STANDARD SETTING AND METAL SPECIATION: ARSENIC

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Abstract. Environmental quality standards are usually based upon concentrations of metals as such, not taking into account essential differences in toxicokinetics and toxicodynamics between different compounds of the same element. There is an urgent need for setting specific standards for different (groups of) metallic compounds; the possibility of total exposure standards is discussed. The present confusion and logical inconsistency between standards is illustrated for arsenic but applies also to other metals.

INTRODUCTION
Different compounds of the same metal may carry widely different health risks. The fractional gastrointestinal absorption of soluble PbCl₂ is about four times that of insoluble PbS in fasting humans. Inorganic mercury and short-chain alkylmercury carry essentially different health risks. Differences in water or fat solubility, aggregation state, chemical structure and volatility may determine intake, uptake, distribution, accumulation, biotransformation and excretion, i.e., the toxicokinetics, but can also affect the working mechanisms, critical organs and critical effects, i.e., the toxicodynamics.
Environmental and occupational standards for metals as regards ambient or workroom air, food, drinking water, or beverages are usually expressed as concentrations of the metal as such, suggesting exposure to the same agent. In that case logical consistency might be expected between quality standards for above mentioned exposure routes. It might also allow the derivation of total exposure standards which are particularly relevant for metals, because man is usually exposed simultaneously to all environmental compartments mentioned. However, no logical consistency appears to exist (46). This discrepancy is due to:

- "compartmentalization," i.e., regulatory agencies which set standards for one compartment, do not cooperate with one another, e.g., the present WHO-drinking water standard for lead is not consistent with the proposed WHO-health-based-occupational exposure limit (44);
- lack of similar procedures (43,47), i.e., agencies do not always at first critically evaluate the available toxicity data. A criteria document should allow the establishment of no-adverse-response levels on which recommended health-based quality limits can be based and which only take into account considerations of health protection. This first step should be followed by a second step: the decision making process, in which regulatory agencies together with representatives of industry and of the population at risk (e.g., workers' unions) take into account both the health-based recommended limits and socioeconomic, political, and technological constraints (43,47). Too often the first step is never taken; the present CEC and WHO drinking water standards are not based upon criteria documents (however, WHO has announced such a document for the near future (22));
- lack of metal speciation data: the total metal concentrations are analyzed; different metal compounds are not measured. Two international conferences of CEC-WHO on "Heavy Metals in the Environment" (11,12) emphasized the urgent need for relevant metal speciation information; various studies were presented on, e.g., methylation of metals in natural waters, sediment, soil, and solid waste. To protect human health, metal speciation is particularly needed when different compounds of the same metal, which differ in metabolism and/or toxicity, are present in food, air, water, etc.

We have examined the logical consistency of various arsenic (As) standards as an example. The objective was to answer the following three questions:

1. Can As be treated as an entity, or is it necessary to distinguish between (groups of) As-compounds?