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Guidelines in Case of Emergency

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Overview:
The most common laboratory emergencies include chemical spills, fire or explosion, electric shock, and personnel injuries. Most laboratory accidents occur due to poor planning or lack of attention. Therefore it's always better to prevent accidents (being *pro*active) than having to take any actions during an emergency (being *re*active). Always wear proper personal protective equipment (PPE) in the laboratory. Regular laboratory inspection and equipment maintenance is beneficial to prevent laboratory accidents. However, once the emergency occurs, it's also essential to know what to do. Ensure your personal safety first and call local emergency responders when and if necessary. The extent of your response will depend on the seriousness of the incident and documented laboratory protocol for dealing with such incidences. Keep calm and take proper actions according to the type and level of emergency.

Principles:
Be aware of possible laboratory accidents in advance before working in the lab and prevent accidents from happening by following safety regulations. Take precautions when dealing with hazardous chemicals and/or severe working conditions. Plan in advance what should to be done in all kinds of accidents. In the case of an emergency, keep calm and be safe first. Call local emergency responders for assistance and alert people in the vicinity of the emergency and its potential impact on them. Take proper actions to decrease damage or injuries.

Procedure:
1. General Emergency: Depending on the type of the emergency, there are specific guidelines to follow; however, there are a few general principles to follow for any type of emergency:

    1.1. Keep yourself safe first and keep calm.

    1.2. Call local emergency responders or safety department (*i.e.*, Environmental Health and Safety (EHS)) when possible to report the emergency.

    1.3. Let people nearby be aware of what happened and pull the emergency alarm when and if necessary.

2. Chemical Spills: Chemical spills are the most common accidents when working in a laboratory requiring chemicals. Improper or careless opening, handling, or storage of chemicals might lead to chemical spills. Large-volume spills of a non-hazardous chemical or even a small-quantity spill of a hazardous chemical spill might threaten laboratory personnel's lives. Therefore, caution need to be taken when working with chemicals and always wear proper personal protective equipment (PPE) to prevent bodily exposure in the case of a spill.

    2.1. Chemical spills to surroundings.

2.1.1. Identify the area of the chemical spill and let your laboratory co-workers be aware of the spill. Evacuate the location and surrounding areas of the spill when necessary.

2.1.2. Identify the spilled chemicals and amount of chemical that has spilled. Depending on the hazardous properties and quantities of the spilled chemicals, proper actions need to be taken. Refer to the chemical's safety data sheet (SDS) for hazards assessments.

2.1.3. Minor spills refer to spills of less than 1 gallon of low-hazardous chemicals or less than 20 mL of hazardous chemicals:

2.1.3.1. Wear proper PPE first before taking any action. Care should be taken to avoid bodily exposure to chemicals.

2.1.3.2. If possible, correct the spill source to avoid further issues.

2.1.3.3. If possible, turn off any nearby heat or ignition source if the chemical is flammable.

2.1.3.4. Avoid breathing any vapors from spilled chemicals. This applies especially to chemicals that are toxic and volatile.

2.1.3.5. Locate the spill kit and use appropriate kit tools to confine and contain the spill area.

2.1.3.6. Use suitable adsorbent to cover the spill and neutralize the spill if the chemicals are acidic or basic in nature.

2.1.3.7. Collect the residues and place in a suitable container.

2.1.3.8. Report to EHS in order to dispose of any chemical spill waste.

2.1.3.9. Refill the spill kit.

2.1.4. Major spills refer to spills of larger than 1 gallon of low-hazardous chemicals or larger than 20 mL of high-hazardous chemicals:

2.1.4.1. Secure and evacuate the spilled area immediately.

2.1.4.2. Make sure all people around are aware that a major spill has occurred.

2.1.4.3. Call emergency responders or EHS for help.

2.1.4.4. Never attempt to clean up a major spill even when wearing PPE.

2.1.4.5. If possible without exposure to the spill, shut down the power to any heat source if the spilled chemical is flammable.

2.1.4.6. Help the emergency personnel identify the spilled area when arriving.

2.2. Chemical spill to body.

2.2.1. Wash off all chemicals spilled on body immediately using a safety shower for at least 15 min. If clothes are saturated with spilled chemical, remove clothing immediately.

2.2.2. If the spill splashed into eyes, use eyewash right away for at least 15 min. Open the eyes to allow complete washing. Only attempt to remove contact lenses after eye washing has commenced.

2.2.3. If the spilled chemical is a strong acid, wipe out the residues first before washing to avoid excessive or painful burning.

2.2.4. Remove contaminated cloth immediately to avoid further exposure to chemicals.

2.2.5. Call local responders or EHS for emergency assistance and alert people in the vicinity of the spill.

3. Fire or Explosion

3.1. Fire or explosion may occur from overheating, leakage or spillage of flammable chemicals, or gases exposed to excessive heat, an open flame, or electric sparks in the laboratory. Be careful when working with flammable or explosive chemicals and avoid heat or electric sparks nearby. Safely operate electric equipment and any source of heat to prevent fire or explosion.

3.2. In case of a fire involving an individual's clothing, never run since it might accelerate the fire. Stop, drop on to the ground with hands covering the face, and roll to extinguish the fire. If possible, use safety shower to distinguish the fire.

3.3. In case of lab fire or explosion, ensure your safety first and call emergency responders immediately for help.

3.4. Evacuate the building safely and pull fire alarms or notify people around if possible.

3.5. Don't use elevators. Use stairs and locate the nearest exit.

3.6. If possible, shut down the electric power before evacuating.

3.7. Use a wet tower to cover mouth and nose if the smoke is heavy.

3.8. In case of a small fire, use a proper fire extinguisher and make sure an easy exit is available if you fail in extinguishing the fire. Here we listed the types of extinguisher and discussed the circumstances which one should we use.

3.8.1 Types of fire.
Class A: Ordinary combustible solids such as paper, wood, clothes.
Class B: Flammable liquids such as gasoline, petroleum oil and paint and flammable gases such propane, methane and butane.
Class C: Electrical equipment such as appliances, motors.
Class D: Combustible metals such as sodium, aluminum and potassium.
Class K: Cooling oil and greases such as animal or vegetable fats.

3.8.2 Types of extinguisher.
a. Water and Foam: for Class A fire only. Not suitable for class B or C fires. Water and foam extinguish fire by reducing the heat and foam helps to separate oxygen from objects.

b. Carbon Dioxide: for Class B and C fires. Not effective for Class A fire. Carbon dioxide distinguishes fire by separating oxygen from the object and removing heat.

c. Dry Chemical: multipurpose dry chemical works for Class A, B and C and ordinary dry chemicals works for Class B and C only. Dry chemical extinguishes fire by interrupting the chemical reaction.

d. Wet Chemical: for Class K fire only. Wet chemical extinguishes fire by removing heat and separate oxygen from fuel elements.

e. Clean agent: for Class B and C. Clean extinguisher used halon or halocarbon agents to interrupt the chemical reactions.

f. Dry Power: for Class D only. Dry power takes away heat and separate oxygen to extinguish fire.

3.9. Be safe first and help others if possible.

3.10. Be aware of a second fire or explosion.

4. Personnel Injuries

4.1. Besides chemical spills, fire, or explosion, there are many other accidents that might happen in the lab, such as electric shock, heat burn, bleeding, or poison. Here are some general principles to follow for personnel injuries.

4.1.1. Access the situation before taking any actions.

4.1.2. Ask the person what happened to them first if conscious. Look for possible signs of injury if the person is unconscious and/or unresponsive.

4.1.3. Call local emergency immediately if the person is in danger.

4.1.4. Don’t move the injured people unless danger is imminently present.

4.1.5. If an individual has received an electrical shock, shut down the power first if possible. Do not touch the person with bare hands. Use non-conductive material such as wood, glass, or rubber to pull the person away from the electric contact.

4.1.6. If bleeding from minor cuts, flushed with water to avoid contamination and treated with first aid supplies. If serious cuts, call for medical assistance.

4.1.7. Keep the person warm.

4.1.8. If knowledgeable and willing to help, initiate first aid to help.

Summary:

Emergencies may happen in the laboratory no matter how detailed safety regulations are made. Don’t panic and ensure your safety first before attempting additional action. Assess the situation and call local emergency agencies for assistance. For severe injuries, wait until emergency responders come and don’t take any actions without appropriate knowledge. For minor injuries, use first aid kit to help when necessary.

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