INTERNATIONAL INSTITUTE FOR PATHOLOGY AND FORENSIC SCIENCE RESEARCH

COLLEGE of AMERICAN PATHOLOGISTS FOUNDATION

DAVID UMAHI FEDERAL UNIVERSITY OF HEALTH SCIENCES UBURU, EBONYI STATE.

Ensuring Laboratory Safety, Biosafety, and Equipment Management

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Week 10

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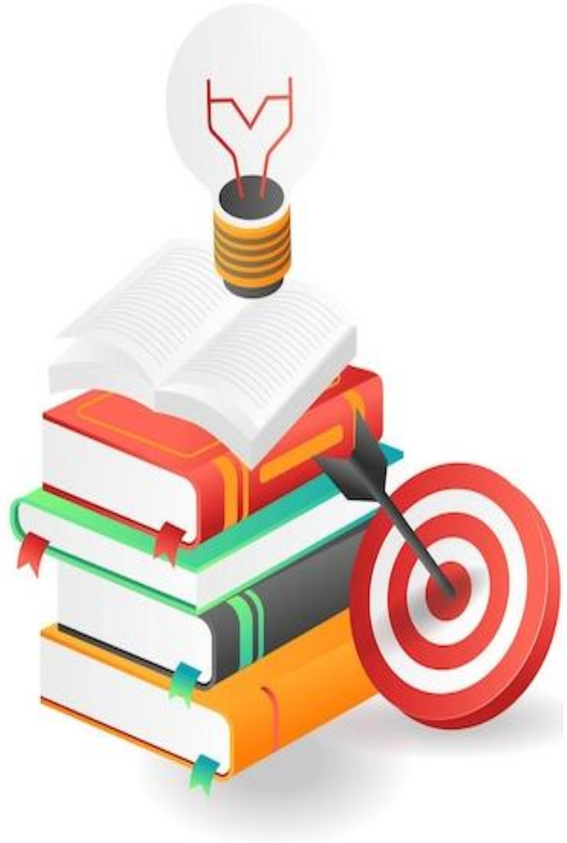
Advancing Laboratory Quality Management Systems for Better Patient Outcomes

Learning Objectives

- By the end of this session, participants should be able to:
  - Describe key principles of laboratory safety and biosafety, with reference to WHO and CDC guidelines.
  - Apply biosafety practices appropriate for various risk groups and containment levels in routine laboratory operations.
  - Identify best practices for equipment maintenance, calibration, and validation to ensure optimal performance and data integrity.
  - Demonstrate understanding of sustainable laboratory practices, including waste reduction, energy efficiency, and adoption of green initiatives.
  - Integrate safety, biosafety, and equipment management into a cohesive QMS framework for continuous improvement.



Pre-course Assessment 1

- **Which of the following groups is at a higher occupational risk of infection from blood-borne pathogens?**

a. Laboratory scientists

b. Biotech engineers

c. Public health educators

d. Pharmacists

Pre-course Assessment 2

- **Concerning safety in the medical laboratory.**

a. Only the safety officer and lab manager are concerned

b. Every lab staff is concerned and should take action

c. Only the staff directly involved in running lab tests on the bench should be trained on safety measures

d. Laboratory safety trainings need not involve cleaners working in the lab

Pre-course Assessment 3

- **A 'Green Lab' is…**

a. A lab which adopts green as their colour as reflected in their logo and lab forms

b. A lab designed mainly with green colour

c. A lab which adopts sustainable and eco-friendly practices

d. A lab beautified with live flowers and natural plants

Introduction

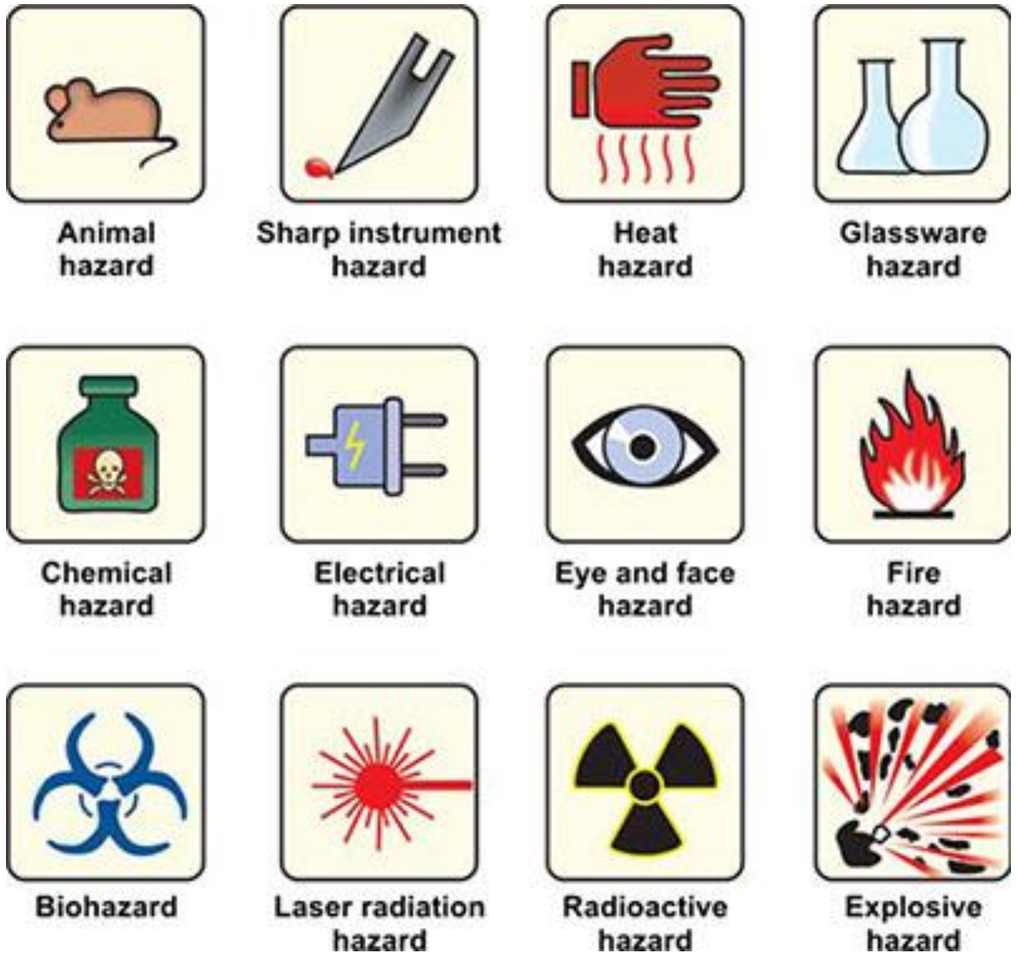
- Set of practices, procedures, and guidelines designed to ensure the well-being of individuals working in a laboratory
- Ensuring lab safety is critical to minimize the risk of exposure to hazardous materials and pathogens
- Both WHO and CDC guidelines emphasize the importance of a robust safety program in laboratories
- Laboratory safety is a high priority for CAP.
- **Why is it important?**
  - To protect the lives of employees and patients,
  - To protect laboratory equipment,
  - To protect the facilities,
  - To protect the environment.

Laboratory hazards; a cause for concern…

- Hazards – any potentially harmful phenomenon, substance, human
- activity, or condition that has the potential to result in loss of life, injury, diseases, property damage, loss of livelihoods and services, social and economic upheaval, or environmental harm (WHO).
- Hazards in the lab include biological, chemical, physical or radioactive
- Health care workers are known to be at a higher risk of infection from blood-borne pathogens than the general population (Nsubuga, 2005).

Laboratory hazards; a cause for concern…

- Those most at risk are those whose activities entail exposure to blood and body fluids.
- Medical laboratories handle a wide range of materials and a large number of potentially dangerous pathogenic agents.
- Important blood-borne pathogens in this regard include Hepatitis B (HBV), Hepatitis C (HCV), HIV, TB, Salmonella etc
- Needlestick injury (NSI), also referred as percutaneous injury, is the penetration of skin by needle or other sharp object, which is contaminated with blood, tissue, or other body fluid before the exposure



Laboratory hazards; a cause for concern…

- Despite the negative health effects of NSIs, it is estimated that half of occurrences are not reported
- In 2007, who estimated annual global NSIs at 2 million per year and another investigation estimated 3.5 million injuries yearly
- In China, about one million accidental NSIs have been reported every year, in which one HCW was exposed to NSI every 30s
- It is worthy of note that the estimates given are only the reported cases and about 40–70% cases of NSI are unreported in developing countries
- Concerning chemical hazards, a study in Lebanon reported that the main cause of accidents in the lab was exposure to chemicals (73.7%) and more specifically by inhalation (45.4%).

Safety is everyone's business!!!

- ***Safety officer (or quality manager),*** necessary to:
- Develop a complete and thorough description of basic safety rules, and ensure that personnel are trained in their specific duties, and when new activities or techniques are introduced into the lab;
- Know the basics of safety and biosafety mgt issues when working with chemicals and pathogens of moderate or low level of risk;
- Know how to perform an extensive risk assessment when developing new activities in the lab;
- Conduct laboratory safety audits.

As a **laboratorian,** it is important to:

- Be aware of basic safety rules and processes;
- Understand the basics of safety and biosafety management issues when working with toxic chemicals, biological samples and physical hazards, and when interacting with patients.

Safety Management Program

- Safety management program include:
  - Developing a manual to provide written procedures for safety and biosafety in the laboratory;
  - Organizing safety training and exercises that teach staff to be aware of potential hazards and how to apply safety practices and techniques
  - Setting up a process to conduct risk assessments—both initial risk assessments, as well as ongoing lab safety audits to look for potential safety problems

Who is responsible?

- Safety officer/Lab manager

Training Deliverables

- Information about universal precautions,
- Infection prevention and control,
- Chemical and radiation safety,
- How to use PPE,
- How to dispose of hazardous waste,
- And what to do in case of emergencies;

General safety equipment

The safety officer is responsible for ensuring that there is an adequate supply of appropriate equipment for safety and biosafety, such as:

- Personal Protective Equipment
- Fire extinguishers and fire blankets
- Appropriate storage and cabinets for flammable and toxic chemicals
- Eye washers and emergency shower
- Waste disposal supplies and equipment
- First aid equipment.

Standard safety practices

- Limiting or restricting access to the lab.
- Washing hands after handling infectious or hazardous materials and animals, after removing gloves, and before leaving the lab.
- Prohibiting eating, drinking, smoking, handling contact lenses, and applying cosmetics in work areas.
- Prohibiting mouth pipetting.
- Using techniques that minimize aerosol or splash production when performing procedures—biosafety cabinets should be used whenever there is a potential for aerosol or splash creation, or when high concentrations or large volumes of infectious agents are involved.

Standard safety practices

- Use PPE when working in the lab – sandals and open-toe shoes are prohibited in work areas.
- Preventing inhalation exposure by using chemical fume hoods or other containment devices for vapours, gases, aerosols, fumes, dusts or powders;
- Properly storing chemicals according to recognized compatibilities
- Studying Safety Data Sheets for chemicals
- Decontaminating work surfaces daily;
- Decontaminating all cultures, stocks and other regulated wastes before disposal via autoclave, chemical disinfection, incinerator or other approved method

SAFETY DATA SHEET

Hydrogen Sulfide

Section 1. Identification

GHS product identifier	:	Hydrogen Sulfide
Chemical name	:	hydrogen sulphide
Other means of identification	:	Hydrogen sulfide; Hydrogen sulfide (H2S); Sulfuretted hydrogen; Sewer gas; Hydrosulfuric acid; dihydrogen sulfide
Product use	:	Synthetic/Analytical chemistry.
Synonym	:	Hydrogen sulfide; Hydrogen sulfide (H2S); Sulfuretted hydrogen; Sewer gas; Hydrosulfuric acid; dihydrogen sulfide
SDS #	:	001029
Supplier's details	:	
Emergency telephone number (with hours of operation)	:	

Section 2. Hazards identification

OSHA/HCS status	:	This material is considered hazardous by the OSHA Hazard Communication Standard (29 CFR 1910.1200).
Classification of the substance or mixture	:	FLAMMABLE GASES - Category 1 GASES UNDER PRESSURE - Liquefied gas ACUTE TOXICITY (inhalation) - Category 2 SPECIFIC TARGET ORGAN TOXICITY (SINGLE EXPOSURE) (Respiratory tract irritation) - Category 3 AQUATIC HAZARD (ACUTE) - Category 1

GHS label elements

Hazard pictograms :

Signal word : Danger

Hazard statements :
Extremely flammable gas.
May form explosive mixtures with air.
Contains gas under pressure; may explode if heated.
May cause frostbite.
Fatal if inhaled.
Extended exposure to gas reduces the ability to smell sulfides.
May cause respiratory irritation.
Very toxic to aquatic life.

Precautionary statements

MATERIALS SAFETY DATA SHEET (MSDS) Ethanol (C_2H_5OH)	MSDS Number	MSD/A/1
	Version Number	5.0
	Date issued	10 Oct 2022
	Next Review date	October 2024

Company Details

Name: MSD Alcohols Address :120 Durban,4001, South Africa	Emergency telephone No. Telephone Fax	+27 (31) 579 2005 +27 (31) 579 2005 +27 (31) 579 2006

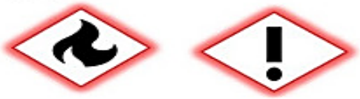
1. Product & Company Identification

Trade name- Ethanol (Industrial, Absolute or Anhydrous, Light Spirits, Extra Neutral Potable, Rectified Extra) Chemical Family- Aliphatic Alcohol Chemical Name- Ethanol Synonyms- Ethyl Alcohol	Chemical abstract no.-56-14-3 Molecular Mass - 48.07 NIOSH No.- KQ 8900000 Hazchem code- 2(S) E; 3(S) E UN No. - 1170

2. Composition

Hazardous components: Ethyl Alcohol (75.0 -99.9%)
EEC classification :200- 578-6[10]
R Phrases- R11

3. Hazard Identification

Classification of substance 3.1 EU-GHS / CLP Hazard Class and category code(s) EU-DSD / DPD Indication(s) of danger and R phrase(s) 3.2 Label elements EU-GHS / CLP Hazard pictogram(s)/Symbols-	Flammable liquid Flam. Liq. 2 Serious eye Irritation Eye Irrit. 2 Highly flammable R11 

Material Safety Data Sheet

Methanol

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Methanol

OTHER/GENERIC NAMES: Methyl Alcohol, Carbinol, Wood Alcohol

PRODUCT USE: Solvent

MANUFACTURER: Honeywell
1953 South Harvey Street
Muskegon, MI 49442

DISTRIBUTOR: VWR International
1310 Goshen Parkway
West Chester, PA 19380

FOR MORE INFORMATION CALL:
(Monday-Friday, 8:00am-5:00pm)
1-800-932-5000

IN CASE OF EMERGENCY CALL:
(24 Hours/Day, 7 Days/Week)
1-800-424-9300 (USA Only)
For Transportation Emergencies:
1-800-424-9300 (CHEMTREC - Domestic)
1-613-996-6666(CANUTEC- Canada)

NOTE: Emergency telephone numbers are to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure, or accident involving chemicals. All non-emergency questions should be directed to customer service.

2. COMPOSITION/INFORMATION ON INGREDIENTS

INGREDIENT NAME	CAS NUMBER	WEIGHT %
Methanol	67-56-1	100

Component Information/Information on Non-Hazardous Components
This product is considered to be hazardous according to the criteria specified in 29 CFR 1910.1200 (Hazard Communication Standard) and the Canadian Controlled Product Regulations.

Trace impurities and additional material names not listed above may also appear in Section 15 toward the end of the MSDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons.

3. HAZARDS IDENTIFICATION

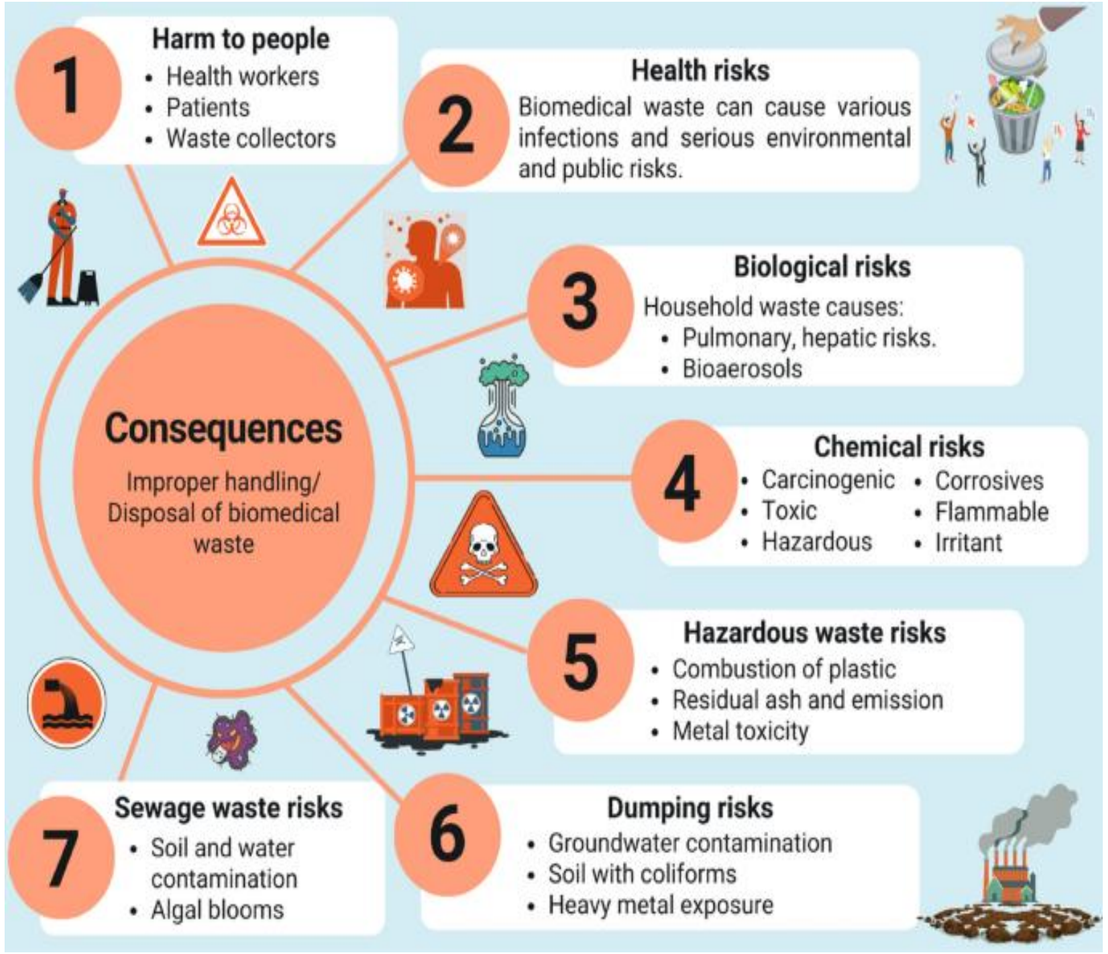
EMERGENCY OVERVIEW: This product is a clear, volatile, flammable liquid. Has a slight alcoholic odor. Highly flammable. Vapours may form explosive mixtures with air. The product causes irritation of eyes, skin and mucous membranes. Toxic by inhalation, in contact with skin and if swallowed. Methanol can cause blindness. Causes headache, drowsiness or other effects to the central nervous system. Do not allow product to contact skin, eyes and clothing. Do not breathe vapours.

Fire Drills and Evacuation Procedures

- Monthly and yearly exercises must be organized for fire drills and laboratory evacuation procedures.
- This is an occasion for the safety officer to emphasize risks to lab staff and to review with them the specific procedures for evacuation, handling of incidents and basic security precautions
- Importance:
  - Enhancing Emergency Preparedness
  - Reducing Panic and Confusion
  - Protecting Lives and Property
  - Ensuring Regulatory Compliance
  - Reinforcing Safety Culture

Waste management

- Laboratory waste management is a critical issue.
- Separate waste containers should be used depending on the nature of the waste, and must be clearly identified by **a colour code**.
- Specific attention should be given to the management of potentially harmful contaminated waste such as sharps, needles or broken glassware.
- **Sharps containers** must be available and easily accessible
- All potentially harmful and dangerous materials (including liquids and radioactive materials) must be treated in the appropriate way before disposing



General Waste

Biomedical Waste

BIOHAZARD

Empty bottles, Discarded papers, Carton Boxes of medicine, Empty plastic bags, containers, Wrappers

Recyclable

Black

Food Wastes like vegetable & fruits , left over food, papers, egg shells etc.

Biodegradable

Green

Human Anatomical Waste, Foetus, Dressing, Plaster, Blood Bag, Chemicals
Medical & Surgical Masks, N95 masks, Head cover, Cap, Disposable linen gown, Non-plastic or semi-plastic coverall, Diapers, sanitary napkins, any item soaked with blood or body fluids, expiry or discarded medicines, Cytotoxic wastes, Lab Wastes

Yellow

Recyclable Infected Wastes, Goggles, Face shield, Splash Proof Apron, Plastic Coverall, Hazmat Suit, Nitrile Gloves, IV sets, syringes without needles, tubes, catheters, urobags, drains, IV sets/ bottles, vacutainers

Red

Glass wares/ ampoules, vials, metallic implants

Puncture Proof & leak proof box with blue marking

Sharp items, blades, broken sharps, syringes with needles

Puncture Proof Container

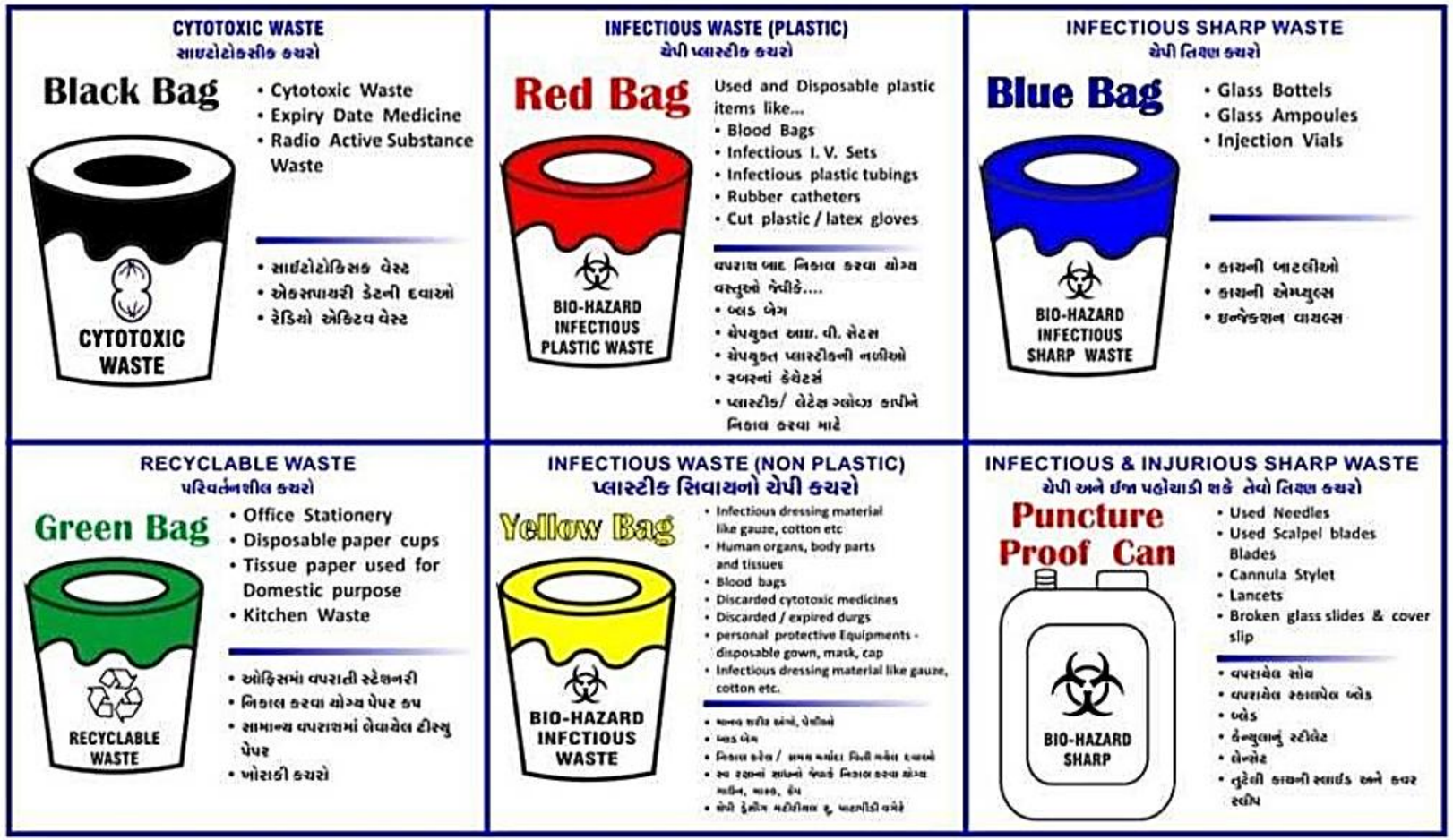
Incorrect Method

Correct Method

*Segregation to be done by the HCW who generates the waste.

*All Waste bins to be sanitized using 0.1% Sodium hypochlorite

BIOMEDICAL WASTE MANAGEMENT



Safety Audits

- Systematic evaluations of workplace practices, equipment, and procedures to ensure compliance with safety standards and identify areas for improvement.
- Their importance includes:
  - **Ensuring Regulatory Compliance** with local, national, and international safety regulations (e.g., WHO, CDC, OSHA, ISO 15190).
  - **Identifying Hazards**: Detects potential risks such as chemical exposure, equipment malfunction, or inadequate waste disposal.
  - **Preventing Accidents and Incidents**: Enables proactive corrective action before accidents occur.
  - **Promoting Continuous Improvement**: Drives enhancements in laboratory safety culture and operational efficiency.
  - **Documenting Safety Performance**: Provides evidence of due diligence for inspections, accreditation, and audits.

Laboratory safety is a high priority for CAP!!!

- GEN. 73300 – There are records for the training of all personnel in safety policies and procedures.
- GEN. 74200 - Personnel are instructed in the proper use of personal protective clothing/equipment (eg, gloves, gowns, masks, eye protectors, footwear) and records are retained
- GEN. 74700 - Personnel reasonably expected to have direct contact with blood and other potentially infectious materials are identified and offered hepatitis B vaccinations free of charge.
- Personnel that decline the vaccine sign a declination form.

Laboratory safety is a high priority for CAP!!!

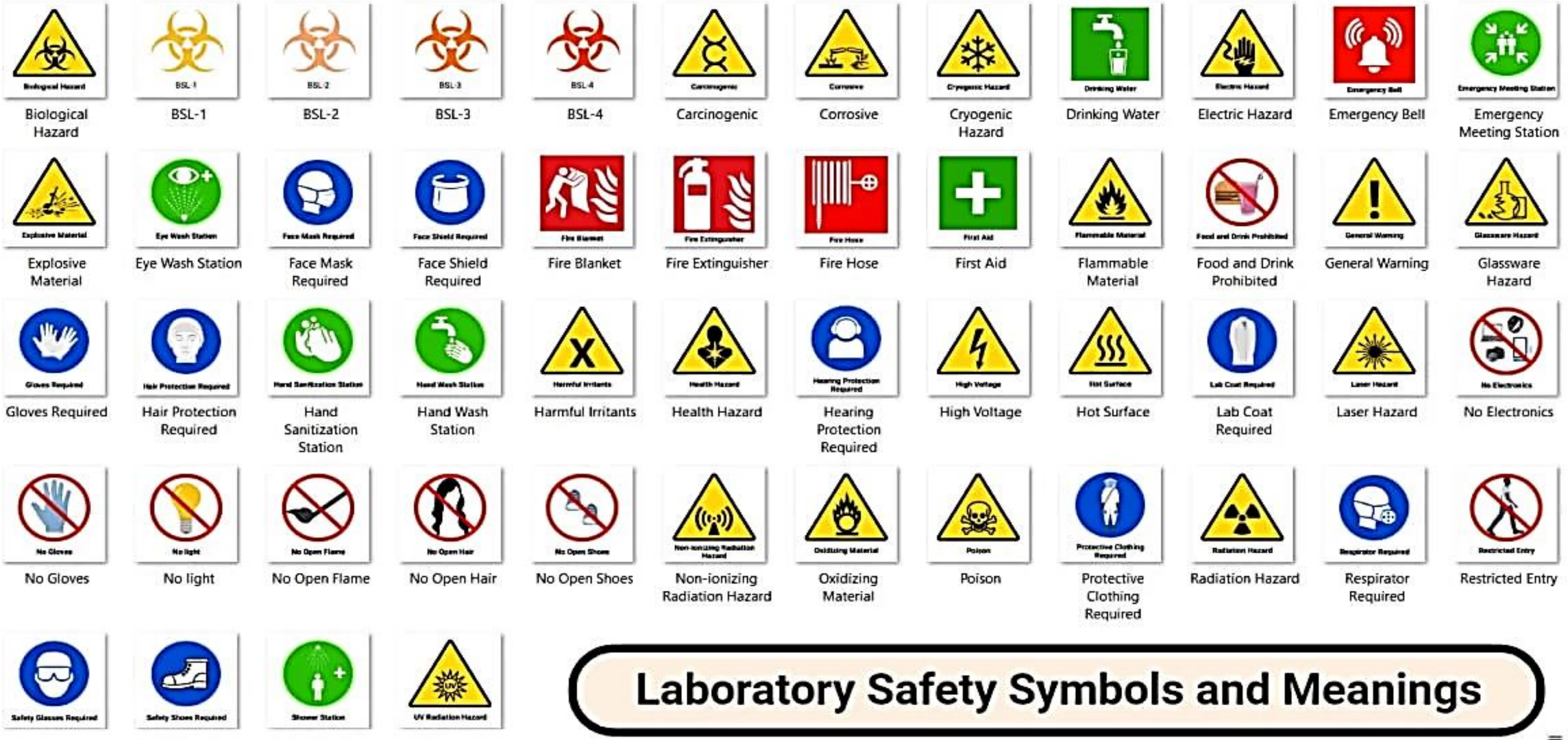
- GEN 75400 - New personnel are trained on fire safety, with a fire safety review conducted at least annually.
- GEN 76000 - The laboratory has a Chemical Hygiene Plan (CHP) that defines the safety policies and procedures for all chemicals used in the laboratory.
- GEN 76100 - Personnel have access to all of the following documents;

1. Current Safety Data Sheets (formerly MSDS) and other references that list the details of hazards and the precautions for safe handling and storage

2. Chemical Hygiene Plan of the laboratory

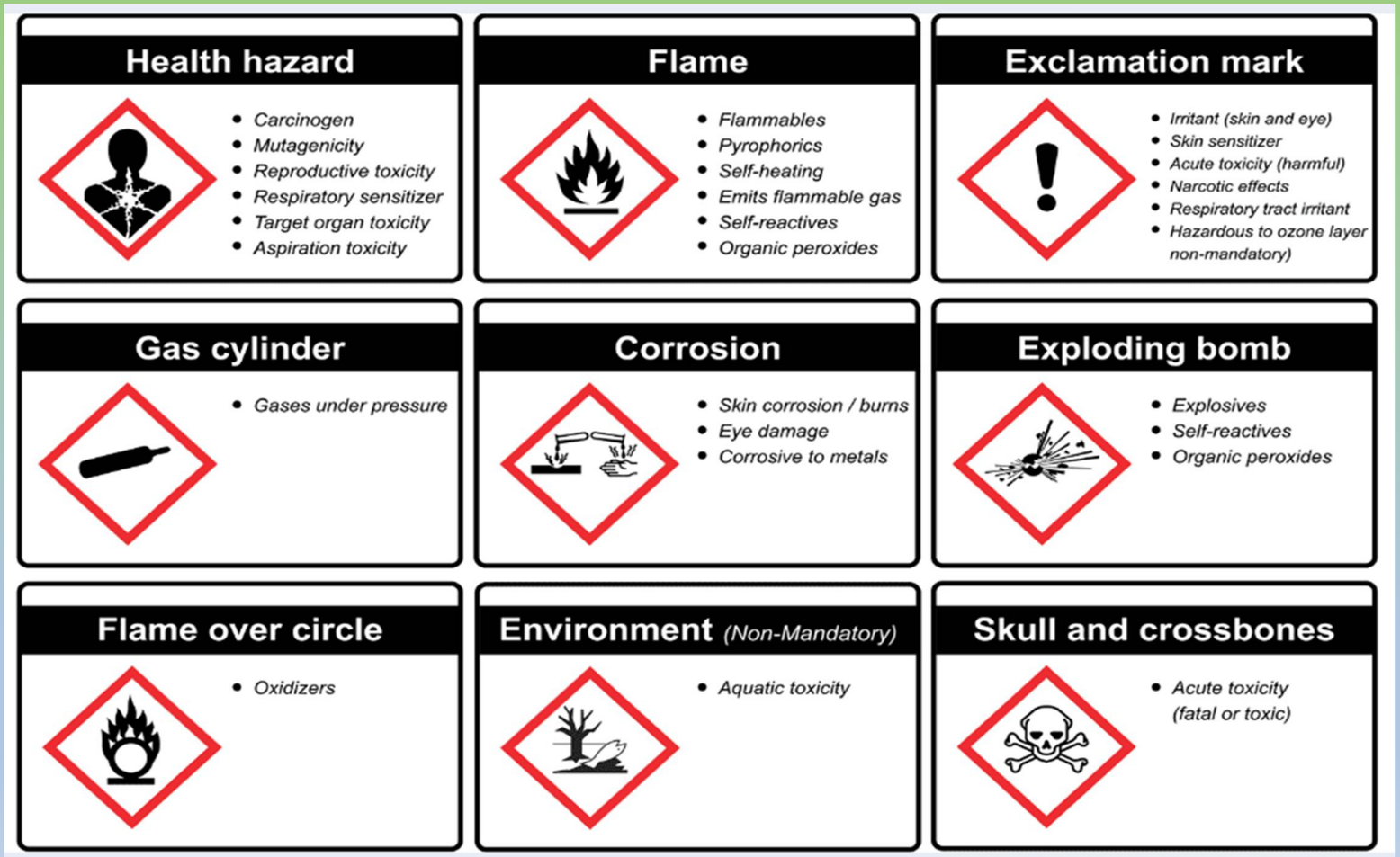
Laboratory safety is a high priority for CAP!!!

- GEN. 77110 - There is an up-to-date radiation safety manual that includes sections on decontamination and radioactive waste.
- GEN. 77400 - The laboratory has adequate plumbed or self-contained emergency eyewash facilities in every area where exposure to the eye from corrosive chemicals, as defined by the laboratory's chemical hygiene plan, may occur.

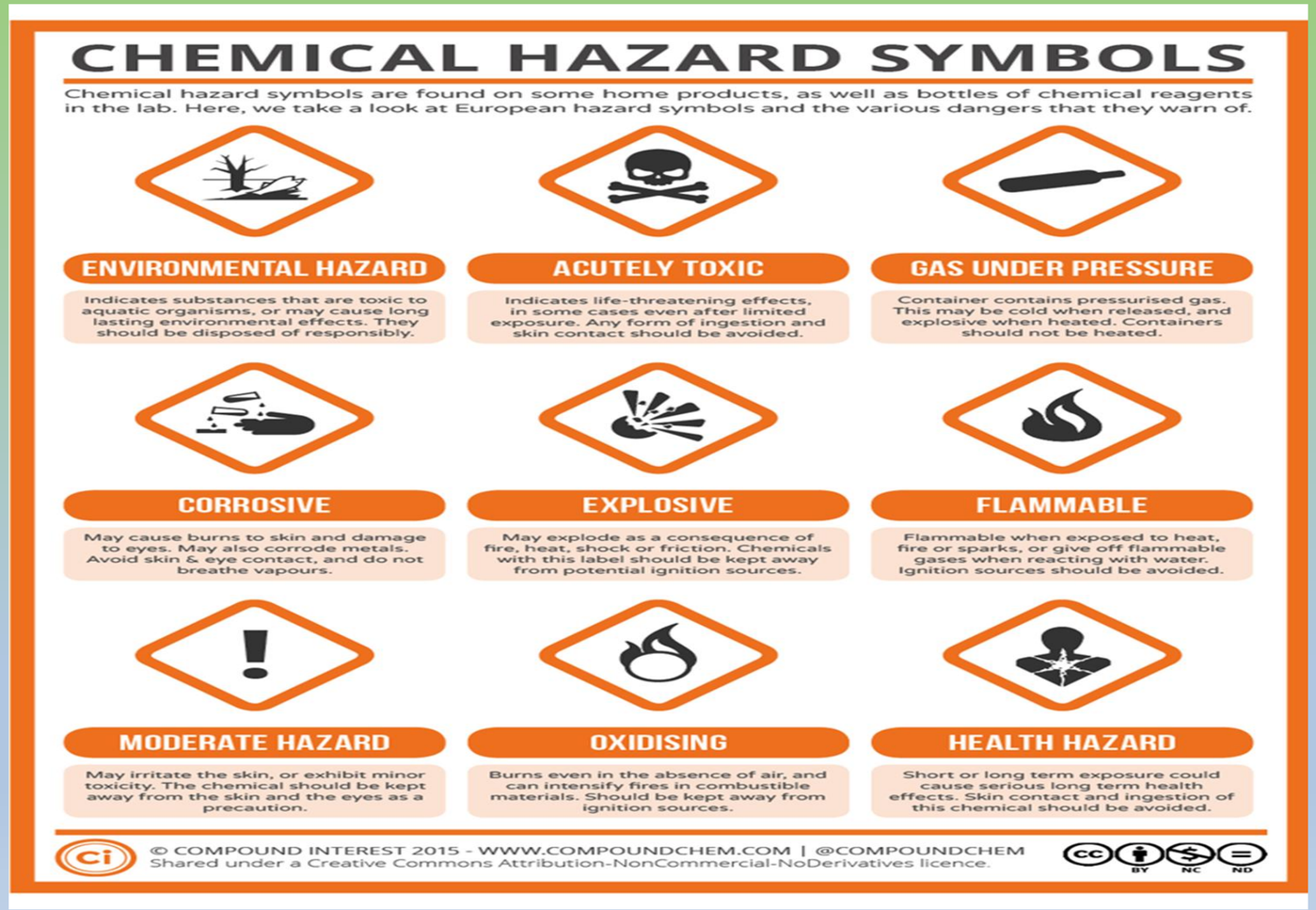


Laboratory Safety Symbols and Meanings

Lab Safety Symbols…



Lab Safety symbols…



Best practices for equipment maintenance, calibration, and validation

- ***These are critical steps in ensuring optimal performance, accuracy, and reliability in the laboratory***
- ***Both in short and long term, they help to ensure the accuracy and reliability of lab results, the longevity of equipment and facilities, and the productivity of the research that is carried out in the laboratory***
- ***Can help labs avoid accidentally violating regulations and standards***

Equipment Maintenance – Best Practices:

ISO 15189: 2022 Sect 6.4.5:

- The laboratory shall have preventive maintenance programs, based on manufacturer's instructions.
- Equipment shall be maintained in a safe working condition and working order. This includes electrical safety, any emergency stop devices, and the safe handling and disposal of hazardous materials by authorized personnel.
- Defective equipment – Mark 'OUT OF SERVICE"
- DECONTAMINATE before servicing or repairs, provide appropriate PPE

Essential Equipment Records to be Maintained:

Identification and Procurement

- Manufacturer and supplier details
- Unique equipment identification (including software/firmware versions)
- Condition upon receipt (e.g., new, used, reconditioned)Date of receipt and date of entering into service

Installation and Verification

- Results of acceptance testing and conformance with specified criteria
- Current physical location of the equipment
- Manufacturer’s instructions and user manuals

Essential Equipment Records to be Maintained – contd:

Preventive and Corrective Maintenance

- Preventive maintenance schedule and records
- Maintenance activities performed (by lab personnel or external service providers)
- Documentation of damage, malfunction, modifications, or repairs

Calibration and Performance Checks

- Calibration and/or verification reports or certificates
- Include dates, times, results, reference standards, and responsible personnel

Operational Status and Lifecycle

- Equipment status (e.g., in-service, out-of-service, quarantined, retired, obsolete)
- Documentation of any major updates, relocations, or decommissioning

Steps in Equipment Maintenance…

Establish a Maintenance Schedule

- Create a routine maintenance plan based on manufacturer recommendations and usage, including regular inspection, cleaning, and servicing.

Document Maintenance Activities

- Maintain accurate logs of all maintenance performed, noting dates, tasks completed, issues identified, and personnel involved.

Train Personnel

- Provide ongoing training to ensure staff are competent in equipment use and maintenance procedures, including periodic refreshers.

Review and Update Procedures

- Regularly evaluate and revise maintenance protocols based on equipment performance, user feedback, and technological updates.

Equipment Calibration – Best Practices:

Calibration is the process of verifying and adjusting the accuracy of an instrument's measurements by comparing its output to a known reference standard, ensuring that results remain precise and reliable for diagnostic or analytical use

Follow Established Calibration Procedures

- Always use manufacturer-recommended protocols with clear instructions tailored to the equipment.

Use Traceable Calibration Standards

- Ensure calibration standards have traceability to recognized national or international references (e.g., NIST) for reliable and comparable results.

Calibrate at Regular Intervals

- Frequency depends on equipment type and usage: Follow manufacturer's and reagent instructions, Recalibrate with each reagent lot change and Recalibrate if QC results show systematic bias.

Document the Calibration Process

- Maintain comprehensive records to ensure reproducibility and compliance with regulatory standards. It should include; Unique equipment identifier, date, Standard used, procedure followed, and results.

Implementing Sustainable Laboratory Practices and Green Initiatives

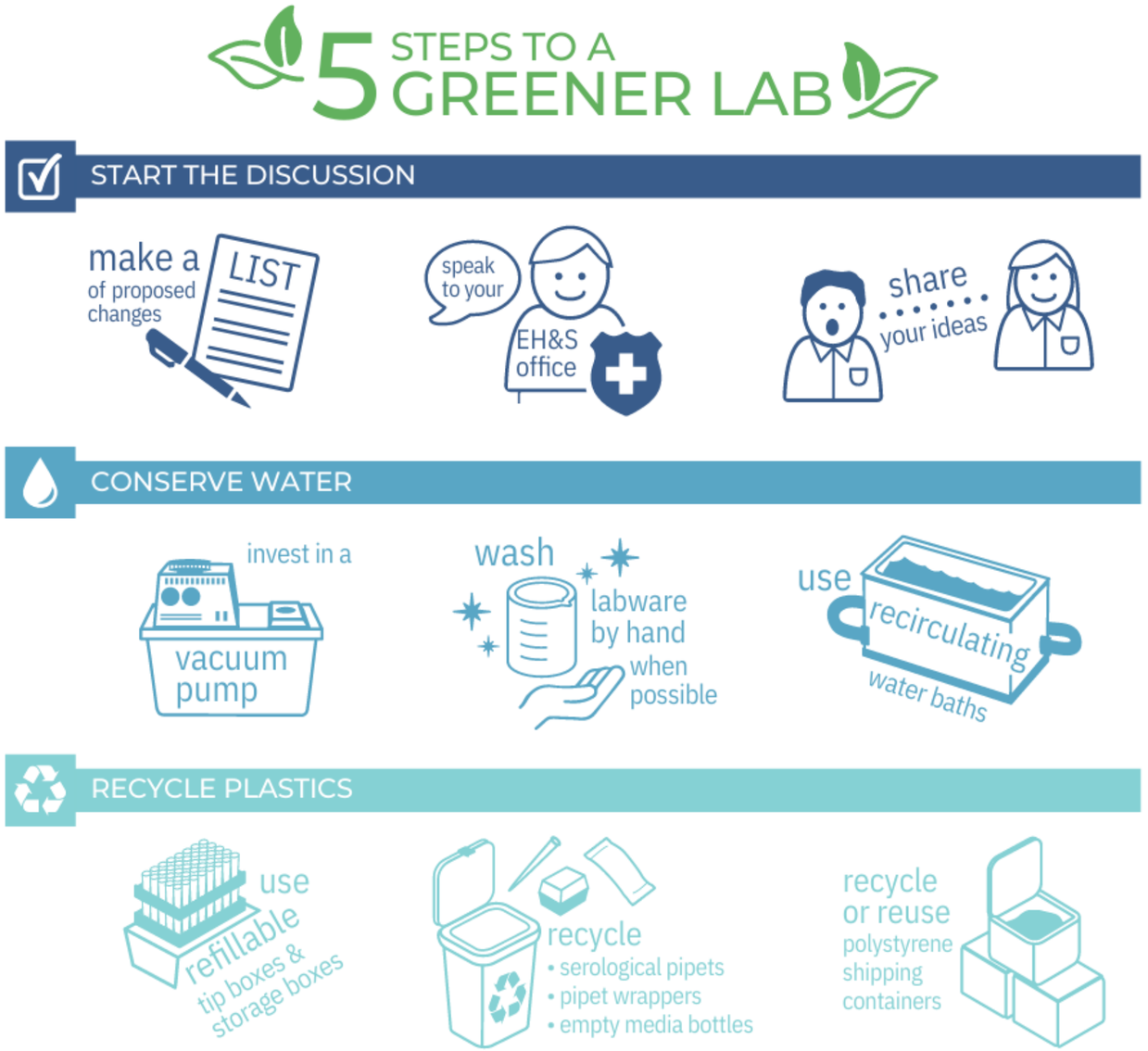
- Green initiatives refer to programs, strategies, or activities aimed at promoting environmental awareness, sustainability practices, and eco-friendly behaviors
- A "**Green Lab**" is one that minimizes its environmental impact through sustainable practices, reducing resource use, and waste while maintaining healthcare quality
- Green initiative aims at reducing carbon emissions and plastic usage, promote recycling, and reuse consumables where appropriate

‘Reduce, reuse and recycle’

Green initiatives and SDG goals:

Green initiatives strongly align with several Sustainable Development Goals (SDGs), particularly:

- Goal 7: Affordable and Clean Energy,
- Goal 12: Responsible Consumption and Production,
- Goal 13: Climate Action, and
- Goal 15: Life on Land.



Why the Concern???

- **Laboratories, while essential to healthcare and research, have a disproportionately large environmental footprint.**
- **Every lab test requires significant energy, water, and chemical resources—often before a single result is produced.**
- **In fact, laboratory buildings can consume up to 10 times more energy and 4 times more water than standard commercial buildings.**
- **The extensive use of single-use plastics, hazardous chemicals, and high-energy equipment such as ultra-low temperature freezers further exacerbates this impact.**

Why the Concern???

- These operations contribute not only to climate change, air and water pollution, and biodiversity loss, but also pose health risks due to unsafe chemical handling and disposal.
- The chemical industry, central to laboratory function, is itself a major polluter and resource-intensive sector.
- According to *Healthcare Without Harm*, the healthcare industry accounts for up to 4.6% of global carbon emissions, underscoring the urgency of sustainability.
- As environmental concerns rise, laboratories are now actively seeking ways to:
  - Minimize waste and resource consumption
  - Improve energy and chemical efficiency
  - Reduce their overall carbon footprint

Sustainable laboratory practices and green initiatives

- **European Federation of Clinical Chemistry and Laboratory Medicine (EFLM) Task force – Green and Sustainable Laboratories TF-GSL founded in 2021**
- **This was in alignment with the European Green Deal (EGD) Investment Plan – Initiative of EU to become climate neutral by 2050**
- **Goal of TF-GSL is to promote sustainable practices in clinical laboratories, focusing on carbon footprint reduction, guidance, and greater sustainability**
- **Offers guidelines and recommendations to decrease energy, water, waste, and chemical use.**

EFLM
EUROPEAN FEDERATION OF CLINICAL CHEMISTRY AND LABORATORY MEDICINE

Green Labs
EFLM Task Force
Green and Sustainable Laboratories
(TF-GSL)

Sustainable laboratory practices and green initiatives

- In 2022, Malaysia recorded a 6.5% increase in their carbon emissions → in response,
- Implemented green technology policies, including the National Energy Transition Roadmap, with clinical labs keying in
- The sustainability practices in laboratories have been embraced by renowned institutions worldwide.
- - Harvard University's Sustainable Labs Programme
- - University of California, Berkeley's Green Labs Programme
- No longer optional – scientific, ethical & operational necessity for a sustainable future

Key Green Initiatives for Sustainable Laboratory Practice (Advocated changes):

1. Waste Reduction

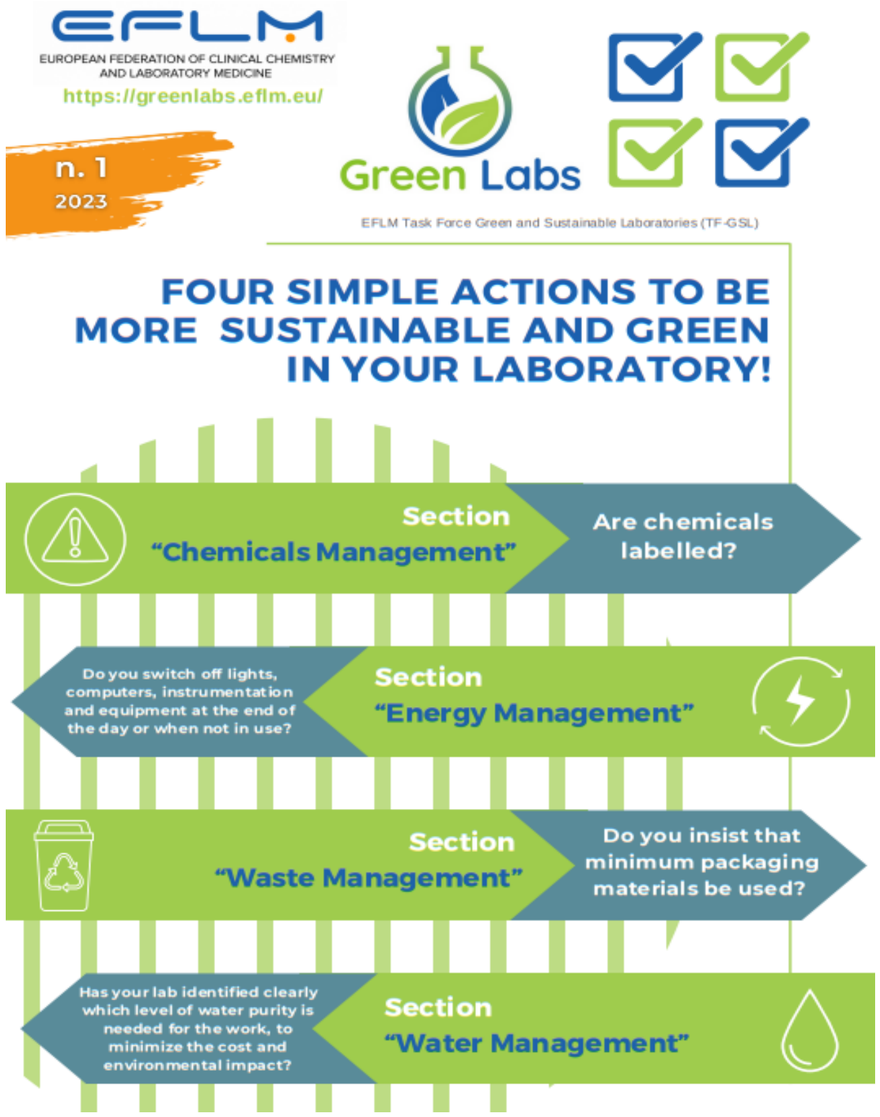
- Transition from single-use plastics to reusable glass containers
- Use recyclable plastics where possible
- Minimize paper use by adopting digital documentation and electronic data systems

2. Energy Conservation

- Install energy-efficient lighting (e.g., LED, motion-activated systems)
- Use energy-efficient refrigerators, freezers, and air-cooling systems
- Consider renewable energy options like solar panels
- Invest in energy-saving lab equipment (e.g., incubators, ovens, centrifuges with auto-shutoff, insulation, efficient motors)

3. Water Conservation

- Install low-flow faucets and promptly fix leaks
- Optimize water-dependent processes to minimize waste



Key Green Initiatives for Sustainable Laboratory Practice – contd:

4. Sustainable Procurement

- Choose vendors committed to environmental responsibility (e.g., minimal packaging, recycled materials, eco-friendly products)

5. Sustainable Lab Design and Layout

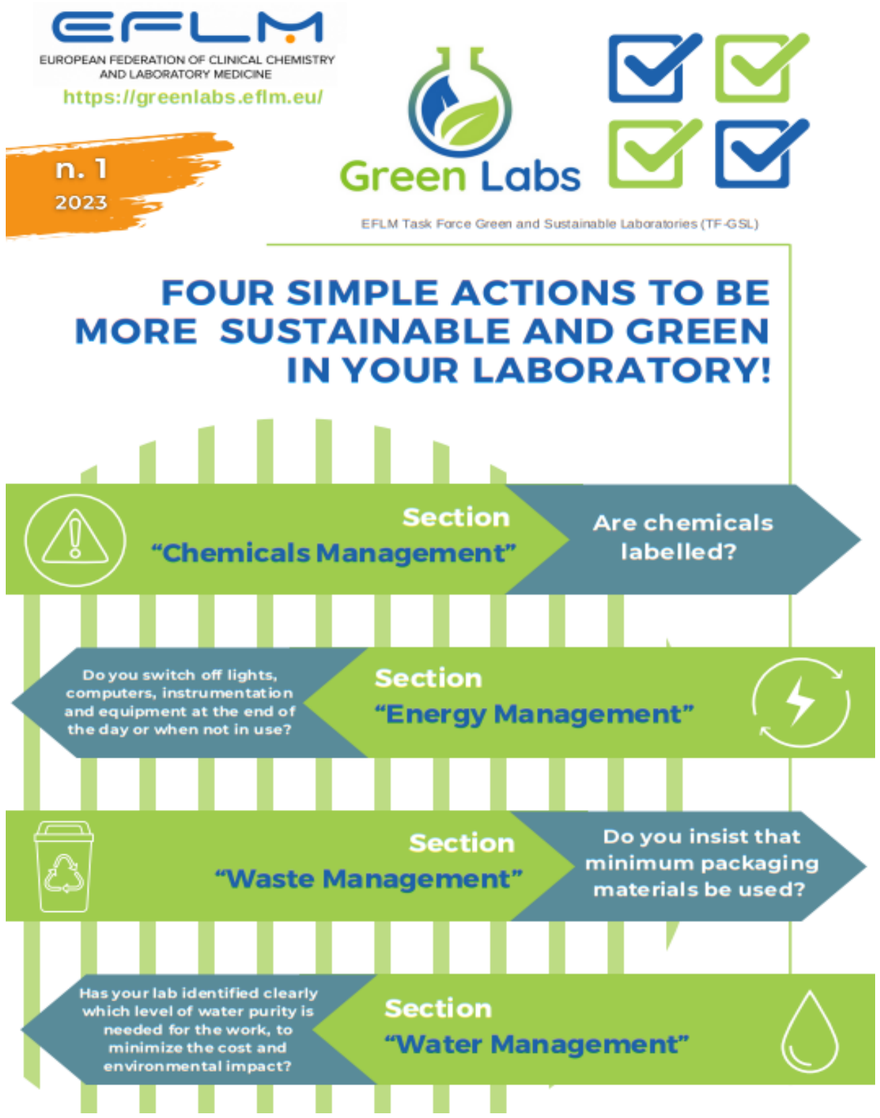
- Design for optimal workflow and space utilization to reduce energy demand
- Implement behavior-based changes such as closing fume hood sashes when not in use (saving up to 30% of associated energy)

6. Operational and Cultural Shifts

- Adopt a lean laboratory approach to minimize unnecessary steps and waste
- Power down idle equipment, lights, and air-conditioners
- Promote the 3Rs: Reduce, Reuse, Recycle

7. Awareness and Engagement

- Educate staff on sustainability practices and foster behavioral change
- Join green lab networks (e.g., Irish Green Labs, Sustainable European Labs, My Green Lab Ambassador Program)
- Green certifications to validate and guide efforts



Benefits of Green Initiative:

Tangible cost savings – reducing waste reduces disposal expenses and environmental impact.

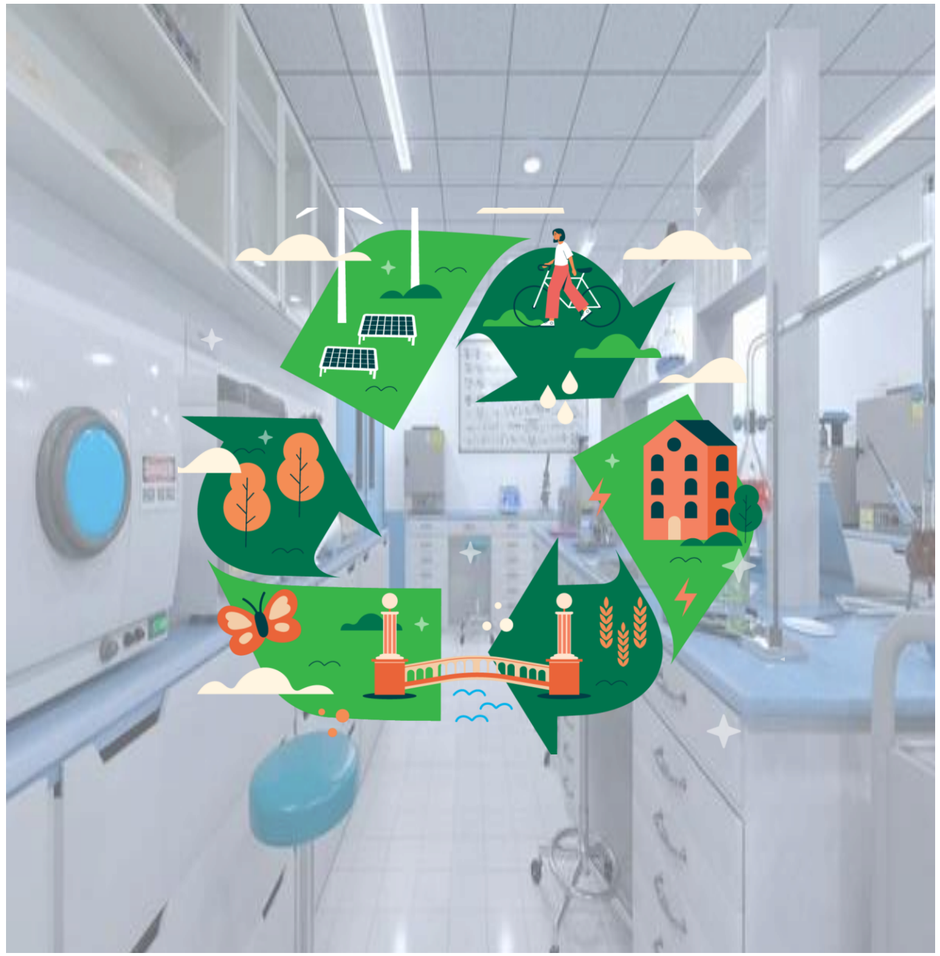
Less harmful effect on the environment

Promote environmental awareness – such changes in mindset also have impacts outside of work

Enhances lab's brand and image with its customers, suppliers, and other stakeholders.

Challenges of green initiatives in the lab:

- **Fear/Resistance to change**
- **Fear of contamination with reuse of materials**
- **Finding sustainable alternatives**
- **Green alternatives may have lower performance characteristics**
- **Poor awareness**
- **Initial costs required for upfront investments in new equipment, infrastructure**
- **Developing effective recycling and disposal systems for waste can be challenging in resource-limited settings**



Conclusion:

- **Key competencies acquired:**
  - **Lab safety and biosafety principles based on WHO & CDC guidelines**
  - **Appropriate containment practices for various risk groups**
  - **Best practices in equipment maintenance, calibration, and validation**
  - **Sustainable lab practices: waste reduction, energy efficiency, and green initiatives**
- **Integration of safety, biosafety, and equipment management into a cohesive system is essential for continuous improvement.**

Some References:

- Nsubuga FM, Jaakkola MS. Needle stick injuries among nurses in sub-Saharan Africa. Trop Med Int Health. 2005;10(8):773–781
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Thank You

NEXT WEEK (19th May 2025):

Optimizing Supply Chain, Inventory, and Procurement in Laboratory QMS – Dr. Eze E.O (MBBS, FMCPath., IFCAP)

- Managing reagent shortages and mitigating supply chain disruptions
- Implementing digital inventory tracking for efficient resource utilization
- Sustainable procurement strategies for laboratory cost-effectiveness and reliability

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