Practical Disinfection Guidance for the Clinical Laboratory
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Continuing Education Credits

The Association of Public Health Laboratories (APHL) is approved as a provider of continuing education programs in the clinical laboratory sciences by the ASCLS P.A.C.E.® Program. Participants who successfully complete this program will be awarded 1 P.A.C.E. contact hour.
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Course Learning Objectives

• At the end of this webinar, each participant will be able to:
  ✓ Describe the difference between cleaning, sanitization and disinfection
  ✓ Find the list of EPA approved disinfectants available on the web
  ✓ Choose and appropriate disinfectant for use with human samples and infectious agents
  ✓ Describe an appropriate plan for disinfecting/cleaning of surfaces and equipment in the laboratory
Definition of Disinfection

• A process that eliminates many or all pathogenic microorganisms on inanimate objects, with the exception of bacterial spores.
Why Use Disinfectants?

• To get rid of unwanted microorganisms, which MAY be pathogenic…

• To eliminate exposure risk
  – Medical waste treatment
  – Spill cleanup
  – Minimization of nosocomial infections
  – Routine surface decontamination

• OR:
Why use disinfectants?

• To eliminate contamination risk
  – Preparation of microbiological media & supplies
  – Cross contamination of samples and tissue culture
  – Preparation of work area for cleanliness-critical tasks
Disinfection

• Decontamination - disinfection or sterilization of contaminated articles to make them suitable for use
  – Does not imply that all organisms are inactivated, only that the numbers have been reduced to make the material safe to handle

• Sanitizer - an agent that reduces the numbers of vegetative bacteria only
Other Terms

- Sterilization - the act or process, physical or chemical, that destroys or eliminates all forms of life, including bacterial spores.

- Cleaning – the removal of visible soil (organic and inorganic) from objects and surfaces.
  - Manual or mechanical
  - Using water with detergents or enzymatic products
Hierarchy of Resistance to Disinfection

- Prions
- Bacterial spores
- Protozoal oocysts (Cryptosporidium)
- Helminth eggs (Ascaris)
- *Mycobacterium tuberculosis*
- Small nonlipid (nonenveloped) viruses (parvovirus)
- Protozoal cysts (Giardia)
- Fungal conidia (spores)
- Rickettsiae, Chlamydiae
- Gram negative bacteria
- Vegetative fungi & algae
- Vegetative helminths and protozoa
- Large nonlipid (nonenveloped) viruses (Adenovirus)
- Gram positive bacteria
- Lipid-containing (enveloped) viruses (HIV)
Disinfection in Laboratories

- Chlorine (bleach, Clorox Healthcare® Bleach Germicidal Cleaners)
- Iodine (Wescodyne Plus, Betadine)
- Alcohol (Ethyl, Isopropyl)
- Phenolics (Lysol, Cavicide)
- Quaternary Ammonium Compounds (Quats: Clorox® Broad Spectrum Quaternary Disinfectant Cleaner, Super Sani-cloth)
Label Claims

• Limited efficacy
  – Activity vs. one specific group of organisms
    • Gram + claim = *Staph aureus*
    • Gram – claim = *Salmonella enterica* (formerly *cholerasuis*)

• General Purpose or Broad Spectrum
  – Activity against both organisms above

• Hospital or medical environment claim
  – Activity against both above + *Pseudomonas aeruginosa*
How to Choose a Disinfectant

• Human samples, OPIM, tissue culture
  – Included under OSHA Bloodborne Pathogen Law
  – Therefore, must either:
    • Be EPA/FDA registered sterilant
    • Be EPA registered tuberculocide, or
    • Be effective against HBV/HIV

• Federal Law
  – Disinfectants must be prepared and used according to label claims
    • E.g., pre-cleaned surface, soak, remain wet

Note: these disinfectants will also be effective for most infectious agents found at BSL-2
The “EPA Lists”
https://www.epa.gov/pesticide-registration/selected-epa-registered-disinfectants

Currently 12 lists:

- **List A**: EPA’s Registered Antimicrobial Products as Sterilizers
- **List B**: EPA Registered Tuberculocide Products Effective Against *Mycobacterium tuberculosis*
- **List C**: EPA’s Registered Antimicrobial Products Effective Against Human HIV-1 Virus
- **List D**: EPA’s Registered Antimicrobial Products Effective Against Human HIV-1 and Hepatitis B Virus
- **List E**: EPA’s Registered Antimicrobial Products Effective Against *Mycobacterium tuberculosis* Human HIV-1 and Hepatitis B Virus
- **List F**: EPA’s Registered Antimicrobial Products Effective Against Hepatitis C Virus
- **List G**: EPA’s Registered Antimicrobial Products Effective Against *Norovirus*
- **List H**: EPA’s Registered Antimicrobial Products Effective Against Methicillin Resistant *Staphylococcus aureus (MRSA)* and Vancomycin Resistant *Enterococcus faecalis or faecium (VRE)*
- **List J**: EPA’s Registered Antimicrobial Products for Medical Waste Treatment
- **List K**: EPA’s Registered Antimicrobial Products Effective Against *Clostridium difficile Spores (PDF)*
- **List L**: EPA’s Registered Antimicrobial Products that Meet the CDC Criteria for Use Against the Ebola Virus
- **List M**: Registered Antimicrobial Products with Label Claims for Avian (Bird) Flu Disinfectants
### Example of Old Tuberculocidal List

- **Note Lysol products with different ingredients!**

  Unfortunately, the EPA lists no longer give the active ingredients!

<table>
<thead>
<tr>
<th>Product</th>
<th>Active Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>LPH MASTER PRODUCT</td>
<td>Amylphenol 7.600% ; Phenylphenol 7.7%</td>
</tr>
<tr>
<td>LPH-SE</td>
<td>Amylphenol 7.6% ; Phenylphenol 7.7%</td>
</tr>
<tr>
<td>LYSOL BRAND DISINFECTANT TOILET BOWL CLEANER</td>
<td>Hydrogen chloride (=hydrochloric acid, anhydrous) 9.5%</td>
</tr>
<tr>
<td>LYSOL BRAND FOAMING DISINFECTANT BASIN TUB&amp;TILE CLEANER II</td>
<td>Didecyldimethyl ammonium chloride 0.025% Octyl decyl dimethyl ammonium chloride 0.05% Diocetyl dimethyl ammonium chloride 0.025%</td>
</tr>
<tr>
<td>LYSOL® BRAND DISINFECTANT S.A. CLEANER</td>
<td>Citric acid 2.5%</td>
</tr>
<tr>
<td>LYSOL BRAND DISINFECTANT TRIGGER SPRAY</td>
<td>Hydrogen chloride (=hydrochloric acid, anhydrous) 90.5%</td>
</tr>
</tbody>
</table>
# Tuberculocidal List

Listing only in numerical order now, so you must search by registration #

## List B: EPA’s Registered Tuberculocide Products

<table>
<thead>
<tr>
<th>Registration #</th>
<th>Product Brand Name</th>
<th>Company</th>
</tr>
</thead>
<tbody>
<tr>
<td>211-32</td>
<td>PHENO-CEN SPRAY</td>
<td>CENTRAL SOLUTIONS, INC.</td>
</tr>
<tr>
<td></td>
<td>DISINFECTANT/DEODO RANT</td>
<td></td>
</tr>
<tr>
<td>211-36</td>
<td>TRI-CEN</td>
<td>CENTRAL SOLUTIONS, INC.</td>
</tr>
<tr>
<td>211-62</td>
<td>LOW PH PHENOLIC 256</td>
<td>CENTRAL SOLUTIONS, INC.</td>
</tr>
<tr>
<td>303-223</td>
<td>BEAUCOUP</td>
<td>HUNTINGTON PROFESSIONAL PRODUCTS</td>
</tr>
<tr>
<td></td>
<td>GERMICIDAL DETERGENT</td>
<td></td>
</tr>
<tr>
<td>498-134</td>
<td>SRAYPAK SPRAY</td>
<td>CHASE PRODUCTS CO</td>
</tr>
<tr>
<td></td>
<td>CLEANSE</td>
<td></td>
</tr>
<tr>
<td>498-194</td>
<td>SPRAYPAK SPRAY</td>
<td>CHASE PRODUCTS CO</td>
</tr>
<tr>
<td></td>
<td>DISINFECTANT/LUBRIC ANT</td>
<td></td>
</tr>
<tr>
<td>498-197</td>
<td>SPRAY DISINFECTANT</td>
<td>CHASE PRODUCTS CO</td>
</tr>
<tr>
<td>675-1</td>
<td>VANi-SOL BOWL</td>
<td>RECKITT BENCKISER LLC</td>
</tr>
<tr>
<td></td>
<td>CLEANSE</td>
<td></td>
</tr>
<tr>
<td>777-71</td>
<td>LYSOL BRAND FOAMING DISINFECTANT</td>
<td>RECKITT BENCKISER LLC.</td>
</tr>
<tr>
<td></td>
<td>BASIN TUB &amp; TILE CLEANER II</td>
<td></td>
</tr>
<tr>
<td>777-81</td>
<td>LYSOL BRAND</td>
<td>RECKITT BENCKISER LLC.</td>
</tr>
<tr>
<td></td>
<td>DISINFECTANT TOILET BOWL CLEANER</td>
<td></td>
</tr>
<tr>
<td>777-99</td>
<td>BRACE</td>
<td>RECKITT BENCKISER LLC.</td>
</tr>
<tr>
<td>777-105</td>
<td>LYSOL BRAND IV I.C. DISINFECTANT</td>
<td>RECKITT BENCKISER LLC.</td>
</tr>
<tr>
<td>954-10</td>
<td>CLIPPERCIDE SPRAY</td>
<td>KING RESEARCH, INC.</td>
</tr>
<tr>
<td>954-13</td>
<td>SPACIDE</td>
<td>KING RESEARCH, INC.</td>
</tr>
<tr>
<td>1043-19</td>
<td>STAPHENE DISINFECTANT SPRAY AND DEODORIZER</td>
<td>STERIS CORPORATION</td>
</tr>
<tr>
<td>1043-26</td>
<td>1-STROKE ENVIRON</td>
<td>STERIS CORPORATION</td>
</tr>
</tbody>
</table>
Where is the EPA Registration #?

Manufacturer ID #  Product ID #

**SPOR-KLENS** Ready To Use

Cold Sterilant

**STERIS (the technology of clean)**

**ORDER NUMBER**

For Use in Pharmaceutical, Medical Device, Biotech and Cosmetic Manufacturing Facilities.

Sisteris®/Sporidal, Bactericidal, Tuberculocidal, Fungicidal, Virucidal, Non-food Contact Sanitizer

Uses: Primarily intended for sterilization or disinfection of stainless steel, plastic items and surfaces, hard surfaces e.g. countertops, floors, walls, bathroom fixtures, glass, forrnica, vinyl.

Active Ingredients:

Hydrogen Peroxide........................................ 100.00%

Peracetic Acid............................................... 0.08%

Inert Ingredients........................................... 98.92%

**TOTAL** .................................................. 100.00%

**KEEP OUT OF REACH OF CHILDREN**

**DANGER - PELIGRO**

See side panel for precautionary statements. EPA Est. No. 52252-MN-01

Manufactured by STERIS Corporation

7501 Page Avenue  St Louis, MO 63133  USA

K 800-548-4873 www.steris.com

**ORDER NUMBER**

6525-01  3.2 Liters (3.38 qts.)

**EPA REG. NO.**

1043-119

**PRECAUTIONARY STATEMENT**

**Hazard to Humans and Domestic Animals**

**DANGER** - PELIGRO. Corrosive. Causes Irreversible eye damage. Do not get in eyes, on skin, or on clothing. Avoid contact with drinking, chewing gum, using tobacco or using the toilet. Remove hands before reuse. Caution should be used when applying and removing this product to seawater systems, particularly in the presence of sewage systems. For guidance, contact your State Water Board or Regional Protection Agency.

**Physical and Chemical Hazards:** This product contains an oxidizing agent. 

**KILLS HIV-1 ON PRE-CLEARED ENVIRONMENTAL SURFACES WITH BLOOD/BODY FLUIDS:** In health care setting, the general likelihood of soiling is greater, and greater attention needs to be paid to cleaning the surfaces after possible exposure. The mode of transmission of HIV (Human Immunodeficiency Virus Type 1) is predominantly by blood or body fluids. For more information, see the CDC guidelines for cleaning and decontaminating surfaces in health care settings.

**SPECIAL INSTRUCTIONS FOR CLEANING AND DECONTAMINATION OF SURFACES/OBJECTS SOILED WITH BLOOD/BODY FLUIDS:** Specific barriers should be used to prevent skin contact with blood or body fluids. Examples include disposable gloves, covers, cleaning procedures, and other barrier materials. Blood and other body fluids can be cleaned from surfaces and objects before the application of the final disinfectant. **CONTACT TIME:** Leave surfaces completely immune to SPOR-KLENS Ready To Use for at least 10 minutes.

**DIRECTIONS FOR USE**

It is a violation of Federal law to use this product in a manner other than that directed by the label. **DO NOT USE AFTER EXPIRATION DATE.** Do not re-use. For use with pharmaceuticals, it is recommended to mix with alkaline substances such as sodium hydroxide or sodium carbonate. Use purified water (e.g., distilled) for making and rinsing. Some materials may be incompatible with this product. **TEST MATERIAL PRIOR TO USE.** This product is compatible with Polyvinyl chloride, polypropylene, polystyrene, stainless steel.

**REUSE OF DILUTED SPOR-KLENS READY TO USE IS NOT RECOMMENDED.**
**Example of Name/Company Shift**

**EPA List B (tuberculocides)**

<table>
<thead>
<tr>
<th>Product</th>
<th>EPA Reg#</th>
<th>Registrant</th>
<th>Approval Date</th>
<th>Active Ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>VIRAHOL HOSPITAL SURFACE DISINFECTANT TOWELETTE</td>
<td>601-42-3</td>
<td>VERIDEN CORP</td>
<td>01/29/1997</td>
<td>Isopropanol 70.0%</td>
</tr>
<tr>
<td>WAVICIDE-06 PLUS</td>
<td>15136-9</td>
<td>MEDICAL CHEMICAL CORP.</td>
<td>06/22/1999</td>
<td>Ethyl alcohol 50.0% and Glutaraldehyde 0.25%</td>
</tr>
<tr>
<td>WEX-CIDE CONCENTRATED GERMICIDAL DETERGENT</td>
<td>34810.8</td>
<td>WEXFORD LABS, INC.</td>
<td>09/09/1975</td>
<td>Benzyl-4-chlorophenol 5.76%, Phenylphenol 0.06%</td>
</tr>
<tr>
<td>WEX-CIDE-128</td>
<td>34810.31</td>
<td>WEXFORD LABS, INC.</td>
<td>06/26/2007</td>
<td>Benzyl-4-chlorophenol 3.03%, Phenylphenol 3.4%</td>
</tr>
<tr>
<td>YYY DISINFECTANT</td>
<td>4959-24</td>
<td>WEST AGRO INC</td>
<td>05/27/2003</td>
<td>Nonylphenoxypolyethoxylethanol – iodine complex 0.35%</td>
</tr>
<tr>
<td>ZZZ DISINFECTANT</td>
<td>4959-16</td>
<td>WEST ARGO INC</td>
<td>01/26/2007</td>
<td>Nonylphenoxypolyethoxylethanol – iodine complex 1.75%</td>
</tr>
</tbody>
</table>
Label Information

- You must use a commercial disinfectant as specified on the label:
  - Type of surface
  - Pre-cleaning
  - Contact time
  - Dilution
  - Temperature
  - Type of water
Where to find labels

https://iaspub.epa.gov/apex/pesticides/f?p=PPLS:1

Pesticide Product and Label System

The Pesticide Product and Label System (PPLS) provides a collection of pesticide product labels (Adobe PDF format) that have been accepted by EPA under Section 3 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). New labels were added to PPLS on February 06, 2018.

Pesticide product labels provide critical information about how to safely handle and use registered pesticide products. An accepted pesticide product label represents the full content of EPA’s registration decision regarding that product. Pesticide labels contain detailed information on the use, storage, and handling of a product. This information will be found on EPA stamped-accepted labels and, in some cases, in subsequent related correspondence, which is also included in PPLS. You may need to review several PDF files for a single product to determine the complete current terms of registration.

Note:
There are differences between product labels provided in PPLS and those found in the market place. The EPA stamped-accepted label describes the legal requirements for sale and use of that pesticide in the United States. States also register pesticide products and may apply more restrictive requirements than those found on the EPA label. Companies may add or change graphics, alter the product name (after notifying EPA), and add other marketing information. The label is the law!

To find a specific pesticide product label, enter the information requested below and select the Search button.

EPA Registration, Distributor Product, or Special Local Need Number:

The EPA Registration Number (EPA Reg. No.) appears on all registered pesticides sold in the United States. It is usually found on the back panel of the label along with the detailed instructions for use. Enter the company number (the first set of digits before the dash) to see all products marketed by that company or the entire number (including the dash) to view the label for a particular product. To search by
Check Your Understanding

• True or False – disinfectants that are acceptable per the Bloodborne Pathogen law will be appropriate for most BSL-2 labs?

• If a disinfectant says it kills HIV-1, H1N1, Adenovirus and is fungicidal, it would be a good selection for a clinical lab that works with human serum.

• Why did OSHA choose “tuberculocidal” disinfectants as a good product to use with blood, serum, etc. . .?
Factors Influencing Efficacy

- Surface topography
- Temperature
- Relative humidity
- Water hardness
- Organic load
- Concentration
- Contact time
Some Other Factors

- pH
- Age of the product/solution
- Method of application
  - spray vs. wipe
- Rate of application
- Storage conditions
  - Opaque vs. clear containers
Chlorine

• Household bleach usually 5-6% Sodium hypochlorite (or ~50,000 ppm)

• In-use dilutions depend on application and amount of organic material present
  • Clean surfaces - 1,000 ppm Av CL (2% bleach or 0.1% sodium hypochlorite)
  • General disinfection - 5,000 ppm Av Cl (10% bleach or 0.5% sodium hypochlorite)
  • Organic material - 10,000 ppm Av Cl (20% bleach or 1% sodium hypochlorite)
# Bleach Dilutions

<table>
<thead>
<tr>
<th>Dilutions of bleach solution</th>
<th>Use</th>
<th>JIK bleach</th>
<th>Normal commercial bleach</th>
<th>Ultra Clorox</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undiluted (in the bottle)</td>
<td>Large spills</td>
<td>3.85% sodium hypochlorite</td>
<td>5.25% sodium hypochlorite</td>
<td>6.15% sodium hypochlorite</td>
</tr>
<tr>
<td>= g/L</td>
<td>~35 g/L</td>
<td>~50 g/L</td>
<td>~60 g/l</td>
<td></td>
</tr>
<tr>
<td>= Chlorine ppm</td>
<td>~35,000 ppm chlorine</td>
<td>~50,000 ppm chlorine</td>
<td>60,000 ppm chlorine</td>
<td></td>
</tr>
<tr>
<td>OSHA 1:100</td>
<td>BBP work</td>
<td>~15 ml in 985 ml water</td>
<td>10 ml in 990 ml water (1% bleach)</td>
<td>~9 ml in 993 ml water</td>
</tr>
<tr>
<td>=500 ppm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>= 0.05% NaOCl</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WHO recommends for “clean conditions”:</td>
<td>Benchtops, BSCs</td>
<td>~30 ml JIK in 870ml water</td>
<td>~20 ml in 980 ml water (2% bleach)</td>
<td>~17 ml in 883 ml water</td>
</tr>
<tr>
<td>=1g/L</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>=1,000 ppm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>= 0.1% NaOCl</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WHO recommends for “dirty conditions”</td>
<td>Spills, liquid waste decontamination</td>
<td>~150 ml JIK in 850 ml water or waste. Liquid waste should sit for 2 hours before sewering.</td>
<td>~100 ml in 1000 ml water (or waste) (10% bleach)</td>
<td>~85 ml in 915 ml water</td>
</tr>
<tr>
<td>=5g/L</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>=5,000 ppm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>=0.5% NaOCl</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Alcohols

• Not acceptable for disinfection of Bloodborne Pathogens (per OSHA)
  – i.e., Human tissue culture activities
• Typically ethyl or isopropyl alcohol
  – Often used in combination with other disinfectants
• 70% in water is most effective concentration
  – 100% alcohol is not effective!!!
• Should primarily be used in the lab for sanitization
  – Killing environmental organisms
  – Removing other disinfectants from surfaces
General Laboratory Cleaning:

- **Lab floor**: weekly with a germicidal detergent
  - LPH, 1-Stroke Environ
  - Tuberculocidal plus actually clean dirt...

- **Lab benches after working**
  - Disinfectant, such as 2% bleach, Super Sani-Cloth
  - Unused areas also need cleaning (dust, mold)

- **Sinks**: weekly
  - Disinfectant or normal commercial cleaning products
  - Encourage mold growth

- **Laboratory equipment (carts, centrifuges, trays)**: weekly
  - Disinfectant
BSC Daily Cleaning

• Clean all surfaces with a disinfectant before/after working
  – Alcohol OK before work
  – Disinfectant after work
    • Human/primate cell culture
    • Infectious agents
  – 2% bleach, Cavicide
    • Followed by alcohol

• Swiffer Sweeper for cleaning BSC surfaces
  – Dry Swiffer pad
  – Spray with disinfectant
  – Use new pad each time
Interval BSC Cleaning

- Monthly minimum (SOP)
  - Remove work surface and grill
  - Clean with disinfectant
    - Soak if necessary to remove crusty material
- Clean after a spill in the BSC

Clean trough and under work surface regularly
Additional Disinfectants

• For decontamination of BSCs, occasionally incubators
  – Formaldehyde
  – Vapor Phase Hydrogen Peroxide
  – Chlorine Dioxide

• Use of these requires training, specialized equipment, special PPE

• Algaecides, fungicides:
  – For water baths and incubators
Decontamination of Biohazardous Liquid Waste

• Considerations
  – Mixed chemical/biohazardous or radioactive/biohazardous?
    • Usually remove biohazard status first, then ship or treat as radioactive or chemical waste
  – Local regulations or wastewater treatment plant requirements
    • Some may not allow large amount or concentrations of bleach, such as in an industrial setting
Methods of Biohazardous Liquid Waste Decontamination

- Add full strength bleach to the waste, for a final dilution of 10% bleach
  - Allow to sit for > 30 minutes (or longer, depending on the organism of concern)
  - Sewer carefully, with water running (eye protection)
  - Higher concentrations of bleach may be problematic for personnel and equipment
Other solutions for liquid wastes

- If large quantities of serum or blood present, bleach may be problematic
  - Gas, odors
  - Engineered pumping and treatment systems
  - Biowaste holding tanks, etc.

Treatment and pumping system for instrument waste
Check Your Understanding

• What common, inexpensive disinfectant should be prepared daily?
• Which common class of disinfectant is more effective when diluted, and has no activity against bacterial spores?
• True or False? Disinfectants such as “Lysol” may use the same name for many different formulations.
Other Handy References?

Public Health Agency of Canada
Pathogen Safety Data Sheets

SECTION IV - VIABILITY

DRUG SUSCEPTIBILITY: No specific antiviral available; cidofovir has shown promise in the treatment of adenoaviral ocular infections.

SUSCEPTIBILITY TO DISINFECTANTS: Susceptible to 1% sodium hypochlorite, 2% glutaraldehyde, 0.25% sodium dodecyl sulfate

PHYSICAL INACTIVATION: Sensitive to heat>56°C; unusually stable to chemical or physical agents and adverse pH conditions

SURVIVAL OUTSIDE HOST: Resistance to chemical and physical agents allows for prolonged survival outside of the body. Adenovirus type 3 survived up to 10 days on paper under ambient conditions; adenovirus type 2 survived from 3-8 weeks on environmental surfaces at room temperature

PSDS by Pathogen Name:

- Actinobacillus spp. Updated!
Other References

- Useful comparisons and summaries of agents
- Charts of various applications


1Hospital Epidemiology
University of North Carolina Health Care System
Chapel Hill, NC 27514

2Division of Infectious Diseases
University of North Carolina School of Medicine
Chapel Hill, NC 27599-7030

https://www.cdc.gov/infectioncontrol/guidelines/disinfection/index.html
Other References

www.aphl.org/biosafety

- Biosafety/Biosecurity Training
- Resources/Tools
- Additional Resources
Questions?