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Mohana Rao A • Vasili Ashok • Kalyani P

Laboratory Precautions & Animal Care



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2 Chapter

Prevention of Laboratory Accidents

In the laboratory, accidents are caused due to chemicals, fire, electricity, infectious samples and improper handling of glassware. By taking care in dealing with these, accidents can be prevented.

CAUSES OF ACCIDENTS

Accidents are caused due to the following (Fig. 2.1).

Acids

Acids are harmful, corrosive and irritant. They may fall or spill during their transfer or usage. They damage the body parts such as skin, eyes, etc. if they fall on them. Give appropriate first aid.

Alkalis

Alkalis are corrosive and sticky. During transport, transfer and usage, they may splash and fall on the body or floor. They damage the body parts. Give appropriate first aid.

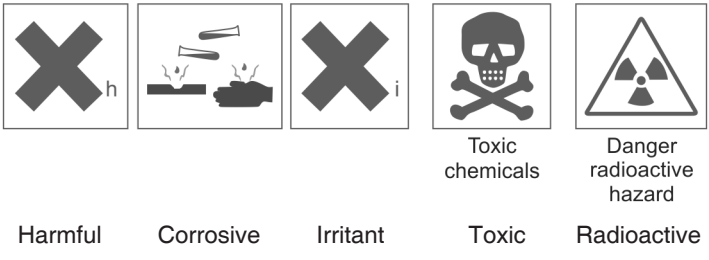

FIGURE 2.1: Various symbols of hazardous chemicals

Toxic Substances

During pipetting, carcinogenic or toxic chemicals may be aspirated into the mouth or get swallowed accidentally. Chemicals like potassium cyanide, sodium azide, mercuric nitrate, formaldehyde, chlorine, bromine, sodium nitroprusside, etc. are toxic chemicals. These, if inhaled or aspirated, come in contact with the skin, mouth, nose, etc. causes irritation and death. Proper labeling with the sign is important for uneducated workers. So, keep these chemicals under lock and key.

Heat

Heat may cause burns or scalds. Unattended boiling or heating leads to loss of chemicals and causes fire accidents.

Flame

Naked flames lead to fire accidents. Unprotected and unattended heating leads to loss of men and material, especially if inflammable chemicals and combustible materials are present nearby.

Broken Glass

Test tubes may break during heating and centrifugation. If these pieces fall on the floor, workers with barefeet may get injured when they walk on them. If they break in hands, the glass pieces may injure the hand. If hot liquid falls on the body, it may cause burns. Any glass apparatus may break during various laboratory operations causing injuries to the workers.

Poisons

Accidental or wanton poisoning may occur in the laboratory as it has many poisonous chemicals. If food is eaten in the laboratory, it may be contaminated with poisonous chemicals or with infectious agents. In such cases, make the worker vomit, if needed. Dilute the poison with large intake of water and administer antidote. Consult the physician. A list of poisons and first aid is mentioned in Chapter 4.

PREVENTION OF ACCIDENTS IN THE LABORATORY

Handling of Acids and Alkalis

Diluting Sulfuric Acid

Take a large beaker of required capacity. Add distilled water up to two-third or three-fourth volume of it. To this beaker, add small quantities (three or four drops at a time) of concentrated sulfuric acid (H_2SO_4) and stir with a glass rod. As this is exothermic reaction, large amount of heat will be evolved. Hence, keep the beaker in a tray containing ice cubes for cooling. After the addition of the required quantity of acid, mix thoroughly and test it for its dilution and normality after cooling. Do not add water to concentrated sulfuric acid. As large amount of heat evolves during the reaction, the solution may boil, spurt or splash causing injuries and accidents to the worker.

Pipetting

Avoid mouth pipetting to prevent accidental swallowing of the caustic, corrosive, infectious, poisonous and toxic reagents, especially acids and alkalis. Use pipettes with rubber bulb, teat and safety bulb or with a mechanical device to avoid accidents (Fig. 2.2).

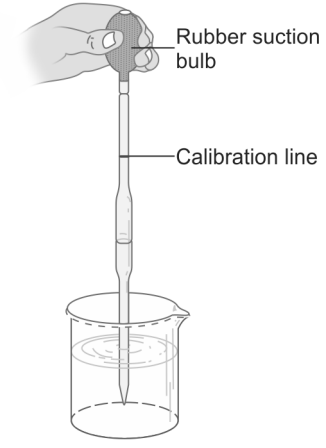

FIGURE 2.2: Suction with rubber bulb

Bottles of Acids and Alkalis

All laboratories generally purchase their annual requirement of chemicals in bulk and store them in large bottles or carboys. Whenever they require, they transfer small volumes of liquid reagents for their daily use in the laboratory. During the transfer, accidents like splashing and spilling of chemicals and breakage of

the bottles may occur. Do not lift large bottles and avoid direct manual transfer of the reagents into small laboratory reagent bottles. Use small plastic devices for transferring reagents from the stock bottles into laboratory reagent bottles. The large stock bottles should be kept in lower racks in storeroom. Both alkalis and acids should not be kept together as their quality may deteriorate during their storage.

Handling Glassware and Liquids

Test Tubes

Test tubes can be made from either soda glass or Pyrex glass. The test tubes made up of soda glass are brittle and cannot withstand heat, while those of Pyrex glass are of superior quality, can withstand heating and are less brittle. Test tubes of inferior quality may break easily because of non-uniformity in the wall thickness, improper annealing, presence of air bubbles in the wall of test tubes, etc.

Ordinary Glass and Pyrex

Different types of glass available with different properties to meet the specific needs. The different types of glass are as follows:

1. Borosilicate glass (similar to Pyrex).
2. Pyrex glass.
3. Soda-lime glass.
4. Treated soda-lime glass.

Borosilicate glass: This is a special type of glass used exclusively for making scientific glassware like conical flasks, test tubes, etc. Flasks made from this special glass resist the action of corrosive chemicals, acids and alkalis, and has a better heat resistance. The heat resistance is due to the presence of boron and aluminum.

Pyrex glass: It is similar to borosilicate glass. It is hard, has high resistance to heat and hence it is used for boiling. The name 'Pyrex' is a trademark.

Soda-lime glass: This is an ordinary glass with no special properties. Soda-lime glass (SLG) is used for preparing glass sheets, bottles, glass trays, cups, stoppers, toys, glass, balls, etc. This glass has least

heat and chemical resistance, and undergoes blooming. This is used for making ordinary storage bottles.

Treated soda-lime glass: The commercial soda-lime glass is exposed to an atmosphere of water vapor plus sulfur dioxide. By such treatment the soda-lime glass acquires special protective character against blooming or weathering. It is known as treated soda-lime glass (TSLG).

Blooming/Weathering

The glass is composed of chemicals like sodium carbonate, oxides of aluminum, boron and silica. The water vapor present in the atmosphere condenses on the glass causing leaching of sodium salts present in it, thus resulting in the uneven surface of the glass. This phenomenon is called blooming or weathering.

Inflammable Liquids

The chemicals like ether, alcohol, acetone, benzene, carbon tetrachloride and toluene have low boiling point or flash point. Hence they easily catch fire. Such liquids are called inflammable liquids. Do not bring naked flames like burning matchsticks, candles or lighted cigarettes near such chemicals. Short circuit of electricity also leads to burning of these chemicals. The chemicals like camphor easily catch fire as they have low flash point or boiling point. Do not open such chemicals near the open flame or burning candles.

Fire Hazards

In the laboratories fire hazards can occur due to the following:

1. Inflammable liquids.
2. Liquefied petroleum gas (LPG) and kerosene stoves.
3. Electric current and short circuits.

Contamination from Infective Materials

Fire and other accidents result in the physical loss of property. But the infections result in individual disability and mental agony. The person becomes a source of infection for spread of diseases among

the neighborhood. The infections could be temporary as in the case of malaria or perpetual as in HIV, hepatitis B diseases.

Here, the society at large may be infected. The laboratory workers, being in touch with the patients, must ensure that they are protected from getting infection by scrupulously following preventive measures and using personal protective wears like, gloves, face masks, washing hands after coming in contact with each patient, etc. He/She must take vaccines to ward off infection. He/She must disinfect hands properly by using disinfectants.

Precautionary Measures

Fire Extinguisher

Fire extinguishers are cylinders filled with carbon dioxide (dry) under pressure. It has a knob. By pressing the knob, the CO_2 gas is released under pressure and is directed on to the flame. It surrounds the flame and prevents its exposure to atmospheric oxygen. Thus, the flame will be extinguished. There are other cylinders, which have thick foam. When the knob is pressed, the foam encircles the flame and cuts off atmospheric oxygen. Due to non-availability of oxygen, the flame gets extinguished.

Keep Sand/Water in Buckets

When there is small flame, it can be extinguished by pouring sand/water over the flame. The flame will be put off as the combustible material is covered with sand and cannot have access to atmospheric oxygen.

Prevent Electrical Short Circuiting

Periodical checkup and replacement of wires, plug points, loose and open ends of current wires prevent accidents. Inflammable liquids/materials, chemicals, cotton rolls and bandages should not be kept near the heaters or in hot air oven.

No Smoking in the Laboratory

Do not smoke in the laboratory as it may cause fire accidents due to the presence of inflammable liquids and combustible materials.

Do not Eat in the Laboratory

The presence of poisonous chemicals, infectious materials, contaminated work benches, etc. may contaminate the food and water. Intake of contaminated food may lead to health hazards. The leftover food residues in the laboratory may invite mice, rodents and birds. Hence, avoid eating in the laboratory.

Safety Measures in the Laboratory

Safety measures to be followed to prevent laboratory accidents are as follows:

1. Always keep the floor dry.
2. Wear shoes while working in the laboratory. Sandals are not safe.
3. Wear a protective covering over the dress (a coat, apron or gown).
4. Broken glassware on the floor must be immediately cleaned with a small broom and a collecting tray (or cardboard).
5. All the broken glassware should be discarded in a separate container, so that it can be handled carefully.
6. Use rubber sheaths, waterproof cords and connecting wires on all equipment to prevent electric shocks.
7. Extension box should not be used except as a temporary measure.
8. Replace all damaged wires, plugs and broken equipment in time.
9. Do not attach a two or three way outlet to a single outlet. This may overload the wire and fire may result.
10. Never place hands on the electrical instruments when the current is 'ON'.
11. If electrical equipment fails to function properly, particularly when smoke is visible or sparks are seen, immediately disconnect the apparatus and notify the maintenance department or the dealer.
12. In case of electric fire, use only a carbon dioxide extinguisher. Never throw water.
13. Never store inflammable chemicals (ether, acetone, alcohol, xylol, etc.) together or in refrigerators. This may lead to explosion.
14. Always store inflammable chemicals in metal containers.

15. Do not use rubber bungs for volatile chemicals as they attack the rubber. Use wax-lined or cork-lined screw caps.
16. Never pour ether down the sink. The best way to dispose ether is to cover spills of ether by cloth or paper towels and let it evaporate under the fume hood.
17. Bunsen burners and electric devices with thermostat should be turned off immediately until the odor has disappeared.
18. Inhalation of toxic fumes or volatile organic compounds can cause difficulty in breathing (asphyxia). In such cases loosen the neck tie and provide the victim with fresh air.
19. Follow the manufacturer's instructions for unpacking and storing chemicals.
20. Use laboratory carts for moving big containers and gas tanks. Move containers slowly and carefully.
21. Promptly enter the articles, especially chemicals in the inventory register or card as soon as they are received.
22. Do not carry too many containers in hands or arms. Instead use plastic buckets.
23. Do not touch solid chemicals with hands. Use a spatula or spoon.
24. Wear aprons and rubber gloves, while handling corrosive chemicals (e.g. strong acids and alkalis).
25. Wear asbestos gloves, while handling dry ice and hot articles.
26. Dispose of chemicals only by recommended procedures.
27. Most chemicals, except solutions with cyanide are discarded during and after use into the sink followed by a copious flow of running water.
28. Trapped acid in the sink may produce dangerous toxic gas (hydrogen cyanide). Discard acids with large amount of running water.
29. Mouth pipetting is dangerous. Use various automated devices available in the market.
30. Pregnant women must not work with radioactive chemicals.
31. Technicians must always wear badges while handling radioactive chemicals and these should be screened at regular intervals.
32. The technician should be replaced temporarily in case of exposure beyond the safety limits of radiation.

33. Special chemicals are used to absorb and clean up spillage of radioactive chemicals.
34. In general, radioactive waste stored for some period returns to non-radioactive harmless ground state and it can then be discarded as any other waste, when the radioactivity is low.
35. Open flames are one of the sources of fire hazard in the laboratory. Never leave them unattended.
36. After installing a new gas cylinder, always check the joints for leakage with soapy water. Leakage of cooking gas or propane from the gas cylinder may cause an explosion.
37. Check the fire extinguisher at least once a year. Recharge it immediately, if necessary.
38. Keep a bucket of sand with a scoop and a fire blanket in ready-to-use condition.
39. In case of fire accident, close all doors and windows to prevent air draft.
40. Use sand, water and a fire blanket to put out a small blaze of fire. Use a fire extinguisher for a large blaze of fire.
41. Do not use water on an electric fire or a fire caused by grease, oil or gasoline. Turn off the electric current and use only a carbon dioxide or foam fire extinguisher, which will not conduct the electric current.
42. Sand is used to smother the fire on grease or oil.
43. While escaping, it is safe to crawl and stay close to the floor.
44. Cover the mouth and nose with a damp cloth to filter out some of the fumes and reduce the danger of inhaling them.
45. Always turn off flame before leaving the laboratory at any time. Never keep an open flame near inflammable liquids.
46. Put 'No smoking' signs in areas where inflammable chemicals are handled.
47. Do not throw burning matches into a waste basket. Throw them into a non-flammable metal container.
48. Specimens should be handled carefully to prevent the spread of infections.

CODE OF CONDUCT FOR MEDICAL LABORATORY TECHNICIAN

1. Dress and appropriate addressing are the primary requisites for laboratory technicians.
2. Place patient's interests above your interests.
3. Be loyal to the profession by:
   a. Updating the skills and professional knowledge.
   b. Maintaining high standard of work.
4. Be honest and have scientific approach to work.
5. Do not misuse the professional skills and knowledge for personal gain.
6. Do not steal or misplace the laboratory articles.
7. Do not disclose the results of investigation to unauthorized persons.
8. Advise the patient for any information to contact officer in charge.
9. Keep the personal information of the patient confidential and never disclose it to others.
10. Never keep the work assigned to you pending, postpone or hand over to your colleague.
11. Be courteous to the patient or his attendant.
12. Maintain team spirit among the laboratory staff.
13. Keep the reagents in proper order. Use them judiciously.
14. Promote health care and prevent spread of infectious diseases among the laboratory staff.
15. In emergency cases, follow the first aid procedures. Keep the first aid kit handy in the laboratory.
16. Use disposables only. Do not recycle the used syringes, needles, etc.
17. Avoid alcohol, smoking and eating in the laboratory.
18. Familiarize well with the apparatus before using.
19. Use the equipment with due care and clean it after use.
20. Be faithful to the organization and adhere to the service conditions.

21. Speech is silver, silence is gold and service is platinum.
22. Always have a positive approach.
23. Avoid professional jealousy.

REVIEW QUESTIONS

1. How do you prevent spread of infectious diseases?
2. What precautions do you take to prevent laboratory accidents?
3. Name the accidents that may occur, while handling glassware, acids and alkalis. How do you prevent them?
4. Who are the risk group categories to get infection? What care they should take to prevent infection?
5. How do you store large stock bottles of acids, alkalis, corrosive chemicals and poisonous chemicals in the laboratory?
6. How do you prepare dilute sulfuric acid solution?
7. How do fire accidents occur? How to prevent them?
8. Write about the code of conduct for medical laboratory technicians.
9. What are the symbols for poisons, radioactivity and inflammable liquids?

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Shelving Recommendation
VETERINARY

ISBN 978-93-5152-449-6

9 789351 524496

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