## Conclusions Made on HFRS Virus Transmission and Control

It is not known how the Japanese rat colonies became infected; however, wild rats were observed in an animal facility where infections occurred. This was considered a probable source since the virus causing HFRS was present in the wild house rat population, and had caused a community outbreak of HFRS in Osaka in the 1970s. In addition to exposure to wild rodents, rodent colonies were potentially contaminated by 1) introduction of infected commercially-obtained rodents, 2) sharing of animals between institutions, and 3) injection of contaminated tumors or cells into rodents. The infectious agent for this disease was first isolated in 1978 and an IFA identification method was published in the literature; making screening rodent colonies easily feasible. Today, accepted practices for rodent colony maintenance include serological screening, micro-isolator cages or ventilated cage racks, stringent ventilation and humidity control, and husbandry practices that minimize aerosolization. However, we should all remember that rodent colonies present unique occupational environments and the scientific community must always carefully assess the potential for microbial transmission within their colonies.

## References

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# Ask the Experts

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Do you have a biosafety question and you're not sure who to ask? Send your questions to the "Ask the Experts" column and I'll get them answered for you. Drawing from my own experience or that of other experts in the field, we'll try to compile a thorough and comprehensive answer to your question. Please e-mail your questions to jkeene@biohaztec.com or to Co-Editor Barbara Johnson at barbara_johnson@verizon.net or Co-Editor Karen B. Byers at karen_byers@dfci.harvard.edu.

## Disinfectants, What Kind and When?

Questions have arisen about the potential for development of resistance to antibiotics and disinfectants in the laboratory along with the use of these agents to clean up spills and decontaminate laboratory surfaces. In addition, there have been concerns about the efficacy of antimicrobial soaps for hand washing. In this article, we will attempt to clear up some of the questions regarding the use and abuse of disinfectants.

## Can microorganisms develop resistance to disinfectants, as they seem to do against antibiotics?

The mechanism of action of disinfectants and antibiotics is significantly different. Disinfectants are hazardous chemicals that destroy things like proteins, lipids, nucleic acids in living organisms (**all living organisms**—you, me, experimental animals, bacteria, etc.). Destruction of one's proteins by hazardous chemicals is difficult to overcome. Therefore, while there may be some increased tolerance to disinfectants by organisms, the concentrations used generally exceed the lethal dose of the agent and the disinfectant still works.

Antibiotics generally work by interfering in the metabolic pathways of those organisms that are susceptible. Interference with metabolic pathways can be overcome when there are mutant organisms already present in the population and these are actually selected for by the presence of the antibiotic in the environment, at which point the antibiotic is no longer effective (Rice, 2004). Given the mechanism of action of each type of agent, it is much more likely that resistance to antibiotics will develop than true resistance to disinfectants.

## What type of disinfectant should be used in the laboratory?

There are two answers to this question, in spite of the fact that the OSHA Bloodborne Pathogen Standard states that an EPA registered disinfectant with Tuberculocidal activity is required. (For a complete list of the EPA registered disinfectants, see www.epa.gov/oppad001/

chemregindex.htm.) The OSHA requirement is a general statement that provides guidance on the decontamination of spills of "unknown" organisms, such as might be present in blood and body fluids. The reasoning for using the registered disinfectant with Tuberculocidal activity is that, if these agents are effective against *Mycobacteria,* they will be effective against the major organisms that might be present in blood and body fluids.

On the other hand, if you are working in the laboratory with a known organism of known sensitivity to a particular disinfectant then that disinfectant may be used whether or not it is effective against *Mycobacteria*. I know of a laboratory that used "Tween 80" (Polyoxyethylene Sorbitan Monooleate)® (USB Corporation) as a disinfectant against a particular virus whose ability to bind to cells was destroyed by the surface acting activity of this material, i.e., it was inactivated.

The keys to the actual decontamination process by the use of disinfectants are contact time, concentration and quantity of non-microbial organic matter. No matter what the "ads" may say, no disinfectant kills all germs on contact. Therefore, an appropriate procedure for spill clean up involves allowing the manufacturer's recommended concentration of disinfectant to remain in contact with the spill for an appropriate period of time. Simply wiping up the spill does not necessarily decontaminate the surface contaminated by the spill. The disinfectant has to be in contact with the microorganism long enough to enter the cell and destroy critical enzymes or nucleic acids.

In addition, the manufacturer, using a specific concentration, tests disinfectants for efficacy. The concept of "more is better" is not appropriate in the mixing of disinfectants. Changing the concentration, even making it more concentrated, can result in less activity. The use of 70% EtOH as a disinfectant is a good example of the concentration issue. At 70%, the EtOH is active because there is sufficient water in the disinfectant to allow for protein denaturation. On the other hand, 95% EtOH is actually a drying agent, which pulls water out of the cell and inhibits the denaturation process. Furthermore, mixing of two or more disinfectants in order to cover all bases is not recommended, since there may be interaction between the different chemicals that could result in either complete inactivity, or a potential release of toxic materials capable of causing harm to the user.

Finally, the amount of organic matter present effects the efficacy of the disinfectant since the disinfectant must act on all the protein or nucleic acid present in the spill and cannot differentiate between microbial and extraneous organic material. Therefore, in the process of cleaning up a biohazardous spill, it is prudent to allow the chosen disinfectant to remain in contact with the spill for a proscribed period of time, then wipe up the spill and again re-treat with the disinfectant to inactivate any residual organisms.

There are a number of other parameters that must be taken into account. A full review of the selection and use of disinfectants, as well as modes of action of disinfectants, can be found in *Hospital Epidemiology and Infection Control* (Rutala & Weber, 2004) and *Disinfection, Sterilization and Preservation* (Block, 2001).

## How effective are "antimicrobial soaps" for hand washing?

For the most part, the use of disinfectant soaps is a "sales gimmick" since, as mentioned above, the antimicrobial activity of any disinfectant requires an exposure time, which is generally longer than most of us wash our hands. The purpose of hand washing is to physically remove the dirt, grime and microorganisms from your hands. The "detergent" present in the hand soap is probably the most active ingredient since that is what loosens up the materials and allows the water to wash it away. The disinfectant action takes place in the sewer line, not on your hands. THE SOLUTION TO POLLUTION IS DILUTION.

With regard to the use of common hand disinfectant techniques, three things should be remembered:

1. Alcohol wipes will be active against most surface skin bacteria, but only at the right concentration, and are not active against all bacteria and viruses. (There is no such thing as a universal disinfectant that is completely safe for use on your skin.)
2. Hand cleaning foams that contain alcohol or other disinfectant also contain some type of detergent-based material for loosening the dirt and grime. The disinfectant works in the trash can or sink trap, not necessarily on your hands.
3. The Quaternary ammonium (Quats) disinfectant wipes are not always effective since we know that many organisms will actually grow in these disinfectants. In addition, Quats are surface acting agents and their antimicrobial activity in hand washing is most likely related to the fact that they have a detergent action and the "germs" are physically removed, than to their actual affect on the organisms on the hands.

Many eons ago, in another life as a clinical microbiologist and infection control practitioner, we actually stopped an epidemic of hand-transmitted urinary tract infections in an ICU by removing the "antimicrobial" soap the nurses were supposed to use, but didn't because of the harshness of the agent. We replaced it with a mild hand soap which was easy on the hands and smelled nice. It didn't kill anything, but the staff used it, and physically removed the offending organisms.

## Summary

Unlike the development of resistance to antibiotics by microorganisms, these organisms are unlikely to develop sufficient tolerance to disinfectants to result in failure of the efficacy of the disinfectant. A number of factors must be considered when choosing a specific disinfectant for use in the laboratory. Antimicrobial soaps actually have limited usefulness.

## References


Block, S. S. (2001). *Disinfection, Sterilization, and Preservation* (5th ed.). Philadelphia: Lea and Febiger.

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Rutala, W. A., & Weber D. J. (2004). Selection and Use of Disinfectants in Healthcare. In *Hospital Epidemiology and Infection Control* (3rd ed.). C. Glen Mayhall (Ed.). Philadelphia: Lippincott Williams and Wilkins.


## Corrections and Clarifications

Table 4 was omitted in the article "Some Bioterrorism Issues of Quantitative Biosafety" by Alexander Sabelnikov et al., in Volume 11, Number 2, 2006. Information in Table 4 is as follows:

### Table 4

Detection of different doses of a BW agent with $ID_{50}$ index of 5 by the model PCR-, Antibody/antigen-, and MS-based sensors with the best metric characteristics.

| **Risk of Infection** | **Dose of inhaled BW agent ($ID_{50}$ = 5)** | **Probability of detection, $P_{id}$ of BW agents by:** | | |
|---|---|---|---|---|
| | | **PCR-based model biosensor** | **Antibody/antigen-based sensor** | **MS-based model biosensor** |
| 0.000001 | 7.22E-05 | 0.00 | 0.00 | 0.00 |
| 0.00001 | 0.000722 | 0.00 | 0.00 | 0.00 |
| 0.0001 | 0.007215 | 0.00 | 0.00 | 0.00 |
| 0.001 | 0.072186 | 0.00 | 0.00 | 0.00 |
| 0.01 | 0.725132 | 0.00 | 0.00 | 0.01 |
| 0.1 | 7.601769 | 0.00 | 1.00 | 0.05 |

The article "Vaporized Hydrogen Peroxide Based Biodecontamination of a High Containment Laboratory Under Negative Pressure" by Jay Krishnan et al. in Volume 11, Number 2, 2006 has incorrect paragraph headings on page 75. The first heading should read "Preparation for Biodecontamination" and the second heading should read "Biodecontamination Program Cycle."