LABORATORY SAFETY MANUAL			
Applies to:	All CoM- KFU Laboratories	Prepared by:	Dr. Sayed Quadri & Dr. Abeir Bashir
Index Number:		Approved by:	Dr. Fahad Al-Wadani
Issue Date :	01.12.2020	Revision Date:	

LABORATORY SAFETY MANUAL
2020-21 VERSION 1

COLLEGE OF MEDICINE, K. F.U.

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Forward

The importance of ensuring safety at work place in all its dimensions is extremely vital. The College of Medicine, KFU, is committed to the safety of its employees and to the safety of the working environment. Endeavoring to ensure safe working conditions are the responsibility of both the employer and the employee. Implementation of safe work practices requires well laid out protocols for prevention of accidents and protection of the employees.

The College of Medicine has multiple laboratories in its premises, which are involved in practical teaching and training of the undergraduate and postgraduate students and scientific research. Several laboratory procedures are conducted regularly for these purposes. Therefore, it is pertinent that a Laboratory Safety Manual be in place to guide the laboratory personnel in their workplace.

I commend the Financial Affairs and Equipment Committee under the dynamic leadership of ***Dr. Menorah*** *and under the coordinator-ship of* ***Dr. Abdul Rahim Abdul Salam*** *for working tirelessly towards fulfilling the tasks of the Committee. I congratulate and thank them for their endeavors.*

Dr. Fahad Al-Wadena

Dean, College of Medicine, KFU.

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Introduction

The Laboratory Safety Manual has been drafted to ensure that the standard protocols are followed for the safety of all personnel working in the laboratory. It is envisioned that the instructions laid down and the information provided in this manual shall prevent any untoward accidents and protect the personnel in regards to different safety issues.

I thank ***Dr. Abdul Rahim Abdul Salam*** *for being instrumental in outlining the framework of the manual and he deserves accolades for this.* ***Dr. Sayed. A. Quadri*** *deserves special appreciation and thanks for working hard in preparing this manual.* ***Dr. Abeir Bahsir*** *has also contributed in the preparation of this manual and appreciation and thanks are due to her too.*

We hope and expect that all the employees and the students shall adhere to the safety measure while working in the laboratory. The Faculty and the Laboratory technicians are especially responsible in its implementation and adherence.

This is intended to be a dynamic document and shall be revised periodically by competent persons as and when the need is felt.

Dr. Menorah

Chairperson, Financial Affairs and Equipment Committee

College of Medicine, KFU

1.0 POLICY:

It is the policy of the College of Medicine, King Faisal University (CoM-KFU) that all Faculty and Technical staff shall participate regularly in the Safety Program to ensure a safe work environment. Adherence to the National and International Safety standards is applicable to all staff working in CoM-KFU with regards to diverse aspects of safety at work place. This policy is valid for all the laboratories in CoM-KFU.

2.0 PURPOSE:

The main purpose of this manual is to provide a thorough understanding of safety procedures; define responsibilities for the safety program and to ensure a safe environment for all the employees and the students working in various laboratories of CoM-KFU.

The manual is intended to:

2.1 Protect faculty members, laboratory technicians, students and housekeeping staff, from health hazards associated with the use of hazardous chemicals in the laboratories.

2.2 Assure environmental safety from hazardous waste generated in the Labs.

2.3 Ensure proper training and competencies of all faculty members and laboratory technicians to safe laboratory procedures, spill control and disaster management

3.0 OBJECTIVES:

3.1 To establish general laboratory safety rules that meets national and international guidelines.

3.2 To formulate a proper biological safety plan

3.3 To formulate a proper chemical safety plan.

3.4 To ensure protection of laboratory staff from exposure to toxic vapors and fumes.

3.5 To set guidelines for compressed gas safety

3.6 To ensure fire safety including fire prevention, control and loss reduction, as well as to ensure electrical safety

3.7 To include maintenance, training and safe use of PPE, safety shower, emergency eyewash station and first aid kit

3.8 To ensure safe waste disposal regarding sharps and chemicals

3.9 Provide a guide for reporting safety incidents, general laboratory safety practice

3.10 To ensure proper training, competency assessment on all aspects of the plan

3.11 To set laboratory emergency situation guidelines (internal, external), with proper training and documentation

3.12 To set a procedure for hazard control /elimination plan

3.13 To ensure monitoring of all plan aspects in accordance with national and international standards

4.0 CHEMICAL SAFETY PLAN:

4.1 Statement

Chemical Safety Plan includes policies, procedures, and responsibilities designed to develop an awareness of potentially hazardous chemicals in the workplace and to train employees in appropriate, safe working conditions. Thus, employees can make knowledgeable decisions about any personal risks of employment.

4.2 Purpose

4.2.1 To provide a safe working environment based on the premise that employees have a right to know about health hazards associated with their work.

4.2.2 To ensure that the hazards of all chemicals are evaluated and comprehensive hazard communication programs, which are to include container labeling and other forms of warning, material safety data sheets (MSDS) is prepared and transmitted to employers and employees.

4.2.3 Employers and employees assume responsibility for laboratory safety.

4.2.4 All employees have access to relevant safety information through their Department Chairperson, Supervisory staff, safety manuals, and reference materials.

4.2.5 Evaluation of the acute toxicity, carcinogenic potential and reproductive toxicity for all chemicals used in the laboratory

4.2.6 Specific handling requirements for all hazardous chemicals used in the laboratory.

4.2.7 To detect potential hazards in both the facility and in work procedure. Workplace Hazard Assessments will be conducted by the Safety Supervisor, in consultation with Department Chairperson, employees and Safety Supervisor. Hazard Assessments will be conducted at least:

- Whenever a new procedure or hazardous chemical is introduced
- Whenever there is a change in previously assessed procedures.
- Whenever there is a move or physical renovation of the workplace.
-

- When safety concerns arise, employees are encouraged to contact their supervisor or laboratory

4.3 Procedures:

4.3.1 Material Safety Data Sheets (MSDS)

- As part of the comprehensive hazard communication programs, an inventory of all chemicals is present in each Lab along with MSDS for all hazardous chemicals.
- The chemical inventory and MSDS must be readily available for all employees.
- Any newly introduced chemical /different concentration should have its MSDS upon receipt.
- MSDS shall contain:

  a. The identification of the product
  b. Physical and chemical characteristics
  c. Health hazards
  d. Primary routes of entry
  e. Storage ,disposal and transport
  f. Precautions for safe handling
  g. PPE required
  h. Emergency first aid procedures

4.3.2 Chemical labeling

- All chemicals must be appropriately labeled and stored to identify the hazardous chemicals stored, used and disposed off in the laboratory.
- The identification labels must contain:

  a. Chemical name/content
  b. Concentration (whenever applicable)
  c. Date prepared / opened (whenever required)
  d. Expiration date

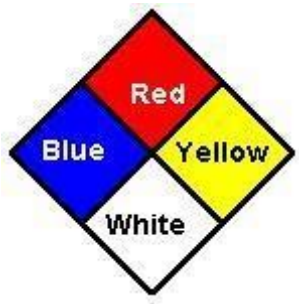
- **Hazard label must contain:**

  a. **NFPA** (National Fire Protection Association) Hazard Rating System , whenever applicable.

b. It should be noted that the primary intent of the NFPA system is to identify potential hazards during conditions of fire. However, the warnings are such that they may be applied to other circumstances.

c. This system uses a diamond divided into four different hazards. A number 0-4 within each diamond indicates the degree the hazard present

Blue indicates a health hazard
White is used for specific hazard notice
Red indicates a fire hazard
Yellow indicates a reactivity hazard



d. If a reagent is prepared from a hazardous chemical and not included under NFPA list , the hazardous reagent must also be labeled with a warning label / sign (e.g. flammable, corrosive, poison, or cancer hazard)

e. Under certain circumstances it may not be possible or impractical to apply hazard labeling directly to a container such as: awkwardly shaped containers, extremely small containers, containers where labels easily become defaced by stains or other chemicals, or containers which are discarded frequently. Under such circumstances, hazard labels may be place on a loop around the neck of the container, or immediately adjacent to the point of use. **This does not obviate the need for identification labeling.**

f. OSHA (OCCUPATIONAL SAFETY AND HEALTH ASSOCIATION and CAP regulations permit chemical transfer containers (such as measuring cylinders, flasks, etc.) to remain unlabeled **IF** and **ONLY** the person dispensing the chemical is present at all times.

UNLABELED CONTAINERS MUST NOT BE LEFT UNATTENDED FOR ANY PERIOD OF TIME, NO MATTER HOW SHORT.

4.3.3 Chemical inventory

- Chemical inventory should prepared and updated annually / or as required by adding or removing new chemicals in each section of the laboratory. A written record of the inventory is maintained in each lab section and an electronic record of all chemical inventories is compiled and maintained in one file.
- The inventory list shall contains:
  - **a** Chemical name, conc^{n}.
  - **b** Quantity stored
  - **c** Maximum permissible quantity
  - **d** Expiration date
  - **e** Chemical hazard
  - **f** Location
  - **g** Purpose for use
  - **h** Responsible person

5. Hazardous Materials/Chemical Waste Removal and Disposal/ Accident Plan

5.1.Hazardous Chemical Waste: waste is considered hazardous if it appears on any one of the four lists of hazardous wastes (F, K, U, P) contained in the Resource Conservation and Recovery Act (RCRA) (Resource Conservation and Recovery Act (RCRA) from EPA, USA), or by virtue of certain chemical characteristics. Certain non-regulated chemicals are further considered to be hazardous waste due to their toxic nature.

- **RCRA Listed wastes:**
  a. F list: nonspecific source waste; generic wastes, commonly produced by manufacturing and industrial processes (e.g. halogenated solvents, electroplating)
  b. K List: specific source waste from specifically identified industries such as wood preserving, petroleum refining and organic chemical manufacturing (e.g. sludges, waste water)
  c. U List: commercial chemical products; commonly used specific commercial chemical products or manufacturing intermediates (e.g. chloroform, sulfuric acid, hydrochloric acid)
  d. P List: waste that is acutely hazardous or fatal to humans in low doses.
- **Characteristic wastes**:
  a. Waste is considered hazardous if it has one or more of the following characteristics: ignitability, corrosivity, reactivity, or Extraction Procedure (EP) toxicity.
  b. Ignitability: flammable or easily combustible; flash point below 60° C (140° F) (e.g. xylene, benzene, ether, acetone, methanol)
  c. Corrosivity: pH less than 2 or greater than 12.5; dissolves metal or burns the skin (e.g. sodium hydroxide, hydrochloric acid, sulfuric acid, formic acid)
  d. Reactivity: unstable at normal temperature and pressure; releases explosive or toxic vapors (e.g. azides, 30% hydrogen peroxide, picric acid, 60% perchloric acid).

e. EP Toxicity: toxic if an Extract from the waste is tested and found to contain concentrations of heavy metals or specific pesticides (e.g. lead-containing compounds, mercury, chromium, arsenic, silver)

- **Non-regulated hazardous wastes:**

a. cytotoxic drug bulk waste
b. asbestos
c. ethidium bromide
d. ethylene glycol

5.2. Standard Hazardous Chemical Waste Precautions

- **Wastes of different hazard characteristics must not be mixed for disposal.**
- If wastes of the same hazard characteristics are mixed for disposal, the chemicals must be compatible with each other. Mixing of solid and liquid waste should be avoided.
- Waste container should be not more than 3/4 full
- Waste container must be compatible with the chemical. Containers must be securely capped at all times, except for the purposes of adding additional waste
- Waste must be stored appropriately in a well- ventilated, secure, low traffic area. Flammable waste must be stored in accordance with flammables storage requirements
- Waste containers must be clearly labelled as "Hazardous Waste", and must bear the date and area collection was initiated.
- Waste must be collected in the area of generation prior to disposal. **Waste generated in one lab may not be transferred to another for storage.**
- Dispose chemicals in its original container, if not possible , in a compatible container

5.3. Chemical accidents / injuries

5.3.1. General guidelines

- Identify the chemical involved ,Follow MSDS guides for first aid , a copy of MSDS sheet should be shown to the ED physician on seeking medical advise
- Do NOT use salves, ointments, creams, sprays, or any other covering on any type of burn.
- Do NOT attempt to rupture blisters over the burn.
- Any injury, whether minor or serious, must be reported to a supervisor and documented with an incident report. First aid kits for minor injuries are available in the laboratory , checked monthly and after each use

5.3.2. Spill to eye:

Immediately wash eye with normal temperature running water for 15 minutes before seeking medical advice (with spilled material MSDS)

5.3.3. Spill to body /wounds :

- immediately rinse with normal temperature running water for 15 minutes before seeking medical advice (with spilled material MSDS), remove clothes (especially shoes and socks) if contaminated with residuals of the spilled chemicals
- Keep the wound as clean as possible. Remove or cut away any clothing covering the wound. Flush with water to wash out loose dirt anddebris , Do NOT try to pick out foreign matter embedded in the wound
- If bleeding is profuse, apply steady, direct pressure over the wound using a sterile dressing, if possible, or clean cloth
- Control bleeding by direct pressure, but do not apply pressure on the impaled object itself or on immediately adjacent tissues. Stabilize the impaled object with a bulky dressing and immediately transfer to ED

5.3.4. Toxic vapor inhalation:

- Breath through a mask or wet **towel,** Call for help**,** Pull the victim out of the room to fresh air**,** Open Windows or turn off A/C

5.3.5. Thermal burn:

- Immerse the burned area in cold water or apply cold compresses to the burn for 30 minutes

5.4.Disposal of Acidic/Basic Materials

- Acidic or basic materials of pH 2.0 or 12.5 must be disposed with the assistance of Safety Supervisor. Labelled with name , concentration , main hazard
- Rinse empty bottles thoroughly with tap water and discard the UNCAPPED bottle. Glass should be disposed of in rigid waste containers.

5.5.Disposal of Formaldehyde

- Expired formaldehyde as well as used formaldehyde are disposed as medical waste through medical waste manager.

5.6.Disposal of Flammable solvents

- All solvent wastes are to be put in properly labeled waste containers.
- Aqueous solutions of alcohols containing less than 24% (w/v) alcohol, and which contain no other hazardous materials, may be disposed of as non-hazardous wastes by pouring down a clinical sink, followed by copious amounts of water.
- Deliberate dilution of alcohols for the purposes of disposal is strictly prohibited.
- **Do not combine incompatible solvents. IF IN DOUBT as to compatibility, do not combine solvents from different procedures.**
- Solvent waste bottles must be kept under a fumes hood or in a flammable storage cabinet or flammable storage room until picked up
- Allow empty solvent bottles to evaporate to dryness under a fumes hood, and discard the uncapped bottle. Glass should be disposed of in rigid waste containers.
- Alternatively, empty containers of alcohols may be rinsed with tap water prior to being discarded.
- Place uncapped empty ether cans under a fumes hood until evaporation is complete. Rinse container thoroughly and discard the uncapped can.

5.7.Disposal of empty chemical containers

- Empty containers should always be cleaned out, as far as is practicable, before disposal to minimize both hazard and waste of residual chemical labeled as the chemical waste; and type of hazard and originating area.

5.8.Chemical Spills General Standards

Chemical Spills will inevitably occur and personnel should be properly trained to recognize the hazards associated with the spill, minimize the spill and to notify to proper response personnel when necessary.

- If the spill requires respiratory protection for fumes, the room shall be evacuated and Safety Supervisor called **IMMEDIATELY.**
- Help any injured victim first
- Code orange shall be activated, when a spill involves:

a. More than 100 ml of an OSHA regulated chemical carcinogen or a highly toxic chemical; or

b. More than 1 liter of a volatile or flammable solvent; or

c. More than 1 liter of a corrosive (acid or base) liquid; or

d. Material not readily identifiable, or for which no MSDS is available.

e. Spill requires respiratory protection for fumes

f. Cannot be properly handled due to some lack or properly trained personnel and/or equipment to perform a safe, effective clean up

g. Involves any quantity of metallic mercury

5.8.1. Spilled liquid

Small spills (less than 100 ml)

- Help any injured victim first
- Confine spill (with paper towel around the spill at 5 cm separation from the edge)
- Notify surrenders ,Put spill mark, don't allow people to move over
- **Wear PPE**

- Identify what exactly you are dealing with.
- Pour enough vermiculite or other inert absorbent material (sand) on spill to soak up liquid.
- Remove any sharp object first , using a forceps, add in plastic bag.
- Refer to MSDS, determine the degree of hazard ,act accordingly (NB . For small quantities of Acids, use a neutralizing agent or absorbent mixture (i.e., soda ash, sodium bicarbonate, or diatomaceous earth). Bases can be neutralized by using citric acid or boric acid. For small quantities of other materials, absorb the materials with non- reactive materials (i.e., vermiculite, clay, dry sand)
- collect the mixed spill with absorbent paste or powder by the use of dust pan and brush
- Let housekeeping wipe area with paper towels and place in spill waste container.
- Mop up the spill, wringing out the mop in a sink or pail equipped with rollers. Do not use your hands.
- Double bag contaminated clean up materials and seal. These materials must be disposed of as hazardous waste. Label spill waste / sharp waste container as to contents, dispose as hazardous.
- When clean up operations are complete, wash hands with soap and water for at least 1 minute. Check any non-disposable personal protective equipment (boots, respirators) for contamination. Clean, dry completely and place back in storage
- Inform supervisor / safety representative, write OVR within 24 hours of incidents

5.8.2. Large Spills (greater than 100 mls)

- Follow previous steps till step 6 escaping 5 then
- Lock the door and place a sign on the door warning of spill.
- Label the sign as to contents of spill
- Inform supervisor / safety representative

5.8.3. Spilled solid

- Alert other persons to the spill and the need to evacuate the area.
- Determine the degree of hazard before attempting clean up and take the necessary preventive measures (i.e., protective equipment, eye protection, etc).
- Generally, solids of low toxicity can be swept up into a dustpan and place into a container compatible with the chemical. Damp toweling should be used to pick up and transfer materials of a higher toxicity level to a compatible waste container. Make sure the material is not water sensitive before using this procedure .
- Dispose of residue as hazardous waste, remembering brooms, dustpans and other items may require disposal as hazardous waste also.
- Double bag contaminated clean up materials and seal.
- When clean up operations are complete, wash hands with soap and water for at least 1 minute. Check any non-disposable personal protective equipment (boots, respirators) for contamination. Clean, dry completely and place back in storage

5.8.4. General Purpose Spill Kit for Chemicals Should Include

- Available in every laboratory section where chemicals are used / stored
- Clearly labeled , in a easily recognizable place with a clear sign
- Near to MSDS and chemical inventory
- Checked monthly and after each use
- Contents :
  - a Plastic dustpan and brush
  - b Forceps
  - c Heavy duty black bags
  - d Strong plastic closure
  - e Chemical resistant gloves (nitrile, at minimum)
  - f PPE as Safety goggles or face shield, Splash-proof coverall or apron and shoe protector, Inert absorbent materials-kitty litter, vermiculite, sand etc.
  - g Paper towels or rags
  - h Medical waste disposal sticker, NFPA label
  - i In specialized areas based on chemical risk assessment and HVA,
  - j Neutralizing agents for acid such as sodium bicarbonate (baking soda) or sodium carbonate (soda ash)
  - k Neutralizing agents for bases such as boric acid or citric acid

- specialized spill kits (formaldehyde spill kit)

5.8.5. Reporting :

- Any hazardous material spill , leak ,together with any other incident (needle prick injury ,etc) **should be reported to Safety Supervisor within not more than 24 hours** , details about nature ,possible reason ,situation of incident ,type ,estimated volume of hazardous substance ,exact space, spill management compliance per policy ,any accidental injuries ,etc should be clearly mentioned in the **Incident Report Form**. **Safety Supervisor** will further analyze and apply extra steps if necessary.
- Root cause analysis should be done whenever high volume /high impact or problem prone are analyzed. Measures to prevent further incidents should implemented whenever possible.

5.9.Chemical storage

Basic Rules for Hazardous Chemical Storage:

- With few exceptions, chemicals kept in the lab are hazardous (e.g. toxic, corrosive, flammable and volatile). Quantities should be limited to working solution to reduce damages due to fire or spillage of substances which are hazardous to the environment as well as the occupants of the building.
- Chemical storage should follow the rule of **ABOVE FLOOR BELOW EYE** level
- Stored chemicals should be protected against laboratory activities, extremes of temperature, and the possibility that they might be knocked over or broken
- CoM- KFU laboratories follows the alphabet role in storing chemicals with respect to chemical incompatibility
- **Incompatible chemicals** (those which react together violently or release highly toxic or flammable products) should be kept apart in separate storage units or cabinets in separate areas of the laboratory or, if in small quantities, separated by a compatible chemical or empty container
- **Hazardous / flammable chemical storage** cabinets should be high quality , following international safety specifications ,located in separate area of the laboratory but not

- immediately adjacent to high-risk activities or processes , Never store flammable chemicals in a standard domestic refrigerator
  - All storage cabinets or closets should be locked when not in use , used only by authorized staff
  - Storing chemicals should follow manufacturer specification mentioned in MSDS
  - Do not store chemicals in fume hoods or work areas
  - Label storage areas and cabinets to identify the hazardous nature of products stored within , Properly identify all unlabeled products before storing
  - Lips on storage shelves are recommended to prevent bottles from falling off
  - Chemical storage under, over or near a sink should be avoided since many chemicals are affected by moisture and can become highly hazardous
  - Install smoke detectors and appropriate fire extinguishers in all chemical storage areas

5.10. Transport of chemicals

- Hazardous liquid chemicals should not be transferred by hand ,, transfer on trolley with secured lids , tightly closed container , wearing PPE , by authorized trained staff , with the minimum required quantities , with accompanying spill kit if possible

5.12. Evaluation of the Carcinogenic Potential, Reproductive Toxicity and Acute Toxicity for All Chemicals Used in the Laboratory

Poisons and Carcinogens:

- All materials included in the Chemical Inventory List have been evaluated for carcinogenic potential, reproductive toxicity (defined here to include fetal effects, reproductive effects, mutagenicity and teratogenicity), and acute toxicity.
- **Definitions:**
  - **CARCINOGEN:** Substance or agent capable of causing or producing cancer in mammals.
  - **MUTAGEN:** Substance or agent capable of altering the genetic material in a living cell.
  - **TERATOGEN:** Substance or agent to which exposure of a pregnant female can result in malformation in the fetus

- The International Agency for Research on Cancer (IARC) classifies materials into five groups, based on carcinogenic potential.
  - a **Group 1** includes those materials which are carcinogenic to humans.
  - b **Group 2A** includes those materials which probably are carcinogenic to humans.
  - c **Group 2B** includes those materials which possibly are carcinogenic to humans.
  - d **Group 3** includes those materials which are unclassifiable as being carcinogenic to humans. (This category includes substances where data may be inadequate or conflicting.)
  - e **Group 4** includes those materials which are probably not carcinogenic to humans.
- **The following materials, present in the KFU Laboratories are listed as Group 1 ("Carcinogenic to Humans") by the IARC:**

  Formaldehyde

  Sulfuric acid (only on prolonged exposure to inhaled mists)
- **Storage:**
  - a Store carcinogenic materials only in a closed cabinet, not on an open bench top.
  - b Store carcinogens as required based on their chemical and physical characteristics, e.g. flammable carcinogens must be stored in a flammables room or cabinet.
  - c Do not store carcinogenic materials near a heat source or electrical switch.
  - d Evaluation of material for acute toxicity and reproductive toxicity is based on information provided in the Material Safety Data Sheets. The status of a material as an acute or reproductive toxin is included in the Chemical Inventory List.
  - e Extreme care must be taken when working with acute and reproductive toxins.
  - f Appropriate PPE and engineering controls (gloves, masks, fumes hoods, etc.) must be used, based on the nature of the material (light powder, volatile or nonvolatile liquid, etc.) and its route of exposure (absorption through skin, inhalation, ingestion, etc.

6. BIOLOGICAL SAFETY PLAN

Statement

Biological Safety Plan includes policies, procedures, and responsibilities designed to develop an awareness of potentially biological hazards in the workplace and to train employees in appropriate, safe working conditions. Thus employees can make knowledgeable decisions about any personal risks of employment.

4.2 Purpose

4.2.1 To provide a safe working environment based on the premise that employees have a right to know about health hazards associated with their work.

4.2.2 To ensure that the all biohazards are evaluated and comprehensive hazard communication programs is prepared and transmitted to employers and employees.

4.2.3 Employers and employees assume responsibility for laboratory safety.

4.2.4 All employees have access to relevant safety information through their Department Chairperson, Supervisory staff, safety manuals, and reference materials.

4.2.5 awareness of blood borne pathogens and the potential routes of transmission in the laboratory.

4.2.6 Awareness of biosafety levels and the prerequisites for each BSL labs.

4.2.7 To ensure that the lab staff are aware of potential biological accidents in the lab and the preventive measures to be taken.

6.1. General Safety in lab/Infection control / Major safety measures:

- Decontamination and washing of work surfaces/benches after each class and after every spill
- Eating, drinking, smoking, and storing food are not permitted in labs
- All wastes must be decontaminated before disposal
- A biohazard sign should be posted at the entrance to the lab

- Wearing gloves and masks to avoid diseases transmission (airborne and direct contact transmission). [1,2]

6.2. Possible Routes of Exposure to Infectious Agents in the Clinical Laboratory*

Route	***Situation***
Ingestion	*Mouth pipetting*
	Splashed infectious material
	Contaminated clothing, devices, fingers, or gloves
	Contaminated pens or pencils inserted into the mouth
	Consumed food /drink
Inoculation	*Needle stick accident*
	Cuts from sharp objects
Skin and mucous membrane contamination	*Splashes into eyes, mouth, nose*
	Spills or splashes on intact or non-intact skin
Inhaled infectious aerosol	*Streaking media*
	Flaming or cooling inoculating loop
	Mixing microbial suspensions by pipette
	Expelling air from a syringe
	Withdrawing needle from rubber stopper
	Separating needle from syringe
	Centrifuging specimens
	Mixing instruments such as blenders or shakers
	Pouring or decanting fluids
	Opening culture containers or blood tubes
	Spilling infectious material

*Adapted from Sewell, D.L. (1996)

6.3.Blood-borne Pathogens:

- **Blood-borne Pathogens** are microorganisms that can be present in blood, tissue and other materials (semen, saliva, CSF, amniotic fluid, other body fluids).
- The **Blood-borne Pathogens Standard** was enacted to protect any individual who might reasonably contact blood or other possible infectious material in the normal course of performing their job or laboratory procedure.
- **Universal Precautions** refers to a standard method of infection control in which **ALL** human blood and certain human body fluid specimens are treated as if known to be infectious for HBV, HIV, and other pathogens. [1,2]

6.4.Classification of infective microorganisms by risk group: [3]

- **Risk Group 1** (no or low individual and community risk):

  A microorganism that is unlikely to cause human or animal disease.

- **Risk Group 2** (moderate individual risk, low community risk):

  A pathogen that can cause human or animal disease but is unlikely to be a serious hazard to laboratory workers, the community, livestock or the environment. Laboratory exposures may cause serious infection, but effective treatment and preventive measures are available and the risk of spread of infection is limited.

- **Risk Group 3** (high individual risk, low community risk):

  A pathogen that usually causes serious human or animal disease but does not ordinarily spread from one infected individual to another. Effective treatment and preventive measures are available.

- **Risk Group 4** (high individual and community risk):

  A pathogen that usually causes serious human or animal disease and that can be readily transmitted from one individual to another, directly or indirectly. Effective treatment and preventive measures are not usually available.

6.5.Standard Precautions:

In 1996, the CDC published new guidelines which synthesized the major features of Universal Precautions and Body Substance Isolation to prevent transmission of a variety of organisms. Standard Precautions represent minimum infection prevention measures that apply to all patient care. Standard Precautions include:

- Guidelines on hand hygiene,
- Use of personal protective equipment,
- Respiratory hygiene and cough etiquette,
- Safe injection practices, and safe handling of potentially contaminated equipment or surfaces.

Standard Precautions imply that "all blood and body fluids are potentially infectious and should be treated accordingly." [1,2]

6.6.Biosafety Lab Levels (BSL) [4]

- **BSL1**
    1. Controlled access
    2. Hand washing sink
    3. Sharp hazards warning policy
    4. Personal protective equipment
    5. Laboratory bench
    6. Autoclave
- **BSL2**
    1. Controlled access
    2. Hand washing sink
    3. Sharp hazards warning policy
    4. Physical containment device
    5. Personal protective equipment
    6. Laboratory bench
    7. Autoclave
- **BSL3 (with risk-based enhancements)**
    1. Air tight when disinfecting
    2. Self-closing, double-door access
    3. Controlled access
    4. Personal shower out (risk-based enhancement)
    5. Sharp hazards warning policy
    6. Hand washing sink
    7. Sealed penetrations
    8. Physical containment device

9. Powered air purifying respirator (risk-based enhancement)
10. Laboratory bench
11. Autoclave
12. Exhaust HEPA filter (risk-based enhancement)
13. Effluent decontamination system (risk-based enhancement)

- **BSL4**
  1. Air tight
  2. Self-closing, double-door access
  3. Controlled access
  4. Sharp hazards warning policy
  5. Hand washing sink
  6. Sealed penetrations
  7. Physical containment device
  8. Positive pressure protective suit
  9. Laboratory bench
  10. Autoclave
  11. Chemical shower out
  12. Personal shower out
  13. Supply and exhaust HEPA filter
  14. Effluent decontamination system

FINANCIAL AFFAIRS AND EQUIPMENT COMMITTEE
COLLEGE OF MEDICINE, KING FAISAL UNIVERSITY

LABORATORY SAFETY MANUAL			
Applies to:	All CoM- KFU Laboratories	Prepared by:	Dr. Sayed Quadri & Dr. Abeir Bashir
Index Number:		Approved by:	Dr. Fahad Al-Wadani
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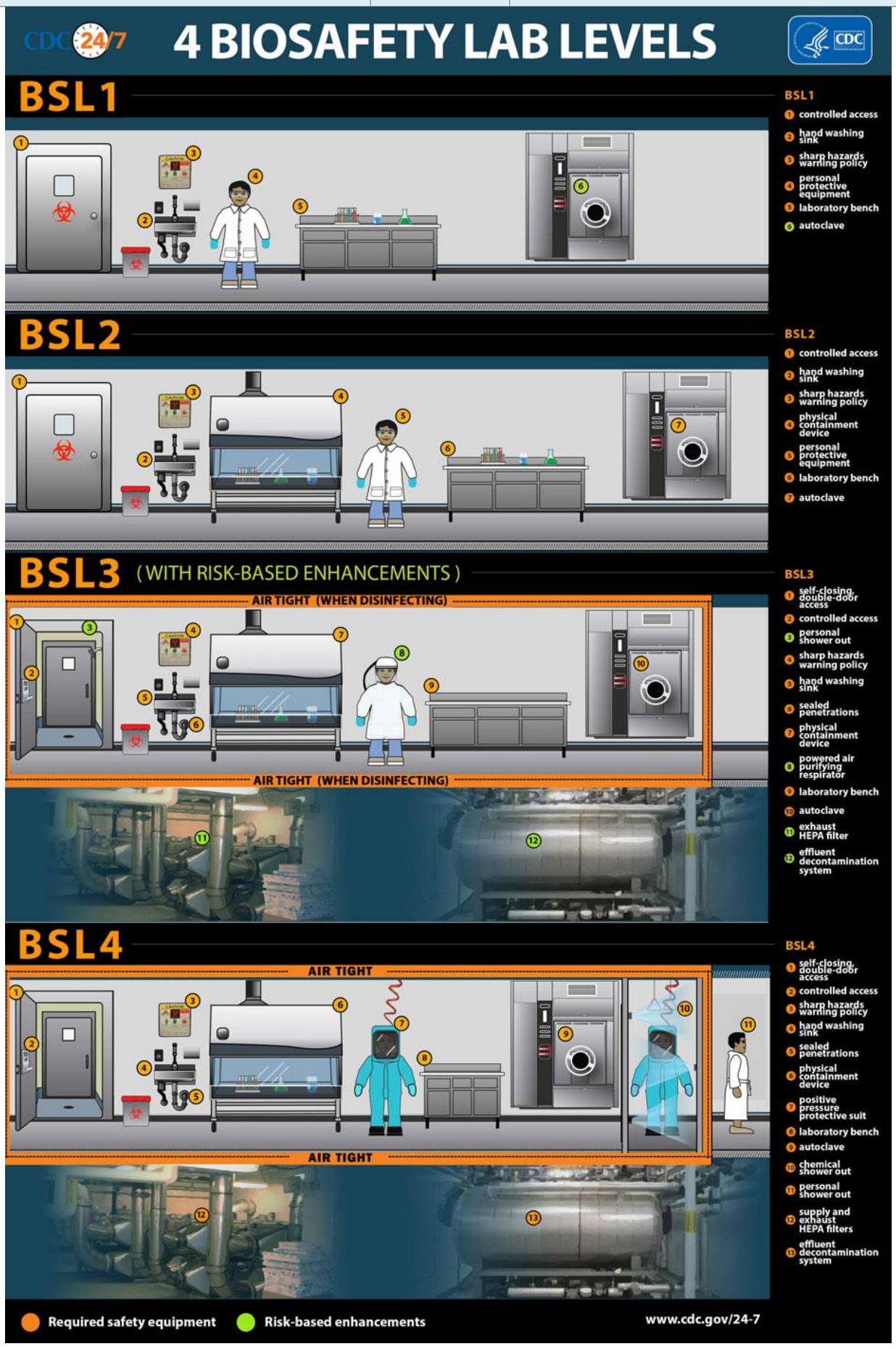

7 The Biological injuries and accidents management: [5]

7.1 General protective measures:

- All laboratory personnel (staff, students, etc) shall perform all tasks and comply with the safety guidelines for the work being performed.
- Laboratory personnel shall report all un safe practices to the safety officer.
- Laboratory personnel shall report all accidents and injuries to the safety officers.

7.2 Administrative controls

7.2.1 Bio hazard warning signs and posting:

- Each laboratory must clearly display a sign that provides safety information to visitors and service personnel. Sign must contain designations for all laboratory hazards in use with the laboratory (carcinogens, toxic agents, reproductive hazard, radioactive material, etc
- A bio hazardous must be posted by a biohazard sign. The sign must be red / orange in color with a bio hazard symbol in black letters.
- All area in the laboratory containing bio-hazardous or toxic agents must clearly display stating (EATING, DRINKING, SMOKING IS BROHIBITED IN THIS AREA).

7.3 Infectious and biological waste management:

- All disposable of infectious waste, autoclave bags, pipettes, sharp and biological waste must be performed in safety methods to prevent the infection of laboratory personnel.

7.4 Treatment, handling of biological waste:

- Proper treatment, handling and disposal of cultures and items contaminated by potentially bio hazardous agents is a vital step toward the protection of laboratory personnel from infectious diseases and also prevent the release of infectious disease to the community.

7.5 Proper segregation, storage, treatment and disposal of bio hazardous waste is essential and important to:

- Reduce personnel exposure to infectious materials, an exposure occurs when infectious materials are permitted to enter blood stream through break in the skin or contact with eyes, nose or mouth such as:
  - **a.** splashing liquid biological waste in to the eye during pour off for disposal
  - **b.** Puncturing the skin with biological contaminated needle.
  - **c.** Spilling liquids from a ruptured bio hazardous bag a broken un protected skin.

7.6 Dealing with sharps:

- A highly degree of caution should always be used when handling any sharp object (Contaminated or not)

  All disposable sharps that have contact with infectious agents must be placed in sharp container immediately following use to reduce the puncture risk.
- Approved sharp container must be leak proof, puncture resistant, closable and bears the biohazard symbol.
- Once filled must be permanently closed and disposed.

7.7 Solid non sharps bio-hazardous waste:

- All non sharp laboratory materials (microorganisms, recombinant DNA, cell cultures etc) must be treated prior to disposal by an approved contaminated methods such as autoclaving.
- Should be stored in bags bearing the bio-hazardous symbol prior to decontamination.
- Bio hazardous bags must be secured in a manner that will eliminate spillage.
- If the bag is used for items that are not likely to release liquids it should be placed in a wire bag rack or rigid container.
- If the bag is used for items that are likely to release liquids and possible result in leakage , it must be stored in leak proof container such as trash can with a lid that labeled with the bio hazardous symbol.
- After autoclaving any bag displaying the bio hazard symbol should be placed in a non transparent plastic bag or non transparent container prior to the disposal in to a normal trash.

7.8 Action to be taken after exposure to potentially infectious materials:

- Wash the exposed skin or flush the mucous membrane for 10 – 15 minutes
- Notify the lab supervisor and infection control officer for further instruction and as soon as possible refer **to a health-care provider for** medical evaluation**, testing, medical examination, prophylaxis, counseling procedures and** possible treatment.
- The incident should be reported to the Department Director or his/her designee**.**
- Document the incident and include:
    - Date, time and type of exposure
    - How the incident occurred
    - Name of the source individual (if known).

REFERENCES

1. WARD'S Science Lab Safety Manual, Gerald Bergman, Ph.D. Northwest State Community College, Archbold, Ohio and Medical College of Ohio Toledo, Ohio.
2. Laboratory Safety Manual, Revised July 2017 Medical Laboratory Science Program, Department of Pathology, University of Utah
3. WHO Library Cataloguing-in-Publication Data World Health Organization. Laboratory biosafety manual. – 3rd ed. 1.Containment of biohazards - methods 2.Laboratories - standards 3.Laboratory infection - prevention and control 4.Manuals I.Title. ISBN 92 4 154650 6 (LC/NLM classification: QY 25) WHO/CDS/CSR/LYO/2004.11
4. www.cdc.gov Biosafety in Microbiological and Biomedical Laboratories 5th Edition U.S. Department of Health and Human Services Public Health Service Centers for Disease Control and Prevention National Institutes of Health HHS Publication No. (CDC) 21-1112 Revised December 2009

8 ELECTRIC SAFETY PLAN

8.1 Operation of Electrical Equipment

- Before using electrical equipment, including loaned equipment, demonstration or research equipment, be sure that such equipment has been inspected.
- Complete all connections before turning main power switch on.
- Before using electrical equipment, be sure work area and equipment are completely dry.
- Exercise caution when working with liquids around electrical equipment. Do not place containers of liquids on top of electrical equipment.
- Before
- All equipment and electrical outlets must be grounded, if so equipped. Grounding must not be bypassed.
- Electrical apparatus with frayed or worn cords or other safety hazards must be repaired or removed from service.
- Remove plugs from outlets by grasping the plug itself and pulling, not by pulling on the cord.

8.2 Electrical Safety Checks

- All circuits supporting fixed electrical receptacles are checked for ground integrity annually by General Maintenance Department.
- Electrical outlets should be protected if it is separated from water source by less than 6 feets.
- All electrical equipment, including loaner, demonstration or research equipment, must be inspected for electrical safety before initial use, after repair or modification, or when a problem is suspected.

Exceptions:

a. Devices protected by double insulation or equivalent.
b. Devices operating at 220v must be checked only for ground integrity.
c. In general, electrical inspection of appliances, such as refrigerators, freezers, icrowave ovens, and incubators, is the responsibility of Maintenance Department.

d. Inspection of Instruments, such as microscopes, analyzers, water baths, and centrifuges, is the responsibility of Maintenance Department.

e. The power cords of portable electrical equipment must be visually inspected for external defects whenever moved. Such inspections may be carried out by the person responsible for moving the equipment. Report all defects to the Supervisor at once, and remove the equipment from use until it can be serviced, repaired, or discarded.

- **Repair of Electrical Equipment:**

DO NOT work on or attempt to repair any instrument while it is plugged in. An exception is the calibration of instruments which require adjustment while plugged in. In this case, be sure hands are dry, remove all jewelry (watches and rings), and proceed with caution.

- **Electrical Shock**

a. Whenever there are electrical outlets, plugs, wiring or connections there is danger of electrical shock.

b. Report all shocks to the Supervisor, including small tingles. Small shocks often precede major shocks, and a light tingle may indicate potential trouble.

c. Do not attempt to use an instrument that is causing shocks, no matter how minor. This is potentially dangerous, and any laboratory test results from the instrument would be suspect.

d. Shut off the current and/or unplug the instrument from outlets by grasping the plug itself and pulling, not by pulling on the cord.

- **Extension Cords and Power Strips**

a. The laboratory may use an extension cord (checked, tested and approved for use) to supply power to critical areas when the normal electrical supply is out of service.

b. Power strips may be used to energize small office equipment, such as computers and related peripherals.

c. Such power strips must:

- ✓ be composed of three conductors no smaller than AWG #14
- ✓ have a capacity of at least 15 amperes
- ✓ have a three-pronged grounding attachment plug
- ✓ contain a 15-amp circuit breaker.

9 FIRE PREVENTION AND CONTROL (refer to KFU Safety & Security Department Plan)

9.1 Fire Prevention

- A key aspect in fire prevention is training. This is achieved through orientation and continuing education. Employees should attend the periodic firre drills conducted by the **KFU Safety & Security Department**.
- Be aware of ignition sources in the laboratory. Do NOT use or store flammables in the presence of ignition sources.
- Be aware and follow safe practices. Report any potential fire hazard promptly to any of the following:
    a. Laboratory Technical Supervisor
    b. Head of the Department
- Know the location of fire pull boxes, fire extinguishers, hoses, and fire exits.

9.2. Life Safety Codes

The National Fire Protection Association (NFPA) 101 Life Safety Code provides minimum requirements with regard to a building's function, operation, and maintenance in order to protect occupants from fire and similar emergencies. Safety is achieved with a combination of prevention, protection, egress, and other features listed in the code.

9.2.1. Egress

A means of egress is a continuous and unobstructed way of exit travel from any point in a building or structure to a public way. The means of egress consists of three parts: Exit, exit access, and exit discharge.

9.2.2. Door

Door Locks restricting access from corridors into rooms are permitted on access controlled egress doors; locks are not permitted restricting access from rooms into corridors unless clinical needs require security.

Fire doors provide fire protection to an opening. Fire doors must be constructed to resist the passage of smoke and must be self-closing or automatic closing.

9.2.3. Sprinklers

There must be an 18" clearance below and to the sides of ceiling-mounted sprinkler heads. Make sure that boxes or other stored materials do not block these and reduce the effectiveness of the automatic sprinkler system.

9.3. Fire Alarm Codes

Code red is the official code announced through overhead paging in in case of fire / smoke

Tones and Lights Only -- No Announcement

An automatic smoke detector has been activated. The "alert tone" and "fire signal lights" go off only in the building involved. This results in immediate response by Maintenance. Employees should stand by for further information.

9.3.1 "Code Red " announced 3x

Smoke or fire has been reported by a means other than the automatic detector system (by pull box, telephone, etc.). Employees should respond according to the hospital fire plan.

9.3.2 "Code green: All Clear" announced 3x

The alarm has been checked out or the fire has been extinguished. Employees should resume normal work activities.

9.4 Fire Evacuation Procedures

In a fire resistive structure, the students and employees may be moved horizontally or downward to an area clear of heat and smoke, and kept there until the danger is over. "Evacuation" usually refers to movement away from the danger zone. Primary evacuation routes should be to predetermined areas of refuge within the building. It is important to remain within the building, if possible, in order to hear further announcements. In rare cases, general evacuation would involve clearing the entire building.

The Laboratory Supervisor and/or /Safety Officer or designee is responsible for coordinating personnel to assist patients, visitors, and handicapped employees during a fire. In laboratory areas where patients and/or handicapped employees are located, the

order of the evacuation will be determined according to the patient's/employee physical condition.

9.4.1 Vision, Mobility or Hearing Impaired Employees The Laboratory Safety Supervisor will designate an employee to lead an ambulatory patients/vision, mobility or hearing impaired employees to safety and to remain with them until the all clear signal.

9.5 Laboratory Specific Fire/Emergency Evacuation Plans

The laboratory is required to prepare a Site-Specific Fire/Emergency Evacuation Plan. This plan must be available in the department, and must include the following information:

- Department Name/Location
- The locations of the nearest:
    i. Emergency Assembly Point (Predetermined areas of refuge/safe zones within the building)
    ii. Manual Call Point Stations (BreakGlass)
    iii. Fire Exits
    iv. Fire Extinguishers
    v. Fire Telephone Sockets
    vi. Fire Hose Cabinet

The laboratory's Site-Specific Fire Evacuation Plans including evacuation routes out of the immediate laboratory are posted in the following locations: Laboratory Hallway

9.6 Fire Emergency Plan

The acronym "RACE." may be used as a memory aide for employees reacting to a fire.

R: Shout Code **R**ed 3x to alert others and remove any patients from immediate danger if necessary.

A: Activate alarm.

1. Break the glass or pull the fire pull station nearest the fire location.
2. Dial **Ext.** -----to activate Code Red and report the fire.

3. Give the exact location in a calm, clear voice and/or other details of conditions.
4. Alert other employees in the immediate area.

C: Confine the fire.

1. Close all vents, windows, and doors.
2. Turn fans off.
3. Shut down electrical and gas equipment.

E: Evacuate/**E**xtinguish

a. Evaluate the type and extent of the fire and the type of material burning

b. If necessary, evacuate to a safe area. **KNOW THE SITE SPECIFIC PLAN FOR YOUR WORK AREA AND THE** EMERGENCY EXIT **ROUTES** which are posted at various locations in the laboratory.

c. If the fire is small and isolated, attempt to extinguish the fire, using the appropriate Fire Extinguisher.

9.7. Operation of Fire Extinguisher: **"PASS"**

- **P: Pull** the safety pin.
- **A: Aim** the nozzle.
- **S: Squeeze** the handle.
- **S: Sweep** from side to side at base of fire.

Note: Watch for re-flash and reactivate the Extinguisher if necessary.

9.8 Other Fire Safety Equipment in the Laboratory

- **Sand** or appropriate **Spill Control Kits** are to be used to contain the spread of
- spilled flammable liquids.
- **Fire blankets** may be used to smother a clothing fire. Wrap the victim and/or roll the victim on the ground. Fire blankets may also be wrapped around a person who has to pass through a burning area. To avoid smoke inhalation, the fire blanket should **not** be wrapped around the face and head. The ideal location for the fire blanket is in the area of greatest potential fire hazard and near an escape route.

- A **fire hose** or **safety shower**, if nearby can be used to put out a clothing fire. Use only by security personnel .

9.9 Fire Drills

Laboratory fire drills are:

- Conducted by the Security Department in coordination with the Ofice Manager and the Financial Affairs and Equipment Committee CoM-KFU.
- Conducted quarterly as per the required safety training plan of the laboratory in consultation with Safety Supervisor
- Conducted on a predetermined date and time for a total of 4 fire drills per year.
- Each employee is expected to participate in a fire drill at least once per year.
- The drill is simulated or conducted with a given scenario.
- All employees must participate in the fire drill. It is not necessary to shut off instruments, gases, etc., nor is it necessary to interrupt patient care-related work.
- The key person designated to facilitate the drill must:
    a. Verify employees' understanding of the operation and meaning of the fire alarm system coded situation and announcements.
    b. Verify employees' understanding of the acronyms **"RACE"** and **"PASS"**
    c. The drill report form containing the attendance sheet must be forwarded to the Financial Affairs and Equipment Committee CoM-KFU for signature and a copy is furnished to it

9.10 Fire safety equipment in college of medicine (Prepared by Dr. Mohammed Bahgat)

Various Fire safety equipment are installed at regular distances, in the College of Medicine. These equipment include Security Fire Alarm, Fire hose cabinet, Fire Extinguisher, blanket, Thro Fire Extinguisher, Fire Shower for body and eye and Automatic fire alarm and sprinkler systems. As an example, in the corridors of the male building, there are 17 Fire hose cabinet (8 in ground floor and 9 in the first floor), 10 Fire Extinguisher (6 in ground floor and 4 in the first floor) and many Automatic fire alarm and sprinkler systems. Each lab has 1 – 2 Fire Extinguisher (powder ±CO2), a number of blanket (beside each door), Thro Fire Extinguisher (variable number 3 – 4/ one beside each door), fire shower for body and eye. (CM/6.0.8.2 - Fire safety equipment in college of medicine).

N.B. Training (in the form of orientation) of technicians, students and doctors on how to use Fire safety equipment is an essential part to ensure effective use of Fire safety equipment when required.

9.10.1: Fire hose cabinet

Ground floor		First floor	
Fire hose cabinet	**Location**	**Fire hose cabinet**	**Location**
√	Beside Computer lab	√	Beside pharmacology lab
√	PBL rooms	√	Beside 2045
√	Beside 1030	√	Beside 2117
√	Beside Mosque	√	Beside skill lab
√	Beside Histology lab	√	Beside exit 2044
√	Beside Physiology lab	√	Beside 2002
√	Beside Neuro lab	√	Beside 2033
√	G37 ---- G35	√	Beside 2150
		√	Beside 2151

9.10.2: Fire Extinguisher (Fire Retardants)

Ground floor	First floor

Fire extinguisher	Location	Fire extinguisher	Location
√	Beside 1032	√	Beside 2120
√	Beside 1033	√	Beside 2052
√	Beside 1097	√	Beside 2145
√	Beside histology lab	√	Beside 2153
√	Beside Neuro lab		
√	Beside anatomy lab		

N.B. Inside each lab there are Fire Extinguisher (powder ±CO2), a number of blanket (beside each door), Thro Fire Extinguisher (variable number 3 – 4), fire shower for body and eye.

9.10.3: Security Fire Alarm
(Flame/smoke detector & sensor and fire suppression system)

Security Fire Alarm

Many automatic detection and suppression of fire (fire alarm and fire sprinkler systems) are distributed in the ceiling of the ground and first floor.

Automatic fire alarm and sprinkler systems

Many automatic detection and suppression of fire (piping and nozzles, fire alarm and fire sprinkler systems) are distributed in the ceiling of the ground and first floor.

Ground floor		First floor	
Fire Alarm	**Location**	**Fire Alarm**	**Location**
√	Corridors ceiling	√	Corridors ceiling
√	Corridors ceiling	√	Corridors ceiling
√	Corridors ceiling	√	Corridors ceiling
√	Corridors ceiling	√	Corridors ceiling
√	Corridors ceiling	√	Corridors ceiling
√	Corridors ceiling	√	Corridors ceiling
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√	Corridors ceiling	√	Corridors ceiling
√	Corridors ceiling	√	Corridors ceiling

√	Corridors ceiling	√	Corridors ceiling
√	Corridors ceiling	√	Corridors ceiling

Improvement Plan

Education - the provision of information regarding passive and active fire protection systems to technicians, students, workers, doctors and emergency personnel so that they have a working understanding of the intent of these systems and how they perform in the fire safety plan.

FINANCIAL AFFAIRS AND EQUIPMENT COMMITTEE
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Laboratory Incident Report Form

Department: **Laboratory:**	
Date/Time of Incident:	
Description of the Incident:	
Did the Incident result in Injury? ○ Yes ○ No	
Description of the Injury:	
Laboratory Safety Officer Notified: ○ Yes ○ No	
Name of the Reporting Staff	**Signature:** **Date:**
Name of the Laboratory Safety Officer	**Signature:** **Date:**