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Health and security risk management method in university laboratories

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Abstract— There are many possibilities for accidents in university laboratories, given the diversity and the high number of operations carried out, the equipment and apparatus used, and the wide variety of chemical and biological products used or stored.
The aim of this article is to propose an approach for the analysis and control of risks in the university, in particular in the laboratories of chemistry and biology.

Key words—health and security, risk assessment, institutions of higher education, laboratories, risk management.

I. INTRODUCTION

The question of occupational health and security arises in academic laboratories as well as in industrial companies, as can be seen from the following examples of accidents:

• 2005: Southampton (United Kingdom) destroyed the micro-manufacturing unit of the University of Southampton, which housed the computing and optoelectronics laboratories, by a fire with extremely serious material damage.

• 2006: Mulhouse (France), The explosion of a chemistry building followed by a fire at the national high school of chemistry with the consequent death of a professor, and many injured people.

• 2008: Lausanne (Switzerland), an eye exhibition of a student with a laser beam in a physics laboratory.

• 2008: Delft (Netherlands), fire caused by an electrical hazard (short circuit) in a Technical University building causing considerable losses, including the loss of a library.

• 2008: University of California, Los Angeles (USA), death of a research assistant in a fire in the Department of Chemistry and Biochemistry in January.

• 2011: Catholic University of Louvain (Belgium), an explosion in a laboratory made 1 very seriously wounded and 4 lightly wounded.

• 2011: University of Stirling (USA) died of asphyxia of a student in a chemistry laboratory. Indeed, it is too often forgotten that many activities involving the common use of chemicals, bacteriological, inflammable, unstable or even dangerous fittings are carried out in the academic community.

They are all situations where laboratory workers, including teachers, researchers, students and laboratory technicians, are at risk of accidents or illnesses.

The risks involved vary according to the nature of the laboratory, the techniques applied, the equipment of the

laboratory ... etc. Knowing these risks is the first step to anticipate, avoid and act quickly and effectively .

II. MAIN TYPES OF RISKS:

Chemistry and biology laboratories face a range of risks, such as chemicals, biological agents, physical phenomena and others. A list of the main types of risks and hazardous situations that generate these risks is proposed.

2.1. Chemical risks:

These are all the risks associated with the dangers presented by manipulation, use, interaction, absorption, presence of chemical products.

Several risks have been identified as follows:

TABLE I: POSSIBLE CHEMICAL RISK AND DANGERS IN CHEMISTRY-BIOLOGY LABORATORIES

Risk type	**Dangerous situations**
Health Risk: acute intoxication, long-term effects and risk of irritation: Health effects may occur directly (acute toxicity) or long-term (chronic toxicity). A large number of solid, liquid or gaseous chemical compounds have toxic properties by inhalation, ingestion or contact	• The transport of glass bottles or containers containing volatile toxic products presents a risk of breakage, and consequently a risk of poisoning, which can be rapid if the space is small and confined (elevator). • Leaks in gas containers or equipment may cause accidental releases of toxic gases • Toxic products are sometimes used in laboratories, as benzene, carbon tetrachloride, carbon disulphide, methyl alcohol, mercury ... • Some reactions are accompanied by release of toxic gaseous products. • Solid carbon dioxide volatilizes continuously. Too much concentration can become dangerous. • After use, the material may be contaminated with a certain amount of hazardous materials. • The atmosphere in the laboratory can be accidentally polluted by a bursting reactor, a broken glass bottle, a spilled container, a leak ... • The following operations pose risks of intoxication by ingestion: pipetting in the mouth, taste of a chemical (galenical recognition). Eating or drinking in a laboratory • Introduce hazardous products into containers normally used for food or vice versa in containers that have been used to contain hazardous or toxic substances. • Smoking in a laboratory where substances that can cause intoxication are used create a risk of intoxication by ingestion. • Despite preventive measures, there may still be inhalation exposure. • In some laboratories, asbestos is still present in the form of ropes, cardboard, plates as thermal insulation and protection against flames
Risk of chemical burns: Chemical burns are severe skin lesions, ocular and respiratory mucous membranes generally appear immediately on contact with corrosive products such as concentrated acids (hydrochloric, sulfuric, nitric, hydrofluoric ...) and alkaline concentrates (soda, potash ...) Strong oxidizing products (concentrated hydrogen peroxide), phenol and chlorine ...	• Pouring these products creates a risk of splashing. • Heating on a flame may cause sudden breakage of glass containers containing solutions. • A large number of operations can cause sprays of corrosive liquids on the body. • A splash of solvent, acid or base in the eye causes irritation or even severe burns, even under contact glasses
Thermal burns Risk: Thermal burns are the consequences of contact with products carried at high temperatures.	• The boiling of a liquid in a glass container occurs irregularly with jerks. • A glass flask containing a volatile liquid may break if it is immersed in a hot bath • It is mainly water, oil or molten metal baths that create the risk of thermal burns.

2.2. Biological risks:

It represents the contamination of personnel by pathogenic biological products. Contamination results from failure or lack of adequate protection when handling biological organisms or naturally pathogenic microorganisms.

Knowledge of the transmission modes is essential to understand the risk of contamination during handling. The pathways of contamination can be respiratory, digestive, cutaneous or conjunctival.

TABLE II: BIOLOGICAL RISKS AND BIOLOGICAL HAZARDS IN BIOLOGICAL LABORATORIES

Risk type	**Dangerous situations**
Respiratory contamination risk : The respiratory tract is often the main entry route for laboratory contamination. It is borrowed by aerosols (fine solid or liquid particles) which constitute a physical support for biological agents	• Pipetting by the mouth. • Breathing of contaminated air. • Use of centrifuges without a watertight bucket, without lid. • Use of agitators, spoilers, grinders, mortars. • Agitation of a culture, aspiration, repression. • Transfer of liquids and decantation of supernatant. • Projection when dispensing reagents. • Drop of microbial suspension fallen on the work surface. • Tubes broken or inverted. • Flame sterilization of the platinum loop used to collect microbial colonies.
Risk of dermal contamination: The contamination is done by the burglary of the skin	• Stitching by a soiled needle • Cuts or scratches by broken and contaminated glassware. • Biological splashes on excoriated skin. • Hand soiling through the telephone, sink faucets, towels. • Infection through unprotected injuries or skin lesions
Risk of digestive contamination:	• Oral pipetting is the most common cause of contamination. • Similarly, ingestion of microbes can be carried out by wearing contaminated objects in the mouth, onychophagy, feeding or smoking in the laboratory
Contamination risk by conjunctival route:	• Contamination can occur by spraying eye drops of biological products, aerosols infecting the conjunctival mucosa • Projection of splashes, aerosols or sprays

2.3. Physical risks*:*

The most common physical hazards are fire, explosion, electrocution and exposure to radioactive material.

TABLE III:POTENTIEL RISKS AND DANGERS IN CHEMISTRY -BIOLOGY LABORATORIES

Risk type	Dangerous situations
Explosion risk	• Explosion may occur when working with explosive or unstable compounds due to shock, friction, or temperature rise • In potentially explosive atmospheres where flammable gases (hydrogen, ethylene, etc.) and / or gas escapes are used. • The distillation of peroxidizable products (eg isopropyl ether, ethyl ether, tetrahydrofuran, etc.) stored for several months may cause explosions. • Very oxidizing products combine with certain organic materials (wood, putty) to form compounds capable of exploding with impact. • In household type refrigerators, storage of open containers with flammable gases or vapors may cause explosion or fire. • Prolonged storage of monomers, even in a refrigerator, may result in an explosive polymerization reaction. • During destruction (eg at the preparatory stage of an analysis) both in pressure receptacles (destruction bombs) and in open systems, there is a real danger of explosion.
Fire risk : The risk comes from flammable products and many sources of ignition that are often present in a laboratory. It also comes from reactions between certain oxidants and reducing agents or certain compounds and water	• Some substances are spontaneously flammable in air (as metals, finely divided metals, hydrides, phosphorus ...). • Simultaneous use of combustible and combustible materials in a single laboratory creates a fire hazard. Ex .: Sugar oxygenates (chlorates, peroxides, etc.), with combustible or easily oxidizable products, form mixtures which ignite under the influence of a rise in temperature, shock or friction. • The use of flaming heaters in the vicinity of flammable volatile liquids may cause fires. • The use of spark-generating devices (electric motors with collectors, switches, thermostats, etc.) as well as electric heaters can cause fires. • Some products may ignite spontaneously in air at high temperature, for example: Carbon sulphide: 102 ° C; Diethyl ether (ethyl ether): 180 ° C. • Products, at low flash point, may form a mixture with air that may ignite under the influence of ignition. • When a flammable liquid is distilled, a lack of water in the refrigerant of the distillation apparatus causes the vapors of the boiling compound to escape into the atmosphere. • A heated jacket with poor thermal insulation may be a cause of local overheating that can break the glass container of a distiller. If the liquid is flammable, a fire will suddenly burst. The same accident occurs if the container is cracked. • The boiling of a liquid is sometimes irregular with jerks. • The evaporation of flammable liquids gives rise to the emission of vapors which can ignite at a distance. • When extracting a chemical compound with an ether, overpressure or leakage of ether vapor may cause a fire. • Spreading a volatile flammable liquid (breaking, spilling ... a container) creates a fire risk because vapors spread rapidly at distances of several meters.
Electric Shock risk:	• In chemistry laboratories, a large number of electrical appliances operating on 230 V are used. • There is a risk of electric shock when conductors are stripped or torn off. • An insulation fault may cause the metal casing of the unit to be exposed to dangerous voltage. • Faulty electrical installation without maintenance or supervision.
Risk due to radiation:	• The dispersal of radioactive material (for example when working with liquid isotopes) can cause contamination and uncontrolled irradiation. • Breathing, ingestion or absorption of a radioactive preparation causes 24 hours a day irradiation of the organ in which the isotope is located. • UV lamps handled without care can irritate the eyes and burn the skin.

2.4. Other risks:

Many other risks can appear in laboratories as shown in the following table IV.

TABLE IV : OTHER RISKS IN CHEMISTRY-BIOLOGY LABORATORIES

Risk type	Dangerous situations
Injury risk	• The implosion of a vacuum glass device can splash violently. • Centrifuges are dangerous when the hood is opened while the rotor is rotating at high speed. • Handling a glass tube in a rubber stopper requires a few precautions to avoid hand injuries. • Syringe needles can cause injury with injection of hazardous materials • Broken glassware, thrown into garbage cans, can cause injuries to persons responsible for emptying them. • Compressed gas candy are very heavy and unstable because they are used in a standing position
Risk of falling on one level	• Slippery surfaces • Disorder • Visibility conditions

III. RISK MANAGEMENT METHODOLOGY IN THE UNIVERSITY ENVIRONMENT:

3.1. General gait to risk management:

Occupational risks are linked to general working conditions. In our context ,these are risks to which are exposed the teacher-researchers, the students, the technicians of laboratories, and whose consequences can be translated by an occupational disease or an accident at work. Consequently, it is essential to control these risks in order to protect this person at work in the laboratories of educational institutions.

"Mastering occupational risks" means both "knowing" these risks and "keeping them under control". Since the term "risk knowledge" is not widely used in the field of industrial risks, we will use the notion of risk assessment as synonym ", the estimation of the extent of risk and decision-making concerning the acceptability of risk. The word "control" should be taken in the broad sense and not merely in the sense of inspection or surveillance. To assess risks, it is essential to evaluate them from an objective point of view, but also to decide on their acceptability. To keep them under its control, it is essential to take appropriate measures with regard to these risks.

In keeping with this principle, the approach to risk control in a university setting is structured in three stages:

• Step 1: Identification of hazards / hazardous situations / risks.

• Step 2: Assess the risks associated with these hazards.

• Stage 3: development of appropriate prevention actions.

The purpose is to identify risks and to determine the exposure to hazards. Identification is based on:

• Observations of situations and the working environment.

• Listings of occupational risks.

• Listening to the people concerned (students, teachers, and laboratory technicians)

• Documentation available (product sheets, documentation of biological and chemical agents and their possible hazards, etc.).

Risk assessment:

This involves estimating the risks identified in the previous step and then classifying them. The classification of risks makes it possible to define those which are the most important and subsequently give them priority of actions.

Development of prevention actions:

The aim is to propose relevant prevention measures that address the human, technical and organizational aspects.

3.2. Risk Assessment Approach:

Risk assessment consists of estimating the seriousness of the potential damage and the frequency of exposure to hazards for each hazardous situation in order to prioritize risks and then give priority to action.

In order to do this, we used a risk assessment methodology applied in the industrial environment and adapted it to a university setting .

The advantage of this method compared to other conventional methods is that it allows not only to estimate the risk but also to calculate the level of residual risk after the implementation of measures and means of prevention.

The proposed risk assessment methodology consists of three steps:

The first step is to calculate the level of gross risk (NBR):

GRL = Gravity (G) x probability of occurrence(PO) (1)

The second one is to determine the level of mastery:

Mastery (M) = Mastery degree (MD) (2)

The third step is to determine the residual risk level (RRL):

RRL = Gross Risk Level (RBL) / Mastery (M) (3)

Step 1: Calculation of the gross risk level:

Gravity (G): Predicted Gravity of damage is assessed on 4 levels:

TABLE V :GRAVITY LEVELS

Level	Low	Medium	Severe	Verysevere
Graduation	*1*	*2*	*4*	*8*
Gravity (G)	Almost accidents Repetitive Benign superficial injuries requiring first aid	Accident with work stoppage of less than 20 days requiring medical follow-up or repeated care.	Accident with work stoppage greater than 20 days. Partial permanent disability Exposure resulting in occupational disease (acute or chronic reversible disease)	deadly accident or internal injury Exposure resulting in occupational disease (cancer or disease with poor prognosis)

Occurrence probability (PO): The Occurrence Probability depends on 2 parameters which are:
- Exposure index
- The Historical Incident Occurrence Index (IH):

It is calculated as follows:

OP = staff numbers Index *(I SN) + Exposure Index (I Exp) + Historical Accident Occurrence Index (I H)* (4)

The Index of staff numbers that is involved and exposed to risk is evaluated in 4 levels:

TABLE VI : STAFF NUMBER EVOLUTION

Graduation	1	2	4	10
Staff number	1 to 2 Person	3 to 10 Person	11 to 50 Person	More than 51 Person

The Exposure Index (E Exp) is evaluated in 3 levels :

TABLEVII:EXPOSURE INDEX

Graduation	1	2		3
Exposure	*Low*	*Medium*		*High*
Exposure Calculation Matrix		Average exposure time per day		
		More than 4 hours	1 to 4 hours	15 min to 1 hours	<15 min

Repeatability	1 to several times a day	**3**	**3**	**2**	**2**
	1 to several times a week	**3**	**2**	**2**	**1**
	1 to several times a month	**2**	**2**	**1**	**1**
	1 to several times a year	**2**	**1**	**1**	**1**

The Historial Incident Occurrence Index (IH): The history of occurrence of accidents and almost accidents is evaluated in 3 levels

TABLE VII1:HISTORICAL INCIDENT OCCURENCE INDEX

Graduation	**0**	**1**	**3**
History	- Absence of accidents - Absence of almost recurring accidents in the past	History showing the occurrence of almost recurring accidents in the past.	History proving the accident occurrence (s) in the past

Step 2: Determination of masters level:

The Master's degree is calculated according to the following formula:

$$MASTERY\ (M) = Mastery\ Index\ (MI) \quad (5)$$

Table VIII: Mastery index

Graduation	**1**	**2**	**3**	**4**
Level of Operational Mastery (MO)	No Master's degree Operational Implementation (Absence of: Instructions Particularly, Authorizations, PPE, existence And checks Security installations)	Partial Mastery. Operational control measures implement But inadequate or not applied in part.	Measures to Masters Operational, Adapted, put in place applied. The surveillance Is defined and planned.	Total control. Measures to Masters Operational put in place, Adapted, Applied, Monitored and The Is appropriate *. Surveillance is Defined, putting in place, Applied and effective.

(*) Understands, respects and uses systematically and effectively

Step 3: Definition of the risk acceptability threshold:

The risks identified are of varying importance and can't be addressed immediately. Priorities for action therefore, need to be defined. In this spirit, a risk classification must be established and a risk acceptability threshold must be defined by consensus of the group of participants in the evaluation the acceptability threshold is defined as follows:

3.3. Method application:

The study was carried out in general for certain risks

Table IX: Risk acceptability threshold

Level of Acceptability	RRL	Mastery of Decisions
Unacceptable Risk	RRL ≥43	Unacceptable Risk Requires immediate action or compensatory measures. Failing this, discontinuation of the activity
Risk High	20 ≤ RRL <43	Risk to be monitored Risk to reduce If Risk associated with very serious consequences, need for short-term actions.
Risk Moderate	10 ≤ RRL <20	Risk to be monitored Reducing Risk Action to be planned in the medium or long term
Low Risk	RRL < 10	No further checks are required Surveillance to be ensured Opportunities for Improvement

Incurred in the field of chemistry and biology.
The results are presented below:

Risk identification	Dangers identification	Damages identification	Risk evaluation						
Risk category	*Danger description*	*Damage*	*G*	*P*	*GRL*	*M*	*RRL*	*Current means*	*Means to implement*
Explosion risk/burning	Usage of Flammable chemical products near to a flame source	Burns, deaths	8	10	80	2	40	-Product Safety Data Sheet Fire extinguishers -Wear of the individual protection equipments	-Accounting for manipulations realized at the same time -Supervision of students during manipulation -Sensitization of students on risks and precautions to avoid exposure Fire -Safety Training -Evacuation Plane Poster - Installing a Flame Sensor -Fire alarm -Safety shower
Explosion risk/burning	Distillation of peroxidizable produts stored since several months	Serious injury, death, burns	8	7	56	2	28	-Means of fire-fighting -Distillation procedure -Wear of the individual protection equipments	-Establishment of a specific instruction to carry out a chemical test to detect the presence of the peroxide before undertaking distillation the -Distullation assembly check
Chemical risk	Concentrated sulfuric acid splash in the eye	Irritation/blindness	4	4	16	1	16	None	-Implementation of a signaling system about the wear of the individual protection equipments - Provision of ocular showers for immediate rinsing of the eye - medical monitoring
Chemical risk (irritation, Poisoning)	Chemical transfer	Irritation, poisoning	2	4	8	1	8	None	-Transfer of products into a fume hood equipped with vapor aspiration - Awareness of compliance with label instructions on containers
Injury risk	Broken glass	injury	1	7	7	2	4	Wear of the individual protection equipments.	-Handling laboratory glassware carefully -Verification of glassware before use
Chemical risk	Circulation of products in presence of persons within the institution	Several accidents	2	4	8	1	8	None	Delivery at schedules where there is no student - Verification of glassware before use
Biological risk	Uncertainty about the pathogenicity of certain biological products (cell cultures, biological patterns)	Several accidents	8	5	40	3	13	-Biological safety station suitable for containment -Displayed instructions -Personal protective equipment (gown + gloves).	Regular medical examinations. waste management

Figure 1. First extract of the application method in biology laboratory *(figure caption)*

Risk identification	Dangers identification	Damages identification	Risk evaluation						
Risk category	*Danger description*	*Damage*	*G*	*P*	*GRL*	*M*	*RRL*	*Current means*	*Means to implement*
Infection risk	Formation of aerosols following dropping of drops of liquid containing pathogenic germs on the worktop during pipetting	Health disease	2	5	10	3	3	-Wear of the individual protection equipments -Working in a safety cabinet	Place on the work surface an absorbent material which will be disposed in accordance with the procedure applicable to infectious waste
Infection risk	Onychophagy	Health Disease	3	4	12	2	6	-Wash hands -Wear of adapted individual protection equipments. -Soap dispenser	Awareness about pathways of contamination

Figure 2. Second extract of the application method in biology laboratory (figure caption)

IV. RECOMMENDATIONS:

The purpose of the analysis and the risk [6] assessment consists in reducing the extent of the various risks through the implementation of appropriate prevention measures, we propose, in this way, recommendations that we classify it into four complementary categories: strategic, organizational, human and technical. On the managerial / strategic level: The decision to implement a security policy in a university environment implies the involvement of all the hierarchies (Ministry, University Presidency, and Direction of the institution). Concretely, this requires that each actor is involved in the process of reflection and budgetary decisions.

On the one hand, this involves allocating and making available the human, material and financial resources necessary to achieve the objectives set out in the field of OSH and, on the other hand, cross-sectoral exchanges in order to involve everyone in this field Decision-making process and to benefit from the feedback of OSH experiences from all academic institutions.

It is also essential to:

•Ensure transparency of information on all aspects of security.

•Facilitate the reporting of accidents and near accidents or even set up a database at national level in all universities in order to have statistics and then try to analyze the reported facts to draw lessons to improve and safeguard working conditions in university laboratories.

•Define and integrate indicators in the performance of universities (number of accidents, distribution of causes of accidents at work, budget invests in OSH, number of days absent, severity rate, frequency rate ...)

And finally, Integrate the security approach within universities within the framework of a Safety Management System according to international standards, in particular the OHSAS 18001, based on continuous improvement.

On the organizational level:

We insist on:

•The definition of the working group mobilized for the safety approach and the definition of the responsibilities of each member.

This concern:

-The person in charge of the safety department and the person or persons responsible for the implementation of the health and safety rules.

-Members of the health and safety committee.

-A doctor working full-time or even part-time.

-Nurses

•Improved internal communication within universities on health, hygiene and safety aspects.

•Formalization of the procedures and procedures used in the chemistry-biology laboratory.

•Formalization of maintenance and maintenance procedures for premises and equipment.

•Formalization of chemical management procedures (purchase, receipt, labeling, SDS, storage, suppliers ...), management of hazardous waste / packaging ... etc.

On the human level:

Training must be provided for anyone working in such an environment. This training in safety concerns:

•Health risks and hygiene requirements,

•The precautions to be taken to avoid exposure (good laboratory practices, collective protections ...) and to prevent incidents and accidents (laboratory notebook, working procedures, instructions ...),

•The wearing and use of personal protective equipment and clothing,

•The methods of sorting, collecting, storing, transporting and disposing of waste,

•How the fire extinguishers work.

•What to do in the event of an accident. The content of these training courses should make it possible to address both the theoretical aspects and practical and practical aspects of safety at work,

In addition to training, the notion of security can be disseminated and integrated into the academic community through awareness campaigns, posters, booklets (practical manual, good practice manual, laboratory safety guide, safety manual, Etc.), security days, seminars and seminars.

On the technical level:

A well-designed laboratory design is the first preventative measure that protects people by providing them with suitable premises for surfaces, equipment and circuits.

A university laboratory must possess the following characteristics:

•An appropriate ventilation system to allow rapid evacuation of toxic gases or vapors within the laboratory.

•Adequate lighting at all times (replace defective lamps as soon as possible). An emergency lighting system must be activated automatically during an electrical failure.

•Sufficient space for students to perform their manipulations appropriately and without clutter.

•Protection of current currents in case of earth leakage of current. Note that a laboratory must have grounded electrical outlets as well as easily accessible electrical distribution panels.

•Emergency evacuation routes and emergency exits, fire extinguishers, fire alarms, smoke detectors, etc.

•Security displays indicating emergency telephone numbers, safety rules to be observed in the laboratory room, hazardous materials storage locations, fire extinguisher locations, first-aid kit.

•Provided with equipment with a safety system and maintained periodically or even refurbished if necessary.

•Provided with personal protective equipment specific to each individual and adapted to the nature of the manipulation carried out.

•Provided with metal or plastic containers to place waste.

•Provided with a fixed shower that must be easily accessible to allow first aid in case of thermal or chemical burns. The installation of eye washer is also recommended. The ideal is basins controlled by the foot allowing to wash both eyes and the whole face.

In a laboratory of chemistry:

In addition to the above, a chemistry laboratory must contain the following elements:

• Hoods / fume cupboards allowing the extraction of toxic fumes from products used during handling

• Places for gas cylinders.

• Sufficient spaces for work and student traffic.

• Ventilation and fume capture devices closest to their points of emission

• Fire-fighting equipment, including fire extinguishers that must be distributed within laboratories, easily visible and easily accessible

• A Ventilation Warehouse located near the laboratory to store chemicals.

• Labeling of any container or bottle containing a chemical and storage of the products in cabinets and in the necessary quantities.

• Absorbents for inverted liquids

In a laboratory of biology:

• Biology and microbiology laboratories should be developed on the principle of gradual confinement, which prevents first the [7] deamination of the biological agent in the working environment, then its transmission to the workers and finally limit the Accidental spread in the environment. 4 security levels are defined, rated 1.2, 3.4 to be compared with the classification of pathogens.

• a pictogram indicating the risks associated with the presence of biological hazards of level 2 and above must be affixed to the laboratory entrance, to any workstation concerned and to any enclosure

enclosing biological agents (boxes or refrigerators containing samples, ..)

• An autoclave must be available to decontaminate laboratory equipment (Petri dishes, pipettes, culture tubes, glassware, etc.)

• Chemical disinfectants to decontaminate surfaces and devices that can't be autoclaved.

• Non-manual [8] hand wash basins, liquid soap dispensers, disposable paper hand towels and a used paper waste bin.

• Installation of appropriate technical equipment (microbiological security station PSMII or PSMIII as required). Finally, regardless of the level of risk and the type of laboratory or handling, compliance with the general rules of good hygiene practice is the basis of safety.

V. CONCLUSION:

In the university, laboratory in practical manipulation or research, especially in chemistry and biology, exposes students, technicians and teachers to a number of occupational risks. This requires taking the necessary measures to ensure their safety and to protect their health. A priori risk analysis is the essential part of the dynamic risk management and prevention process, which consists of identifying, analyzing and finally dealing with risks.

The purpose of this article is the implementation of effective measures aimed at the elimination of risks in accordance with the general principles of prevention. It therefore aims to increase the protection of the health and safety of staff and to improve working conditions within the institution.

The risk analysis process is not ephemeral, it must be continuous and must be updated annually or even integrated into a safety management system that emanates from a clearly defined strategy and which is part of an approach to social responsibility.

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