

## **Uranium in Drinking-water**

Summary statement

Extract from Chapter 12 - Chemical fact sheets of  
*WHO Guidelines for Drinking-water Quality, 3<sup>rd</sup> edition, 2004.*

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**12.122 Uranium**

Uranium is widespread in nature, occurring in granites and various other mineral deposits. Uranium is used mainly as fuel in nuclear power stations. Uranium is present in the environment as a result of leaching from natural deposits, release in mill tailings, emissions from the nuclear industry, the combustion of coal and other fuels and the use of phosphate fertilizers that contain uranium. Intake of uranium through air is low, and it appears that intake through food is between 1 and 4 mg/day. Intake through drinking-water is normally extremely low; however, in circumstances in which uranium is present in a drinking-water source, the majority of intake can be through drinking-water.

Provisional guideline value	0.015 mg/litre The guideline value is designated as provisional because of outstanding uncertainties regarding the toxicology and epidemiology of uranium as well as difficulties concerning its technical achievability in smaller supplies.
Occurrence	Levels in drinking-water are generally less than 1 mg/litre, although concentrations as high as 700 mg/litre have been measured in private supplies.
TDI	0.6 mg/kg of body weight per day, based on the application of an uncertainty factor of 100 (for inter- and intraspecies variation) to a LOAEL (equivalent to 60 mg of uranium per kg of body weight per day) for degenerative lesions in the proximal convoluted tubule of the kidney in male rats in a 91-day study in which uranyl nitrate hexahydrate was administered in drinking-water. It was considered unnecessary to apply an additional uncertainty factor for the use of a LOAEL instead of a NOAEL and the short length of the study because of the minimal degree of severity of the lesions and the short half-life of uranium in the kidney, with no indication that the severity of the renal lesions will be exacerbated following continued exposure. This is supported by data from epidemiological studies.
Limit of detection	0.01 mg/litre by ICP/MS; 0.1 mg/litre by solid fluorimetry with either laser excitation or UV light; 0.2 mg/litre by ICP using adsorption with chelating resin
Treatment achievability	1 mg/litre should be achievable using conventional treatment, e.g., coagulation or ion exchange
Guideline derivation allocation to water weight consumption	80% of TDI (because intake from other sources is low in most areas) 60-kg adult 2 litres/day
Additional comments	The data on intake from food in most areas suggest that intake from food is low and support the higher allocation to drinking-water. In some regions, exposure from sources such as soil may be higher and should be taken into account in setting national or local standards.  The concentration of uranium in drinking-water associated with the onset of measurable tubular dysfunction remains uncertain, as does the clinical

significance of the observed changes at low exposure levels. A guideline value of up to 30 mg/litre may be protective of kidney toxicity because of uncertainty regarding the clinical significance of changes observed in epidemiological studies.

Only chemical, not radiological, aspects of uranium toxicity have been addressed here.

A document on depleted uranium, which is a by-product of natural uranium, is available.

### ***Toxicological review***

There are insufficient data regarding the carcinogenicity of uranium in humans and experimental animals. Nephritis is the primary chemically induced effect of uranium in humans. Little information is available on the chronic health effects of exposure to environmental uranium in humans. A number of epidemiological studies of populations exposed to uranium in drinking-water have shown a correlation with alkaline phosphatase and b-microglobulin in urine along with modest alterations in proximal tubular function. However, the actual measurements were still within the normal physiological range.

### ***History of guideline development***

The 1958 and 1963 WHO *International Standards for Drinking-water* did not refer to uranium. The 1971 International Standards stated that uranium should be controlled in drinking-water, but that insufficient information was available to enable a tentative limit to be established. In the first edition of the *Guidelines for Drinking-water Quality*, published in 1984, it was concluded that no action was required for uranium. A health-based guideline value for uranium was not derived in the 1993 Guidelines, as adequate short- and long-term studies on the chemical toxicity of uranium were not available. Until such information became available, it was recommended that the limits for radiological characteristics of uranium be used. The equivalent for natural uranium, based on these limits, is approximately 0.14 mg/litre. In the addendum to the Guidelines, published in 1998, a health-based guideline value of 0.002 mg/litre was established. This guideline value was designated as provisional, because it may be difficult to achieve in areas with high natural uranium levels with the treatment technology available and because of limitations in the key study. It was noted that several human studies are under way that may provide helpful additional data.

### ***Assessment date***

The risk assessment was conducted in 2003.

### ***Principal reference***

WHO (2003) *Uranium in drinking-water. Background document for preparation of WHO Guidelines for drinking-water quality*. Geneva, World Health Organization (WHO/SDE/WSH/03.04/118).