PFAS in Breast Milk
Clinical Perspectives in Exposure Reduction

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Workshop on PFAS Information Gathering

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PFAS in Breast Milk from the United States

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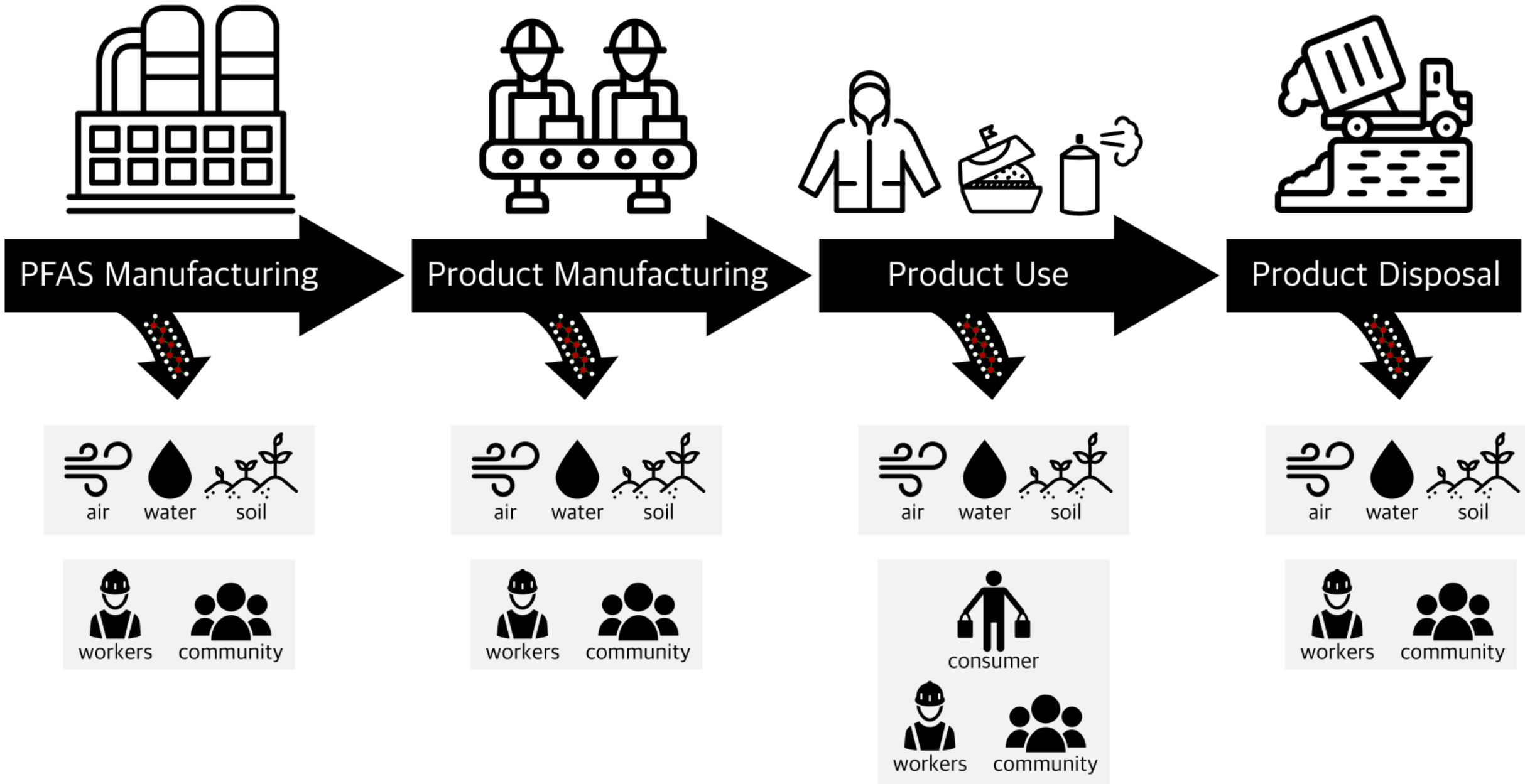
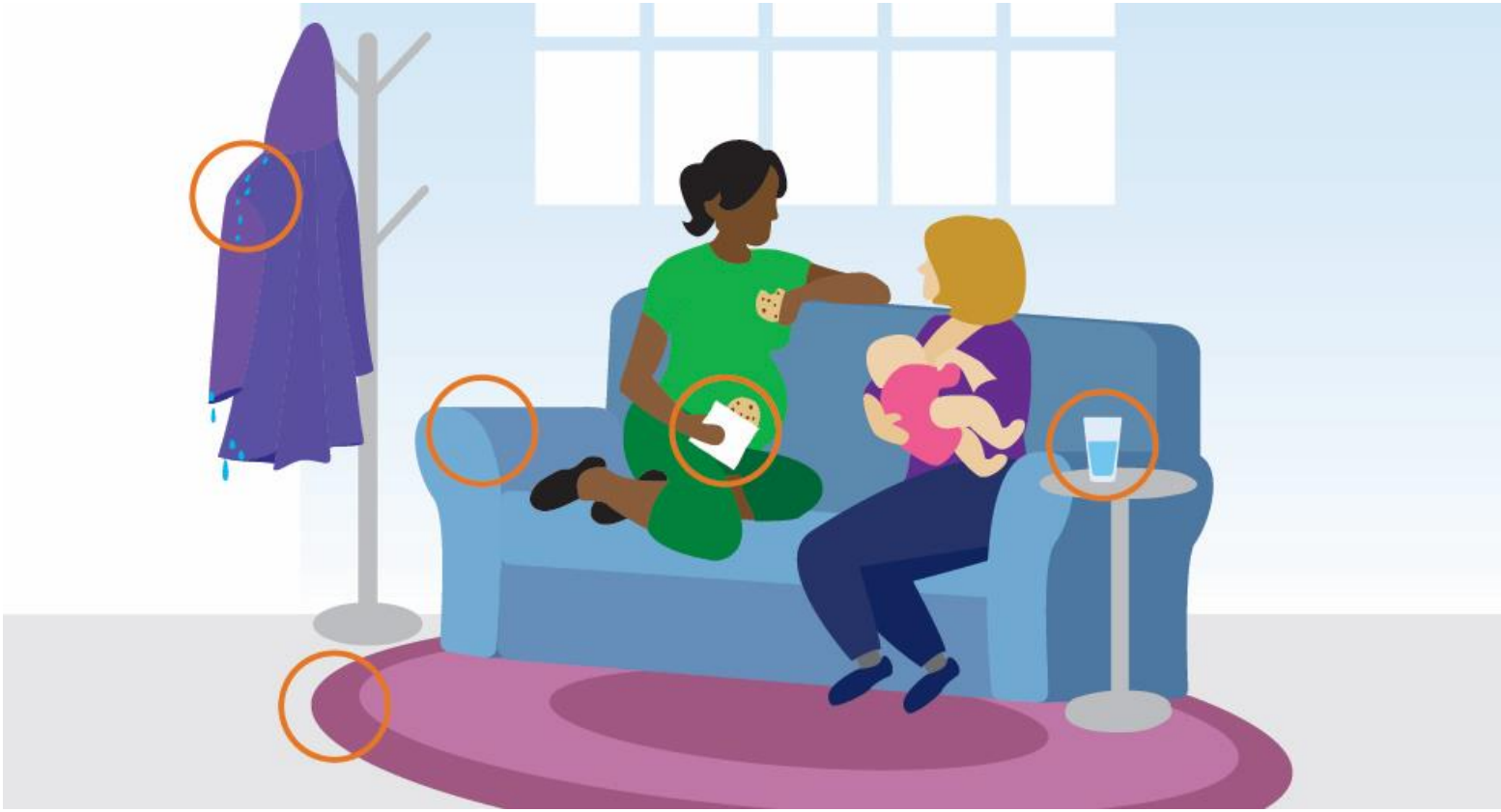

PFAS Manufacturing
Product Manufacturing
Product Use
Product Disposal
air
water
soil
workers
community
consumer

Result: Exposures From Multiple Sources & Routes

- Food
- Drinking water
- Indoor air
- House dust
- Cord blood, breast milk



Early-life PFAS Exposure

- Early-life exposure may lead to adverse effects later in life
- Breastfeeding is an important exposure pathway
- The last two studies on PFAS in breast milk from the U.S. mothers date back to 2004
- More recent studies from Asia have reported build up of the current-use PFAS

PFAS in Breast Milk Study

- Recruited 50 first-time moms residing in and near Seattle, WA (2019)
- Outreach via parenting groups, social media, paper flyers
- Moms asked to manually express 50 ml into a provided glass container
- Researchers collected milk within 24 hours and maintained frozen samples until shipment for analysis

Demographics

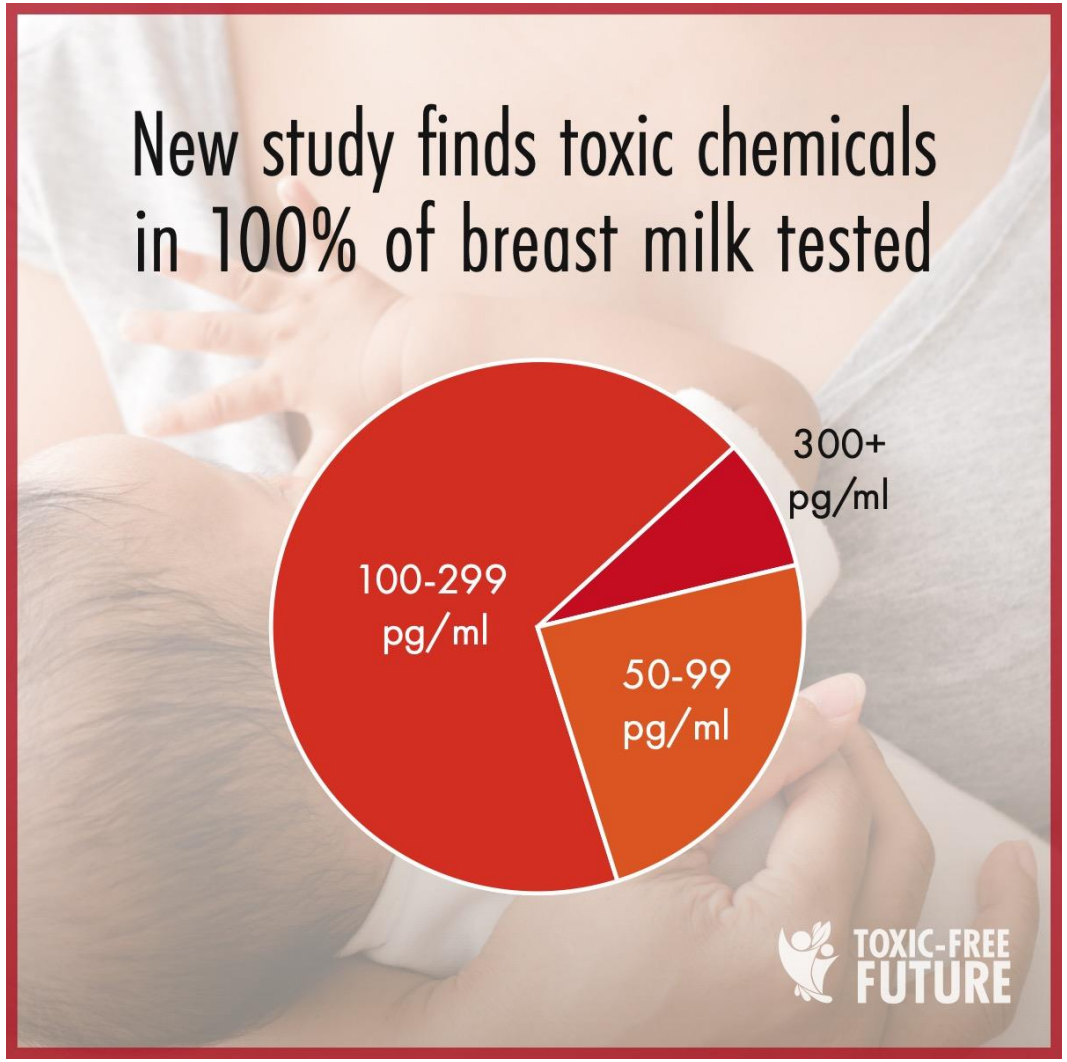
- Race: 95% Caucasian
- Maternal age: mean 34 (24-42 yrs old)
- Residence time in Washington: mean 13y
- Education: 94% had higher education
- Economic status: 82% in middle class or upper-middle class neighborhoods

Analysis

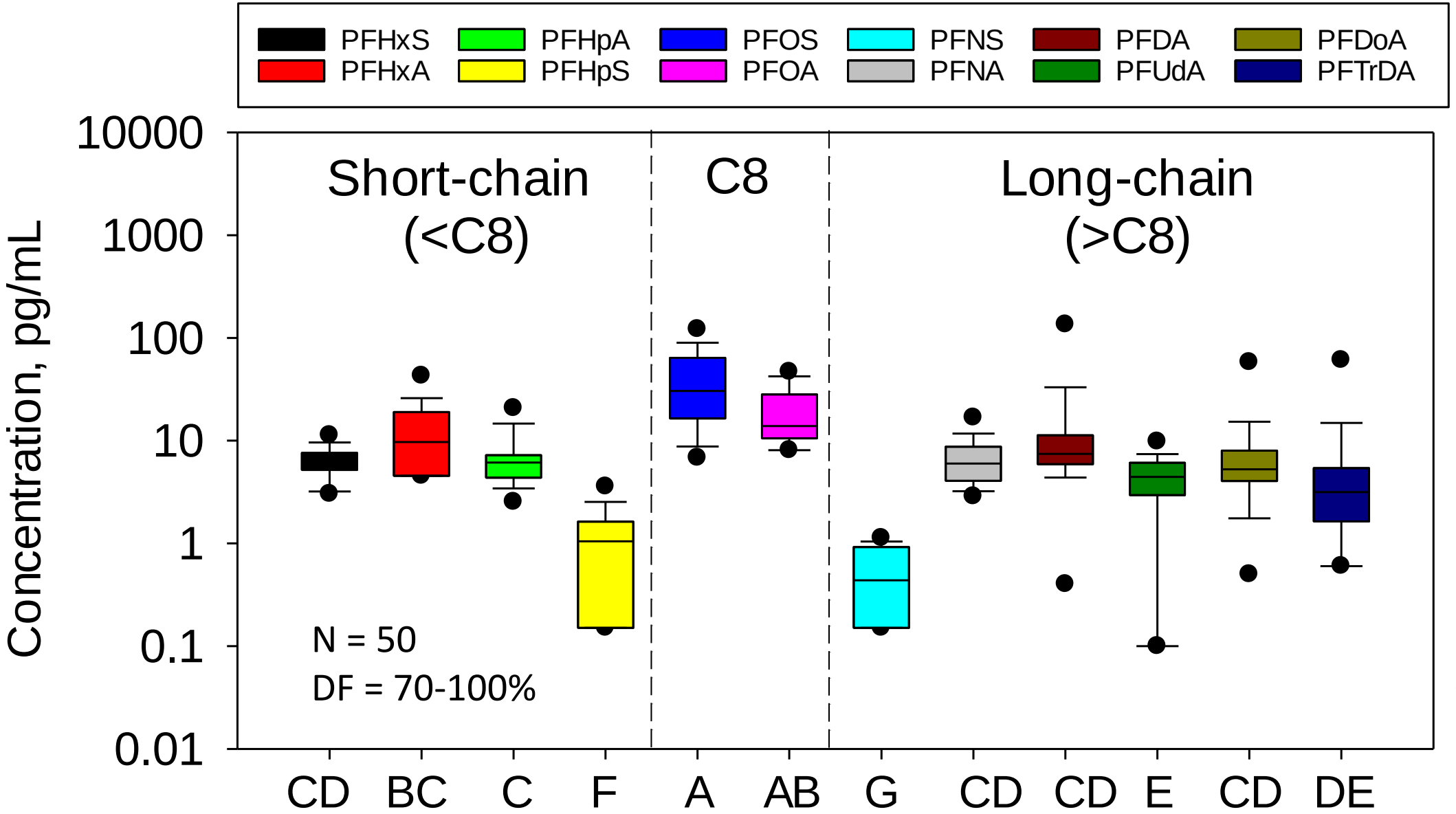
- Samples were analyzed with liquid chromatography tandem mass spectrometry for 39 PFAS:
  - PFOS & PFOA
  - Long-chain (C10-C16)
  - Short-chain (C4-C7)
  - PFAS precursors
- For details see Zheng et al., ES&T 2021

Results

- PFAS detected in 100% of samples
- 16 PFAS total detected, 12 PFAS detected in more than 50% of samples
- ∑PFAS ranged from 52 to 1,580 pg/mL

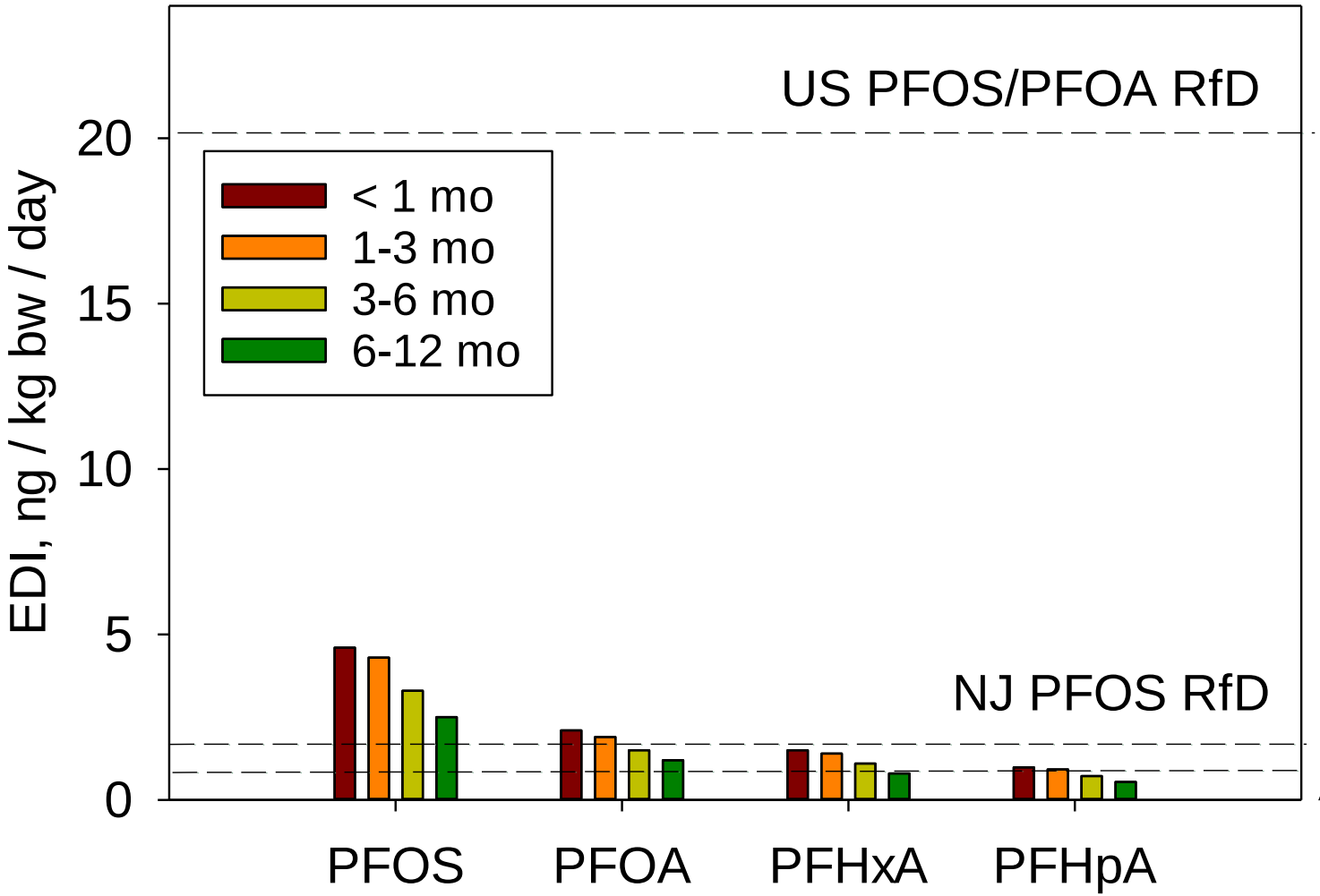


Current-Use PFAS are Abundant in Breast Milk



Zheng et al., EST, 2021

PFAS Estimated Daily Intakes (EDIs)



$$EDI = \frac{Cmilk\ x\ FIR}{1000}$$

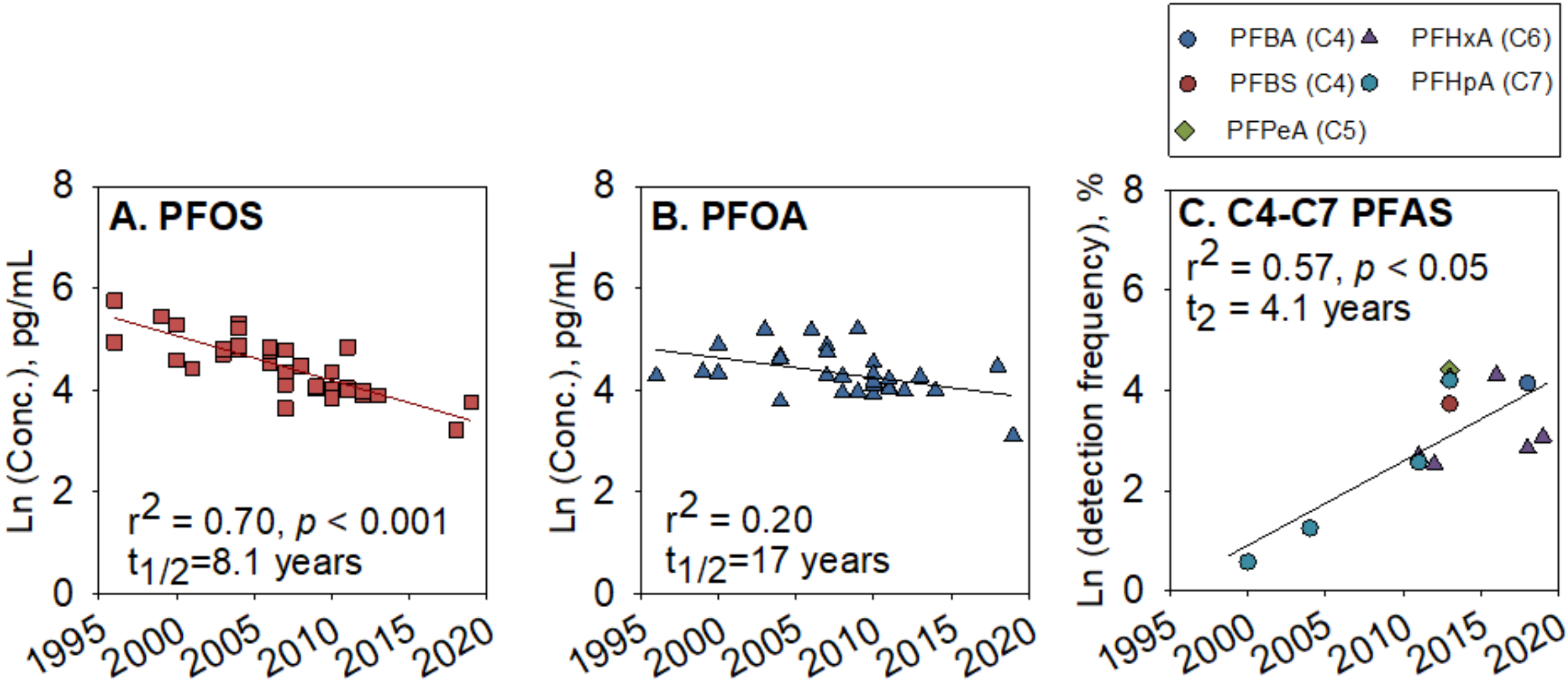
C_{milk}: Median milk concentrations, ng/mL
FIR: Food ingestion rate, ml/kg bw/day

Zheng et al., EST, 2021

Comparison to 2008 Study (Tao et al.)

Compound	Detection Frequency, median 2004	Detection Frequency, median 2019
PFOS (C8)	96%, 106 pg/mL	100%, 30.4 pg/mL
PFOA (C8)	80%, 36.1	86%, 13.9
PFHxS (C6)	51%, 12.1	90%, 6.55
PFHxA (C6)		64%, 9.69
PFHpA (C7)	6.7%, < 24	98%, 6.10
PFNA (C9)	64%, 6.97	100%, 5.98
PFDA (C10)	8.9%, < 24	94%, 7.40
PFDoA (C12)	2.2%, < 24	94%, 5.26

Global Temporal Trends



Summary

- Both current-use and legacy PFAS are now abundant in milk from US mothers.
- While levels for legacy PFAS are going down, the detection of the current-use short-chain PFAS is going up.
- Consistent biomonitoring of breast milk is needed to be able to detect changes in exposure patterns.
- More studies are needed to determine potential health impacts from breast milk exposure

Breastmilk Benefits

- Immune – cytokines and immunoglobulins that directly and immediately fight infection
  - Can reduce the risk of ear infections (50% reduction with 5 months of exclusive breastfeeding) or respiratory infections (72% reduction with 4 months of exclusive breastfeeding) in infancy
- Neurodevelopmental – better behavioral development, increased IQ, and school readiness directly linked with breastfeeding
- Allergies/obesity/gastrointestinal disease – some evidence for improvement in these outcomes
- Maternal- reduced risk of breast and ovarian cancer
  - Bonding - not a direct milk benefit but does improve infant outcomes
- *Recommendation from AAP Exclusive breastfeeding for at least 6 months*

AAP Breastfeeding and Use of Human Milk 2012

Chemicals in Breastmilk and Health Impacts

- Many studies with small numbers of participants report a variety of chemical exposures in breastmilk

- Very few studies relating breastmilk chemical exposure with health outcomes
  - PCBs in breastmilk associated with lack of endurance, hypotonia, expressionless facies (Miller 1977)
  - Often pregnancy biomarkers are used as a proxy for breast milk exposures but the newborn/infancy period is a different developmental/susceptibility time period
  - Current evidence shows that PFOA/PFOS suppress antibody response and NK cell response but breast milk has many other immune factors as well (NTP Monograph 2016)

- Infants who are exposed to lipophilic persistent chemicals have higher concentrations of these in their bodies than infants who consume formula
  - Modeling suggests a decrease in infant exposures after cessation of breastfeeding (Lehmann et al. 2018)

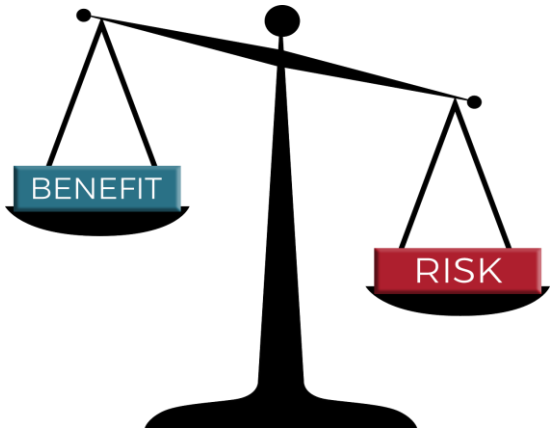
Messaging to New Moms

- Currently, no evidence-based guidelines, *that are simple for consumers to implement*, to reduce exposures (in other words, no studies that show certain guidance will actually reduce exposure)

- Nevertheless, we do know about sources of exposure:
  - Can perform water filtration or consume filtered water
  - Avoid stain repellants on carpets/clothing/fabrics
  - Avoid grease or oil-based packaging for foods like pizza
  - Avoid some non-stick coatings on pans
  - In a highly exposed population, use pre-mixed baby formula or use filtered water to reconstitute powdered formula
  - Check for fish advisories in your areas where waters may be contaminated

Messaging to New Moms

- Goals: Reduce fear and provide reassurance



- Breastmilk still best based on immune protection/reduced infection and associated with positive health outcomes in infancy and early childhood
  - Potential for reduced immune response with higher PFAS exposure based on current evidence but unlikely to completely erase all immune benefit

- There is no zero exposure

- Try to work on reducing overall environmental exposures
  - Fresh and varied food diets
  - Take shoes off when entering home
  - Keep home dust free
  - Use products low in toxic chemicals – check labels

Clinician Training and Approach

General Practitioner (MD trained)	Naturopaths (ND trained)
• Not trained in environmental chemical exposures/health outcomes • Often looking for good sources of information/guidance • Often will only use/rely on evidence-based guidance either from professional organizations or trusted persons in the field • Do not want to test patients unless data will be meaningful and guide counseling • Often would prefer to refer/defer to others (but sometimes give non-informed advice) • Often rely on state and federal public health guidance	• Some limited training in environmental chemical exposures/health outcomes • Tend to recommend broad testing • May recommend treatment approaches that are unorthodox or may cause harm (oral/IV chelation)

Clinician Training and Approach

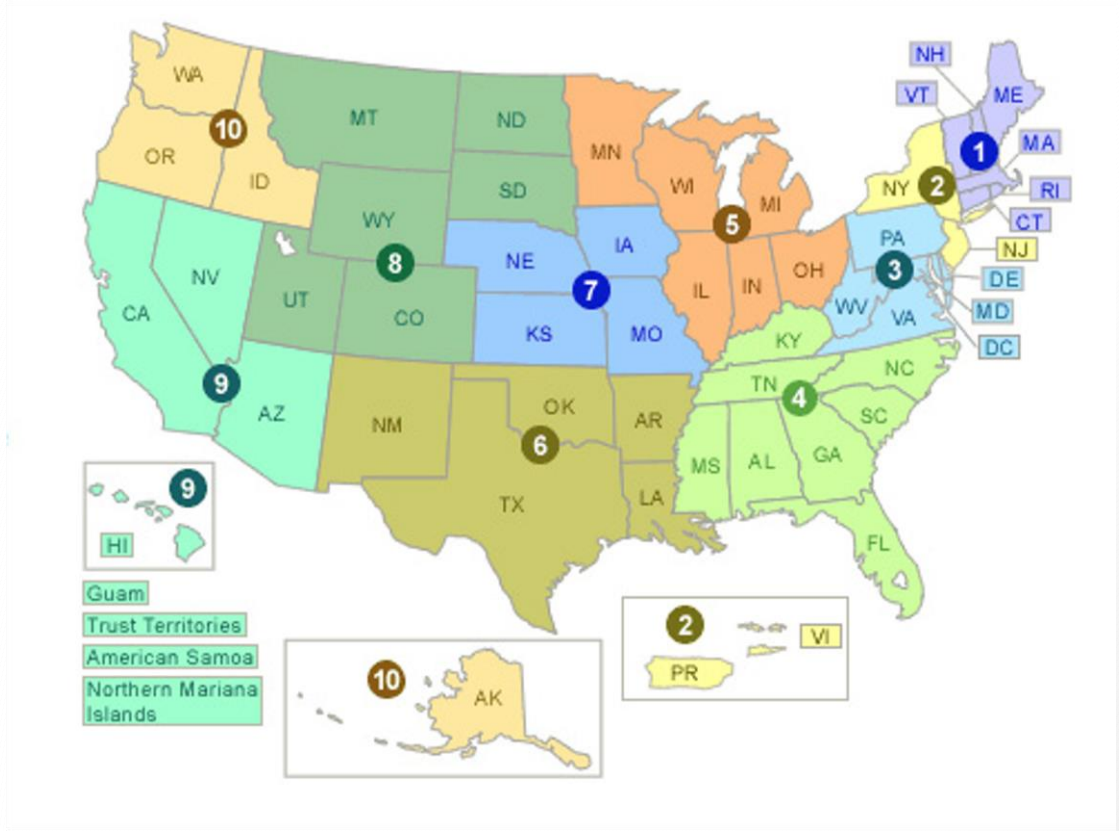
Environmental Health Trained Clinicians (often fellowship beyond MD)

- Adult occupational/environmental medicine – major focus on occupational exposures, accreditation
- Pediatric environmental health trained physicians (very small numbers of these clinicians – likely less than 200 in the country) – no accredited programs for this
- Trained in how to read/interpret scientific studies
- Often have research programs
- Conduct trainings for other clinicians through PEHSUs/other mechanisms
- Work closely with public health officials at state/federal level

Key Points in Environmental Health Risk Communication

- Transdisciplinary effort
- Requires some public health training/essentials
- Need to balance risks/benefits
- In community/media settings
  - Know subject matter thoroughly
  - Show respect
  - Be credible
  - Show empathy
  - Be non-biased

Pediatric Environmental Health Specialty Units (PEHSU)



- CDC/EPA sponsored network of interdisciplinary pediatric EH specialists based at academic medical centers corresponding to federal regions
- NW PEHSU based at Univ WA, Seattle
- Provide free consultation, referral, outreach and education
  - Public Health Depts
  - Clinicians, healthcare professionals
  - Public health and medical trainees
  - Communities

NW PEHSU: 1-877-KID-CHEM; kidchem@uw.edu

https://deohs.washington.edu/pehsu/

Well-networked group of units

Provide important education/guidance/ counseling to communities

Low funding (budgets around 170k/center/year)

Acknowledgements

Amina Salamova, Indiana University

Erika Schreder, Toxic-Free Future

Study Participants

PEHSU Network

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