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CONSIDERATIONS REGARDING THE DEVELOPMENT OF USEFUL TOOLS FOR MANAGING CHEMICAL RISKS

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Abstract

Databases on the exposure of workers to dangerous chemical agents are an important tool for assessing and managing chemical risk but also for recognizing occupational diseases caused by exposure to hazardous chemicals. Both the European Union (EU) authorities and European trade unions have recognized the need for some databases containing as much information as possible on the type and timing of exposure of workers to dangerous chemical agents. In Europe there are only a few databases for chemical agents in the work environment, but a set of centralized data at EU level is needed to establish strategies and measures for managing chemical risks in Europe. The HazChem@Work project has been designed to centralize the most important information on exposure of workers to chemical agents in order to apply health and safety requirements to work and to manage chemical risk at work.

Key words: chemical agents, database, work environment

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1. Introduction

The most substances used at work have harmful effects on health of workers, and other people who may be exposed accidentally. Therefore, it is very important to properly monitor exposures and centralizing the data obtained to track the effect over time of these exposures on the health and safety of exposed workers (Amponsah-Tawaih and Appiah Adu, 2016; London and Kisting, 2017).

In most cases, chemicals enter the workers' bodies by inhalation and less frequently through the skin or by accidental ingestion. The monitoring of exposure to hazardous substances in the work environment should be done by competent persons with experience in occupational hygiene, who can understand the technological process, the type of exposure, but also the short-term or long-term effects on human health (Asante-Duah, 2017; Ashley, 2010; Reason, 2016).

Dangerous substances can be found in many different situations and can be ignored by untrained people in this area. For example, particulate matters (PM) have effects on human health. The exposure time, inhaled dose and chemical constituents carried by PM can influence this effect (Călămar et al., 2017; Ken et al., 2017; Oprea et al., 2017). Despite the existence of legislation on the protection of workers, data on exposure to hazardous chemicals in the work environment are not available, making prioritization of risk prevention and management and recognition of occupational diseases is much more difficult (Choi et al., 2018; Lee et al., 2012).

The HazChem@Work project has been designed to centralize the most important information on exposure of workers to chemical agents in order to

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apply health and safety requirements to work and to manage chemical risk at work (EC, 2016). It is known that, the risk workplace assessments allow eliminate the risk factors by: adequate working conditions, limited risk exposure, proper personal safety equipment, medical survey, ergonomic design of workplace (Antonov et al., 2017; Bejinariu et al., 2017; Hillson and Murray-Webster, 2017; Panainte-Lehadus et al., 2016). When there is no any possibility to eliminate the risks, it is mandatory to reduce it up to the level of residual risks, which must be adequately controlled to ensure healthy workplaces for all workers (Catano and Morrow Hines, 2016; Darabont et al., 2018; Oakmana and Chan, 2015; Vasilescu et al., 2016). The results of these analyses could also be used to inform, instruct, and prepare the population to act adequately in case of accidents (Felegeanu et al., 2016) or, for development of an integrated fire detection (Filizzola et al., 2017; Moraru et al., 2017).

2. Material and methods

Chemistry databases are the result of laborious work involving many chemists, IT specialists, or sociologists specialized in data collection. In the HazChem@Work project, funded by the European Commission, the consortium of specialists from two institutes with OSH (occupational safety and health) experience created a pilot data base to collect data on the exposure of workers to hazardous chemicals.

The first step was to identify the available data sources and updated data on occupational exposure to chemicals in order to establish an overview of the available data sources and up-to-date data on occupational exposure to chemicals in the EU and the EFTA / EEA countries.

To obtain an overview of the available data sources and to facilitate the collection of information from different actors and / or sources of information, a questionnaire was developed, posted on the project website (http://www.hazchematwork.eu). The aim was to get a more detailed description of available data and organizational, technical and legal conditions. The data were collected using a structured template in six sections: chemical identification; exposure and contextual data; production and use of chemicals at national and European level; data on diseases and adverse effects; sector and occupation; general information.

A number of 130 database sources for investigation were identified and contacted. For the survey, a letter from the consortium members and a support letter from Directorate-General (DG) Employment were used to motivate the data providers to get involved in the project. The survey addressed among others questions concerning the content of the database (substances, substance groups, mixtures), questions concerning data on production, use of chemicals, disease data and adverse effects as well as questions concerning reasons for data collection and obstacles to generate/collect exposure data and constraints to use the data.

The data sources used for the initial set of chemicals included REACH (Regulation for Registration, Evaluation, Authorisation and Restriction of Chemicals) registered substances (available on ECHA-European Chemicals Agency site) and data from projects like CAREX (International Information System on Occupational Exposure to Carcinogens). Some criteria regarding the selection of substances were given. These include:

- Substances with a high exposure potential due to typical working tasks;
- Substances known to be linked to occupational diseases;
- Substances with CMR (carcinogenic, mutagenic, reprotoxic) properties according to Annex VI of regulation EC No 1272/2008 (CLP regulation);
- Substances considered to be of an equivalent level of concern to human health according to Article 57f of REACH regulation;
- Dermal and respiratory sensitizers;
- Substances produced or used in very large amounts;
- Substances with a large number of different uses.

This resulted in the first list of 500 dangerous substances. A further filtering in three steps was proposed. The first two steps both use a scoring system to rank the substances. Both scoring systems use the following broad categories: exposure potential, nature of the hazard to human health and assumed consumption. The difference between the first and second step was the level of detail of the scoring criteria. The third selection step used as criterion the availability of exposure data for the remaining substances. Thus, it is ensured that the database will contain a substantial amount of exposure data and not too many “exotic substances” with very little exposure information.

The categories were chosen for maximizing the likelihood of being relevant with regard to occupational safety and health and the availability of measurement data:

- A high potential for exposure to a substance leads to higher ranking in terms of relevance to occupational safety and health.
- Similarly, a substance which is classified more hazardous will also be more relevant for OSH in terms of the level of concern.
- Substances which are produced or used in very large amounts might be used by a large number of workers if the use patterns are other than mere industrial uses/uses as intermediates. Therefore, it is more likely that measurement data exist for such substances even if the risks linked to such usages might be relatively low. Another category is the existence of occupational exposure limits (OEL) for the substance. A substance for which such an OEL exists has previously been targeted by some kind of OSH regulation, thus increasing its relevance. In the course of the first scoring step, Binding Occupational Exposure Limit Values (BOELV) or Indicative Occupational Exposure Limit Values (IOELV) can be considered as well to ensure not to miss such agents.

The score from each category is combined to obtain the final score for each substance. Finally, a list of 11 substances with the highest score was selected for development of a model for estimating prevalence and level of occupational exposures (Table 1).

3. Results and discussions

During the survey 29 exposure data sources (72.5%), 6 productions and use data sources (15%) and 5 disease data sources (12.5%) have been identified (Fig. 1). The inquiry addressed inter alia questions on the content of the database (substances, exposure, production, use of chemicals, diseases) as well as questions about the reasons for data collection and obstacles to generation / collection of exposure data and data usage constraints. The main reasons for data collection were notification of exposure due to legal requirements, regular compliance monitoring, post-communitarian control and accident, disease notifications.

Other reasons accounted for almost half (47%) (Fig. 2). Data collection was supported by IT applications for data mining and extraction from existing databases. The pilot database contains 1397 data for 204 substances. Data were delivered by the following countries: Slovakia, Germany, Poland, Romania, Hungary and Croatia.

Table 1. Proposed substances for the testing

Substance Name	***Reason for inclusion***
Respiratory Crystalline Silica (RSC)	Very wide exposure population
Asbestos	Legacy substance
Formaldehyde	Use restricted to some well-defined sectors
Wood dust	Wide exposure population
Benzene	Broad use, dermal contact
Chromium and compounds	Broad use in industry
Cadmium and compounds	Specific use
Nickel and compounds	Specific use in industry, wide use in welding
Cobalt and compounds	Specific use
Isocyanates	Highly sensitising, broad open and manual use
Acrylamide	Highly sensitising, broad open and manual use

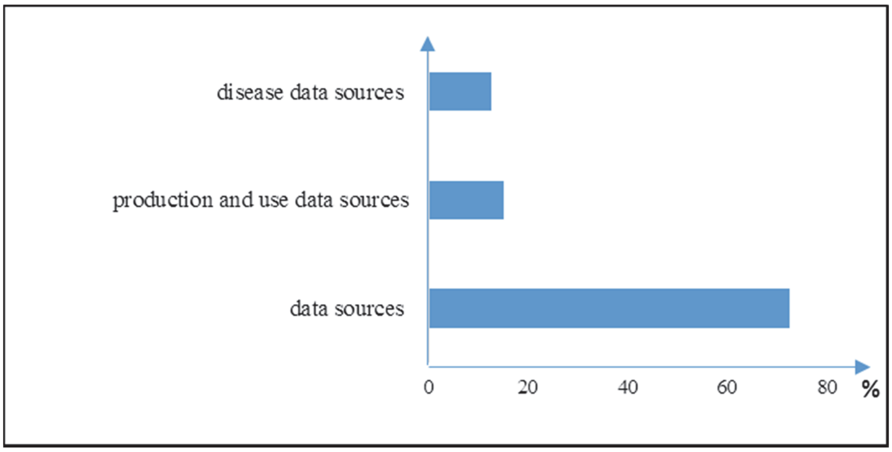

Fig. 1. Type of data sources

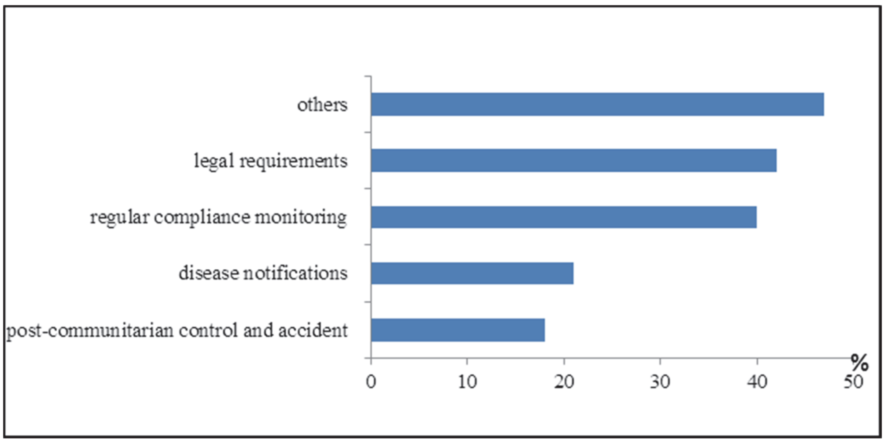

Fig. 2. The main reasons for data collection

The following observations were made during the testing phase:

- Owners of the database are very cautious to provide data. Legal constraints based on property rights are the main obstacle;
- There is a wide variety of data collections in the EU Member States: there are differences in the type of data and how it is presented; not all data were adequate.

Few of the priority substances were monitored by the participants; suppliers seem to have more data on other substances. In order to have more data, substances other than priority substances were accepted. Exposure reports were also used, adjusting the template to accommodate aggregate data.

4. Case study

Three databases have been collected from Romania: database on work accidents at national level, database on occupational diseases at national level and register of measured exposure to chemicals in the workplace (EXPOSSM). EXPOSSM is a register of exposure measurements carried out by the National Research and Development Institute on Occupational Safety - I.N.C.D.P.M. "Alexandru Darabont". Except for the use of data in the HazChem@Work pilot study, the register is for internal use only. The exposure measurements are made almost exclusively as part of contracts with companies in different sectors that periodically check legal compliance to OELs. Some of the data in the register is confidential. Information in the register is collected in Romanian in a structured way that fits the needs of its owner, and it has never been transformed into a database. On the occasion of the pilot testing the information has been translated and codes were used for sectors and operations. The register EXPOSSM contains mostly time weighted averages (8 hours and/or 15 minutes), and some pick values for chemicals and particulate matter. The measurements were made for companies that regularly check their compliance with the compulsory OELs. Beside the values of resulting averages, the register contains information on the measurement method, the ambient conditions (temperature, pressure), existence/state of the ventilation, operations carried out by the exposed workers during sampling.

All data from EXPOSSM refers to the level of concentrations of hazardous chemicals in respirable air from the work environment to which workers are exposed during working hours. The registry contains data on the name of the substance, identification number (CAS-Chemical Abstracts Service number), determination metadata (standardized or not), temperature and pressure conditions at which the samples were taken, number of workers exposed (on substance and operation), duration and frequency of exposure, as well as risk management measures such as exposure monitoring, health surveillance, substitution, or other organizational measures (instructions, training etc.). The EXPOSSM also contains information on the size of the company, categorization for sector and categorization for occupation. Concentrations in mg substance / m^3 air refer to both short-term and 8-hour values. EXPOSSM contains data about several substances; the data is presented as a Fig. 3. It is noted that most data refer to exposure to carbon monoxide (29%), and the fewest refer to mercury and silver (0.6%).

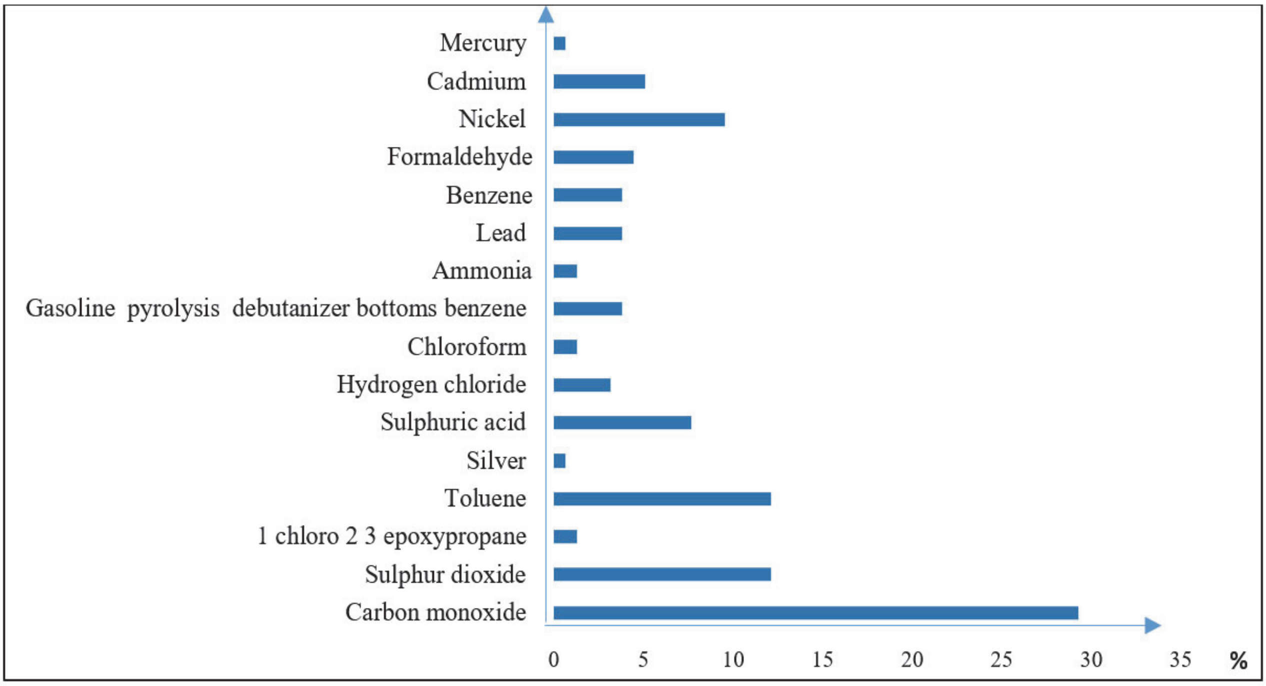

Fig. 3. Substances in EXPOSSM

5. Conclusions

Databases on the exposure of workers to dangerous chemical agents are important tools for assessing and managing chemical risk but also for recognizing occupational diseases caused by exposure to hazardous chemicals. There is currently little data available on the level of exposure of workers to hazardous chemical substances in the work environment.

The following obstacles to generating data on exposure and data usage constraints have been identified:

- reported enterprise data are (partially) treated as confidential and are often incomplete;
- in many Member States there is no legal obligation to make employers submit data;
- lack of data due to insufficient application of the obligation / recommendation to perform exposure measurements;
- lack of funding for exposure measurements (especially for small businesses) and lack of such measurements for representative samples;
- exposure data collected over time has not been categorized and stored using a (common) format that would facilitate access, analysis, and transfer;
- lack of chemical knowledge, poor risk assessment, limited capacity to establish risk management measures based on measured data.

The HazChem@Work database is a first step in unified data collection at European level. A special section of the database could be used in particular for the data required by Article 6 of the Carcinogens and Mutagens Directive. Providing such tools to companies could encourage them to collect the required data, especially if they are supported by the authorities. This will generate data on both the number of workers exposed and the level of exposure, which will be easily centralized at national and EU level.

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