International Society of Doctors for the Environment (ISDE)

Call to action toward asbestos-free drinking water

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The presence of asbestos fibres (AFs) in drinking water is a growing problem worldwide and mainly derives from the extensive use of asbestos containing materials, to their unavoidable and progressive deterioration over time, to the lack of monitoring procedures (completely absent in large geographical areas) and to inadequate directives.

Asbestos cement tanks and pipes were installed broadly in Europe, USA, Canada, and Australia from the late 1920s to the late 1980s. Additionally, although all forms of asbestos have been banned from 58 world countries [1], new water supply systems could be made with asbestos cement in countries where chrysotile is still not banned.

The WHO International Agency for Research on Cancer (IARC), stated that (i) the ingestion of AFs is, together with inhalation, a primary source of human exposure to this natural substance, which is toxic and able to induce cancer with a medium-long term latency and in several target organs; (ii) the "risks of exposure to asbestos in drinking water may be especially high for small children who drink seven times more water per day per Kg of body weight than the average adult" [2].

Data on cancer risk deriving from ingestion of AFs have been considered "not conclusive" when the IARC monograph 100C was published, in the year 2012. As a consequence, the WHO has not established a guideline value for AFs in drinking water[3]. International regulations have not fixed particularly restrictive limits to the concentration of AFs in drinking water and in several countries there are currently no limits.

However, some evidence associates AFs ingestion with gastric and colorectal cancer [2,4-11]. No certain threshold has been identified for this carcinogenic risk, until now [4]. Experimental studies point to the toxicity of ingested AF, to the role for the timing and extent of exposure and show that ingested AFs induce toxic effects in the gastrointestinal tract and at a molecular level [4,12-17]. Furthermore, it has been demonstrated that AFs are able to cross the placenta and enter fetal organs [18,19] where they might act as a co-carcinogen agent [20].

Health risks deriving from ingestion of AF might be very high for children who are, in general, more susceptible than adults to hazards from environmental origin [21,22]. In the absence of remediation, exposed children living for long-term in a contaminated geographical area have a higher exposure to orally ingested AFs than adults. Finally, globally the amount of water drunk by children is about seven times higher than that ingested by adults [2].

Irrespective of scientific indications, in the EU asbestos is not explicitly included in the parameter list in the Drinking Water Directive (directive 98/83/EC of 3.11.98). As in the majority of countries worldwide (including Canada and Australia), there are currently no legal regulations setting the maximum contaminant level for asbestos in drinking water.

On the other hand, the US EPA estimated a very high threshold (7 million fibres/L), only considering fibres longer than 10µm. More than 95% of asbestos fibres deriving from A/C pipe systems and tanks are shorter than 10µm [23], and the estimation procedures applied to calculate the EPA threshold disclose a number of limitations [4].

Thus it is reasonable to assume that many communities worldwide are exposed to an additional risk factor for the occurrence of digestive cancers, irrespective of the precautionary and prevention principles. The risk might be higher in the case of exposures starting during pregnancy and childhood. Because drinking water is not only used for drinking but also for irrigation, bathing, and showering, inhalative asbestos exposure, a proven cancer risk, is an issue.

Therefore we call for global policy action:

- Any new use of asbestos should be banned worldwide.

- All asbestos cement installations need to be closely monitored and, when ever possible and necessary, removed. To that end additional research is needed into alternative safe, feasible, easy-to-manage and safe means of asbestos removal. Technical help should be provided for communities where it is needed.

- The conclusions from the WHO and the appropriateness of the current threshold established by US EPA could be reconsidered in the light of all the available scientific evidences, including experimental and more recent studies exploring the effects of asbestos at a molecular level.

- In the light of the precautionary principle and the emerging scientific evidence ambitious limit values for AF in drinking water should be set and enforced through a broad monitoring program.

- This monitoring program in combination with epidemiological research should also help strengthening our knowledge base.

References

1. International Asbestos Ban Secretariat. Current asbestos bans and restrictions. [Revised 2016 Oct 16; cited 2017 Jan 6]. Available from: http://ibasecretariat.org/alpha_ban_list.php

2. IARC. Arsenic, metals, fibres, and dusts. *IARC monographs on the evaluation of carcinogenic risks to humans / World Health Organization, International Agency for Research on Cancer*, 100(Pt C), 11-465 (2012).

3. World Health Organization. Guidelines for drinking-water quality. World Health Organization Ed., Geneva, 2011

4. Di Ciaula A. Asbestos ingestion and gastrointestinal cancer: a possible underestimated hazard. *Expert review of gastroenterology & hepatology*, 1-7 (2017).

5. Wigle DT. Cancer mortality in relation to asbestos in municipal water supplies. *Archives of environmental health*, 32(4), 185-190 (1977).

6. Conforti PM, Kanarek MS, Jackson LA, Cooper RC, Murchio JC. Asbestos in drinking water and cancer in the San Francisco Bay Area: 1969-1974 incidence. *Journal of chronic diseases*, 34(5), 211-224 (1981).

7. Levy BS, Sigurdson E, Mandel J, Laudon E, Pearson J. Investigating possible effects of abestos in city water: surveillance of gastrointestinal cancer incidence in Duluth, Minnesota. *American journal of epidemiology*, 103(4), 362-368 (1976).

8. Kjaerheim K, Ulvestad B, Martinsen JI, Andersen A. Cancer of the gastrointestinal tract and exposure to asbestos in drinking water among lighthouse keepers (Norway). *Cancer Causes Control*, 16(5), 593-598 (2005).

9. Andersen A, Glattre E, Johansen BV. Incidence of cancer among lighthouse keepers exposed to asbestos in drinking water. *American journal of epidemiology*, 138(9), 682-687 (1993).

10. Kanarek MS, Conforti PM, Jackson LA, Cooper RC, Murchio JC. Asbestos in drinking water and cancer incidence in the San Francisco Bay area. *American journal of epidemiology*, 112(1), 54-72 (1980).

11. Mi J, Peng W, Jia X *et al.* [A case-control study on the relationship of crocidolite pollution in drinking water with the risk of gastrointestinal cancer in Dayao County]. *Wei sheng yan jiu = Journal of hygiene research*, 44(1), 28-32 (2015).

12. Kogan FM, Vanchugova NN, Frasch VN. Possibility of inducing glandular stomach cancer in rats exposed to asbestos. *British journal of industrial medicine*, 44(10), 682-686 (1987).

13. Jacobs R, Humphrys J, Dodgson KS, Richards RJ. Light and electron microscope studies of the rat digestive tract following prolonged and short-term ingestion of chrysotile asbestos. *British journal of experimental pathology*, 59(5), 443-453 (1978).

14. Donham KJ, Berg JW, Will LA, Leininger JR. The effects of long-term ingestion of asbestos on the colon of F344 rats. *Cancer*, 45(5 Suppl), 1073-1084 (1980).

15. Corpet DE, Pirot V, Goubet I. Asbestos induces aberrant crypt foci in the colon of rats. *Cancer letters*, 74(3), 183-187 (1993).

16. Westlake GE. Asbestos fibers in the colonic wall. *Environmental health perspectives*, 9, 227 (1974).

17. Yee H, Yie TA, Goldberg J, Wong KM, Rom WN. Immunohistochemical study of fibrosis and adenocarcinoma in dominant-negative p53 transgenic mice exposed to chrysotile asbestos and benzo(a)pyrene. *Journal of environmental pathology, toxicology and oncology : official organ of the International Society for Environmental Toxicology and Cancer*, 27(4), 267-276 (2008).

18. Haque AK, Ali I, Vrazel DM, Uchida T. Chrysotile asbestos fibers detected in the newborn pups following gavage feeding of pregnant mice. *Journal of toxicology and environmental health. Part A*, 62(1), 23-31 (2001).

19. Haque AK, Vrazel DM, Uchida T. Assessment of asbestos burden in the placenta and tissue digests of stillborn infants in South Texas. *Archives of environmental contamination and toxicology*, 35(3), 532-538 (1998).

20. Varga C, Horvath G, Timbrell V. On the mechanism of cogenotoxic action between ingested amphibole asbestos fibres and benzo[a]pyrene: II. Tissue specificity studies using comet assay. *Cancer letters*, 139(2), 173-176 (1999).

21. Wild CP, Kleinjans J. Children and increased susceptibility to environmental carcinogens: evidence or empathy? *Cancer epidemiology, biomarkers & prevention: a publication of the American Association for Cancer Research, cosponsored by the American Society of Preventive Oncology*, 12(12), 1389-1394 (2003).

22. Perera FP. Environment and cancer: who are susceptible? *Science*, 278(5340), 1068-1073 (1997).

23. Millette JR, Clark PJ, Pansing MF, Twyman JD. Concentration and size of asbestos in water supplies. *Environmental health perspectives*, 34, 13-25 (1980).