

The role of environmental monitoring in chemical risk assessment: the experience in service laboratories at the University of Urbino

Il ruolo del monitoraggio ambientale nella valutazione del rischio chimico: l'esperienza nei laboratori di servizio dell'Università di Urbino

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Urbino University offers a wide typology of worker activities, one of which is represented by the so-called service laboratories, dealing with wooden artefacts, ancient canvases and contemporary art. The health and safety of professional figures and internal personnel involved in the mentioned activities must be guaranteed, as for all other University workers. This investigation aimed to evaluate the chemical risk in three service laboratories of the University of Urbino, starting from the MoVaRisCh model and supporting it, where deemed appropriate, by environmental chemical monitoring. The final output of the MoVaRisCh model, in all cases, indicated a high-risk condition, while chemical monitoring did not reveal the presence of hazardous substances at values above the reference TWA, OEL, or STEL; indeed, in most cases, the concentrations were below the instrument's detection limit. The results obtained allow us to affirm that when the model predicts a risk that is too high for the type of activity carried out, as occurred in our service laboratories, environmental monitoring can be a useful tool for further investigation. Our final approach, in agreement with the employer, was not to select the most favourable information, but to inform workers of the results, illustrating the differences and explaining the methodologies used, reassuring them about the risks associated with the activities examined and taking adequate prevention measures.

L'esposizione a composti chimici in numerosi contesti professionali richiede una valutazione del rischio chimico che può rivelarsi un'attività complessa in determinati luoghi di lavoro, come i laboratori universitari di ricerca o di servizio, caratterizzati da esposizioni multiple ad agenti chimici, spesso a bassa concentrazione. L'obiettivo di questa indagine è stato quello di valutare il rischio chimico in 3 laboratori di servizio dell'Università di Urbino, partendo dal modello MoVaRisCh e supportandolo, ove ritenuto opportuno, con il monitoraggio chimico analitico. I risultati ottenuti mettono in luce le differenze tra i dati, dimostrando che il rischio era basso quando venivano utilizzate le misurazioni ed era elevato quando veniva utilizzato il modello MoVaRisCh (più conservativo). Il nostro approccio finale, in accordo con il datore di lavoro, non è stato quello di selezionare le informazioni più favorevoli, ma di informare i lavoratori dei risultati, illustrando le differenze e spiegando le metodologie utilizzate, con l'obiettivo di rassicurarli sui rischi associati alle attività esaminate, adottando adeguate misure di prevenzione. La sensibilizzazione dei lavoratori sui rischi resta la più importante tra le misure di prevenzione applicabili, poiché coinvolge direttamente gli utilizzatori, avvicinandoli ai problemi delle loro attività e proponendo soluzioni basate sui loro suggerimenti.

Keywords: Chemical agents; Methodological approach; Risk values

Introduction

The Italian government has adopted the European Regulations concerning the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH) [Regulation (EC) No.1907/2006] and the Classification, Labelling and Packaging (CLP) [Regulation (EC) No.1272/2008] of substances and mixtures. Moreover, in 2008, the Italian le-

gislation enacted a law regulating all actions involved in workers' health, safety and protection (Decree 81/2008) to guarantee protection, among all the other risks, those related to chemicals used at the workplaces [Legislative Decree 9 April 2008, n. 81].

Exposure to chemical compounds occurs in numerous occupational settings, but the chemical risk assessment can be a complex activity to carry on in particular workplaces, such as research or service university laboratories, characterized by multiple exposures to chemical agents, often at low concentration [Caporossi et al., 2015]. In addition, the perception of the chemical risk among the different professional profiles involved in the laboratory activities (from highly trained staff to doctoral researchers, undergraduates, and trainees) can be different [Al-Zyoud et al., 2019].

The university environment offers a wide typology of worker activities, one of which is represented by the so-called service laboratories. In this category, at Urbino University, are the restoration laboratories dealing with wooden artefacts as well as that involved in ancient canvases and contemporary art laboratory, characterized by the use of chemical agents such as thinners, paints and solvents. The activities carried out in these service laboratories, supported by the University of Urbino, are related to specific requests from private collectors, local museums or artistic assets of the University itself and/or thesis activities within the degree courses in the field of restoration. For this, the health and safety of the professional figures and the internal personnel involved in the mentioned activities, must be guaranteed, as for all other workers of the University.

As regards the assessment of occupational exposure to chemical agents for risk assessment purposes, the instrumental and analytical approach involves the use of environmental and/or biological monitoring to compare the results of the exposure assessment with the appropriate occupational exposure limits (OELs) or to conduct specific investigations. The above-mentioned approach remains the preferred choice for chemical risk assessment, as indicated by both Legislative Decree 81/2008 and the REACH Regulation, even if, in practice, the use of qualitative/semi-quantitative modelling approaches to risk assessment (index or numerical algorithms for risk estimation) is widespread [Mastrantonio et al., 2020; Spinazzè et al., 2020]. The models available for this purpose are different, such as MoVaRisCh, LaboRisCh, the ARPA/ISPRA algorithm or Datarisch inspired to the Control Banding [Strafella et al., 2008], and are extremely useful in the assessment of chemical risk in work environments, especially where many chemicals are used at low concentrations (as the university research laboratory). Specifically, MoVaRisCh, widely adopted within

the Italian regulatory framework to ensure compliance with Legislative Decree 81/08, operates through an algorithmic structure that quantifies risk (R) as the product of the intrinsic hazard of the agents (P) - derived from H-statements - and an exposure index (E) calculated based on operational conditions and physicochemical properties. This process results in a binary risk classification (irrelevant or non-irrelevant for health), essential for determining health surveillance and environmental monitoring obligations. In parallel, the Control Banding methodology complements this analysis with a pragmatic and prescriptive approach: rather than focusing only on numerical estimation, this method groups substances and operational scenarios into hazard and exposure “bands” to directly identify the required level of technical control. To summarize, MoVaRisCh provides the necessary rigor for regulatory risk characterization within the Risk Assessment Document, while Control Banding completes the framework by offering scalable engineering solutions - ranging from general ventilation to total containment - ensuring that safety management remains strictly proportionate to the toxicity and volatility of the handled agents [Strafella et al., 2008].

However, in service laboratories, which, due to the activities carried out, may be more similar to an artisanal laboratory, these models should be supported by analytical method (environmental monitoring) to confirm the risk estimate obtained with an algorithm. In this direction, this investigation aimed to evaluate the chemical risk in the service laboratories of the University of Urbino, starting from the MoVaRisCh model and supporting it, where deemed appropriate, by environmental chemical monitoring. From a methodological point of view, it is essential to differentiate the assessment of chemical risk for health and safety. In this work, only the chemical risk to health will be presented and discussed.

Materials and methods

Study design

The study was carried out in 3 service laboratories of Urbino University (Table 1). Before starting the data collection, preliminary inspections were conducted in the different workplaces to observe the tasks performed by each laboratory staff and inform them about the potential risks of chemical substances according to SDSs provided by the various manufacturers. The modality of data collection was also described to each Laboratory Responsible.

Table 1. Examined service laboratories (SL) of Urbino University (ID) and related information about the carried-out activities and quantity (n) of used chemical agents.

ID	Activities	Chemical agents (n)
SL 1	conservation and restoration of cultural heritage	80
SL 2	restoration of canvases and contemporary art artefacts	83
SL 3	conservation and restoration of ancient instruments	16

Data collection and chemical risk assessment

For the chemical risk assessment in service laboratories, we decide to use MoVaRisCh model (updated 2025), a tool applied for small and medium-sized enterprises. The

first step is the collection of data from each laboratory using the form (data sheet) presented in Figure 1, filled out by each Laboratory Responsible or supervisor.

Product/Chemical agent	Professional role	Daily exposure amount (in Kg/litres) per worker*	Exposure mode	Daily exposure time per worker*
	<input type="checkbox"/> warehouse worker	<input type="checkbox"/> <0.1	<input type="checkbox"/> with suction	<input type="checkbox"/> <15 min
	<input type="checkbox"/> colorist	<input type="checkbox"/> 0.1-1	<input type="checkbox"/> no suction	<input type="checkbox"/> 15 min-2 h
	<input type="checkbox"/> salesman/deliveries	<input type="checkbox"/> 1-10	<input type="checkbox"/> closed system (no contact/exposure)	<input type="checkbox"/> 2-4 h
	<input type="checkbox"/> teacher restorer	<input type="checkbox"/> 10-100	<input type="checkbox"/> with half-mask	<input type="checkbox"/> 4-6 h
	<input type="checkbox"/> student	<input type="checkbox"/> >100	<input type="checkbox"/> _____	<input type="checkbox"/> > 6 h
	<input type="checkbox"/> _____			

Figure 1. Data sheet used to collect data from service laboratories for chemical risk assessment by MoVaRisCh.

In this way, information regarding the type of used product/chemical agent, the professional role, the daily exposure as well as time and amount were available for MoVaRisCh method, based on a matrix algorithm, where the risk (R) is the result of the intrinsic hazard (P) of a substance or mixture multiplied by the exposure (E).

For hazard P, the tool considers the hazardous properties of the chemical agent for health (represented by the H sentences in section 2 of the related SDS) based on the assigned score; for exposure E, the model ranks and scores based on chemical type, duration of exposure, manipulation mode, used amount, efficacy of the preventive and protective measures. The risk R can be calculated separately for inhalation exposures ($R_{inhal} = P \times E_{inhal}$) as well as for dermal exposures ($R_{cute} = P \times E_{cute}$). In case the substance is absorbed by both of the above-mentioned ways, the risk R is cumulative (R_{cum}) and can be obtained by calculating the square root of the sum of the squares of R_{inhal} and R_{cute} :

$$R_{cum} = \sqrt{R_{inhal}^2 + R_{cute}^2}$$

The hazard index P and, therefore, the toxicological properties of a chemical agent are derived from the value designated to the H-statement of the most hazardous property. For the chemicals not considered dangerous for health, the model assigns a P score for non-dangerous chemicals that, in any case, are contained in a mixture, and at least one dangerous substance and/or non-dangerous chemicals having a specified OEL. In this way, a numerical hazard index is obtained (specifically a score, ranging from 1 to 10) for each chemical agent. This methodology does not consider the carcinogenic and mutagenic properties, which are not assigned a score.

As regards the inhalation exposure index (E_{inhal}), the value is the result of a Sub index I (Intensity of exposition) by a Sub index d (distance of the worker from the intensity source I):

$$E_{inhal} = I \times d$$

The Sub-index I is determined on the basis of five variables related to the accurate analysis of the technological cycle and the work activity with chemical agents: physicochemical properties, amount in use, type of use, type of control, time of exposure.

The physicochemical properties are distinguished in four types as follows: solid state/mists (large particle size spectrum), low volatile liquids (low vapour pressure), high and medium volatile liquids (high vapour pressure) or fine dust gaseous state. The amount in use refers to the quantity of chemical agent or preparation actually present and intended, in any way, for use in the workplace on a daily basis and five classes are identified: <0.1 Kg; 0.1-1 Kg; 1-10 Kg; 10-100 Kg; >100 Kg. With regard to the type of use, four levels, in ascending order, are recognized related to the potential atmospheric dispersion: use in closed system, use in inclusion matrix, controlled and non-dispersive, use with significant dispersion. The model identifies the measures that can be envisaged and implemented in order to avoid exposure to chemicals in the workplace. In order of decreasing effectiveness, are reported: complete containment; ventilation – local exhaust ventilation (LEV); segregation – separation; dilution – ventilation; direct manipulation (with individual protection systems). As regards the time of exposure, five intervals are identified: lower than 15 minutes; between

15 minutes and two hours; between two hours and four hours; between four and six hours; more than six hours. Lastly, the sub-index “d” takes into account the distance between a source of intensity “I” and the exposed worker/workers in meters: from less than 1 meter, from 3 to 5 meters, from 5 to 10 meters, and greater than or equal to 10 meters.

The final output of the algorithm is a classification of the risk values (R) as irrelevant for the health (green zone), uncertainty zone (yellow), not irrelevant for health, high-risk area, serious risk area (red zone). For each risk area, prevention and protection measures are foreseen to be implemented (Table 2). According to the provisions of Paragraph 3 of Article 223 of Legislative Decree no. 81/2008, in the case of work activities involving exposure to multiple dangerous chemical agents, the risks are assessed on the basis of the risk posed by the combination of all the aforementioned chemical agents (i.e., the chemical agent with the highest P value is considered among all the substances used).

Table 2. Criteria for risk assessment from hazardous chemical agents (MoVaRisCh).

Risk values	Classification	Zone	Measures
$0.1 \leq R < 15$	Irrelevant health risk	Green	Consult the Occupational Physician in any case.
$15 \leq R < 21$	Uncertainty range	Orange	Review the scores assigned and the prevention and protection measures adopted; consult the Occupational Physician.
$21 \leq R \leq 40$	Risk greater than the irrelevant chemical risk to health	Dark Orange	Apply articles 225, 226, 229 and 230 of Legislative Decree 81/08.
$40 < R \leq 80$	High risk area	Red	Implement prevention and protection measures; intensify health surveillance; carry out environmental monitoring.
$R > 80$	Severe risk area		

Environmental monitoring

On the basis of the R values obtained by MoVaRisCh method, the SL 1 was selected as representative workplace for the assessment of workplace air quality by sampling and analysis of volatile organic compounds (VOCs) using chemical personal monitoring (ISO 16200:2:2000). Among the various working activities with hazardous chemical agents carried out in SL 1, the measures considering the following working conditions:

- gelled emulsion with isooctane plus isooctane wash

(total processing time 60 min);

- gelled emulsion with isooctane plus white spirit wash (total processing time 60 min);
- gelled emulsion with isooctane and benzyl alcohol plus white spirit wash (total processing time 30 min).

As regards the environmental conditions during the monitoring in SL 1, this laboratory was well ventilated and equipped with mobile extraction systems, with a relative

humidity of 50 %, a pressure of 946 hPa and a temperature of 20°C. The personal monitoring, following the ISO 16200-2:2000, was carried out with a diffusive sampler for collecting air during the described working conditions. The sampling was carried out using a “radiello” that is a cartridge of 5.8 mm diameter made of stainless-steel mesh filled with 530±30 mg of activated carbon with a grain size of 35-50 mesh. It was attached to a selected participant clothing during the measurement period within 30 cm of the nose and mouth. The rate of sampling is determined by prior calibration in a standard atmosphere. The volatile organic compounds released in the air during each working activity migrate into the sampler by diffusion and are adsorbed by the activated charcoal cartridge inside. Thereafter, samplers were transferred to the laboratory, and the collected vapors were desorbed by a solvent, typi-

cally carbon disulfide, and each solution was analyzed with a capillary gas chromatograph GC-MS Agilent 7890-5975C with an FID detector (Agilent Technologies Italia S.p.A., Cernusco sul Naviglio, Milano, Italy).

Results

In the present investigation, the risk values identified for the three examined service laboratories (SL 1, SL 2 and SL 3) are summarized in Table 3. As observed, in all the cases, the final output is in the red zone (high-risk area), a situation that must be managed with great care by the employer, following the indication of Legislative Decree 81/08 (Table 2). It can be said that these results are related to the substance/chemical with the highest P-value, because the applied method bases the final out-put on this data.

Table 3. Results of the semiquantitative assessment of risk values of each service laboratory (SL) obtained by MoVaRisCh model.

Laboratory	Risk Value	Classification	Substance with the highest P value	Hazard Statements
SL 1	78.30	High risk area	Thinner 372 (Gustav Berger's O.F. 371)	H225, H361d, H304, H373, H315, H336, H411
SL 2	78.30	High risk area		
SL 3	52.20	High risk area	Ligroin	H225, H340, H350, H304

In detail, for SL 1 the reported risk value of 78.30 is that of Thinner 372 (Gustav Berger's O.F. 371), but analyzing the risk values of all the substances used in this laboratory (Figure 2), we can observe that 22.5% of the chemicals are in the green zone ($0.1 \leq R < 15$, risk irrelevant),

15% in the orange zone ($15 \leq R < 21$, uncertainty range), 43.75% in the dark orange ($21 \leq R \leq 40$, risk greater than the irrelevant chemical risk to health) and only 18.75% in the red zone ($40 < R \leq 80$, high-risk area).

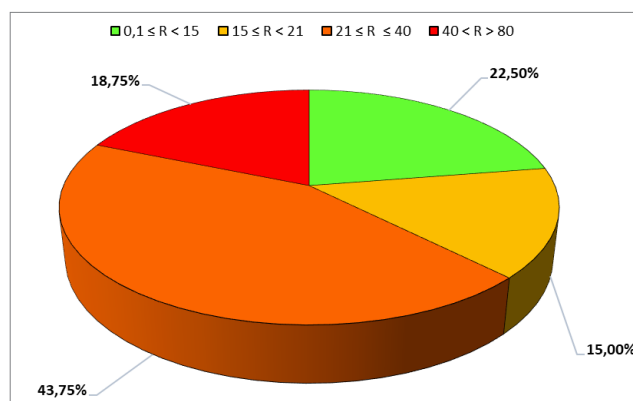


Figure 2. Risk values (R), expressed in percentage, assigned to the chemical agents (80 in total) used in the laboratory SL 1 obtained with MoVaRisCh (four groups with different R, ranging from 0.1 to > 80, are identified by this model).

Analogously, SL 2, showing the same risk value of 78.30 of Thinner 372 Gustav Berger's O.F. 371, has a quite similar distribution of the used chemicals (Figure 3): 16.87% in the green zone ($0.1 \leq R < 15$, risk irrelevant), 19.27% in the orange zone ($15 \leq R < 21$, uncertainty range), 45.78% in the dark orange zone ($21 \leq R \leq 40$, risk greater than the irrelevant chemical risk to health) and only 18.07% in the red zone ($40 < R \leq 80$, high-risk area).

in the orange zone ($15 \leq R < 21$, uncertainty range), 45.78% in the dark orange ($21 \leq R \leq 40$, risk greater than the irrelevant chemical risk to health) and only 18.07% in the red zone ($40 < R \leq 80$, high-risk area).

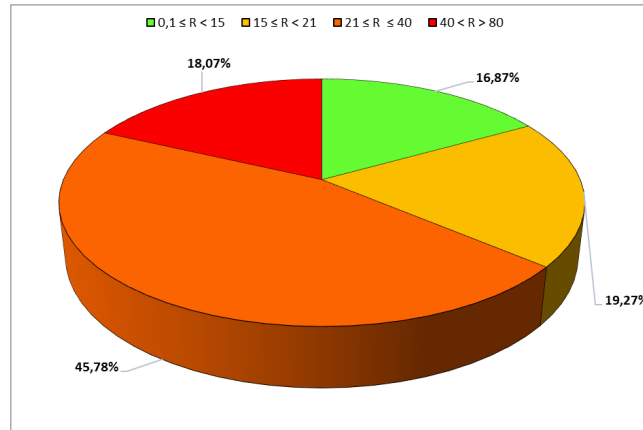


Figure 3. Risk values (R), expressed in percentage, assigned to the chemical agents (83 in total) used in the laboratory SL 2 obtained with MoVaRisCh (four groups with different R, ranging from 0.1 to > 80, are identified by this model).

In the case of SL 3, the risk value is 52.20 (that of Ligroin) and the distribution of the chemicals is very different from the other two laboratories (Figure 4): 56.25% in the green zone ($0.1 \leq R < 15$, risk irrelevant), 6.25% in the orange zone ($15 \leq R < 21$, uncertainty range), 31.25% in the dark orange ($21 \leq R \leq 40$, risk greater than the

irrelevant chemical risk to health) and 6.25% in the red zone ($40 < R \leq 80$, high-risk area). However, the final output was the same for all the examined service laboratories, regardless of the types or the number of chemicals used (really, one very hazardous chemical is sufficient to obtain a very high-risk value).

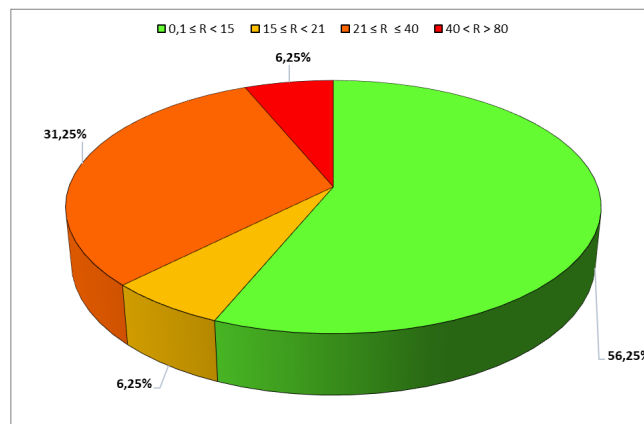


Figure 4. Risk values (R), expressed in percentage, assigned to the chemical agents (16 in total) used in the laboratory SL 3 obtained with MoVaRisCh (four groups with different R, ranging from 0.1 to > 80, are identified by this model).

Based on these results, the first action by the prevention office would be to recommend replacing the product/s in the aforementioned laboratories with a less dangerous one. However, having heard the opinion of the users of such substances, in particular of Thinner 372 Gustav Berger's O.F. 371 and according to the purpose of the study, the employer agreed to carry out environmental monitoring in SL 1 (as indicative workplace) to obtain analytical

data and, if necessary, proceed with appropriate preventive measures.

The results relating to environmental chemical monitoring are presented in Table 4. As shown, for each substance detected by gas chromatography, the corresponding OELs available from the American Conference of Governmental Industrial Hygienists (ACGIH) and/or European

Chemical Agency (ECHA) are listed. OELs are reference values for concentrations of chemicals in workplace air, below which most workers can be repeatedly exposed without adverse health effects. In our case, chemical monitoring did not reveal the presence of hazardous substances at values above the Time-Weighted Average (TWA), OEL, or Short-Term Exposure Limit (STEL); inde-

ed, in most cases, the concentrations were below the detection limit of the instrument (0.00001 mg), suggesting that the presence in the air during the examined activities was very low. The only chemical agent recovered and quantified was isooctane at a concentration of 49.55 mg/m³, still lower than that indicated as TWA (300 mg/m³) by ACGIH.

Table 4. Result of the personal environmental monitoring in SL 1 (ISO 16200-2:2000) with the related available reference values (from ACGIH and/or ECHA) of each revealed substance. All data are expressed as mg/m³.

Substance	Value	ACGIH		ECHA*	
		TWA	STEL	EU-OEL	STEL
Isooctane	49.55	300	/	/	/
Benzyl alcohol	< 0.01	44.2	88.4	/	/
1,1,1,2-tetrachloroethane	< 0.22	/	/	/	/
1,1,1 Trichloroethane	< 0.22	1909	2455	555	1110
1,2,4-trimethylbenzene	< 0.01	/	/	100	/
1-Methoxy-2-propyl acetate	< 0.01	275	550	275	550
2-Butoxyethanol	< 0.01	98	246	98	246
Acetone	< 0.01	594	1187	1210	/
n-butyl alcohol	< 0.01	61	/	61	/
Ethyl alcohol	< 0.01	1880	1880	1880	1880
Isobutyl alcohol	< 0.01	152	/	/	/
Isopropyl alcohol	< 0.01	492	983	492	983
Methyl alcohol	< 0.01	260	327	260	/
N-butyl alcohol	< 0.01	75	/	75	/
Benzene	< 0.01	3.25	/	1.65	/
Bromobenzene	< 0.25	/	/	/	/
Butyl acetate	< 0.01	238	712	241	712
Cyclohexane	< 0.01	350	1050	700	/
Cyclohexanone	< 0.01	80	220	40.8	81.6
Dichloropropane	< 0.01	46	/	46.22	/
Ethylbenzene	< 0.01	86.87	/	442	884
Ethyl acetate	< 0.01	1441	/	734	1468
Isobutyl acetate	< 0.01	238	712	241	723
Mesitylene	< 0.01	/	/	100	/
Methyl ethyl ketone	< 0.01	221	442	600	900
Methyl isobutyl ketone	< 0.01	82	307	83	208
n-Butylbenzene	< 0.01	/	/	/	/
sec-Butyl acetate	< 0.01	283	712	241	723
Styrene	< 0.01	42.62	85.24	/	/
Toluene	< 0.01	75.34	/	192	384
Xylenes	< 0.01	86.87	/	221	442
Diacetone alcohol	< 0.01	47.53	/	237	/

*Data from International Labour Organization (ILO).

Discussion

Risk assessment often involves steady-state models (such as MoVaRisCh), whereas monitoring methods must necessarily be related to the specific location and time of collection and, therefore, may be part of a dynamic data set. For this, it's fundamental to carry on the monitoring measures in an appropriate context, evaluating some parameters such as the working conditions and the processes utilized by the workers [Duarte et al., 2014].

In the examined workplaces, identified as service laboratories and characterized by peculiar work activities, a first-level assessment using the MoVaRisCh method algorithm is useful to qualify the risk level and define prevention and remediation measures. The application of a model cannot replace the environmental measurement of the chemical agent, but it can be useful in allowing the selection of those for which further assessment is justified. It is important to underline that MoVaRisCh does not take into account the carcinogenicity and mutagenicity properties, and, for this reason, the determination of the E index requires a careful analysis of the work activities, the technological cycle used and the values assigned to the different parameters. In any case, the analysis represents a conservative approach, which, in case of uncertainty, favours the conditions that entail a more burden some situation for the worker (and consequently a greater protection in terms of applied measures). It can be noted that the operators are formed and informed on the risks related to carcinogens and mutagens, the operative measures to be applied (such as handling them under a chemical hood) and are subjected to health surveillance.

In the present investigation, the obtained results from MoVaRisCh placed all the three service laboratories in the red zone (high risk area) (Table 2), and, as a consequence, prevention and protection measures should be implemented to guarantee the safety of workers' health, as indicated by the relevant normative. However, data analysis clearly shows that this ranking is closely linked to a single substance for each laboratory (Table 3). Considering the low quantities indicated by users during the data collection (data not shown), the results appear very conservative but not entirely realistic, as they are based on risk estimation and not on analytical data. These results should be considered for the application of prevention measures; however, in this specific context (service laboratories), it was decided to verify the actual quantity of chemicals released during work activities through personal environmental monitoring (a measure already indicated by MoVarRisCh in the red zone).

In terms of air quality, the presence of volatile organic compounds (VOCs) represents a health concern in indoor, outdoor and occupational environments [Bolden et al., 2015; Mitchell et al., 2007]. Risk assessment of VOCs requires representative exposure measurements, which are generally achieved by large sample sizes and frequent and long-term sampling [Sampling Strategies for Volatile Organic Compounds (VOCs) in Indoor Air [(Report EUR 16051 EN), 1995]. Among workplaces, laboratories tend to subject workers to a greater risk of VOC emissions due to the manipulation of chemical agents. However, whilst numerous research works have been performed on indoor air quality monitoring in several workplaces [Caro and Gallego 2009; Lolli et al., 2022; Pitarma et al., 2017], less attention has been paid to research centers and laboratories [Davardoost and Kahforoushan 2018; Li et al., 2021]. In this direction, our data can be useful to improve the information related to laboratory chemical risk assessment obtained with a specific tool of estimation system, such as MoVaRisCh [Caporossi et al., 2015; Vecchi et al., 2024]. In our case, the results of the MoVaRisCh assessment are inconsistent with those obtained through environmental monitoring. Indeed, the former places SL 1 in the high-risk range, while the latter places it in a safe zone, demonstrating that the amount of hazardous substances actually present in the air is very low. For employers and the Prevention and Protection Service, these findings have very different implications, both operationally and legislatively (Table 2). Indeed, according to the MoVaRisCh assessment, the application of a series of measures is necessary (implementation of prevention and protection measures, or intensification of health surveillance), while based on analytical data from environmental monitoring, the measures to be implemented are minimal or even nonexistent. Differences in the results obtained by models and measurements are reported by Landberg and colleagues, who compared the risk assessment using different tools, including environmental monitoring. Correctly, their conclusions evinced the problems connected to this evaluation, on one hand, expensive unnecessary installations of control measures, on the other, an underestimation of risks. Our approach, in agreement with the employer, was not to ignore the information obtained by selecting the most favourable ones, but to inform workers, through face-to-face meetings, of the results obtained, illustrating the differences and explaining the methodologies used, with the aim of reassuring them about the risks associated with the activities examined, acting the ade-

quate prevention measures (such as the replacing the hazardous product/s with a less dangerous one, the use of personal protection equipment and/or collective protection devices, and so on). Raising workers' awareness of the risks still remains the most important of the applicable prevention measures, as it directly involves users, bringing them closer to the problems of their activities and proposing solutions based on their suggestions.

Conclusions

Risk assessments in workplaces are needed to protect workers' health and safety. Several different strategies are available and can be used for risk assessments. In our case, we decided to carry out the chemical risk assessment in the so-called laboratory service of Urbino University both by models and environmental measures. The obtained results evidenced that the risk was low when measurements were used and was high when the model MoVaRisCh was used (more conservative). From our experience, we can state that when the model predicts a risk that is too high for the type of activity performed,

as happened in our service laboratories, environmental monitoring is a useful tool for better understanding the situation in the examined workplace, thus addressing the most adequate protection measures.

Study limitations

We aware that the data presented refer to one of the three service laboratories under consideration. However, this experience offers interesting insights into the use of an analytical system in supporting, but not replacing, a predictive model such as MoVaRisCh, mostly in specific working activities. In this direction, increasing the number of workplaces to be examined can represent a future goal for the representativeness of the results.

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