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About the Cover

Contamination of hamburger, pepperoni in frozen pizza, shredded lettuce, and spinach with E. coli 0157 caused multi-state outbreaks of serious food-borne illness in 2006-2008. The July 2008 outbreak prompted the USDA to recall 5.3 million pounds of ground beef. Additional information about the community-acquired infections, hospitalizations, and fatalities is available on the CDC web site www.cdc.gov/ecoli/2007/october/103107.html. Each outbreak of E. coli 0157 results in increased occupational risk to clinical microbiology staff, and laboratory-acquired infections with this pathogen have occurred. See the Biosafety Tips column on page 37 for a review and citations supporting the use of Biosafety Level 2 practices as described in the CDC-NIH Biosafety in Microbiological and Biomedical Laboratories to minimize this risk.

The front cover image is an SEM of E. coli 0157 in the small intestine. The image is courtesy of and copyrighted © by Dennis Kunkel Microscopy, Inc.
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The American Biological Safety Association is dedicated to expanding biological safety awareness to prevent adverse occupational and environmental impact from biohazards.

Goals
• Expand professional and public awareness of biological safety through effective communication.
• Participate in the development of biological safety and biosecurity standards, guidelines, and regulations.
• Develop ABSA as the recognized resource for professional and scientific expertise in biological safety and biosecurity.
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President’s Page

Robert P. Ellis
Colorado State University, Fort Collins, Colorado

During December 2008 and January 2009, two incidents involving passenger planes in the United States garnered immediate international attention. A Continental Airlines plane was taking off from Denver International Airport when it suddenly veered off the runway, rolled across the grass and down a slight embankment, came to a stop, and caught fire. All 107 passengers and 5 crew members escaped. There were 38 persons with injuries, none of them life-threatening. Less than a month later, on January 15, a U.S. Airways plane had both engines fail shortly after takeoff from Laguardia Airport in New York City. The plane had reached about 3,200 feet altitude when the engines failed, and the captain was able to fly it over parts of New York City to the Hudson River, where he put it down in the water. Fortunately, no serious injuries were suffered by the 155 persons on board.

The extensive coverage of both incidents concluded that preventing the loss of any lives was due to the training of the pilots and attendants on each flight. The pilots and the rest of the crew have all been through countless hours, and in some cases years, of training, exercises of the training, and experience. We place our lives in their care from start to finish of each flight. In the two cases cited above, we saw immediately how the training and exercises paid off in preventing more serious injuries and loss of life.

We stress training in the biosafety profession too, with numerous training opportunities available from ABSA and many other venues. The opportunities are such that an individual does not have enough time or money to attend them all. Most of the training courses are classroom-style training with varying amounts of interaction and exercises about what the training taught. When we enroll in and complete a training course, do we practice what was taught? Are the notebooks, CDs, and other materials we received during the training courses worn from repeated use, or are they sitting neatly on shelves in excellent near-new condition? Do we go back home, and exercise the training to be sure we can make it work in our own unique environment?

Moreover, training is not just for biosafety personnel. Include other safety personnel, laboratory animal personnel, and greenhouse managers, and definitely include laboratory investigators. Exercising the training we obtain should not be limited to emergency response protocols. Correct use of biosafety cabinets and autoclaves, use of eye washes, donning and doffing lab clothing and personal protective equipment, and other procedures are best practiced before utilizing them in the lab.

When conducting emergency response protocol exercises, be sure to include emergency responders from the community. They are the professionals who will be summoned when fires and medical emergencies occur. When they are included in your exercises, emergency responders can give valuable advice that may save lives in an emergency. It is also a learning experience for them and will enhance their ability to assist when emergencies do occur. Emergency responders who are included and have input into biosafety training protocols and exercises become ambassadors for the research community to the general public and can assure the public that the research community is taking the proper actions to ensure the safety of the community regarding infectious disease research.

Remember when conducting training that the general public does not have an accurate understanding of the breadth and depth of the training that is conducted to ensure that the persons doing the research and the surrounding community are adequately protected from the agents utilized in the research. When discussions arise regarding the safety of the research (don’t be timid in initiating some of those discussions), be sure to communicate accurately how we in the biosafety profession are constantly being trained, the many opportunities for training that our profession offers, how highly we all value training, and the importance of the training to the community.

In conclusion, you can apply examples from outside the biosafety world to illustrate how training and exercise of the training pay substantial dividends in daily safe research applications and in instances when emergencies occur. Remember in all our training and training exercises that “failure to conduct our research safely is not an option.”
Chlorine Dioxide Gas is Now Approved for the Decontamination of Biological Safety Cabinets

Kevin Lorcheim
ClorDiSys Solutions, Inc.

Chlorine Dioxide Gas has been approved by NSF International under Annex G of NSF/ANSI 49 for the decontamination of Biological Safety Cabinets (BSCs). Chlorine Dioxide Gas now joins formaldehyde as the only formally approved methods for decontaminating BSCs. Without some of the drawbacks of formaldehyde, including its need for residual clean up and its status as a carcinogen, chlorine dioxide gas has many of its benefits. It is easily distributed throughout the BSC due to its gaseous nature, has good penetrability, and has the proper sporcidal activity. The total time for decontamination is also much shorter, a cycle which generally went overnight with formaldehyde only takes 90 minutes when using chlorine dioxide gas.

Testing proved successful as Chlorine Dioxide Gas passed all requirements set forth in the validation protocol by NSF International. In all trials, no material degradation or residues were noticed within the BSCs used. Both Type A and Type B BSCs were used in the validation study, both being shown to be compatible with Chlorine Dioxide Gas and its decontamination process. Chlorine Dioxide gas was shown to be effective in penetrating and decontaminating HEPA filters, as well as the entirety of the Biological Safety Cabinet. As such, Chlorine Dioxide Gas has been approved under Annex G of NSF/ANSI 49 to be used in the decontamination of Biological Safety Cabinets.

New Report—National Science Advisory Board

The National Science Advisory Board for Biosecurity (NSABB) has issued a new Report on Outreach and Education entitled “Strategic Plan for Outreach and Education on Dual Use Research Issues.” The NSABB was established by the government to advise Federal departments and agencies on ways to minimize the possibility that knowledge and technologies emanating from life sciences research will be misused to threaten public health or other aspects of national security. Among other aspects of its charge, the NSABB was asked to provide recommendations on developing programs of outreach and education on dual use research issues for all scientists and laboratory workers at federally-funded institutions. The report can be found at:
http://oba.od.nih.gov/biosecurity/PDF/FinalNSABBReportonOutreachandEducationDec102008.pdf

Federal Register—Vol. 74, No. 41—Wednesday, March 4, 2009—Notices

DEPARTMENT OF HEALTH AND HUMAN SERVICES
National Institutes of Health
Office of Biotechnology Activities; Recombinant DNA Research:

Proposed Actions Under the NIH Guidelines for Research Involving Recombinant DNA Molecules (NIH Guidelines)
AGENCY: National Institutes of Health (NIH), PHS, DHHS.
ACTION: Notice of consideration of a proposed action under the NIH Guidelines.

If you would like more information on the biosafety aspects of research with recombinant and synthetic nucleic acid molecules and other aspects covered in the federal Register, please go to the ABSA web site at: http://absa.org/pdf/090304NSABB.pdf
Decontamination of Bacillus anthracis Spores: Evaluation of Various Disinfectants

Sara J. Heninger, Christine A. Anderson, Gerald Beltz, and Andrew B. Onderdonk

Harvard Medical School, Boston, Massachusetts

Abstract

The present study compares the efficacy of various disinfectants against Bacillus anthracis spores. While Bleach Rite® and 10% bleach reduce spore numbers by 90% within 10 minutes, a long contact time is required for complete disinfection. By contrast, although SporGon® did not initially reduce the number of spores as quickly as Bleach Rite or 10% bleach, shorter contact times were required for complete eradication of viable spores.

Introduction

With renewed interest in the possible use of Bacillus anthracis (B. anthracis) as a biological weapon, the urgency to understand the biologic characteristics of this organism has increased. B. anthracis spores are extremely resistant to harsh environmental conditions (Mock & Fouet, 2001), and as a result, many challenges are encountered when trying to eliminate a spore population. Recent studies addressing this issue have focused predominately on decontamination of large facilities subjected to a bioterrorism event (Buttner et al., 2004; Canter et al., 2005; Kenar et al., 2007). While there are studies examining decontamination of spores on hard, nonporous and porous surfaces (Kolb & Schneiter, 1950; Majcher et al., 2008; Rogers et al., 2007; Rogers et al., 2005; Sagripanti et al., 2007), few studies directly measure the decontamination of spores in liquid suspension as used routinely in many laboratory manipulations. Furthermore, many of these studies examine a variety of disinfectants such as formaldehyde gas (Rogers et al., 2007) and methyl bromide (Kolb & Schneiter, 1950). These disinfectants are considered hazardous if inhaled or exposed to the skin and, therefore, are not applicable to routine laboratory decontamination measures.

Most scientific research with B. anthracis is conducted in stainless steel biosafety cabinets, and current recommendations for decontamination by the Environmental Protection Agency (EPA) and the Centers for Disease Control (CDC) suggest a 10% household bleach solution at pH 7 (Decon Laboratories, 2006; Moran, 1999). However, 10% bleach is known to be corrosive for certain grades of stainless steel. Furthermore, bleach solutions are also known to be unstable in diluted form. Rutala et al. (1998) demonstrated that the concentration of chlorine for a 1:5 dilution was only 83%-85% of the initial concentration, and 1:50 or 1:100 dilutions were only 40%-50% of the initial values after 30 days of storage. Moreover, many studies that tested the efficacy of disinfectants used Bacillus species other than B. anthracis (Buttner et al., 2004; Perez et al., 2005) and do not specifically address decontamination of varied spore concentrations that are routinely used in a laboratory setting. The present study compares the usefulness of various disinfectants in a laboratory where B. anthracis spores are routinely used for experimental work.

When choosing a disinfectant it is important to consider the properties of the microbiological agent in use and the equipment and tools that will require decontamination during the course of a laboratory procedure. Several disinfectants are widely used for decontamination in scientific research laboratories; these include SporGon®, 10% bleach, Bleach Rite®, Vesphene®, and Sporicidin®. As described in Table 1, SporGon® is a hydrogen peroxide/peracetic, acid-based disinfectant (Decon Laboratories, 2001) that is considered effective against many different organisms but has an expiration date that extends only 14 days after opening (Decon Laboratories, 2006). Although SporGon® has passed the AOAC sporicidal test against B. subtilis spores as well as Clostridium sporogenes spores, no published data describe its activity against B. anthracis spores (Decon Laboratories, 2006). A 10% solution of household bleach is widely used for decontamination of surfaces and tools exposed to biological agents including B. anthracis spores. However, it requires long contact times (Table 1) to inactivate spores, is corrosive for certain grades of stainless steel, and is highly unstable in the diluted form. Bleach Rite®, a pre-mixed stable formula of buffered (pH 12.3) 10% bleach is considered safe for stainless steel (Current Technologies, 2006), but no data are available on its effectiveness for killing bacterial spore populations such as B. anthracis. Sporicidin® contains 1% glutaraldehyde and 1.9% phenol as active ingredients (The Sporicidin Company, 2006). While many studies demonstrate the
sporicidal activity of glutaraldehyde against *Bacillus* species, solutions ranging from 2%-5% are typically used, long contact times are required, and species of *Bacillus* other than *anthracis* were used as test organisms (Dyas & Das, 1985; Kenar et al., 2007; Manchee et al., 1983). Vesphene, the other disinfectant noted in Table 1, is a broad-spectrum disinfectant but does not indicate efficacy against spores (Steris Corporation, 2004). With such a wide range of disinfectant products available, it is important to determine the optimal disinfectant for a variety of biological agents, including *B. anthracis*, under conditions that are consistent with a scientific research environment.

**Results and Discussion**

In the present study, we tested the efficacy of the disinfectants described in Table 1 against *B. anthracis* strain ANR-1 spores (gift from T. Koehler, University of Texas). This strain is a variant of the virulent Ames strain that is devoid of the plasmid responsible for capsule production in the vegetative state (pXO1+/pXO2-). As shown in Table 2, when a sample containing 100,000 spores was analyzed, either Bleach Rite® or 10% bleach was able to dramatically reduce (<0.0001% remaining) the number of viable spores at the earliest time point, and no viable spores were detected after 20 minutes of treatment. Complete sterilization was not attained until 20 minutes post-inoculation due to 1 cfu being present at 10 minutes in the 10% bleach-treated groups. We believe this is due to random variation, and that while 10% bleach and Bleach Rite® immediately reduce spore numbers (>0.9999%) at this concentration, an occasional spore can persist. Similarly, no spores were detected after 20 minutes of treatment with SporGon®, although this agent was not as effective as bleach or Bleach Rite® at the earlier time point. Although SporGon® was unable to greatly reduce the bacterial

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**Table 1**

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<td>Bleach Rite® (Current Technologies Inc., 2006)</td>
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<td>10% Bleach (U.S. Environmental Protection Agency, 2003)</td>
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<td>SporGon® (Decon Laboratories, 2006)</td>
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**Method**

A spore stock was prepared (Heninger et al., 2006) and used to determine the rate of killing *B. anthracis* spores at two different concentrations, 100,000 and 1,000,000 cfu/ml. Spores, at a concentration of 100,000 cfu/ml, were added to a flask containing the recommended concentration of disinfectant (Vesphene® 1:128; bleach 1:9; Sporicidin®, Vesphene®, and Bleach Rite® were used undiluted) and were continuously mixed. One milliliter of the spore/disinfectant mixture was removed immediately after addition and at 10, 20, 30, and 60 minutes post-inoculation. The sample was immediately diluted into 9 ml phosphate buffered saline (PBS, filtered through a 0.2 mm analytical filter (Nalgene; ThermoFisher Scientific, Waltham, MA) and then the filter was washed three times with 50 ml PBS. Because the intent of treatment with disinfectants is to rapidly achieve complete or nearly complete sterilization, we chose not to enumerate the number of spores remaining following the use of a disinfectant that clearly failed to disinfect spore samples. Following the final wash, the filter was removed, placed onto a blood agar plate (Remel, Lenexa, KS), and incubated at 30°C. Twenty-four hours post-inoculation, filters were examined for the presence or absence of *B. anthracis*. Colonies were enumerated and recorded as log₁₀ cfu/ml only if the disinfectant reduced the bacterial load to a discernable number.
Table 2
Disinfection of 100,000 spores/ml

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Table 3
Disinfection of 1,000,000 spores/ml

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Figure 1
A. SporGon®  B. Bleach Rite®

spore numbers at the earliest sample time points, complete sterilization was still achieved in 20 minutes. As expected, Vesphe® and Sporcidin® were completely ineffective in killing spores.

Because scientific manipulations often deal with different concentrations of spores, we evaluated the efficacy of each disinfectant at a higher test dose (Table 3, Figure 1). For this experiment we repeated the procedures above but added 1,000,000 spores per ml of disinfectant. While 10% bleach and Bleach Rite® were each able to reduce viable spore numbers immediately (within 2-3 minutes) at the higher inoculation dose, residual
viable spores remained after 30 minutes of treatment. This demonstrates that long contact times are required to achieve complete sterilization when using 10% bleach and 10% bleach products. By contrast, although treatment with SporGon® does not result in an immediate reduction in viable spore numbers, complete sterilization is achieved within 10-20 minutes.

These experiments demonstrate that 10% bleach, Bleach Rite®, and SporGon® are all effective disinfectants capable of successfully killing B. anthracis spores. Either 10% bleach or Bleach Rite® is an appropriate choice for daily decontamination of work surfaces due to the ability of these disinfectants to effectively kill a large portion of B. anthracis spores immediately. Bleach Rite® is a pre-mixed stable formula that is not corrosive to stainless steel (Current Technologies, 2006) and therefore ideal for disinfection of stainless steel biosafety cabinets. SporGon® is slightly corrosive for stainless steel; yet, complete sterilization was reached more quickly when compared to 10% bleach or Bleach Rite®. This makes SporGon® an appropriate disinfectant when dealing with biological spills outside the biosafety cabinet or when working with highly concentrated spore stocks. Therefore, we have implemented the use of Bleach Rite® for our daily laboratory decontamination of equipment and SporGon® in the event of a biological spill or when working with high concentrations of bacteria. While we use two separate disinfectants for different situations, it remains important to note that SporGon® and Bleach Rite® cannot be mixed and that each scientific laboratory is unique and should evaluate disinfectants based on its own individual needs.

We would like to thank John Warner for his excellent photography and technical assistance. This work was supported by New England Regional Center of Excellence (NERCE) grant AI057159-05.

References


Current Technologies, Inc. Bleach Rite Disinfecting Spray with bleach. Material Safety Data Sheet (pp. 1-3).


Comparative Analysis of the Fourth and Fifth Editions of Biosafety in Microbiological and Biomedical Laboratories, Vertebrate Animal Biosafety Level Criteria (ABSL1-4)

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Abstract

We have developed a matrix of changes between the Vertebrate Animal Biosafety Level Criteria sections of the current and former editions of Biosafety in Microbiological and Biomedical Laboratories (BMBL). Citations containing multiple statements were subdivided into individually-addressable statements and statements with similar/identical scope were aligned, thereby allowing a precise comparative analysis. In addition, statements were categorized for further analysis based on the subject of the change. Results are presented in a change matrix tool that uses a basic Microsoft Excel filter function to allow the user to sort the data based on the animal biosafety level and subject. The tool also contains a side-by-side comparison of animal biosafety levels one through three (ABSL1-3) in the fifth edition of BMBL. In this report, we present a brief summary of major changes.

Introduction

First introduced in 1984, Biosafety in Microbiological and Biomedical Laboratories (BMBL) is an advisory document recommending best practices for the safe conduct of work in biomedical and clinical laboratories. Since its inception, it has become one of the most frequently used codes of practice in biosafety and an authoritative reference for the development of laboratory policies and procedures, the construction of new laboratories, and the renovation of existing laboratories (U.S. Dept. of Health and Human Services, CDC, & NIH, 1999). Over the past two decades, periodic updates have been made to BMBL to “refine guidance based on new knowledge and experiences and to address contemporary issues that present new risks that confront laboratory workers and the public health” (U.S. Dept. of Health and Human Services, CDC, & NIH, 2007). In February 2007, a consortium of individuals from the Centers for Disease Control and Prevention (CDC) and National Institutes of Health (NIH) released the fifth edition of BMBL which contained a number of revisions and additions from the former, including:

• Added guidance on laboratory biosecurity and risk assessment.
• Added guidance on agricultural Biosafety Level 3 (BSL3-Ag) laboratories.
• Revisions and additions to agent summary statements.
• Expanded guidance on a number of topics including decontamination, sterilization, occupational medicine, and immunization.

In 2008, we developed a matrix of changes between the Laboratory Biosafety Level Criteria sections of the current and former editions of BMBL and published our findings in Applied Biosafety, Volume 13, Number 1, 2008 (Crews & Gaunt, 2008). We report here the development of a change matrix between the Vertebrate Animal Biosafety Level Criteria sections of the fourth and fifth editions of BMBL (BMBL4 and BMBL5, respectively). Our analysis is organized by subject matter with a particular focus on identifying key similarities and differences between animal biosafety levels. To facilitate a side-by-side comparison, we have also aligned BMBL5 animal biosafety levels one through three (ABSL1-3). Due to the extent of procedural and facility differences between ABSL4 and the other containment levels, ABSL4 is considered separately in our analysis.

Methods

The Vertebrate Animal Biosafety Level Criteria sections from both BMBL4 and BMBL5 were analyzed and a matrix of changes was developed for ABSL1-ABSL4. (Note: The PDF version of BMBL5 used for this analysis was revised on March 31, 2008 and available at: www.cdc.gov/od/ohs/biosfty/bmbl5/BMBL_5th_Edition.pdf.) Both editions were transferred electronically to a Microsoft Excel spreadsheet and separated by citation. Citations containing multiple statements were further subdivided into individually-addressable statements to facilitate a detailed comparative analysis independent of simple structural/format differences not affecting meaning. BMBL4 statements were then reorganized and horizontally aligned with BMBL5 statements having similar or identical scope (Figure 1). The ABSL1-ABSL3 sections from BMBL5 were also horizontally aligned to facilitate biosafety level comparisons (Figure 2). Each statement, or statement pair, was also categorized based on subject. Based upon observed trends in BMBL topics and laboratory commonalities, the following 16 biosafety-related subjects were assigned to each statement or statement pair:

• Animal Containment
•...
# Figure 1

A sample of the change matrix comparing the Vertebrate Animal Biosafety Level Criteria sections from the fourth and fifth editions of *Biosafety in Microbiological and Biomedical Laboratories*. The complete tool may be obtained on the ABSA web site at www.absa.org/restool.html.

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<th>Heading</th>
<th>Subject</th>
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<th>BMBL4 Citation</th>
<th>BMBL4</th>
<th>BMBL5 Section</th>
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<td>BSCs (Class II, Class III) must be installed so that fluctuations of the room air supply and exhaust do not interfere with its proper operations.</td>
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<td>Class II BSCs should be located away from doors, heavily traveled laboratory areas, and other possible airflow disruptions.</td>
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<td>HEPA-filtered exhaust air from a Class II biological safety cabinet can be recirculated into the animal room if the cabinet is tested and certified at least annually.</td>
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<td>HEPA filtered exhaust air from a Class II BSC can be safely re-circulated back into the laboratory environment if the cabinet is tested and certified at least annually and operated according to manufacturer’s recommendations.</td>
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<td>When exhaust air from Class II safety cabinets is to be discharged to the outside through the building exhaust air system, the cabinets must be connected in a manner that avoids any interference with the air balance of the cabinets or the building exhaust system (e.g., an air gap between the cabinet exhaust and the exhaust duct).</td>
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<td>If the Class III cabinets are connected to the supply system, it is done in a manner that prevents positive pressurization of the cabinets (see Appendix A).</td>
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<td>Class III BSCs must supply air in such a manner that prevents positive pressurization of the cabinet or the laboratory room.</td>
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Figure 2
A sample of the Change Matrix comparing Animal Biosafety Levels 1-3 in the fifth edition of Biosafety in Microbiological and Biomedical Laboratories. The complete tool may be obtained on the ABSA web site at www.absa.org/restool.html.

<table>
<thead>
<tr>
<th>BMBL5 Section</th>
<th>Subject</th>
<th>ABSL1 Citation</th>
<th>Animal Biosafety Level 1</th>
<th>ABSL2 Citation</th>
<th>Animal Biosafety Level 2</th>
<th>ABSL3 Citation</th>
<th>Animal Biosafety Level 3</th>
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<tr>
<td>C</td>
<td>Heading</td>
<td>Heading</td>
<td>C. Safety Equipment (Primary Barriers and Personal Protective Equipment)</td>
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<td>Personal Protective Equipment</td>
<td>3</td>
<td>Protective eyewear is worn when conducting procedures that have the potential to create splashes of microorganisms or other hazardous materials.</td>
<td>3</td>
<td>Eye and face protection (mask, goggles, face shield or other splatter guard) are used for anticipated splashes/sprays from infectious or other hazardous materials and when the animal or microorganisms must be handled outside the BSC or containment device.</td>
<td>3</td>
<td>Appropriate eye, face and respiratory protection are worn by all personnel entering areas where infectious materials and/or animals are housed or are manipulated.</td>
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<td>C</td>
<td>Personal Protective Equipment</td>
<td>3</td>
<td>Persons who wear contact lenses should also wear eye protection when entering areas with potentially high concentrations of airborne particulates.</td>
<td>3</td>
<td>Persons who wear contact lenses should also wear eye protection when entering areas with potentially high concentrations or airborne particulates.</td>
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<td>Persons who wear contact lenses should also wear eye protection when entering areas with potentially high concentrations or airborne particulates.</td>
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<td>Personal Protective Equipment</td>
<td>3</td>
<td>Persons having contact with the NHP should assess risk of mucous membrane exposure and wear appropriate protective equipment (e.g., masks, goggles, face shields, etc.) as needed.</td>
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<td>C</td>
<td>Personal Protective Equipment</td>
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<td>Respiratory protection is worn based upon risk assessment.</td>
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<td>C</td>
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<td>Gloves are worn to protect hands from exposure to hazardous materials.</td>
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<td>Gloves are worn to protect hands from exposure to hazardous materials.</td>
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<td>Gloves are worn to protect hands from exposure to hazardous materials.</td>
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<td>Procedures may require the use of wearing two pairs of gloves (double-glove).</td>
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Results and Discussion

Animal Containment

Our discussion of animal containment focuses on the use of restraint devices and the design and usage considerations for animal housing. Cage washing is discussed in the “Decontamination and Waste” section.

Restraint Devices

BMBL5 recommends the use of restraint devices (e.g., physical restraint devices, chemical restraint medications, mesh, or Kevlar gloves) for research at ABSL2-4. The use of these devices is not addressed at any containment level in BMBL4. For ABSL2-3, BMBL5 recommends that “consideration should be given to the use of restraint devices and practices that reduce the risk of exposure during animal manipulations.” For ABSL4, BMBL5 states that these devices and practices “should be used where practicable” in the cabinet laboratory.

Animal Housing

The recommendations for primary animal biosafety containment at ABSL2 have been elaborated upon in BMBL5 to address both rodents and “larger animals.” Solid wall and bottom cages covered with filter bonnets are recommended for rodents in BMBL5 whereas “large cages placed in inward flow ventilated enclosures or other equivalent primary containment systems” are recommended for larger animals. BMBL5 specifies that the need for primary containment at ABSL2 should be determined by risk assessment (as opposed to “as needed”).

Additional recommendations for the design and use of actively ventilated caging systems at ABSL3 are provided in BMBL5. These systems must be designed to prevent the escape of microorganisms though the sealing of exhaust plenums, the HEPA filtration of exhaust, the incorporation of safety mechanisms to prevent positive air flow, and the installation of an alarm system to indicate operational malfunctions.

The recommendations for animal housing in the ABSL4 suit lab at BMBL5 are similar to BMBL4; however, unlike the previous edition, BMBL5 explicitly states that “infected animals should be handled within a primary barrier system, such as a Class II biological safety cabinet (BSC) or other equivalent containment system.”

Biological Safety Cabinets

We have organized our discussion of biological safety cabinets (BSCs) by class (Class II and III). The special requirements for ABSL4 BSCs are discussed separately.

Class II BSCs

New criteria for Biological Safety Cabinet (BSC) design and use at ABSL2 have been added to BMBL5. For ABSL2, BMBL5 states that “if BSCs are present, they must be installed so that fluctuations of the room air supply and exhaust do not interfere with proper operations, and “should be located away from doors, heavily traveled laboratory areas, and other possible airflow disruptions.” These criteria are also echoed in the Class II BSC guidance for ABSL3 and ABSL4 (when Class II cabinets are present). Although no requirements for the class of BSCs required at ABSL2 are provided, guidance...
on the use of Class II BSCs is provided that mimics Class II BSC guidance at ABSL3 and ABSL4. Like BMBL4, BMBL5 permits HEPA filtered exhaust air from Class II BSCs to be re-circulated into the laboratory if the cabinet is tested and certified at least annually and operated according to the manufacturer’s recommendations. They can also be connected to the laboratory exhaust system by either a thimble (canopy) or direct (hard) connection.

Class III BSCs

Major changes in the design and use recommendations for Class III BSCs exist between BMBL4 and BMBL5. In BMBL5, Class III BSCs in the ABSL3 facility “must supply air in such a manner that prevents positive pressurization of the cabinet or the laboratory room.” In BMBL4, the recommendation is rather that “if Class III cabinets are connected to the supply system, it is done in a manner that prevents positive pressurization.” A host of other Class III BSC design requirements for ABSL4 cabinet laboratories are introduced in BMBL5. These include specific requirements for decontamination (e.g., pass-through dunk tank or fumigation chamber), HEPA filtration requirements, supply and exhaust, maintenance, and general design characteristics. The reader should consult the change matrix for a comprehensive list of additions.

ABSL4 BSC Requirements

BMBL5 requires that procedures involving the manipulation of infectious materials at ABSL4 be conducted within a biological safety cabinet or other physical containment device. This requirement is absent from BMBL4. BMBL5 guidance for ABSL4 cabinet laboratories states that “all manipulations of infectious animals and materials within the laboratory must be conducted in the Class III BSC,” and “when procedures can not be performed in a BSC, alternate containment equipment should be used.” This is more stringent than previous BMBL4 guidance for ABSL4 cabinet laboratories which states that “laboratory animals infected with Biosafety Level 4 agents must be housed within a Class III BSC in a BSL4 cabinet laboratory.”

Decontamination and Waste

The subject of decontamination practices and waste handling is one of the most heavily expanded topics in BMBL5. While it is impossible to detail every change with potentially important implications here, the most pertinent changes are addressed.

Autoclaves

The requirements for autoclave availability in the ABSL2 laboratory have been lowered in BMBL5. Whereas BMBL4 requires that an autoclave be available in the ABSL2 animal facility, BMBL5 states that “an autoclave should be considered in the animal facility.” At ABSL3, the requirements for autoclave availability have not changed. As in BMBL4, BMBL5 states that “an autoclave is available which is convenient to the animal rooms where the biohazard is contained.” Unlike BMBL4, however, BMBL5 states that “a method for decontaminating all infectious materials (e.g., autoclave, chemical disinfection, or other approved decontamination method) must be available within the facility, preferably within the areas where infectious materials and/or animals are housed or manipulated.” There are numerous new recommendations in BMBL5 for autoclaves in the ABSL4 laboratory. For instance, BMBL5 requires that gas and liquid discharge from the autoclave chamber be decontaminated. BMBL5 also states that “when feasible, autoclave decontamination processes should be designed so that over-pressurization cannot release unfiltered air or steam exposed to infectious material to the environment.” Both of these statements are echoed for both the ABSL4 cabinet and suit laboratories. The reader should consult the change matrix for more details on ABSL4 autoclave recommendations.

Cage Washing and Bedding Decontamination

BMBL4 is silent about the need to autoclave cages prior to washing at ABSL2; however, it is stated explicitly in BMBL5. In addition, the authors of BMBL5 have listed additional factors to consider when designing a cage wash area in an ABSL2 (or higher containment) facility. These include: the ability to accommodate high pressure systems, humidity, strong chemical disinfectants, and 180°F water temperatures.

At ABSL3 containment, BMBL4 states explicitly that “cages are autoclaved or thoroughly decontaminated before bedding is removed and before they are cleaned and washed.” On the other hand, BMBL5 states that “it is recommended that animal bedding and waste be decontaminated prior to manipulation and before removal from the areas where infectious materials and/or animals are housed or are manipulated, preferably within the caging system.”

Special Decontamination Practices

Several specific decontamination practices are recommended or required in BMBL5 that were not previously addressed in BMBL4. For instance, BMBL5 recommends that “consideration should be given to [a] means for decontaminating routine husbandry equipment, sensitive electronic and medical equipment” at ABSL2-4. At ABSL2 containment, BMBL5 also states that “materials to be decontaminated outside of the immediate areas where infectious materials and/or animals are housed or are manipulated must be placed in a durable, leak proof, covered container and secured for transport.” For ABSL3 and ABSL4 cabinet and suit labs, BMBL5 recommends that “decontamination of an entire animal room...
should be considered when there has been a gross contamination of the space, significant changes in usage, for major renovations, or maintenance shut downs.”

Also at ABSL4, BMBL5 requires that “equipment or material that might be damaged by high temperatures or steam must be decontaminated using an effective and validated procedure such as gaseous or vapor method in an airlock or chamber designed for this purpose.” In the ABSL4 suit laboratory, there is a new requirement for a method for decontaminating positive pressure suits in the event of an emergency exit or failure of the chemical shower. Finally, BMBL5 requires that the decontamination of all liquid wastes be documented at ABSL4.

**Entry/Exit Procedures**

The entry and exit procedures for ABSL4 laboratories have been expanded in BMBL5 to include guidance on the removal of biological materials that are to remain in a viable or intact state. These materials must:

- Be transferred to a non-breaking, sealed primary container and then enclosed in a non-breaking, sealed secondary container,
- Be transferred through a disinfectant dunk tank, fumigation chamber, or decontamination shower, and
- Not be opened outside of ABSL4 containment unless inactivated by a validated method.

In addition, BMBL5 also includes new guidance on personnel entry and exit procedures for ABSL4 laboratories. For instance, BMBL5 requires that “a logbook, or other means of documenting the date and time of all persons entering and leaving the ABSL4 laboratory must be maintained.” Also, BMBL5 includes a provision that necessary staff may enter and exit the ABSL4 laboratory without following the clothing change and shower requirements if the laboratory has been completely decontaminated by a validated method.

**Facility Construction and Design**

In this section, we discuss the new guidance on sinks, flooring, and other facility appurtenances introduced in BMBL5. Ventilation and filtration are discussed in the next section.

**Sinks/Eyewashes**

Sink traps are not discussed in BMBL4, but are made a requirement in BMBL5 for ABSL1-4. For ABSL1-3, sink traps must be “filled with water and/or appropriate liquid to prevent the migration of vermin and gases.” At ABSL4, sinks must contain traps and be connected to the wastewater decontamination system.

BMBL5 states for ABSL2-3 that in addition to the requirement for a hand washing sink located at the exit of the of the areas where infectious materials and/or animals are housed or are manipulated, “additional sinks should also be located in other appropriate locations within the facility.” The guidance goes on to state that “if the animal facility has segregated areas where infectious materials and/or animals are housed or manipulated, a sink must also be available for hand washing at the exit from each segregated area.” Furthermore, guidance for ABSL3 suggests that these sinks “should be hands-free or automatically operated.” In BMBL5, emergency eyewashes and showers must be readily available in ABSL1-4 laboratories. The location of these fixtures should be determined by risk assessment.

**Penetrations/Flooring**

BMBL4 does not address the sealing of penetrations in floors, walls, or ceilings except for ABSL3 containment levels and above. However, BMBL5 recommends that penetrations in floors, walls, and ceiling surfaces (including openings around air ducts, doors, and door frames) be sealed at ABSL1, and requires that these penetrations be sealed at ABSL2 and above. Likewise BMBL5 requires that flooring in the ABSL3 laboratory be “seamless, sealed resilient or poured floors, with integral coved bases,” therefore aligning the ABSL3 flooring requirements with those found at ABSL4.

**Other General Design Considerations**

Prior guidance on ABSL3 facility design, found in BMBL4, indicates that “entry into the animal room is via a double-door entry which may include a change room and shower(s).” A similar statement is found in BMBL5 that puts more emphasis on the requirement for a change room. Specifically, BMBL5 states that “entry into the containment area is via a double-door entry which constitutes an anteroom/airlock and a change room. Showers may be considered based on risk assessment.”

A new recommendation is found in BMBL5 for ABSL4 laboratories which states that one should “consider placing ABSL4 areas away from exterior walls of buildings to minimize the impact from the outside environmental [sic] and temperatures.” The requirement for an automatically activated emergency power source is not discussed in BMBL4 for the ABSL4 cabinet laboratory, though it is stated explicitly for the suit lab. In BMBL5, an automatically activated emergency power source is required for ABSL4 cabinet and suit laboratories, and there is an added recommendation that “monitoring and control systems for air supply, exhaust, life support, alarms, entry and exit, and security systems should be on a UPS” (uninterruptible power supply).

**Facility Ventilation**

This section focuses on new design characteristics for ventilation systems in the ABSL4 laboratory, and new recommendations for local and central vacuum systems.
Ventilation Systems

A new recommendation for ventilation systems is introduced in BMBL5 which states that “ventilation system design should consider the heat and high moisture load produced during the cleaning of animal rooms and the cage wash process.” It is recommended that this be a consideration for ventilation system design at all four ABSL containment levels. Also new to BMBL5 is the requirement that atmospheric venting systems in ABSL4 cabinet laboratories “be provided with two HEPA filters in series and be sealed up to the second filter.”

Like BMBL4, BMBL5 states that a dedicated non-recirculating ventilation system must be provided for ABSL4 cabinet and suit laboratories. However, BMBL5 adds that “only laboratories with the same HVAC requirements (i.e., other BSL-4 labs, ABSL-4, BSL-3 Ag labs) may share ventilation systems if each individual laboratory system is isolated by gas tight dampers and HEPA filters.” BMBL4 previously stated that in an ABSL4 suit lab supply/exhaust system, “redundant supply fans are required” and redundant exhaust fans are required.” This is echoed in BMBL5, but extended to ABSL4 cabinet laboratories as well.

Vacuum Systems

Considerations for central or local vacuum services were previously unaddressed in BMBL4 for ABSL2. BMBL5 states that “if vacuum service is provided, each service connection should be fitted with liquid disinfectant traps and an in-line HEPA filter, placed as near as practicable to each use point.” Neither BMBL4 nor BMBL5 recommend central vacuum systems in ABSL4 containment suites; however, BMBL4 states that if there is a central vacuum system, in-line HEPA filters are placed as near as practicable to each use point or service cock. In BMBL5, this practice is continued; however, BMBL5 specifically recommends that two in-line HEPA filters be placed at each use point.

Medical Surveillance and Restrictions

Key differences between BMBL4 and BMBL5 exist regarding the restriction of access to the laboratory based on a person’s susceptibility to infection and the need for specific medical surveillance practices, including serum banking.

Restricting Laboratory Access

BMBL4 states that “in general, persons who may be at an increased risk of acquiring infection, or for whom infection might be unusually hazardous, are not allowed in the animal facility unless special procedures can eliminate the extra risk.” This statement applies in BMBL4 to ABSL2-4. In BMBL5, the concept of restriction from laboratory access based on a person’s susceptibility to infection has been eliminated. Rather, BMBL5 states that “all laboratory personnel...should be provided with information regarding immune competence and conditions that may predispose them to infection. Individuals having these conditions should be encouraged to self-identify to the institution’s healthcare provider for appropriate counseling and guidance.”

Medical Surveillance

In general, the importance of an “appropriate medical surveillance program” at all ABSL containment levels has not changed between BMBL4 and BMBL5. However, BMBL5 places more emphasis on the necessity of a proper risk assessment to determine what constitutes an “appropriate” program. At ABSL4 containment, BMBL4 states that “a medical surveillance program must be instituted for all personnel entering the ABSL4 facility [that includes] appropriate immunizations, serum collection, and availability of post-exposure counseling and potential prophylaxis.” However, BMBL5 does not make the same blanket statement concerning the need for serum collection. Rather, BMBL5 states that “each institution must establish policies and procedures describing the collection and storage of serum samples from at-risk personnel.”

BMBL5 offers expanded guidance on the factors to be considered as part of a medical surveillance program. Factors not mentioned in BMBL4 include the need to consider an animal allergy prevention program, and the need to enroll personnel using respirators in an “appropriately constituted respiratory protection program.” The reader should consult the change matrix for other medical surveillance considerations.

Personal Protective Equipment

Most of changes and additions to personal protective equipment (PPE) guidance in BMBL5 focus on the use (and disposal) of gloves and eye/face protection. As with other sections, the importance of conducting a risk assessment is emphasized in BMBL5. The reader should consult the change matrix for details on other types of PPE.

Gloves

The use of gloves at ABSL1 is not specifically addressed in BMBL4; however, BMBL5 explicitly states that “gloves are worn to prevent skin contact with contaminated, infectious and hazardous materials, and when handling animals.” At ABSL1 and above, BMBL5 states that “a risk assessment should be performed to identify the appropriate glove for the task and alternatives to latex should be available.” The need for latex alternatives is not addressed in BMBL4. At ABSL3, BMBL5 states that “double glove practices should be used when dictated by risk assessment”—a practice not mentioned in BMBL4. In the ABSL4 cabinet lab, BMBL5 states that “gloves must be worn to protect against breaks or tears in the cabinet gloves.” Likewise, in the
ABSL4 suit lab, “inner gloves must be worn to protect against breaks or tears in the outer suit gloves.”

BMBL4 does not address the disposal requirements for used gloves until ABSL3, in which it states that gloves should be “removed aseptically and autoclaved with other animal room wastes before disposal.” In BMBL5, a blanket statement is provided for glove disposal at ABSL1-4 which directs the user to “dispose of used gloves with other contaminated waste.” In the ABSL4 suit lab, BMBL5 requires that “inner gloves must be removed and discarded in the inner change room prior to the personal shower.” Likewise, BMBL5 states that the “decontamination of outer suit gloves is performed during operations to remove gross contamination and minimize further contamination of the laboratory.”

Eye, Face, and Respiratory Protection

The use of eye and face protection at ABSL1 in BMBL4 is recommended for persons having contact with non-human primates. This is echoed in BMBL5; however, BMBL5 also states that eye, face, and respiratory protection “should be used in rooms containing infected animals, as dictated by the risk assessment.” Likewise, “when conducting procedures that have the potential to create splashes or microorganisms or other hazardous materials,” protective eyewear must be used. BMBL5 also states for all animal biosafety levels that persons who wear contact lenses should also wear eye protection “when entering areas with potentially high concentrations of airborne particulates.”

The recommendations for eye and face protection at ABSL1 in BMBL4 become requirements at ABSL2 for “all personnel entering animal rooms that house non-human primates. BMBL5 builds upon this ABSL2 requirement, stating that eye and face protection must be used “for anticipated splashes/sprays from infectious or other hazardous materials and when the animal or microorganism must be handled outside the BSC or containment device.” BMBL5 states that at ABSL2, “respiratory protection is worn based on risk assessment.” Also, for ABSL2 and above, “eye and face protection must be disposed of with other contaminated laboratory waste or decontaminated before reuse.” Finally, in the ABSL4 cabinet lab, BMBL5 adds that “prescription eye glasses must be decontaminated before removal through the personal body shower.”

Sharps Handling

The authors of BMBL5 have elaborated upon BMBL4 guidance by providing more details on the precautions that must be taken when handling sharp items in the laboratory. These precautions are universal to all animal biosafety levels. Some specific BMBL5 precautions not mentioned in BMBL4 are listed below; however, the reader should consult the change matrix for a complete list.

- Disposable needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal.
- Used disposable needles must be carefully placed in puncture-resistant containers used for sharps disposal and placed as close to the work site as possible.
- Non-disposable sharps must be placed in a hard-walled container for transport to a processing area for decontamination, preferably by autoclaving.
- Broken glassware must not be handled directly. Instead, it must be removed using a brush and dustpan, tongs, or forceps.
- Equipment containing sharp edges and corners should be avoided.

BMBL5 also contains new guidance on other topics, such as the development of policies and procedures, the requirements for laboratory signage, reporting spills and incidents, and the conduct of specialized training; the change matrix can be sorted based on all of these criteria.

Summary

Although BMBL is not intended as a regulatory document, in some circumstances, compliance with BMBL has been mandated by legislature. For individuals tasked with ensuring that their animal facilities are in compliance with BMBL, keeping abreast of changing guidance poses a unique challenge since the revision summaries of rapidly and dramatically changing guidance documents are often scant or non-existent. The change matrix we have developed is intended to be a resource for biological safety officers, veterinarians, investigators, and others with a vested interest in biosafety to assist in the identification of the issues most pertinent to their facility or institution. The information contained herein does not necessarily represent the position of the federal government. Questions regarding the interpretation of BMBL5 should be addressed to its authors.

References


Decontamination of Personal Computers with Formaldehyde Gas
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Abstract

Personal computer boxes, keyboards, and monitors were placed in routine decontamination chambers and decontaminated with gaseous formaldehyde. Assessment of decontamination effectiveness by biological indicator data demonstrated that successful decontamination of internal spaces was achieved without prior dismantling of the computer components.

Introduction

Formaldehyde gas has been used successfully for decades to decontaminate laboratories, biosafety cabinets, laboratory equipment, and animal rooms. Since the initial report (Taylor et al., 1969), the critical values for temperature, time, relative humidity, and gas concentration have been refined (Ackland et al., 1980; Songer et al., 1972).

Lach (1990) showed that maintenance of uniform gas concentration levels within spaces to be decontaminated was essential to avoid polymerisation of the formaldehyde and to achieve uniform activity. Although formaldehyde gas has some ability to penetrate crevices and porous materials (Hoffman & Spiner, 1970; Spicher & Borchers, 1983), some reports contend that formaldehyde diffuses poorly (Cheney & Collins, 1995) and is unreliable for decontamination of surfaces that are porous or not well exposed (Phillips, 1977).

The overall reliability and effectiveness of the method for decontamination of laboratory spaces, biosafety cabinets, and filter housings were demonstrated in a long-term study by Abraham, Le Blanc Smith, and Nguyen (1997). The present study shows that formaldehyde gas is able to penetrate inside the covers of conventional personal computers, keyboards, and monitors to completely decontaminate biological indicator spore strips.

Method

The external casings of the monitor, keyboard, and computer box of a standard desktop personal computer were removed. Strips containing 10^4 spores of Geobacillus stearothermophilus (grown from American Type Culture Collection # 7953) were placed in various positions inside the monitor, keyboard, and computer box casings prior to reassembly.

Formaldehyde gas (5g m^-3) was generated in a 27 m^3 airlock as described previously (Abraham et al., 1997). An electric fan was placed at one corner position of the airlock to circulate the gases but was not directed specifically at any computer component.

Decontamination proceeded for 15 hours at an ambient temperature of 21°C, after which the formaldehyde was neutralized by ammonia gas as described previously (Abraham et al., 1997). After purging the room, the dust covers were again removed from the computer components and the spore strips recovered and incubated in bacterial growth medium for 7 days at 56°C. An unexposed positive control spore strip was incubated in parallel and growth was determined by cloudiness of the medium.

Results

Four similar experiments were done in which biological spore strip indicators (G. stearothermophilus) were placed in various positions inside the personal computer monitor, keyboard, and control box during a standard gaseous formaldehyde decontamination cycle. In the particular experiment shown in the Figures, 12 spore strips were placed in relatively inaccessible positions inside the casings of a computer control box and monitor. After the decontamination cycle, the external casings were removed and spore strips (#1 and #2) were recovered from beneath the power supply (Figure 1) and behind the hard drive (Figure 2).

Spore strips #7 and #8 were recovered from inside the LCD screen inner cover of the monitor (Figure 3). The 12 indicator spore strips were placed in separate culture tubes and incubated at 56°C for 7 days. None of the test culture tubes contained any viable spores, determined by lack of bacterial growth in the indicator medium. As expected, the control tube showed bacterial growth after 24 hours. Three other experiments where spore strips were placed in other positions within computer components including the keyboard produced identical results.

Discussion

Formaldehyde gas is known to be a very effective decontaminant for clean surfaces and room spaces (Abraham et al., 1997; Ackland et al., 1980; Taylor et al., 1969). Hoffman & Spiner (1970) and Spicher & Borchers (1983) showed formaldehyde gas had a reasonable ability to penetrate materials and crevices and...
Figure 1
The position of a test spore strip under the power supply of a computer control box prior to reassembly and formaldehyde decontamination.

Figure 2
The position of a test spore strip behind the hard drive of a computer control box prior to reassembly and formaldehyde decontamination.
to decontaminate such surfaces. In contrast, the need to disperse formaldehyde gas thoroughly to establish uniform concentrations and to avoid condensation problems (Lach, 1990) has been reported.

Personal computers and laptops are critical tools in biocontainment laboratories, and their removal for repair or replacement is a frequent requirement. An effective method for decontamination without damage to electronic equipment is highly desirable. To our knowledge, no reports demonstrating the efficacy of formaldehyde gas for the decontamination of personal computers currently exist. The validity of the procedure is important in view of the contrasting reports that the gas must be effectively dispersed (Lach, 1990) and that formaldehyde can penetrate crevices (Spicher & Borchers, 1983). In addition, it is important to know if effective decontamination can be achieved without removal of external dust casings from various components of personal computers.

To provide greater decontamination certainty, the outer covers of personal computer components were removed and spore strips placed specifically in places where complete formaldehyde gas penetration was considered less likely. The results show that effective decontamination, measured by inactivation of very resistant G. stearothermophilus spores, was achieved in all experiments. The biological indicator chosen for this work was $10^4$ spores/strip as the internal spaces of electronic equipment were not expected to be heavily contaminated with pathogens. While a 6-log decontamination is considered usual to prove sterilization, a 4-log decontamination of the very resistant thermophile was considered adequate for this particular application, as pathogens of concern are known to be very much less resistant to decontamination by formaldehyde (Abraham et al., 1997).

This general procedure has been used perhaps hundreds of times for more than 10 years to decontaminate personal computers at this institute without any detectable damage or interference with the electronic function of the computers. However, biological monitoring of the effectiveness of the decontamination was usually done only in the decontamination chamber itself and not within each computer component; therefore, such data are less detailed than those described here.

This work demonstrates that gaseous fumigation with formaldehyde using the conditions described allows personal computers to be completely decontaminated prior to removal from microbiological containment laboratories without the need to disassemble the components.

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References


Review of the Emory University Applied Laboratory Emergency Response Training (ALERT) Program

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Abstract

With an increased number of newly constructed high-containment laboratories and staff working in these facilities, the risk for emergency situations has increased, as has the need for systematic training of the emergency responders who assist during an emergency at a high-containment laboratory. With support from the National Institutes of Allergy and Infectious Diseases (NIAID) and the Southeast Regional Center of Excellence for Emerging Infections and Biodefense (SERCEB), Emory University developed the Applied Laboratory Emergency Response Training (ALERT) Program. In close collaboration with the City of Atlanta Department of Fire Rescue, Emergency Medical Service (EMS), and other emergency medicine professionals, staff at the Rollins School of Public Health developed a comprehensive training program aimed at bridging the gap between high-containment laboratory staff and emergency responders. Since March 2006, over 750 emergency responders have participated in the ALERT Program. Over 95% of ALERT Program participants demonstrated an increase in knowledge, with the average excellence rating for the ALERT Program at 4.45 (on a scale of 1=Poor and 5=Excellent). Additionally, the perception of risk that high-containment laboratories bring to the public, staff working in the laboratory, staff working outside the laboratory, and emergency responders was individually evaluated, with significant reductions in the ratings of risk occurring among individuals who had attended the ALERT Program. Long-term evaluation of the participants’ knowledge retention, risk perception, as well as implementation in other locations outside of Atlanta, Georgia, is still needed.

Background

The safety of high-containment biological laboratories is garnering increased public scrutiny and professional attention, particularly with respect to emergency response in these laboratories. In October 2007, the United States Government Accountability Office released a report titled, “High-Containment Biosafety Laboratories: Preliminary Observations on the Oversight of Proliferation of BSL-3 and BSL-4 Laboratories in the United States” (U.S. Government Accountability Office, 2007). Several findings were discussed in this report, including the increased number of high-containment laboratories and the need for strategic planning with emergency responders. Also released in 2007, the fifth edition of the National Institutes of Health/Centers for Disease Control...
and Prevention’s *Biosafety in Microbiological and Biomedical Laboratories* (BMBL) (U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, & National Institutes of Health, 2007) discusses the need to provide police, fire, and emergency responders with information regarding biological risks and plans for handling emergency situations. In addition, the Select Agent Program Rules and Regulations (CFR 73.14) (U.S. Department of Health and Human Services, Office of the Inspector General, 2005) states that all organizations working with select agents must plan and coordinate with emergency responders. If emergencies require medical attention, the responsible organization(s) should develop and provide training on procedures for medical evacuation and rescue. The above issues call for a partnership between laboratory and emergency response professionals.

Unfortunately, individuals who are unfamiliar with biological agents may feel unsafe and unsure about what they should do when responding to incidents in high-containment laboratory environments. Concerned community members are asking about emergency situations and want to be reassured that containment is a consideration when a medical or other emergency (e.g., fire) response occurs. There is a need to develop and implement effective partnerships with emergency responders, and these efforts should be communicated to the public at large.

Effective partnership with emergency responders goes beyond laboratory tours and includes emergency response training during which laboratory experts work with first responders to develop a best-practice approach to medical emergency situations. Past emergency situations, exercises, and training experiences clearly demonstrate the gap between having a plan and successfully performing the plan during an emergency event. First responders must understand high-containment laboratory operations, and this awareness can be provided through lectures and tours of laboratory facilities. Coordination between first responders and laboratory personnel is greatly needed for effective response and evacuation procedures.

**Method**

The Applied Laboratory Emergency Response Training (ALERT) Program began in March 2006. Several representatives from the City of Atlanta Department of Fire Rescue, EMS, and emergency medicine came together to discuss the development and delivery of a comprehensive training program aimed at bridging the gap between high-containment laboratory staff and emergency responders. Existing gaps in knowledge among first responders were identified through key informant interviews. These gaps included the lack of high-containment laboratory awareness surrounding equipment, fire suppression systems, access, differences between exposure and infection, primary controls of biosafety, medical emergency procedures, emergency decontamination procedures, explosions, and incident command system (operations structure). Once the training needs were identified, an agenda was developed based on the time allocated for training and the number of emergency response personnel needing training. Learning objectives were identified, participant manuals were developed, and 5 risk perception questions plus a 15-question written examination were designed and delivered prior to and after completion of the course.

The goal of the ALERT training program is to increase first responder awareness for three specific areas. These include:

**Introduction to the High-containment Laboratory Environment**

First responders learn about BSL-3 and BSL-4 laboratories, laboratory equipment (e.g., incubators, biosafety cabinets, freezers, and animal cages), laboratory redundancy (i.e., breathing air, HVAC systems, liquid decontamination, and generators), fire suppression systems, and laboratory security (Figures 1-5).

**Emergency Operations in High-containment Laboratories**

First responders learn about pathogen transmission (and the difference between exposure and infection), primary controls which laboratories have in place for the protection of staff and community, laboratory chain of command, medical emergency procedures, and emergency evacuation procedures (Figures 6-10). Most importantly, first responders are taught that processes in different laboratories will differ based on the agents being worked with and the existing engineering, procedural, personal protective equipment, and administrative controls in place.

**Building Emergencies in High-containment Laboratories**

First responders learn about levels of engagement (for first responders), building emergencies, explosions and breaches of containment, life-threatening emergency decontamination processes, systems failures, and structure breaching (Figures 11-15).

Content for the training program was developed utilizing subject matter experts in biosafety, emergency response, and behavioral training. Together, these experts developed materials appropriate for first responders. Additionally, working with medical emergency specialists, the Emory University training program staff developed medical emergency evacuation recommendations for unconscious individuals in high-containment laboratory environments (Figure 9).

Once materials were developed and ready to deliver,
BSL3 and BSL4 Laboratories

BSL3 laboratories are designed for pathogens which are known to be spread through the aerosol route.

BSL4 laboratories are designed for pathogens that have limited or unavailable treatment. BSL4 laboratories may be used to identify unknown pathogens.

Both images produced by CIH2A for the World Health Organization’s Laboratory Biosafety Manual.

There are many engineering controls in place for BSL3 and BSL4 laboratories. One of the most critical controls is directional airflow.

Directional airflow in BSL3 and BSL4 laboratories means air flows from the cleanest part of the building to the dirtiest. Maintaining directional airflow is critical and keeps pathogens contained within the laboratory environment.

If a BSL3 or BSL4 laboratory loses directional airflow, an alarm system will sound and work in the laboratory will end until the problem has been fixed.

Most BSL3 laboratories have HEPA filtered exhaust systems and have to be sealable. All BSL4 laboratories must have a HEPA filter on supply systems, two HEPA filters on exhaust systems and are leak proof. Additionally, all BSL4 laboratories must have locked doors systems (ensuring only one door can be opened at one time) and interlocked exhaust and supply air systems (ensuring that if the exhaust fans shut down – the supply fans shut down keeping the room from going positive).

Key Points:
Directional airflow ensures contaminated air does not leave the laboratory environment – except through the designated HEPA filtered exhaust systems.

BSL3 and BSL4 Laboratory Equipment

Biosafety Cabinets:
Area where pathogens are manipulated.
Biosafety Cabinets (BSCs) provide personnel, product, and environmental protection.

Animal Cages:
Area where research animals are kept.
Depending on the stage of research, these animals may be healthy or infected with dangerous pathogens.

Incubators:
Area where pathogens are grown.
Incubators provide optimal environment (temperature and humidity) for the growth of pathogens.

Freezers:
Area where pathogens are stored.
Freezers keep pathogens frozen and minimizes the risk of storing pathogens in a laboratory.

Key Points:
Biosafety cabinets, animal cages, incubators, and freezers provide laboratory containment. When responding to an emergency situation, first responders should ensure laboratory equipment is not damaged while understanding the role of critical laboratory equipment.
Laboratory Redundancy

There are few required redundancy systems in BSL3 laboratories. The design of the BSL3 laboratory and work being done in the BSL3 laboratory may require the installation of redundant systems.

In order to ensure the safe and uninterrupted operation of the BSL4 laboratory, several redundant systems are required by the current Centers for Disease Control and Prevention (CDC)/National Institutes of Health (NIH) guidelines. These include redundancy for:

- Breathing air (for suite laboratories)
- Electrical systems
- HVAC systems
- Liquid decontamination systems

These systems are required to ensure the safety of the staff in the laboratory and for the protection of the environment.

Key Points:
- Emergency situations at typical building sites may require the shut-down of HVAC and electrical systems. Leaders from emergency response organizations must consult with BSL4 laboratory leaders to ensure critical containment systems are not interrupted.

Fire Suppression Systems

BSL3 and BSL4 laboratories typically have fire suppression systems. Most of these suppression systems utilize water or may shut down HVAC systems (sealing containment spaces) and starving the fire of oxygen if temperatures within a contained space reach a pre-specified level.

Water suppression systems may cause serious complications in BSL4 laboratories (waste water treatment and equipment loss). More sophisticated systems such as Halon gas, misting systems, or waterless gas systems (Heptafuoropropane) may be used. Heptafuoropropane is a replacement product for the ozone damaging properties of Halon gas. Carbon Dioxide (CO2) fire suppression systems are not used in laboratories because it replaces oxygen and could suffocate laboratory workers.

Fire suppression systems are activated by a sudden rise in temperature. Once activated, laboratory HVAC systems may shut down to ensure fire suppression and laboratory containment. After a fire has been contained, a biological risk assessment should be made before entry into the laboratory.

Key Points:
- Depending on the laboratory fire suppression system, HVAC systems may respond differently from one laboratory to another. First responders should discuss fire suppression systems and ask about the function of HVAC systems during a laboratory fire alarm event.
High-Containment Laboratory Security Systems

Security at a BSL4 laboratory is taken very seriously. By law, all BSL4 laboratories are required to maintain and facilitate a security plan. This plan includes:

- Securing the laboratory environment
- FBI background checks
- Specified PIN numbers for laboratory entry and exit
- Training and observation of all staff and guests
- Extensive camera surveillance
- On ground 24 hour surveillance
- Locked freezers (with PIN numbers required)
- Inventoried pathogens
- Inventoried animals

These factors could be a serious barrier for emergency responders attempting to gain access to a BSL4 laboratory during an emergency situation. Partnerships between emergency responders and laboratory leaders are needed to ensure effective response strategies are successfully implemented.

Key Points:
First responders may need immediate access to laboratory environments during emergency situations. The multiple security systems may prevent easy access. Therefore, partnerships between first responders and laboratory leaders is needed to ensure effective emergency response.

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Chain of Infection – Exposure vs. Infection

Exposure

When emergency responders go into a laboratory – pathogens don’t come alive and begin moving towards people. In other words, getting sick is not as easy as people think it is (thank goodness).

In order for an individual to become ill, several things must occur.

- First, the pathogen must escape from somewhere (sneeze, insect, secretions, excretions).
- Second, the pathogen must be spread (droplets, aerosols, blood).
- Third, the pathogen must be able to enter the individual (inoculation, ingestion, contact, respiratory).
- Fourth, the pathogen must find a susceptible host (animals, humans, compromised immune systems).
- Finally, the pathogen must make it through the incubation period – time between exposure and illness (recognition, prophylaxis, social distancing, quarantine).

Emergency responders wearing proper personal protective equipment close all routes of entry for pathogens. In some cases, vaccinations can be given to minimize the likelihood of infection should an exposure occur.

Key Points:
If an exposure occurs, there is a period of time to start treatment of take proactive measurements to minimize risk of infection. Exposure does not mean infection!
Four Primary Controls of Biosafety

When a laboratory exposure occurs – it is the result of the failure of all four primary controls.

Staff working in high-containment laboratories are protected by the four primary controls of biosafety. Each primary control offers a different type of protection and together form a sound strategy for workforce protection.

Laboratories are typically safe environments unless an accident has occurred. Each control provides staff several activities which can be utilized to minimize the likelihood of an accident and maximize effective response when an accident does occur.

For example, if there was a large spill in the laboratory:

1. The engineering controls would clean the air;
2. The personal protective equipment would protect the routes of entry;
3. The training and vaccinations (administrative control) would ensure appropriate response and minimize infection; and
4. The standard operating procedures would provide a safe guideline for cleaning and responding to the spill.

Key Points:
When an laboratory exposure occurs – it is a failure of all four primary controls in biosafety. When an engineering control fails, staff are trained, protected with PPE, and have standard operating procedures to follow.

Laboratory Chain of Command

Emergency responders utilize the Incident Command System (ICS) during emergency situations. To assist the Incident Commander, the diagram (left) provides a general chain of command for the typical laboratory organization. Each laboratory may have a unique structure which addresses the individual challenges of the specific laboratory.

During an emergency response at a high-containment laboratory, emergency responders are usually greeted by security officials. The Incident Commander should request representatives from the Science, Facility, Safety, and Animal Care offices. Information from these individuals will provide a complete picture of potential risks in the laboratory environment.

For example, the Science Director will be able to discuss the pathogens, the Facility Director will offer advice on the structure and functioning of critical systems, the Safety Director will identify items needed to protect emergency responders, and Animal Care Director will discuss risk associated with any animals being worked with in the laboratory environment.

Key Points:
Depending on the size and leadership of the organization – the laboratory chain of command may vary from one organization to another. Emergency responders should request a laboratory chain of command prior to emergency situations.
Medical Emergencies in High-Containment Laboratories

This medical model was developed by containment and medical experts and is a strategy which is taught in the Emory University Science and Safety and Onsite BSL3 and BSL4 training programs.

High-Containment laboratories are isolated areas and require substantial time for decontamination processes. The American Heart Association reports that brain death begins four to six minutes after someone experiences cardiac arrest if no CPR and defibrillation occurs during that time. High-containment laboratory staff should have reasonable access to defibrillators, allowing them to respond in less than five minutes should cardiac arrest occur.

It is important to distinguish between life-saving and life-sustaining strategies. If someone is unconscious in the laboratory and defibrillators are not available, laboratory staff should focus on decontaminating the unconscious staff so when emergency responders arrive – immediate care can be provided. If laboratory staff have access to a defibrillator (lifesaving), they are advised to check breathing and if the unconscious individual is not breathing, facilitate the defibrillation process.

Key Points:
Emergency responders may not work with individuals who could be contaminated by laboratory pathogens.

Therefore, emergency responders should encourage laboratory leaders to develop a strategy which increases the likelihood a quality care for unconscious individuals.

Emergency Evacuation in High-Containment Laboratories

When emergency evacuation in high-containment laboratories is required, it can be broken into three emergency evacuation categories.

Red: Rapid Evacuation
Containment is not maintained – Risk to life was substantial.

Green: Normal Evacuation
Emergency occurs immediately when a fire or critical support system alarm occurs. Laboratory staff are asked to secure their work (pathogens and animals) and exit the laboratory using normal decontamination processes.

Yellow: Modified Evacuation
Emergency occurs immediately when there is an unconscious or injured staff prohibiting the abilities of staff to adhere to normal evacuation procedures. Laboratory staff are asked to immediately evacuate using modified decontamination processes.

Red: Rapid Evacuation
Red evacuation occurs immediately when life is at risk. Laboratory staff are asked to immediately evacuate the laboratory using whatever means necessary.

Key Points:
Emergency responders should ask laboratory leadership about strategies for each emergency evacuation category. Actions plans with emergency responders and laboratory leadership will need to be develop for both yellow and red emergency evacuation categories.
Levels of Engagement (Emergency Situations)

Laboratory emergency situations can be broken into the following four categories:

1. Catastrophic:
   - Major engagement of emergency responders.

2. Major:
   - Significant engagement of emergency responders.

3. Significant:
   - Minimal engagement of emergency responders.

4. Minor:
   - Little to no engagement of emergency responders.

Typically, emergency responders should not have to access laboratory environments. However, during major and catastrophic situations, emergency responders may be needed. In these cases, emergency responders should be prepared to rescue and provide life-saving strategies.

Following the facilitation of these strategies, containing and mitigating the situation with proper decontamination of personnel and equipment is needed.

Key Points:
- There are clear priorities when working in high-containment laboratories. Life is the top priority, followed by containment and decontamination. Containment is never more important than life.

Building Emergencies (Probability)

Laboratories are designed for containment of pathogens, protection of laboratory workers and the surrounding community. When an emergency occurs in a high-containment laboratory, emergency responders may need to determine if a breach in containment has occurred.

If no breach in containment occurs, risk of exposure to pathogens is low. However, if a breach in containment occurs risk to pathogens increases. This risk can be minimized by wearing proper personal protective equipment (PPE).

The figure (shown on left-side) shows a list of emergencies which may occur in a high-containment laboratory. Typically, most laboratory building emergencies are successfully handled by laboratory staff and maintenance personnel.

Emergency responders will be needed if a fire, explosion, medical emergency or other catastrophic event occurs.

Key Points:
- Building emergencies do occur. However, most building emergencies do not cause a breach of containment and are handled by laboratory staff. If emergency responders are needed, risks can be minimized by wearing respiratory personal protective equipment and properly decontaminating following the entry of any laboratory with a breach of containment.
Explosions and Breach of Containment

In BSL3 and BSL4 laboratories there are multiple levels of containment in which all must be breached for the loss of containment to occur.

Laboratory explosions accompanied by fire can be serious events leading to injuries and loss of life. Additionally, emergency responders may face the risk of exposure to pathogens.

High-containment laboratories have primary and secondary containment features. The laboratory is considered secondary containment (because it houses pathogens). The biosafety cabinet, animal cages, freezers, and incubators are considered primary containment (because this is where the pathogens are stored, worked with, or grown). If the explosion is contained inside the laboratory, escape of pathogens is most likely minimal. However, if laboratory containment (secondary) and equipment (primary) have been breached or damaged, the risk increases.

Emergency responders must be able to recognize breaches in primary and secondary containment. In some laboratories, infected animals may be present. Animals are housed in cages and their behavior may be unpredictable. Emergency responders MUST NOT attempt to pet or free these animals. Animal bites have led to infection among animal staff and laboratory workers.

Key Points:
Emergency responders must make sure their actions do not lead to a breach of primary or secondary containment. Recognizing a containment breach has occurred is critical for minimizing risk of exposures to pathogens during emergency situations.

Life-Threatening Emergency Decontamination

BSL3 laboratories are typically required to have standard operating procedures in place and training of staff for life-threatening emergency decontamination processes. Depending on the pathogen being researched, the level of decontamination required before leaving the laboratory could vary.

BSL4 laboratories operating with positive pressure suits require more specific decontamination procedures. Typically, positive pressure suits are worn by laboratory staff and require a chemical shower to effectively decontaminate the suit. After exiting the chemical shower a full body shower including washing of hair is required.

Once the decontamination process is completed, emergency responders may need to provide treatment and transportation to a medical facility. However, when life is at risk – laboratory staff are told to evacuate immediately (leading to a breach of containment). When this occurs, a special decontamination process (similar to chemical decontamination) is needed.

Key Points:
The goal of laboratory staff during emergency evacuations from high-containment laboratories is to ensure containment. During a life-threatening emergency, life is the priority and therefore laboratory staff may need the assistance of emergency responders for proper decontamination processes.
first responders from the City of Atlanta Department of Fire Rescue and EMS were invited to attend the 3-hour Emory University ALERT Program. Participants were split into three groups and rotated every hour into one of three training modules. Each participant completed a pre- and post-course assessment evaluating the effectiveness of the training program.

Results and Discussion

In October 2006, 228 first responders attended the ALERT Program and completed pre- and post-tests. Participants' self-reported job titles included fire personnel, paramedics, and battalion chiefs from the Atlanta local emergency response agencies. In addition to participant performance, evaluations of faculty and course content were gathered to determine best-practice strategies for the delivery of biosafety information tailored to first responders.

All participants were evaluated twice using a 15-question true or false examination. The pre-assessment mean score for course participants was 51%. By the end of the course, participants achieved a mean score of 91%. Over 87% of participants scored higher than 85% on the final examination. Performance levels on the 15 questions increased. The instructors and course were rated using a three-point Likert scale (Hulley & Cumnings, 1988) (i.e., excellent, good, poor). Over 74% rated the course as “excellent,” with less than 1% rating the course as “poor.”

In November 2008 and in collaboration with the Boston Public Health Commission, staff at Emory University trained over 400 first responders in the National Emerging Infectious Diseases Laboratory (NEIDL) at Boston University. Data are currently being analyzed; however, similar trends to those mentioned above are apparent. Additionally, significant reductions in risk perceptions of high-containment laboratories are occurring among participants in the ALERT Program.

This program demonstrates that a brief, 3-hour training opportunity increased first responders' awareness and reduced risk perceptions specific to high-containment laboratories. Once first responders were informed about biosafety controls and the world of high-containment laboratories, they were able to relate these controls to those they are trained to use in the emergency response world. Training and education of emergency responders may contribute to a reduction in the apprehension the general public may have about high-containment laboratories.

On June 18, 2007, nine fire fighters in Charleston, South Carolina lost their lives as a result of responding to a furniture store fire (Dewan, 2007). A fire starving for oxygen in a contained room (i.e., a sealed room) caused a very large explosion when the door was opened and...
oxygen was allowed to enter the room. If an oxygen-starved fire was occurring in a contained room within a high-containment laboratory and HVAC systems were shut down, air pressure indicators outside laboratories may display a negative pressure reading in the room as a result of a starving fire. If the door was opened under specific circumstances, both laboratory staff and emergency responders could be severely injured. Though the likelihood of this event has been minimized by existing guidelines and recommendations, the facts about the design of high-containment laboratories serve as an opportunity to express concern for fire personnel. Expressing this concern is needed for successful partnership-building.

Managers of containment and high-containment laboratories must work with their first responders to identify access routes to ensure that first responders quickly gain access to the site of the emergency. At the same time, responsibilities for the laboratory staff must be delineated to ensure first responders are not placed at additional risk from the laboratory environment. This requires joint planning and periodic exercise to improve the chance of a successful outcome.

Medical emergencies will require careful coordination between laboratory staff and first responders. The time between the reporting of a laboratory emergency and the arrival of emergency responders, and what actions the laboratory staff must take during this time, have to be addressed. Communication equipment must notify individuals outside the laboratory that emergency assistance should be considered. Panic buttons, surveillance, and intercom systems should be available to staff in high-containment laboratories if an incident requires immediate assistance. Distinctions between life-saving and life-sustaining technologies and strategies should be noted and included in all medical emergency response plans and exercises. Physical emergencies (e.g., fire, explosion) require coordination among a larger number of interested parties. In addition to first responders, facility safety personnel, laboratory personnel, and physical plant personnel must be included in planning discussions and exercise events.

Laboratory leaders must begin developing partnerships with local responders and consider the inclusion of first responders in emergency exercises. The results of this course demonstrate a desire for partnership development by the emergency responders, as well as the need for the development and delivery of laboratory training tailored and designed for emergency responders. The results also indicate that a 3-hour training session in a high-containment laboratory environment decreased risk perception and increased first responder awareness of the safety inherent in the design and operations of high-containment laboratories. Further development and evaluation of emergency responder training are needed.

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**CDC Guideline for Disinfection and Sterilization in Healthcare Facilities, 2008**

A Three-Year Experience to Implement Laboratory Biosafety Regulations in Taiwan

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Abstract

In 2003, Taiwan experienced a laboratory-acquired infection (LAI) of Severe Acute Respiratory Syndrome (SARS). To prevent similar LAIs from happening again, the Centers for Disease Control of Taiwan (Taiwan CDC) established a set of regulations for laboratory biological safety. The “Regulations Governing Management of Infectious Biological Materials and Collection of Specimens from Patients of Communicable Diseases” was promulgated in September 2005 to provide a legal basis for the control of infectious biological materials and management of related laboratory biosafety issues. This set of regulations has three core principles: (1) self-management, (2) autonomous notification, and (3) periodic assessment. With nearly three years since its implementation, this set of regulations has been duly modified to become easier for laboratories to follow. As long as industry, government, and academia continue their efforts and cooperate to design, build, and maintain safe biological laboratories, as well as install a culture of safe laboratory practices, the laboratory-acquired infection rates in Taiwan will be minimized or even eliminated.

A Retrospective View of Laboratory-acquired Infections in Taiwan after the SARS Outbreak in 2003

1. Laboratory-associated Infection of Dengue Fever: In April 2004, a graduate student at a university in central Taiwan, who was performing research on genes responsible for anti-bacterial proteins in the mosquito species Armigeres subalbatus, suddenly became infected with the local Type 1 Dengue Fever. The Taiwan CDC determined that the mosquito-rearing area in his laboratory was not properly designed to effect a complete separation of the infected, virus-bearing mosquitoes from the healthy ones. The entrance to the mosquito-handling room was also not equipped with double screening in order to prevent any Dengue virus-borne mosquitoes from escaping from the room. This made it possible for the mosquitoes to transmit Dengue Fever to the laboratory personnel. After this incident was revealed, not only did the Taiwan CDC instruct this laboratory to immediately halt all related empirical studies, but it also developed and disseminated the publication, Guidelines for Laboratory Management and Operations on Invertebrate Animals, to all similar laboratories in Taiwan.

2. Laboratory-associated Infection of Shigellosis: In August 2006, a graduate student in a university in central Taiwan who was working with Shigella in his research fell victim to Shigellosis. An inspection of the incident by the health authority suggested that it may have resulted from two possibilities. First, the student may have had little knowledge of the hazards associated with his work or how to minimize the risks incurred by these hazards by using good laboratory practice. Second, the design of the engineering controls in the laboratory may have been inappropriate. The Taiwan CDC thus provided the following list of recommendations to improve laboratory safety in this laboratory:

- All operations and cultivation of Shigella should be conducted in a specific area of the laboratory.
- The manual sliding door inside the laboratory should be automated.
- The hand-washing basin in the working area should be foot operated.
- The laboratory workers should be trained to practice good microbiological procedures.

After the laboratory complied and implemented the necessary improvements and training as recommended, the Biosafety Committee of this university in a documented report to the Taiwan CDC, reassessed this laboratory and granted it permission to resume its work.

The Legislation for Laboratory Biosafety

Long before the occurrence of the laboratory infection of SARS, the Taiwan CDC had already recognized the importance of instituting proper management practices for the use of infectious materials, as well as prudent laboratory and biological safety principles. The laboratory-acquired SARS incident highlighted the necessity of regulating research performed with infectious materials; therefore, an entirely new set of regulations entitled “Regulations Governing Management of Infectious Biological Materials and Collection of Specimens from Patients of Communicable Diseases,” was developed and introduced on September 26, 2005. This law came into effect six months later on March 26, 2006. These Regulations contain 19 Articles whose core principles are self-management, autonomous notification, and regular assessment of laboratory activities.
Self-management

Any installation unit using or storing Risk Group (RG) 2 and above infectious biomaterials shall have an authorized person or committee responsible (such as a biosafety committee or biosafety officer) for managing and supervising the laboratory biological safety issues.

Autonomous Notification

In the event of laboratory incidents involving infectious agents, the installation units shall immediately report this event to the Taiwan CDC. Any modifications (new laboratory additions to the agent inventory, changes in experimental protocol, destruction of organisms, or sharing with collaborators) of RG3 and above infectious biological materials may be made only after they are approved in advance by the Taiwan CDC.

Regular Laboratory Assessments

The Taiwan CDC shall have an annual inspection of each BSL-3 laboratory and above in operation so as to review the ongoing operations and management of each laboratory.

Status Quo of Laboratory Biosafety in Taiwan

From experiences acquired during the resolution of the above-mentioned laboratory infection incidents, the Taiwan CDC realized that either the involved laboratories were not operating at the proper biosafety level, or that the workers were not properly trained to work with the organisms in the laboratory. Before 2006, there was no compulsory requirement for laboratories storing and/or using RG2 and above infectious biological materials to establish any biosafety-managing programs; however, the new “Regulations Governing Management of Infectious Biological Materials and Collection of Specimens from Patients of Communicable Diseases” clearly state that all laboratories storing or utilizing RG2 and above infectious biomaterials must have a biosafety committee or a biosafety officer, depending on the size of the affiliated laboratory (i.e., if the operating staff has five or more members, a committee shall be established; but if the number is less than five, then a designated biosafety officer shall be responsible for managing the laboratory biosafety program). By the end of 2007, 291 laboratory units had established their biosafety committees, another 62 units had appointed their biosafety officers, and all of them had completed the required registration with the Taiwan CDC.

Ever since the implementation of this set of regulations, whenever a laboratory unit introduces or changes an experimental protocol for a BSL-2 laboratory or higher, or renovates or constructs a new laboratory, it must first get approval from the unit’s biosafety committee or biosafety officer. If the laboratory intends to collaborate with another laboratory on a research project involving RG2 or higher organisms, then prior approval has to be granted by the biosafety committee or officer of both laboratories. For any status change or modification of RG3 and above infectious biomaterials, a report and approval by the Taiwan CDC are required in addition to approval by the biosafety committees. In 2007, the CDC received notification of 57 cases of status changes for RG3 and above infectious biomaterials. Through this piece of legislation, the managing of RG2 and above infectious biomaterials in Taiwan, including the transfer of biological materials, is now a much safer established practice.

The fact that the SARS laboratory-acquired infection incident took place in Taiwan had cast much doubt as to the effectiveness of the Taiwan CDC to oversee the safe management of laboratories in general and that of laboratories designated as BSL-3 and above in particular. Before the year 2003, Taiwan had only three BSL-3 laboratories and one BSL-4 laboratory; however, at the end of 2007, there were 21 BSL-3 and above laboratories in Taiwan, and 16 of them had passed inspection by the Taiwan CDC and begun operation. After each laboratory opening, the Taiwan CDC would conduct an annual on-site inspection. Any deficiencies spotted during the inspection would be corrected or improved by the unit within two months, and those deficiencies would then be reevaluated at the next inspection. By implementing this continuous inspection process, the laboratory would be reviewed and improved continuously with regard to biosafety issues.

Revision of Regulations Under the New Act of 2007

Although the original “Regulations Governing Management of Infectious Biological Materials and Collection of Specimens from Patients of Communicable Diseases” came into force less than two years ago, industry, government, and academic professionals in various related fields have already voiced different views and opinions. A new amended version of its parent law, the “Communicable Disease Control Act,” was promulgated on July 18, 2007, so a revision of this subsidiary law, scheduled to take effect by the end 2008, has also been worked on at the Taiwan CDC with the following intended changes:

1. The title of the Regulations will be revised and changed to “Regulations Governing Management of Infectious Biomaterials and Laboratories.”
2. The original biosafety management regulations combined the risk group of a biological agent with the appropriate laboratory biosafety level (i.e., an RG2 disease-causing pathogen shall be operated in a BSL-2 laboratory and a RG3 disease-causing pathogen shall be operated in a BSL-3 laboratory). However, the risk group of
an infectious biomaterial does NOT always necessitate assignment to a specific biosafety protection level. Rather, the risk group should relate to the specific risks of the operation being performed (such as large-scale cultivation, PCR, or microscopic diagnosis) and whether these manipulations of the organism present sufficient risk of exposure to warrant assignment to a given biosafety level. Thus, the context is to be revised to reflect this management change (Table 1).

3. Over the past decade, Taiwan has focused much of its energy on learning about and creating innovative business ventures in order to establish an intellectual type of entrepreneurial society. One major approach to this grand scheme was to promote the operation of incubation centers for various technologies and skills. Currently, the majority of such centers are located on university campuses. Since such biological/technology research and development projects carried out at those on-campus centers may be entirely or partly financed and co-sponsored by outside constituents and may often use agents in RG2 and above, an amendment of the Regulations was added to address these outside partners in a given laboratory unit. The amendment states that should non-facility members work with infectious materials within the facility, those users and their operations are strictly subject to the management jurisdiction of the laboratory unit.

Based on the requirement for biosecurity, the original text of the Regulations will now include that the inventory of all RG2 and above infectious biomaterials at the laboratory should be accounted for periodically. Any discrepancies found during the inventory process should be reported to the unit’s biosafety committee or designated biosafety officer. Discrepancies involving RG3 and above infectious biomaterials must be reported immediately to the Taiwan CDC as well as to the local health department.

**Conclusion**

Along with continuous biosafety education as well as experiences dealing with laboratory infection incidents, Taiwanese laboratory workers have gradually become more conscious of and cognizant about laboratory biosafety. Some of the positive changes that have occurred as a consequence include:

1. **Negligence of individual vs. responsibility of the laboratory unit:** After the 2003 SARS laboratory infection incident, the news media appeared to focus on the individual involved in the incident. Little attention was given to whether there was any negligence in the management of the laboratory or the institution, or if either should be held responsible. Similarly, in the 2004 Dengue Fever laboratory infection case, only the laboratory Principal Investigator was interviewed by the Taiwan CDC. It was interesting that the university already had a biosafety committee, but the committee did not investigate the exposure. Now, however, the Regulations implemented in 2006 stipulate that the biosafety organization of an installation unit should bear the burden of managing and supervising all the biosafety concerns at the laboratory. Therefore, when the Shigellosis laboratory infection occurred later that year, the biosafety committee of that university actively participated in the investigation and discussion, demonstrating that the biosafety committee of this unit organization had begun to operate effectively.

**Table 1**

A comparison of laboratories of various biosafety levels needed to operate with Level 2 and above infectious biomaterials.

<table>
<thead>
<tr>
<th>Risk Level</th>
<th>Operation</th>
<th>Infectious Biological Materials</th>
<th>Inactivated Biomaterial (b)</th>
<th>Noninfectious Biomaterial (c)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Cultivation (a)</td>
<td>Non-cultivation Process</td>
<td></td>
<td></td>
</tr>
<tr>
<td>RG2</td>
<td>BSL2⁺ or above</td>
<td>BSL2 or above</td>
<td>BSL2 or above</td>
<td>BSL1 or above</td>
</tr>
<tr>
<td>RG3</td>
<td>BSL3 or above</td>
<td>BSL2⁺ or above</td>
<td>BSL2 or above</td>
<td>BSL1 or above</td>
</tr>
<tr>
<td>RG4</td>
<td>BSL4</td>
<td>BSL4</td>
<td>BSL3 or above</td>
<td>BSL2 or above</td>
</tr>
</tbody>
</table>

(a) Cultivation: When HIV or HTLV is propagated or cultivated in-vitro in a BSL-2⁺ laboratory, the total volume has to be kept under 200 ml, and the total number of individual virus should not exceed \(1 \times 10^9\). As to the cultivation of SARS virus or new HsN₅ type influenza virus, no matter how big or small the volume will be, it must be done in a BSL-3 laboratory.

(b) Inactivated biomaterials: This means that the originally pathogenic biomaterial has gone through certain inactivation processes, but is short of being verified by some reliable methods (such as culture method) to assure that it’s indeed inactivated.

(c) Noninfectious biomaterials: This means that the biomaterial has gone through certain inactivation processes and has also been verified by some reliable methods (such as culture method) to assure that it’s indeed inactivated.

2. **Passive vs. active effort to coordinate the attitude of the laboratory workers and the installation unit:** During the two investigations of laboratory infection incidents before 2006, laboratory personnel were not willing to cooperate with the investigation. The laboratory personnel assumed that investigators from the health authorities were accusatory and looking for excuses to have them penalized; therefore, they were uncooperative at the interview sessions. However, with proactive and sustained laboratory biosafety education and training and the outreach campaign launched by the Taiwan CDC over the past few years, laboratory workforces have gradually realized that whenever a laboratory infection occurs, the purpose of the investigation that follows is to find the root cause and provide solutions to rectify the problems that caused the incident. Once this was realized, the involved unit’s biosafety committee actively cooperated with the investigation and did its best to correct the deficiencies based on the investigation findings and to follow the recommendations provided by the outside investigators.

3. **Passive investigation vs. active notification:** The Taiwan CDC learned about the three aforementioned laboratory infection incidents from physicians who report all suspected cases of communicable diseases. This is followed by onsite epidemiology investigations and confirmed by laboratory assays. None of the laboratory infection incidents were voluntarily reported to the Taiwan CDC by the laboratory. Then in January 2007, a research institute located in Northern Taiwan detected a suspected laboratory infection outbreak of influenza vaccine strain H5N1, and instead of covering up the incident, it immediately reported the finding to the Taiwan CDC. Although this incident later turned out to be false, it did demonstrate that Taiwan laboratories have evolved into becoming more responsible and proactive with regard to the biosafety of their own laboratory.

4. **The Taiwan CDC will continue its efforts to reinforce:** The functioning of all laboratory units’ biosafety organizations, whether a committee or a designated individual, to campaign and aid their laboratory personnel’s internal educational training program and to carry out emergency response drills related to laboratory biosafety incidents. Hopefully, all these efforts will further promote a sound laboratory biosafety management system, elevate the importance of the Taiwan laboratory biosafety standards, and advance Taiwan towards the target of a zero incident rate for laboratory-acquired infections.

### References


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**Online Journal Submission Site**

*Applied Biosafety: Journal of the American Biological Safety Association* is a peer-reviewed, scientific journal committed to promoting global biosafety awareness and best practices to prevent occupational exposures and adverse environmental impacts related to biohazardous releases. The goal of *Applied Biosafety* is to provide a forum to exchange and promote sound biosafety and biosecurity initiatives through the publication of new research in biosafety, as well as information on best biosafety practices, policy issues and position papers, editorials, commentaries, and reviews.

The new online submission site for *Applied Biosafety* is user-friendly and available at www.x-cd.com/absa/article.cfm. If you have any questions, please contact the Production Editor, Karen Savage, at the ABSA Office at 1-866-425-1385 (toll free) or 847-949-1517 or via e-mail at karen@absa.org.
Biosafety Tips
Karen B. Byers
Dana-Farber Cancer Institute, Boston, Massachusetts

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 $10^4$ 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 0157 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 0157: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 0157:H7, to themselves and to their coworkers.”

<table>
<thead>
<tr>
<th>Site</th>
<th>% volunteers who transferred virus to site</th>
<th>Mean viral titer recovered from site log_{10} MPN</th>
<th>% contaminated sites with visible tracer (N=10)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nondominant glove</td>
<td>80</td>
<td>2.2</td>
<td>10</td>
</tr>
<tr>
<td>Right hand (skin)</td>
<td>90</td>
<td>2.4</td>
<td>20</td>
</tr>
<tr>
<td>Left hand (skin)</td>
<td>70</td>
<td>1.8</td>
<td>0</td>
</tr>
</tbody>
</table>

MPN: most probable number

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)
Table 2
Four U.S. cases of clinical laboratory staff infected with E. coli 0157:H7 (Spina, 2005).

<table>
<thead>
<tr>
<th>Glove use</th>
<th>Handwashing practice</th>
<th>Lab coat</th>
<th>Procedures conducted</th>
<th>Contributing factor?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Intermittent; vortexed without gloves; answered phone with and without gloves</td>
<td>Washed prior to exiting lab, not after each glove removal</td>
<td>Open</td>
<td>Handled agar plates; vortexed on open bench; used automated ID system; performed slide latex agglutination procedure</td>
</tr>
<tr>
<td>2</td>
<td>Always wore gloves; changed gloves frequently; wore gloves for vortexing</td>
<td>Always washed after glove removal</td>
<td>Buttoned</td>
<td>Made suspension with swab; vortexed on open bench</td>
</tr>
<tr>
<td>3</td>
<td>Did not wear gloves</td>
<td>Buttoned</td>
<td>Subculture only; no vortexing</td>
<td>Two coworkers also manipulated proficiency sample. One wore gloves on computer and turning sink faucets. Did not routinely wash hands after glove removal</td>
</tr>
<tr>
<td>4</td>
<td>Gloves worn; also worn to answer phone and use computer</td>
<td>Did wash hands after each glove removal</td>
<td>Buttoned</td>
<td>Latex agglutination test; no vortexing</td>
</tr>
</tbody>
</table>

References


Special Features

Capsule

Ed Krisiunas
WNWN International, Burlington, Connecticut

What’s new? What’s hot? What’s timely? If you don’t have time to search the Internet for the latest developments that might impact your work environment, you just might find some of this information in the “Capsule” column. Please e-mail any comments or suggestions to ekrisiunas@aol.com or to Co-Editor Barbara Johnson at barbara_johnson@verizon.net or Co-Editor Karen B. Byers at karen_byers@dfci.harvard.edu.

Recommended Adult Immunization Schedule—United States, 2009

The Recommended Adult Immunization Schedule has been approved by the Advisory Committee on Immunization Practices, the American Academy of Family Physicians, the American College of Obstetricians and Gynecologists, and the American College of Physicians. (MMWR, January 9, 2009, Volume 57, Number 53. Available at: www.cdc.gov/mmwr/mmwr_wk.html)

The Advisory Committee on Immunization Practices (ACIP) annually reviews the recommended Adult Immunization Schedule to ensure that the schedule reflects current recommendations for licensed vaccines. In October 2008, ACIP approved the Adult Immunization Schedule for 2009. No new vaccines were added to the schedule. However, several indications were added to the pneumococcal polysaccharide vaccine footnote; clarifications were made to the footnotes for human papillomavirus, varicella, and meningococcal vaccines; and schedule information was added to the hepatitis A and hepatitis B vaccine footnotes.

Additional information is available as follows: schedule (in English and Spanish) at www.cdc.gov/vaccines/recs/schedules/adult-schedule.htm; adult vaccination at www.cdc.gov/vaccines/default.htm; ACIP statements for specific vaccines at www.cdc.gov/vaccines/pubs/acip-list.htm; and reporting adverse events at www.vaers.hhs.gov or by telephone at 1-800-822-7967.

Personal Protective Equipment and Risk for Avian Influenza (H7N3)

An outbreak of avian influenza (H7N3) among poultry resulted in laboratory-confirmed disease in 1 of 103 exposed persons. Incomplete use of personal protective equipment (PPE) was associated with conjunctivitis and influenza-like symptoms. Rigorous use of PPE by persons managing avian influenza outbreaks may reduce exposure to potentially hazardous infected poultry materials.

In April 2006, an outbreak of avian influenza occurred on three poultry farms in Norfolk, England. Reverse transcription-PCR (RT-PCR) of poultry blood samples and cloacal swabs detected low-pathogenic avian influenza (H7N3) on one farm, and veterinary investigation confirmed influenza subtype H7N3 on the two adjacent farms. Surveillance and protection zones were established around all infected premises, and all birds were culled. Persons who had been exposed were offered oseltamivir prophylaxis; those with influenza symptoms were offered oseltamivir treatment and influenza vaccination. All persons at risk were orally instructed to wear personal protective equipment (PPE).

Morgan, O., Kuhne, M., Nair, P., Verlander, N. Q., Preece, R., McDougall, M., et al. (2009 January [date cited].) Personal protective equipment and risk for avian influenza (H7N3). Emerging Infectious Diseases [serial on the Internet]. Available at: www.cdc.gov/EID/content/15/1/59.htm

Highly Pathogenic Avian Influenza Virus (H5N1) Infection in Red Foxes Fed Infected Bird Carcasses

Eating infected wild birds may put wild carnivores at high risk for infection with highly pathogenic avian influenza (HPAI) virus (H5N1). To determine whether red foxes (Vulpes vulpes) are susceptible to infection with HPAI virus (H5N1), we infected three foxes intratracheally. They excreted virus pharyngeally for 3-7 days at peak titers of $10^{3.5}-10^{5.2}$ median tissue culture infective dose (TCID$_{50}$) per mL and had severe pneumonia, myocarditis, and encephalitis. To determine whether foxes can become infected by the presumed natural route, we fed infected bird carcasses to three other red foxes. These foxes excreted virus pharyngeally for 3-5 days at peak titers of $10^{4.2}-10^{4.5}$ TCID$_{50}$/mL, but only mild or no pneumonia developed. This study demonstrates that red foxes fed bird carcasses infected with HPAI virus (H5N1) can excrete virus while remaining free of severe disease, thereby potentially playing a role in virus dispersal.

**Exposure to *Streptococcus suis* Among U.S. Swine Workers**

Despite numerous cases of human infection with *Streptococcus suis* worldwide, human disease is rarely diagnosed in North America. We studied 73 swine-exposed and 67 non-swine-exposed U.S. adults for antibodies to *S. suis* serotype 2. Serologic data suggest that human infection with *S. suis* occurs more frequently than currently documented.

Smith, T. C., Capuano, A. W., Boese, B., Myers, K. P., & Gray, G. C. (2008 December [date cited]). Exposure to *Streptococcus suis* among U.S. swine workers. *Emerging Infectious Diseases* [serial on the Internet]. Available at: www.cdc.gov/EID/content/14/12/1925.htm

**Delinquent Mortgages, Neglected Swimming Pools, and West Nile Virus, California**

Adjustable rate mortgages and the downturn in the California housing market caused a 300% increase in notices of delinquency in Bakersfield, Kern County. This led to large numbers of neglected swimming pools, which were associated with a 276% increase in the number of human West Nile virus cases during the summer of 2007.

Reisen, W. K., Takahashi, R. M., Carroll, B. D., & Quiring, R. (2008 November [date cited]). Delinquent mortgages, neglected swimming pools, and West Nile Virus, California. *Emerging Infectious Diseases* [serial on the Internet]. Available at: www.cdc.gov/EID/content/14/11/1747.htm

**OSHA Safety and Health Topics—Bioterrorism**

Bioterrorism is the intentional use of microorganisms to bring about ill effects or death to humans, livestock, or crops. The use of microorganisms to cause disease is a growing concern for public health officials and agricultural organizations. The terrorist attacks on September 11, 2001 and the subsequent bioterrorist releases of anthrax have led to an increased awareness of workplaces as possible terrorist targets. Specific OSHA Safety and Health Topics Pages are available for Plague, Ricin, Smallpox, Tularemia, and Viral Hemorrhagic Fevers (VHFs). There is also an OSHA Anthrax eTool. Available at: www.osha.gov/SLTC/bioterrorism/index.html

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**Notice of Executive Order**

The United States government has enacted policies and regulations that apply to facilities that possess biological select agents and toxins to protect against theft, misuse, or diversion to unlawful activity of such agents and toxins. A new Executive Order signed January 9, 2009 by former President Bush has established a Working Group to further study biosecurity. For more information on “Executive Order: Strengthening Laboratory Biosecurity in the United States” please visit: www.whitehouse.gov/news/releases/2009/01/20090109-6.html
Ask the Experts

John H. Keene
Global Biohazard Technologies, Inc., Midlothian, Virginia

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@globalbiohazardtechnologies.com or Co-Editor Barbara Johnson at barbara_johnson@verizon.net or Co-Editor Karen B. Byers at karen_byers@dfci.harvard.edu.

Can a biological safety cabinet be used as a fume hood?

Question
When can you use a biological safety cabinet as a fume hood? Currently we have a BIO-Hood and we would like to keep it as a fume hood. Is this possible?

Answer
First, let’s make one thing clear: Biosafety cabinets are not fume hoods. While some level of volatile hazardous chemicals can be used in biosafety cabinets, they are not designed to be used in the same way that fume hoods are used. Even the Class II B2 (total exhaust) cabinets do not operate in the same way a fume hood operates.

Fume hoods draw air through the front opening of the hood, across the work surface, and out through the back of the hood to an exhaust duct. Generally, there are no internal fans and no recirculation of potentially contaminated air. Fume hoods can be connected to variable volume dampers that permit reduced airflow during times when no one is using the facility. These dampers also can compensate for varying the sash height of the front opening. Biosafety cabinets are generally constant volume devices and the working sash height is static, not variable.

The biosafety cabinet is designed to keep the work surface clean and, therefore, protect the work from potential contamination, provided the person using the cabinet follows the recommended procedures for working in the cabinet. Air that is introduced into the cabinet enters through the front grill and does not pass directly over the work surface. In the case of the B2 cabinet, air not only is drawn in through the front grill by the building exhaust fan, but is also drawn to the top of the cabinet by a supply fan. In any case, the air passing over the work surface is cleaned by HEPA filtration above the work surface. This filter will not remove toxic/hazardous vapors, but is designed to remove particulates.

The working sash height of biosafety cabinets makes performing routine chemical laboratory work with certain pieces of equipment generally used in chemistry laboratories very difficult. They either are not easily introduced into the work area, or are too big for the working space of the cabinet. The sash on modern biosafety cabinets may be designed so that it can be opened in order to introduce equipment into the cabinet, but the sash must be returned to its working position prior to initiation of work or the containment capability of the cabinet is lost.

Stuart and his coworkers (1983) studied the fate of toluene vapors generated in the work area of three types of biosafety cabinets (Class II Type A, Class II Type B1, and Class II Type B2) and found that a constant level of toluene vapor was reached in the Class II Type A cabinet, despite the location of the vapor generator in the work space. In the Class II Type B1 cabinet, the detectable toluene vapor level was dependent upon the location of the generator; the highest levels were associated with the generator placed in the front area, and no detectable levels were evident when the generator was placed closest to the rear of the work area. The Class II Type B2 cabinet, a total exhaust cabinet, exhausted the entire volume of generated toluene vapor.

From the results of these experiments, it would seem that a B2 cabinet could be used as a fume hood, but care must be taken in such a decision. In addition to the concerns mentioned above with regard to the size and types of equipment used in chemistry labs and the fixed nature of the biosafety cabinet sash, the Class II Type B2 cabinets have another problem. It has become apparent that the use of these cabinets causes significant problems with air balancing that has to be addressed initially and be checked on a regular basis to ensure appropriate airflow, not only to the cabinet but also within the facility.

In summary, Class II Type A biosafety cabinets should never be considered for use as a fume hood. Class II Type B1 cabinets can be used in biological experiments with small amounts of potentially hazardous vapor-producing chemicals as long as the work is performed in the back half of the cabinet. Finally, the Class II B2 100% exhaust biosafety cabinets do remove any hazardous vapors that may be generated in the cabinet; however, they are still not fume hoods and should not be used in chemical laboratories as a substitute for a dedicated fume hood.

Reference
EBSA News—Letter from Europe
Heather Sheeley
EBSA President, Salisbury, Wiltshire, United Kingdom

So what’s been happening in and around biosafety in Europe? The European Biosafety Association (EBSA) is at the heart of biosafety throughout the diverse continent of Europe—not just in the European Union (EU). Back in March 2008 we had a fantastic conference in the lovely Italian city of Florence, with high attendance and an interesting programme that kept attendees away from the sights and shopping. The conference dinner made all of us feel like royalty in such grand surroundings.

Recent projects initiated by the European commission have made it possible, with key partners including the American Biological Safety Association (ABSA), to develop the Biorisk Management Standard. ABSA members will know how to access it and the ongoing projects to develop auditing tools and certification. In addition, EBSA has been participating in the Sandia Wikipedia assessment workshop. Because we realized there was a lack of recognition and description of the responsibilities of biosafety officers/advisors across the European countries, this is now directed toward a CEN Workshop agreement, similar to the one for the Biorisk Management Standard. This effort has been aided by financial support from the Dutch, Swiss, and Canadian governments and others.

EBSA also works to inform and influence the rule makers in Europe to put in place proportional risk-, and evidence-based legislation. Although a common legal framework for biological risk is set out in the biological agents directive, it seems multiple different ways to interpret it exist. A large project sponsored by the EU Sixth Framework on Biosafety-Europe has recently reported its findings. These clarified that much additional work is required to raise and harmonise biosafety risk management in Europe.

The biosafety community in Europe is lively with too many conferences and symposia to mention all equally here. Bookmark our web site www.ebsaweb.eu and see if there is something there for you.

Fund Donations
ABSA thanks the many of you who have generously contributed to the Richard C. Knudsen Memorial Fund. Richard Knudsen was a President of ABSA and Editor of Applied Biosafety. The proceeds from this fund are used annually to recognize an author who’s article in Applied Biosafety contributes to the scientific body of knowledge in biosafety. Those wishing to make donations to this fund should make their checks payable to the American Biological Safety Association. Please add a notation to the memo line that the check is to be used for the Richard C. Knudsen Memorial Fund. Checks should be mailed to ABSA, 1200 Allanson Road, Mundelein, Illinois 60060-3808.
Lights! Camera! Action! The Making of TIOBC and “Lab Wars III”

Patricia D. Cox
Mississippi State University, Mississippi State, Mississippi

May 29, 2008—the day it all began. I had been conducting a systematic search of campus buildings over the past year to verify the presence of BSL-2 laboratories. On this particular day I was on the second floor of the Food Science and Nutrition building. I found a closed door with all the requisite signs for a BSL-2 lab (one supposedly working with food-borne pathogens as indicated by the hazard sign) with a room number that was not on my list of currently approved BSL-2 labs. Upon entry, I found three students hard at work: heating their lunches in the microwave, eating cookies at their work stations, drinking cans of soda, and wearing shorts and flip flops. The shock of this incident left an indelible mark.

Fast forward to July when I received an e-mail from Mike Durham of LSU asking if MSU would like to contribute some items for display at the CSHEMA (Campus Safety, Health and Environmental Management Association) conference in St. Louis advertising the 2009 conference in New Orleans. Sure, I could send some pictures, ball caps, and t-shirts. So began a search of the MSU web site where I ran across videos that were used during nationally televised football games or as public relations spots. Wanting to string a few of these together into one DVD, I asked around for a company in the area that could create a DVD. VideoMagicOne, a full-service video production company specializing in corporate training and safety films, was more than happy to help. I met with owner and CEO, Andy Bryant, and to paraphrase Humphrey Bogart in Casablanca, said, “Andy, I think this is the beginning of a beautiful friendship.”

Recognizing the Need

In the process of evaluating MSU’s biosafety program, a key issue was the successful transfer of information to the users. The Office of Regulatory Compliance (ORC) had struggled with credibility and effectiveness over the years as we were understaffed, underfunded, and needed more support from our senior leadership. That, however, changed with the hiring of a new Vice President for Research who made a commitment early on to Regulatory Compliance. Our staff numbers increased, a separate biosafety budget was generated, and an embryonic environmental health and occupational safety initiative was implemented. As a result of these changes, ORC had many meetings exploring various avenues of information dissemination: revamping the web site, developing internal listserves, offering a daylong summer workshop for PIs (principle investigators) covering all aspects of compliance (a free, catered BBQ lunch certainly increased participation), submitting articles to various newsletters, attending new faculty and graduate student orientations, etc.

Being a movie and YouTube junkie, I had the idea of making a short informational movie to play at ORC functions, based on the format of the promotional videos submitted for the CSHEMA conference. And so was born The Importance of Being Compliant (available at www.youtube.com and affectionately known as TIOBC). The 3-minute movie received such a great reception at MSU functions and was so much fun to make that I felt a short movie format might be a good way to reinforce safety material that may otherwise be less than exciting although important.

So what topic would lend itself to a movie format? Flashback to May 29. The basic tenets of working in a microbiology or biomedical lab are the standard microbiological practices (SMPs) upon which subsequent containment practices are based. This became the subject of the new movie.

The Production

The production of both movies was based on project management principles: initiation, planning and design, execution, monitoring, and closing. The need for training and a novel way to broadcast information were the initiating factors. Our modern pop culture is so visually oriented to music videos, gaming programs, and action movies that I felt a short, graphic, to-the-point movie would capture short attention spans and reinforce critical concepts.

The crucial step was how to present the material, and this is where VideoMagicOne was so invaluable. Andy Bryant, the CEO, explained the differences between the usual video productions of a “how to” and a marketing-type production that uses a “hook” to capture the audience’s attention. Excellent examples of this include GEICO’s cavemen and lizard and Budweiser’s Clydesdale horses. Our strategy was to produce something very...
similar to an infomercial—an entertaining way to persuade people to do things they might really not want to do. The hook for ORC’s movie would be the professor/graduate student characters played by the same actors throughout the film series.

Planning and Design

For “Lab Wars III,” whose working title was “10 Things Not to Do in the Lab” (more about that later), I sat down with the standard microbiological practices from the CDC/NIH BMBL, read them over, and thought how one could incorporate these 11 practices into a story with a beginning, middle, and end. It was obvious that the first scene had to be the two “scientists” working in the lab and doing everything wrong. I started writing a script for that scene that had enough dialog and action to capture as many of the SMPs as possible. Each scene had its own script that included the required actors, stage directions, props, costumes, and make-up. Scene 2 (the hospital scene) was written to demonstrate the health ramifications that can occur if SMPs are not followed. This was probably the funniest scene to shoot because of the costuming, make-up, prop design, and actor direction (how to appear to vomit, writhing in agony, etc.). Imagine wandering the aisles of Wal-Mart and wondering if vanilla or tapioca pudding would make better vomit or turning into the chips aisle, seeing row upon row of salsa jars and not thinking “Yum, nachos” but rather “Wow, what great bloody diarrhea.”

Each scene was visualized numerous times for unity and flow and also to identify props that ranged from very small (a needle) to very large (a biological safety cabinet). Scene 3 showed even more consequences but on a broader, more institutional scale and identified the etiologic agent and reasons for the exposures. Scene 4 was the resolution which segued into the point of the movie—the standard microbiological practices. The two main characters were played by amateur actors, both non-scientists, who are heavily involved in local community theatre. Both Lyle Tate and Gabe Smith have acted, sung, danced, and directed many a production at the Starkville Community Theatre.

Execution

Some of the difficulties and challenges associated with the actual filming included technical and non-technical issues. Finding sets and scheduling their use were problematic at times. The lab had to be the right size as well as clean enough to do the things that were planned. Fortunately, a small, renovated, as yet unused lab in the Life Sciences and Biotechnology Institute was found to be perfect. The trauma room in the Student Health Center had to be reserved after business hours to reduce the chance of an actual emergency admission. (The medical director seemed to think that a student crisis would take precedence over filming—humph!) Permission to do the movie had to be obtained not only from the Director of Regulatory Compliance, but also from all the departments where sets were located. Supporting actors had to be found and convinced to participate. Sets were prepared in advance and inevitably some prop was missing at the beginning of each shoot. Actor and shoot schedules had to be finalized. But trying to schedule 30 minutes with the Vice President for Research so that he could participate was probably the most difficult thing in the entire production. Special thanks to the Office of Research and Vice President Dr. Kirk Schulz. The production crew descended upon that office and wreaked havoc during filming. Scene 3 was done in 30 minutes with very few retakes because of the VP’s schedule. Parts of Scene 4 were re-shot several weeks later because I kept changing the script and action. All in all the entire fall semester was needed to plan, write, prepare, film, and edit.

Technical Aspects

Prior to filming each scene, the cameraman performed a light test for the camera to produce a “white balance.” This procedure blanks the camera to white, which will then automatically adjust other colors to that baseline. Three-point lighting was established for each scene. This included backlight, frontal light, and hair light (light coming from above). Special lighting was used for the hospital scene to create a glow around the pasty complexion of the graduate student.

A Panasonic HVX200 camcorder was used in 480i 24p film mode, which basically means the film speed mimics the number of frames per minute used in films, and the size is appropriate for widescreen display. This allows for a more cinematic look.

Multiple takes of each scene were shot from different camera angles. This creates a sense of perspective: placing the camera inside the refrigerator to show the grad student reaching for his lunch or using an upward close-up shot of the professor dropping a needle into the wastebasket. As a general rule, plan 1 hour of filming for 1 minute of finished film. Allocate 2 hours for set preparation and clean-up. For “Lab Wars III” approximately 10 hours of raw video footage was needed to produce a 12-minute movie. Due to scheduling issues, the scenes were not shot in order.

Sound effects were added depending upon the scene and the activity. The sound of the bottle falling onto the floor and the microwave beeps were added at the very end.

In total, 20-30 hours were needed to edit scenes, add music, adjust film color, and create/mute sound. An Apple computer with Final Cut Pro editing software and Adobe Photoshop for work with certain still shots and the transformation of the MSU mascot “Bully” into “Bully Vader” were used.
Price Tag

It cost approximately $100 to $150 per minute of finished movie depending upon the length and complexity of each scene.

Artistic or Dramatic License

As a scientist, I have always pooh-poohed movies or TV shows with a scientific slant that seemingly do the improbable or impossible; for example, the movie Outbreak, where Dustin Hoffman’s character finds one monkey that will generate all the antisera to save the world in about 2 days, or the new TV show Fringe that centers around a scientist with a lab in the basement of a building at Harvard where he keeps an experimental cow (no IACUC [Institutional Animal Care and use Committee] there) and conducts research on humans (both living and dead) with no IRB (Institutional Review Board) approval or appropriate PPE (personal protective equipment). Dramatic license distorts or ignores fact and asks viewers to suspend their disbelief in order to glamorize a scenario or improve cinematic cohesiveness. After producing “Lab Wars III,” I have better insight as to why that is done. Would the CDC or NIH actually visit MSU if something like this happened? Probably not, but it certainly makes for more drama. Would the PI/professor have been allowed to return to work or even been kept on by the University? Who knows, but in order to resolve the story, the PI had to return in the last scene to introduce the SMPs.

The Star Wars Theme

And finally, why Star Wars? I did not start out with the Star Wars theme in mind. I was looking for a title that would lend itself to the standard microbiological practices such as the movie 10 Things I Hate About You. I had considered the Lab Wars take-off, but it wasn’t until I noticed several movie shorts on YouTube using the iconic Star Wars graphics that I considered it. An Internet search led to a computer program that allowed the insertion of text into the Star Wars format. A check of the George Lucas web site indicated that its use was allowed for educational purposes. And the rest, as they say, is history. “Lab Wars Episode III: Revenge of the Bacterium” is available at www.vimeo.com.

May the force be with you.

Important

A change of address notice should be sent at least 6 weeks in advance to the ABSA Office to ensure that all mailings, including the journal, will reach you. ABSA is not responsible for misrouted mail as a result of insufficient notification of an address change. Undelivered copies resulting from an insufficient address change notification will not be replaced, but single issues may be purchased at the single issue price.

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Effective Date______________________

Registered Biosafety Professional (RBP) Report and List

Betty Kupskay
Public Health Agency of Canada, Winnipeg, Manitoba, Canada

A Registered Biosafety Professional (RBP) is an individual with a documented university education plus specialized training and experience in relevant biological safety disciplines who has submitted the application and been found to be eligible for registration by the ABSA RBP Evaluation Review Board. An RBP understands sufficient pathogenic microbiology, molecular genetics, immune responses of hosts, and concepts of infectious transmission to enable them to apply safeguards to work with biohazardous materials.

The 2008 Registration Evaluation Review Board is composed of five members: Betty Kupskay, Chair; Paul Meechan; Tom Boyle; Sheldon Cooper; and Patty Olinger.

The purpose of the Registration Evaluation review Board is to review applications for registration as a biological safety professional and determine if the applicant meets the established criteria.

Summary of activity from April 2008 to January 2009: 31 RBP applications received; 17 applications approved; 2 applications disapproved; and 14 applications pending review.

There are currently a total of 173 Registered Biological Safety Professionals.

Aamer Ikram
AFIP, Rawalpindi Punjab, Pakistan
Approved: June 24, 2008

Patricia Barbosa
Lawrence Livermore National Labs, Livermore, CA
Approved: June 13, 2008

JeT’Aime Newton
University of Texas Medical Branch, Galveston, TX
Approved: June 24, 2008

Anne Sophie Brocard
University of Texas Medical Branch, Galveston, TX
Approved: June 24, 2008

Felix Gmuender
Basler & Hofmann Pte., Ltd., Singapore
Approved: July 30, 2008

Kalpana Rengarjan
Emory University, Atlanta, GA
Approved: July 30, 2008

Tamece Knowles
Florida International University, Miami, FL
Approved: August 9, 2008

V. Paul Landon
NBACC, Frederick, MD
Approved: August 15, 2008

Johanna vanderSpek
Anjin Group, Inc., Worcester, MA
Approved: August 15, 2008

Colleen Driskill
Pfizer, Inc., Salem, CT
Approved: August 15, 2008

Nasr Gergis
LATTC, Walnut, CA
Approved: September 4, 2008

Laurence Mendoza
HHMI-Janelia Farm Research Campus, Ashburn, VA
Approved: September 11, 2008

Gregory Lupinski
Rutgers University, Piscataway, NJ
Approved: December 2, 2008

Benjamin Perman
Booz Allen Hamilton, Inc., McLean, VA
Approved: December 2, 2008

Richard Le
Florida State University, Tallahassee, FL
Approved: December 2, 2008

Mitchell Pate
Southern Research Institute, Birmingham, AL
Approved: December 2, 2008

James Hartling
Ft. Dodge Animal Health, Ft. Dodge, IA
Approved: January 9, 2009

Julie Jackson
Amgen, Inc., Thousand Oaks, CA
Approved: January 9, 2009

Stacey Kraemer
Medical College of Georgia, Augusta, GA
Approved: January 9, 2009
Certified Biosafety Professional (CBSP) Report and List

Krista Murray
University of Delaware, Newark, Delaware

Certification as a Biological Safety Professional is available to individuals who have successfully completed the NRM exam to become a Specialist Microbiologist [(SM) NRM]. Individuals who have attained the certification are internationally recognized as experts in the field. This is a valuable step in professional development.

Upon successful completion of the NRM examination, individuals can apply to ABSA for the designation of Certified Biosafety Professional (CBSP). Once the designation has been awarded, individuals participate in the Certification Maintenance (CM) program. This program was implemented to assure that CBSPs maintain their professional qualifications and stay current with the field. CBSPs are required to submit worksheets documenting their certification maintenance activities every five years. This year, the number of points required to maintain the certification was lowered to eight points per year, or 40 over the five year recertification period. This aligns the requirements better with other similar certifying agencies. In addition, when the Certification Maintenance Committee reviews courses to assign maintenance points, it is using the NRM Task List from the certification exam. This is to ensure that the courses meet the essential functions of a biosafety professional.

The 2008-2009 Certification Maintenance Committee members are: Krista Murray, Chair; Marian Downing; Raymond Hackney; Lynn Harding; Bob Hashimoto; Melissa Morland; Deborah Newby; Byron Tepper; and Carol Whetstone.

Join a Committee

Have you ever considered joining a committee? When you choose to serve on a volunteer committee, you open a world of possibilities for networking, professional growth, and career opportunities while serving your profession. Volunteer member groups are the backbone of the association because they: serve as a forum for exchange of information; advance the science in all specialties of biosafety; develop guidelines and standards; provide education and training; and link ABSA to many other institutions.

You should explore committees in areas of the profession where you are active or have an interest. There is a great variety; you can be sure to find one of interest to you. Please review the list of committees and identify those areas in which you would like to participate or contact the chair of the committee (www.absa.org/abocommittees.html) that interests you to find out more information about the committee’s goals.
New ABSA Members for 2009

Khakimjon Abdulazizov
Ministry of Emergency Situations
Tashkent, Uzbekistan

Ekaterine Adeishvili
Midwest Research Institute
McLean, VA

Malikahon Akhmedova
Samarkand Oblast Center for State Sanitary and Epidemiology Ctrl.
Samarkand, Uzbekistan

Sradjeddin Babakhodjaev
Research Institute of Epidemiology, Microbiology, and Infectious Dis.
Tashkent, Uzbekistan

Stephen Born
University of California, San Francisco
San Francisco, CA

John Burress
Boston University Medical Center
Boston, MA

David Burton
Commissioning Agents, Inc.
Greenwood, IN

Mahmud Butaev
Uzbek Scientific Research Institute of Veterinary, Samarkand
Samarkand, Uzbekistan

Phil Chearmontet
Camfil Farr
Amherst, NY

Lesley Colby
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Ann Arbor, MI

Brent Cooley
University of California, Santa Cruz
Santa Cruz, CA

Abdurokhmat Dusanov
Kashkadarya Oblast Veterinary Lab.
Karshi, Uzbekistan

Despina Felis
Children’s Hospital Boston
Boston, MA

William Galdenzi
Boehringer-Ingelheim Pharm., Inc.
Ridgefield, CT

Pietro Gasparrini
Merk Frosst Canada
Quebec, Quebec, Canada

Bajtiyor Haydarov
Ministry of Emergency Situations
Tashkent, Uzbekistan

Megan Kaltinger
Kansas State University
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Thomas Letonja
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Josef Matu
Lams University of Cincinnati
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Larry Mendoza
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Bavarian Healthy/Food Safety Auth.
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DTRO-K
Kiev, Ukraine

Nicoletta Previsani
World Health Organization
Geneva, Switzerland

Saydimurat Saydaliev
Ministry of Public Health
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Amy Smith
Battelle National Biodefense Institute
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Rhoda Speare
University of Prince Edward Island
Charlottetown, Prince Edward Island, Canada

Bakhrom Tadjiniyazov
Center for Prophylaxis of Quarantine and Most Hazardous Infections
Tashkent, Uzbekistan

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Peter Tay
University of North Texas
Denton, TX

Lynn Thiry
University of Michigan
Ann Arbor, MI

Jamie Van Cleemput
Canadian Light Source
Saskatoon, Saskatchewan, Canada

Yvonne Walker
Armed Forces Institute of Pathology
Washington, DC

New Members of Existing Corporations

American Red Cross
Rockville, MD
Larisa Cervenakova

Centers for Disease Control, Taiwan
Taiwan, ROC
Hsu-Sung Kuo
Wen-Chao Wu

Dept. of Agriculture, Fisheries, & Food
Dublin, Ireland
John Moriarty

ENV Services, Inc.
Hatfield, PA
Ken Waterhouse

MEDCOM Safety
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Catherine Hall

Micro-Clean, Inc.
Lehigh Valley, PA
Ted Charles
Tim Franges

Saf-T-Pak
Edmonton, Alberta, Canada
Bob Chalsson

Wyeth Vaccines
Sandford, NC
A. Czar
J. Farley
Calendar of Events

April 20-23, 2009
ABSA Spring Seminar and Review Course
Hard Rock Hotel, San Diego, California
Contact: Phone: 1-866-425-1385 or 847-949-1517; Fax: 847-566-4580; E-mail: absa@absa.org; www.absa.org

April 20-24, 2009
Asia-Pacific Biosafety Association (A-PBA) Preconference Workshop and Conference
Manila, Philippines
Contact: www.a-pba.org

June 15-17, 2009
European Biological Safety Association (EBSA) Preconference Workshop and Conference
Stockholm, Sweden
Contact: www.ebsaweb.eu

October 18-21, 2009
ABSA 52nd Annual Biological Safety Conference
Hyatt Regency Miami, Miami, Florida
Contact: Phone: 1-866-425-1385 or 847-949-1517; Fax: 847-566-4580; E-mail: absa@absa.org; www.absa.org

November 8-12, 2009
American Association for Laboratory Animal Science (AALAS) 60th National Meeting
Denver, Colorado
Contact: http://nationalmeeting.aalas.org/future_sites.asp

October 3-6, 2010
ABSA 53rd Annual Biological Safety Conference
Hyatt Regency Denver at Colorado Convention Center, Denver, Colorado
Contact: Phone: 1-866-425-1385 or 847-949-1517; Fax: 847-566-4580; E-mail: absa@absa.org; www.absa.org

October 10-14, 2010
American Association for Laboratory Animal Science (AALAS) 61st National Meeting
Atlanta, Georgia
Contact: http://nationalmeeting.aalas.org/future_sites.asp

October 2-6, 2011
American Association for Laboratory Animal Science (AALAS) 62nd National Meeting
San Diego, California
Contact: http://nationalmeeting.aalas.org/future_sites.asp

October 30—November 2, 2011
ABSA 54th Annual Biological Safety Conference
Anaheim Marriott Hotel, Anaheim, California
Contact: Phone: 1-866-425-1385 or 847-949-1517; Fax: 847-566-4580; E-mail: absa@absa.org; www.absa.org

October 24-27, 2012
ABSA 55th Annual Biological Safety Conference
Hilton Bonnet Creek Hotel, Orlando, Florida
Contact: Phone: 1-866-425-1385 or 847-949-1517; Fax: 847-566-4580; E-mail: absa@absa.org; www.absa.org
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  - Men’s or  Women’s

- 50th Annual Conf. Poster........ $20.00

- Baseball Cap............................ $15.00

- Pin .............................................. $5.00

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- 50th Annual Conf. Historical Rountable and Interviews DVD ............ $35.00

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You will assist the Head of Biosafety in leading the Ministry’s efforts in the area of biosafety and biosecurity. In addition, you will also be responsible in the day to day operations of the Biosafety Office.

You should have the following:
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Y. pestis

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