Crisis Response Toolkit

OneLab

Disclaimer

This resource is intended for informational purposes only and should not replace laboratory-specific procedures. References to non-CDC resources do not constitute or imply endorsement by CDC or U.S. Department of Health and Human Services. **Important: We recommend that you use this toolkit in its online form so direct links to templates and resources are easily available to you.**

Introduction

The Crisis Response Toolkit is a guide with information and resources for clinical and public health laboratories to use during emergency situations. During the **response phase**, laboratory staff and outside responders manage the emergency, doing their best to quickly end the emergency and minimize its effects. The laboratory's response is more effective and efficient when laboratory responders understand their roles by knowing laboratory risks, have the training to perform their duties, and obtain supplies needed for any event.[1]

The purpose of the Crisis Response Toolkit is to provide a structured, easy to use, and proactive approach to managing emergencies in laboratory environments. This toolkit aims to equip laboratory personnel with essential resources and information to effectively respond to a range of situations. The toolkit should be used in conjunction with the laboratory's **standard operating procedures (SOP)** to ensure safety of laboratory operations and personnel. Ultimately, the Crisis Response Toolkit aims to enhance laboratory organizational resilience, foster a culture of safety through planning and preparedness, and identify steps needed for crisis response.

What is crisis response?

Crisis response refers to the advance planning and action taken to address disasters, crises, critical events, and tragic incidents. Crisis response can also be referred to as crisis management or crisis intervention. **Crisis management** is a process that organizations develop to identify and respond to critical events. A **critical event** can be defined as any threat, unanticipated incident, or negative disruption with the potential to impact an organization's people, property, productivity, or business processes.

For every potential emergency, consider the history of occurrence at your laboratory or comparable institutions, and review your laboratory's SOPs. Evaluate how the emergency would affect the laboratory: for example, damage to critical equipment, staffing limitations, loss of data, and the severity of impact on laboratory operations. Making a list of potential risks, available emergency response resources, and the location of those resources, assists in this task.[1]

Who is involved in crisis response?

Individuals working in or visiting a laboratory may experience a crisis. All laboratory personnel need to know how to respond to a crisis. Awareness of potential risks and training in preparedness both support readiness and laboratory safety. Properly trained laboratory personnel can guide visitors during a crisis. Laboratories may also develop a crisis response team to deploy during a crisis.

[1] Emergency Planning - Prudent Practices in the Laboratory - NCBI Bookshelf (nih.gov)

Laboratory crisis response involves a multidisciplinary team of scientists, researchers, laboratory technicians, safety officers, administrators, and external partners, such as emergency responders or public health officials.

Review this example of a multidisciplinary crisis response team:

- Scientists and researchers play a central role in:
  - Identifying the crisis.
  - Analyzing the situation's impact on ongoing experiments or projects.
  - Developing strategies to mitigate effects of the crisis.
  - Conducting thorough and regular risk assessments that anticipate all possible crisis scenarios.
- Laboratory technicians make sure:
  - Equipment is functioning properly and is regularly serviced.
  - Logs of equipment and process checks are kept consistently like daily checks of essential freezer temperatures or maintenance and sterilization logs.
  - Safety and contingency training are completed.
  - Assistance is provided in executing response plans according to designated roles.
- Safety officers oversee:
  - Adherence to safety protocols and regulations
  - Implementation of measures to protect personnel and minimize hazards.
- Administrators manage:
  - Logistical aspects of emergency response.
  - Communication with essential workers, all personnel, and external partners.
  - Allocation of resources.
- External partners may provide:
  - Specialized knowledge or assistance in complex situations, particularly in cases involving public health concerns or hazardous materials.
  - Contingency or secondary workspace if the situation leads to closing of the primary laboratory.

Effective collaboration among team members is essential for swift and effective crisis management in laboratory settings.

Why is crisis response important?

Laboratory crisis response is like first aid for an urgent situation. Crisis response is a balance between preparedness and the actual response. Advanced planning can reduce or prevent other problems and assist with a swift return to routine operations. An example of advanced planning is the Continuity of Operations Plan (COOP). COOPs ensure continued performance of essential functions under a broad range of circumstances.[2] If the laboratory facility or any portions of it are involved in a crisis or emergency, or are declared unusable for normal operation, the COOP is activated immediately.

[2] Laboratory Continuity of Operations Planning (COOP) | OneLab REACH (cdc.gov)

A COOP can be activated after natural or man-made disasters, such as hurricanes and tornados, biological or chemical terrorist events, or disease-preventing operations, such as pandemic protocols.[3] The CDC's Laboratory Continuity of Operations (COOP) Planning course provides guidance and tools necessary for the development of laboratory continuity plans. For additional information, visit the OneLab REACH course Laboratory Continuity of Operations (COOP) Planning.

[3] Examples of Applicability and Scope (cdc.gov)

Crisis Response by Type of Crisis

The types of incidents and emergencies to consider vary depending on the type of laboratory, geographical location, and other factors that are unique to an institution or laboratory. The following sections cover the most common crises faced in laboratories:

- Natural and Man-made Hazards and Disasters
- Personnel Injuries
- Outages/Utility Failures
- Chemical Spills
- Fires or Explosions

Natural and Man-made Hazards and Disasters

Natural hazards and natural disasters are related but are not the same. A **natural hazard** is the threat of an event that will likely have a negative impact. Natural hazards are defined as environmental phenomena that have the potential to impact societies and the human environment.[4] These should not be confused with other types of hazards, such as **man-made hazards**, which is threats having an element of human intent, negligence or error, or involving a failure of a man-made system. [5] For example, a flood resulting from changes in river flows is a natural hazard, whereas flooding due to a dam failure is considered a man-made hazard.

A **man-made disaster** results from man-made hazards. They differ from natural disasters that result from natural hazards.[5]

A **natural disaster** is the negative impact following an occurrence of a natural hazard that significantly harms a community.[4] Natural disasters are often weather-related critical events such as thunderstorms, tornadoes, and hurricanes. They can also include other emergencies from critical events such as forest fires and earthquakes. Storms and flash flooding can disrupt power, cause damage to buildings, and result in impassable roads. In severe cases, a local state of emergency in response to weather might close roads to all but essential travel.

In areas where tornadoes or hurricanes are common, laboratories should prioritize protection of critical hazardous operations. For example, in some areas, hydrogen cylinders and liquid nitrogen tanks are located outside the building. Likewise, certain laboratory chemicals, equipment, and procedures should be located away from outside windows.

The following job aid can assist with advanced planning of response to natural disasters.

---

[4] Natural Hazards | National Risk Index (fema.gov)
[5] Public Safety - Emergency Management - Man-Made-Disasters (pbcgov.org)

Natural Disaster Preparedness Job Aid

With any emergency, natural or man-made, staff should be trained on emergency procedures. Laboratory personnel should know where to access the SOP for emergency response. Follow these steps for natural disaster-related emergencies:

1. Stop what you are doing.
2. Secure hazardous materials or dangerous equipment only if you are trained and have enough time to leave safely.
3. Follow your laboratory emergency procedures.[6]

Be Prepared

When developing policies for natural disaster-related emergencies, consider questions like these, especially if your laboratory does not have a COOP:

- What are the available communication methods? How will individuals be informed of updates related to operations?
- If there are travel restrictions, would anyone be able to reach the laboratory?
- What operation functions are priority? Are there critical functions that must be up and running immediately? Are there functions that can be suspended or prioritized for later activation?

- What possible problems could arise if no one is able to come to the laboratory for a day, a few days, or longer?
- Have rally points been identified and shelter-in-place protocols distributed in areas where tornadoes occur?

Make emergency preparedness part of new employee onboarding and annual training for all laboratory employees.

- Update emergency contact information regularly.
- Ensure employees have access to appropriate supplies and SOP in case of an emergency in the laboratory.[1]

[6] Taken from job aid for "Fundamentals of Laboratory Safety" course at https://reach.cdc.gov/training.

Evacuations

Fires, spills, hurricanes, tornados, and other emergencies may require evacuation of the building or the laboratory. All laboratory personnel should be aware of the evacuation procedures for the building and laboratory.

Shutdown Procedures

Some laboratories may have operations, materials, or equipment that could pose a hazard if abandoned and left unattended for an extended period. If a building is evacuated for an emergency, hours may elapse before personnel are allowed back inside. Consider the hazards in the laboratory and establish procedures to follow during an evacuation. For instance, are there chemical or biological hazards that could be released into the environment? If the building was abandoned mid-procedure, were heating elements or electrical equipment left on?

Assembly Points and Evacuation Routes

It is important for each building, section of a building, or group to have a designated assembly point to which individuals evacuate and an emergency coordinator to direct crisis response activities. At the assembly point, the emergency coordinator will account for individuals who should have evacuated and advise emergency responders on the probability of individuals left in the building.

Main and alternative evacuation routes should be posted. Supervisors should ensure that all laboratory personnel are familiar with the safest way to evacuate the building, where to find evacuation route maps and procedures, and where to assemble. In case of evacuation, sign-in/sign-out boards or other check-in methods can be used as an aid to determine whether employees are in the building.[1]

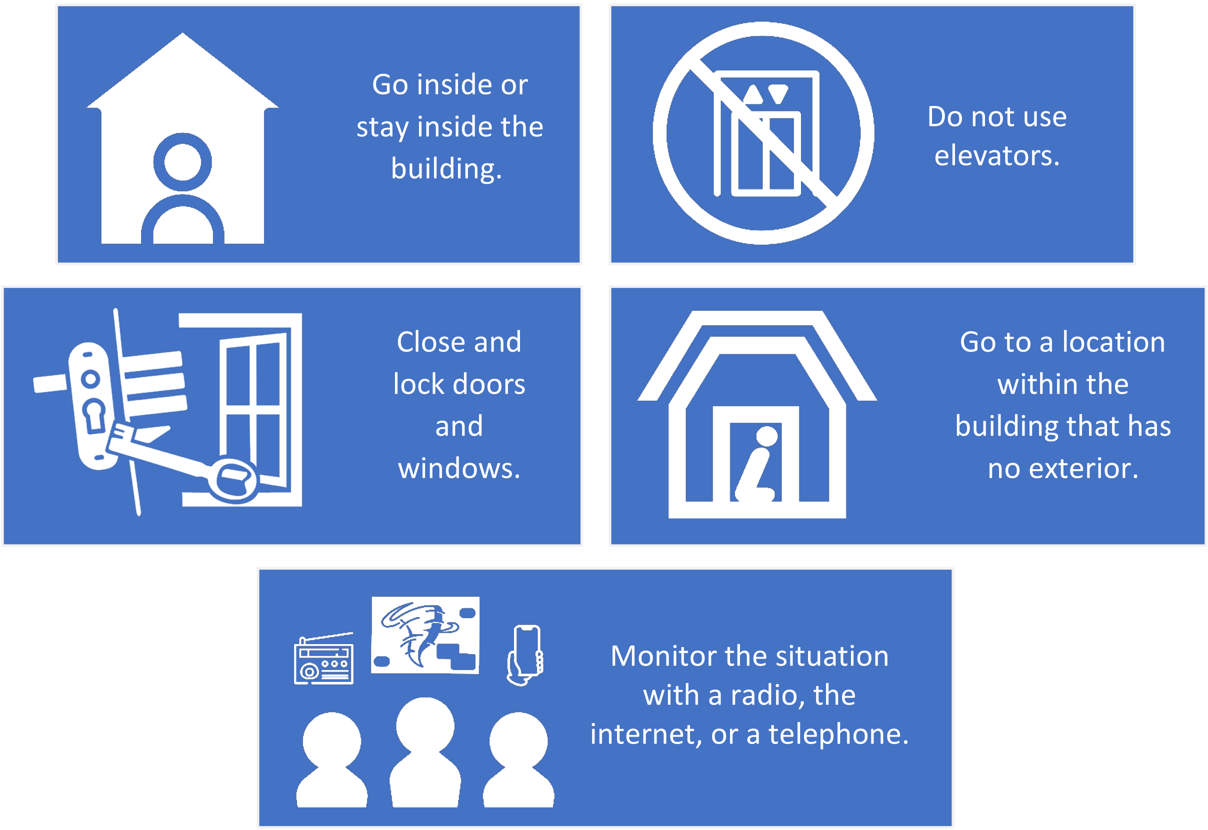
Shelter-in-Place

For certain emergency situations, emergency responders may advise that people **shelter-in-place**. This means that people remain inside the building instead of evacuating. Such circumstances may include hazardous material releases into the environment; weather emergencies, such as hurricanes, tornadoes, or severe thunderstorms; unsafe roads covered in hail, sleet, or ice; hazardous accidents on roadways; or suspects using weapons.

Shelter-in-place instructions typically involve securing the facility, staying indoors, and monitoring the status of the critical event. A detailed plan is essential, and everyone must know their role during such situations.

Shelter-in-Place Job Aid

When directed to shelter-in-place, take the following actions:



Ensure that the laboratory is prepared by having a battery-powered radio and flashlight on hand.

Provide an overview of shelter-in-place procedures to laboratory personnel as part of their orientation.[1] One resource your laboratory can use is the CDC's Laboratory Onboarding Toolkit. This toolkit can help new hires and existing staff access site-specific information and links to SOPs and training resources.[7]

[7] LOT (cdc.gov)

Earthquakes

Laboratories in areas where seismic activity is common should take special precautions to secure and restrain equipment and chemicals in the laboratory. An earthquake can render a building unusable for days or months or cause it to be condemned. Consider the damage that falling equipment could cause. Note that the earthquake may cause secondary hazards such as gas leaks, fires, biological and chemical spills, electrical hazards, broken glass, reduced structural integrity of buildings, and flooding from broken water pipes.

Ask questions such as these to prepare your laboratory for potential earthquakes and add information to SOPs as appropriate.

- Is all freestanding equipment that may shift or fall during an earthquake secured appropriately? For example, are compressed gas cylinders properly secured?
- Are connections to that equipment, including gas and water lines, flexible to allow for movement?
- Are items stored on open shelves appropriately organized (e.g., heavier items below, appropriate lips on the shelving, restraints used where necessary)?
- If multiple containers fall and are damaged during a quake, is there potential for incompatible chemicals to mix?

Also, consider the likelihood of other sensitive equipment falling to the ground, such as computers and analytical equipment. If possible, secure those items to the desk or benchtop.[1]

Floods

Floods are a common weather hazard and natural disaster. Flooding occurs when an overflow of water comes onto dry land. This can happen during heavy rains, hurricanes, tropical storms, when dams or levees break, or other non-weather-related events. Pipes or reservoirs leaking can pose a direct flooding hazard to a laboratory. A flood can happen within minutes or over a long period of time and can last days or weeks.

Flash floods can be the most dangerous kind of flood, usually resulting from storms dropping large amounts of rain within a brief time. They occur with little to no warning. Although flooding is a threat that can be experienced anywhere, some areas are at higher risk of flash flooding.

Flooding Concerns for Laboratories

Some areas are more prone to floods than others. Laboratories in basements or at ground level are more likely to be flooded in a storm than those on higher floors. Safety showers and eyewash stations that may be improperly plumbed or do not have floor drains nearby may also be a source of flooding. Consider the likelihood of flooding and its impact. The laboratory might have equipment that is sensitive to water damage or that is in the potential path of flood waters.[1]

Before Flooding

First, know whether any factors put your laboratory at risk of flooding.

Second, locate your laboratory's SOP relating to flooding and continuity of operations after flooding.

Third, take note of any equipment or storage areas that could be affected by flooding.

Fourth, familiarize yourself with terms that are used to forecast flooding.

- **Flood Watch:** Flooding is possible. Monitor radio and television stations for more information.
- **Flood Warning:** Imminent threat — Flooding is occurring or will occur soon. If advised to evacuate, do so immediately.
- **Flash Flood Watch:** Flash flooding is possible. A flash flood is a sudden rise of water in a low-lying area, usually in response to heavy rain. Be prepared to move to higher ground; monitor radio and television stations for more information.
- **Flash Flood Warning:** Imminent threat — A flash flood is occurring or will occur soon. Seek higher ground on foot immediately.[4]

During Flooding

Closely monitor a local radio or TV station for flood information. If advised to evacuate, follow the instructions of local officials.

Never drive through standing water. Underwater currents can be dangerous. Move to higher ground away from rivers, streams, creeks, and storm drains.

Stay out of floodwaters. The water may be contaminated, electrically charged, or much deeper and faster moving than it appears. If your car stalls in rapidly rising waters, get out immediately and seek higher ground.

Stay away from downed power lines to avoid the risk of electric shock or electrocution.

Follow any designated procedures if you must evacuate or shut down the laboratory.

After Flooding

Do not return to the laboratory until local authorities say it is safe. Even after floodwaters recede, roads and bridges may be weakened and could collapse. Buildings may be unstable, and drinking water may be contaminated.

Listen to water advisories from local authorities to determine whether your water is safe for drinking and other uses.

Follow designated procedures to resume operations if the laboratory shuts down.

Personnel Injuries

Laboratories are on the frontline of protecting everyone's health. Laboratory safety sustains the wellness of local communities and the people who live, work, and play in them. Safe laboratories enable trained staff to conduct accurate and timely tests and research without jeopardizing the health of workers, the environment, or the public.[8]

According to the Bureau of Labor Statistics, in 2022, almost 350,000 people worked as technicians and technologists in U.S. clinical laboratories.[9] The laboratory environment can be a hazardous place to work. Laboratory workers are exposed to numerous potential hazards, including chemical, biological, physical, and radioactive hazards, as well as musculoskeletal stresses. Laboratory safety is governed by numerous local, state, and federal regulations. The Occupational Health and Safety Administration (OSHA) has shared regulations and published guidance to make laboratories increasingly safe for personnel.

This information is provided to help you prevent injuries to laboratory personnel and to make your laboratories as safe as possible.

Federal Regulations and Laboratory Safety

As noted in the publication *Laboratory Safety Guidance*, section 5(a)(1) of the Occupational Safety and Health Act of 1970 (OSH Act), the General Duty Clause requires that employers "shall furnish to each of his [*sic*] employees employment and a place of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees." Therefore, even if an OSHA standard has not been published to address a

[8] Lab Safety Portal | CDC

[9] Clinical Laboratory Technologists and Technicians : Occupational Outlook Handbook: : U.S. Bureau of Labor Statistics (bls.gov)

specific hazard or hazardous operation, the protection of workers from all hazards or hazardous operations may be enforceable under section 5(a)(1) of the OSH Act.[10] Other regulations that specifically address laboratory safety appear below in the Resources section.

OSHA's *Laboratory Safety Guidance* publication from provides instructions for reducing the risk of a variety of hazards:

- **Chemical hazards:** Laboratory chemicals include cancer-causing agents (carcinogens), toxins, irritants, corrosives, sensitizers, and agents that harm the blood system or damage the lungs, skin, eyes, or mucous membranes.

- **Biological hazards:** These include blood and body fluids, culture specimens, body tissue and cadavers, and laboratory animals; bacteria, viruses, and other biological agents; as well as other workers (such as illness).

- **Physical hazards:** These include ergonomic hazards related to personal movement, ionizing radiation, non-ionizing radiation, and noise.[11]

- **Safety hazards:** These include the hazards of using laboratory equipment such as autoclaves and centrifuges, compressed gases, cryogens, and dry ice, electric shocks and fires, lockout/tagout injuries, and trips, slips, and falls.

Risk Assessment and Risk Management

Risk management is a continuous process for identifying, evaluating, controlling, and monitoring risks to personnel from hazards in the laboratory environment. **Risk assessment** is an important aspect of the process that involves identifying and evaluating risks presented by specific hazards.

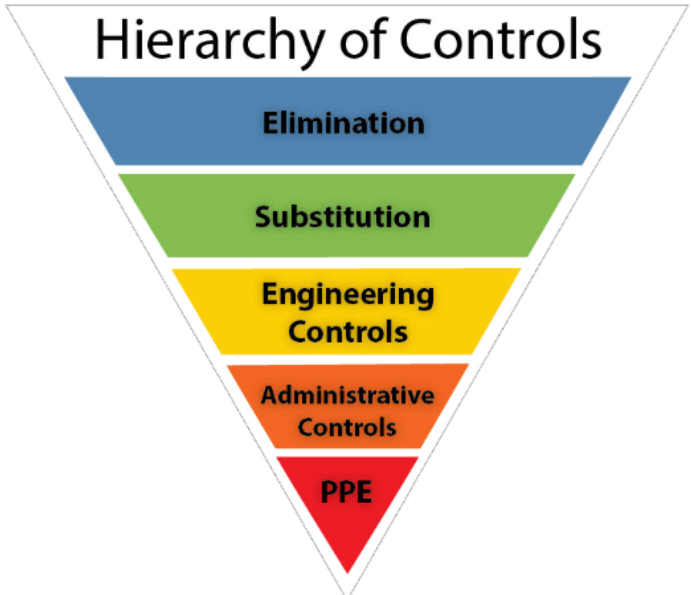
Each laboratory will have its own hazards and associated risks. Potential hazards could include a broken vial of blood with the risk of getting a puncture wound and potential infection. Another potential hazard is a hazardous chemical; the risk is getting burned by skin contact or inhaling dangerous fumes.

The risk management process has five main steps:

1. Identify the hazards and the risks they present.
2. Evaluate the severity and likelihood of each risk.
3. Determine which controls to implement in a risk mitigation plan.
4. Implement controls from the risk mitigation plan.

[10] OSHA Laboratory Safety Guidance
[11] OSHA FACTSHEET LABORATORY SAFETY ERGONOMICS:OSHA FACTSHEET PPE

5. Evaluate the effectiveness of the controls.



In laboratory safety, a **control** is a means of addressing a hazard and mitigating its risks. There is a hierarchy of laboratory safety controls. Some are more effective at protecting personnel than others. These controls are listed from most effective to least effective:[12]

- **Elimination:** Physically removing the hazard.
- **Substitution:** Replacing the hazard.
- **Engineering controls:** Physically isolating people from the hazard.
- **Administrative controls:** Changing the way people work.
- **Personal protective equipment (PPE):** Providing clothing and gear to protect personnel.

In the process of evaluating risks, you must decide what levels of risk you can accept. Based on the risk assessment, you must determine:

1. Which risks are acceptable-conducting work within existing controls.

2. Which risks are unacceptable-refusing certain types of work until additional mitigation controls are implemented to reduce the risk to an acceptable level.

The CDC offers many resources to assist with developing risk management strategies for laboratories. One resource is the OneLab REACH course Introduction to Laboratory Risk Management (LRM). This basic-level eLearning course provides details on applying risk management principles and briefly describes related practices to emphasize the importance of risk management in laboratory settings.[13] Additionally, you can review the Risk Assessment for

[12] Safety Management - Hazard Prevention and Control | Occupational Safety and Health Administration (osha.gov)
[13] Introduction to Laboratory Risk Management (LRM) | OneLab REACH (cdc.gov)

Clinical Laboratories - Call Materials presentation on risk assessment in clinical laboratories, including audio and slides, from a staff member with the Montana Laboratory Services Bureau.[14] It includes a case study of a situation that sickened a laboratory staff member.

Risks from Sharps

Sharps are a group of hazards including syringes, needles, scalpel blades, broken glassware, and more. The CDC estimates that hundreds of thousands of people suffer sharps injuries in healthcare settings and other workplaces each year. Sharps injuries are primarily associated with occupational transmission of hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV), but they have been implicated in the transmission of more than 20 other pathogens.[15]

The CDC has created the *Workbook for Designing, Implementing and Evaluating a Sharps Injury Prevention Program*[16] to help healthcare facilities prevent needlesticks and other sharps-related injuries. The workbook is a guide for risk assessment and risk management focused on sharps. Select safety controls can help reduce risks of injury from glassware.[17]

Standard Operating Procedures

An **incident** is a type of accident that does not lead to an exposure or injury. An **exposure** is an accident that leads to an exposure or injury. Both need to be reported and recorded along with **near misses**, which are defined as situations that could cause an injury or exposure.[6] Your laboratory SOP should address each type of injury that laboratory personnel might face. Use resources from CDC, OSHA, and organizations such as the Association of Public Health Laboratories (APHL) to ensure your SOPs address each potential hazard in your laboratory.

The following guidance applies to most laboratory safety incidents. Laboratory personnel must be trained to know how to find and follow SOPs for safety incidents.

If you are exposed to blood or other potentially infectious materials (OPIM), follow these steps first:

- If possible, notify your co-workers in the laboratory about the exposure so they can assist or evacuate the area if necessary.
- Remove contaminated personal protective equipment (PPE).

[14] Risk Assessment for Clinical Laboratories - Call Materials (cdc.gov)
[15] About the Workbook | Sharps Safety | CDC
[16] Sharpsworkbook_2008.pdf (cdc.gov)
[17] Glass and other Sharps Injury and Illness Prevention in Labs | Environmental Health and Safety (uiowa.edu)

- For sharps injuries and cuts, wash the wound with soap and water for at least 15 minutes.
- For splashes to the nose, mouth, or skin, flush with water for at least 15 minutes.
- For contact with eyes, irrigate eyes with clean water, saline, or sterile wash for at least 15 minutes.
- Promptly report all exposures to ensure you receive appropriate follow-up care. Follow laboratory SOPs for proper response and reporting.

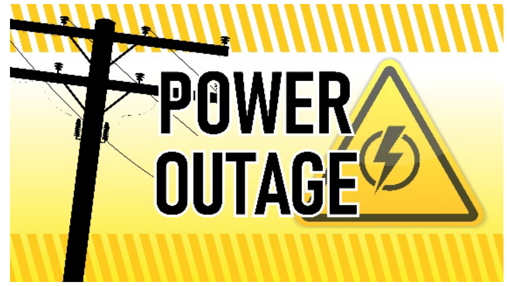
Outages/Utility Failures

Power/Electricity

Power outages in the laboratory can be caused by extreme weather, rolling blackouts, equipment malfunctions, or other circumstances. You can reduce the effects of a power outage and your chances of losing your hard work by being prepared and following some easy procedures.

Critical equipment that must run continuously, like specimen freezers and environmental chambers, should be plugged into emergency power sources. If laboratory personnel are present when power is lost, and power is not restored immediately, consider the following actions:

Power Outages Job Aid



Responding to Power Outages:

- Locate emergency lighting such as flashlights.
- Unplug or turn off equipment that can be unplugged, particularly if you leave before power is restored. Some equipment can be damaged if it turns on abruptly when power is restored. [1]
- Shut down or stabilize tests that involve hazardous materials.
    - Make sure tests are stable and won't create uncontrolled hazards.
- Check fume hoods and biosafety cabinets and take the following precautions, if applicable:
    - Stop any operations that may emit hazardous vapors, fumes, or infectious agents.
    - Securely cap any open containers.
- Close fume hoods and biosafety cabinet sashes.
- Check equipment running on emergency power to ensure it's running properly.
    - Note: It may take 20 to 30 seconds for emergency power to activate after a power failure.

- Reduce electrical use and risk of power surges:
    - Disconnect equipment that runs unattended on emergency power.
    - Turn off unnecessary lights and equipment.
- Transfer vulnerable items from cold rooms and refrigerators that have lost power to equipment served by emergency power.[18]
    - Dry ice may help maintain temperatures in refrigerators or freezers. Because demand for dry ice increases significantly during a power loss, have a list of alternative vendors in case the regular vendors are unable to provide supplies.

When the power returns and personnel are cleared to enter the lab, check the equipment.

- Reset or plug in all the equipment as needed and check to make sure each is functioning properly.[19]
- Confirm air flow in fume hoods is restored.
- Recalibrate and reprogram equipment as necessary.
- Keep doors closed on refrigerators and freezers that failed until they have been repaired and returned to safe working temperature.
    - **Note:** Some refrigerators and freezers require a manual restart.
- Check for unusual odors. This could be a sign of a leak or spill.

[18] How to Prepare for a Power Failure in a Lab (ucsd.edu)
[19] Labs and Power Outages.docx (yale.edu)

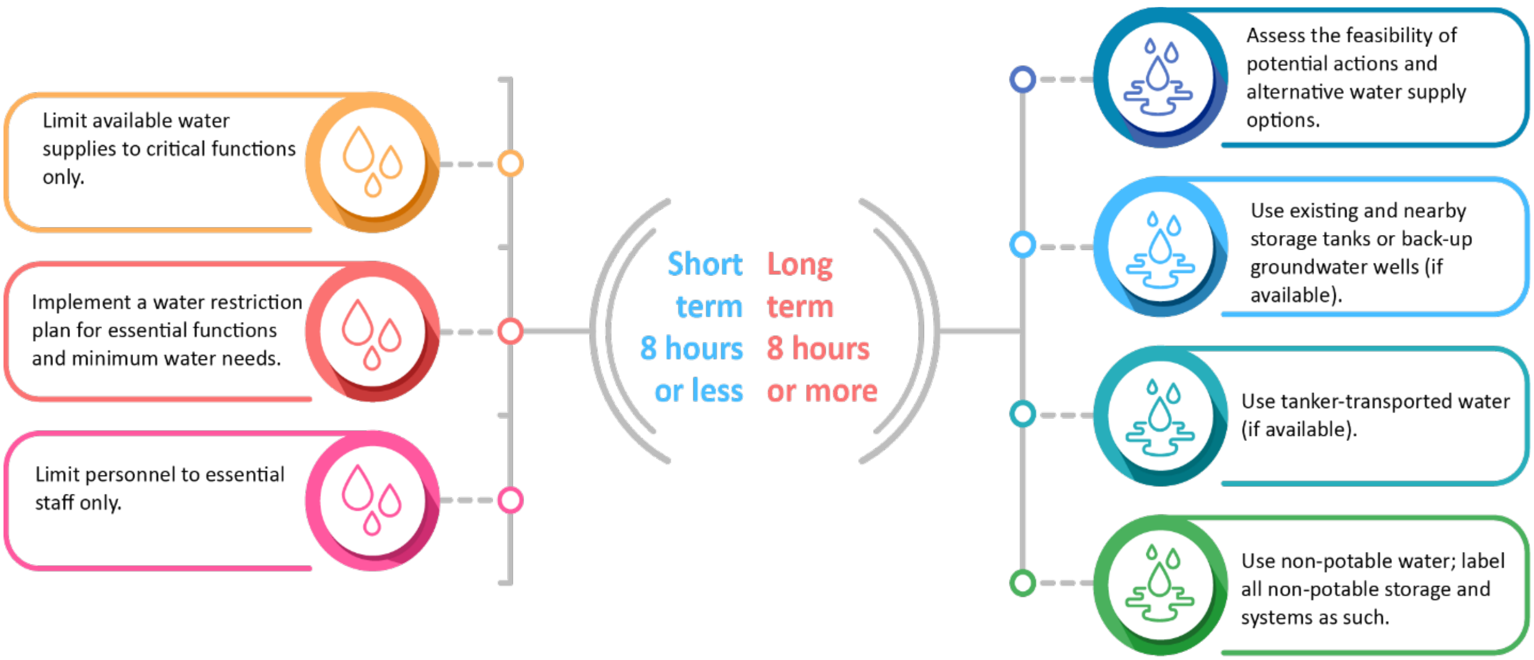
Water

When the water supply to a facility is interrupted, management should assess the problem quickly. The response to the interruption will depend greatly on the type of interruption (e.g., complete loss of water, reduced pressure, or water contamination) and the estimated length of time necessary to return the water service to normal. If facility management is not assured that the problem can be fixed soon (e.g., in 8 hours or less), they should start the short-term response and prepare to implement the longer-term water emergency response if necessary.

Responding to Water Utility Failure Job Aid

The response to water utility failure depends on the type of problem and the estimated length of time necessary.

- Identify emergency water supply options.
- Consult with the water utility and other authorities about the nature of the utility failure and the expected duration (see below).[20]



[20] [Emergency Water Supply Planning Guide for Hospitals and Healthcare Facilities (cdc.gov)]

Chemical Spills

Chemical spills can have dangerous consequences for laboratory staff, the public, and the environment. It is essential to prepare for possible chemical spills.

OSHA standard 29 CFR 1910.1450 is the Occupational Exposure to Hazardous Chemicals in Laboratories standard. It is often called the Laboratory standard. This standard applies to all hazardous chemicals having the potential for worker exposure when used in ways meeting the definition of “laboratory use.”

When the Laboratory standard applies, employers must develop a chemical hygiene plan (CHP). These are important parts of a CHP:[21]

- Minimizing exposure to chemicals by establishing SOPs, requirements for PPE, engineering controls (e.g., chemical fume hoods, air handlers, etc.), and proper waste disposal procedures.
- For some chemicals, the work environment must be monitored for exposure levels that require action or medical attention.
- Procedures to obtain free medical care for work-related exposures must be stated.
- The means to administer the plan must be specified.
- Responsible persons must be designated for obtaining and handling material safety data sheets, organizing training sessions, monitoring employee work practices, and annual revision of the CHP.

There are exceptions to the Laboratory standard. Here are some examples: [22]

- Chemicals used in building maintenance of a laboratory are not covered under the standard.
- The production of a chemical for commercial sale, even in small quantities, is not covered by the standard.
- Quality control testing of a product is not covered under the standard.

These three steps provide a foundation for emergency preparedness with chemical spills. [22]

---

[21] OSHA FACTSHEET LABORATORY SAFETY OSHA LAB STANDARD :OSHA FACTSHEET PPE
[22] Guide for Chemical Spill Response - American Chemical Society (acs.org)

Emergency Preparedness

First, learn about the hazards of the chemicals in your laboratory. Consult published data, such as **safety data sheets (SDS)** and chemical handbooks for response planning. Know whether the chemicals you use are flammable, reactive to air or water, corrosive, or toxic.

Second, write response procedures to address those hazards. Explain the initial steps to take when a spill occurs; include staff responsibilities, communication methods, instructions on using spill response equipment, and spill cleanup and residue disposal.

Third, ensure you have the equipment and training necessary to follow those procedures. Check regularly to ensure that spill kits are in their assigned places. Use training and documentation to make safety and emergency preparedness integral parts of your work culture.

Responding to Chemical Spills

When a chemical spill occurs, always tell your colleagues and your laboratory director (or designated safety officer). Warn others about the potential for danger.

There are two types of spills:

- Simple spills are those you can clean up yourself.
  - They do not spread rapidly
  - Are not a major danger to people, property, or the environment except by direct contact
- Complex spills require outside assistance and expertise.

Know where to find emergency contacts for complex chemical spills.

Follow these three steps to determine whether a spill is simple or complex[18]:

Responding to Chemical Spills Job Aid

Evaluating a Chemical Spill

Chemical spills in laboratories fall into two categories: simple spills and complex spills. Identify the chemical by checking the label, SDS, or container. As required, alert your supervisor, environmental safety officer (if available), and Environmental Health and Safety (EHS) team.

Laboratory staff should clean up simple spills, but the cleaning of complex spills requires trained specialists. Use these three steps to determine if your spill is simple or complex:

1. Evaluate the spill's risks:

- Is the chemical a risk to human health?
- Will the chemical damage physical property?
- Will the chemical harm the environment?

If you answered yes to any of the above, your spill is complex and requires expert attention.

2. Evaluate the quantity of spilled chemicals:

- Do you have enough PPE to clean the spill?
- Do you have enough spill control material to address the spill?
- Is the physical space preventing access to thoroughly clean the spill?

If you answered yes to any of the above, your spill is complex and requires an expert to clean.

3. Evaluate the spill's potential impacts:

- Will the spill spread to other areas through plumbing, ventilation, or other means?
- Will the spill interact with incompatible chemicals?

If you answered yes to any of the above, please contact experts to address the spill.

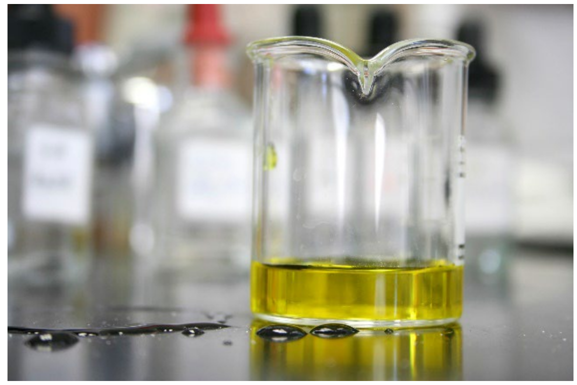
Include the phone number for your laboratory emergency safety team: ____

If it is your responsibility to call for experts to clean up complex spills, include the name of the company and phone number:

____

Cleaning a Simple Chemical Spill

After donning appropriate PPE, follow these steps to clean up a simple spill. As the American Chemical Society notes, if you need a respirator, you do not have a simple spill, and you need to request outside assistance.



1. Prevent the spread of dust and vapors.
   - If the substance is volatile, close the laboratory door and turn on ventilation, if available (such as a fume hood).
2. Neutralize acids and bases, if possible.
   - Neutralize acids with soda ash or sodium bicarbonate. Bases can be neutralized with citric acid or ascorbic acid. Use pH paper to determine when spills have been neutralized.
3. Control the spread of the liquid.
   - Make a dike around the outside edges of the spill.
   - Use absorbent materials such as vermiculite, cat litter, or spill pillows.
   - Consult your laboratory supervisor, standard operating procedure, environmental safety, or chemical safety office before using special products for chemicals such as hydrofluoric and concentrated sulfuric acids. This process may generate heat.
4. Collect and contain the cleanup residues.
   - Place neutralized residue into a plastic bucket or other container.
   - Double-bag dry powders or absorbed liquids.
   - Label each container of residue.
5. Dispose of the wastes.
   - Separate cleanup materials from normal trash.
   - Promptly place cleanup wastes in appropriate hazardous waste receptacles.
6. Decontaminate the area and affected equipment.
   - Open windows or use a fan unless the area is under negative pressure.

Take special precautions when handling flammable liquids, volatile toxic compounds, direct contact hazards, and mercury spills. After you have cleaned up the spill, follow the assigned procedures for reporting the spill. Consult your laboratory SOP for specific protocols and reporting procedures.[18]

CDC Support through the Laboratory Response Network for Chemical Threats

The Laboratory Response Network for Chemical Threats (LRN-C) was created to strengthen CDC's testing capacity for responding to a large-scale emergency involving chemical warfare agents. Over the years, the LRN-C expanded its mission and provided critical local and state infrastructure for a wide range of chemical threats affecting U.S. communities.[23]

CDC's LRN-C Technical Program supports local and state public health laboratory members of the LRN-C. These services include chemical threat response materials, proficiency testing, lab referral capabilities, secured data messaging, response readiness drills, hands-on training, and laboratory technical assistance. In return, LRN-C member laboratories provide CDC with expanded national testing capacity for identifying chemical threat exposures. In addition to chemical testing capabilities, laboratories provide coordination with local hospitals and first responders as well as support to local laboratories with specimen packaging and shipping.

CDC can respond to large-scale chemical exposure events requested by the FBI or senior state health officials. Members of the LRN-C may be called upon to assist with testing. This system combines CDC's expertise with the efficiency provided by LRN-C member laboratories.[24]

[23] Laboratory Response Network 20th Anniversary (cdc.gov)
[24] Chemical Exposure Event | CDC

Fires or Explosions

A fire requires three elements: heat, oxygen, and fuel. A fire starts when a flammable or combustible material with an adequate supply of oxygen or another oxidizer is subjected to enough heat. Many substances commonly used in laboratories can cause explosions, including common flammable gases, vapors of flammable liquids, vessels with pressure differences, and chemical reagents.

Most laboratory fires are caused by the ignition of flammable liquid spills or vapors that may have spread from open containers near ignition sources. Small bench-top fires in laboratory spaces are not uncommon. Large laboratory fires are rare. However, the risk of severe injury or death is significant because fuel load and hazard levels in labs are typically very high.

Fire Safety in Laboratories

Fire Prevention

Fires and related accidents can harm laboratory personnel, equipment, and buildings. Follow these guidelines to prevent fires in laboratories:[6]

Fire Prevention Job Aid

Fire is the most common hazard that laboratory staff face. Laboratory fires may harm personnel, equipment, rooms, and buildings. Your laboratory's fire safety and response protocols can usually be found in your laboratory's SOP. It's best practice to be familiar with these protocols before beginning your work. Consult your SOP and your supervisor for any laboratory-specific procedures.

- Plan: Have a written emergency plan in place. Ensure that work procedures account for fire safety. Check your laboratory SOP for laboratory-specific safety protocols.
- Minimize materials: Use only the minimum amount of chemical materials needed for work in progress.
- Clean your work area: Keep work areas uncluttered and clean. Properly store unused materials.
- Follow proper safety practices.
- Keep barriers in place, including fume hood sashes, shields, cabinet doors, and laboratory doors.
- Wear proper clothing and PPE.
- Avoid working alone.
- Avoid heating solvents with a hot plate.
- Keep combustibles, flammables, and oxidizing agents away from open flames.
- Store solvents in approved cabinets.
- Use open flames only under fume hoods and only when constantly attended.
- Keep electronic equipment up to code and serviced properly to prevent shorting and electrical fire.
    - Avoid overloading outlets and extension cords. Don't daisy-chain surge protectors and extension cords.
- Regularly maintain equipment. Follow procedure manuals for equipment use.
- Follow chemical storage, use, and disposal instructions to avoid starting fires, especially with oxidizing agents near flames.

Fire Safety Equipment

All laboratories should have the following safety equipment and employees should know their locations:

- Fire alarms
- Fire extinguishers
- First aid kits
- Evacuation route map
- Safety shower
- Fire blankets
- Emergency shutoffs
- Flame retardant lab coats
- Eye wash station
- Safety data sheet folder

Fire Emergency Procedures

Your laboratory's emergency plan should include the following steps:

- Isolate the fire area: lower the hood sash, close laboratory and corridor doors.
- Notify other occupants of the immediate space and facility.
- Use the fire alarm and call emergency responders.
- Evacuate the immediate area of the fire and the building.

Remember the "**RACE**" rule in case of a fire.

- **R** = Rescue/remove all occupants.
- **A** = Activate the alarm system.
- **C** = Confine the fire by closing doors.
- **E** = Evacuate/extinguish.

Glossary

Chemical hygiene plan (CHP): A document with guidance and procedures for preventing incidents and exposures to hazardous chemicals in laboratories.

Control: A means of addressing a hazard and mitigating risks ranked in a Hierarchy of Controls.

Critical event: Any threat, unanticipated incident, or negative disruption with the potential to impact an organization's people, property, or business processes.

Crisis management: A process that organizations develop to identify and respond to critical events.

Crisis response: Advance planning and real-time action taken to address disasters, crises, critical incidents, and tragic events.

Exposure: an accident that leads to an exposure or injury.

Incident: type of accident that does not lead to an exposure or injury.

Hazard: Something with the potential to cause harm.

> **Chemical hazards:** Laboratory chemicals include cancer-causing agents (carcinogens), toxins, irritants, corrosives, sensitizers, and agents that act on the blood system or damage the lungs, skin, eyes, or mucous membranes.
>
> **Biological hazards:** These include blood and body fluids, culture specimens, body tissue and cadavers, laboratory animals, bacteria, viruses, and other biological agents, and other staff.
>
> **Man-made hazard:** Threats involving human intent, negligence, or error or a failure of a man-made system.
>
> **Natural hazard:** Environmental phenomena that have the potential to impact societies and the human environment.
>
> **Physical hazards:** These include ergonomic hazards related to personal movement, ionizing radiation, non-ionizing radiation, and noise.
>
> **Safety hazards:** These include hazards of using laboratory equipment such as autoclaves and centrifuges; compressed gases, cryogens, and dry ice; electric shocks and fires; lockout/tagout injuries; and trips, slips, and falls.

Man-made disaster: negative results from man-made hazards

Natural disaster: negative impact following an actual occurrence of natural hazard if it significantly harms a community.

Near Misses: situations that could cause an injury or exposure.

Response phase: Efforts to manage an emergency or crisis as it occurs.

Risk: A combination of the likelihood of an incident occurring and the severity of the consequences (harm) if that incident were to occur.

Risk assessment: Part of risk management that involves identifying and evaluating risks presented by specific hazards.

Risk management: A continuous process to identify, evaluate, control, and monitor risks to personnel from hazards in the laboratory environment.

Safety control: A means of addressing a hazard and mitigating its risks. The following list shows the hierarchy of controls from most effective to least effective.

Elimination: Physically removing the hazard.

Substitution: Replacing the hazard.

Engineering controls: Physically isolating people from the hazard.

Administrative controls: Changing the way people work.

Personal protective equipment (PPE): Providing clothing and gear to protect personnel.

Safety data sheet (SDS): A quick-reference document that lists information about occupational safety and health for the use of specific substances and products.

Sharps: A group of hazards including syringes, a variety of needles, scalpel blades, broken glassware, and more.

Shelter-in-place: Remaining inside a building during a critical event instead of evacuating.

Resources

About the Workbook for Designing, Implementing & Evaluating a Sharps Injury Prevention Program | by CDC | Webpage with link to 168-page workbook

Glass and other Sharps Injury and Illness Prevention in Labs | by University of Iowa | Webpage

How to Prepare for a Power Failure in a Lab | by University of California at San Diego | Webpage

Laboratories and Power Outages | by Yale University | 2 pages

Laboratory Continuity of Operations (COOP) Planning | by CDC | Online training course

Laboratory Safety Guidance | by OSHA | 52 pages

OSHA Fact Sheet: Laboratory Safety Ergonomics for the Prevention of Musculoskeletal Disorders | by OSHA | 2 pages

Risk Assessment for Clinical Laboratories | by CDC | Transcript of a presentation, plus audio and slides

Safety Management - Hazard Prevention and Control | by OSHA | Webpage with links to resources

Relevant regulations

- The Bloodborne Pathogens standard (29 CFR 1910.1030)
- The Control of Hazardous Energy standard (29 CFR 1910.147)
- The Eye and Face Protection standard (29 CFR 1910.133)
- The Hand Protection standard (29 CFR 1910.138)
- The Hazard Communication standard (29 CFR 1910.1200)
- The Occupational Exposure to Hazardous Chemicals in Laboratories standard (29 CFR 1910.1450)
- The Personal Protective Equipment standard (29 CFR 1910.132)
- The Respiratory Protection standard (29 CFR 1910.134)

References

1. National Research Council (US) Committee on Prudent Practices in the Laboratory. Emergency planning. Prudent Practices in the Laboratory: Handling and Management of Chemical Hazards: Updated Version. Published January 1, 1970. Accessed May 3, 2024. https://www.ncbi.nlm.nih.gov/sites/books/NBK55874/.
2. Centers for Disease Control and Prevention (CDC). Laboratory Continuity of Operations Planning (COOP). OneLab REACH. Accessed May 30, 2024. https://reach.cdc.gov/course/laboratory-continuity-operations-planning-coop
3. CDC. Examples of Applicability and Scope. CDC.gov. Accessed May 30, 2024. https://www.cdc.gov/labtraining/docs/job_aids/lab_coop_planning/Examples_of_Applicability_and_Scope_508.pdf
4. Federal Emergency Management Agency. Natural Hazards. National Risk Index. Accessed July 23, 2024. https://hazards.fema.gov/nri/natural-hazards
5. Palm Beach County, FL. Man-Made Disasters. Published 2024. Accessed July 23, 2024. https://discover.pbcgov.org/publicsafety/dem/Hazards/Man-Made-Disasters.aspx
6. CDC. Fundamentals of Laboratory Safety. OneLab REACH. Accessed May 3, 2024. https://reach.cdc.gov/course/fundamentals-laboratory-safety
7. CDC. Laboratory Onboarding Template. OneLab REACH. Accessed July 23, 2024. https://reach.cdc.gov/jobaid/laboratory-onboarding-template-lot
8. CDC. Lab Safety Portal. CDC.gov. Published November 17, 2020. Accessed May 1, 2024. https://www.cdc.gov/labsafety/index.html
9. U.S. Bureau of Labor Statistics. Clinical Laboratory Technologists and Technicians. Accessed July 23, 2024. https://www.bls.gov/ooh/healthcare/clinical-laboratory-technologists-and-technicians.htm
10. Occupational Safety and Health Administration (OSHA). *Laboratory Safety Guidance*. OSHA.gov. Published 2011. https://www.osha.gov/sites/default/files/publications/OSHA3404laboratory-safety-guidance.pdf
11. OSHA. Laboratory safety ergonomics for the prevention of musculoskeletal disorders. OSHA.gov. Published August 2011. Accessed May 3, 2024. https://www.osha.gov/sites/default/files/publications/OSHA4382.pdf
12. OSHA. Safety Management - Hazard Prevention and Control. OSHA.gov. https://www.osha.gov/safety-management/hazard-prevention#ai1
13. CDC. Introduction to Laboratory Risk Management (LRM). Accessed June 27, 2024. https://reach.cdc.gov/course/introduction-laboratory-risk-management-lrm
14. CDC. Risk Assessment for Clinical Laboratories - Call Materials. CDC.gov. Published January 24, 2024. Accessed May 3, 2024. https://www.cdc.gov/safelabs/resources-tools/Risk_Assessment_Clinical_Laboratories_Call_Materials.html
15. CDC. About the Workbook. CDC.gov. Published February 11, 2015. Accessed May 1, 2024. https://www.cdc.gov/sharpssafety/resources.html

16. CDC. *Workbook for Designing, Implementing, and Evaluating a Sharps Injury Prevention Program*. CDC.gov. Published 2008. Accessed May 1, 2024. https://www.cdc.gov/sharpssafety/pdf/sharpsworkbook_2008.pdf
17. University of Iowa. Glass and Other Sharps Injury and Illness Prevention in Labs. Uiowa.edu. Published 2019. https://ehs.research.uiowa.edu/glass-and-other-sharps-injury-and-illness-prevention-labs
18. University of California San Diego. How to Prepare for a Power Failure in a Lab. Blink: Information for UC San Diego Faculty & Staff. Published October 27, 2022. Accessed May 3, 2024. https://blink.ucsd.edu/safety/research-lab/laboratory/power-failure.html#2.-While-the-power-is-off
19. Yale University. *Laboratories and Power Outages*. Emergency Management. Accessed May 1, 2024. https://emergency.yale.edu/sites/default/files/files/Laboratories-and-Power-Outages.pdf
20. CDC. *Emergency Water Supply Planning Guide for Hospitals and Healthcare Facilities*. CDC.gov. https://www.cdc.gov/healthywater/emergency/pdf/emergency-water-supply-planning-guide-2019-508.pdf
21. OSHA. Laboratory safety OSHA laboratory standard. OSHA.gov. Published August 2011. Accessed May 3, 2024. https://www.osha.gov/sites/default/files/publications/OSHAfactsheet-laboratory-safety-osha-lab-standard.pdf
22. American Chemical Society. Guide for Chemical Spill Response. American Chemical Society. Published 1995. Accessed May 1, 2024. https://www.acs.org/about/governance/committees/chemical-safety/publications-resources/guide-for-chemical-spill-response.html
23. CDC. *Laboratory Response Network for Chemical Threats.* CDC.gov. Accessed May 3, 2024. https://www.cdc.gov/nceh/dls/pdf/306812-A_20thAnniversary.pdf
24. CDC. Chemical Exposure Event. CDC.gov. Published August 23, 2021. Accessed May 3, 2024. https://www.cdc.gov/nceh/dls/lrnc_exposure_event.html