Response form for public review

Document title: PFOS and PFOA in Drinking-water, *Draft background document for development of WHO Guidelines for Drinking-water Quality*

Author: World Health Organization

Background

One of the primary goals of WHO and its member states is that "all people, whatever their stage of development and their social and economic conditions, have the right to have access to an adequate supply of safe drinking water." A major WHO function to achieve such goals is the responsibility "to propose ... regulations, and to make recommendations with respect to international health matters ...."

The first WHO document dealing specifically with public drinking-water quality was published in 1958 as *International Standards for Drinking-water*. It was subsequently revised in 1963 and in 1971 under the same title. In 1984–1985, the first edition of the WHO *Guidelines for Drinking-water Quality* (GDWQ) was published in three volumes: Volume 1, Recommendations; Volume 2, Health criteria and other supporting information; and Volume 3, Surveillance and control of community supplies. Second editions of these volumes were published in 1993, 1996 and 1997, respectively. Addenda to Volumes 1 and 2 of the second edition were published in 1998, addressing selected chemicals. An addendum on microbiological aspects reviewing selected microorganisms was published in 2002. In 2004, Volume 1 and Volume 2 of the GDWQ were revised, combined and published as the 3rd edition of the GDWQ. Following a further revision and publication of addenda, the 4th edition of the GDWQ was published in 2011 and the 1st addendum to the 4th edition was published in 2017.

The GDWQ are subject to a rolling revision process. Through this process, microbial, chemical and radiological aspects of drinking-water are subject to periodic review, and documentation related to aspects of protection and control of public drinking-water quality is accordingly prepared/updated. Per- and polyfluoroalkyl substances (PFAS), including perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA), have not previously been considered in the WHO GDWQ nor the *International Standards for Drinking-Water.* These compounds are currently being considered for inclusion in the 3rd addendum to the 4th edition of the GDWQ, for publication in Q4 of 2022 or Q1 of 2023.

Public review process

As part of the GDWQ document preparation and adoption process, all chemical background documents are subject to international peer and public review. Please note that comments provided will not be posted to the public web site. The details given on the comment form will not be voluntarily shared or sold to any outside company and will only be used for verification. Please note that WHO reserves the right to contact reviewers in case comments require further

clarification. By submitting ideas and comments in response to this questionnaire, you agree to abide by the instructions and accept the terms to which submissions are subject in all respects.

When reviewing, please keep in mind the following:

- The document has yet to be edited and therefore focus of comments should be on technical aspects, rather than language, format or other editorial issues.
- Notify page, section number and line number for easier handling of comments.
- A summary of the background document will be included as a fact sheet in the next addendum of the GDWQ.

Please complete the following details

Name : Betsy Southerland, Linda Birnbaum, Ronnie Levin, Tracey Woodruff

Function : Volunteer

Institution : Environmental Protection Network

E-mail : michelle.montoya@environmentalprotectionnetwork.org

Please choose one of the alternatives below:

☐ I wish my review to be kept confidential

☑ My name can be disclosed to the authors and included in the background document to the GDWQ.

Please send your completed review by e-mail to gdwq@who.int by **11 November 2022.**

As a sign of recognition for your work, all reviewers that have given their consent, will be acknowledged in the final background document to the GDWQ.

We are seeking feedback on the following areas

Wherever possible, please provide references to information you cite and indicate page, section number and line number for easier handling of comments.

Does this text respond to an issue of concern?

The Environmental Protection Network (EPN) agrees that this document responds to an issue of concern. EPN is an organization of more than 550 U.S. Environmental Protection Agency (EPA) alumni volunteering their time to protect the integrity of EPA, human health, and the environment. We note that PFAS contamination has been found worldwide in air, water, soil, wildlife, and food. Further, biomonitoring studies have confirmed worldwide human exposure,

finding PFAS in human samples of whole blood, plasma, serum, cord blood, and breast milk. The Environmental Working Group review of the scientific literature from around the world found PFAS chemicals in every umbilical cord blood sample across 40 studies conducted over the last five years.[1] Those studies collectively examined nearly 30,000 samples and identified over 35 different PFAS compounds, including some newer short chain PFAS that industry claimed would not accumulate in the body. In the U.S., PFAS contamination is a major public health concern, with multiple federal agencies conducting research and regulation of PFAS and Congress passing legislation to speed those actions. In July 2022, the U.S. National Academies of Sciences, Engineering and Medicine (NAS) concluded that there is sufficient evidence for an association between exposure to PFOA, PFOS, and five other PFAS compounds and increased risk of lowered antibody response in adults and children, decreased infant and fetal growth, and kidney cancer in adults.[2] Based on this association, NAS recommended that clinicians nationwide screen people with blood serum PFAS concentrations as low as 2 parts per billion for various health conditions. This new report adds to the overwhelming evidence that PFOA and PFOS pose a substantial danger to people around the world.

Does this text compete or complement other publications in the area – if so, which?

This text mischaracterizes hundreds of animal, human, and epidemiology studies on the health effects of PFOA, PFOS, and other PFAS compounds used by multiple public health agencies throughout the U.S. and the rest of the world. As a result, this document undermines every health-based guideline value developed by those public health agencies. *Chapter 7: Summary of Health Effects* dismisses every animal and human study cited in the document as too flawed to provide public health advice, including every study on immunotoxicity, liver disease, reproductive effects, decreased birth weights, kidney cancer, and thyroid hormone effects. *Chapter 9: Conclusions, Section 9.1 Considerations in Establishing Health-based Values* further states that because of the uncertainty in every animal and human study, WHO could not develop a health-based guideline value and instead had to develop a provisional guideline based on technology.

Every study has strengths and weaknesses, and there is uncertainty in every health study conducted, including randomized controlled studies. WHO ignores this truism, instead highlighting trivial inconsistencies and ignoring statistical methods developed specifically to address uncertainties for the purpose of assessing risks. We believe that WHO surely knows that the strong weight of evidence—numerous studies demonstrating the same effects—minimizes uncertainty, both categorical and statistical. WHO points to the widely varying public health guidelines for PFOA and PFOS across countries as evidence that the human health studies are too uncertain for use. We believe that WHO also surely knows that those differences reflect the unique factors applying to each country and the availability of data at the particular time that each

[1] https://www.ewg.org/news-insights/news/2022/09/pregnant-pfas-threat-forever-chemicals-cord-blood
[2] https://nap.nationalacademies.org/catalog/26156/guidance-on-pfas-exposure-testing-and-clinical-follow-up

guideline was developed.

Several national and international reviews of the health effects of PFAS have concluded that the health data are sufficient to warrant caution and public health protection. These include the European Food Safety Authority (EFSA), the US Agency for Toxic Substances and Disease Registry, the European Commission, and EPA. EPA is currently completing a comprehensive review of the PFOA and PFOS health and environmental science as the basis for national drinking water standards, scheduled for proposal in December 2022.

Is the level of guidance and information provided appropriate? Please consider the practical aspects and conclusion sections in particular.

This background document does not provide the level of rigor expected of WHO documents. It is deficient not only in its rigor, but in its method and its comprehensiveness. WHO did not conduct a systematic review of the health effects literature of PFOA and PFOS nor build upon the systematic reviews already conducted by EFSA in 2020,[3] EPA in 2021,[4] or the NAS in 2022 (ref. 2). Consequently, this document does not provide adequate guidance and information on those health effects. For instance, in *Chapter 7: Summary of Health Effects*, WHO arbitrarily summarizes a few animal and human studies and then dismisses all of them as too uncertain. Standard methods are to evaluate existing literature and recommend how each study comports with the weight of the evidence and if/where not, how to account for differences. Indeed, we do not understand how WHO could have ignored the entire body of health effects literature.

On the other hand, WHO's very high bar for accepting the results of health studies is inappropriately matched by a very low bar for accepting the results of technology studies. The document fails to provide adequate guidance on the technology basis for the provisional guidelines because WHO again failed to conduct a systematic review of the literature and select critical studies. *Section 8.4: Treatment Methods and Performance* acknowledges that the removal efficiency of PFAS from source water depends on variables such as influent concentrations, background contaminants in the water matrix, available treatments, and the range and characteristics of the PFAS species present. On page 76, line 32, the document simply states that "under optimized conditions and operation, it is reasonable to assume that RO and GAC treatment can reliably reduce PFOS and PFOA concentrations to below 0.1 ug/L." Only two studies are listed to support this provisional guideline. No information on these two studies is presented regarding the influent PFAS concentrations, background contaminants in the water matrix, the range and characteristics of the PFAS species present, or the optimized conditions and operation. On page 76, line 39, the document states: "when high pressure membrane processes or GAC operating under optimized conditions are exposed to higher total PFAS concentrations (within the range typically observed in the environment), they should be expected

[3] https://efsa.onlinelibrary.wiley.com/doi/full/10.2903/j.efsa.2020.6223
[4] https://www.epa.gov/sdwa/drinking-water-health-advisories-pfoa-and-pfos

to reduce total PFAS concentrations to below 0.5 ug/L." Only two studies are listed to support this provisional guideline. No information on these two studies is presented regarding the influent PFAS concentrations, background contaminants in the water matrix, the range and characteristics of the PFAS species present, or the optimized conditions. The sole basis of the WHO provisional guidelines appears to be four studies with little data presented about those studies. In order to support technology-based provisional guidelines, WHO should conduct a systematic review of studies on the treatment of PFAS-contaminated water and report the range of treatment effectiveness under varying influent PFAS species and concentrations and influent background contaminants. WHO should also identify the optimized conditions and operation needed to achieve PFAS removals for each recommended technology. WHO does not provide adequate technical justification for the provisional guideline of 100 ppt for individual PFOA and PFOS concentrations or the provisional guideline of 500 ppt for the total combined PFAS concentrations in drinking water.

Are there major omissions that should be corrected?

Because WHO did not conduct a systematic review of health effects studies or treatment technology studies, WHO has omitted many critical studies and mischaracterized the studies it does include.

WHO concludes that immunotoxicity may be the most sensitive health endpoint but then focuses on dismissing the immune suppression data. The WHO ignores the systematic reviews by authoritative bodies that concluded PFAS suppresses the immune system by decreasing vaccination effectiveness for multiple diseases in multiple populations and age groups, an effect that is also supported by experimental animal data as well as wildlife data. In 2016, the National Toxicology Program's systematic review evaluating the evidence of exposure to PFOA or PFOS and immune-related health effects identified 33 human studies, 93 animal studies, and 27 *in vitro*/mechanistic studies and concluded that both chemicals are presumed to be an immune hazard to humans based on a high level of evidence from animal studies and a moderate level of evidence from studies in humans.[5] Additional studies conducted over the past six years have added to the evidence of immune suppression.

WHO is trying to infer ecological-level associations from individual data, and thus committing the atomistic fallacy when arguing that the prevalence of infectious diseases should rise if PFAS is related to antibody changes. The most dramatic misunderstanding is on page 69, line 10: "for example, according to CDC (2019) data the number of new cases of diphtheria in the United States over a 40-year period was less than one per year on average. Additionally, a mode of action has not been established for immunotoxicity, and this endpoint is associated with high intraindividual variability." The diphtheria and tetanus vaccines are both so-called toxoids that stimulate generation of specific antibodies so that quantitative assessment of the outcome is

[5] https://ntp.niehs.nih.gov/ntp/ohat/pfoa_pfos/pfoa_pfosmonograph_508.pdf

feasible. This has nothing to do with the occurrence of the specific infections as such, but the WHO report from 2012 recommends this approach as an assessment of immune competence. PFAS suppression of antibodies produced in response to vaccinations raises a concern about the chemicals' suppression of antibodies produced in response to all diseases with or without vaccinations.

In addition, we suggest that the WHO review is misleading in regard to antibody responses to vaccinations. WHO has issued recommendations on the importance of immune challenge in detecting immunotoxicity in chemical risk assessments,[6] which are not cited in the review. The review states on page 34 that "studies report inconsistencies in the relationship between PFAS exposure and infection propensity in early life," ignoring studies from the Faroe Islands, Denmark, Japan, China, and elsewhere. Instead, it cites a 2022 report that was financed by the PFAS manufacturer 3M.[7] A better review of the subject was published earlier.[8]

Four studies show that childhood exposure to PFOA is associated with decreased concentrations of antibodies to diphtheria, tetanus, and *Haemophilus influenzae* type B (HiB) among children in Greenland, Germany, West Africa, and the Faroe Islands.[9,10,11,12] These associations were observed across multiple populations and at low-level serum PFOA concentrations and strengthen the body of evidence showing that PFOA is associated with reduced antibody response. A recent study of antibody response to COVID-19 vaccines among workers with a wide range of exposure to PFAS also found immune suppression, particularly for PFOS.[13]

Another concern is the review's treatment of early life PFOS exposures: "Post-natal transfer of PFOS is also possible via breastmilk, and breastmilk PFOS concentrations have been reported in several publications" (pages 18-19); "Placental transfer of PFOS was also shown to occur in rats, with fetal serum levels approximately 1–2 times greater than maternal serum levels at GD 20" (page 19); and, for PFOA, "[p]lacental and lactational transfer occurs for both PFOS and PFOA" (page 66). But the report does not consider developmental toxicity and barely mentions prospective studies in birth cohorts, both of which have been reviewed elsewhere.[14]

Another mischaracterization is on page 38, concerning prostate cancer: "the finding was not repeated in another case control study in a Danish population" (Hardell et al., 2014). Hardell actually found a significant PFOA-related excess risk (in Swedes) in the presence of family history of prostate cancer.

---

[6] https://apps.who.int/iris/handle/10665/330098 See Section 2.2
[7] https://pubmed.ncbi.nlm.nih.gov/35695909/
[8] https://pubmed.ncbi.nlm.nih.gov/30739020/
[9] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7303054/
[10] https://www.tandfonline.com/doi/full/10.1080/1547691X.2021.1922957
[11] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7416537/
[12] https://www.sciencedirect.com/science/article/pii/S0013935121010069?via%3Dihub
[13] https://www.sciencedirect.com/science/article/pii/S0160412022004640?via%3Dihub
[14] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7906952/

We find that ignoring all the data on cancer occurrence is problematic. More than five years ago, in 2017, the International Agency for Research on Cancer found PFAS to be a possible human carcinogen based in part on limited epidemiological evidence of associations with cancers of the kidney and testis in heavily exposed populations.[15] Since then, scores of studies have been published, and while each study has its strengths and weaknesses, the combined evidence is notable. Multiple studies have found higher incidence and mortality from kidney and testicular cancer associated with elevated PFOA/PFAS exposures. Similarly, studies show evidence of increased incidence and mortality risks related to prostate, ovarian, endometrial, non-Hodgkin lymphoma, pediatric leukemia, and thyroid cancers. The discounting and omission of all of these studies because of concerns of uncertainties is scientifically and medically indefensible.

Finally, we question some of the studies cited favorably within the WHO guidelines. Frequently, studies by G. Olsen and other 3M employees are cited. Please note that falsification of at least one of their publications has been demonstrated.[16] Furthermore, while literally hundreds of studies by academic researchers from across the world are rejected due to "excessive uncertainty in results," articles by privately paid researchers are cited favorably (e.g., M. Dourson). A clear pattern of censorship is evident.

The report repeatedly insists that the "critical" organ is controversial when in fact this is a manufactured controversy without scientific support.

Is there superfluous information that could be omitted?

We recommend that WHO delete all the health effects information in this document if WHO will not conduct a systematic review using a peer-reviewed protocol or base their document on a systematic review conducted by another entity using a peer-reviewed protocol. The current health effects information is incomplete and biased. We recommend instead that WHO conduct a systematic review of the technology literature and provide detailed support for technology-based provisional guidelines based on the best available science.

Are there errors of fact or interpretation that should be corrected – if so, what?

Section 8.4 Treatment Methods and Performance, page 77, lines 1-5, state that for resource-limited water systems, prioritization should be given to more imminent water quality risks, and expenditures for removal of contaminants such as PFAS should be justifiable and achievable. What is WHO recommending? Is WHO saying that resource-limited drinking water systems need only treat for acute, short-term risks posed by bacteria and viruses? Most chemical contaminants pose chronic, long-term risks that could not be characterized as imminent. Is WHO recommending that resource limited drinking water systems focus only on disinfection? If so, this is setting a very low bar for drinking water quality in resource-limited water systems, which are now required to treat

[15] https://publications.iarc.fr/547
[16] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6195218/

for a number of toxic chemicals posing chronic, long-term risks.

Additional comments

EPN is concerned that WHO is racing to get these provisional guidelines reviewed before EPA publishes a proposed MCL and MCLG for PFOA and PFOS in December 2022. That proposed rule will include a systematic review of the health studies in order to support the MCLG and a systematic review of the treatment technology studies in order to support the MCL. WHO should wait for EPA to provide this invaluable information before proceeding with a document that mischaracterizes and omits many critical studies on both health effects and treatment technology.

EPN is also concerned with the lack of transparency regarding the authors of the WHO report, who provided peer-review comments, and what organizations those authors and peer reviewers represent. EPN notes that this lack of transparency will be compounded with this public review because reviewers can choose to remain anonymous, and WHO will not post any comments received. WHO does not provide the public with any assurance that they have prevented a biased report by authors and reviewers with conflicts of interest.

In conclusion, EPN finds that the provisional guidelines reflect a biased and dangerous approach to public health protection that falsely equates the natural and unavoidable uncertainty inherent in all scientific studies with a lack of evidence. Health studies are summarily dismissed and technology-based standards proposed without adequate scientific basis. WHO has failed in its "rolling revision" process to ensure the relevance, quality, and integrity of the GDWQ by failing to include the latest scientific evidence and ensure their continuing development in response to new, or newly-appreciated, information and challenges.