

# PFAS risk implications in the general food supply: Is commercial food “safe”?

BEYOND SCIENCE AND DECISION WORKSHOP XIV

Washington, D.C.

Usha Vedagiri, Ph.D., VP.

WSP, Oakland, California

# Acknowledgements

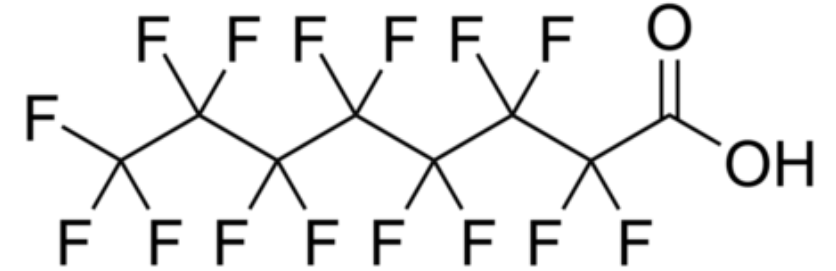
- Thomas Blackmon, M.S. – Assistant Consultant, Toxicologist, WSP
- Violaine Desgens-Martin, Ph.D. – Consultant, Toxicologist, WSP



Produce image source: <https://www.ardrossanherald.com/news/17821393.free-drop-in-messy-munchers-parents-babies-beith/>

# Outline

- **Understanding the question**
  - Defining “Commercial food supply”
  - Defining “Safe”
  - Which PFAS?
- **Understanding the answers**
  - FDA Approach
  - USDA Approach
  - Other studies
- **Where do we go from here?**
  - What we know/ don’t know
  - What we really need to know



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# Understanding the Question

# Safe **Commercial** Food Supply?

## Defining and Regulating **Commercial** Food Supply



### USEPA (US Environmental Protection Agency)

- Foods that are not home-grown, not harvested for recreation or subsistence
- Regulates only pesticides and some pathogens in food
- Not involved with PFAS in commercial foods



### USDA (US Department of Agriculture)

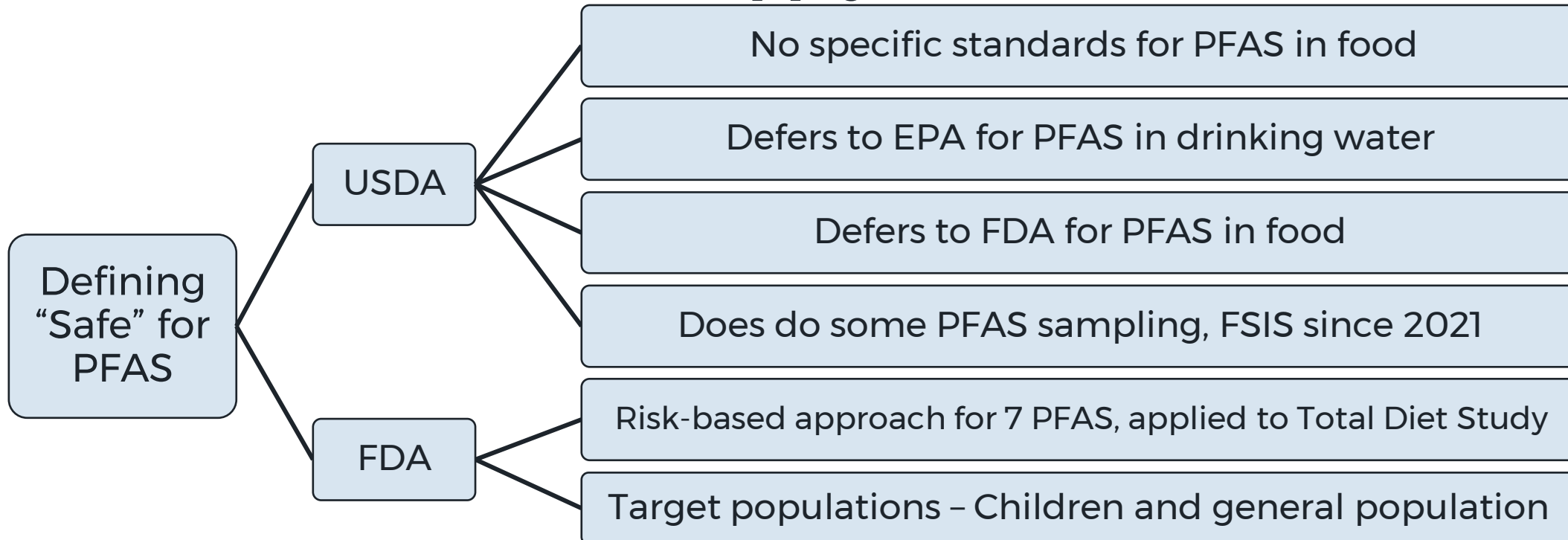
- Oversees farming, ranching and forestry industries
- Raw produce, Meat, Poultry and processed egg products
- Some overlap with the FDA



### FDA (Food and Drug Administration)

- Food and dietary supplements introduced into or offered for sale in interstate commerce by retail and food-service industries (e.g., restaurants, grocery stores, institutions), including food contact materials (e.g., packaging, handling); Also regulates bottled water (not included in this presentation)

# Safe Commercial Food Supply?



## Which PFAS?

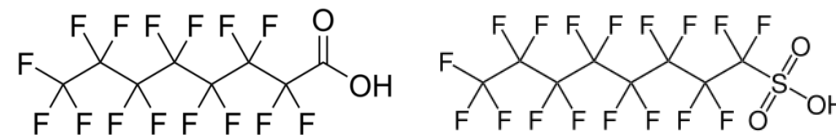
FDA – 7  
PFAS with  
TRVs

- PFOA
- PFOS
- PFNA
- PFHxS
- HFPO-DA [GenX]
- PFBS
- PFBA

Other PFAS

- Not assessed (even if detected)

$$\text{Risk} = \text{Exposure} * \text{Toxicity}$$



TRVs=Toxicity Reference Values

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# Understanding the Answers

# FDA Approach to PFAS in Food

Develop analytical methods for PFAS in Food (2021)

Execute sampling program – fresh and processed foods (2019-2023)

Perform human health assessment for sample data (2020-2023)

Provide recommendations (2020-2023)

Separately authorize PFAS in specific food contact applications (Beginning in 2016)

# FDA – Analytical Methods

|                                                      | <b>Food</b>                                                                                                     | <b>Seafood</b>                                                          | <b>Food and Feed</b>                                                                                       |
|------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------|
| <b>Method</b>                                        | <b>LC-MS/MS<br/>Method C-010.02</b><br>(method C-010.01 to which additional matrices were added)                | <b>LC-MS/MS<br/>Method C-0.10.02 + 4<br/>more analytes added</b>        | <b>LC-MS/MS<br/>Method C-0.10.02 +<br/>16 more analytes added</b>                                          |
| <b>Matrices</b>                                      | <b>Dairy, grains, produce,<br/>salmon, infant formula,<br/>cereal, gelatin, cream cheese,<br/>pancake syrup</b> | <b>Clams, crab, tuna,<br/>shrimp, tilapia, cod,<br/>salmon, pollock</b> | <b>Lettuce, milk<br/>(chocolate), salmon,<br/>bread, eggs, clams,<br/>blueberries, silage, corn</b>        |
| <b># Validated PFAS<br/>Analytes</b>                 | <b>16</b>                                                                                                       | <b>20</b>                                                               | <b>30</b>                                                                                                  |
| <b>Detection Limits/<br/>LOQs in µg/kg<br/>(ppb)</b> | <b>MDL: 0.003 - 0.067</b>                                                                                       | <b>MDL: 0.011 - 0.345</b>                                               | <b>For PFOS, PFOA, PFNA, PFHxS,<br/>EURL POP LOQs: 0.005 - 0.300<br/>FDA Method<br/>LOQ: 0.005 - 0.180</b> |

# Total Diet Study – Sample collection regions and materials



*Total Diet Study collection regions based on population size*

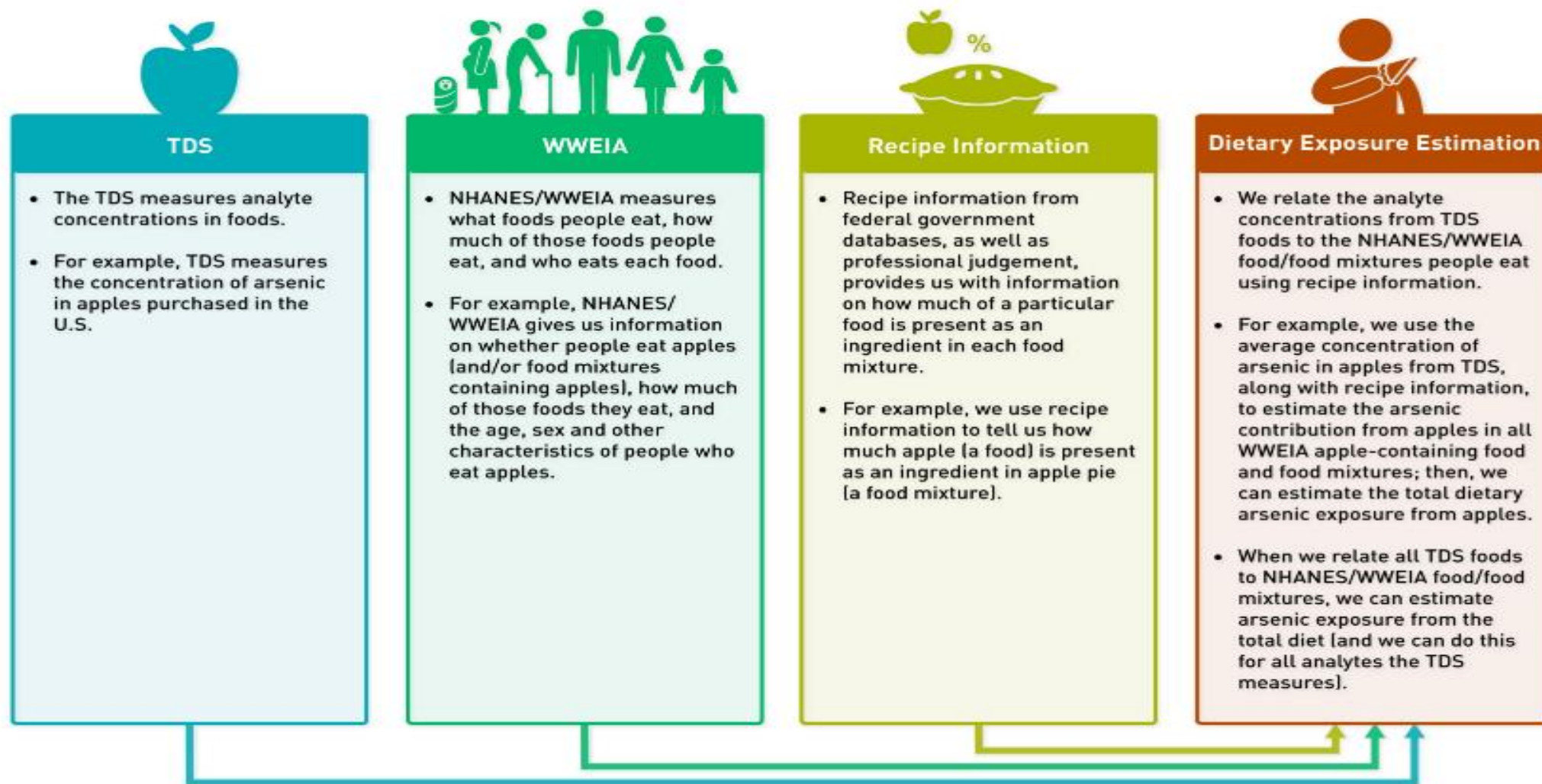
Source: FDA TDS: Design and Implementation

- > 900 items included in TDS Sampling: Dairy, Cooked and/or processed meats, eggs, fish, shellfish, produce, nuts, grains, breads, pastas, cereals, fruits, desserts, condiments, oils, beverages, infant foods
- Focus on single ingredient foods over food type mixtures.
- Data combined into one single “market basket”, consisting of regional or national combinations of the sampled foods.



# FDA – Exposure Assessment – Total Diet Study

## *Dietary Exposure Estimation using TDS Data*



WWEIA – What We Eat in America

NHANES – National Health and Nutrition Examination Survey

# FDA TDS Data and Findings (2019-2023)



|                                   | General Food Supply (TDS) (2019 – 2023)                                   | Seafood (TDS) Subset                                     | Targeted Seafood Study (2022)                                                                |
|-----------------------------------|---------------------------------------------------------------------------|----------------------------------------------------------|----------------------------------------------------------------------------------------------|
| Total # samples analyzed          | 711<br>(excludes bottled water samples, n=7)                              | 30                                                       | 81                                                                                           |
| # of samples detected             | 17 (2.4%)                                                                 | 14 (47%)                                                 | 60 (74%)                                                                                     |
| Food categories with detections   | Fish, Meat, Shrimp, Beef, Fish (processed), Tuna (canned), Protein powder | Cod, Tilapia, Fish Sticks, Tuna (canned), Shrimp, Salmon | PFAS were detected in all seafood samples (e.g., Crabs, Clams and Tuna (100%); Shrimp (10%)) |
| Detected PFAS*                    | PFNA, PFDA, PFOS, PFUdA, PFDoA, PFTTrDA                                   | PFNA, PFDA, PFOS, PFUdA, PFDoA, PFTTrDA                  | PFHxA, PFHpA, PFOA, PFNA, PFDA, PFUdA, PFDoA, PFTTrDA, PFTeDA, PFBS, PFHxS, PFOS             |
| Concentration range (µg/kg) (ppb) | 0.023 – 0.233                                                             | 0.023 – 0.233                                            | ND – 20<br>(max: Canned Clams)                                                               |

## FDA – PFAS Toxicity Values

| Compound            | Oral RfD<br>(mg/kg/day) | Critical Effect (Non-cancer)                     |
|---------------------|-------------------------|--------------------------------------------------|
| PFOA*               | $3 \times 10^{-6}$      | Skeletal effects in mice; UF = 300               |
| PFOS*               | $2 \times 10^{-6}$      | Developmental effects in rats; UF/MF = 30/10     |
| PFHxS*              | $2 \times 10^{-5}$      | Hyperplasia in thyroid rats; UF/MF = 30/10       |
| PFNA*               | $3 \times 10^{-6}$      | Developmental delays in mice; UF/MF = 30/10      |
| PFBS**              | $3 \times 10^{-4}$      | Decreased serum total T4 in mice; UF = 300       |
| HFPO-DA**<br>(GenX) | $3 \times 10^{-6}$      | Liver lesions in parental female mice; UF = 3000 |
| PFBA**              | $1 \times 10^{-3}$      | Hepatic and thyroid effects in rats; UF = 1000   |

Sources:

\* ATSDR (2021) Intermediate MRL; \*\* USEPA (2021-2023), Chronic Oral RfD

# FDA – PFAS Health Assessment Status

## TOTAL DIET STUDY (2019-2022)

- “Market baskets” of 24 regional + 2 national food collections ; > 700 samples collected, only 25% of market basket complete
  - **Cannot draw conclusions about specific foods**
  - **No indication that the PFAS at the levels found in the limited sampling of foods collected for the TDS present a human health concern.**

## TARGETED SEAFOOD STUDY (2022, 2023)

- 2022 - Sampled 6 **finfish** species, 2 **shellfish** species, and one **crustacean** species
  - **Canned clams from China may be a concern for PFOA**
- 2023 – Additional bioaccumulation studies in filter feeders
  - Clams, oysters, mussels, scallops

## GEOGRAPHIC AREAS CONTAMINATED WITH PFAS

- In collaboration with states (**dairy farm, produce, cranberries**)
- FDA notes that analyses demonstrate that **food grown in PFAS contaminated environments may not contain detectable PFAS**
- The type of PFAS and food characteristics are a few of the factors affecting PFAS uptake

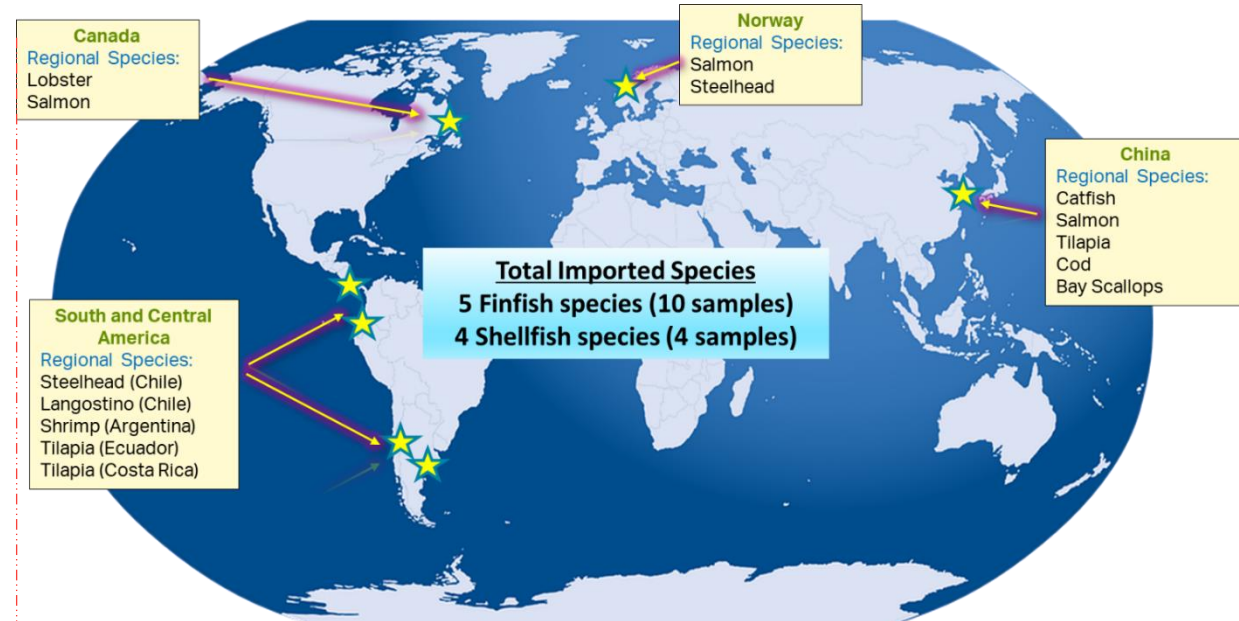
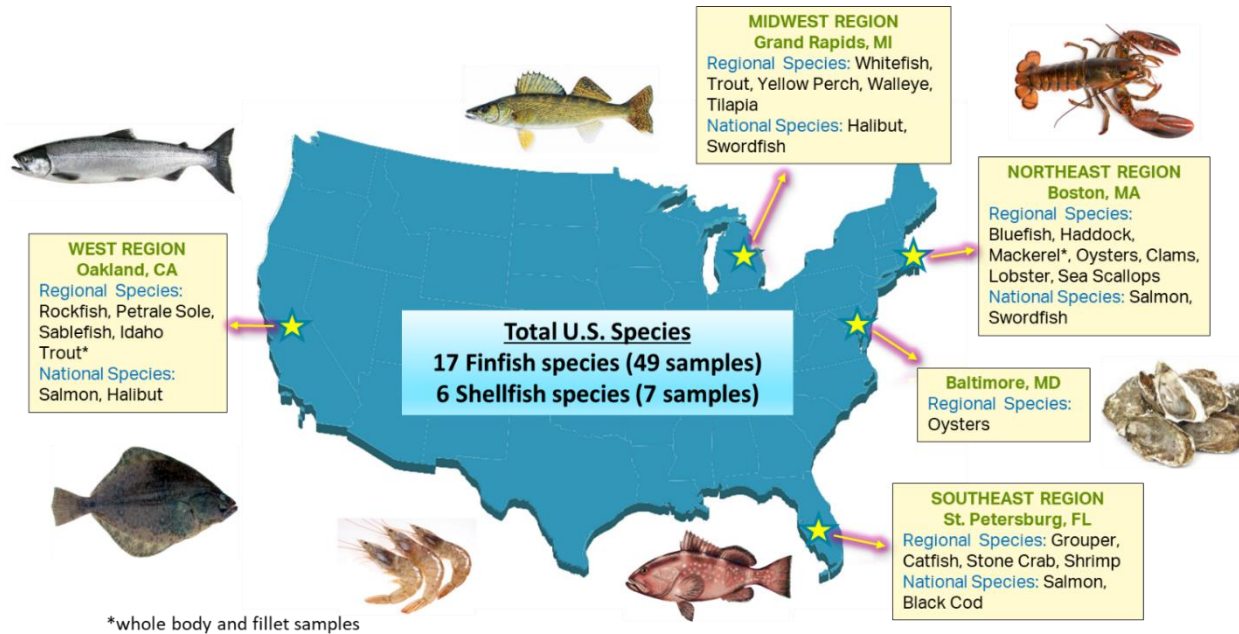
## USDA FSIS Monitoring Data and Findings (2021-2022)

|                                            | 2021                                                             | 2022                                                                                |
|--------------------------------------------|------------------------------------------------------------------|-------------------------------------------------------------------------------------|
| <b>Total # samples analyzed</b>            | <b>2153</b>                                                      | <b>1591</b>                                                                         |
| <b># of samples detected</b>               | <b>49 (2.3%)</b>                                                 | <b>41 (2.6%)</b>                                                                    |
| <b>Food categories with detections (#)</b> | <b>Cattle (1), Market Swine (1), Siluriformes (catfish) (47)</b> | <b>Cattle (1), Young Chicken (1), Siluriformes (catfish) (39)</b>                   |
| <b>Food categories without detections</b>  | <b>Sow, Swine, Whole Chicken, Young Chicken</b>                  | <b>Sow, Swine, Swine (Feral &amp; Market), Chicken, Chicken (Whole &amp; Young)</b> |
| <b>Detected PFAS</b>                       | <b>PFOS, PFDA, PFUnA, PFDS, PFTTrDA, PFHpA</b>                   | <b>PFOS, PFDA, PFUnA, PFDS, PFDoA</b>                                               |
| <b>Concentration range (µg/kg) (ppb)</b>   | <b>0.52 - 65</b>                                                 | <b>0.53 - 28</b>                                                                    |

FSIS – Food Safety and Inspection Service

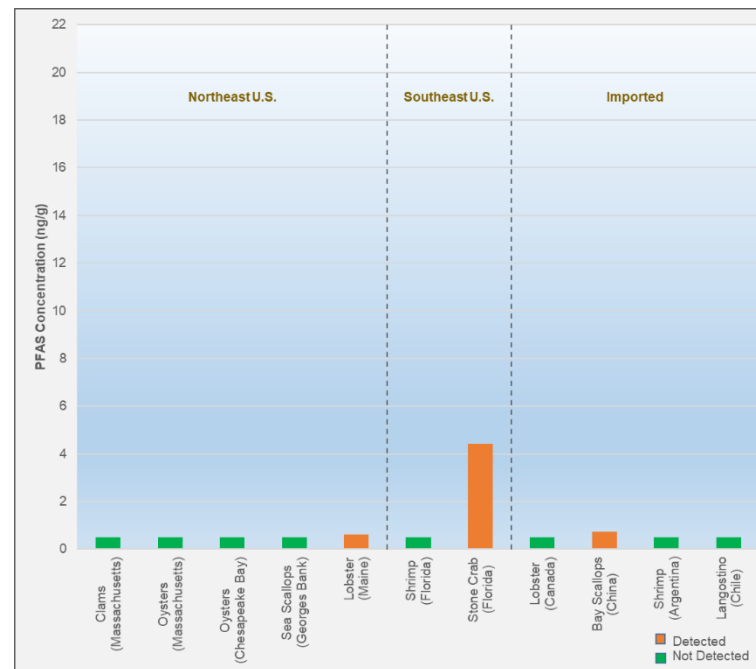
# Commercial Fish/Seafood Study - Ruffle, Vedagiri, et al (2020)

- 70 purchased samples of fish and shellfish from 4 US regional markets
- PFAS detections in 21 samples (30%)



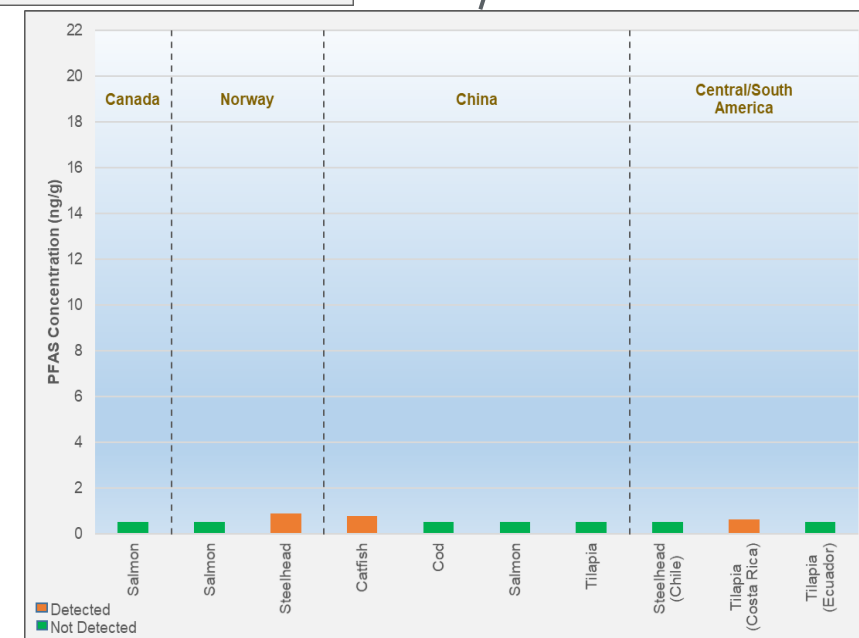
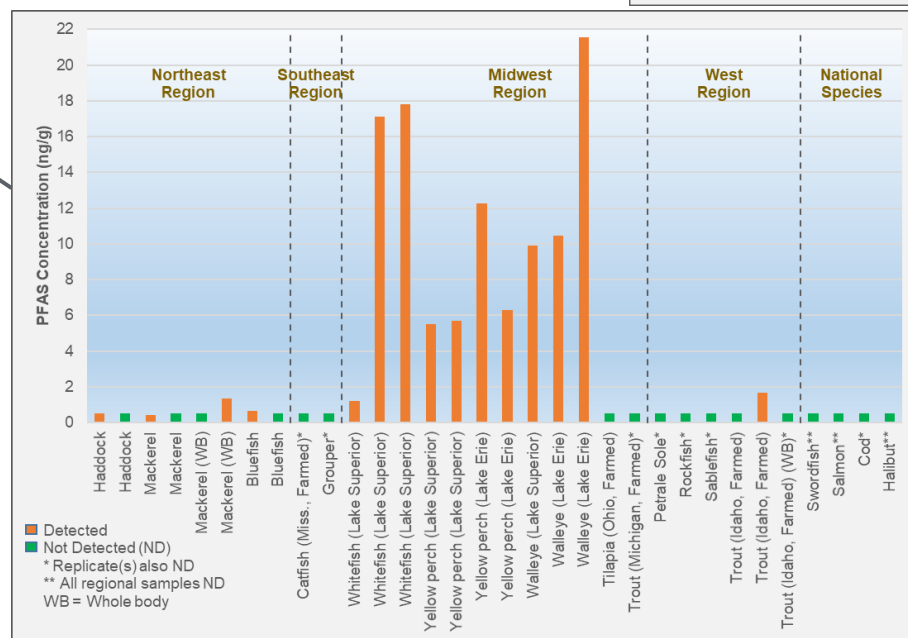
# Commercial Fish/Seafood Study - Ruffle, Vedagiri, et al (2020)

- Total PFAS < 10 ppb, PFOS dominant.
- Higher PFAS in Great Lakes area finfish
- International samples generally non-detect



International

U.S. regional samples



# WSP Inappropriate Risk Assessment for Commercial Food Supply / Why TDS is Important

| PFAS Analyte and Oral RfD (mg/kg/day) | Max detected PFAS in food item (mg/kg) | Assumed Ingestion rate (95 <sup>th</sup> , Child, Adult) (mg/kg/day) | Screening Level (Target HQ=1) (mg/kg) | Non-cancer Hazard Quotient (HQ) |                    |
|---------------------------------------|----------------------------------------|----------------------------------------------------------------------|---------------------------------------|---------------------------------|--------------------|
|                                       |                                        |                                                                      |                                       | Child (Birth - < 6 years)       | Adult (6-26 years) |
| PFOA<br>3 x 10 <sup>-6</sup>          | Fish (Cod): 0.0001                     | Child: 4,900<br>Adult: 2,900                                         | 6.12E-04<br>1.03E-03                  | 0.2                             | 0.1                |
|                                       | Shellfish (Clam): 0.02                 | Child: 3,500<br>Adult: 2,200                                         | 8.57E-04<br>1.36E-03                  | 23                              | 15                 |
| PFOS<br>2 x 10 <sup>-6</sup>          | Cattle: 0.028                          | Child: 9,600<br>Adult: 6,700                                         | 2.08E-04<br>2.99E-04                  | 134                             | 94                 |
|                                       | Siluriformes (catfish): 0.065          | Child: 4,900<br>Adult: 2,900                                         | 4.08E-04<br>6.90E-04                  | 159                             | 94                 |
| PFNA<br>3 x 10 <sup>-6</sup>          | Fish (Cod): 0.0002                     | Child: 4,900<br>Adult: 2,900                                         | 6.12E-04<br>1.03E-03                  | 0.3                             | 0.2                |

- HQs based on assumed consumption of maximum detected concentration in single food item from TDS, Targeted Seafood, USDA or Fish and Seafood Study at the highest 95<sup>th</sup> percentile ingestion rate per age group for Consumers Only for entire food group, from USEPA Exposure Factors Handbook. Therefore, these are very conservative assumptions.
- Although these assumptions can be used for risk screening for food ingestion from locally contaminated sites, they do not represent the diverse source areas, suppliers, and products that comprise commercially-available foods. The “market basket” approach of the Total Diet Study is more representative of an integrated evaluation of risks related to purchased foods.

# FDA - Authorized Uses in Food Packaging

## Non-stick cookware

- **Bound polymerized coating with low migration potential**

## Gaskets, O-Rings and parts in food processing equipment

- **Migratable PFAS removed from resins**

## Processing aids to reduce buildup in food manufacturing equipment

- **Low PFAS quantity used**

## Paper and paperboard food packaging

- **Phase-outs due to potential for the attached PFAS “sidechain” to detach and migrate under certain conditions**



# States with food-packaging regulations for PFAS

## Food Packaging Restrictions

Currently, about 10 states have passed PFAS regulations for food-packaging

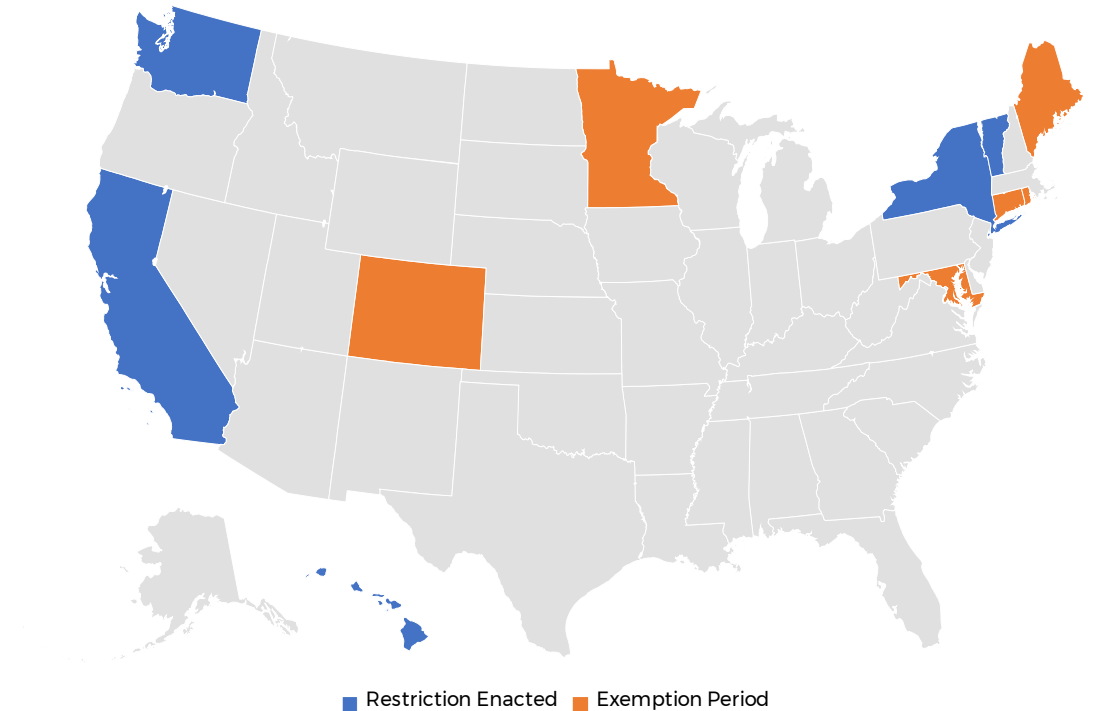
— Enacted states

— CA, WA, HI, NY, VT

— Exemption states

— CO, MN, MD, CT, ME

e.g., California Assembly Bill 1200 bans intentionally-added PFAS, as represented by 'total organic fluorine' greater than 100 ppm (0.01%)



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Where do we go  
from here?

## Summary – What We Know

- Target PFAS - **Low detection frequency** in general food supply
- **Produce, fruits, grains** – generally non-detect
- Foods with most detections – **fish and shellfish > beef, other meat products**
- Most frequently detected in food – **PFOS**
- Detected PFOS concentrations in fish/seafood:  
**<25 ppb average (Range (detections): 0.03 – 64.8 ppb)**
- **Local sources and non-commercial food supplies can be a concern**



# Summary – What We Don't Know

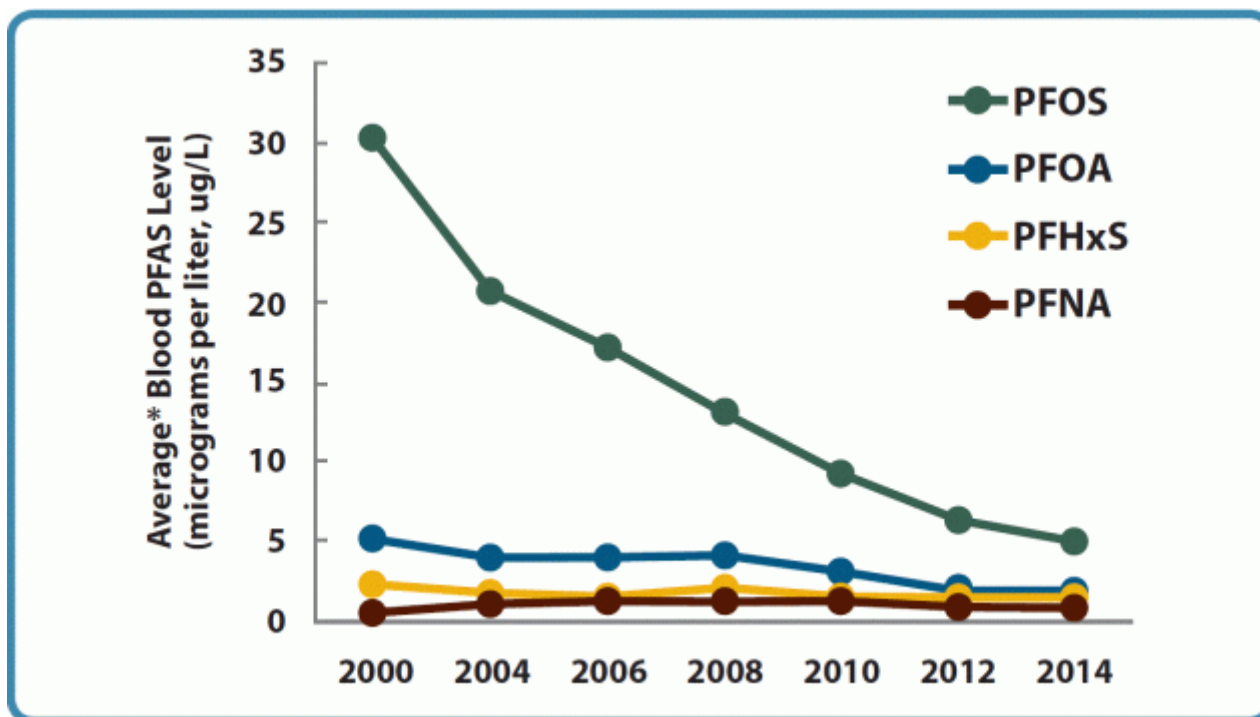
- **Uncertainties**

- Non-target PFAS – unknown occurrence
- PFAS without TRVs – not addressed in risk assessments
- Additivity – unknown
- PFAS in food vs blood serum trends and target levels



# PFAS Trends in Blood Serum – US Population

## Blood Levels of the Most Common PFAS (2000-2014)



<https://www.atsdr.cdc.gov/pfas/health-effects/us-population.html>

## NASEM Clinical Guidelines (2022)

### Sum of multiple PFAS

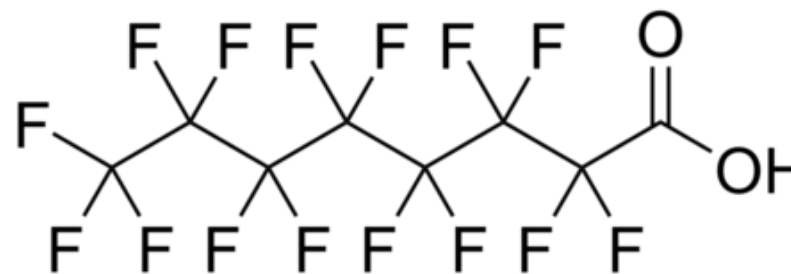
**0-2 ug/L** – Adverse effects unlikely

**2-20 ug/L** – Potential for adverse effects in sensitive sub-populations; health screening advised

**>20 ug/L** – Higher risk of adverse effects; health screening and testing advised;

[PFAS Guidance Highlights.pdf \(nationalacademies.org\)](#)

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25

# Key References

1. [Food Chemical Safety | FDA](#)
2. [FDA vs. USDA: What's the Difference?](#)
3. [USDA Farm Production and Conservation \(PFAS\)](#)
4. [USDA FSIS Sampling Updates](#)
5. [Chemical Residues and Contaminants | Food Safety and Inspection Service \(usda.gov\)](#)
6. [Testing Food for PFAS and Assessing Dietary Exposure | FDA](#)
7. [Determination of 16 Per and Polyfluoroalkyl Substances \(PFAS\) in Processed Food using Liquid Chromatography-Tandem Mass Spectrometry \(LC-MS/MS\)](#)
8. [Authorized Uses of PFAS in Food Contact Applications | FDA](#)
9. [Analysis of Per- and Poly\(fluoroalkyl\) Substances \(PFASs\) in Highly Consumed Seafood Products from U.S. Markets | Journal of Agricultural and Food Chemistry \(acs.org\)](#)
10. [Analyte and matrix method extension of per- and polyfluoroalkyl substances in food and feed | Analytical and Bioanalytical Chemistry \(springer.com\)](#)
11. [FDA Total Diet Study \(TDS\): Design and Implementation | FDA](#)
12. [Analytical Results of Testing Food for PFAS from Environmental Contamination | FDA](#)
13. [Perfluoroalkyl Substances in U.S. market basket fish and shellfish - PubMed \(nih.gov\)](#) (Ruffle, Vedagiri, et al., 2020).
14. Exposure factors handbook. USEPA.2011, 2018
15. [Guidance on PFAS Exposure, Testing, and Clinical Follow-Up | The National Academies Press \(2022\)](#)

Sites accessed between October 12 and October 17, 2023



# Thank you



[wsp.com](http://wsp.com)