MEDICAL LABORATORY

NTQF Level III

Learning Guide -42

Unit of Competence: -	**Prepare Laboratory Solutions**
Module Title: -	**Preparing Laboratory Solutions**
LG Code:	**HLT MLT3 M08 LO4-LG-42**
TTLM Code:	**HLT MLT3 TTLM 1019v1**

LO 4: Maintain safe work environment

Instruction Sheet	Learning Guide #-

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics –

- Safety precautions for use of laboratory equipment and hazardous chemicals/reagents
- Using Appropriate laboratory glassware and measuring equipment
- Safe work practices and using personal protective equipment
- Cleaning of splashes of chemicals
- Waste generation and safe environment
- Waste management and disposal
- Cleaning and storage of glass ware
- Reagent storage according to OHS standard

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, **you will be able to –**

- Apply Appropriate safety precautions for use of laboratory equipment and hazardous chemical materials
- Use appropriate laboratory glassware and measuring equipment
- use established safe work practices and PPE to ensure personal safety and that of other laboratory personnel
- cleaned up Spills by using appropriate techniques to protect personnel, work area and environment
- minimize Generation of waste and environmental impacts
- ensure The safe collection of laboratory hazardous waste for subsequent disposal
- clean and store Glassware and equipment in accordance with enterprise procedures
- store equipment and reagents as required

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information “Sheet 1, Sheet 2, Sheet 3 and Sheet 4,---”**in page ---, ---, --- and ---** respectively.
4. Accomplish the “Self-check 1, Self-check t 2, Self-check 3 and Self-check 4” ,---”**in page ---, ---, --- and ---** respectively
5. If you earned a satisfactory evaluation from the “Self-check” proceed to “Operation Sheet 1, Operation Sheet 2 and Operation Sheet 3 ”**in page ---.**
6. Do the “LAP test” **in page – ---**

Information Sheet-1	**Appropriate safety precautions are applied for use of laboratory equipment and hazardous chemical materials**

1.1. Introduction

- First of all, pay attention to what you are doing and what you are working with. Always wear safety equipment when working with dangerous chemicals. Recognize any accidents immediately. Keep food and drinks out of the laboratory work area. Always read labels of chemicals carefully.
- Never do unauthorized experiments. Never work alone in laboratory. Keep your lab space clean and organized. Do not leave an on-going experiment unattended. Always inform your instructor if you break a thermometer. Do not clean mercury yourself!!Never taste anything. Never pipette by mouth; use a bulb. Never use open flames in laboratory unless instructed by TA. Check your glassware for cracks and chips each time you use it. Cracks could cause the glassware to fail during use and cause serious injury to you or lab mates. Maintain unobstructed access to all exits, fire extinguishers, electrical panels, emergency showers, and eye washes. Do not use corridors for storage or work areas. Do not store heavy items above table height. Any overhead storage of supplies on top of cabinets should be limited to lightweight items only. Also, remember that a 36" diameter area around all fire sprinkler heads must be kept clear at all times. Areas containing lasers, biohazards, radioisotopes, and carcinogens should be posted accordingly. However, do not post areas unnecessarily and be sure that the labels are removed when the hazards are no longer present. Be careful when lifting heavy objects. Only shop staff may operate forklifts or cranes. Clean your lab bench and equipment, and lock the door before you leave the laboratory.

- Never mix two unknown chemicals. Wipe spill of chemicals immediately. In case if contact with chemical, rinse it off immediately with lots of water. Never taste, smell or touch anything chemical. Coats, backpacks, etc., should not be left on the lab benches and stools. Always wash your hands before leaving lab. Learn where the safety and first-aid equipment is located (fire extinguishers, fire blankets, and eye-wash stations)

- Consider **all** chemicals as if hazardous. Only liquid be put in the lab sinks. Always pour acids into water. Never leave burners unattended. Label all materials clearly. Never pipette anything by mouth. Clean up your work area before leaving. Avoid working alone. Do not use flammable liquids near open flames.

- ✓ Treat every chemical as if it were hazardous. Make sure all chemicals are clearly and currently labeled with the substance name, concentration, date, and name of the individual responsible.

- ✓ Never return chemicals to reagent bottles. (Try for the correct amount and share any excess.)Comply with fire regulations concerning storage quantities, types of approved containers and cabinets, proper labeling, etc. If uncertain about regulations, contact the building coordinator. Use volatile and flammable compounds only in a fume hood. Procedures that produce aerosols should be performed in a hood to prevent inhalation of hazardous material. Never allow a solvent to come in contact with your skin. Always use gloves. Never "smell" a solvent!! Read the label on the solvent bottle to identify its contents. Dispose of waste and broken glassware in proper containers. Clean up spills immediately. Do not store food in laboratories.

- ✓ Do not use any equipment unless you are trained and approved as a user by your supervisor. Never eat, drink, or smoke while working in the laboratory. Shorts and sandals should not be worn in the lab at any time. If you have long hair or loose clothes, make sure it is tied back or confined

- ✓ Turn off all ignition sources and lock the doors when leaving. Properly dispose wastes and used material in appropriate containers. Never return chemicals to reagent bottles.

1.2. ***Personal and General laboratory safety***

- ✓ Never eat, drink, or smoke while working in the laboratory. Read labels carefully. Do not use any equipment unless you are trained and approved as a user by your supervisor. Wear safety glasses or face shields when working with hazardous materials and/or equipment. Wear gloves when using any hazardous or toxic agent. Clothing: When handling dangerous substances, wear gloves, laboratory coats, and safety shield or glasses. Shorts and sandals should not be worn in the lab at any time. Shoes are required when working in the machine shops. If you have long hair or loose clothes, make sure it is tied back or confined. Keep the work area clear of all materials except those needed for your work. Coats should be hung in the hall or placed in a locker. Extra books, purses, etc. should be kept away from equipment, that requires air flow or ventilation to prevent overheating. Disposal - Students are responsible for the proper disposal of used material if any in appropriate containers. Equipment Failure - If a piece of equipment fails while being used, report it immediately to your lab assistant or tutor. Never try to fix the

problem yourself because you could harm yourself and others. If leaving a lab unattended, turn off all ignition sources and lock the doors. Never pipette anything by mouth. Clean up your work area before leaving. Wash hands before leaving the lab and before eating.

Self-Check -1	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-2	Using Appropriate laboratory glassware and measuring equipment

2.1 Introduction/definition of terms/concepts/overview/principles

2.2 Components/Classification/Types/parts

2.3 purpose/use/Importance/advantages and dis advantages

2.4 OHS hazards and suitable PPE

2.5 Necessary tools and equipments

2.6 Rules to follow

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-3	Safe work practices and using personal protective equipment

3.1. Introduction

- Safe laboratory practice is based on understanding and respect, not fear; the regulations intended to help you work safely with chemical reagents. Before beginning an experiment, be sure you have this information at hand and that you understand it. Do not hesitate to consult or questions about any experiment or about the regulations.

3.2. General safety rules in the lab

- Safety goggles must be worn at all times in the laboratory.
- No eating or drinking in the laboratory.
- Never taste or touch the laboratory chemicals.
- Always wash your hands before leaving the laboratory.
- Wear proper clothing: safety glasses, closed-toed shoes, and an apron; tie long hair back and remove all jewelry.
- Always follow the written directions, and never perform an unauthorized experiment.
- Always add acid to water. This prevents the acid from spatter.
- Point heating test tubes away from others and yourself, and heat them slowly.
- Never return unused chemicals to their original containers. This prevents contamination.
- Always use a pipette bulb or a pipetter to transfer when using a pipette. Never use your mouth.
- Always use a fume hood when working with toxic substances. Never inhale fumes directly.
- Never use an open flame near flammable liquids.
- Dispose of chemicals in the designated disposal site—not in the sink or trash can.
- Use laboratory equipment for its designed purpose only
- Use warning signs to designate particular hazards
- Never put solids in the sink

3.3. Personal protective equipment (PPE)

- PPE is comprised of clothing or equipment that is used to isolate a worker from direct exposure to workplace hazards.

- It is used to provide worker health and safety.
- PPE provide adequate protection if it is properly worn and appropriately used.
- PPE examples include:
  - ✓ Partial and full body protective garments (aprons, lab coats and coveralls)
  - ✓ Headwear
  - ✓ Face and eyewear (goggles and mask)
  - ✓ ·Gloves
  - ✓ Footwear (shoe covers/boots)
  - ✓ Respirators (disposable, air purifying and air supplied)
  - ✓ Hearing protectors (earplugs and earmuffs)

3.4. Guidance for the Selection and Use of Personal Protective Equipment (PPE) in Healthcare Settings

- Types of PPE Used in Healthcare Settings
  - ✓ Gloves – protect hands
  - ✓ Gowns/aprons – protect skin and/or clothing
  - ✓ Masks and respirators– protect mouth/nose
  - ✓ Respirators – protect respiratory tract from airborne infectious agents
  - ✓ Goggles – protect eyes
  - ✓ Face shields – protect face, mouth, nose, and eyes

3.5. Factors Influencing PPE Selection

- Type of exposure anticipated
  - ✓ Splash/spray versus touch
  - ✓ Durability and appropriateness for the task
  - ✓ Fit
- **Gloves**

Purpose:

- ✓ To reduce the risk of staff acquiring infections from patients,
- ✓ To prevent staff from transmitting their skin flora to patients,
- ✓ To reduce contamination of the hands of staff by microorganisms that can be transmitted from one patient to another (cross-contamination)

Glove material – vinyl, latex, nitrile, other

- ✓ Sterile or non-sterile
- ✓ One or two pair

- ✓ Single use or reusable

Gloves should be worn when:

- There is a reasonable chance of hand contact with blood or other body fluids, mucous membranes, or non-intact skin,
- Performing an invasive medical procedures,
- Before handling soiled instruments, contaminated waste items or touch contaminated surfaces.
- When disposing contaminated waste items
- Handling chemicals or disinfectants

Self-Check –N	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-4	Cleaning of splashes of chemicals

3.1 Introduction

- A chemical spill is considered to be minor only if:
  - The person who spilled it is familiar with the chemical
  - Knows the associated hazards
  - Knows how to clean up the spill safely
- The recommended steps for dealing with a minor spill include:
  - Alert coworkers, then clean up spill
  - Follow procedures for disposal of materials used to clean up spill
  - Absorb free liquids with an appropriate absorbent, as follows

- Caustic liquids—use polypropylene pads or diatomaceous earth
- Oxidizing acids—use diatomaceous earth
- Mineral acids—use baking soda or polypropylene pads
- Flammable liquids—use polypropylene pads

– Neutralize residues and decontaminate the area.

- Anything beyond a **minor spill** and that requires help from outside of the laboratory group constitutes a **major spill**.
- Steps to deal with **major spills** include:
  – Alerting coworkers
  – Moving to a safe location and
  – Calling authorities to report the situation

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5points**

Answer Sheet

Score = _____
Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-5	**Waste generation and safe environment**

3.2 Introduction

- **Waste-** is any substance or object the holder discards, intends to discard or is required to discard
- **Hazardous waste-**is a waste that is dangerous or potentially harmful to health or env't

Key facts

- Of the total amount of waste generated by health-care activities, about 85% is general, non-hazardous waste. The remaining 15% is considered hazardous material that may be infectious, toxic or radioactive. Every year an estimated 16 billion injections are administered worldwide, but not all of the needles and syringes are properly disposed of afterwards.
- Open burning and incineration of health care wastes can, under some circumstances, result in the emission of dioxins, furans, and particulate matter.
- Measures to ensure the safe and environmentally sound management of health care wastes can prevent adverse health and environmental impacts from such waste including the unintended release of chemical or biological hazards, including drug-resistant microorganisms, into the environment thus protecting the health of patients, health workers, and the general public.

Classification of waste

1. **Non-hazardous waste**
    - Include papers, packaging boxes, plastic bags and hand paper towels etc that have no contact with hazardous materials
2. **Hazardous waste**
    - This includes different types

Waste category	**Description and examples**
Infectious waste	Waste suspected to contain pathogens e.g. laboratory cultures; waste from isolation wards; tissues (swabs), materials, or equipment that have been in contact with infected patients; excreta
Pathological waste	Human tissues or fluids e.g. body parts; blood and other body fluids; fetuses

Sharps	Sharp waste e.g. needles; infusion sets; scalpels; knives; blades; broken glass
Pharmaceutical waste	Waste containing pharmaceuticals e.g. pharmaceuticals that are expired or no longer needed; items contaminated by or containing pharmaceuticals (bottles, boxes)
Genotoxic waste	Waste containing substances with genotoxic properties e.g. waste containing cytostatic drugs (often used in cancer therapy); genotoxic chemicals
Chemical waste	Waste containing chemical substances e.g. laboratory reagents; film developer; disinfectants that are expired or no longer needed; solvents
Wastes with high content of heavy metals	Batteries; broken thermometers; blood-pressure gauges; etc.
Pressurized containers	Gas cylinders; gas cartridges; aerosol cans
Radioactive waste	Waste containing radioactive substances e.g. unused liquids from radiotherapy or laboratory research; contaminated glassware, packages, or absorbent paper; urine and excreta from patients treated or tested with unsealed radionuclides; sealed sources

The major sources of health-care waste are:

- hospitals and other health facilities
- laboratories and research centres
- mortuary and autopsy centres
- animal research and testing laboratories
- blood banks and collection services

- nursing homes for the elderly

High-income countries generate on average up to 0.5 kg of hazardous waste per hospital bed per day; while low-income countries generate on average 0.2 kg. However, health-care waste is often not separated into hazardous or non-hazardous wastes in low-income countries making the real quantity of hazardous waste much higher.

Health-care activities generating waste

- Diagnosis
- Treatment
- Prevention of diseases
- Alleviation of disablement
- Associated research

Who is at Risk of laboratory waste?

- Laboratory workers
- Doctors and nurses
- Patients
- Hospital support staff
- Waste collection and disposal staff
- General public

Health risks

Health-care waste contains potentially harmful microorganisms that can infect hospital patients, health workers and the general public. Other potential hazards may include drug-resistant microorganisms which spread from health facilities into the environment.

Adverse health outcomes associated with health care waste and by-products also include:

- sharps-inflicted injuries;

- toxic exposure to pharmaceutical products, in particular, antibiotics and cytotoxic drugs released into the surrounding environment, and to substances such as mercury or dioxins, during the handling or incineration of health care wastes;
- chemical burns arising in the context of disinfection, sterilization or waste treatment activities;
- air pollution arising as a result of the release of particulate matter during medical waste incineration;
- thermal injuries occurring in conjunction with open burning and the operation of medical waste incinerators; and
- radiation burns.

Sharps-related

Worldwide, an estimated 16 billion injections are administered every year. Not all needles and syringes are disposed of safely, creating a risk of injury and infection and opportunities for reuse.

Injections with contaminated needles and syringes in low- and middle-income countries have reduced substantially in recent years, partly due to efforts to reduce reuse of injection devices. Despite this progress, in 2010, unsafe injections were still responsible for as many as 33 800 new HIV infections, 1.7 million hepatitis B infections and 315 000 hepatitis C infections *(1)*.

A person who experiences one needle stick injury from a needle used on an infected source patient has risks of 30%, 1.8%, and 0.3% respectively of becoming infected with HBV, HCV and HIV.

Additional hazards occur from scavenging at waste disposal sites and during the handling and manual sorting of hazardous waste from health-care facilities. These practices are common in many regions of the world, especially in low- and middle-income countries. The waste handlers are at immediate risk of needle-stick injuries and exposure to toxic or infectious materials.

Environmental Impact

Treatment and disposal of healthcare waste may pose health risks indirectly through the release of pathogens and toxic pollutants into the environment.

- The disposal of untreated health care wastes in landfills can lead to the contamination of drinking, surface, and ground waters if those landfills are not properly constructed.
- The treatment of health care wastes with chemical disinfectants can result in the release of chemical substances into the environment if those substances are not handled, stored and disposed in an environmentally sound manner.
- Incineration of waste has been widely practised, but inadequate incineration or the incineration of unsuitable materials results in the release of pollutants into the air and in the generation of ash residue. Incinerated materials containing or treated with chlorine can generate dioxins and furans, which are human carcinogens and have been associated with a range of adverse health effects. Incineration of heavy metals or materials with high metal content (in particular lead, mercury and cadmium) can lead to the spread of toxic metals in the environment.
- Only modern incinerators operating at 850-1100 °C and fitted with special gas-cleaning equipment are able to comply with the international emission standards for dioxins and furans.
- Alternatives to incineration such as autoclaving, microwaving, steam treatment integrated with internal mixing, which minimize the formation and release of chemicals or hazardous emissions should be given consideration in settings where there are sufficient resources to operate and maintain such systems and dispose of the treated waste.

Safe working environment

- Rules concerning access to the laboratory and displaying of safety signs and notices for staff, patients, and visitors to the laboratory
- Procedures to follow to maintain local laboratory security
- How to keep the laboratory clean
- How to separate and dispose of general waste, broken glass and other ‘sharps’, contaminated materials, and different specimens

- Decontamination procedures
- Washing of reusable specimen containers, needles, syringes, lancets, slides, cover glasses, pipettes
- Disinfectants and their use in the laboratory
- Sterilization procedures
- Ventilation of the laboratory
- How to check the laboratory for structural damage and wear that may lead to accidents or make the premise less secure
- Maintenance schedules and routine cleaning of equipment
- Inspecting electrical equipment for damage to insulation and loose connections in plugs
- Rules for the storage and labeling of chemicals and reagents and how to keep an inventory of chemicals
- Regulations covering the safe packing and transport of specimens
- Procedure for the reporting of faults

Safe working practices

- Personal hygiene measures and wearing of safe footwear
- Regulations concerning the wearing, storing, decontamination and laundering of protective clothing
- Preventing laboratory acquired infection including regulations to avoid the accidental:

- Ingestion of pathogens
- Inhaling of pathogens
- Inoculation of pathogens
- What to do when there is a spillage of a specimen or liquid culture

- Safety rules concerning the handling and storage of chemicals and reagents that are flammable, oxidizing, toxic, harmful, irritant, and corrosive, and how to manage chemical spillages
- What to do when there is a glass breakage
- How to pipette and dispense safely
- Safe operation of manual, electrical, and battery operated laboratory equipment
- Working tidily, use of racks, and rules to prevent the floor and benches from becoming cluttered and exits obstructed
- Use of protective gloves, goggles, face shield dust mask, eyewash bottle
- How to control noise levels and other causes of loss of concentration

Safe laboratory working environment

- The safety of the working environment must take into consideration:
- Type of work being performed, ie specimens which the laboratory handles and pathogens which may be encountered
- Working practices including the procedures and equipment used
- Number of staff and workload
- Laboratory's location, climatic conditions, and security of premise

The following are important in making the workplace safe:

- Laboratory premise that is structurally sound and in good repair with a reliable water supply and a safe plumbing and waste disposal system. Drainage from sinks must be closed and connected to a septic tank or to a deep pit. *Note:* If there is a shortage of piped water, provision must be made for the storage of water, e.g. collection of rain water in storage tanks. It is not safe for a laboratory to function without an adequate water supply

- Adequate floor and bench space and storage areas. The overall size of the laboratory must be appropriate for the workload, staff numbers, storage and equipment requirements
- Well constructed floor with a surface that is nonslip, impermeable to liquids, and resistant to those chemicals used in the laboratory. It should be bevelled to the wall and the entire floor should be accessible for washing. The floor must not be waxed or covered with matting. Floor drains are recommended
- Walls that are smooth, free from cracks, impermeable to liquids, and painted with washable light colored paint
- When practical, a door at each end of the laboratory so that laboratory staff will not be trapped should a fire break out. Doors should open outwards and exit routes must never be obstructed. Where fitted, internal doors should be self closing and contain upper viewing panes. External doors must be fitted with secure locks
- Adequate ventilation supplied by wall vents and windows that can be opened. The windows should not face the prevailing winds to avoid excessive dust entering the laboratory in the dry season and the wind interfering with work activities. Windows should be fitted with sun blinds and insect proof screens, and when indicated secure window bars
- Sectioning of the laboratory into separate rooms or working areas. The area where blood samples are collected from patients must be away from the testing area of the laboratory. Seating should be provided for patients outside the laboratory. The specimen reception area must be equipped with a table or hatchway which has a surface that is impervious, washable, and resistant to disinfectants. There should also be a First Aid area in the laboratory containing a First Aid box, eyewash bottle and fire blanket
- Bench surfaces that are without cracks, impervious, washable, and resistant to the disinfectants and chemicals used in the laboratory. Benches, shelving, and cupboards need to be well constructed and kept free of insect and rodent infestation. Benches should be kept as clear as possible to provide maximum working area and facilitate cleaning

- Suitable storage facilities, including a ventilated locked store for the storage of chemicals and expensive equipment
- Where required, a gas supply that is piped into the laboratory with the gas cylinder stored in an outside weatherproof, well-ventilated locked store
- A staff room that is separate from the working area where refreshments can be taken and personal food and other belongings stored safely. Near to the staff room there should be a separate room with toilet and hand-washing facilities. There should be separate toilet facilities for patients.
- A hand basin with running water preferably sited near the door. Whenever possible, taps should be operated by wrist levers or foot pedals. Bars of soap should be provided, not soap dispensers. Ideally paper towels should be used. If this is not possible small cloth hand towels that are laundered daily should be provided
- Provision of protective safety cabinets and fume cupboards as required and when feasible
- Safe electricity supply with sufficient wall electric points to avoid the use of adaptors and extension leads
- Fire extinguishers sited at accessible points. These need to be of the dry chemical type. Several buckets of sand and a fire blanket are also required
- As good illumination as possible. Low energy tube lights are recommended. Window screens must be fitted to protect from direct sunlight and glare but these should not make the working areas too dark

Provision of *separate* labeled containers for the decontamination of infected material, discarding of needles, syringes, lancets, glassware for cleaning, broken glass, and general laboratory waste. A warning symbol such as a red triangle can be used to mark containers in which infected material is placed.

Self-Check -5	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-6	Waste management and disposal

3.3 Introduction

- **Laboratory Waste management**
  - The practice of collecting and disposing of the waste produced by laboratory activities
- **Why manage hazardous waste?**
  - To protect human health & the environment
  - To minimize the generation of hazardous waste
  - To meet compliance with National and/or local Regulations
  - To prevent contact with human **blood or blood products** or with certain **chemicals used in the lab**
- **Waste Management Processes**
  1. Segregation
  2. Packaging
  3. Labeling
  4. Handling, and storage of waste products
  5. Transportation
  6. Disposal
- **Waste minimization**
  - Significant reduction of the waste generated in health-care establishments and research facilities
  - These include:
    - Source reduction
    - Reuse/Recyclable products
    - Good management and control practices

- Treat

- **Waste segregation**
- Grouping waste into different categories according to the **specific treatment** and **disposal requirements**
- Ensure that waste will be treated according to the **hazards of the waste** and the **correct disposal routes** are taken and that the **correct transportation** equipment will be used.
- Without effective segregation system, the complete waste stream must be considered as hazardous
- The correct segregation relies on a clear identification of different **categories of waste** and separate **disposal system**
- Must be done at point of generation
- **Waste Collection**
- **Color coding** of waste container for collection
  - **Yellow/Red**-infectious waste
  - **Brown**-for chemical and pharmaceutical waste
  - **Black**-for General waste
  - **White or yellow sharp container**- sharp waste

Solids waste Collection and labeling

Primary Containment:

  - Collect dry, solid waste in a "**biohazard bag**".
  - The bag must have the international **biohazard symbol** and the word "**biohazard**"

Secondary Containment:

- Rigid container with a lid that is resistant to leaks and punctures.
- The primary bag must be kept in the secondary container during use, storage, and transport.

Packaging (Bag tying)

- **Correct bag tying**
  - Twist bag into single braid.
  - Use the braid to tie single knot.
  - Tighten knot
- **Wrong bag tying**
  - Tied into bunny ears
  - Tape tied



Common problems

Bag on floor

Bag on bench

Full bags must be in secondary containment at all times

- Collect in a rigid, puncture & leak resistant and properly labeled container with the word "**Biohazardous waste**"
    - **Biological Hazard symbol**
    - Placed near workspace
    - Replace sharps containers when 3/4 full
- No mercury thermometers
- Generator information-Lab Name, Initial, Date

- **Liquid waste collection**

Storage:

- Label and secure bulk vessels if not disposed immediately

Treatment:

- Chemical disinfection

Disposal:

- Flush to sewer
- Use proper PPE!
- **Bench top, and equipment disinfection**
- For bench tops, external surfaces and laboratory equipments a freshly prepared **0.5%** sodium hypochlorite disinfectant solution is used.
- HIV is inactivated by 10 minutes exposure to 0.5% bleach and HBV by 2 minutes exposure to the same concentration.
- Depending on the concentration needed, dilutions can be made from the concentrated solutions.
- **Bleach dilutions**

$$= \frac{\%\ \text{concentrated solution}}{\%\ \text{diluted solution}}$$

E.g.

- To make a 0.5% dilution from 5 % concentrated solution
- Part of water to be added= 5%/0.5% -1=9
- **Personal Decontamination**

Wash hands for 20-30 seconds after:

- Handling infectious materials or animals
- Removing gloves
- Before leaving lab
- **Storage, transport and spills**
- Plastic bags with sufficient strength for the collection and storage
- Sharps container for sharp wastes
- Biohazardous waste spills must be cleaned up immediately unless unsafe to do so.
- Protect personnel handling waste


Wrong waste bag handling

- **Biological Waste Treatment**

Autoclaving

- Highly infectious waste should autoclaved before transported for disposal

- Sterilize by high pressure saturated steam at 121 °C for around 15–20 minutes
- In resource limited setting can be used for sterilizing reusable materials

Chemical Inactivation/Disinfection

- Kill or inactivate the pathogens
- Is most suitable for treating liquid waste such as blood, urine, stools, or hospital sewage

Incineration

- Can destroy pathogens and toxins by high temperatures
- Reduce volume of original waste by 95+%
  - Significantly reduces amount of waste sent to landfill
- Waste converted into ash, flue gases, and heat
- Flue gases may be required to be cleaned of pollutants before released to atmosphere

Waste types not to be incinerated

- Pressurized gas containers
- Large amounts of reactive chemical waste
- Silver salts and photographic or radiographic wastes
- Halogenated plastics such as polyvinyl chloride (PVC)
- Waste with high mercury or cadmium content, such as broken thermometers, used batteries, and lead-lined wooden panels
- Sealed ampoules or ampoules containing heavy metals

– **How to Dispose of Sharps and Sharp Containers**

– Use puncture-resistant sharps containers and work practices that minimize the unnecessary handling of sharps.

- When container is three-quarter full, remove from the procedure area for disposal.
- Dispose of the sharps and sharp containers by burning, burying or encapsulating.
- Always put on a heavy duty gloves when handling sharps containers.
- **How to Dispose of Liquid Waste**
- Wear PPE including utility gloves, protective eyewear and plastic apron when handling and transporting liquid waste.
- Pour waste down a utility sink drain or a flushable toilet and rinse with water. Avoid splashing.
- If no sewage system available, dispose of liquid in a deep, covered hole, not into open drains.
- Decontaminate containers by placing them in a 0.5% chlorine solution before washing them
- Remove utility gloves, wash and dry hands or use antiseptic hand-rub as described in the guidelines.
- **How to Dispose of Solid Waste**
- Wear heavy duty or utility gloves when handling and transporting solid wastes.
- Dispose of solid wastes by placing them in a plastic or galvanized metal container with a tight fitting cover.
- Collect the waste containers on a regular basis and transport the burnable ones to the incinerator or area for burning.
- Remove gloves and wash and dry hands or use an antiseptic hand-rub.
- **How to Dispose of Hazardous Waste**
- All hazardous waste material—chemical, pharmaceutical and one containing heavy metals— should be incinerated or buried if the quantity is very small.
- The large quantity of such materials should be sent back to the original supplier.

- **Final Disposal of Wastes**
- Open site of waste should be avoided because they:
- Pose infection risks and fire hazards
- Produce foul odor
- Attract insects
- Are unsightly
- Use heavy duty utility gloves and appropriate personal protective equipment when handling wastes.
- Decontaminate and clean gloves between use.
- Handle wastes carefully to avoid spills or splashes.
- Always wash hands after removing gloves and handling contaminated wastes.
- Avoid transferring contaminated waste from one container to another.
- Incineration is the preferred method for waste disposal, as the heat will generally be sufficient to destroy infectious microorganisms and will also prevent scavenging and reuse of discarded items.
- If incineration is not possible, then careful burial is the next best alternative.
- Dispose of used toxic chemicals or medicine containers properly:
- Rinse glass containers thoroughly with water; glass containers may be washed with detergent, rinsed, dried and reuses
- For plastic containers that contained toxic substances such as glutaraldehyde, rinse three times with waster and dispose by incineration and/or burial; these containers may be used for sharp disposal containers, but do not reuse them for any other purpose
- Equipment that is used to hold and transport wastes must not be used for any other purpose in the clinic or healthcare facility, and contaminated waste containers should be labeled clearly.

- Contaminated waste containers should be cleaned each time they are emptied and non-contaminated ones when they are visibly soiled.
- **Material safety Data Sheet (MSDS)**
- Definition:
- Health-related, chemical- and brand-specific information
- MSDS Should be immediately accessible to laboratory workers.
- This contain
- Chemical Product and Company Identification
- Composition and Information on Ingredients
- Hazard identification
- First aid measures
- Fire and Explosion Data
- Accidental Release Measures
- Handling and Storage
- Exposure Controls/Personal Protection
- Physical and chemical properties
- Stability and reactivity Data
- Toxicological information
- Ecological information
- Disposal considerations
- Transport information
- Regulatory information
- Other information

Self-Check -N	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-7	Cleaning and storage of glass ware

3.4 Introduction

- Care of glassware
  - ☐ All glass ware must be handled carefully.
  - ☐ Breakage can some times be dangerous and may result in the loss of valuable and irreplaceable materials.
  - ☐ Flasks and beakers should be placed on a gauze mat when they are heated over a Bunsen flame. Gauze mat is made from asbestos and its function is to distribute the heat evenly.
  - ☐ Test tube exposed to a naked flame should be made of heat resistant glass such as Pyrex.
  - ☐ If liquid are to be heated in a bath or boiling water the glass contents should be heat resistant.
  - ☐ When diluting concentrated acids, thin walled glassware should be heat resistant. Because the heat evolved by the procedure often cracks thick glassware.
  - ☐ Containers and their corresponding ground glass stopper should be numbered.
  - ☐ pipettes should never be left lying on the bench.

Cleaning of glass wares

- It is clear that volumetric glass wares and glass apparatus must be absolutely clean, otherwise volumes measured will be inaccurate and chemical reactions are affected adversely.
- Checking cleanness-fill the vessel with distilled water and then empty it and examine the walls to see whether they are covered by a continuous thin film of water.

- Imperfect wetting or the presence of discrete of droplets water indicates that vessel is not sufficiently clean.
    - Wide varieties of methods have been suggested for the cleaning of most glassware.
    - In all cases, glassware for the clinical laboratory must be:
        - Physically clean
        - Chemically clean
        - Bacteriologically clean or sterile

General cleaning procedure

1). *Preliminary rinsing*

- ☐ Rinse all glassware immediately after using cold or warm water.

2) Soaking in detergent solution

- ☐ Place in detergent solution (2%).

3).Scrubbing

- Scrub thoroughly with good quality brush

4). Washing

- Wash each glassware one by one under running water 5 times or more.

5). Rinsing

- ☐ Rinse each glassware with distilled water or deionized water at least three times.

6). Drying

- ☐ Place in a wire baskets and dry glassware completely.

7). Plugging

- The clean dry glassware should be put away in a cup board to protect it from dust.

- It is recommended that containers should be plugged with non – absorbent cotton wool or the mouth covered with little cups made from wrapping paper or preferably thin sheeting of paraffin wax.

- If the glassware becomes highly spoiled (dirty), it must be cleaned with acid cleaning solution.
- Potassium dichromate and sulphuric acid are both power full corrosive solutions and the mixture makes it even more so=> used to remove coagulated organic matter.
- Diluted HCl- 50% in water removes iron stains.
- nitric acid for stains due to Nesslers reagents (iodine).
- boiling with weak alkali solution remove grease
- acetone and ether remove ordinary grease
- Note: All the cleaning reagents must be washed away and the glassware rinsed finally with distilled water or Deionized water.

Self-Check -N	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-8	Reagent storage according to OHS standard

3.5 Introduction

- storing reagents incorrectly are important causes of unreliable test results
- Reagents should be stored in a clean, cool, dry location to maximize shelf life.
- Refrigerate reagents only if indicated on the label.
- Reagents that are stored at elevated temperatures or in humid locations may experience accelerated degradation and reduced shelf life
- Storage requirements are to be indicated on container labels:
- a. **Temperatures**

- 1. Store reagents at required temperatures indicated by manufacturer
- 2. Reagents with temperature storage requirements shall have these listed on the labels.
- 3. Store reagents that must be refrigerated or frozen in freezers or Refrigerators with the required temperature ranges.
- b. **Light sensitivity**
- 1. If indicated store in cabinets or in a dark container.
    - Secure storage areas against unauthorized removal of chemicals.
    - Where possible, storage areas should have two separate exits.
    - Maintain clear access to and from the storage areas.
    - Do not store chemicals in aisles or stairwells, on desks or laboratory benches, on floors or in hallways, or in fume hoods.
    - Use an appropriate "Acid Cabinet" for any acid solutions of 6 M concentration or higher. Nitric acid needs to be isolated.
    - Label storage areas with a general hazard symbol to identify hazardous chemicals and indicate correct fire fighting procedures.
    - File a Material Safety Data Sheet (MSDS) for every chemical stored in the laboratory.

Store all reagent chemicals in compatible family groups. Do not alphabetize.

- Store all chemicals at eye level and below. The preferred shelving material is wood treated with polyurethane or a similar impervious material.
- All shelving should have a two-inch lip. If you use shelving with metal brackets, inspect the clips and brackets annually for corrosion and replace as needed.
- Store chemical reagents prepared in the laboratory in plastic bottles (if possible and appropriate to the chemical) to minimize the risk of breakage.
- Date containers upon receipt and again when opened.

- Attach chemical labels with all necessary information to all containers.
- When opening newly received reagent chemicals, immediately read the warning labels to be aware of any special storage precautions such as refrigeration or inert atmosphere storage.

Test peroxide-forming substances periodically for peroxide levels; dispose of these substances after three months unless the MSDS for the substance indicates a longer shelf life.

- Check chemical containers periodically for rust, corrosion, and leakage.
- Store bottles of especially hazardous and moisture-absorbing chemicals in chemical-safe bags.
- Maintain a complete inventory in the room where the chemicals are stored, and make a copy available to fire fighters.
- Keep storage areas clean and orderly at all times.
- Have spill cleanup supplies (absorbents, neutralizers) in any room where chemicals are stored or used.
- Limit the amount of flammable and combustible materials stored to that required for one year of laboratory work.
- Use only metal flammables cabinets to store flammable and combustible liquids. Label the cabinets *FLAMMABLE - KEEP AWAY FROM FIRE*.

3.6 Components/Classification/Types/parts

3.7 purpose/use/Importance/advantages and dis advantages

3.8 OHS hazards and suitable PPE

3.9 Necessary tools and equipments

3.10 Rules to follow

Self-Check -N	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

3.11 Components/Classification/Types/parts

3.12 purpose/use/Importance/advantages and dis advantages

3.13 OHS hazards and suitable PPE

3.14 Necessary tools and equipments

3.15 Rules to follow

Self-Check -N	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Information Sheet-4	Cleaning of splashes of chemicals

3.16 Introduction

- Spills of blood and body fluids occur frequently in the laboratory.
- Blood and body fluids spills can harbor infectious agents such as Hepatitis B, HIV or Hepatitis C and as such pose a potential risk.
- Management of blood and body fluid spills is vital due to:
    1) Spread of infectious diseases
    2) Risk of falls
    3) Promotes sense of uncleanliness, foul odor and unpleasant appearance
- When surfaces are contaminated by biological spills, the appropriate actions to take are:

1. Define/ isolate the contaminated area
2. Alert coworkers
3. Put on appropriate PPE
4. Remove glass/lumps with forceps or scoop
5. Apply absorbent towel(s) to the spill; remove bulk and reapply if needed.
6. Apply disinfectant to towel surface.
7. Allow adequate contact time (**20 minutes**)
8. Remove towel, mop up, and clean the surface with alcohol or soap and water.
9. Properly dispose of materials.
10. Notify the supervisor, safety officer, and other appropriate authorities.

- **Disinfectant**:
  - For most spills, use a **1:50** solution (1 g/l chlorine) of household bleach (sodium hypochlorite solution containing 50 g/l chlorine)-0.1% bleach solution
  - For spills containing large amounts of organic material, use a 1:10 solution (5 g/l chlorine) of household bleach, or an approved mycobactericidal-0.5% bleach solution
  - Alcohols are not recommended as surface decontaminating agents because they evaporate quickly, thus decreasing contact time
- If laboratory personnel become contaminated with biological hazards due to splashes or spills, immediate steps to take include:

1. Clean exposed skin or body surface with soap and water, eyewash (for eye exposures) or saline (for mouth exposures)
2. Apply first aid and treat as an emergency.
3. Notify supervisor, safety officer, or security desk (after hours).
4. Follow appropriate reporting procedures

Report to physician for treatment or counseling

- **Chemical spills**
- A chemical spill is considered to be minor only if:
  - The person who spilled it is familiar with the chemical
  - Knows the associated hazards
  - Knows how to clean up the spill safely
- The recommended steps for dealing with a minor spill include:
  - Alert coworkers, then clean up spill
  - Follow procedures for disposal of materials used to clean up spill
  - Absorb free liquids with an appropriate absorbent, as follows

- Caustic liquids—use polypropylene pads or diatomaceous earth
- Oxidizing acids—use diatomaceous earth
- Mineral acids—use baking soda or polypropylene pads
- Flammable liquids—use polypropylene pads

– Neutralize residues and decontaminate the area.

- Anything beyond a **minor spill** and that requires help from outside of the laboratory group constitutes a **major spill**.
- Steps to deal with **major spills** include:
  – Alerting coworkers
  – Moving to a safe location and
  – Calling authorities to report the situation

3.17 Components/Classification/Types/parts

3.18 purpose/use/Importance/advantages and dis advantages

3.19 OHS hazards and suitable PPE

3.20 Necessary tools and equipments

3.21 Rules to follow

Self-Check -N	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

Note: **Satisfactory rating - 5 points** **Unsatisfactory - below 5points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short Answer Questions

Operation Sheet 1	CONTENT-

Methodof----------:

Step 1-

Step 2-

Step 3-

Step N

.

Operation Sheet 2	CONTENT-

Procedures for----------

Step 1-

Step 2-

Step 3-

Step N

Operation Sheet-N	CONTENT-N

Techniques for----------:

Step 1-

Step 2-

Step 3-

Step N

.

LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary templates, tools and materials you are required to perform the following tasks within --- hour.

Task 1.

Task 2.

Task N.

List of Reference Materials

1- BOOKS

2- WEB ADDRESSES (PUTTING LINKS)

- The following are important hazards that require assessment and management in health laboratories:

- Unsafe premises
- Naked flames
- Microbial hazards
- Chemical hazards
- Equipment hazards
- Explosions
- Infestation by ants,
- Glassware hazards

- Unreliable water supply
- Sharps hazards

Common causes of accidents in health laboratories

laboratory premises

- When emergency exit routes from the laboratory are blocked by equipment, storage boxes, etc
- -When, in a subdivided laboratory, there is only a single exit and staff Become trapped in one section.
- **Staff are injured by falling on a slippery or damaged floor or from broken glass on the floor:**
- When the floor is not cleaned properly after spillages or glassware breakages
- When wax or other slippery cleaning substance is applied to the floor
- When damaged areas of the floor are covered with matting.
- **Risk of infection to staff and others:**
- When there is no separate hand basin with a reliable water supply for hand washing
- When no separate rest-room is provided for staff and food and drink are consumed in the laboratory
- When laboratory staff do not leave their protective clothing in the laboratory
- When bench surfaces are not disinfected or cleaned properly each day.
- When the working area is not separated from the areas where Outpatients are received and blood samples collected.
- When the laboratory has no safe systems for decontaminating infective Materials, disposing of waste and washing reusable laboratory ware.
- **Injury from chemicals:**
- When chemicals with irritating fumes are used in a laboratory with inadequate ventilation.
- When hazardous chemicals are stored on high shelves or on the floor under benches.

- **Injury from equipment:**
- When electrical equipment has faulty earthling or insufficient ventilation.
- When unsafe adaptors or extension leads are used because there are Insufficient electric wall points.
- When the laboratory has no preventive maintenance schedules and equipment is not inspected regularly for defective insulation, corrosion, And loose connections.

Naked flames

- Injury from fire caused by lighted Bunsen burners, spirit burners, tapers, matches, alcohol swabs, ring burners, stoves
- When a lighted burner is placed in sunlight, making the flame difficult to see
- When a Bunsen burner, ring burner, match, or taper is lit too close to a Flammable chemical.
- When a lighted taper is carried across the laboratory close to where a flammable stain or reagent is being used or stored

Microbial Hazards

- **Pathogens are accidentally ingested:**
- From contaminated fingers when personal hygiene is neglected
- When hands are not washed after handling specimens or cultures
- When specimens or liquid cultures are mouth-pipetted
- **Pathogens are accidentally inoculated:**
- Through needle stick injuries caused by resheathing needles after Collecting blood or careless handling of needles and lancets.
- Through open uncovered skin wounds Through injury from broken contaminated glassware
- **Pathogens are accidentally inhaled in airborne droplets (aerosols):**
- When snap-closing specimen containers
- When vigorously dispensing or pouring infectious fluids
- When sucking up and blowing out fluids from pipettes
- When specimens are hand-centrifuged in open containers or when a container breaks in an electric centrifuge and the lid is opened before the aerosols have settled.
- When infectious material is spilled following the dropping or knocking over of a specimen container or culture.

Chemical Hazards

- **Toxic or harmful chemicals causing serious ill health, injury, or irritation:**
- When toxic or harmful chemicals are swallowed by being mouth- Pipetting.
- When fumes from irritant chemicals are inhaled in poorly ventilated areas of the laboratory

- When no protective goggles or gloves are worn and harmful chemicals enter the eye or come in contact with the skin
- **Flammable chemicals causing fire:**
- When flammable chemicals are used or stored near a naked flame
- When a lighted ‘swab’ is used to heat stain in the Ziehl-Neelsen method and ignites nearby flammable chemicals
- When a flammable chemical is spilled near a flame
- **Corrosive chemicals causing serious injury and burns:**
- When corrosive reagents are ingested by being mouth-pipetted
- When strong acids are accidentally knocked from shelves or spilled
- When a corrosive chemical comes into contact with the skin, or the eyes are splashed when opening and pouring a corrosive chemical

Equipment hazard

- **Electric shock:**
- When equipment is not reliably earthed or electrical circuits are faulty
- When touching live wires in attempting to repair equipment or replace components, e.g. lamp, without first disconnecting the equipment from the mains
- When handling electrical equipment with wet hands or standing on a wet floor
- **Fire:**
- When cables and electrical equipment overheat due to overloading of conductors
- When there is overheating caused by the overuse of adaptors
- When insulation is inadequate or becomes damaged
- When thermostats fail and there is no temperature cut-out device to prevent overheating

When electrical sparking or arching causes flammable material to ignite

- When preventive maintenance is not carried out to check for corrosion, wear, and loose connections.
- **Injury from moving parts:**
- When an open hand-centrifuge is used in a part of the laboratory where it can easily injure a person.

  When a centrifuge is not balanced, resulting in the buckets and trunnions spinning off the rotor, particularly when there is corrosion

General factors that contribute to the occurrence of accidents

- Inexperience and insufficient training and supervision of staff and lack of health and safety awareness by senior laboratory officers
- Untidy working, allowing the bench to become cluttered and not using racks to avoid spillages
- Too heavy a workload for the size of laboratory and number of staff
- Rushing to finish work 'on time'
- Loss of concentration due to a noisy working environment, constant interruptions, and excessive heat particularly in small poorly ventilated outreach laboratories
- Fatigue due to frequent emergency work during night hours.
- **Many of these factors can be remedied by:**
- On-going health and safety training in the workplace
- Good laboratory practice and common sense
- Changing the work attitudes of laboratory staff
- Increasing health and safety awareness in the laboratory by frequent discussions on safety issues and displaying appropriate safety symbols and notices
- Monitoring and improving the working conditions of district laboratory personnel as part of total quality management

-

3.6. Components/Classification/Types/parts

3.7. purpose/use/Importance/advantages and dis advantages

3.8. OHS hazards and suitable PPE

3.9. Necessary tools and equipments

3.10. Rules to follow

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