GOBIERNO DE ESPAÑA
MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES

CSIC
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTÍFICAS

Training Capsule: General Risks in the Laboratory

Unit 1. Basic Principles

The CSIC is a state agency devoteddicated to scientific research and technological development. Its multidisciplinary scope means that a wide variety of activities are carried out across different fields of knowledge. A significant portion of these activities takes place in laboratories aiming at conduct studies in different scientific areas ranging from physics, chemistry, biology, humanities, etc. others.

Despite the differences between the various types of laboratories, in this text we will identify a series of risks that are common to them all

Each of these risks will be accompanied by the corresponding preventive measures—whether technical or organizational—designed to eliminate and/or reduce risks and prevent occupational accidents or harm to the health and safety of our personnel. These measures may include incidents such as falls, cuts, thermal or chemical burns, poisoning, fires, and even occupational diseases.

Throughout this training, we will address the specific risks associated with laboratory work, as well as the preventive related measures including risks arising from safety conditions, chemical hazards risks due to the use of substances and chemical products, ergonomic risks associated with laboratory tasks, and a brief introduction to specific risks such as biological hazards, ionizing radiation, and psychosocial risks.

We hope that these basic notions about the risks you may encounter in any CSIC laboratory will arouse your interest in health and safety and encourage safe work practices in your daily activities.

Unit 2. Risks Arising from Safety Conditions

Within a laboratory, a wide range of risks can be found, with the most common being:

1. Same-level falls.
2. Falls from height.
3. Falling objects on workers.
4. Cuts, splashes, and punctures.
5. Thermal risks (burns from heat or cold).
6. Electrical hazards.
7. Risk of exposure to chemical, biological, or physical agents.

Some general rules

1. Prepare and update safe work instructions. These preventive documents must contain all the information regarding chemical, physical, biological, ergonomic, risks, etc. associated with each task to be performed, the preventive measures to be applied by the workers while carrying them out, as well as specific guidelines for dealing with foreseeable accidents/incidents.
2. Provide all laboratory personnel with the safe working instructions. Laboratory staff must apply these instructions in their daily tasks.The laboratory supervisor is responsible for ensuring compliance.
3. Clearly demarcate and signpost laboratory areas, equipment and/or specific materials indicating their use and if they pose greater risks.
4. Wear appropriate work clothing and personal protective equipment (PPE) suitable for the activities being carried out, ensuring they are in perfect conditions.
5. Wash hands thoroughly with soap and water before leaving the laboratory, whenever or not there is contact with chemical or biological materials. Dry hands with disposable paper towels. Do not wear bracelets, rings, watches, or any other kind of jewellery; hair should always be tied back.
6. Never pipette with your mouth. Use appropriate tools for this purpose, such as manual or automatic aspiration systems.
7. Clean up any liquid spills , chemicals, or biological samples immediately using the appropriate materials and procedures for each case.
8. Do not drink, smoke, or eat in the laboratory.
9. Do not use laboratory containers or refrigerators to store drinks or food, nor store chemicals in food containers (e.g., water bottles, etc.).

Order and cleannness

- Keep the laboratory and work area tidy and clean.
- Do not overload shelves or cabinets. Always place the heaviest and bulkiest items at the bottom. Ensure that shelves are properly anchored to the wall.
- Do not leave cables, boxes, or other objects in walkways or obstructing access to exits or safety equipment (e.g., emergency showers, fire extinguishers, etc.).

Proper use of equipment and devices

1. Have the manufacturer's manual in Spanish at hand and follow its recommendations both for use and for periodic maintenance.
2. All laboratory equipment must comply with the requirements set out in Royal Decree 1215/1997. Before using any equipment, it must be checked to ensure that all safety guards are in place, its operating conditions are adequate, and that its handling does not pose a hazard to others.
3. When handling electrical equipment, follow the manufacturer's manual carefully to avoid direct or indirect electrical contact.
4. All laboratory equipment must be certified, bear the CE marking, and undergo regular maintenance/inspection, with proper documentation of such actions.
5. Equipment must no longer be used if there is any damage, malfunction, or other conditions that may compromise safety, and must be clearly marked as "out of service".

Handling of Glassware

The use of this type of material in laboratory work involves risks such as cuts or injuries, explosions, implosions, or burns. These risks can be avoided by implementing appropriate preventive measures, such as:

- Discarding any glassware that shows defects and/or has been damaged.
- Introducing glass containers into thermostatic baths slowly and safely.
- Using personal protective equipment appropriate to the activity being performed, such as protective gloves and face shields.

Unit 3. Chemical risk

When working in a laboratory, improper use and contact with chemical agents can lead to various health effects through different routes of exposure (ingestion, skin contact, inhalation, etc.) to chemical contaminants.

Safety Data Sheet (SDS)

Before using a new chemical product, the Safety Data Sheet (SDS) must be carefully read. It must be provided by the manufacturer in Spanish. These sheets include very important information about each chemical: substance identification and its hazards, first aid and emergency response (fire, spills, etc.), handling and storage, exposure control and personal protection, stability and reactivity, toxicological and ecological information, as well as disposal and transport instructions.

Labelling

Any chemical agent must be properly labelled (name, pictograms, H and P phrases, manufacturer, etc.). H and P phrases are particularly useful: H phrases indicate hazards, while P phrases provide precautionary advice that must be followed during handling.

Safe Work Procedures

To work safely in the laboratory, specific safe work instructions must be established and followed for each activity.

Unit 4. Biological risk

Biological Agents

Biological agents include microorganisms, cell cultures, and human endoparasites that may cause various types of infections, allergies, or toxicity.

Exposure to a biological risk is understood as the presence of a biological agent in the workplace that results in contact between the agent and laboratory staff.

It is important to understand that exposure to biological agents can occur in two different situations:

- **Deliberate exposures**: These can result from work activities where there is an intentional use or handling of a biological agent, which constitutes the main purpose of the work. For example, personnel in microbiology laboratories and cell culture labs.
- **Unintentional exposures**: These arise from work activities that do not involve direct handling or deliberate use of the biological agent. For example, cleaning and/or maintenance personnel who enter microbiology laboratories.

Therefore, not only personnel who handle biological agents are directly at risk of exposure. This must be taken into account during risk assessments and when establishing measures to minimize such risks.

Unit 5. Physical risks

Non-ionizing Radiation

In the usual context of laboratory activities, the most frequent types may include: radiofrequencies, NMR (nuclear magnetic resonance), ultraviolet, infrared, microwaves, and lasers.

Thermal Environments

In cases where some laboratories may have extreme thermal and hygrometric conditions (cold rooms, culture rooms, etc.), to avoid thermal stress and overload, appropriate preventive measures should be applied, such as temperature monitoring, use of appropriate work clothing, etc.

Noise

In laboratories, there are some work equipment that generate noise, such as ultrasonic generators, compressors, centrifuges, etc. Normally, noise levels in laboratories do not exceed the daily exposure limit of 80 dB(A) set by legislation.

What possible effects could it have on health?

The effects on workers' health can be very diverse, ranging from auditory disorders, hearing loss,to hypoacusis to cardiovascular, neurological disorders, or stress.

Preventive Measures

The first step to reducing noise is to acquire machines/equipment with a low noise levels. If this is not possible, other measures should be taken, such as:
• Organizing the workspace by relocating the loudest devices to less frequented areas or rooms. Investigating potential shielding solutions offered by the manufacturer according to technical advancements.

• Use of hearing protection is mandatory when exposed to daily noise levels exceeding 85 dB(A).
• Consult the Prevention Service if advice is needed.

Vibrations

In the laboratory, vibrations can be transmitted to the hand-arm system. For example, when using equipment like sonication probes or vortex mixers. Whole-body vibration has not been identified when using laboratory equipment.

Unit 5. Physical risks

Health Effects:

• **Vascular Disorders**: The most well-known is Raynaud's phenomenon (or white finger induced by vibrations). This is perceived as a loss of sensitivity and dexterity in the fingers, which can increase the risk of accidents. In more severe cases, it can even lead to ulceration and gangrene.

• **Neurological Disorders**: Tingling and numbness in the fingers and hands. Hand-arm vibrations are a factor that can increase the risk of developing carpal tunnel syndrome (a disorder caused by the compression of the median nerve at the wrists).
•**Musculoskeletal and Articular Disorders**.

• **Other Disorders**: Hearing loss.

Preventive Measures

• Proper use of equipment, following the manufacturer's instructions and performing preventive and/or periodic maintenance of the equipment.
• Organize work to reduce exposure to vibrations: task alternation, job rotation, taking breaks, etc.

• Use of personal protective equipment (PPE): gloves can absorb vibrations and reduce the intensity of transmission. When selecting gloves, it is important to consider how well they fit the user's hands and consult the Prevention Service.
• Train and inform staff about risks and preventive measures related to their job and the use of specific equipment.

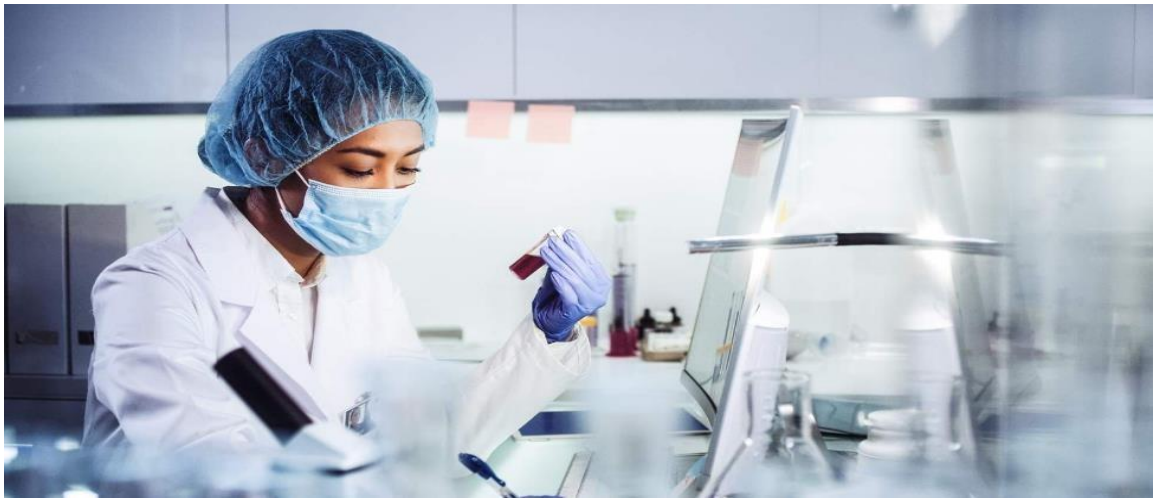
• Ensure the development, communication to staff, and implementation of work instructions for each task to be performed.

Unit 6. Ergonomic and Psychosocial Risks

When the conditions of the job are not adequate, it can lead to risks such as physical, visual, and mental fatigue.

Frequent use of computers and data display screen equipment (VDTs) can pose risks if more than 4 hours a day or 20 hours a week of actual work with VDTs are exceeded.

In the laboratory, repetitive movements are often performed, which can also pose health risks. These include repetitive motions during pipetting or manual handling of loads, as well as adopting forced postures.



Ergonomic risks

Manual Handling of Loads (MHL)

It is common when handling boxes and packages that arrive at the laboratory, especially when placing them in storage areas such as shelves, warehouses, etc.

Some general preventive measures to avoid or reduce the risk associated with manual handling of loads (MHL) would be as follows:

• Use of mechanical equipment for load handling.
• If manual handling of the load cannot be avoided, the weight of the load should be minimized and not exceed 25 kg. The load should have appropriate dimensions and be equipped with suitable size handles to allow hands to fit comfortably.

• Avoid lifting loads from floor level or above the shoulders, for example, by using auxiliary devices. During handling, trunk twisting and turning should be avoided.
• MHL tasks should be organized in a way that they alternate with lighter tasks.
• Proper handling techniques should be known and applied in each case to perform tasks with correct posture and optimized effort.

Let's look at the following preventive measures:

• Take short, frequent breaks or micro-breaks every 15-20 minutes. During these breaks, perform stretching exercises to reduce static load on the shoulders and upper limbs.
• Alternate work tasks that use different movements and/or body parts.
• Facilitate alternation between the use of the right and left hands.
• Vary grips when performing fine motor tasks; for example, using the thumb and first finger to pinch, or the thumb and second finger.
• Maintain proper posture throughout the day, keeping the shoulders and neck in a neutral position, the head upright, the arms and elbows close to the sides, wrists in a neutral position (i.e., neither flexed nor extended), and the back straight and vertical.
• For sitting or standing work, the work surface and chair should be adjusted so that the work can be performed at the following appropriate heights:

- Precision work: above elbow height.
- Light work: just below elbow height.
- Heavy work: below elbow height.

• Automate, whenever possible, processes that involve excessive force and repetitive movements.
• Select tools that eliminate or reduce excessive grip force and allow for maintaining neutral positions.

Physicosocial risks

In Applied Psychosociology, there is discussion of psychosocial factors (working time, workload, participation, supervision, etc.) present in the workplace. These factors are generally present in all working conditions and can affect the safety and health of laboratory personnel, in this case, if they are not adequately designed. Due to the research nature of the work, the most important factors may include: work overload, prolonged working hours, excessive or lack of supervision, etc.

When there are psychosocial factors in the workplace that are likely to negatively affect the health and well-being of the staff, these are considered psychosocial risk factors.

If exposure to psychosocial risk factors leads to a high probability of harm to the health of the individuals exposed, we then speak of the likelihood of exposure to a psychosocial risk. The origin of psychosocial risk is multifactorial, meaning it is not solely due to the presence of a single risk factor, but rather to a combination of several of them. Non-psychosocial factors, such as environmental or hygienic conditions, personal vulnerability, and/or family or social situation, may also contribute.

A work-related psychosocial risk is an event, situation, or condition that results from the organization of work, has a high probability of affecting the worker's health, and whose consequences are usually significant.

In this case, for example, a high workload becomes a psychosocial risk factor if it has a high probability of having significant consequences on the health of the staff, potentially triggering—along with other factors and variables to be studied—work-related tension and stress.

Unit 7. Collective protection

Collective protection refers to all safety elements whose objective is the simultaneous protection of several workers exposed to a particular risk.

Measures should be adopted that prioritize collective protection over individual protection. In the laboratory, we find a series of collective protection equipment, such as:

- **Fume cupboards**: They prevent the exposure of personnel to chemical contaminants.
- **Safety showers and eye wash stations**: These should be used in the event of chemical splashes, spills, or projections onto individuals, with the risk of contamination or chemical burns.
- **Spill kits and absorbent materials**: For collecting possible chemical spills.

- **Fire safety equipment**: Alarms, sprinklers, fire extinguishers, detectors, etc. As there are different types of fires, the laboratory will have the most suitable extinguisher for each case. The appropriate extinguishing agent should be determined for each situation.

Unidad 8. Individual protection

Royal Decree 773/1997 defines personal protective equipment (PPE) as "any equipment intended to be worn or held by the worker to protect them from one or more risks that could threaten their safety or health at work, as well as any complement or accessory designed for this purpose."

It is important to differentiate what constitutes PPE from what does not, and ensure that they comply with the regulations. To do this, we must ensure that:

- They comply with the relevant UNE standard.
- They bear the CE marking.
- They are accompanied by user instructions (in the language of the country where they will be marketed).
- A documented record of PPE delivery to staff must be kept.
- Staff must use and maintain the PPE properly.

CE

The most commonly used PPE in the laboratory are:

1. **Protective gloves**: Their purpose is to prevent contact and penetration of chemical and/or biological agents through the skin, as well as to avoid burns from thermal contact (cold or heat). In some cases, they may cover part of the forearm and arm.
2. **Protective goggles and face shields**: Their purpose is to protect the face (face shields) and eyes (goggles) from possible splashes or particle projection. Contact lenses should be avoided, but if the user requires them, the following should be done: prescription protective glasses, use of "goggles covers," etc.
3. **Respiratory protection**: Its purpose is to act as a barrier to prevent contaminants from entering the body through the respiratory tract. It can be of two types:

   - **Filtering equipment (environment-dependent)**: These retain airborne contaminants before they are inhaled. There are three types of filters: those that protect against particles, filters for gases and vapours, and filters for particles, gases, and vapors.
   - **Isolating equipment (environment-independent)**: These provide protection for both contaminated atmospheres and oxygen-deficient environments. In these systems, the air the user breathes is not the same as that present in the work environment. They are classified as autonomous and semi-autonomous.

4. **Hearing protection**: Its function is to reduce the noise to which the staff is exposed, that is, to reduce the noise level below the action level established in Royal Decree 286/2006. Hearing protection must be worn when noise level exceeds 85 decibels. Types: earplugs and earmuffs.
5. **Protective footwear**: For laboratory work, it is recommended to wear footwear that fully covers and protects the feet. Sandals, clogs, high heels, or shoes that leave the foot exposed should not be worn.

> ⓘ **Work clothing: Remember that work clothing is not strictly considered personal protective equipment. The most commonly used item is the laboratory coat. It should always be worn buttoned up, cover down to below the knee, and preferably have elastic cuffs.**

Unit 9. Safe work instructions

Develop and update safe work instructions.

These are documents in which each technique or task to be performed in the laboratory should be detailed, along with the way to carry it out, indicating the risks and the appropriate measures to be applied for their elimination or reduction (use of a specific work technique, personal protective equipment to be used, etc.).
Specific guidelines for actions in the event of an emergency, incident, or work accident should also be provided.

You have reached the end of this basic training on general laboratory hazards.
Put into practice everything you have learned, and you will be contributing to creating a safer and healthier work environment.
Now it's your turn!