

Observation

## RESULTS OF CLINICAL-TOXICOLOGICAL ASSESSMENTS PERFORMED IN THE POISON CONTROL CENTRE IN ZAGREB OVER A 10-YEAR PERIOD

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The aim of this study was to see which harmful substances and which occupational settings most often required toxicological assessment, to evaluate exposure data provided by employers and to see to what extent could this assessment rely on actual measurements of harmful substances in a working environment. We reviewed the documentation that was submitted for toxicological assessment in all patients referred from occupational health physicians between 1992 and 2001. From 1992 to 2001, the Poison Control Centre performed a total of 260 toxicological evaluations of occupational exposure to harmful chemicals. In 162 cases (62 %), measurements of harmful substance concentrations in the working environment would have been of primary significance for the best comparison of potential adverse effects and the level of exposure. The most frequent was exposure to organic solvents in the production line and the use of various paints and varnishes, adhesives and thinners in shoe, chemical and metal-processing industry. Follows exposure to respiratory irritants, mostly in plastic and metal processing. However, measurement data of harmful substances in the working environment were available only in 24 cases, that is, in 9 % of all documents submitted for toxicological assessment. Exposure to organic solvents is characteristic for a large number of work places in industry and small enterprises in Croatia, and it is necessary to carry out a more comprehensive study about the real levels of exposure and modes of effective control. It is important because the EU regulations on the indicative occupational exposure limits (OELs) of harmful substances in the working environment, that will soon be implemented into Croatian legislation, recommend a reduction of maximum allowable concentrations (MAC) for commonly used solvents.

**KEY WORDS:** *maximum allowable concentration, occupational exposure, organic solvents*

Measurement of air contaminants at work is one of the most important procedures in the evaluation of exposure to harmful agents in the working environment as the basis for health protection of workers (1). Consequently, the starting premise is that a safe concentration limit of a harmful agent could be reliably established, below which no adverse health effects are expected. This limit is defined as the maximum allowable concentration (MAC). In 1993, regulations establishing MAC values for 868 harmful agents and biological exposure indices (BEI) for 38

harmful agents came into force in Croatia, and have not been updated ever since (2). Data on exposure to harmful chemicals at work are essential for any occupational physician to be able to reasonably diagnose an occupational disease. One of our interests was to determine the quality of work exposure data for patients referred to the Outpatient Department for Occupational Health of the Institute for Medical Research and Occupational Health in Zagreb, Croatia. The Poison Control Centre (PCC) was requested to perform clinical-toxicological assessment of toxic

effects and of occupational exposure to chemicals for individual patients. The PCC of the Institute for Medical Research and Occupational Health in Zagreb is the only toxicological information centre in Croatia providing a 24-hours telephone information service.

The aim of this study was to see which harmful substances and occupational settings most often required toxicological assessment, to evaluate exposure data provided by employers and to see to what extent this assessment could rely on actual measurements of contaminants in a working environment. We reviewed documentation submitted for toxicological assessment in all patients referred by occupational physicians to the PCC between 1992 and 2001.

## RESULTS

From 1992 to 2001, PCC performed a total of 260 assessments of occupational exposure to harmful chemicals. Each assessment included considerations, whose aim was to see whether a correlation between symptoms and toxic exposure required a measurement of toxicant air concentrations or the working diagnosis of an occupational physician and data on the toxic effects of chemical agents involved were sufficient.

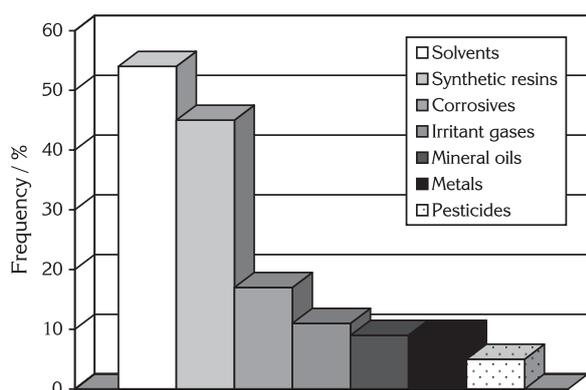
For example, critical factors for developing contact dermatitis are the type, duration and intensity of skin contact with a harmful substance, and the causal agent need not be an airborne contaminant at work, because the disease is caused by direct contact of a harmful agent with the skin. In contrast, air concentration of irritant gases and vapours in the working environment is directly connected with the development of irritation symptoms on the respiratory system and eyes. In 162 cases (62 %), measurements of harmful substance concentrations in the working environment would have been of primary significance for the best comparison of potential adverse effects and the level of exposure. However, data on the level of occupational exposure to airborne harmful agents were available only in 9 % of documents submitted for toxicological assessment, i.e. for only 24 individual patients.

Among 260 analysed cases, the most common exposure was to organic solvents (54 %) and synthetic resins (45 %) used in products such as adhesives, paints, varnishes and thinners, followed by corrosives (17 %), irritant gases (11 %), mineral oils (9 %), metals (9 %) and pesticides (5 %) (Figure 1).

The assessment of exposure at individual workplaces revealed a characteristic overall presence of solvents with the highest proportion in shoe,

**Table 1** Exposure of patients to harmful agents at workplace in most common industries (N=209)

Workplace	Total number of cases	Number of cases (n) exposed to						
		Organic solvent n (%)	Resins n (%)	Corrosives n (%)	Irritant gases n (%)	Mineral oils n (%)	Metals n (%)	Pesticides n (%)
Metal processing	54	24 (44)	21 (39)	7 (13)	9 (17)	22 (40)	20 (37)	-
Shoe manufacture	32	32 (100)	30 (93)	-	-	-	-	-
Production of plastic	20	10 (50)	19 (95)	1 (5)	4 (20)	1 (5)	1 (5)	-
Wood processing	20	13 (65)	12 (60)	-	-	1 (5)	1 (5)	-
Paint and varnishes industry	19	18 (95)	11 (58)	-	1 (5)	-	-	-
Chemical laboratories	15	13 (87)	-	12(60)	1 (7)	-	-	2 (13)
Textile industry	14	5 (35)	6 (42)	9 (64)	-	-	-	-
Pharmaceutical industry	13	9 (70)	-	7 (54)	4 (30)	-	-	-
Agriculture and food processing	12	-	-	5 (41)	-	-	-	10 (83)
Manufacture of electric equipment	10	4 (40)	9 (90)	-	-	-	-	-



**Figure 1** Harmful substances most frequently submitted for clinical-toxicological assessment (N=260)

chemical, wood and metal processing industry. Exposure to respiratory irritants was most frequent in the production of plastic, pharmaceuticals and again in metal processing (Table 1).

The analysis of actual measurements of air contaminants in the working environment available for 24 patients showed that exposure exceeded MAC values set by the Croatian regulations in 11 (45.8 %) cases, whereas in respect to the European indicative exposure limits, there were 16 (66.7 %) cases of excessive exposure. The MAC values were exceeded for the following agents: benzene, xylene, toluene, styrene, buthyl acetate, phenol, mineral oils, nitrogen oxides, and carbon dioxide. The OEL values were additionally exceeded for acetone, ethyl acetate, cyclohexanone, and ammonia.

## DISCUSSION AND CONCLUSION

Within the process of joining the European Union (EU), Croatia must adopt EU directives and regulations which include protection and safety at work and occupational health. Protection from chemical agents at workplace has been regulated by several EU Directives and by-laws, the most important of which is the Council Directive 98/24/EC on the protection of health and safety of workers from the risk related to chemical agents and Commission Directive 2000/39/EC, establishing the first list of indicative occupational exposure limit values (OELs) (3, 4). Although OELs are presently established only for a limited number of chemicals, the adoption of this Directive in Croatia would lead to a significant reduction in MAC values presently in force as well as in short-term allowable concentrations (STAC) for a number of organic solvents and irritant gases (Table 2).

**Table 2** Croatian maximum allowable concentrations (MAC) and short-term allowable concentration (STAC) values for harmful agents at work in comparison with the indicative occupational exposure limit values (OELs) and short-term limit values (STELs) set by the European Commission Directive 2000/39/EC

Agent	MAC STAC		OELs STELs	
	mg/m <sup>3</sup>		mg/m <sup>3</sup>	
Acetone	1780	2400	1210	
Ammonia	18	27	14	36
Benzene	15		3	
Cyclohexanone	100		40.8	81.6
Ethylene glycol	125		52	104
Phenol	19		7.8	
Hydrogen fluoride	2	5	1.5	2.5
n-Hexane	180		72	
Chloroform	50		10	
o-Xylene	440	655	221	442
1,1,1-Trichlorethane	1080	2450	555	1110

The process of setting MAC values can be divided into several stages. The first is scientific evaluation of data on toxic effects and exposure to potentially harmful agents. This evaluation is followed by risk assessment, with the purpose of determining critical harmful effects, dose-response relationship, and of reviewing the available methods of measurements, their reliability and practical implementation. The second stage includes cost-benefit analysis, i.e. comparison of cost and gains (not only according to economic, but also public health and social welfare criteria). Finally, technological and economical feasibility criteria are taken into consideration and the analysis of consequences is discussed. However, this process has not been implemented in Croatia, and there is no systematic collection of data or a database on occupational exposure of workers to harmful chemical in this country.

This study shows that exposure to organic solvents is typical for a number of workplaces in Croatian industry. Consequently, we may expect difficulties in the implementation of EU regulations that recommend further reduction of occupational MAC values, and it would be useful to carry out more comprehensive study about the actual levels of exposure and the feasibility of their control. Occupational health physicians are usually given incomplete data on the levels of contamination of a working environment, which makes exposure assessment and diagnosis of an occupational disease problematic.

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**Sažetak****PRIKAZ KLINIČKO-TOKSIKOLOŠKIH MIŠLJENJA IZRAĐENIH U CENTRU ZA KONTROLU OTROVANJA U ZAGREBU U 10-GODIŠNJEM RAZDOBLJU**

Cilj rada bio je utvrditi za koje se štetne tvari i u kojim radnim uvjetima najčešće tražilo kliničko-toksikološko ispitivanje, kakvi su bili podaci o izloženosti dobiveni od poslodavca te dostupnost rezultata ispitivanja štetnosti u radnom okolišu. Pregledana je dokumentacija za izradu kliničko-toksikoloških mišljenja za sve pacijente upućene od liječnika medicine rada u desetgodišnjem razdoblju od 1992. do 2001. godine. U navedenom razdoblju u Centru za kontrolu otrovanja izrađeno je ukupno 260 kliničko-toksikoloških mišljenja za procjenu izloženosti štetnim kemijskim tvarima iz radnog okoliša. U 62 % slučajeva podaci o izvršenim mjerenjima koncentracije štetnih tvari u radnom okolišu bili bi od prvorazrednog značenja za adekvatnu usporedbu potencijalno štetnog učinka i razine izloženosti. Većinom se radilo o izloženosti organskim otapalima tijekom proizvodnje ili uporabe različitih boja, lakova, ljepila i razrjeđivača i to najviše u obućarskoj, kemijskoj i metaloprerađivačkoj proizvodnji. Na drugom je mjestu izloženost nadražljivcima dišnih puteva najviše u proizvodnji i preradi plastičnih masa i obradi metala. Međutim, podaci o štetnostima u radnoj atmosferi bili su dostupni samo u 24 slučaja odnosno u svega 9 % od svih priloženih dokumentacija za izradu toksikološkog mišljenja. Utvrđeno je da je izloženost organskim otapalima karakteristična za veliki broj radnih mjesta u industriji i maloj privredi u Hrvatskoj te je potrebno korisno provesti cjelovitije ispitivanje o stvarnim razinama izloženosti i mogućnostima njihove kontrole. To je posebno važno jer europske norme, koje će se uskoro biti ugrađene u hrvatsko zakonodavstvo, preporučaju dalje sniženje maksimalno dopustivih koncentracija (MDK) za često korištena otapala.

**KLJUČNE RIJEČI:** *maksimalno dopustive koncentracije, organska otapala, profesionalna izloženost*

## REQUESTS FOR REPRINTS:

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