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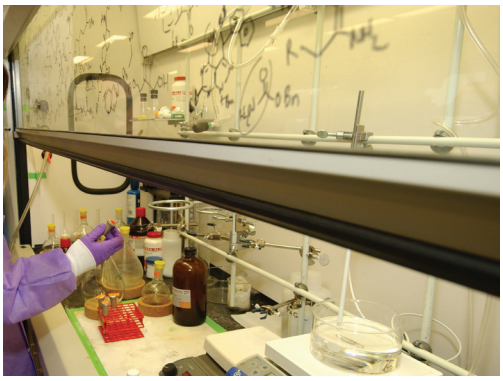
Keeping Laboratory Chemicals Safe and Secure

Maintaining a safe and secure laboratory environment involves carefully tracking chemicals and monitoring who has access to them at every stage of research. When implementing appropriate levels of laboratory safety and security, it is important to specifically consider review and approval of activities that require or create highly toxic chemicals, dual-use materials, or those considered Chemicals of Concern (see box).

Managing Chemicals

Maintain an inventory

A well-managed inventory includes chemicals obtained from commercial sources and those synthesized in the laboratory, as well as the storage location for each container of each chemical. A central, organization-wide inventory can act as a tracking system, identifying the chemical, source, amount of chemical and, potentially, the hazard classification, storage location, and staff member responsible for the material. It should track the purchase, creation, storage and use of every chemical until it is completely consumed or disposed. Inventories and tracking systems should be reviewed and updated on a regular basis to ensure that the inventory is accurate. Chemical inventories should be shared with the local fire departments to protect their personnel in the event of fire in the building.



Chemicals of Concern

Chemicals of Concern include those listed in the Chemical Weapons Convention, chemicals that have potential for mass destruction, explosives and precursors of improvised explosive devices, and chemicals of high acute toxicity (rated as Category 1 in the Globally Harmonized System of Classification and Labeling of Chemicals), or the synthetic precursors of high acute toxicity materials.

Establish specific purchasing policies

When ordering, be aware of the potential for intentional misuse of dual-use laboratory chemicals. Appropriate policies should be adopted to prohibit unauthorized purchases of chemicals and other hazardous materials. Such requirements could include: review of all hazardous materials purchases by an appropriate authority, such as a chemical hygiene officer; demonstration by laboratories that appropriate safety controls are in place prior to the purchase of hazardous chemicals; review and authorization of requests to purchase dual-use or multiple-use chemicals or any purchases above a given volume; and receipt of all chemical shipments by trained personnel in a central receiving area or prep room. Missing shipments or lost inventory should be reported in a timely manner. All free shipments of chemicals or hazardous materials to researchers by chemical companies should be reported to the chemical hygiene officer and added to the chemical inventory for that laboratory.

Order the minimum amount of the chemical needed for the experiment

When ordering chemicals, less is always best. Larger containers of chemicals require more storage space, and substantial disposal costs

Dual-Use Chemicals

Dual-use or multiple-use materials, technologies, or equipment are needed for experimentation but could also be put to nefarious uses. Whether or not security regulations apply, there are prudent steps to reduce the risk of the theft of chemicals, or their use for terrorist activity.

- Only authorized personnel should be able to order dual-use or hazardous materials.
- Maintain up-to-date inventory records of dual-use materials.
- Limit the number of laboratory personnel that have access to dual-use agents.
- Provide easy access to a form of emergency communication, in case of a security breach or a threat from within or outside.
- Periodically review laboratory access controls to areas where dual-use agents are used or stored.
- Maintain a log of who has gained access to areas where dual-use materials are used or stored.
- Develop a formal policy prohibiting use of laboratory facilities or materials without the consent of the principal investigator or laboratory supervisor. Unauthorized purchases and/or deliveries should be immediately reported.
- Monitor and authorize specific use of these materials with a principal investigator or laboratory supervisor being aware of all on-going syntheses having the potential to prepare toxic and controlled substances.
- Remain alert and aware of the possibility of removal of any chemicals for illicit purposes.
- Properly train all laboratory personnel who have access to these substances, including a discussion of the safety risks of dual-use materials.

could be incurred to dispose of unused material. If a stockroom is used, stockroom managers should have a verified list of personnel authorized to withdraw chemicals and should ensure that all withdrawals are conducted by authorized individuals.

Control access to materials

For laboratories where highly toxic chemicals are in use, access should be restricted to people who are authorized and trained in any special precautions that apply. Experimental procedures involving these chemicals should be confined to a designated work area in the laboratory that is recognized by all personnel. Remember that any access controls in place for material should also apply to waste produced by disposing of those materials.

Responsibility for Safety and Security

Institutions need well-developed administrative structures, policies, and identified personnel with responsibility for maintaining a safe and secure laboratory environment. Both the environmental health and safety office and chemical safety and security officer should be able to provide guidance and training to help laboratories develop safety and security systems. However, direct responsibility for the laboratory safety program typically should rest with the laboratory manager or Principal Investigator. All laboratory personnel should be responsible for working safely and safeguarding the chemicals they use, preplanning all experiments, following safety and security protocols, and reporting any suspicious activity, theft of materials, or unauthorized deliveries to the chemical hygiene officer or other appropriate individuals or offices.

Reducing the Vulnerability of Facilities and Laboratories

Laboratory supervisors and managers can choose from a variety of security options, including security guards or controlling access to buildings and laboratories, depending on the level of security needed and the resources available. The value of simple steps, such as adding blinds to windows, ID badges, or requiring sign-in logs, should also be considered.
Security Vulnerability Assessments are one tool to help identify potential security risks to the laboratory, and assess the adequacy of the security systems already in place. Issues to review during these assessments include materials held on-site, existing or known threats, and infrastructure vulnerabilities, such as accessible power lines or poorly lit areas.

Ten Steps to Create a Safety System

1. Create an institutional safety and security oversight committee with representatives from all sections and levels, and appoint a chemical safety and security officer to oversee the safety and security management program.
2. Develop a safety and security policy statement to define, document, and endorse a chemical safety and security management system.
3. Implement administrative controls to define the institution's rules and procedures for safe and

secure practices, and establish the responsibilities of the individuals involved.

4. Identify and address particularly hazardous situations and prioritize efforts to improve safety and security.
5. Evaluate facilities and address weaknesses.
6. Establish procedures for all aspects of chemical management, from purchase to disposal, and include oversight of synthetic transformations capable of producing toxic or controlled substances.
7. Employ engineering controls and provide appropriate personal protective equipment.
8. Plan for emergencies: assess the types of incident most likely to occur, identify decision makers and stakeholders, create a plan for the emergencies identified, and train staff in the procedures outlined in the plan.
9. Identify and address barriers for following safety and security best practices. Partner with the institution's scientific vendors to ensure that all orders to the department are sent to a specific central receiving area, and never sent to an individual laboratory or room.
10. Train, communicate, mentor, inspect, and supervise. Establish a culture of safety by following and enforcing safety and security rules and procedures, training and mentoring all laboratory personnel, and establishing channels for communicating about chemical safety at all levels in the institution.

Chemical Security Resources

This factsheet is based on the National Research Council report Prudent Practices in the Laboratory (2011), and the educational materials contained in Chemical Laboratory Safety and Security: A Guide to Prudent Chemical Management (2010). Other useful resources are available from:

- The American Chemical Society's Committee on Chemical Safety
- The State Department's Chemical Security Engagement Program
- The Department of Homeland Security's Critical Infrastructure: Chemical Security webpage

Committee on Prudent Practices in the Laboratory: An Update: William F. Carroll, Jr. (*Co-Chair***),** Occidental Chemical Corporation; **Barbara L. Foster (***Co-Chair***),** West Virginia University; **W. Emmett Barkley,** Proven Practices, LLC; **Susan H. Cook,** Washington University; **Kenneth P. Fivizzani,** Nalco Company; **Robin Izzo,** Princeton University; **Kenneth A. Jacobson,** National Institute of Diabetes and Digestive and Kidney Diseases; **Karen Maupins,** Eli Lilly and Company; **Kenneth G. Moloy**. DuPont Company Experimental Station; **Randall B. Ogle,** Oak Ridge National Laboratory**; John Palassis**, National Institute for Occupational Safety and Health; **Russell W. Phifer**, WC Environmental, LLC; **Peter A. Reinhardt**, Yale University; **Levi T. Thompson, Jr.,** University of Michigan; **Leyte L. Winfield**, Spelman College.

Committee on Promoting Safe and Secure Chemical Management in Developing Countries: Ned D. Heindel *(Chair),* Lehigh University, Pennsylvania; **Charles Barton**, Independent Consultant; **Janet S. Baum**, Independent Consultant; **Apurba Bhattacharya,** Texas A&M University; **Charles P. Casey,** University Of Wisconsin; **Mark C. Cesa**, INEOS USA, LLC; **M. Iqbal Choudhary,** University of Karachi, Pakistan; **Robert H. Hill,** Battelle Memorial Institute; **Robin M. Izzo,** Princeton University; **Patrick J. Y. Lim,** University Of San Carlos, Phillipines; **Russell W. Phifer,** WC Environmental, LLC; **Mildred Z. Solomon,** Harvard Medical School; **James M. Solyst,** Environ; **Usha Wright,** O'Brien & Gere.

The National Academies appointed the above committee of experts to address the specific task requested by the Department of Energy, the National Science Foundation, and the National Institutes of Health, with additional support from the American Chemical Society, Eastman Kodak Company, DuPont, Howard Hughes Medical Institute, Air Products and Chemicals, Inc., and PPG Industries. *Prudent Practices in the Laboratory)* and the U.S. Department of State *(Chemical Laboratory Safety and Security: A Guide to Prudent Chemical Management).* The members volunteered their time for this activity; their reports were peer-reviewed and the final products approved by both the committee members and the National Academies. This report derivative was prepared by the National Research Council based on the committees' reports.

For more information, contact the Board on Chemical Science and Technology at (202) 334-2156 or http://dels.nas.edu/bcst. Copies of *Prudent Practices in the Laboratory* and *Promoting Chemical Safety and Security in Developing Countries* are available from the National Academies Press, 500 Fifth Street, NW, Washington, D.C. 20001; (800) 624-6242; www.nap.edu; *Chemical Laboratory Safety and Security: A Guide to Prudent Chemical Management* and a toolkit of educational resources is available at http://dels.nas.edu/global/bcst/Chemical-Management.