SECTION

2

BIOSAFETY

Biomedical Science in Society

Biosafety

INTRODUCTION

Biomedical science involves the study of biological processes and mechanisms underlying health and disease. In this section, you will explore the concept of biohazards, which are biological agents capable of causing harm to living organisms, including humans. Understanding the various types of biohazards and their associated risk groups is crucial (important) for safeguarding public health and ensuring safety in laboratory and healthcare settings. You will also look at pathogens. What they are and the various ways one can be exposed to these diseases-causing microorganisms.

To crown the section, the high-risk nature of the laboratory environment and acquiring laboratory infections will be studied. Here, you will explore what laboratory acquired infections are, how they happen, and how to prevent them. You will also analyse some real-life cases to foster your understanding of LAIs.

At the end of this section, you should be able to:

- Discuss various biohazards as well as the risk groups.
- Explain the routes of exposure of pathogens to humans.
- Analyze laboratory-acquired infections (LAIs), including some case studies.

Key Ideas:

- Biohazards are biological agents that pose a threat to human health or the environment.
- Biohazards are classified into different risk groups based on their level of pathogenicity (meaning it's very likely to cause a disease or make you feel unwell) and potential for transmission (spread).
- Understanding biohazards and their risk groups is essential for effective risk assessment and management in biomedical science.
- Pathogens are microorganisms that cause disease in hosts and include bacteria, viruses, fungi, and protozoans.
- Pathogens can be found everywhere in the environment and in the bodies of humans, animals, and plants.
- Pathogens spread through direct contact, ingestion of contaminated food or water, airborne droplets, and insects such as mosquitoes or ticks.
- Laboratory workers can contract Laboratory-Acquired Infections (LAIs) from exposure to infectious agents or materials
- Prevention of LAIs include using suitable Personal Protective Equipment (PPE), following Standard Operating Procedures (SOPs), proper waste management, and classifying laboratories into biosafety levels with containment measures.

BIOHAZARDS

Biohazard may be defined as:

a. A biological substance or infectious agent that poses a threat to the health or well-being of living organisms, especially humans and animals.

b. Any biological material such as bacteria, viruses, toxins, or other microorganisms that has the potential to cause harm.

Categories of Biohazards

Biohazards are found everywhere in the environment. They can be categorized into:

Biological agents: bacteria, viruses, fungi, other microorganisms and their associated toxins.

Biotoxins: poisonous substances produced by living organisms for example snake poison.

Clinical samples: for example, blood, urine, faecal matter.

Medical waste: for example, used syringes, needles, contaminated dressing, laboratory specimens.

Biohazard Symbols

There are widely recognized symbols used to show that hazardous biological materials are present. These symbols are meant to warn people about possible dangers and remind them to take the right precautions. The basic biohazard symbol is shown in Figure 2.1(a). Other specific biohazards are shown in Figure 2.1(b) and (c).

(a) (b) (c)

Fig 2.1 Biohazard Symbols

Risk Levels of Biohazards

Biohazards are categorized into different levels based on their risk levels to both human health and the environment. These levels are commonly known as Biosafety Levels (BSL).

Biosafety Level 1 (BSL-1): This level indicates the lowest risk among biohazardous substances. It includes non-pathogenic microorganisms that do not cause diseases in healthy individuals. For example, *Escherichia coli* strains used in laboratory experiments.

Biosafety Level 2 (BSL-2): This level involves working with biohazardous materials that pose a moderate risk of infection or disease. Common pathogens like *Staphylococcus aureus, Salmonella, hepatitis B* and *C* viruses, and certain strains of influenza virus fall into this category.

Biosafety Level 3 (BSL-3): This level involves handling biohazardous materials with a high risk of causing serious diseases through inhalation. Microorganisms capable of causing severe or potentially lethal illnesses, such as Mycobacterium tuberculosis, SARS-CoV-2 (COVID-19), Yellow fever, Dengue fever, and Zika viruses are classified at this level.

Biosafety Level 4 (BSL-4): pathogens that pose the highest risk of disease for which there are no treatments or vaccines. Examples include the Ebola virus and the Lassa virus.

Activity 2.1: Biohazard Classification:

1. Click here to watch a video on biohazards
2. Observe and identify any biohazard in the video

Activity 2: Forms of biohazards and their risks:

A **B**

Fig 2.2 (A) Refuse dump (B) Discharge of raw sewage from a clinic into a river

Figure 2.2

1. Critically look at Figures 2.2 (A) and (B)
2. Identify various types of biohazards in the two scenarios within the community
3. Determine the potential negative outcome (s) of the hazards

4. Educate a friend in your community or school about the negative impacts of biohazards and their risk levels

Extended Reading:

1. Staying Safe in Labs: What You Need to Know. https://content.iospress.com/articles/cancer-biomarkers/cbm00183
2. Learning About New Germs: Why It Matters. https://doi.org/10.4324/9781912128273
3. The Science of Genetics: How GMOs Are Made and Used. https://doi.org/10.3390/su10051514

PATHOGENS AND HOW THEY ARE SPREAD

Understanding how pathogens spread in humans is crucial for controlling infectious diseases, which remains a major public health concern. In this section, you will explore what pathogens are, the different types with some examples, and the ways one can be exposed to pathogens. This knowledge on pathogens and their routes of exposure will help you to avoid infections and practice proper hygiene.

Now! let us look at what pathogens are, types and some common examples.

Pathogens are microorganisms such as bacteria, viruses, fungi, or protozoans that have the potential to cause disease in their hosts. These microorganisms can be found all around us in the environment, including in soil, water, air, food, and on surfaces. They can also be present in the bodies of humans, animals, and plants. Pathogens can spread in different ways, such as through direct contact, ingestion of contaminated food or water, through the air (airborne droplets), and insects such as mosquitoes or ticks.

Types and Examples of Pathogens

Bacteria: These are microscopic single-celled organisms found in various environments and can cause a wide range of infections. Examples of bacteria include *Escherichia coli* (E. coli), *Staphylococcus aureus*.

Viruses: Viruses are sub-microscopic infectious agents which cause several viral diseases. Some examples of viruses include influenza virus, human immunodeficiency virus (HIV), and SARS-CoV-2 (Coronavirus).

Fungi: Fungi (singular: fungus) are a group of organisms that can cause infections in humans, especially those with a weakened immune system. Examples of pathogenic fungi include *Candida albicans* and *Aspergillus species*.

Fun fact: Just so you know, edible mushrooms are non-pathogenic (harmless) fungi.

Protozoans: Protozoans can be free-living or parasitic, causing infections and diseases in humans. Examples of protozoans include *Plasmodium falciparum* which is the malaria parasite and *Giardia lamblia* which causes diarrhoea.

Routes of Pathogens Exposure

Routes of pathogen exposure describe the various ways in which pathogens can enter and infect a host organism. These routes can vary depending on the type of pathogen and its mode of transmission. Some common routes of pathogen exposure include:

Direct Contact: Pathogens and infectious diseases can spread by directly touching an infected person or their bodily fluids, touching someone with a skin infection like herpes simplex virus, contact with one with a Staphylococcus aureus infection, shaking hands, or handling contaminated objects as well as sexual contact with an infected person can directly transmit pathogens.

Inhalation route: Some pathogens are spread in the air through droplets when an infected person coughs, sneezes, talks, or breathes. These tiny droplets can remain suspended in the air for a period and be inhaled by nearby individuals, leading to an infection. Examples of this way of exposure include spread of influenza virus (which causes flu), tuberculosis, common colds, and SARS-CoV-2.

Ingestion (Faecal-oral Route): Pathogens can enter the body through the ingestion of contaminated food and water. This contamination can occur during production, processing, handling, or storage and consumption of food and water. The ingestion of objects contaminated with faecal matter can also cause infection leading to diseases such as cholera (Vibrio cholerae) and typhoid fever (Salmonella typhi).

Inoculation (Vector-borne Transmission): Some pathogens are transmitted through the bites of insects (vectors) such as mosquitoes, ticks, fleas, or flies. When the vectors bite during feeding, they introduce pathogens into the blood stream which can cause diseases like malaria (transmitted by mosquitoes) and dengue fever (transmitted by mosquitoes).

Activity 1: Ingestion (Faecal-oral route)

Pair up with one of your mates to share your experience(s) of something you ate that led to a stomach upset.

1. Think about a time you had a stomach upset after eating a particular food.
2. What did you eat?
3. How do you think it might have been contaminated?
4. How did you treat the food or water before ingestion?
5. How did you feel afterwards?
6. What pathogen do you think caused the stomach upset?
7. What did you learn from this experience?
8. What will you do differently to avoid such an infection.
9. Research other pathogens that could cause a similar infection.

Activity 2: Pathogen transmission (Direct contact and Ingestion)

1. Pair up with a classmate, a friend, or a relative.
2. Scan the QR codes (both **A** and **B**) or click on the following links: **A** *(Direct contact of transmission of pathogens)* *and* **B** *(Ingestion method of transmission of pathogens)* to watch videos on transmission of pathogens.
3. Share what you observed in the videos.
4. Discuss the role of proper handwashing on the transmission of pathogens.

A (Direct Contact)

B (Ingestion)

Activity 3: Pathogen Transmission (Direct contact)

1. Pair up with a classmate, a friend, or a relative.
2. One of you will volunteer to have non-toxic powder or dye applied to your bare hands.
3. Interact with each other by shaking hands, touching comfortable body parts, surfaces, and items.
4. Observe how the powder or dye transfers from the volunteer to the other person, surfaces, and items.
5. Afterward, the volunteer should wash off the powder or dye with water and soap and repeat the same interactions.
6. Discuss with your partner how the powder or dye transferred from the volunteer to the other person, surfaces, and items.
7. From the previous discussion, relate the transfer of the powder or dye from one person to the other, surfaces, and items to infectious disease and pathogen transmission.

Activity 4: Inhalation as a Route of Pathogen Exposure (Perform this activity in school under strict supervision)

Material needed

a. Choose a material to perform the experiment (A scented substance such as perfume, essential oil, ammonia, formalin, methylated spirit/ethanol, burnt dried orange leaves, food with aroma)
b. An enclosed space/room

Procedure

a. In a group, choose a corner of the room to conduct the experiment.
b. Choose a volunteer or a group leader to be in one corner of the room.
c. Spread out to different points in the room away from the corner.
d. The volunteer/leader sprays or opens the scented material and moves away to a safe space.
e. Breathe normally and observe any changes in scent as the substance disperses into the air.
f. Share observations on when the scent was first noticed and how it spread throughout the room.
g. Discuss how the demonstration reflects the spread of pathogens through inhalation.

Caution

a. Avoid this demonstration if you are asthmatic or have other respiratory challenges to prevent triggers or allergies.
b. Avoid hazardous substances.
c. Do not directly inhale from the scented material.
d. Only use formalin under strict supervision and following the right standard operating procedure (SOP).
e. You should maintain proper ventilation in the room during the activity.

Self-Reflection

1. Consider a time you had malaria.
2. How did you know you had malaria?
3. What were the symptoms you suffered when you had malaria?
4. How do you think you contracted malaria?
5. How do you think malaria is transmitted?
6. Do you think you could have transmitted the malaria to other members of your household? (hint: Malaria cannot be transmitted from one person to the other).

7. How do you think you can protect yourself and your household or community from malaria?

Extended Reading

1. To read more on pathogens and their route of transmission click here.
2. To explore more diseases caused by pathogens click here.
3. For further information on infection control and prevention, click here.
4. To watch a video on routes of pathogen transmission, click *here* or here.
5. To watch an animated video on how Malaria spreads in the body, click here.

LABORATORY-ACQUIRED INFECTIONS (LAIs)

Due to the high-risk nature of the laboratory environment, biomedical scientists stand the risk of acquiring laboratory infections. Remember, laboratories (Labs) are places where scientists work with microorganisms, chemicals, and other materials to conduct experiments and make discoveries.

Let's Look Further into LAIs

Laboratory-Acquired Infections (LAIs) are infections that affect laboratory workers as a result of occupational exposure to infectious agents or materials. These infections can range from mild to severe.

LAIs often occur from accidental contact with pathogens through contaminated samples, inhaling infectious particles, needle pricks, or through other routes.

Sources of Laboratory-Acquired Infections

Pathogenic microorganisms: Laboratory workers handle various harmful microorganisms, such as bacteria, viruses, fungi, and protozoa and accidental exposure to these microorganisms can cause infections

Improper handling of infectious materials: Not handling contaminated samples properly can put laboratory workers at risk and increase laboratory-acquired infections (LAIs). This includes incorrect use of PPE, poor disinfection, and mishandling sharp objects.

Accidental needle sticks or sharps injuries: Laboratory workers using needles or sharp objects risk injuries. If these objects have touched infectious materials, they can transmit infections to the workers.

Preventions of Laboratory-Acquired Infections

Though LAIs happen when a laboratory personnel is accidentally exposed to pathogens, there are some preventive measures that can reduce the risk of these accidents and

infections in the laboratory environment. Let us consider the following:

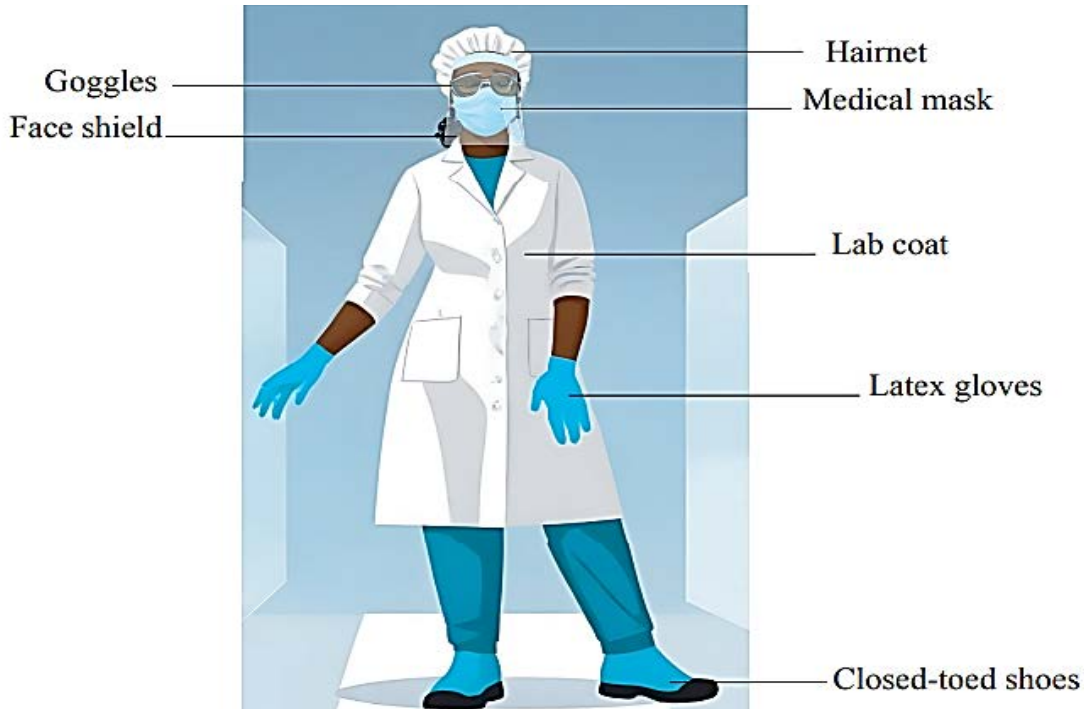
Personal Protective Equipment (PPE): Choose suitable PPE according to the type of work being done. Examples include wearing gloves, lab coats, face masks, hair nets, face shields, closed-toe shoes, and safety goggles (See *figure 1*). Ensure the PPE fits well, and always wear it for the best protection.

Standard operating procedures (SOPs): These are set of rules or guidelines for handling hazardous materials, disposing of waste properly, decontamination processes, emergency response actions, cleanliness, proper labelling, storage of chemicals, and keeping accurate records. It is important to develop and follow SOPs for all lab activities. SOPs should be reviewed and updated regularly.

Waste Management: Strictly follow proper handling and disposal of laboratory waste, like needles, contaminated materials, and biological waste. This can be done by using special containers, autoclaving or disinfecting waste, and following local waste disposal rules.

Biosafety Levels and Containment: Laboratories should be classified into biosafety levels (BSL) based on the pathogens handled there (Check biosafety levels). Use things like biosafety cabinets, glove boxes, or special rooms to keep microorganisms from spreading and to lower the chance of lab workers getting infections.

Training and Monitoring: Everyone in the lab needs to learn about lab safety, like how to handle dangerous stuff and use safety gear right. We also need to check the lab regularly to make sure everything is safe and fix any problems we find.



Activity 1: Rules in the classroom and how they relate to SOPs

1. Recall some of the rules governing biomedical science class and other classes
2. Write down some of these rules
3. Which ones do you find easy or difficult to follow?
4. Share with your colleagues the importance of these rules and regulations?
5. How are these classroom rules similar to SOPs?
6. List other areas or organisations within your community which are governed rules and regulations?

Activity 2: Personal Protective Equipment (PPE)

1. Scan the QR code below or click on this link to watch a video on personal protective equipment.

Personal Protective Equipment

2. Identify the various PPEs you observed in the video
3. Why do you think the laboratory worker wore all the PPEs you identified?
4. What could happen if the laboratory worker failed to wear those PPEs?

Activity 3: Standard Operating Procedures (SOPs)

Scan the Quick Response (QR) code below or click on this link to watch a video on SOPs

1. How would you explain SOPs?
2. Write down some importance of SOPs
3. Besides the lab environment, which other industries, organisations or institutions could benefit from SOPs?
4. How would you apply the concept of SOPs in your daily activities?
5. Do you think SOPs should be updated regularly? Why?

Standard Operating Procedures

Activity 4: Biosafety Levels and Prevention of Laboratory Acquired Infections

Scan the QR code below or click here to watch a video on laboratory safety and infection control.

Laboratory safety and infection control

1. What are the different biosafety levels in order of increasing risk you identified in the video.
2. Write down some general safety precautions in the laboratory.
3. When would you practice hand hygiene in the laboratory?
4. Why do you think hand hygiene is the single most important means of preventing the spread of infections.
5. How does your knowledge of SOPs help in the prevention of laboratory acquired infections?
6. Based on what you have come to know from the video, how will you conduct yourself in the laboratory to avoid LAIs?

Activity 5. Field trip (To be done at school or in a facility outside school under strict supervision)

1. Visit your school's lab (or a lab outside school or listen to a biomedical scientist) for a talk on LAIs.
2. Be obedient, respectful and pay attention to details
3. During this visit or presentation, write down some examples of LAIs, their sources, and methods of prevention.
4. Share your experience with a friend, colleague or relative.

Sample Case Study: Accidental Spill of Infectious Material

During an experiment, a lab technician accidentally spills a culture of *E. coli* onto the lab bench.

Questions:

1. **What immediate actions should be taken after an infectious spill?**

   Hint: Stop working, contain the spill, clean it with disinfectants, and report the incident.

2. **Why is proper pipetting technique important in preventing spills?**

   Hint: It reduces the risk of creating Splashes and tiny airborne particles (aerosols)

3. **How does using PPE help in spill scenarios?**

   Hint: PPE protects the skin and eyes from exposure to infectious materials.

Preventive Measures:

1. **Use Spill Trays**: Place all cultures in spill trays to contain spills.
2. **Proper Pipetting Techniques**: To prevent splashes, don't push liquids out forcefully.
3. **PPE Usage**: Always wear gloves, lab coats, and safety goggles to protect against splashes.
4. **Spill Response Training**: Staff should be trained on how to respond to spills quickly and safely.

Extended Reading

- Laboratory Safety: Principles and Practices by Diane Fleming and Debra Hunt. Click *Here*
- or search (3. BIOSAFETY PRACTICES AND PROCEDURES | Biosafety Program (utk.edu)
- Biosafety in Microbiological and Biomedical Laboratories (BMBL). *Click here* or search (Biosafety in microbiological and biomedical laboratories (cdc.gov))
- CDC Website on Laboratory Safety. *Click here* or search **(**Lab Safety Portal | CDC)

REVIEW QUESTIONS 2

REVIEW QUESTIONS 2.1

1. What are biohazards, and why is it important to understand them in biomedical science?
2. What are the main types of biohazards, and how are they classified?
3. Describe the different risk groups of biohazards and provide examples of biohazards within each group.

REVIEW QUESTIONS 2.2

Case Study

Four friends, Abdullai, Esi, Edem, and Nhyiraba, went on a trip to Lake Volta. When they arrived at their hotel, Edem and Esi ate a welcome dinner, while Abdullai went swimming with other guests. Nhyiraba was already full and tired, so she rested by the bank of the Volta River near the hotel.

The next morning, Esi and Edem woke up with severe stomach cramps, nausea, vomiting, and diarrhoea. The hotel suspected food poisoning from contaminated food. It was later discovered that one of the kitchen staff did not wash his hands properly after using the toilet while preparing dinner. Meanwhile, Abdullai developed a cough, chest tightness, and difficulty breathing. The doctor diagnosed him with a respiratory illness.

Nhyiraba took care of her three sick friends. Three days later, Nhyiraba started feeling feverish, with chills, weakness, a severe cough, chest tightness, headache, and difficulty breathing. She was diagnosed with malaria and a respiratory disease. Nhyiraba then mentioned that she had been bitten by mosquitoes while sleeping by the Volta River.

a. List three routes of pathogen exposure you can identify as a probable route for infection in Nhyiraba
b. Name two types of pathogens that can cause the symptoms observed in Edem and Esi and give two examples of each type.
c. How could the food Edem and Esi ate have been contaminated?
d. What route of pathogen exposure may have facilitated the transfer of pathogens from the improperly washed hands of the kitchen staff to the food?
e. What route of pathogen exposure was involved when Edem and Esi ate the contaminated food?
f. Name two bacteria that can cause the infection in Edem and Esi.
g. How could Abdullai have contracted the respiratory disease?
h. How did Nhyiraba get the respiratory disease?

i. What could have led to malaria in Nhyiraba?

j. How was the malaria parasite (Plasmodium) transmitted to Nhyiraba? *Compare your answers with your friends and discuss them in class at the beginning of the next lesson.*

REVIEW QUESTIONS 2.3

1. **Case study 1**

A lab technician is working with a culture of Salmonella in a petri dish. While transferring the culture using a pipette, they accidentally knock over the dish, causing the liquid to spill onto the lab bench. Some of the liquid splashes onto the technician's face and lab coat.

a. What immediate steps should the lab technician take to minimize the risk of infection following the splash?

b. Why is it important to wear face shields or goggles and lab coats when handling infectious materials?

c. How can such splashes be prevented in the future to avoid laboratory-acquired infections?

2. **Case study 2:**

While working in a biosafety cabinet, a researcher accidentally creates an aerosol when pipetting a solution containing Mycobacterium tuberculosis. The researcher inhales some of the aerosol.

a. What should the researcher do immediately after potentially inhaling an aerosolized pathogen?

b. Why is it crucial to work within a biosafety cabinet when handling airborne pathogens, and what might have gone wrong in this case?

c. What follow-up actions should be taken to monitor and ensure the researcher's health after this incident?

3. **Case study 3:**

A lab worker accidentally pricks their finger with a needle that was used to inject a rabbit with a culture of Brucella.

a. What are the first aid steps the lab worker should take immediately after the needle stick injury?

b. Why are needle stick injuries particularly concerning in a laboratory setting?

c. What preventive measures can be implemented to reduce the risk of needle stick injuries in the future?

4. Why must proper waste disposal be strictly practiced in the laboratory always?

5. Why should PPE be considered in the laboratory setting?

6. What is the relevance of SOPs to biomedical science practice in society

ANSWERS TO REVIEW QUESTIONS 2

ANSWERS TO REVIEW QUESTIONS 2.1

1. Biohazards are biological agents that pose a threat to human health or the environment. Understanding them is crucial for ensuring safety in laboratory and healthcare settings.
2. The main types of biohazards include infectious agents, biological toxins, genetically modified organisms (GMOs), and human and animal tissues. They are classified based on their risk of causing harm and their potential for transmission.
3. The risk groups of biohazards range from RG1 to RG4, with increasing levels of pathogenicity and potential for transmission. Examples include RG1: non-pathogenic bacteria, RG2: influenza virus, RG3: tuberculosis bacteria, and RG4: Ebola virus.

ANSWERS TO REVIEW QUESTIONS 2.2

a. Inhalation route, direct contact, and inoculation (vector-borne) transmission

b. Bacteria (Salmonella, E. coli), Viruses (HIV, Influenza virus), Fungi (Candida albicans, Aspergillus), Protozoa (Plasmodium falciparum, Giardia lamblia)

c. The food Edem and Esi ate could have been contaminated because one of the kitchen staff did not wash his hands properly after using the toilet. This poor hygiene practice could have transferred bacteria from the faeces to the food during its preparation.

d. Direct contact (Pathogens from faeces contaminated the food)

e. Ingestion (Faecal-oral route. Edem and Esi consumed the contaminated food, which introduced the pathogens into their gastrointestinal systems.

f. Two bacteria that can cause such infections are Salmonella and Escherichia coli (E. coli)

g. Abdullai could have contracted the respiratory disease by inhaling water droplets, airborne pathogens or mist contaminated with pathogens.

h. Nhyiraba likely contracted the respiratory disease through close contact with Abdullai while caring for him (as respiratory illnesses can spread through air droplets when an infected person coughs or sneezes).

i. Malaria in Nhyiraba could have been caused by mosquito bites while she was resting by the bank of the Volta River.

h. The malaria parasite was transmitted to Nhyiraba through the bite of an infected Anopheles mosquito, which carries the Plasmodium parasite.

ANSWERS TO REVIEW QUESTIONS 2.3

Hint to Case studies:

1. **Case study 1**
    a. The technician should immediately stop working, wash the affected area on their face with plenty of water, remove the contaminated lab coat, and clean the spill using appropriate disinfectants. They should also report the incident to their supervisor and seek medical evaluation if necessary.
    b. Wearing face shields or goggles and lab coats provides a barrier that protects the skin and mucous membranes (eyes, nose, mouth) from exposure to infectious agents, reducing the risk of infections.
    c. To prevent splashes, lab personnel should use proper pipetting techniques, work carefully, and ensure that containers are stable. Additionally, using splash guards and working within a biosafety cabinet can help contain spills and splashes.
2. **Case study 2**
    a. The researcher should leave the area, inform their supervisor, and seek medical advice immediately. They should also report the incident to the safety officer and follow any recommended procedures for monitoring and treatment.
    b. Biosafety cabinets provide a controlled environment that contains aerosols and prevents them from escaping into the lab. In this case, improper pipetting technique or failure to properly maintain the biosafety cabinet might have led to the aerosol exposure.
    c. The researcher should undergo medical evaluation and possible testing for tuberculosis. Regular health monitoring and follow-up appointments should be scheduled to check for any signs of infection.
3. **Case study 3**
    a. The worker should immediately wash the wound with soap and water without scrubbing. They should apply an antiseptic and cover the wound with a sterile bandage. The incident should be reported, and the worker should seek medical evaluation.
    b. Needle stick injuries are concerning because they can directly introduce infectious agents into the bloodstream, leading to a high risk of infection. This is especially critical when working with pathogens like Brucella that can cause serious illness.
    c. To reduce needle stick injuries, use safer needles, train lab workers in proper handling and disposal, and ensure everyone wears protective gear. Establish clear rules for needle use and accident response, conduct regular safety checks, and promote safety discussions. Collaboration with others helps improve lab safety by implementing best practices and tools.

4. Proper waste disposal prevents contamination, reduces the risk of laboratory-acquired infections, and maintains a safe working environment.
5. PPE protects you from potential exposure to harmful substances and ensures safety while working in the lab. PPE protects the user from possible harm.
6. SOPs provide clear instructions on how to handle materials, use equipment, and dispose of waste safely. SOPs also save time, prevent injuries,

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