PFAS – Beyond PFOA and PFOS
National Perspective

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PFOA AND PFOS CHAOS

Drinking Water Guidelines (in ppt)

	PFOA	PFOS
U.S. EPA	70	70
California	14	13
Connecticut	70	70
Massachusetts	20	20
Michigan	8	16
Minnesota	35	15
New Hampshire	12	15
New Jersey	14	13
New York	10	10
Vermont	20	20

WHY ARE THERE SO MANY DIFFERENCES?

- Development of risk-based drinking water guidelines involves several decisions regarding models and inputs requiring scientific judgment. This is particularly true for PFAS
  - Critical effect/critical study
  - Appropriate uncertainty factors
  - Method for extrapolating doses from animals to humans
    - Unlike most chemicals, there are blood concentration data for many of the toxicity studies
    - Pharmacokinetic data available for a number of laboratory animal species/strains and for humans
    - Uncertainty about some of the pharmacokinetic parameters and the correct concentration metric (average concentration, peak concentration, or something else)
  - The appropriate receptor and associated exposure parameters (e.g., generic adult, pregnant woman, breastfed infant)

STATES WITH GUIDELINE VALUES FOR OTHER PFAS (PPT)

	PFNA	PFHxS	PFHpA	PFDA	PFBA	PFHxA	PFBS	GenX
Connecticut	70	70	70					
Massachusetts	20	20	20	20			2000	
Michigan	6	51				400,000	420	370
Minnesota		47			7000		2000	
New Hampshire	11	18						
New Jersey	13							
North Carolina								140
Vermont	20	20	20					

Adapted from Post presentation SETAC PFAS workshop August 2019

DEALING WITH EXPOSURE TO MULTIPLE PFAS

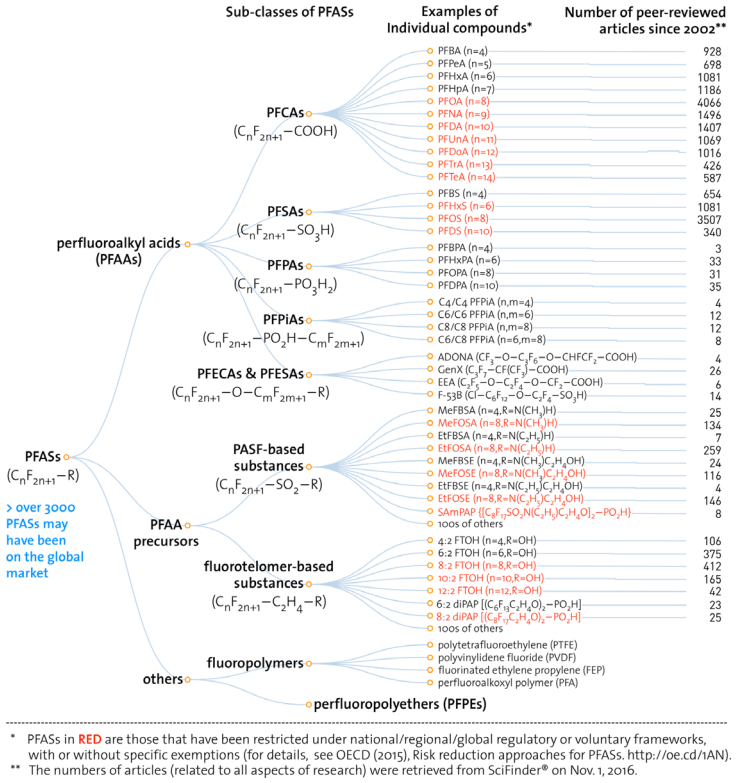
	Guideline Value (ppt)	Sum of
EPA	70	PFOA + PFOS
Connecticut	70	PFOA + PFOS + PFNA + PFHxS + PFHpA
Massachusetts	20	PFOA + PFOS + PFNA + PFHxS + PFHpA + PFDA
Vermont	20	PFOA + PFOS + PFNA + PFHxS + PFHpA

WOULD A TEF APPROACH (LIKE DIOXIN) WORK FOR PFAS?

- The TEF (Toxic Equivalency Factor) approach is well established for mixtures of related compounds such as cancer effects from dioxin and polycyclic aromatic hydrocarbons.
- The concept is that these chemicals are closely related toxicologically as well as chemically, producing the same effects through the same mechanism, albeit with different potencies.
- The problems for PFAS:
  - It is not clear whether they have a common critical effect
  - There is little information on mechanism(s) of toxicity
  - The number of chemicals of potential interest is extremely large (thousands) and chemically diverse

THE SCOPE OF THE PROBLEM

- PFAS are numerous with diverse chemistry
- There are many uses, and therefore many sources of exposure
- Virtually everyone has PFAS in their blood
- Some PFAS are being phased out, but are being replaced by other PFAS
- Knowledge regarding potential health effects is limited to a relative handful of compounds



from Wang et al., ES&T 51:2508-2518, 2017

"WE'RE NOT GOING TO BE ABLE TO TEST OUR WAY OUT OF THIS"

- EPA and NTP are using a Tox21 approach for PFAS (see Patlewicz et al., EHP 2019)
- An initial library of 75 PFAS have been selected as priority for tiered toxicity and toxicokinetic testing, representing various categories of PFAS
- The 75 compounds are undergoing high throughput toxicity (HTT) testing:
  - In vitro assays focused on endpoints such as hepatotoxicity, immunotoxicity, developmental toxicity, and assays to predict toxicokinetics
  - These data will be used to support read-across
- The objective is to combine in vitro data with data on human exposure to develop a Biological Exposure Ratio (BER) to prioritize chemicals for in vivo testing.