CONTROL STRATEGIES

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Contents

Summary

Control strategy in occupational and environmental health is described, taking risk assessment and risk management approach as a common denominator, and with more focus in the former. Importance of risk communication is emphasized. In occupational health, three points of consideration, i.e., chemical identification, exposure assessment, and health effects are explained, and importance of integrated consideration rather than evaluation on individual items is stressed. In environmental health, special consideration necessary in evaluating chemical toxicity in this field is explained in comparison with the practice in occupational health. Two important tools for prevention of environmental pollution are detailed, namely, pollutant release and transfer registry (or PRTR), and environmental monitoring.

1. General Principle

The concept of risk assessment and risk management was first proposed by National Research Council, U.S.A. (1983) more than 15 years ago, and has been shown to be quite effective as the basic strategy for chemical control in environmental and occupational health (for details, see *Risk Assessment and Risk Management*). In short, the strategy consists of two stages of risk assessment and risk management. Risk assessment is in a domain of science and can be classified into four steps, namely, hazard identification (of the chemical in concern, through the compilation of toxicity profile), dose-response assessment (or examination of increasing response as a result of increasing intensity of exposure dose, with special reference to presence or absence of a threshold), exposure assessment (i.e., assessment of possible or existing exposure in the society or in the environment), and risk characterization (as a step of integrated evaluation of the information obtained in the fore-going three steps).Once the risk is identified as really an issue, which needs to be managed, the case moves to the next stage of risk management. This is the stage of administration and politics. The selection of the methods should be made on a case-by-case basis, and not only public health but other various factors such as economic impacts, social ethics, and political balance etc. should be taken into consideration in making decisions.

2. Strategies in Occupational Health

2.2. Walk-through Survey

In occupational toxicology, the strategy can be more practically understood in a shape of a triangle, i.e., identification of chemical in concern, exposure to the chemical in the work environment, and effects on health of the exposed workers, one each on the corner of the triangle. With this triangle in mind, a walk-through survey of the workshop in concern is an important first step to have general and over-all understanding of the situation. The survey gives an opportunity to know the workroom conditions including the environment, practice, and performance of the worker involved as well as that of fellow workers, and to make approximate estimation of possible risk of exposure to chemicals especially through skin contact.

2.3. Chemical Identification

The most practical way of chemical identification is careful reading of the label on the container. Theoretically, it is possible to identify chemical composition by means of instrumental analysis, e.g., by gas chromatography, high-pressure liquid chromatography, inductively coupled plasma spectrometry or their combination with mass spectrometry. The analysis is however generally time-and energy consuming.In many countries, national or local regulation requests that the constituents in a chemical product (e.g., paint), especially highly hazardous chemicals, should be shown on the wall of the container, and this should be done by scientific chemical name(s) [and not by trade name(s)]. Thus, it is possible to know, by reading the explanation in the label, the chemical(s) to which the workers are exposed, and to which primary occupational health attention should be focused. It is possible to obtain further information through a Material Safety Data Sheet (MSDS), which the supplier of the chemical offers (see section 2.5 below).

2.4. Exposure Analysis

Exposure to chemicals in occupational settings takes place most often via inhalation. Depending on the physico-chemical properties of the chemical and work performance in the workshop, however, skin penetration (i.e., absorption through intact skin) may also occur to the extent to induce toxic effects. Chances are generally remote for exposure via ingestion in workplace. Nevertheless, historical experiences showed that exposure of typesetters to lead in old day printing plants occurred when they gave moisture to their fingertips by licking to facilitate picking up types, which were made of lead.Because inhalation is the most common type of exposure in workplace, exposure intensity has been traditionally monitored by workroom air analysis for air-polluting chemicals. For many chemicals, sampling devices are made light enough to allow continuous personal sampling of the breathing zone air for several hours, and the measurement of 8-hour (or whole shift) time-weighted average concentration is recommended. Comprehensive Extensive reviews are available on ambient air monitoring and personal sampling (e.g., Deutsche Forshungsgemeinshaft, 1991–1999; U.S. National Institute For Occupational Safety And Health, 1994–1996). Recently developed biological exposure marker measurement [biological (exposure) monitoring] enables the monitoring of exposure via all routes, i.e., inhalation, ingestion, and also skin penetration, the latter two of which the traditional ambient air monitoring is not able to measure. The method is based on the analysis of biological materials (most commonly venous blood and urine) for the (parent) chemical or its metabolite(s), and the concentration of the chemical [or metabolite(s)] is taken as an indicator of the exposure. Whereas the biological matrix (such as blood and urine) is more complex than air, progress in analytical chemistry has facilitated the analysis dramatically. Nevertheless, the fact that some chemicals (or metabolites) are present even in the samples from the non-exposed subjects (so-called "background" level) requests due caution in making evaluation of exposure (for further details, see World Health Organisation, 1996).

2.5. Health Examination and Over-all Evaluation

With regard to health examination, the examination items for common industrial chemicals such as lead and leading organic solvents (e.g., toluene, xylenes, and hexane, etc.) are established by law in many industrialized countries, in combination with diagnosis criteria. For less common chemicals, MSDS (see section 2.5 below) and the documentation for occupational exposure limits (e.g., American Governmental Industrial Hygienists, 1991 and on; Deutsche Forschungsgemeinschaft, 1991 and on) provides basic information on target organs of the toxicity, and help selecting health examination items. With regard to cancer in particular, International Agency Research on Cancer (1972 and on) has been publishing series of monographs on the evaluation of carcinogenic potential of various agents including industrial chemicals.The results of health examination should be evaluated in comparison with the toxicity profile of the identified chemical, and observed intensity of exposure in reference to occupational exposure limits (e.g., American Governmental Industrial Hygienists, 1998; Deutsche Forschungsgemeinschaft, 1998; and Japan Society For Occupational Health, 1998). In other words, the decision should be made as an interaction among the three corners of the triangle. For example, the case may be most probably due to exposure to the suspected chemical, when the observed clinical picture of the worker is consistent with the toxicity profile in literature, when the exposure is quite in excess of the occupational exposure, when a dose-response relationship is detected between the exposure intensity and response in the health effects of the worker and his/her fellow workers, and when there is no contradiction in time sequence between the exposure and occurrence of the health effect.

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Biographical Sketch

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