Risk assessment of effects of cadmium on human health (IUPAC Technical Report)

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IUPAC Division VII, Chemistry and Human Health, provides guidance on risk assessment methodology and, as appropriate, assessments of risks to human health from chemicals of exceptional toxicity. The aim of this document is to describe dose-response relationships for the health effects of low-level exposure to cadmium, in particular, with an emphasis on causation. The term "cadmium" in this document includes all chemical species of cadmium, as well as those in cadmium compounds. Diet is the main source of cadmium exposure in the general population. Smokers and workers in cadmium industries have additional exposure. Adverse effects have been shown in populations with high industrial or environmental exposures. Epidemiological studies in general populations have also reported statistically significant associations with a number of adverse health effects at low exposures. Cadmium is recognized as a human carcinogen, a classification mainly based on occupational studies of lung cancer. Other cancers have been reported, but dose-response relationships cannot be defined. Cardiovascular disease has been associated with cadmium exposure in recent epidemiological studies, but more evidence is needed in order to establish causality. Adequate evidence of dose-response relationships is available for kidney effects. There is a relationship between cadmium exposure and kidney effects in terms of low molecular mass (LMM) proteinuria. Long-term cadmium exposures with urine cadmium of 2 nmol $mmol^{-1}$ creatinine cause such effects in a susceptible part of the population. Higher exposures result in increases in the size of these effects. This assessment is supported by toxicokinetic and toxicodynamic (TKTD) modelling. Associations between urine cadmium lower than 2 nmol $mmol^{-1}$ creatinine and LMM proteinuria are influenced by confounding by co-excretion of cadmium with protein. A number of epidemiological studies, including some on low exposures, have reported statistically significant associations between cadmium exposure and bone demineralization and fracture risk. Exposures leading to urine cadmium of 5 nmol $mmol^{-1}$ creatinine and more increase the risk of bone effects. Similar associations at much lower urine cadmium levels have been reported. However, complexities in the cause and effect relationship mean that a no-effect level cannot be defined. LMM proteinuria was selected as the critical effect for cadmium, thus identifying the kidney cortex as the critical organ, although bone effects may occur at exposure levels similar to those giving rise to kidney effects. To avoid these effects, population exposures should not exceed that resulting in cadmium values in urine of more than 2 nmol $mmol^{-1}$ creatinine. As cadmium is carcinogenic, a 'safe' exposure level cannot be defined. We therefore recommend that cadmium exposures be kept as low as possible. Because the safety margin for toxic effects in kidney and bone is small, or non-existent, in many populations around the world, there is a need to reduce cadmium pollution globally.

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Vocabulary on nominal property, examination, and related concepts for clinical laboratory sciences (IFCC-IUPAC Recommendations 2017)

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Scientists of disciplines in clinical laboratory sciences have long worked on a common language for the efficient and safe request of investigations, reports of results, and communications of experience and scientific achievements. Widening the scope, most scientific disciplines, not only clinical laboratory sciences, rely to some extent on various examinations in addition to measurements. The 'International vocabulary of metrology—Basic and general concepts and associated terms' (VIM) is designed for metrology, the science of measurement. The aim of this vocabulary is to suggest definitions and explanations of concepts and a selection of terms related to nominal properties, *i.e.* properties that have no size.

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