

Biosafety Tips

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Biosafety Tips brings you practical approaches to biosafety or “news you can use.” If you are looking for a useful and sensible solution to a biocontainment problem or perhaps a reference to help convince a skeptical researcher of the need for caution, this is the place to look. In this column I will share some biosafety insights for managing a variety of workplace situations. I welcome feedback or suggestions for future topics. Please e-mail any comments or suggestions to karen_byers@dfci.harvard.edu or to Co-Editor Barbara Johnson at barbara_johnson@verizon.net.

Do clinical microbiologists need to wear gloves at the bench?

This question stirs up heated debate among clinical microbiologists. While biosafety professionals recommend glove use, followed by handwashing after glove removal when potentially infectious materials are handled, clinical microbiology supervisors are overwhelmed at the prospect of revising personal protective equipment (PPE) use and changing long-established practices. Clinical microbiology laboratories support diverse programs that include patient care and infection control activities, as well as functioning as sentinel laboratories. Their service record has been maintained despite budget cuts, increased demand for services, and the addition of new diagnostic procedures. Added to this equation is a growing national shortage of medical technologists in all types of clinical laboratories (U.S. Department of Labor, 2008).

However, other clinical laboratory specialties have successfully adapted to changes in biosafety standards. When the OSHA Bloodborne Pathogen Standard became

law in 1992, clinical laboratories handling blood faced the problems of: 1) defining where and when gloves would be worn, and 2) requesting budget increases to provide gloves. Staff resistance to wearing gloves when handling blood was overcome by the concern about preventing HIV transmission. In contrast, in microbiology laboratories, regulatory pressure does not carry the same force. Supervisors may not feel compelled to enforce “guidelines.” There are recent reports of clinical laboratory exposures from handling proficiency samples, as well as *MMWR* reports on laboratory-acquired infections, but this information does not appear to be well disseminated to bench microbiologists. These published incidents may be viewed as isolated, unlikely events by the clinical microbiology community, as there is no standardized reporting of laboratory-acquired infections and no statistics to counter their viewpoint. Consequently, with few specific concerns about routine microbiological practices, the overburdened clinical microbiologists are reluctant to change practices. Despite this reluctance, reviewing the science behind the decision supports wearing gloves during routine microbiological tasks and handwashing when gloves are removed.

At present, instead of wearing gloves, many clinical laboratories require handwashing before leaving the bench, using the computer, or answering the phone. The CDC advice on proper handwashing procedure is available at: www.cdc.gov/cleanhands/ (Figure 1).

Adherence to the 20-second rule may increase if biosafety professionals provide education and hang posters above the sink; training aids also are available at the CDC clean hands web site. However, handwashing does have limitations. For an extensive discussion of the practice, and the comparison of handwashing vs. the

Figure 1

When washing hands with soap and water.

- Wet your hands with clean running water and apply soap. Use warm water if it is available.
- Rub hands together to make a lather and scrub all surfaces.
- Continue rubbing hands for 20 seconds. Need a timer? Imagine singing “Happy Birthday” twice through to a friend!
- Rinse hands well under running water.
- Dry your hands using a paper towel or air dryer. If possible, use your paper towel to turn off the faucet.

Remember: If soap and water are not available, use alcohol-based gel to clean hands.

use of alcohol-based hand sanitizers, readers are referred to the CDC *Guidelines for Hand Hygiene in Health-care Settings* (CDC, 2002) available at: www.cdc.gov/mmwr/PDF/rr/rr5116.pdf. The percentage of virus removed by different handwashing preparations varies with the strain of virus. For purposes of this discussion, use the practical summary provided in the educational materials of a Canadian Public Health laboratory: Washing for 20 seconds removes 80% of the germs (Grey Bruce Health Unit, 2006). Given the very low infectious dose of some pathogens and the potential for hands to become contaminated doing routine microbiological procedures; is eliminating 80% of the pathogens really enough in a clinical laboratory environment?

It should also be emphasized that wearing gloves does not eliminate the need for handwashing after their removal; evidence confirming this was published recently (Casanova et al., 2008). Procedures for removal of PPE were tested by adding 10⁴ plaque-forming units (pfu) of a fluorescently labeled bacteriophage on the palm of the dominant, gloved hand. Volunteers were provided with a diagram for proper removal of PPE and asked to follow the procedure. After removal, both gloves and hands were sampled and the results quantified with the most probable number infectivity assay. Results for glove and hand contamination are shown in Table 1.

A 2005 publication in the *Journal of Clinical Microbiology* calls for the enforcement of CDC BSL-2 practices in clinical microbiology laboratories (Spina, 2005). Four cases of *E. coli* O157 acquired in four different clinical laboratories are analyzed in terms of the personal protective equipment worn (gloves, lab coat buttoned or not), procedures performed, and contributing factors to the situation (Table 2).

In the table above, a contributing factor is the risk of infection from activities performed by coworkers or students. Clearly, we need consistent rules for wearing gloves, removing gloves, and handwashing frequency for staff in clinical microbiology laboratories. The conclusion of the Spina article is reproduced here:

“The low infectious dose of *E. coli* O157:H7

and its prolonged survival on stainless steel surfaces may have contributed to laboratory transmission in these cases (Burnens et al., 1993; Coia, 1998; Maule, 2000). Standard laboratory biosafety practices recommended by the Centers for Disease Control and Prevention and the National Institutes of Health should be strictly adhered to at all times when potentially infectious clinical materials and cultures are handled (CDC, 2004). These guidelines recommend that latex gloves be worn when hands may come in contact with potentially infectious materials. If gloves are worn during a laboratory procedure and then not appropriately removed, substantial risk exists for cross-contamination of surfaces and items. Gloves should be discarded after the procedure is completed, or if they become contaminated during the procedure. Hands should be washed thoroughly after each removal of gloves. Phones and computers should be used only after latex gloves have been removed and hands have been washed. In addition, procedures with aerosol or high splash potential, such as the vortexing of suspensions of infectious organisms, should be conducted in a biological safety cabinet.

Upon interview, the four individuals could not recall any obvious breaches in laboratory procedure prior to onset of symptoms. They did not handle stool specimens or reuse gloves. However, all four laboratorians did not strictly follow the recommended standard laboratory biosafety practices. It is the responsibility of each clinical laboratory to adhere to standard biosafety practices and guidelines, to ensure that personnel are fully trained, and to closely monitor adherence to these biosafety procedures. Strict adherence by laboratory workers to the standard laboratory biosafety recommendations will minimize the transmission of any infectious organism, including *E. coli* O157:H7, to themselves and to their coworkers.”

Table 1

Frequency and levels of viral contamination of selected sites, virus transfer study, 2007.
(Reprinted from www.cdc.gov/eid/content/14/8/pdfs/1291.pdf)

Site	% volunteers who transferred virus to site	Mean viral titer recovered from site log ₁₀ MPN	% contaminated sites with visible tracer (N=10)
Nondominant glove	80	2.2	10
Right hand (skin)	90	2.4	20
Left hand (skin)	70	1.8	0

MPN: most probable number

Table 2Four U.S. cases of clinical laboratory staff infected with *E. coli* O157:H7 (Spina, 2005).

	Glove use	Handwashing practice	Lab coat	Procedures conducted	Contributing factor?
1	Intermittent; vortexed without gloves; answered phone with and without gloves	Washed prior to exiting lab, not after each glove removal	Open	Handled agar plates; vortexed on open bench; used automated ID system; performed slide latex agglutination procedure	Working during county fair outbreak of O157; high volume of cultures submitted for identification
2	Always wore gloves; changed gloves frequently; wore gloves for vortexing	Always washed after glove removal	Buttoned	Made suspension with swab; vortexed on open bench	Students in training in laboratory
3	Did not wear gloves		Buttoned	Subculture only; no vortexing	Two coworkers also manipulated proficiency sample. One wore gloves on computer and turning sink faucets. Did not routinely wash hands after glove removal
4	Gloves worn; also worn to answer phone and use computer	Did wash hands after each glove removal	Buttoned	Latex agglutination test; no vortexing	

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