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Full Length Research Paper

Assessment and chemical risk management in healthcare establishments *«case of a laboratory of anatomy and pathological cytology»*

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The risk of being exposed to hazardous chemicals, the health consequences as well as the cost of accidents at work and occupational diseases associated with them require the establishment of an effective and efficient chemical risk management strategy, which must be based on founding principles and a clearly defined and explicitly formulated policy. Regarding the chemical risks within hospitals, we have to admit the significant diversity of products and working situations, which can expose the staff to dangerous chemical agents. This study whose contents are based on the standards, the regulations and the scientific data, consists in the deployment of an approach of assessing and managing of chemical risk within a University Laboratory of Anatomy and Pathological Cytology. The advantage of the adopted approach in our study is that it easily allows the differentiation of toxic effects (local, systemic and CMR), while specifying through the phrases in R the path of absorption of the products. Exposed chemical hazards identified: CMR risks (carcinogen, mutagen, reprotoxic), such as Formol, Hémalun Mayer, MGG, EUKITT. The choice of using a semi-quantitative assessment method is a necessity for raking risks as accurately as possible. It establishes the preliminary stage in the implementation of a quantitative evaluation of the exhibitions by atmospheric measurements or/and biological surveillance. Indeed, although being more precise, the quantitative evaluation of the exhibitions cannot be used in first intention because she answers a methodology involving a not insignificant human and financial cost.

Keywords: Risks, chemical risk management, hospitals, healthcare, anatomy and pathological cytology.

INTRODUCTION

The risk of being exposed to toxic chemicals, their health consequences, the high cost of incidents, as well as professional diseases undoubtedly requires establishing a real chemical risk management strategy that should be based on the founding principles and a simple policy explicitly formulated (Ayana et *al*,2015).

Being subjected to hazardous chemicals, dangerous goods and work situations affects badly the individual's health in different ways within hospitals:

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- **Medical biology laboratories:** solvents, acids, bases, dyes, reagents, diagnostic kits, ...
- **Anatomy and Pathological Cytopathology Laboratories (ACP)**: fixer solution, dyes, oil…
- **Units care:** detergents, disinfectants, cleaning products, disinfectants surgical equipment...
- **Pharmacies:** cytostatic drugs,
- **Operating room:** volatile anesthetic gases,
- **Technical Services:** solvents, glues, chemical waste...(Managing risks of hazardous chemicals in the workplace , 2012)

The activities mentioned above deal with different work situations that must nevertheless be eligible for single method of chemical risk assessment that should be appropriate to the hospital setting.

In Morocco several legislative texts have been established by the Ministry of Health, in order to strengthen the risk prevention susceptible to entail the consequences on the health and the security of the workers at the sanitary sector that are exposed to chemical agents:

- The order of Minister for Health n°2598-10 of 27 Ramadan 1431 (in September 7th, 2010) concerning the GBEA (Guide de Bonne Execution des Analyses): fixing prevention measures to be set up in analysis laboratories, where the workers may be exposed to pathogenic chemical or biological agents.
- The official bulletin N°5926 12 - RabiiII 1432 (17-03-2011)/Chapitre VI - security, Hygiene and risks management.
- Article 87: hygiene of the hospital
- Article 88: the vigilance and the sanitary security.
- Article 99/Chapitre VIII - protection of the staff: protection against the risks
- Official Bulletin N° 2629 of 15/03/1963 (in March 15th, 1963) Dahir N 1-60-223 of Ramadan12th, 1382 (in February 6th, 1963) carrying modification in the shape of the dahir

The main objectives of this risk management system are the following ones:

- **Human being:** protect and ensure the health and the safety of the staff.
- **Cultural:** establish a Safety Culture within the service as well as the learning of the risk based on a reactive approach.
- **Legal**: satisfy the statutory requirements.
- **Economic:** reduce the costs of occupational accidents by the anticipation of the risks.

The content of this study is based on standards, regulations, and scientific data that aim to enhance and deploy an evaluation approach and risk management within **a Laboratory of Anatomy and Pathological Cytology of Ibn Sina University Hospital.**

We chose the Laboratory of Anatomy and Pathological Cytology (ACP) of Ibn Sina University Hospital as a case study since the anatomy and cytology services are sectors that characterize by significant risks toxicity due to the large quantities of formalin (carcinogenic) and Toluene treated.

The assessment of professional risks is a priority in these services (World health organization, 2010).

METHODOLOGY

1. Types of assessment:

It is a semi-quantitative study based on the estimation of levels of risk according to the exposure conditions. This type of methods indeed presents the advantage of simplicity of use and allows more exhaustive evaluations of the exposure to numerous chemicals used in the hospitals environment. Furthermore, she simplifies the inventory of the dangerous chemical agents for compulsory quantitative evaluation that could exist in an establishment as is or within a chemical preparation.

2 Limitation of the field of action:

The study is made in the laboratory of ACP of the CHU Ibn-Sina of Rabat, which is the biggest laboratory of ACP in Morocco.
It is characterized by:

- **Area**

Rooms/Offices	Area in sqm
PREVELEMENT	10.23
CHIEF NURSING OFFICER	10.23
RECEPTION	10.23
ARCHIVES ROOM	6.35
MACROSCOPY ROOM	21.9
TECHNICAL ROOM	60
COURSE ROOM & READING BLADES	49
OFFICE MANAGER	12.54
ROOM DOCTOR 1	8.91
ROOM DOCTOR 2	8.91
ROOM DOCTOR 3	8.91
SECRETARIAT	9.86
BREAK ROOM	13.2
PRODUCTS STOCK	7.60

LIQUID AREA	8.60
TOILETS	9.72
CORRIDORS	21.84
SAS	3.29
TOTAL	**281.32**

- **Human ressources**

The laboratory, presents different type of human resources that participate in various phases.
We distinguish six categories:

HUMAN RESSOURCES	NUMBER
DOCTORS	5
ENGINEERS	2
TECHNICIANS	7
NURSES	3
ASSISTANTS	2
SERVICE AGENTS	2

Other human resources can occur occasionally: Maintenance agents, cleaning and trainers;

3. Steps:

**** Chemical inventory of products:***

The first stage consists in inventorying chemical substances, preparations, present waste (implemented, generated or stored) in the laboratory by identifying them clearly.

- Raw materials, additives, catalysts, solvents ...
- Synthesis intermediates,
- By-products,
- Finished goods,
- Other products (maintenance and cleaning, ...)
- Waste...

This stage also allows to identify the chemical agents who were not used for a long time or who are not any more used (CNRACL, 2007).

*** Identification, characterization and hierarchical organization of the dangers:**

The identification consists in listing all the chemical agents used within the establishment, that exists in gas forms (anesthetic gases e.g.), solid (powders) or liquids (solvents, paints), disinfectants).

In the characterization of the dangers of chemicals, it is decided to use the phrase of risk **(phrase R)** as main information sources because they are easily accessible and allow the characterization of the physico-chemical, environmental and toxicological dangers.

Among the various information sources that allow the access to the phrase R associated with the dangerous chemicals, are the following sources, which are used in an order of priority:

- *Safety data sheets (**FDS**)* (compulsory according to the Labor code article R.231-53, Stopped of January 5th, 1993, modified by the Order of November 9th, 2004, fixing the modalities of elaboration and distribution of the FDS) of every commercial product, obtained from the web sites of the suppliers.

- *Toxicological cheet transmitted* by the INRS (Institut National de Recherche et Sécurité http://www.inrs.fr).

The characterization of the dangers aims at identifying not only the nature of the danger (physico-chemical, toxicological, environmental), the type of effect dreaded (local effect, general effect, CMR) but also the preferential ways of penetration of substances in the body (respiratory, cutaneous, oral), as well as the gravity of their effects. See table below:

Health effects			
Local toxicity			
Way of penetration	**Level1**	**Level 2**	**Level 3**
Respiratory(Lresp)	--	R34 R37	R35
Cutaneous(Lcut)	R38 R66	R34	R35
Ocular(Loc)	R36	R34	R35 R41

Systemic toxicity not CMR			
Way of penetration	**Level 1**	**Level 2**	**Level 3**
Respiratory(Lresp)	R20 R67	R23 R29 R31	R26 R32 R33 R39 R42 R48
Cutaneous(Lcut)	R21	R24 R43	R27 R33 R39 R48
Ocular(Loc)	R22 R65	R25	R28 R33 R39 R48
Toxicity CMR			
Effect's type	**Level 1**	**Level 2**	**Level 3**
Carcinogenic (C)	--	R40	R45 R49
Mutagenic (M)	--	R68	R46
Reprotoxic (R)	--	R62 R63 R64	R60 R61
The CMR products level 3 correspond to the products C, M, R category 1 and 2 of the European legislation			

This algorithm contains 2 inputs:

9 types of danger:

- Local effect through respiratory absorption (Lresp), Skin (Lcut) or ocular (Loc),
- Systemic effect not CMR by arespiratory absorption (Sresp), cutaneous (Scut) or oral (Soral)
- Carcinogenic (C), mutagenic (M) and reproductive toxicant (R) effects.

- 3 levels of danger:

- Slightly dangerous (niveau 1),
- Dangerous (niveau 2),
- Very dangerous (niveau 3).

Each type of danger is calculated as a ***Danger index (ID)***, which will be used to calculate the risk index. This danger index, is the danger level that is raised to the power of 10 using the following formula: ***ID = 10 (level of danger).***

Each product is associated to 9 danger indexes:

- Danger Index of Local effect through respiratory absorption (IDLresp), cutaneous (IDLcut) or ocular (IDLoc) ,
- Danger Index of systemic effect not CMR by respiratory absorption (IDSresp), cutaneous (IDScut) or oral (IDSoral)
- Danger Index carcinogenic (IDC), mutagenic (IDM) reprotoxic (IDR) effects.

For the physico-chemical dangers (fire, explosion, incompatibility) and environmental, products are classified into dangerous category since they contain at least one phrase R, and non-hazardous if they do not possess it.

In the current methodology, neither the evaluation of exposure nor the calculations of risks indexes are afterward realized for these products.

*** Evaluation of the exposure of staff:**

The exposure of the staff to the dangerous chemical agents is characterized by several factors allowing estimating the intensity (in a semi-quantitative way). For professional activities involving the manipulation of one or several dangerous products, observations of ground have to allow collecting the necessary information for the piece of information of these criteria.

Physico-chemical and environmental effects		
Physico-chemical dangers		
	Level 0	**Level 1**
F - Fire	--	R7 R8 R11 R12 R15 R17 R18 R30
E - Explosion	--	R1 R2 R3 R4 R5 R6 R9 R16 R18 R19 R44
S –Stability	--	R14 R29 R31 R32
Environmental dangers		
	Level 0	**Level 1**
Environment	--	R50 R51 R52 R53 R54 R55 R56

The validated method has to take into account two variable types (Persoons and al, 2015): the intensity of the exposure and the efficiency of the means of protection used according to the various ways of absorption of products:

- Frequency of manipulation,
- Used Quantities,
- Use (bearing)) and efficiency of the protection equipment of the respiratory, cutaneous and Ocular ways.

An exposure index (EI) was calculated from the levels of frequency and quantity according to the formula***: IE = 0.1 x frequency level x level of quantity.***

If the calculation gives the value 0.9, EI is considered equal to 1. Therefore, the exposure index ranges from 0.1 (very low exposure) and 1 (maximum exposure)

Exposure intensity		
Type of variable	**Level**	**Signification**
Frequency	**1**	Less than once per week
	2	One or more times per week
	3	One or more times per day
Quantity	**1**	Less than 10 ml or 10 g
	2	Between 10 and 100 ml or between 10
	3	More than 100 ml or 100 g

A protection Index (IP) is calculated for every means of protection by carrying the levels of the efficiency of the means of protection in the power of 10 according to the following formula:

IP = 10 - (level of protection 1).

Three protection factors are so calculated:

- Protection factor of the respiratory way (IPresp),
- Protection factor of the cutaneous way (IPcut),
- Protection factor of the ocular way (IPoc).

Efficiency of the protection means		
Type of variable	**Level**	**Signification**
Respiratory protection	1	General air conditioning or ventilation
	2 2 2	Sorbonne no in compliance with the standards Standard Sorbonne misused Extraction at the source
	3	Substandard sorbonne well used
Cutaneous protection	1	No gloves
	2	Barrier cream or inappropriate gloves
	3	Adapted gloves
Ocular protection	1	No protection
	2	Window of sorbonne lowered
	3	Safety glasses or full face shield

**** Calculation of risk indexes:***

For every type of danger the estimation of the risk level (under the shape of an index) takes into account both the level of danger of the product, the intensity of the exposure, and the efficiency of the means of protection in touch with the way of absorption of the product. From these indications of risks, we defined three levels of risk:

- Level of low risk,
- Level of intermediate, acceptable risk subject to appropriate precautions,
- Level of high risk (priorities of action).

Hierarchical organization of the chemical risks:

For each task of an activity requiring the use of one or more hazardous substances, the risk index (RI) needs to be calculated by taking into consideration (Vincent and al, 2000.):

⇨ Danger indexes (IDLresp, IDLcut, IDLoc, IDSresp, IDScut, IDSoral, IDC IDM, IDR)
⇨ Exposure indexes (EI)
⇨ Protection indexes corresponding to the absorption pathways (IPresp, IPcut, IPOC).

The general formula is: **IR = ID x IExIP**. The details of formulas are based on surveyed effects and potential routes. The table below shows the details.

Effect type	Risk indice	Calculation formula
Local effect through respiratory way	IRLresp	IDLresp x IE x IPresp
Local effect through cutaneous way	IRLcut	IDLcut x IE x IPcut
Local effect through ocular way	IRLoc	IDLoc x IE x IPoc
Systemic effect through respiratory way	IRSresp	IDSresp x IE x IPresp
Systemic effect through cutaneous way	IRScut	IDScut x IE x IPcut
Carcinogenic effect through respiratory way	IRCresp	IDC x IE x IPresp
Carcinogenic effect through cutaneous way	IRCcut	IDC x IE x IPcut
Mutagenic effect through respiratory way	IRMresp	IDM x IE x IPresp
Mutagenic effect through cutaneous way	IRMcut	IDM x IE x IPcut
Retoxic effect through respiratory way	IRRresp	IDR x IE x IPresp
Retoxic through cutaneous way	IRRcut	IDR x IE x IPcut

The working situations associated with a high level of risk should be the object of rapid proposals of prevention / protection, as a supplement to the appeal to other approaches allowing to characterize the risk in a more precise way (atmospheric and/or biological metrology).

For systemic effects not CMR occurring after oral absorption, no IR is calculated because this route of absorption is not typically found in the workplace. For CMR, 2 risk indices are calculated by type of effect depending on the route of absorption (respiratory and / or cutaneous).

A total of 11 risk indices are calculated with values ranging from 0.001 (minimal risk) and 1000 (maximum risk).

Risks are classified into 3 priority levels:

- Low risk level if **IR <4**;
- Intermediate risk level (acceptable subject to appropriate precautions) if **4 ≤ IR <40;**
- High-risk level (priorities for action) requiring corrective actions if **IR ≥ 40**.

Level of risk	0,001 - 3	4 - 30	40 - 1000
Risk acceptability	Low	Medium (acceptable underreserve)	High

4. Validation:

The present valuation method was validated by:

- Its confrontation with other semi-quantitative methods used in branch of industry and check of its coherence,
- Its simultaneous use in the laboratories of hospital hematology of 5 CHU, CENTRE HOSPITALIER UNIVERSITAIRE (Brest, Grenoble, Limoges, Lyon, Reims) in 2006 and 2007. **CNRAC*L, 2007***

5. Limits

Only toxicological hazards are taken into account in this process. The physicochemical and environmental hazards are identified but not subject to a hierarchy of risks.

For the sake of simplification of the process, the physicochemical properties have not been taken into account but should be studied as they are likely to influence the intensity of exposure of individuals.

RESULTS

Table 1. Inventory of chemicals used in a laboratory for ACP, quantity used, frequency of use and means of protection

CHEMICALS PRODUCTS	SENTANCE -R-	-SENTANCE -S-	Qty used during each operation			Frequency of use			Respiratory Protection			Cutaneous Protection			Ocular protection		
			Less than 10ml or 10g	Between 10 and 100 ml or between 10 and 100 g	More than 100 ml or100 g	Less than 1time per week	Once or many times per week	Once or many time per day	Air conditioning or general ventilation	Standard Sorbonne / Substandard Sorbonne misused / extraction at the source	Standard Sorbonne well used	No gloves	Barrier cream or inappropriate gloves	Adapted gloves	No protection	Window of sorbonne lowered	Safety glasses or full face shield
FORMOL	23/24/25/43/34/40	26/36/37/39/45/51			X			X		X			X		X		
TOLUEN	11.20	7/16/25/29/33			X			X	X			X			X		
ABSOLUTE ALCOHOL	11	7.16			X			X	X				X		X		
PERIODIC ACID	8.34	26/36/37/39/45		X			X		X				X		X		
ACETIC ACID	10.35	2.23.26		X		X			X				X		X		
OXALIC ACID	21.22	2.24.25	X			X			X				X		X		
NITRIC ACID	8.35	2.23.26.27		X			X		X				X		X		

Table 1 continue

AMMONIA	84	2.13.35.53.63.67	X			X			X				X		X		
HEMALUN OF MAYER	20.21.22	36.37			X			X	X				X		X		
ECOSINE	36	22.26			X			X	X				X		X		
BLEU TOLUIDINE	22	22.24.25		X				X	X				X		X		
MY GRUN WALD	11.23.24.25	7.16.36.37.45			X			X	X				X		X		
GIEMSA	11.23.24.25 39.23.24.25	7.16.36..37.45			X			X	X				X		X		
EUKITT	10.20.21.38	9.25.37			X			X		X		X			X		
RESCICINE	22.36.38.50	26.61	X			X			X				X		X		
SILVER NITRAT	34.50.53	26.45.60.61	X				X		X				X		X		
PHOSPHO MOLIBDIC ACID	34	26.36.37.39.45	X					X	X				X		X		
CITRIC ACID	36	24.25	X			X			X				X		X		

Table 2. Characterization of Chemicals, Phrase R, danger level

CHEMICALS PRODUCTS	Indices of danger	Indice of environemntal danger	Indice of physico-chimical danger			Indices of toxicological danger									Level of global danger per Product
						Local			Systemic not CMR			CMR			
	Phrase R	Env	Feu	Exp	Inc	IDLresp	IDLcut	IDLoc	IDSresp	IDScut	IDSoral	IDC	IDM	IDR	
FORMOL	23/24/25/43/34/40	0	0	0	0	2	2	2	2	2	2	2	0	0	2
TOLUEN	11/38//48/20/63/65/67	0	1	0	0	0	1	0	3	3	3	0	0	2	3
ABSOLUTE ALCOHOL	11	0	1	0	0	0	0	0	0	0	0	0	0	0	1
PERIODIC ACID	8/34	0	1	0	0	2	2	2	0	0	0	0	0	0	2
ACETIC ACID	10/35	0	0	0	0	3	3	3	0	0	0	0	0	0	3
OXALIC ACID	21/22	0	0	0	0	0	0	0	0	1	1	0	0	0	1
NITRIC ACID	8/35	0	1	0	0	3	3	3	0	0	0	0	0	0	3
AMMONIA	34/50	1	0	0	0	2	2	2	0	0	0	0	0	0	2
HEMALUN OF MAYER	20/21/22	0	0	0	0	0	0	0	1	1	0	0	0	0	1
ECOSINE	36	0	0	0	0	0	0	1	0	0	0	0	0	0	1
BLEU TOLUIDINE	22	0	0	0	0	0	0	0	0	0	1	0	0	0	1
MY GRUN WALD	11/23/24/25	0	1	0	0	0	0	0	0	2	2	0	0	0	2
GIEMSA	39/23/24/25	0	0	0	0	0	0	0	3	3	3	0	0	0	3
EUKITT	10/20/21/38	0	0	0	0	0	1	0	1	1	0	0	0	0	1
RESCICINE	22/36/38/50	1	0	0	0	0	1	1	0	0	1	0	0	0	1
SILVER NITRAT	34/50/53	1	0	0	0	2	2	2	0	0	0	0	0	0	2
PHOSPHO MOLIBDIC ACID	34	0	0	0	0	2	2	2	0	0	0	0	0	0	2
CITRIC ACID	36	0	0	0	0	0	0	1	0	0	0	0	0	0	1

Table 3. Level of global danger per type of toxicity and penetration route

Hazardous products: Local toxicity

Respiratory	
Level 3	ACETIC ACID
	NITRIC ACID
Level 2	FORMOL
	PERIODIC ACID
	AMMONIA
	SILVER NITRAT
	PHOSPHO MOLIBDIC ACID
Cutaneous	
Level 2	ACETIC ACID
	NITRIC ACID
	FORMOL
	PERIODIC ACID
	AMMONIA
	SILVER NITRAT
	PHOSPHO MOLIBDIC ACID
	TOLUENE
	EUKITT
	RESCICINE
Ocular	
Level 3	ACETIC ACID
	NITRIC ACID
Level 2	FORMOL
	PERIODIC ACID
	AMMONIA
	SILVER NITRAT
	PHOSPHO MOLIBDIC ACID
Level 1	TOLUENE
	EUKITT
	RESCICINE

Hazardous products: Systemic toxicity not CMR

Respiratory	
Level 3	TOLUENE
	Giemsa
Level 2	FORMOL
Level 1	HEMALUN OF MAYER
	EUKITT
Cutaneous	
Level 3	TOLUENE
	GIEMSA
Level 2	FORMOL
	MG
Level 1	ACIDE OXALIQUE
	HEMALUN DE MAYER
	EUKITT
Oral	
Level 3	TOLUENE
	GIEMSA
Level 2	FORMOL
	MG
Level 1	OXALIC ACID
	BLEU TOLUIDINE
	RESCICINE

Hazardous products : Toxicity CMR

Carcinogen	
Level 2	FORMOL
Reprotoxic	
Level 2	TOLUENE

Table 4. Calculation of Exposure Indices, Protection and Danger

CHEMICAL PRODUCT	PHRASE R	EXPOSURE			INDICE OF PROTECTION			Indice of toxicological danger											
								Local			Systemic Not CMR		CMR						
													C		M		R		
		Qty used	Fréquency of use	Exposure indic	Resp	Cut	Oc	IDLresp	IDLcut	IDLoc	IDSresp	IDScut	IDCcut	IDMresp	IDMcut	IDRresp	IDRresp	IDRcut
FORMOL	23/24/25/43/34/40	3	3	1	0,1	0,1	1	100	100	100	100	100	100	100				
TOLUEN	11/38/48/20/63/65/67	3	3	1	1	1	1		10		1000	1000					100	100
ABSOLUTE ALCOHOL	11	3	3	1	1	0,1	1											
PERIODIC ACID	8/34	2	2	4	1	0,1	1	100	100	100								
ACETIC ACID	10/35	2	1	2	1	0,1	1	1000	1000	1000								
OXALIC ACID	21/22	1	1	0,1	1	0,1	1					10						
NITRIC ACID	8/35	2	2	0,4	1	0,1	1	1000	1000	1000								
AMMONIA	34/50	1	1	0,1	1	0,1	1	100	100	100								
HEMALUN OF MAYER	20/21/22	3	3	0,9	1	0,1	1				10	10						
ECOSINE	36	3	3	0,9	1	0,1	1			10								
BLEU TOLUIDINE	22	2	3	0,6	1	0,1	1											
MAY GRUNWALD GIEMSA	11/23/24/25	3	3	1	1	0,1	1					100						
	39/23/24/25	3	3	1	1	0,1	1				1000	1000						
EUKITT	10/20/21/38	3	3	1	0,1	1	1		10		10	10						
RESCICINE	22/36/38/50	1	1	0,1	1	0,1	1		10	10								
SILVER NITRAT	34/50/53	1	2	0,2	1	0,1	1	100	100	100								
PHOSPHO MOLIBDIC ACID	34	1	3	0,3	1	0,1	1	100	100	100								
CITRIC ACID	36	1	1	0,1	1	0,1	1			10								

Table 5. Prioritizing Chemical Hazards (calculation of risk indices)

CHEMICAL PRODUCTS	PHRASE R	EXPOSURE		PROTECTION			Indices of toxicological danger										
		Qty used	Frequency of use	Resp	Cut	Oc	Local			Systemic Not CMR		CMR					
												C		M		R	
							IDLresp	IDLcut	IDLoc	IDSresp	IDScut	ID Cresp	ID Mcut	IDMcut	IDRresp	IDRresp	IDRcut
FORMOL	23/24/25/43/34/40	3	3	2	2	1	10	10	100	10	10	10	10				
TOLUEN	11/38/48/20,63,65,67	3	3	1	1	1		10		1000	1000					100	100
ABSOLUTE ALCOHOL	11	3	3	1	2	1											
PERIODIC ACID	8/34	2	2	1	2	1	40	4	40								
ACETIC ACID	10/35	2	1	1	2	1	200	20	200								
OXALIC ACID	21/22	1	1	1	2	1					0,1						
NITRIC ACID	8/35	2	2	1	2	1	400	40	400								
AMMONIA	34/50	1	1	1	2	1	10	1	10								
HEMALUN OF MAYER	20/21/22	3	3	1	2	1				10	1						
ECOSINE	36	3	3	1	2	1			10								
BLEU TOLUIDINE	22	2	3	1	2	1											
MY GRUN WALD	11/23/24/25	3	3	1	2	1					100						
GIEMSA	39/23/24/25	3	3	1	2	1				1000	100						
EUKITT	10/20/21/38	3	3	2	1	1		10		1	10						
RESCICINE	22/36/38/50	1	1	1	2	1		0,1	1								
SILVER NITRAT	34/50/53	1	2	1	2	1	20	2	20								
PHOSPHO MOLIBDIC ACID	34	1	3	1	2	1	30	3	30								
CITRIC ACID	36	1	1	1	2	1			1								

DISCUSSION

The advantage of the approach adopted in our study is that it easily allows the differentiation of toxic effects (local, systemic and CMR), stating the path of absorption of the products through the phrases in R. The only other method that takes into account the entry pathways of the product into the organism in the characterization of hazards is the method of B. Martel, but the complexity of the latter makes its application difficult (Martel, 2002). The approach takes into account the pathways of absorption among the hazard classes, which justifies taking into account the effectiveness of the means of protection (respiratory, cutaneous and ocular) depending on these absorption pathways. Frequently, only respiratory protection is taken into consideration (in the case of the UIC method), which remains insufficient in relation to our field of action. Indeed, in laboratories, direct contact of hands with chemicals is very prevalent. Concerning the calculation of the risk indixes, the

procedure is in agreement with B .Martel where the risk evolves according to a Power function and not according to a geometric function (Martel, 2002) . The formula of the danger indixes follows an exponential function, like the one of the protection indixes. The exponential quotation allows to represent more accurately the actual level of protection of the operator, which is also used by other authors (Martel, 2002 ; Vincent R and al, 2004).

Moreover, the preponderance of the hazard indixes (from 1 to 1000) on the protection indixes (0, 01 to 1) enable to respect the rule of risk predominance with respect to exposure in the expression of the level of risk (INRS, 2015). In contrast, the exposure index is rated according to a geometric progression as in most methods that integrate these variables (Rhodia method, (Martel, 2002 ; Vincent R and al, 2004).). The identification of the most dangerous situations and the proposal for corrective actions are the first steps in the procedure, follow-up improvement actions and periodic re-evaluations incorpurating a medium-term objective. Lastly, the precision of the data gathered allows us to put forward the findings below :

The chemical risk assessment highlights:

Higher risk levels with CRM effects caused by the exposure to Toluene during the steps "from the standard color", "fitting the blades." The risk is highlighted by the respiratory route because of the absence of a respiratory protection means during these steps and by cutaneous route because of the lack of the skin protection "glove adapted" during handling the product.

High risk levels with systemic effects caused by the exposure to Toluene, May Grunwald and Giemsa during various steps. The risk is characterized by respiratory and cutaneous route for toluene and Giemsa, and dermally route for May Grunwald dye, depending on the protection means used in these steps.

High risk levels with local effects caused by the exposure to formalin during the step of "fixing" the risk is highlighted by the ocular route. Also by exposure to Periodic and Acetic Acid in steps "special coloring", the latter is highlighted by respiratory and ocular route and finally by exposure to nitric acid in the step of the "special coloring" which is highlighting by respiratory, cutaneous and ocular route.

Intermediate risk levels of systemic effects caused by exposure to Formaldehyde, Mayer's Hemalun and Eukitt. The risk is highlighted by the respiratory route when handling formalin and Hemalun dye Mayer; and dermal way when handling the Eukitt and formol, depending on the protection means used during the various stages.

Intermediate risk levels of local effects due to exposure to ammonia, nitrate silver and phospho-molybdic acid. The risk is highlighted by both ocular and respiratory routes which are caused by the absence of eye protection means on the one hand and on the other hand labor in general ventilation conditions.

Thus it is also due to the exposure to Formol, periodic acid, acetic acid and Eukitt. The Eukitt highlighted by cutaneous route during handling of "special coloring" of all the aforementioned products and by respiratory route in the use of formol during the step of " fixating organs" and during the mounting of the blades.

Following this assessment, preventive or protective measures which may be proposed are:

- Improve ergonomic conditions of the staff and the architecture of the laboratory.
- Automate the editing stage blades and standard staining "Hemalun-eosin."
- Improve respiratory protection (step "fixing formol, HE Coloring, Installation") or cutaneous by buying resistant gloves Toluene and dyes.
- Improve ocular protection by buying and obligating the staff to wear gloves when handling chemicals.
- Adopte an atmospheric approach and quantitative biological specifically identified as high risk (local effects, Systemic not CMR and CMR)
- Introduce an efficient ventilation system taking into account the area of the laboratory and identified hazards.

ANNEXES

- ***DEFINITIONS***

It is necessary to demonstrate a set of useful definitions to understand the approach.

Chemical agent: " any element or chemical compound, in the brute state, or within a preparation, such as it appears at the natural state or such as it is produced, used or freed in particular in the form of waste, because of a professional activity, whether it is or not produced

deliberately and whether it is or not launched on the market ".

Dangerous chemical agent: " every chemical agent which meets the criteria of ranking of dangerous substances or preparation such as define in the article R.231-51, every chemical agent that, although not satisfying the criteria of classification as is or within a preparation, can present a risk of the health and the security of the workers because of its physico-chemical, chemical or toxicological and terms of its presence in the workplace or use."

Danger: «intrinsic property of a danger or substance that could cause damage for the human health and/or the environment ".

Exposure: "all contact conditions between a chemical agent and an individual, which could cause health effects ".

Risk: "probability of damage during the use and/or the exposure to chemicals. The risk is usually characterized by a probability and gravity ". **(**Norme internationale ISO/FDIS 31000,2009).

CONCLUSION

The choice of using a semi-quantitative assessment method is a necessity to prioritize risks as accurately as possible. It is a preliminary step to the establishment of a quantitative exposure assessment by atmospheric measurements and / or biological monitoring. Indeed, although more accurate, quantitative exposure assessment cannot be used as first-line because it responds to a methodology involving a significant human and financial cost.

The large number of chemicals handled in the health institutions in general and the ACP lab in particular, requires at first the establishment of this semi-quantitative approach that can be completed by annual measurements for CMR products or to specify the acceptability of risk (Lefebvre and *al,* 2001).

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