (6 log)
**Quaternary Ammonium Chloride**

**Features:**
- Alkaline
- Cationic
- EPA registered
- Broad spectrum
- Good cleaner
- For phenol sensitive populations

**Limitations:**
- Not TB effective (generally)
- Activity affected by other chemical agents
- If using Roccal – DO NOT use Roccal-D

**Radiation (UV)**

- Commonly used for interiors of BSCs
- Ineffective in: Shaded areas, Dirt, Distance
- Damages plastics and foam ... And corneas!

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**Sodium Hypochlorite**

**Features:**
- Economical
- Not effected by hard water
- Broad spectrum activity including spores
- Quick kill

**Limitations:**
- Not a registered sporicide
- Affected by pH, organic material, UV and heat
- Poor cleaner
- Corrosive

**Equilibrium:**

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**Quality Control for Sanitization**

- Steam autoclaves: Bacillus stearothermophilus
- Ethylene oxide: Bacillus subtilis
- Gamma irradiation: Micrococccus radiocurans
- Gas plasma: B. stearothermophilus, B. circulans, B. subtilis var. niger

**Mechanical and chemical indicators**

- Mechanical and chemical indicators DO NOT verify sterility
- Do detect procedural and equipment malfunctions
- (Steam) Requires 121 C @ 15 minutes
- What about inside?
Quality Control for Sanitization

- New generation of rapid-read out indicators:
  - 1-3 hours
  - Requires special auto-reader-incubator
  - 3M Attest

Components of An Effective Sanitation Program

- Personnel
- Processes
- Protections

OSHA Hazard Communications Standard

- It is mandatory that the hazardous components of mixtures be disclosed on the MSDS.
- All ingredients which are physical or health hazards present in the mixture at 1% or greater must be included on the MSDS.
- MSDS should be easily accessible to all employees using chemicals

Components of An Effective Sanitation Program

- SOPs and Training are the key!
- Health & Hygiene (handwashing)
- Techniques of cleaning
- Use of chemicals - proper dilution, rinsing
- Disposal of waste

Components of An Effective Sanitation Program

- HANDWASHING IS CRITICAL!
  - Effective Compliance – usually low ... why?
  - Time required (15 secs)
  - Heavy Workloads (too busy)
  - Skin irritation
  - Dry skin
  - Poor access to sinks
  - Proper Technique
  - Commonly used hand antiseptics
    - Alcohols
    - Chlorhexidine
    - Chloroxylenol (PCMX)
    - Iodophors
    - Triclosan

Components of An Effective Sanitation Program

- HANDWASHING IS CRITICAL!
  - How to improve compliance?
    - Make it an institutional priority
    - Implement a multidisciplinary program
    - Provide convenient access to an alcohol-based hand-rub
**Assessment of Disinfection**

**Microbiological Monitoring:**
- Contact Plate Test / RODAC / DIFCO
- Replicate Organism Detection And Counting (direct agar contact)
- Touch agar of plate to the surface to be tested
- Incubate 48 hours
- Count colonies
- What does it mean?????

**Microbiological Monitoring:**
- CHARM (Firefly) test
- ATP (a protein test)
- Store at 2-25°C
- Total sanitation indicator: Microbial, product residue
- Personal hygiene
- SOP deviation
- No reagent preparation
- Foam tip premoistened with biofilm breaking agent

**Cleaning/Disinfection Reminder...**
- Goal is microbial control
- Microbes can multiply and hide out in organic material (dirt, blood, fat) left on surfaces
- Equipment: Cleaning is essential to the success of disinfectant/sterilant efficacy
- Personnel: WASH YOUR HANDS!