# Assessment of confounders in biological monitoring

Volker Schillack,
Ampath Analytical Toxicology,
Drs Du Buisson, Bruinette & Kramer Inc./Ing
E-mail:
schillackv@ampath.co.za

Murray Coombs,
SASOM Chairman,
Scientific Committee on Biological Monitoring
E-mail:
mwcoombs@dow.com

Toxicology is the study of physical and chemical agents and the injury they cause to living cells. The objective of occupational toxicology is to prevent any injury to workers exposed to hazardous chemicals by determining if a certain threshold has been exceeded.

Assessing the probability that injury or illness will occur under specified conditions of exposure is important when dealing with hazardous chemicals. Measurements are normally done for compounds known to the health practitioner without considering other factors associated with normal leisure time activities. Indulging ourselves in the pleasures of relaxation is very often ignored when assessing possible exposure data. Confounders in biological monitoring can often contribute to the overall adverse health effects of the worker.

## The effect of ethanol and other solvents

The distribution and elimination of hazardous substances in the workplace can be affected by the previous night's or weekend's indulgence of ethanol or inhaled vapors of organic solvents.

Alcohol has two opposing effects on the metabolism of organic solvents: (i) stimulation and (ii) inhibition. The length of time elapsed after alcohol consumption determines which effect is predominant. Inhibition of organic solvent metabolism by ethanol is an established phenomenon. In humans, it has been shown that alcohol inhibits the metabolism of several organic solvents such as trichloroethylene, toluene, xylene and styrene.

However, since ethanol is often present in the body in much higher concentrations than organic solvents (in a magnitude of millimolars compared to micromolars of organic solvents), it can specifically inhibit the metabolism of a variety of organic solvents. See Table 1.

## Effects of medication and illicit drugs

Drugs and medication have a large potential to influence and/or confound biological monitoring results. Fifteen to thirty percent of workers may be receiving prescription or nonprescription medication. An unknown amount may be using illicit drugs, while many consume coffee, tea and caffeine-containing sodas or smoke tobacco. These drugs may affect the relationship between external exposure (dose) to a chemical, its active metabolite in a sampled biological medicine (internal dose) and/or they may affect the relationship between the external exposure and concentration at a receptor site. They may even modulate the response of the receptor.

If a medication and industrial chemical have common metabolites (including the parent compounds of one and/or metabolite of the other), the biological level of the chemical is not directly affected by the total metabolites determined in the process. For example, phenol measured in urine for exposure to phenol and as a metabolite of benzene, is common in detergents and antiseptic medicines such as phenol camphor – petroleum lotions, antiseptic throat lozenges, calamine lotions and some over-the-counter antacid preparations. See Table 2.

Illicit drugs like cannabis ('dagga') have been used for their euphoric relaxation effect for more than 4000 years. In South Africa it is so commonly used, that it is accepted as a part time leisure drug in certain circles. As with most of the medication and illicit drugs, metabolism occurs by the hepatic cytodrome P450 enzyme system. Medication and illicit drugs like cannabis with high protein bound in plasma, primarily to lipoprotein, tend to accumulate with long acting effect and low excretion rate. Chronic use of these drugs has an inhibition effect on the metabolism route which can lead to the patient presenting with toxic symptoms due to the hepatic enzymatic depletion.

**Table 1. A few common substances of inhalant abuse**

| Chemical class | Chemical name | Product |
|---|---|---|
| Aliphatic hydrocarbons | n-Heptane<br>n-Hexane<br>Gasoline | Adhesives, paint thinner<br>Adhesives, rubber cement<br>Gasoline, solvent |
| Aromatic hydrocarbons | Benzene<br>Toluene | Degreasers, gasoline<br>Aerosol sprays, adhesives |
| Anaesthetic | Trichloroethylene | Degreaser, dry cleaning |
| Ketones | Acetone<br>Methyl ethyl ketone | Paint thinner, nail polish remover<br>Degreasers, paint thinner |

## Herbal, traditional ('folk') medicine

Despite the continued development of medical and pharmacological therapies for the treatment of illnesses, as many as 50% of people worldwide use alternative treatments, including herbal and traditional medicines.

Toxins can contaminate these medicines by a number of means. Depending on the region where they are grown, they can be contaminated by heavy metals and pesticides, and fungicides are often used to lengthen the shelf life of these compounds. A large number of herbal medicines contain psychoactive substances that are the basis of their use (eg. those containing caffeine). Those associated with central nervous system toxicity include the Kavahava (Piper methystiam) Jimson root (Datura spp), and Nutmeg.

Many herbal teas (eg. Coltsfoot, Comfrey, Groundsel etc.) contain pyrrolizidine alkaloids. These alkaloids are highly hepatotoxic and in some cases, carcinogenic.

Traditional ('folk') medicines can be defined as unrefined products derived from animals, plants or minerals. In many cases, the basis of therapies is a nonorthodox belief about disease processes (e.g. the humoral [hot-cold] theory).

A number of folk medicines (Table 3) associated with clinical toxicity contain heavy metals and are used in the treatment of GI disturbance, headaches, flu symptoms and many other day-to-day illnesses.

## Conclusion

A high percentage of workers in any workplace may be receiving drugs or medication. Some of these drugs interact with industrial chemicals in a way that will affect biological levels of the chemicals or their determinants. A basic knowledge of the pharmacokinetics and pharmacodynamics can predict the interaction these chemicals will have on each other.

Those responsible for biological monitoring programmes should be aware of the potential for these interactions and have access to information of the drugs, solvents, herbal medications which are commonly used and have demonstrated effects on biological monitoring processes.

The possible role of drugs, medication, herbal medication and solvents should be considered when interpreting aberrant or unexpected results.

**Table 2. Common therapeutic drugs that induce the metabolism of chemical substances**

| Class | Drug |
|---|---|
| Anticonvulsant | Phenobarbital, Phenyltoin, Carbamazepine |
| Sedatives / hypnotic | Barbiturates, Glutethimide, Meprobamale |
| Analgesic | Antipyrene |
| Anti-inflammatory | Phenylbutazene |
| Steroid | Testosterone |
| Antifungal | Griseofulvin |
| Antibiotic | Refampicin |
| Antimalarial | Quinine |

**Table 3. Common folk medicines associated with clinical toxicity**

| Name | Contents | Potential toxicity |
|---|---|---|
| Hispanic | Almond, castor oil, toluene, wild cherry, honey | GI upset, catharies, electrolyte disturbance |
| Alcamfor | Camphor | Camphor toxicity |
| Greta | Lead | Lead toxicity |
| Azogue | Elemental mercury | Mercury intoxication |

## References


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