

The Science Behind PFOA Safe Concentrations

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By Michael Dourson — February 14, 2019



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By Michael L. Dourson, Bernard Gadagbui, and Patricia M. McGinnis

Perfluorooctanoate (PFOA) is a simple 8-member carbon molecule that is combined with fluorine molecules. The end result is a chemical that resembles simple forms of fat that occur naturally in our bodies or the environment, but that do not break down to any significant extent. Although PFOA does not occur naturally in the environment, it is very useful (e.g., fire-fighting foam) and stable, and as a result very low concentrations are found in the environment in many places with a few places having much higher levels that may be harmful to our health.

One way governments protect our health from harmful PFOA exposures is to develop a safe or low-risk dose, essentially a dose of PFOA to which we can all be exposed during our lifetimes without experiencing any harmful effects. This dose is determined by qualified scientists after all available and appropriate studies are reviewed. Most of these studies are done in laboratory (experimental) animals, but when human exposures occur these are also considered. These safe or low-risk doses go by various names, for example, the Reference Dose (RfD) of the U.S. Environmental Protection Agency (EPA) (Barnes and Dourson, 1988).

Several safe or low-risk doses have been estimated for PFOA by different governments. Unfortunately, these safe doses differ widely. This is due in part because scientists have not agreed on PFOA's **critical effect**, which scientists define as the first effect judged to be harmful at the lowest dose. For example, US EPA (2016) judges the critical effect to be fetal toxicity in mice exposed during pregnancy. The European Food Safety Authority (EFSA, 2018) judges the critical effect to be an increase in serum total cholesterol in humans.

However, another, and perhaps more important reason for the disagreement among governments is that many scientists assume that the critical effect of PFOA is due to the length of time it takes to clear PFOA from our bodies (i.e., its half-life) rather than due to its peak concentration in blood (i.e., its maximum concentration or Cmax) (Health, 2019). For example, EPA assumed that the critical effect used to develop its safe dose for PFOA was due to its half-life and not its Cmax. Scientists associated with Toxicology Excellence for Risk Assessment (TERA) are not so sure (TERA, 2018). Thus, it has become important to consider whether the critical effect of PFOA is due to its half-life or its Cmax.

In this regard, a preliminary research case study is being proposed at a [Beyond Science and Decisions workshop](#) [2] in February 2019. Here, half-life and Cmax information are compiled from experimental (laboratory) work in mice described by Lau et al. (2006) and Lou et al. (2009), and compared with new half-life and Cmax information found in humans exposed to PFOA as part of a cancer clinical trial (Elcombe et al., 2013, Convertino et al., 2018). Although human populations are generally exposed to much lower levels of PFOA than those used in these experimental animals or clinical human studies, the comparison of half-life and Cmax values between these studies are in agreement with current guidelines of IPCS (2005) and EPA (2014).

Safe or low-risk doses for PFOA and related chemicals by various governments are currently widely disparate. Fortunately, recent findings in humans may reduce some of this disparity. Efforts to use this newer information should allow for harmonization, or at least more consistency, in government positions.

This article was written by Michael L. Dourson, PhD., DABT, FATS, FSRA (who also serves on ACSH's Board of Scientific Advisors), Bernard Gadagbui, MS, PhD, DABT, ERT, and Patricia M. McGinnis, PhD, DABT.

References

- Barnes, D.G. and M.L. Dourson. 1988. Reference dose (RfD): Description and use in health risk assessments. *Regul Toxicol Pharmacol.* 8: 471-486.
- Convertino, M., Church, T.R., Olsen, G.W., Liu, Y., Doyle, E., Elcombe, C.R., Barnett, A.L., Samuel, L.M., MacPherson, I.R., Evans, T.R. 2018. Stochastic Pharmacokinetic-Pharmacodynamic Modeling for Assessing the Systemic Health Risk of Perfluorooctanoate (PFOA). *Toxicol Sci.* 163(1):293–306.
- Elcombe, C.R., C. R. Wolf, and A.L. Westwood. 2013. US Patent Application Publication, Pub. No.: US 2013/0029928 A1, January 31.
- European Food Safety Authority (EFSA). 2018. Risk to human health related to the presence of perfluorooctane sulfonic acid and perfluorooctanoic acid in food. *EJ EFSA Journal.* doi: 10.2903/j.efsa.2018.5194.
- Health, Jenifer. 2019. What Is A Safe Level Of PFOA? American Council on Safety and Health. See: <https://www.acsh.org/news/2019/01/31/what-safe-level-pfoa-13775> [3].
- Lau, C., Thibodeaux, J.R., Hanson, R.G., Narotsky, M.G., Rogers, J.M., Lindstrom, A.B., Strynar,

M.J. 2006. Effects of perfluorooctanoic acid exposure during pregnancy in the mouse. *Toxicol Sci.* 90(2):510–8.

Lou, I., Wambaugh, J.F., Lau, C., Hanson, R.G., Lindstrom, A.B., Strynar, M.J., Zehr, R.D., Setzer, R.W., Barton, H.A. 2009. Modeling single and repeated dose pharmacokinetics of PFOA in mice. *Toxicol Sci.* 107(2):331–41.

IPCS (International Programme on Chemical Safety). 2005. [Chemical-specific adjustment factors for Interspecies differences and human variability: Guidance document for use of data in dose/concentration-response assessment](http://www.who.int/ipcs/methods/harmonization/areas/uncertainty/en/index.html) [4]. Geneva Switzerland. Available at www.who.int/ipcs/methods/harmonization/areas/uncertainty/en/index.html [5]

Toxicology Excellence for Risk Assessment (TERA). 2018. Comment #43 on Draft Toxicological Profile for Perfluoroalkyls by the Agency for Toxic Substances and Disease Registry (ATSDR)

See:

<https://www.regulations.gov/docketBrowser?rpp=25&so=DESC&sb=commentDueDate&po=50&D=ATSDR-2015-0004> [6].

U.S. EPA (U.S. Environmental Protection Agency). 1991. Guidelines for Developmental Toxicity Risk Assessment. *Fed Regist* 56(234): 63798-63826. December 5.

U.S. Environmental Protection Agency (EPA). 2014. Guidance for Applying Quantitative Data to Develop Data-Derived Extrapolation Factors for Interspecies and Intraspecies Extrapolation. EPA/100/R-14/002F. September.

U.S. Environmental Protection Agency (EPA). 2016. Drinking Water Health Advisory for Perfluorooctanoic Acid (PFOA). Office of Water (4304T) Health and Ecological Criteria Division Washington, DC 20460. EPA 822-R-16-005. https://www.epa.gov/sites/production/files/2016-05/documents/pfoa_health_advisory_final-plain.pdf [7]

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[2] https://tera.org/Alliance%20for%20Risk/ARA_Dose-Response.htm

[3] <https://www.acsh.org/news/2019/01/31/what-safe-level-pfoa-13775>

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[7] https://www.epa.gov/sites/production/files/2016-05/documents/pfoa_health_advisory_final-plain.pdf