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| **ARSENIC** |
| **DEFINITION:**  Arsenic is widely distributed throughout the Earth’s crust, generally as arsenic sulphide or as metal arsenates and arsenides. Human exposure to arsenic compounds represents a major public health concern as it has been associated with a range of acute and long-term adverse health effects and diseases (World Health Organization 2019).  **REFERENCE:**  World Health Organization (2019). Preventing disease through healthy environments: Exposure to arsenic: A major public health concern. Available at [apps.who.int/iris/bitstream/handle/10665/329482/WHO-CED-PHE-EPE-19.4.1-eng.pdf?ua=1](https://apps.who.int/iris/bitstream/handle/10665/329482/WHO-CED-PHE-EPE-19.4.1-eng.pdf?ua=1). Accessed 21 November 2019. |
| **ANNOTATIONS:**  **Synonym(s): N/A**  **Additional scientific description:**  Arsenic (symbol As, atomic number 33) can be released into the atmosphere and water in the following ways:   * natural activities, such as volcanic activity, dissolution or desorption of minerals (particularly into groundwater), exudates from vegetation and wind-blown dusts; * human activities, such as metal smelting, combustion of fossil fuels (especially coal), mining, timber treatment with preservatives, and, historically, agricultural pesticide production and use; * remobilization of historic sources, such as mine drainage water; and * mobilization into drinking-water from geological deposits by drilling of tube wells (World Health Organization 2019).   In water, arsenic occurs in one of two main forms: arsenite As(III) under reducing conditions and arsenate As(V) if the water is oxygenated. It can be released to the atmosphere, primarily as the trioxide, mainly by high-temperature processes or through volatilization from aerated soils. In the atmosphere, it is mainly adsorbed on particles, which are dispersed by winds and deposited on land and water (World Health Organization 2019).  Soluble inorganic arsenic is highly acutely toxic. Intake of inorganic arsenic over a long period can lead to chronic arsenic poisoning (arsenicosis). Effects, which can take years to develop depending on the level of exposure, include skin lesions, peripheral neuropathy, gastrointestinal symptoms, diabetes, cardiovascular disease, developmental toxicity, and cancer of the skin and internal organs (IARC . Organic arsenic compounds, which are abundant in seafood, are less harmful to health and are rapidly eliminated by the body.  Human exposure to arsenic and arsenic compounds can occur through environmental or occupational routes. Human exposure to elevated levels of inorganic arsenic occurs mainly through the consumption of groundwater containing naturally high levels of inorganic arsenic, food prepared with this water, and food crops irrigated with high-arsenic water sources. Public health actions need to be continued to reduce human exposure to arsenic, particularly in areas with naturally high levels in groundwater (World Health Organization 2019).  **Metrics and numeric limits:**  In 2002, WHO (2019) reported that it was estimated that at least 140 million people in 50 countries have been drinking water containing arsenic at levels above the WHO provisional guideline value of 10 μg/L.3 Inorganic arsenic is naturally present at high levels in the groundwater of a number of countries, such as Argentina, Chile, China, India (West Bengal), Mexico, the United States of America, and particularly Bangladesh, where it was estimated that in 2012 approximately 19 million people were exposed to drinking-water concentrations above the national standard of 50 μg/L and 39 million people were drinking water with levels of arsenic above 10 μg/L.4 In 2010, 21.4% of all deaths in a highly affected area of Bangladesh were attributed to arsenic levels of above 10 μg/L in drinking-water,5 while another analysis published in 2012 for all districts indicated an annual total of nearly 43 000 deaths (about 5.6% of all deaths) attributable to chronic arsenic exposure (World Health Organization 2019).  World Health Organization (WHO) arsenic guidelines (World Health Organization 2019):   * **Tolerable intake level -** In a review of the latest scientific evidence conducted in 2010, the Joint Food and Agriculture Organization of the United Nations (FAO)/WHO Expert Committee on Food Additives (JECFA) determined the lower limit on the benchmark dose for a 0.5% increased incidence of lung cancer (BMDL0.5) from epidemiological data to be 3.0 μg/kg body weight per day (2–7 μg/kg body weight per day based on the range of estimated total dietary exposure). No new tolerable intake level could be established. In areas where levels in water are below the WHO drinking-water guideline value, human health effects are unlikely. * **Drinking-water -** The provisional guideline value is 10 μg/L, in light of practical difficulties in removing arsenic in drinking water).2,9 Every effort should therefore be made to keep concentrations as low as reasonably possible and below the guideline when resources are available. * **Air -** A safe level of arsenic in air cannot be established   **Key relevant UN convention/multilateral treaty:**   * International Health Regulations * International Labour Organization C042 - Workmen's Compensation (Occupational Diseases) Convention (Revised), 1934 (No. 42) Available at [www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100\_ILO\_CODE:C042](https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C042). Accessed on 21 November 2019.   **Examples of drivers, outcomes and risk management:**  WHO (2019) reports that arsenic is hazardous in the following ways:   * **Drinking-water -** Drinking-water poses the greatest threat to public health from arsenic (World Health Organization 2019). * **Industrial processes -** Most arsenic in industrial processes is used to produce antifungal wood preservatives, which can lead to soil contamination. Other current or historical uses include in the pharmaceutical and glass industries, in the manufacture of alloys, sheep dips, leather preservatives, arsenic-containing pigments, antifouling paints and poison baits and, to a diminishing extent, in the production of agrochemicals (especially for use in orchards and vineyards). Arsenic compounds are also employed in limited amounts in the microelectronics and optical industries. High arsenic levels in air can be found in the working environment as well as the general environment around non-ferrous metal smelters, where arsenic trioxide may be formed, and some coal-fired power plants (especially those using low-grade brown coal) (World Health Organization 2019). * **Food -** In areas where arsenic is not naturally present at high levels, food usually contributes most to the daily intake of arsenic. Fish, shellfish, meat, poultry, dairy products and cereals are the main sources of dietary intake. However, the arsenic in fish and shellfish is usually in the form of organic compounds (e.g. arsenobetaine) that are of low toxicity. In areas where arsenic is naturally present at high levels, food (e.g. rice) prepared with high arsenic-containing water and food crops irrigated with contaminated water also contribute to total daily intake (World Health Organization 2019). * **Smoking -** Exposure of smokers to arsenic arises from the natural inorganic arsenic content of tobacco. Exposures were higher in the past when tobacco plants were treated with lead arsenate insecticide (World Health Organization 2019).   Long-term actions are required to reduce exposure to arsenic from mining, metal smelting and refining, combustion of low-grade coal, pesticide use and timber treatment. In particular, action is needed to reduce the intake of arsenic from drinking-water and food in areas with naturally high levels in the groundwater (World Health Organization 2019).  The WHO factsheet on Preventing disease through healthy environments - exposure to arsenic: a major public health concern (World Health Organization 2019) includes the following risk mitigation recommendations:   * Make available drinking-water with arsenic concentrations below the WHO provisional drinking-water guideline value of 10 μg/L in areas where the level is higher. Possible measures include: * testing water for arsenic levels and informing users of the results; * installing arsenic removal systems, either centralized or domestic, and ensuring appropriate disposal of the removed arsenic; * substituting high-arsenic sources, such as groundwater, with low-arsenic, microbiologically safe sources such as rainwater and treated surface water. Low-arsenic water can be used for drinking, cooking and irrigation purposes, whereas high-arsenic water can be used for other purposes such as bathing and washing clothes; * discriminating between high-arsenic and low-arsenic sources by testing water for arsenic levels and painting tube wells or hand pumps different colours (e.g. red and green); and * blending low-arsenic water with higher-arsenic water to achieve an acceptable arsenic concentration level. * Reduce occupational exposure to arsenic and its compounds. * Make both the general public and the health sector aware of the harmful effects of high arsenic intake and the sources of exposure (including use of high-arsenic water for crops irrigation or food preparation) and how to avoid these sources. * Monitor high-risk populations for early signs of arsenic poisoning, usually skin problems. It should be noted that total urinary arsenic does not differentiate between inorganic arsenic, which is toxic, and organic arsenic, some of which is not. Where possible, arsenic speciation should be attempted in order to differentiate these two forms (and their metabolites). * The WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene monitors progress towards global targets on drinking-water. Under the new 2030 Agenda for Sustainable Development, the indicator of “safely managed drinking water services” calls for tracking the population accessing drinking-water that is free of faecal contamination and priority chemical contaminants, including arsenic.   **REFERENCES:**   * World Health Organization (2019). Preventing disease through healthy environments: Exposure to arsenic: A major public health concern. Available at [apps.who.int/iris/bitstream/handle/10665/329482/WHO-CED-PHE-EPE-19.4.1-eng.pdf?ua=1](https://apps.who.int/iris/bitstream/handle/10665/329482/WHO-CED-PHE-EPE-19.4.1-eng.pdf?ua=1). Accessed on 21 November 2019. * International Labour Organization (1934). C042 - Workmen's Compensation (Occupational Diseases) Convention (Revised), 1934 (No. 42). Available at [www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100\_ILO\_CODE:C042](https://www.ilo.org/dyn/normlex/en/f?p=NORMLEXPUB:12100:0::NO::P12100_ILO_CODE:C042). Accessed on 21 November 2019. * International Agency for Research on Cancer (IARC) Arsenic and Arsenic Compounds : [https://monographs.iarc.fr/wp-content/uploads/2018/06/mono100C-6.pdf](https://monographs.iarc.fr/wp-content/uploads/2018/06/mono100C-6.pdf%20)  Accessed on 3 September 2020 |
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