

Advancing Human Health through Translational Exposomics: The example of PFAS and liver disease

Lida Chatzi, MD, PhD

Professor of Population and Public Health Sciences

Director, Center for Translational Exposomics Research

Director, Southern California Superfund Research and Training Program for PFAS

Assessment, Remediation, and Prevention

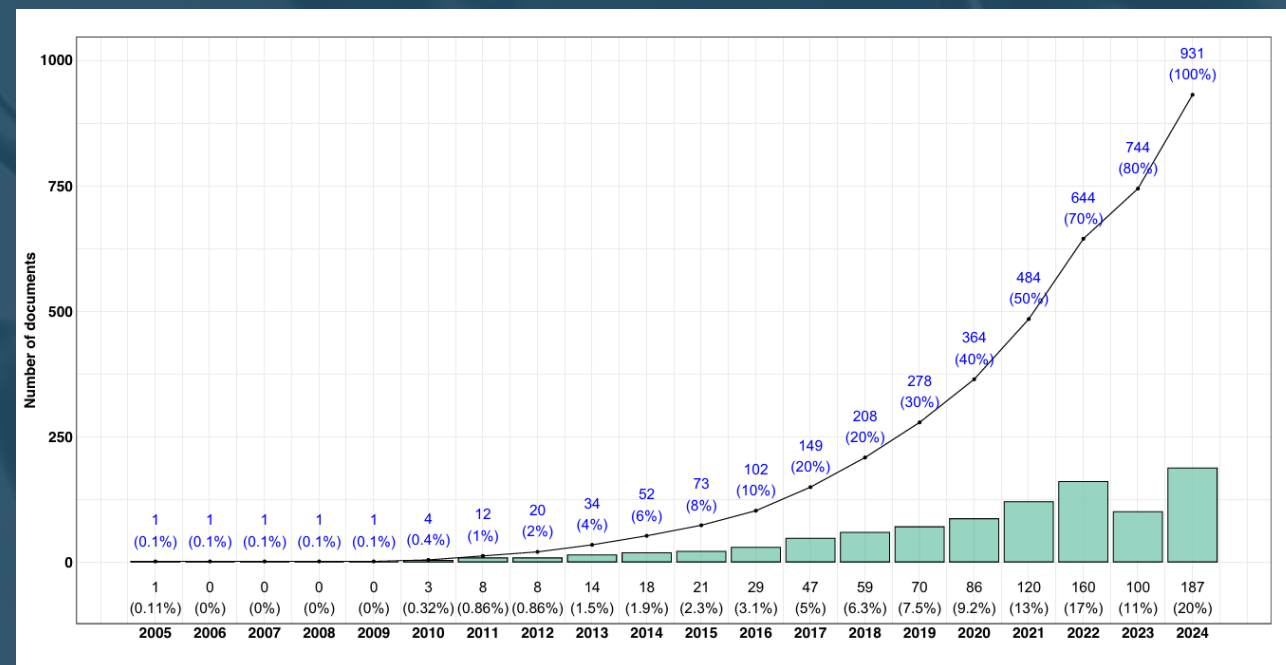
Director, Southern California Environmental Health Sciences Center

Keck School of Medicine of **USC**
Department of Population and
Public Health Sciences

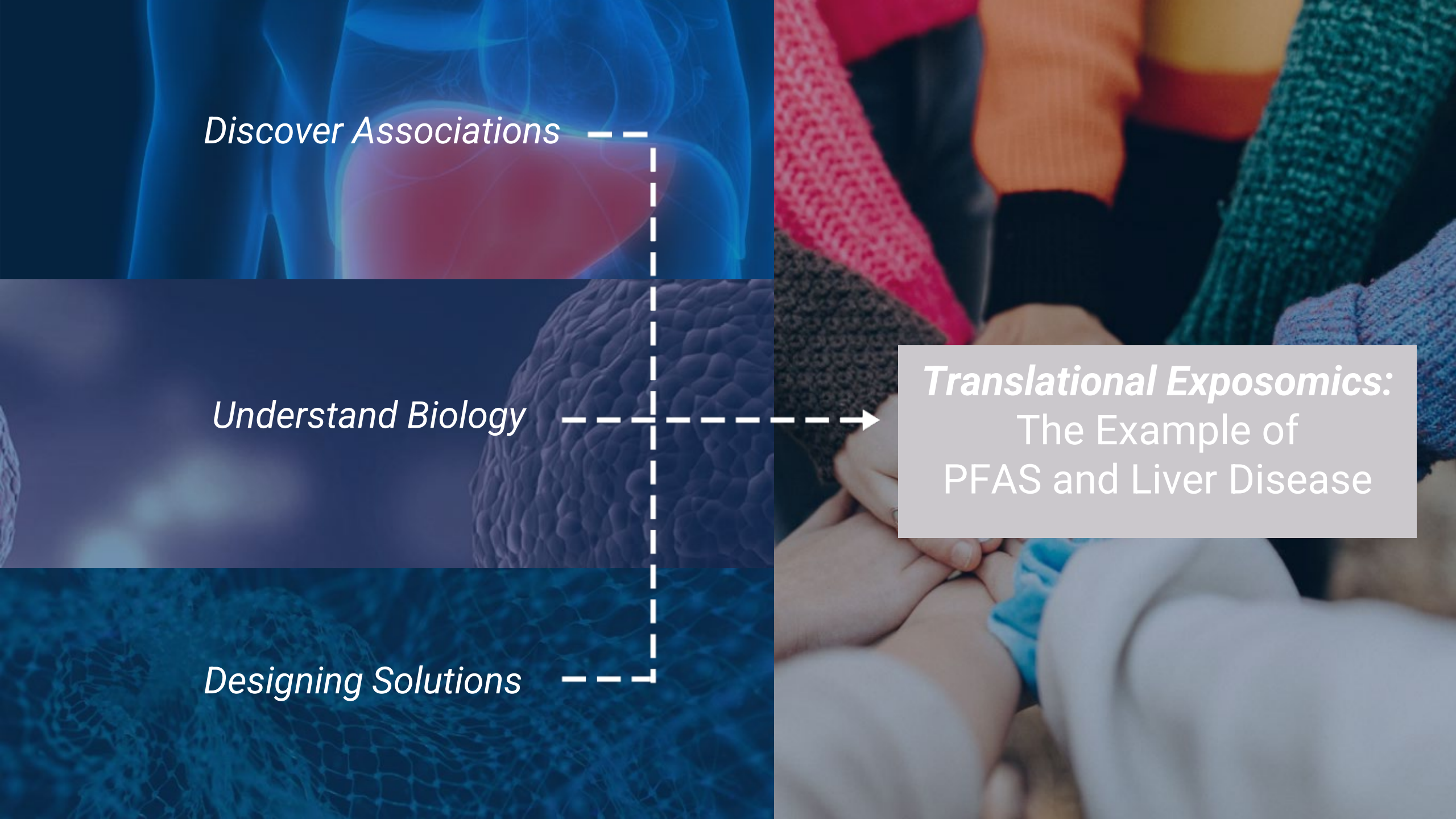


CTER

Global research trends on the human exposome research



Petit et al. Environmental Science and Pollution Research, 2025



Discover Associations

Understand Biology

Designing Solutions

Translational Exposomics:
The Example of
PFAS and Liver Disease

What are PFAS?

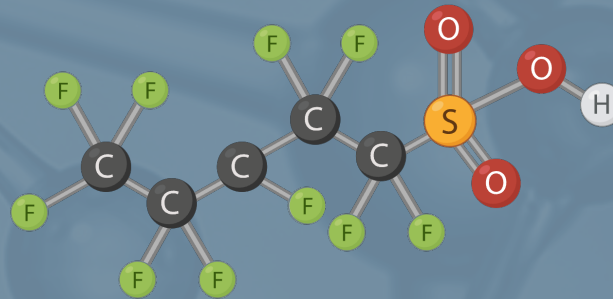
- > 10,000 chemicals

- PFAS have been widely used in industrial applications

- Resistant to degradation

- Detected in the blood of almost everyone in the U.S

PFAS



Exposure Sources



Water Contamination



Nonstick Cookware



Food Packaging & Containers



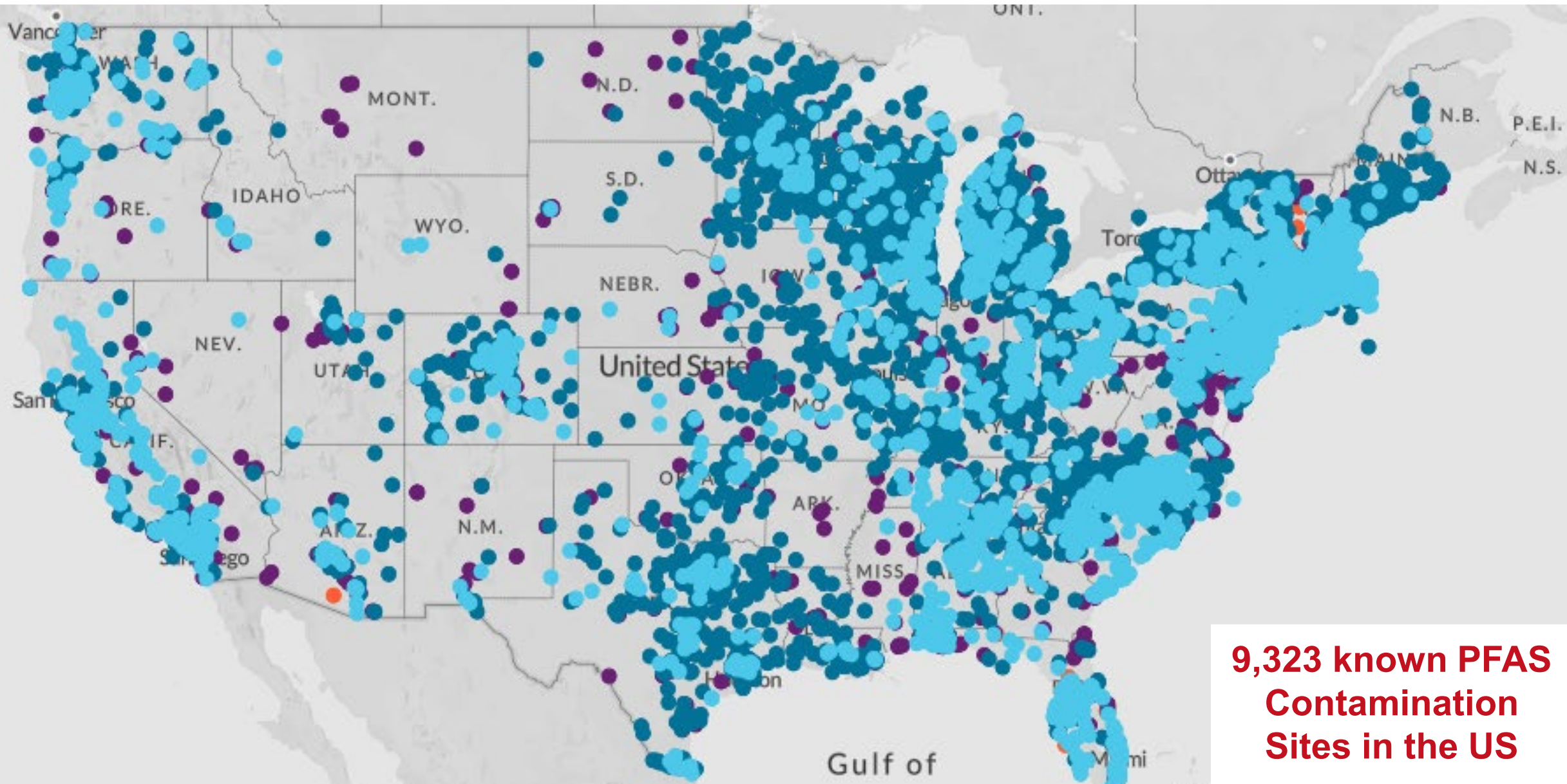
Cosmetics & Personal Care Products



Textiles (Outdoor Gear & Waterproof Clothing)

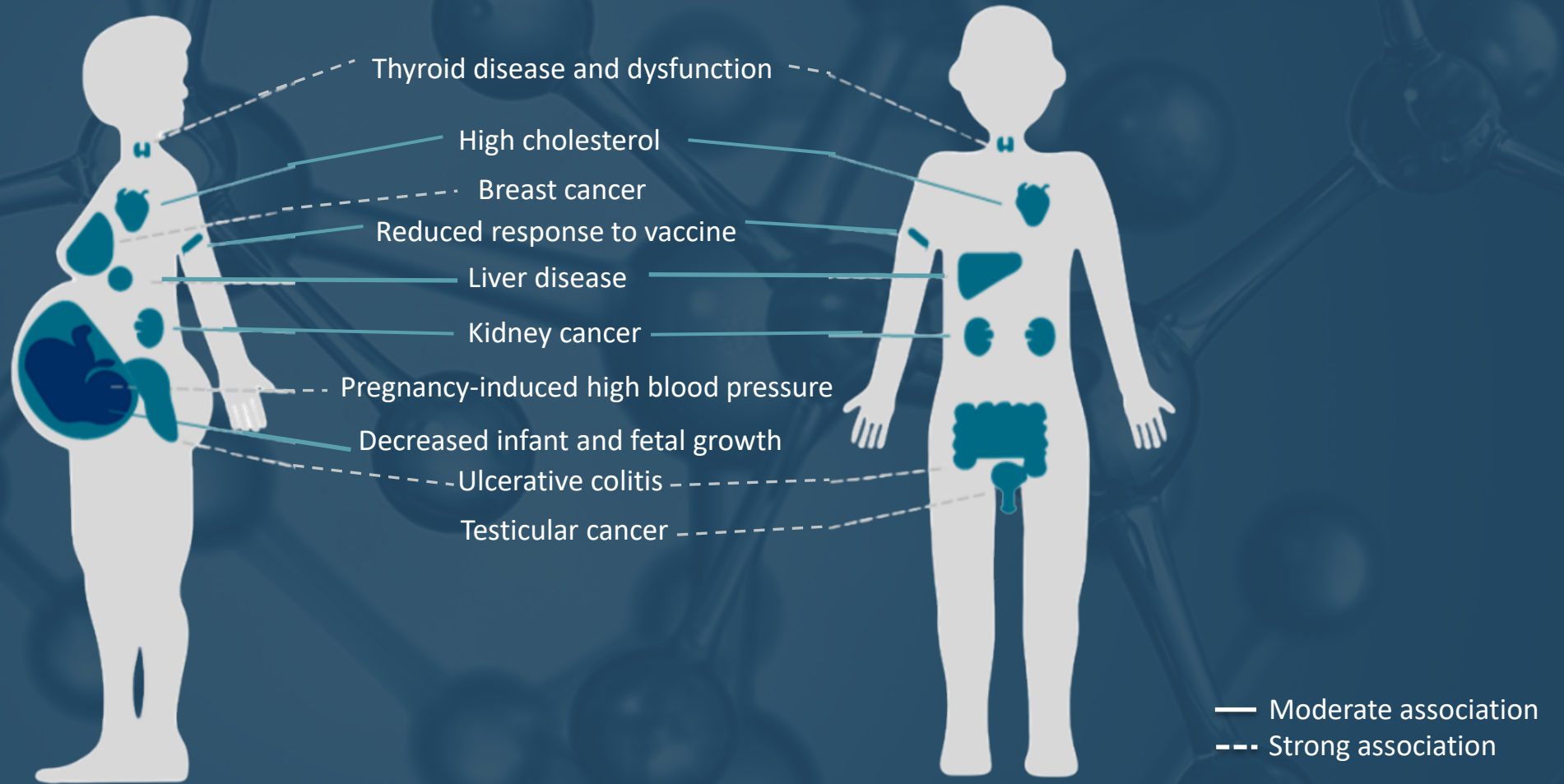
PFAS WATER CONTAMINATION IN THE UNITED STATES , 6/10/2025

Drinking water ~200 million Americans may be contaminated with PFAS (Andrews & Naidenko, 2020)

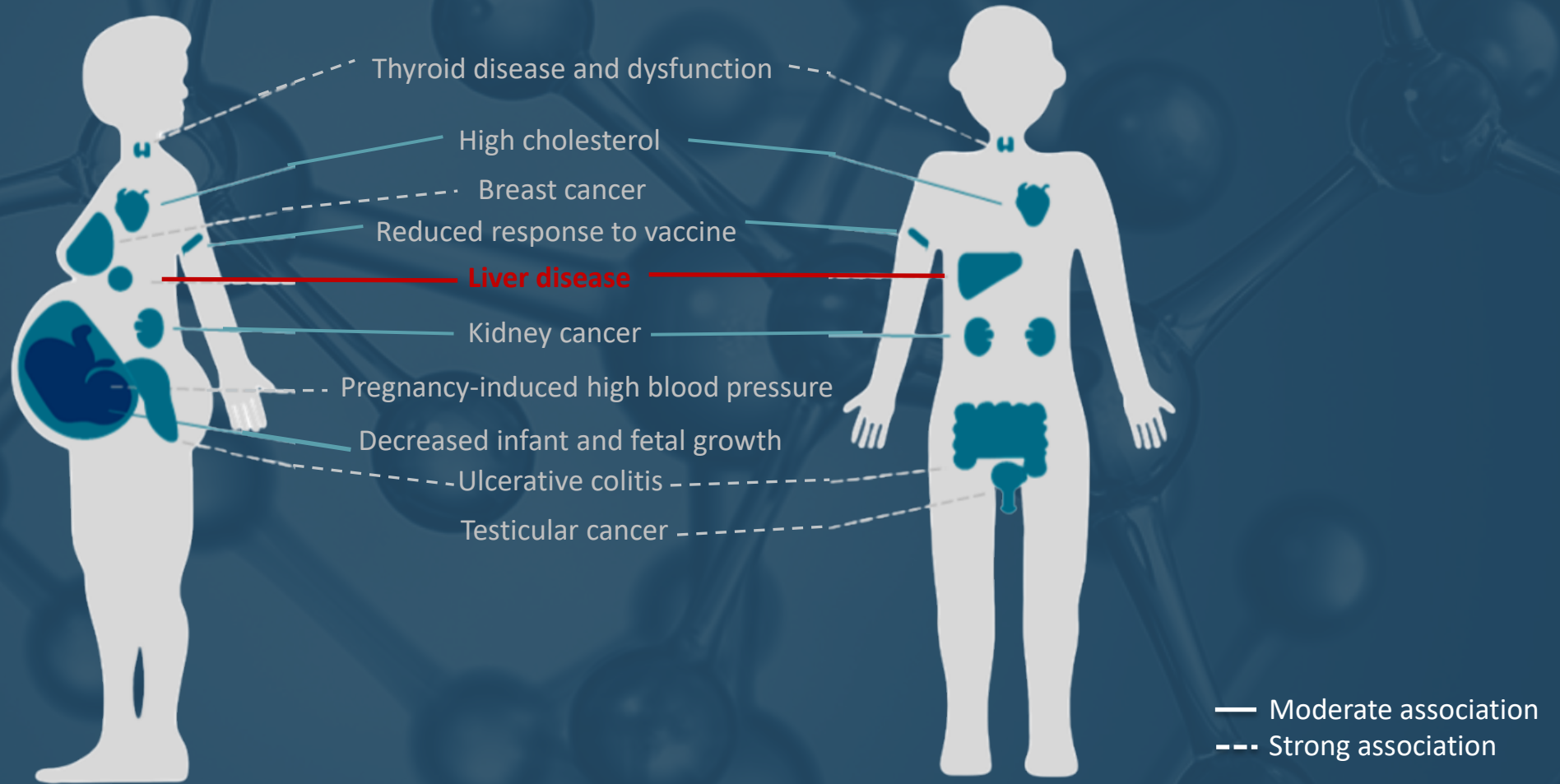


**9,323 known PFAS
Contamination
Sites in the US**

PFAS EXPOSURE Health Effects



PFAS EXPOSURE Health Effects



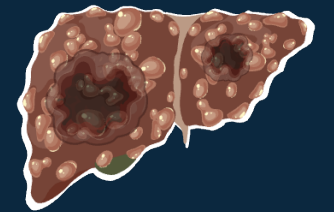


38% of adults around the world have **liver steatosis (MASLD)**

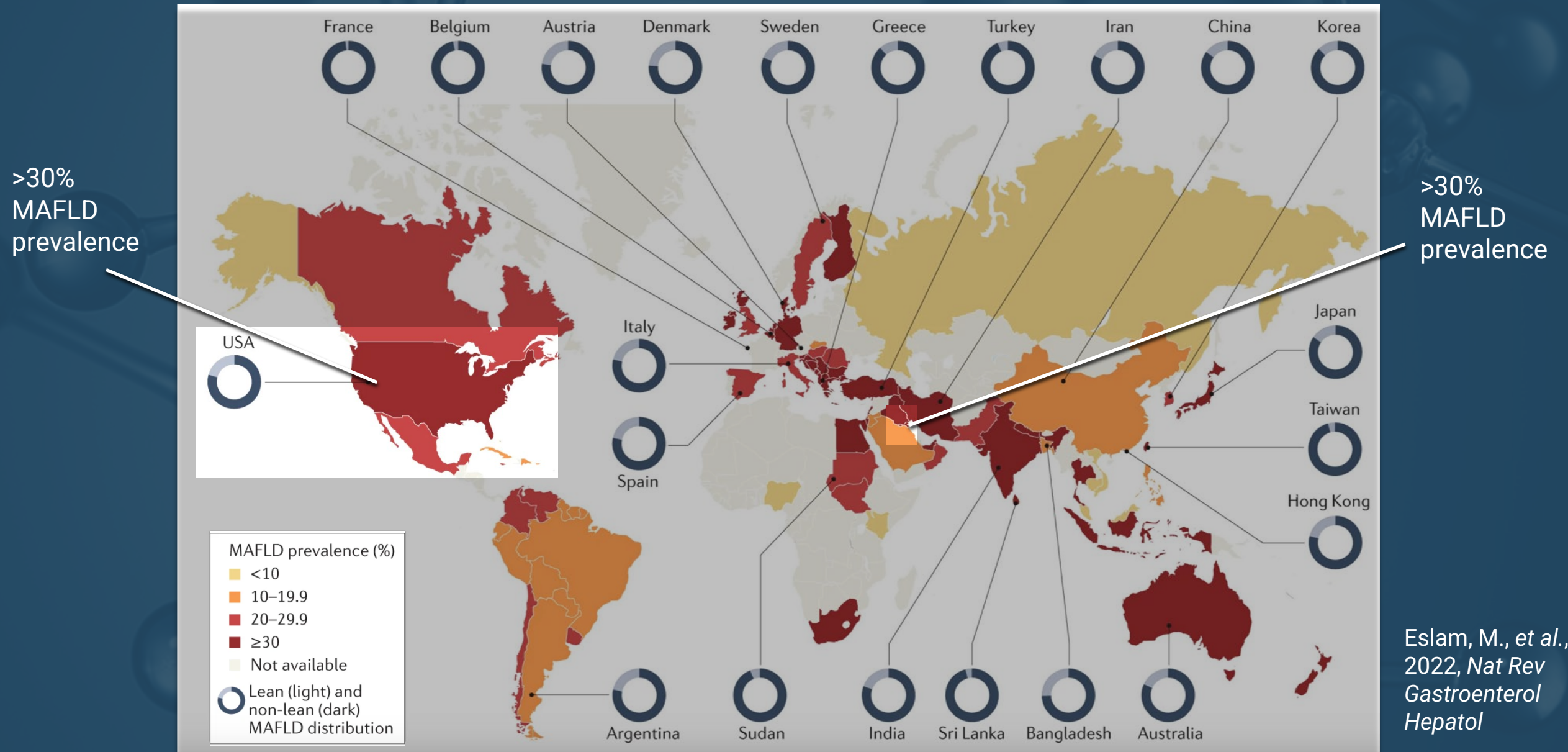


Global **MASLD** incidence is expected to rise to **55.4** by 2040

MASLD is the **LEADING** cause of **LIVER CANCER**



Global Prevalence of MASLD: Similarities between USA and Kuwait



**Metabolic
conditions**



Infection



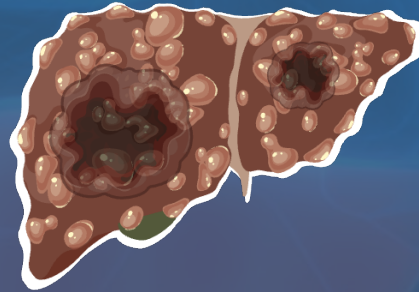
**Excessive
alcohol**

Smoking



Aging

**Chronic liver
disease**



**Metabolic
conditions**



Infection



**Excessive
alcohol**

Smoking



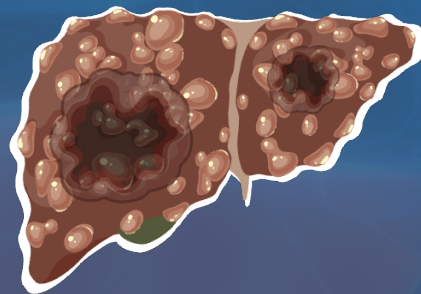
Aging

**Chronic liver
disease**



Environmental Chemicals

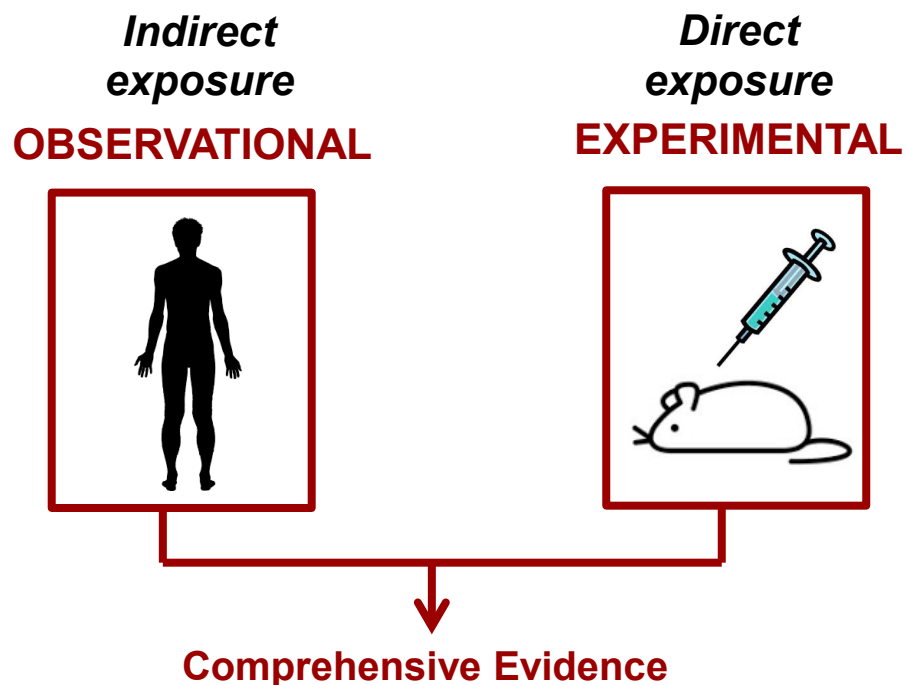
- PFAS
- Air pollution
- Heavy metals



EMERGING EVIDENCE PFAS and Liver Injury

Exposure to per- and Polyfluoroalkyl Substances and Markers of Liver Injury: A Systematic Review and Meta-Analysis

Elizabeth Costello,^{1*} Sarah Rock,^{1*} Nikos Stratakis,¹ Sandra P. Eckel,¹ Douglas I. Walker,² Damaskini Valvi,²
Dora Cserbik,³ Todd Jenkins,⁴ Stavra A. Xanthakos,⁵ Rohit Kohli,⁶ Stephanie Sisley,⁷ Vasilis Vasiliou,⁸
Michele A. La Merrill,⁹ Hugo Rosen,¹⁰ David V. Conti,¹ Rob McConnell,¹ and Leda Chatzi¹



RESULTS

- Human Studies N=25
- Animal Studies N=86
- Long chain PFAS associated with increased risk for liver injury in both human (*increased liver enzymes*) and animal studies (*histopathological changes*)

EXAMPLE First prospective case-control study to link PFOS with HCC



Jesse Goodrich, PhD
Assistant Professor
USC Keck School of Medicine

JHEP|Reports 
Innovation in Hepatology

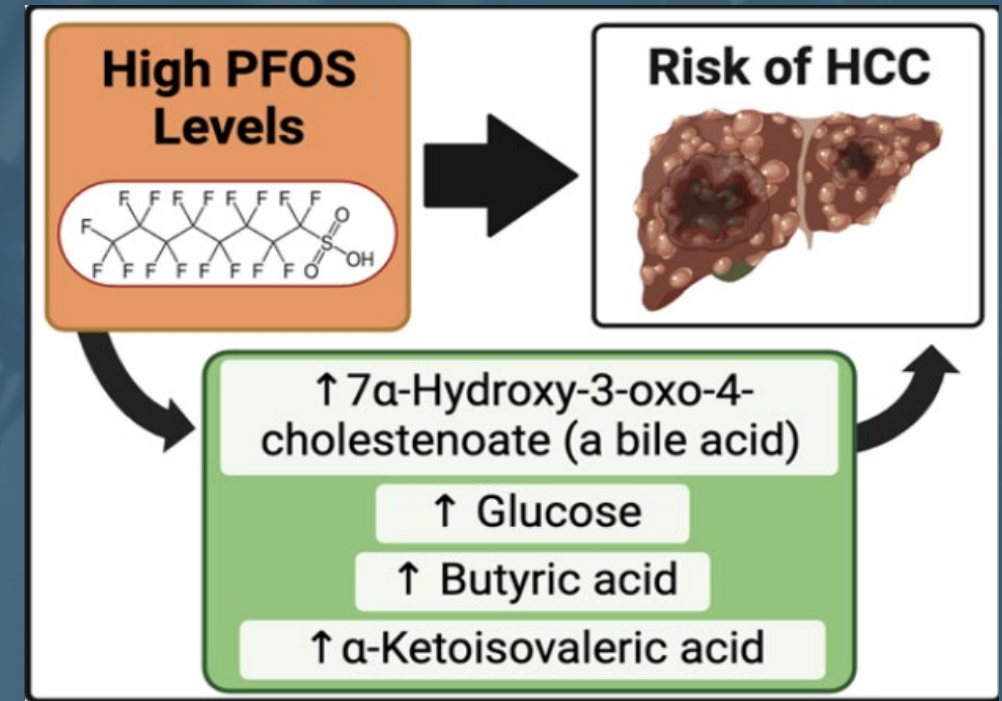
RESEARCH ARTICLE | ARTICLES IN PRESS, 100550

Exposure to perfluoroalkyl substances and risk of hepatocellular carcinoma in a multiethnic cohort

Jesse A. Goodrich   • Douglas Walker • Xiangping Lin • ... David V. Conti • Lida Chatzi  •
Veronica Wendy Setiawan  • [Show all authors](#) • [Show footnotes](#)

Open Access • Published: August 08, 2022 • DOI: <https://doi.org/10.1016/j.jhepr.2022.100550>

RESULTS



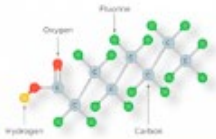
Gaps and Limitations in Current Knowledge

- **Challenges in PFAS exposure assessment**
 - PFAS measurements collected during a single time-point
 - Variability in PFAS biomonitoring
- **Models available for PFAS study**
 - Animal models do not recapitulate human disease
 - Human studies require years of follow-up
 - *In vitro* studies only use single cell types
- **Data integration**
 - Current studies do not integrate *in vitro* or *in vivo* datasets with human data
- **Others**
 - Potential harmful effects of PFAS mixtures are unknown

Translational Exposomics Research Framework

A COMPLEX PROBLEM

Per- and Polyfluoroalkyl Substances



- > 7,000 chemicals
- Strong carbon fluorine bonds
- Bioaccumulation
- Detection in 99% of US adults

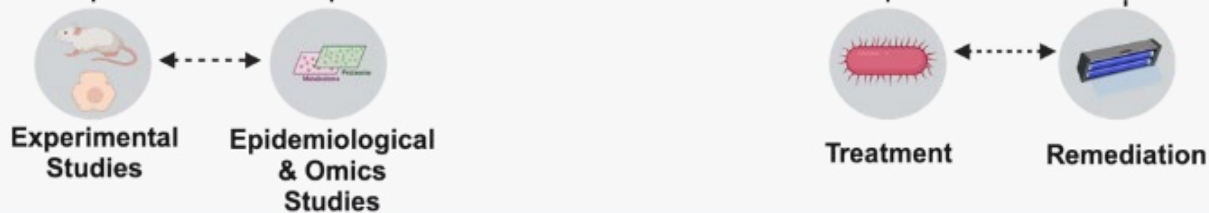
SOURCES OF EXPOSURE



ACCUMULATION & TOXICITY



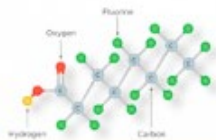
RESEARCH & SOLUTIONS



Translational Exposomics Research Framework

A COMPLEX PROBLEM

Per- and Polyfluoroalkyl Substances

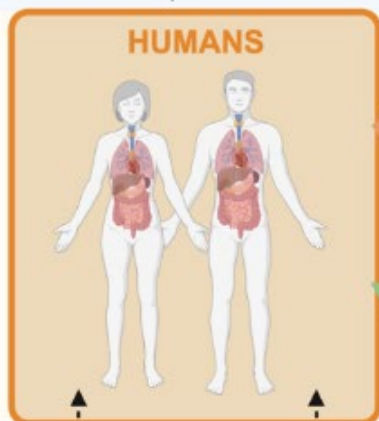


- > 7,000 chemicals
- Strong carbon fluorine bonds
- Bioaccumulation
- Detection in 99% of US adults

SOURCES OF EXPOSURE



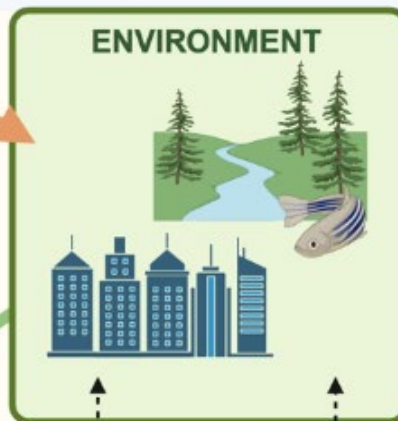
ACCUMULATION & TOXICITY



RESEARCH & SOLUTIONS



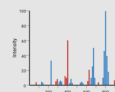
Waste, Wastewater
Drinking Water, Food, Air



Understanding the causal effects of PFAS in human liver disease



Discovering mechanisms of PFAS hepatotoxicity



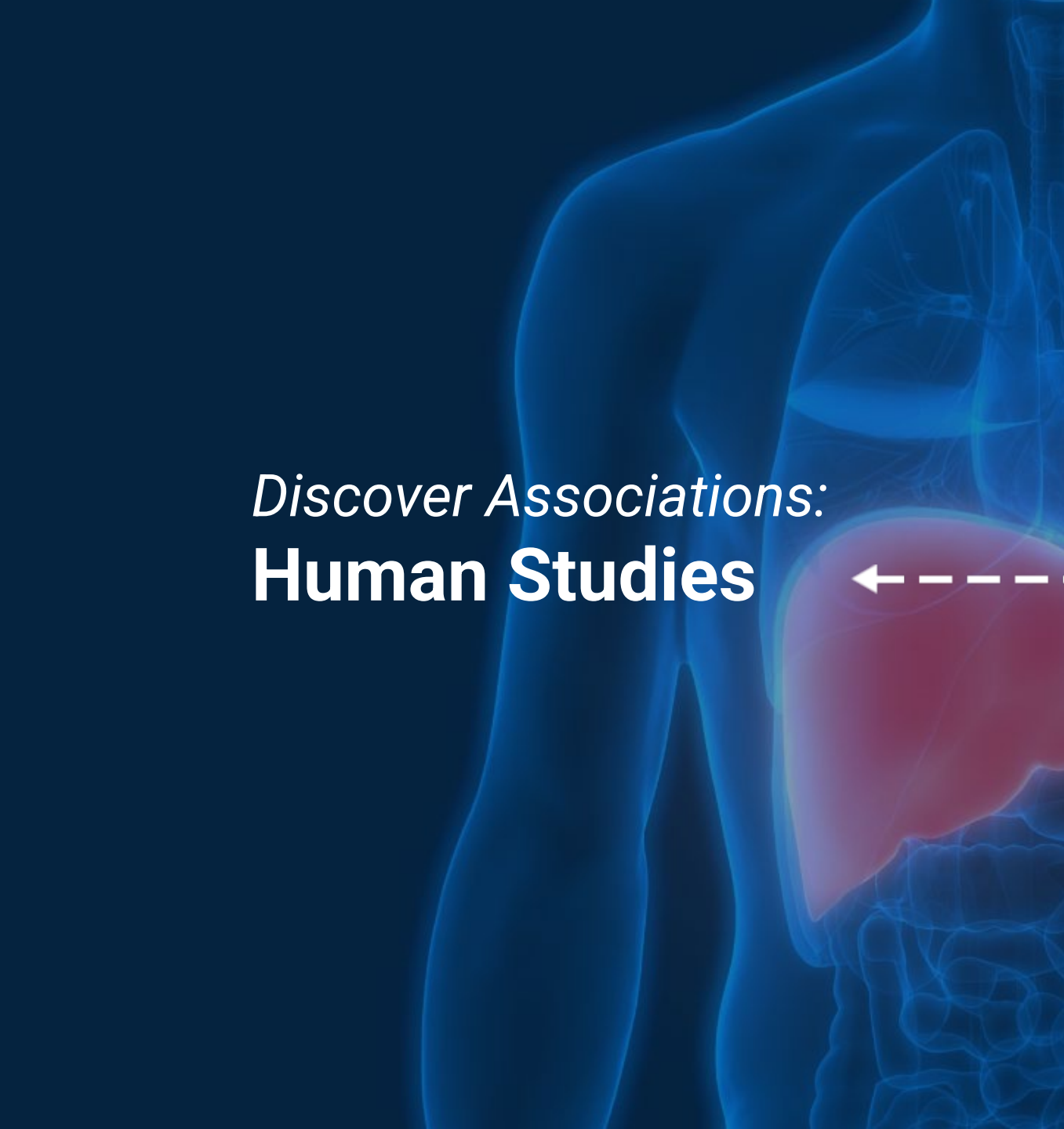
Developing methods for comprehensive PFAS environmental assessment



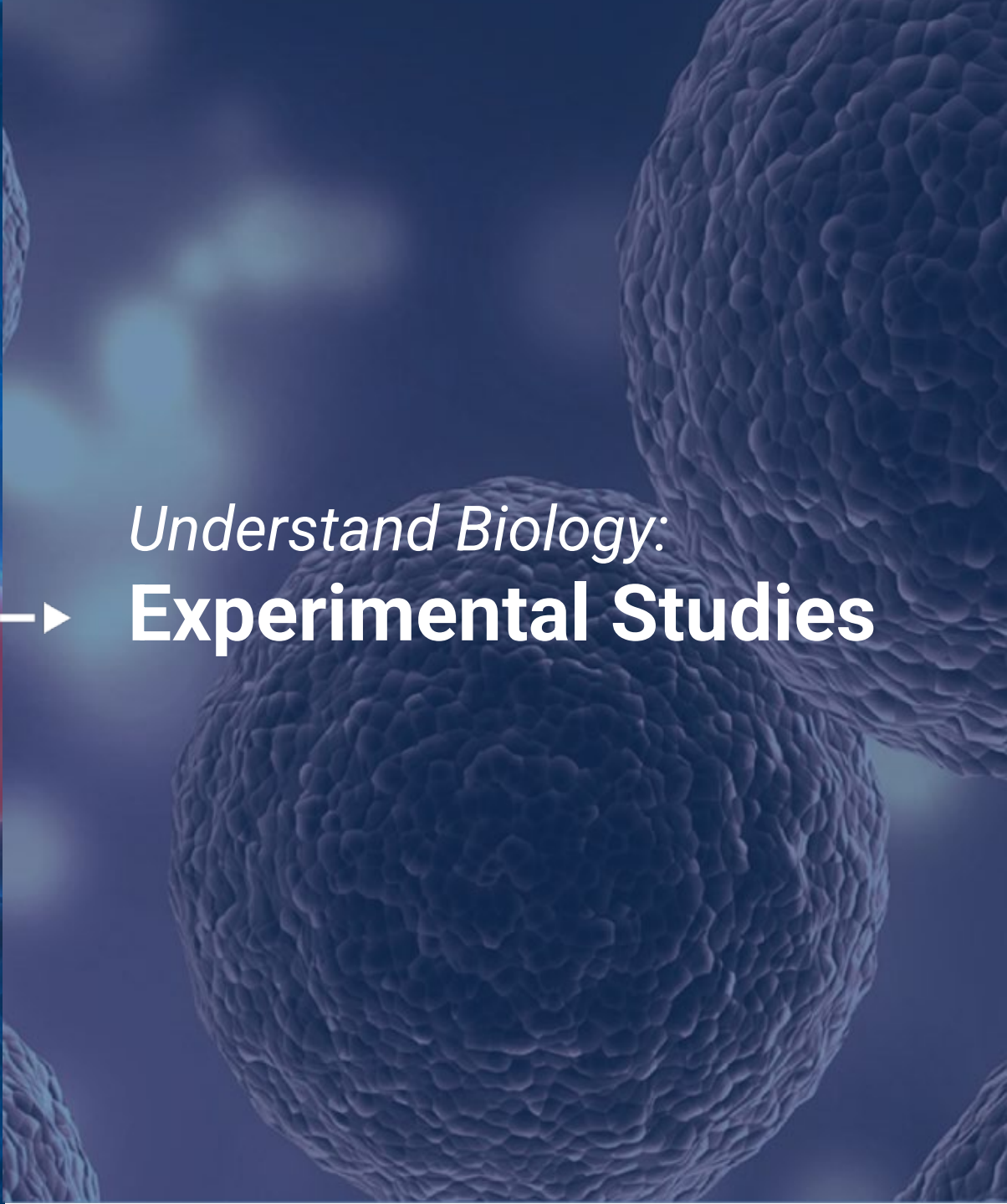
Codesigning sustainable PFAS interventions



P42ES36506



Discover Associations:
Human Studies



Understand Biology:
Experimental Studies

EXPERIMENTAL STUDY PFAS, Lipid Metabolism, and Carcinogenesis in Liver Spheroids

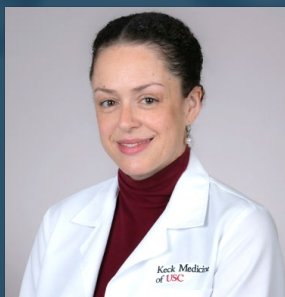
AIMS:

Aim 1: Identify pathways impacted by short- and long-term exposure to PFAS and PFAS mixtures commonly found in human plasma and drinking water.

Aim 2: Test if PFAS removal can reverse or attenuate the harmful effects of PFAS exposure.



Lucy Golden, PhD
Professor
USC

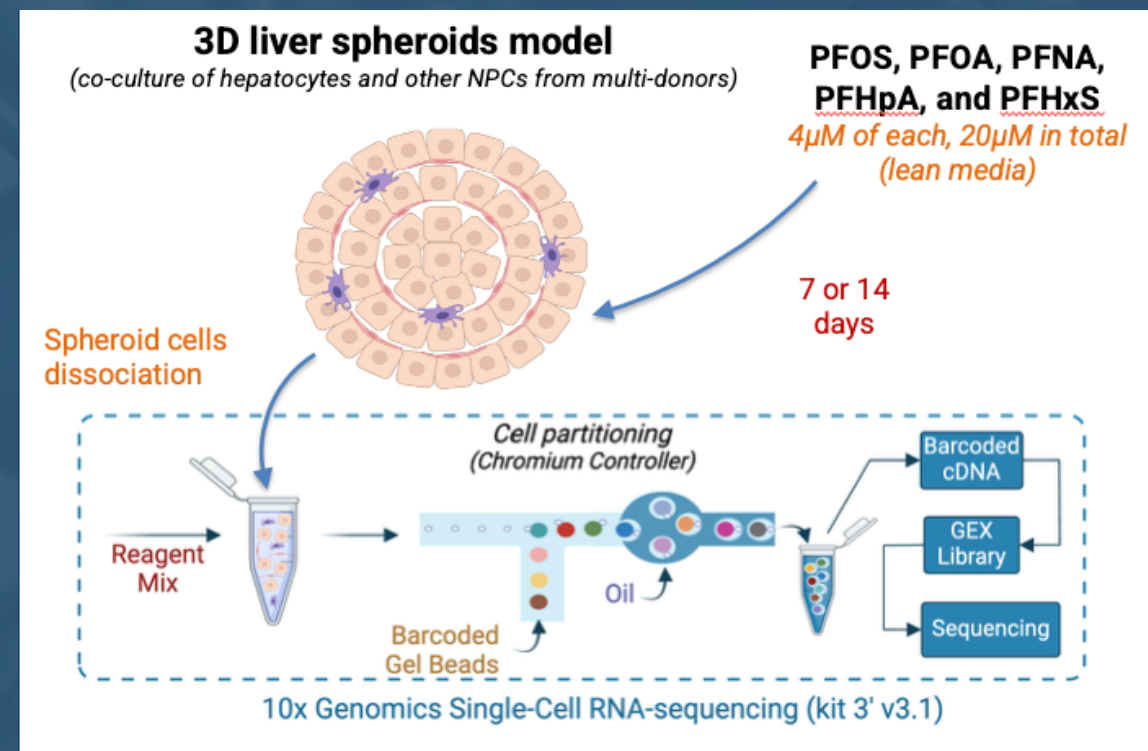


Ana Marette-Garcia, PhD
Assistant Professor
USC



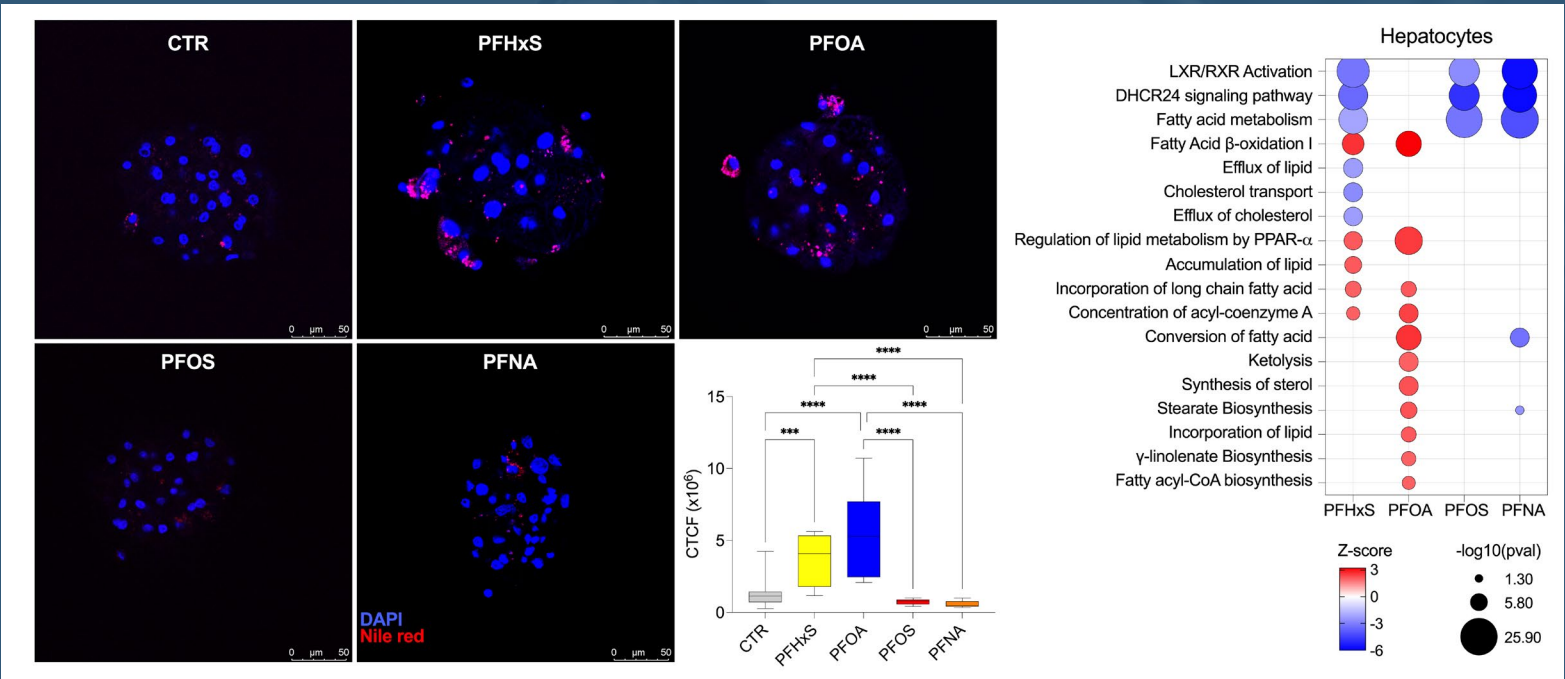
Matthew Salomon, PhD
Assistant Professor
USC

STUDY DESIGN:

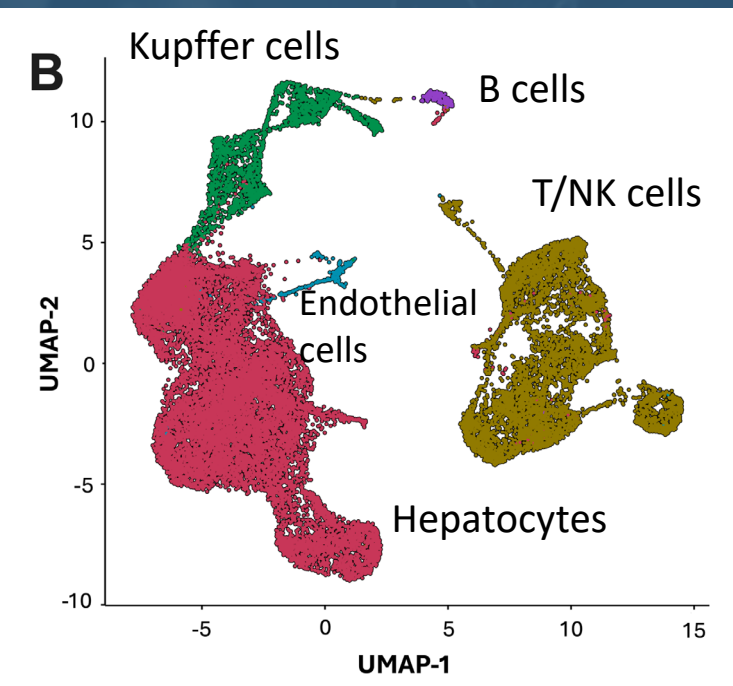


EXPERIMENTAL STUDY Steatogenic Effects

RESULTS: Steatogenic Effect



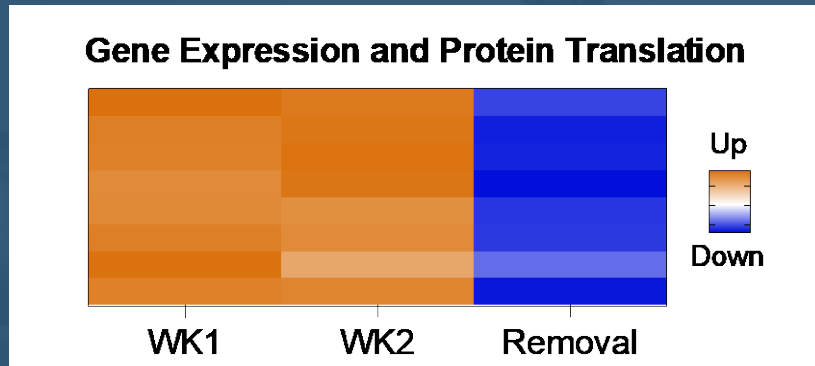
Cell Clusters



EXPERIMENTAL STUDY PFAS Mixtures and Removal

RESULTS:

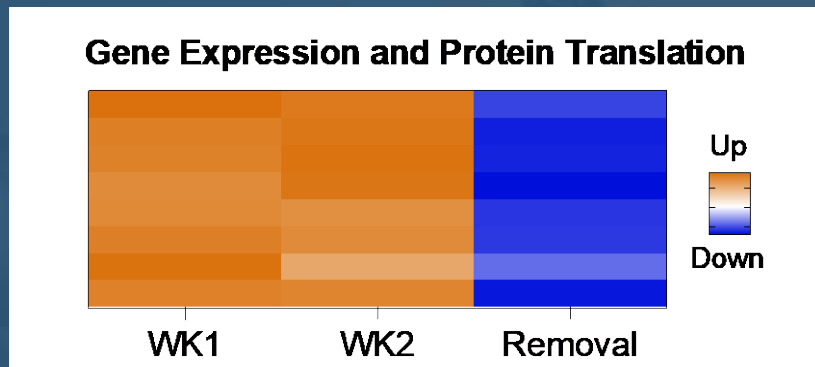
Gene Expression and Protein Translation



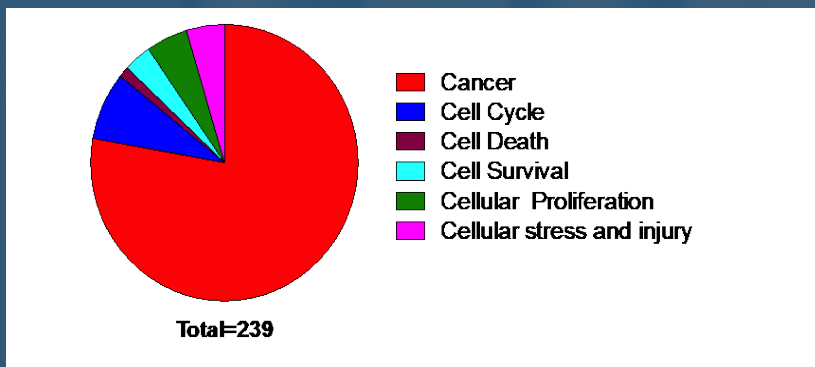
EXPERIMENTAL STUDY PFAS Mixtures and Removal

RESULTS:

Gene Expression and Protein Translation



1 Week of Exposure



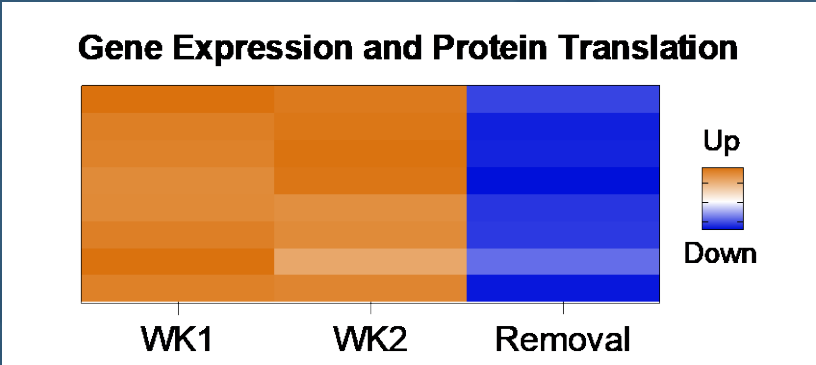
↑ Fibrosis ↑ Necrosis

P42ES036506, P30ES007048

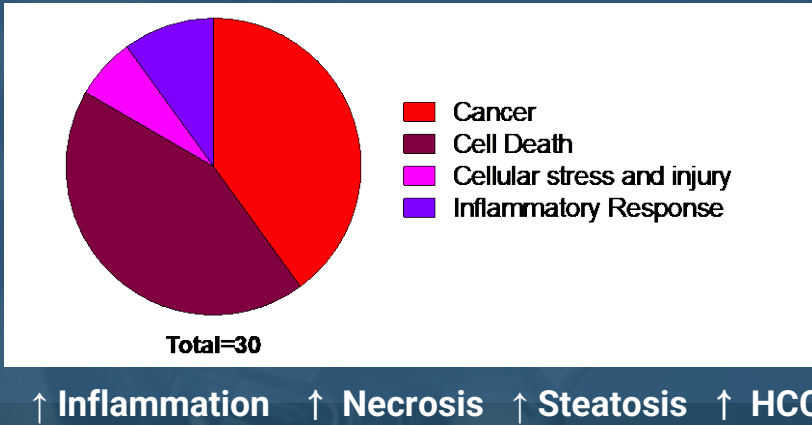
Golden-Mason et al. *Environment International* 2025

EXPERIMENTAL STUDY PFAS Mixtures and Removal

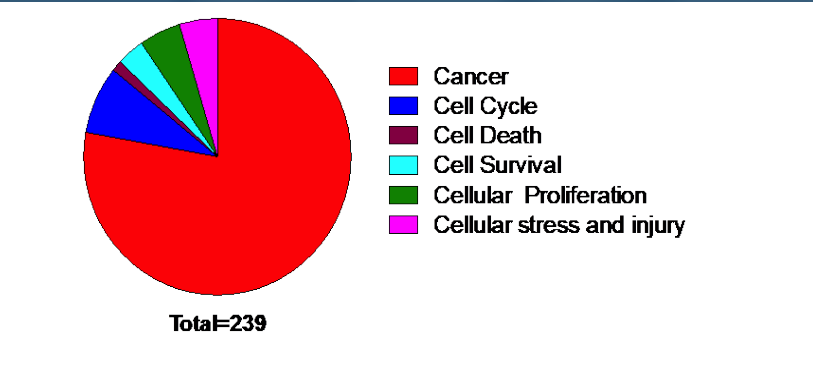
RESULTS: Gene Expression and Protein Translation



2 Weeks of Exposure

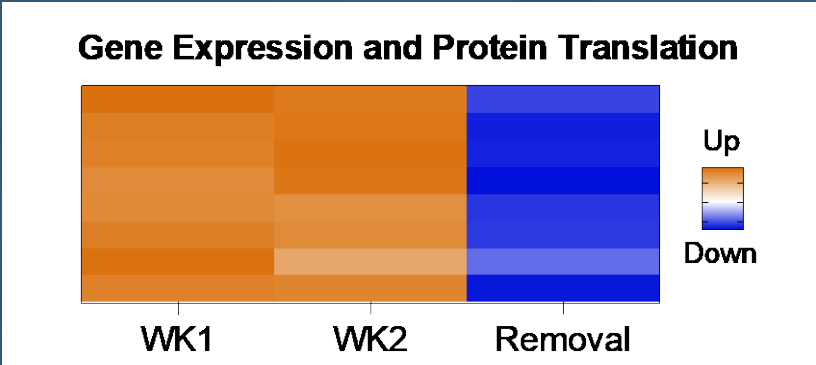


1 Week of Exposure

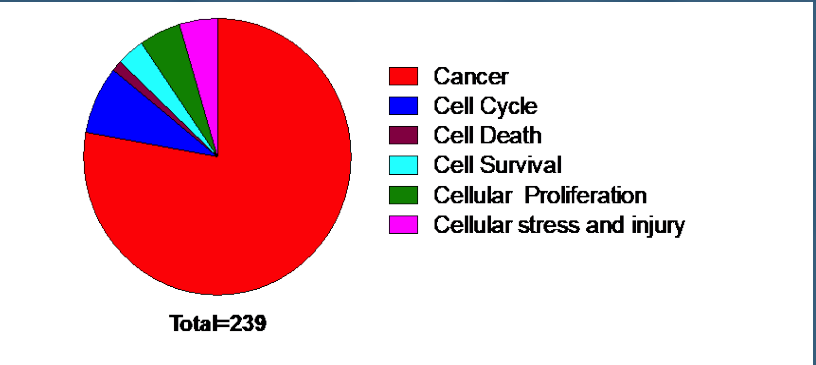


EXPERIMENTAL STUDY PFAS Mixtures and Removal

RESULTS: Gene Expression and Protein Translation

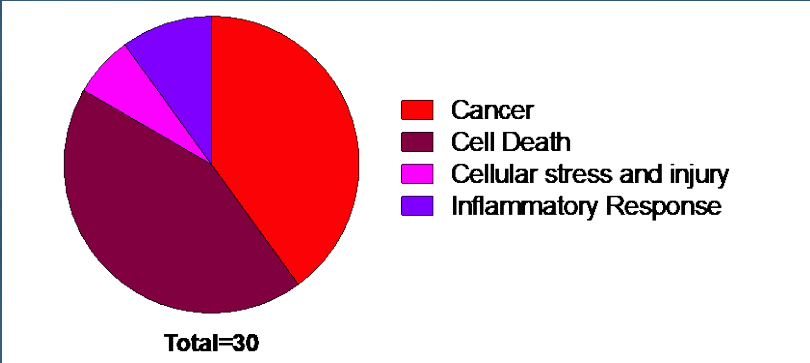


1 Week of Exposure



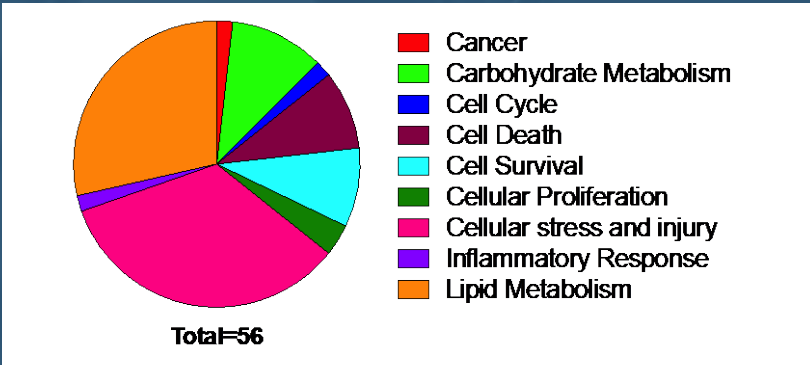
↑ Fibrosis ↑ Necrosis

2 Weeks of Exposure



↑ Inflammation ↑ Necrosis ↑ Steatosis ↑ HCC

1 Week of Exposure + 1 week of recovery

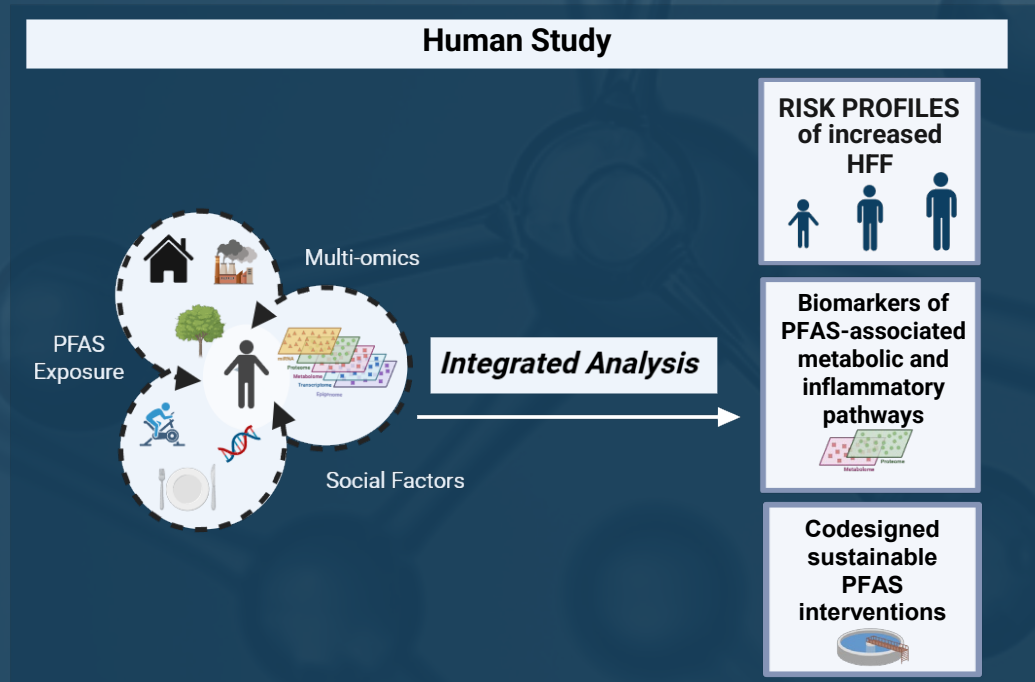


↑ Cell Proliferation ↑ Hepatotoxicity

Normalization of
Liver Functions

HUMAN STUDY: Estimating PFAS health risks in impacted communities

STUDY DESIGN

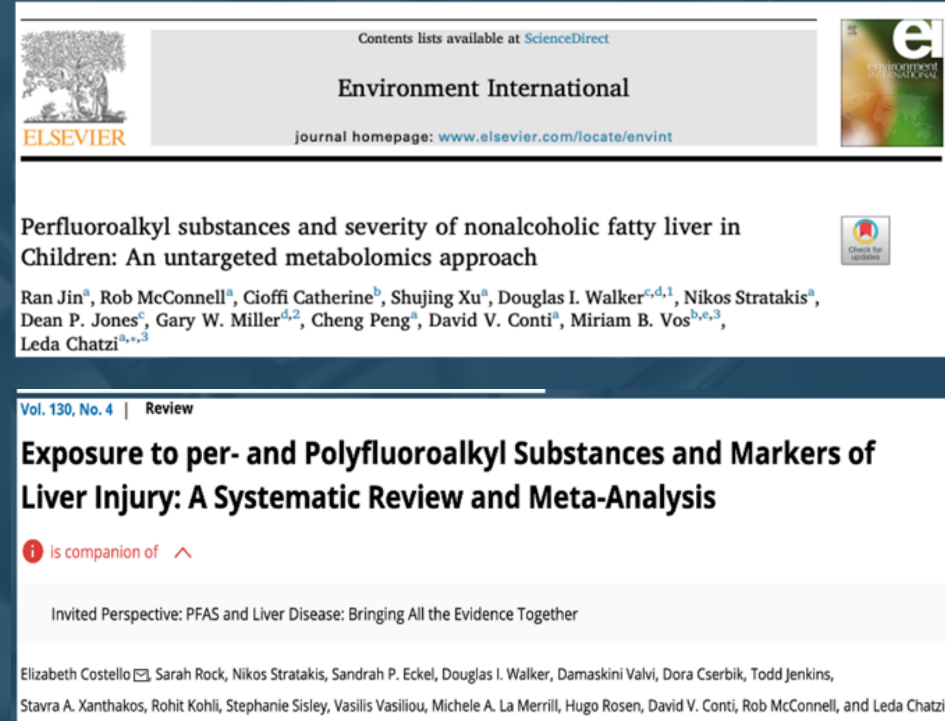


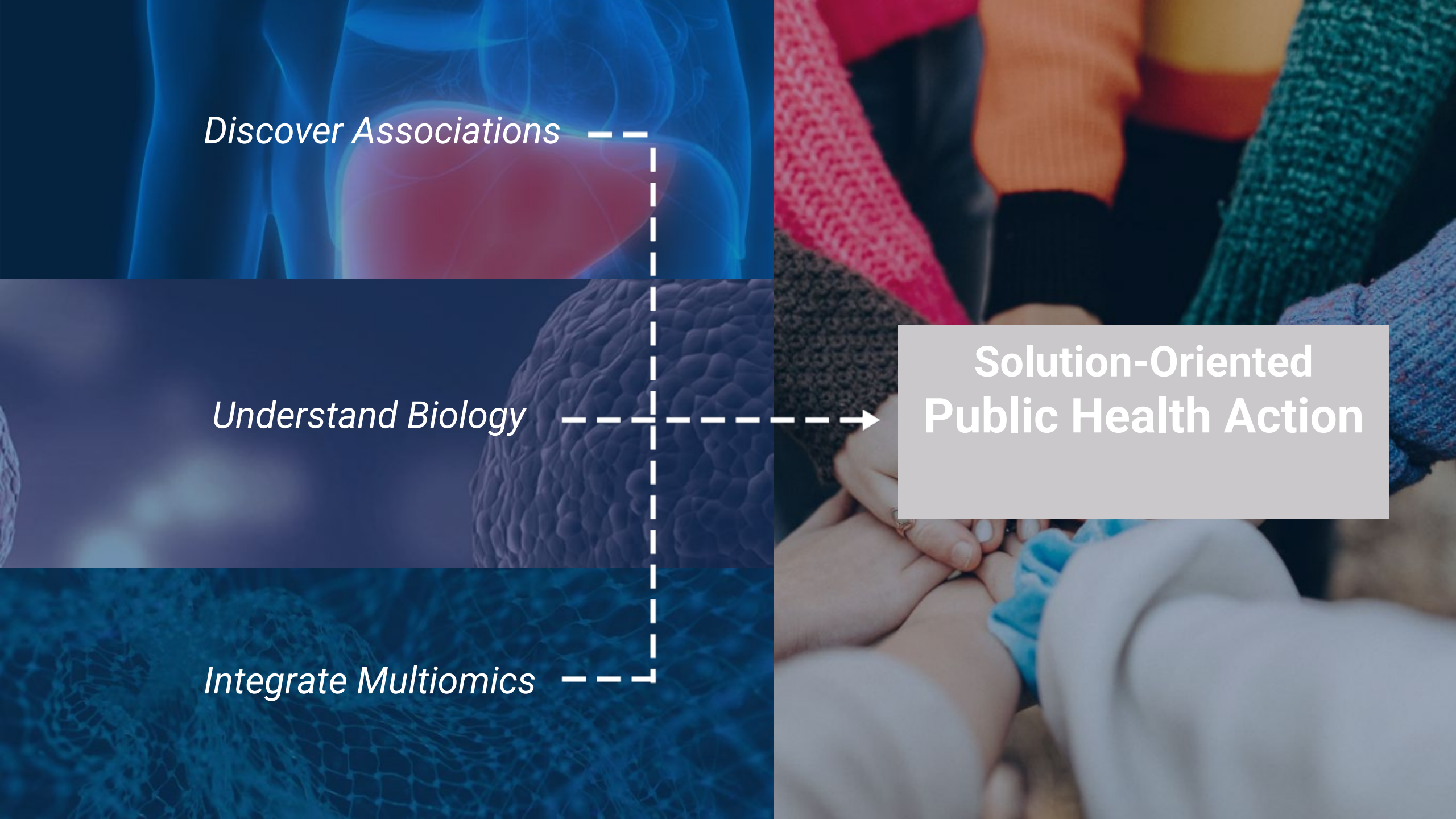
Lida Chatzi, MD, PhD
Project 2
Primary Investigator



Max Aung, PhD
Project 2
Co-Investigator

PUBLISHED RESULTS & PRESS





Discover Associations

Understand Biology

Integrate Multiomics

**Solution-Oriented
Public Health Action**

SOLUTION: PFAS Remediation and Treatment

STUDY DESIGN

Sustainable Remediation



Daniel McCurry, PhD
Project 4
Primary Investigator

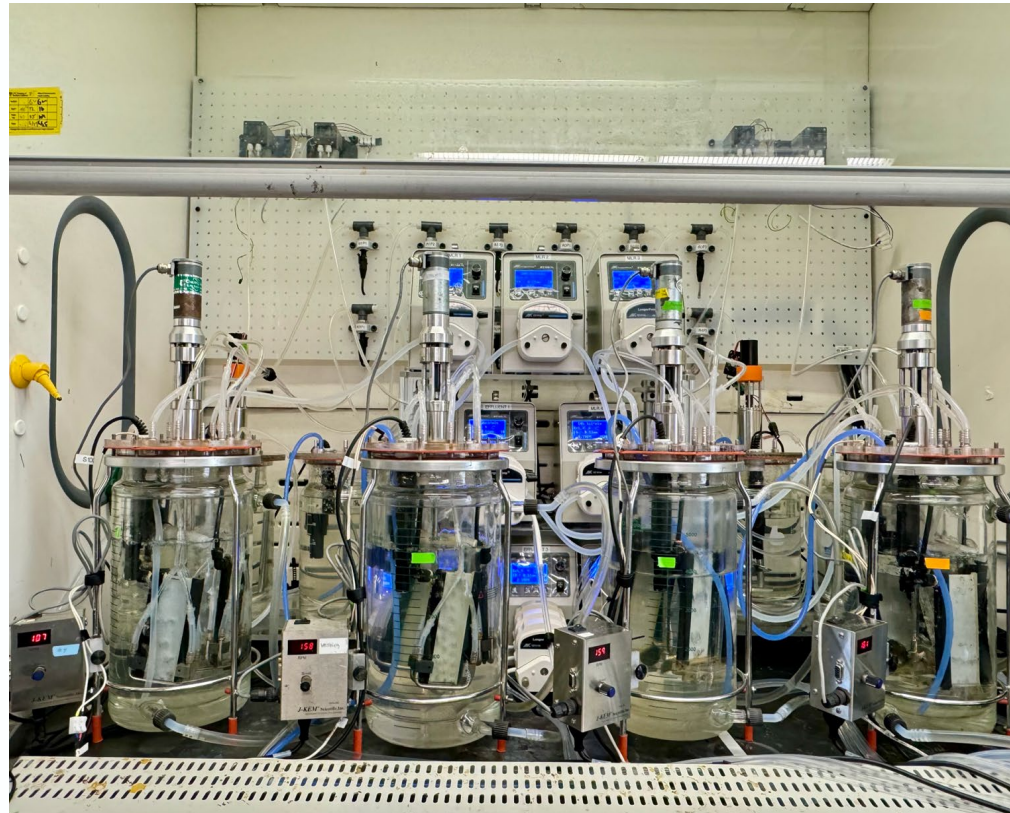


Amy Childress, PhD
Project 4
Co-Investigator



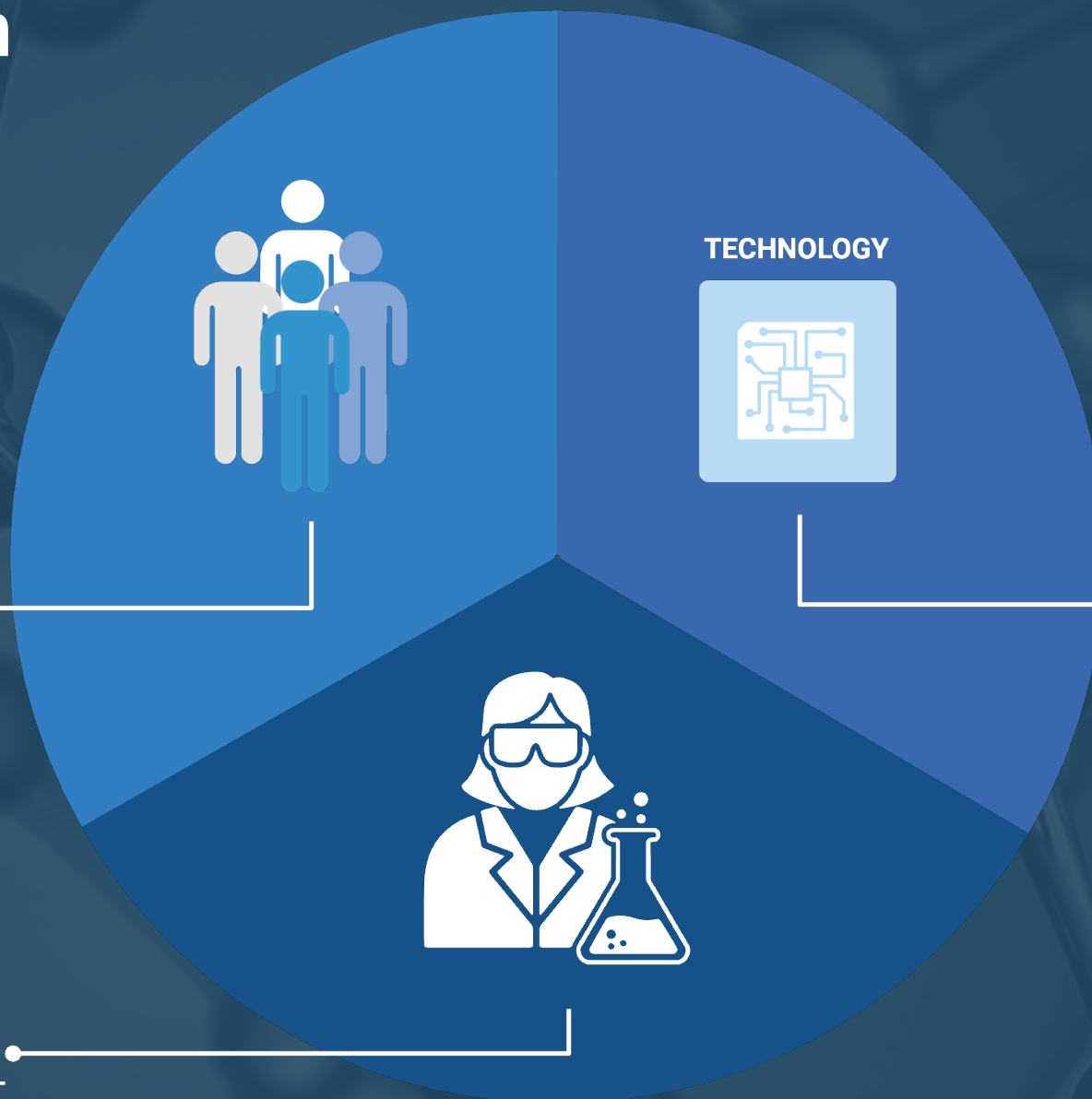
Adam Smith, PhD
Project 4
Co-Investigator

PRELIMINARY RESULTS



Bioreactors: a controlled environment where microorganisms can interact with PFAS and break them down

Impact and Vision



Understand and respond to the health risks of PFAS

TECHNOLOGY

Sustainable technologies for PFAS destruction and clean water

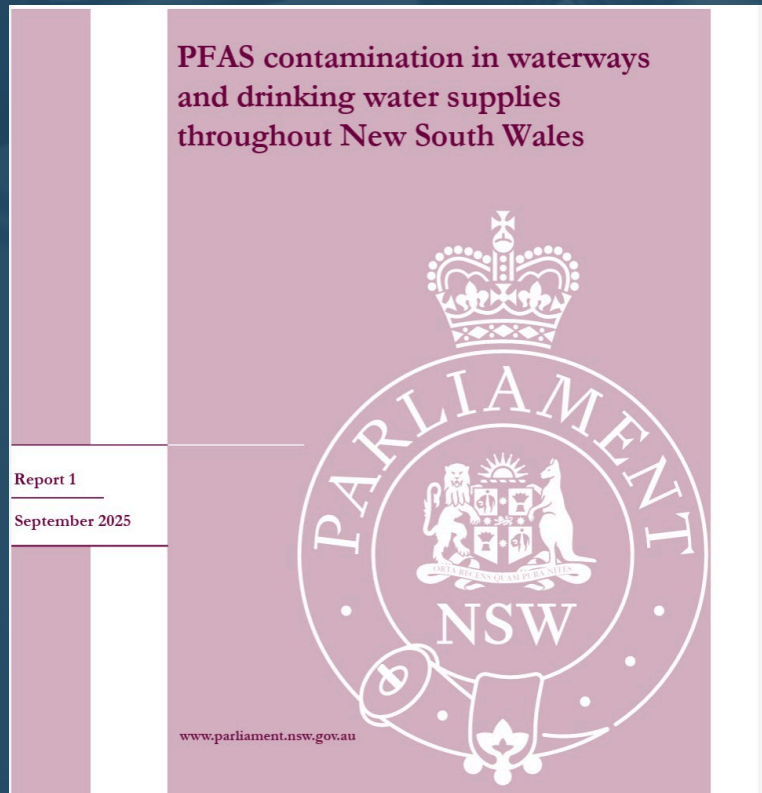
New scientific insights for decision makers on safer water systems, stronger health protections, and clean-up strategies

International Impact

Policy Recommendations

Australia NSW Policy Recommendation & CA SB- 682

Australian New South Wales's parliament published their final report for PFAS policy recommendations, citing project 2 co-Lead **Max Aung's** and **Sherlock Li's** testimony in May and used it as evidence to inform their health recommendations.



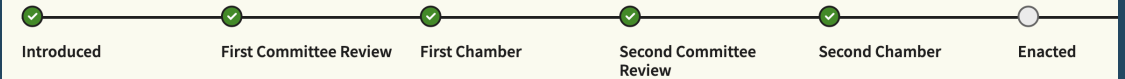
CA SB-682

Max Aung, project 2 co-lead previously testified at CA Senate Health Committee for CA SB-682 in April. The Bill has passed legislative vote and will be going to the Governor's Office.

SB 682: Environmental health: product safety: perfluoroalkyl and polyfluoroalkyl substances.

Session Year: 2025-2026 House: Senate

Current Status: IN PROGRESS (2025-09-23: Enrolled and presented to the Governor at 2 p.m.)



Max Aung, PhD
Project 2 Co-Lead

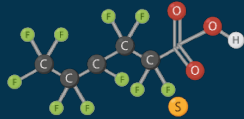


Sherlock Li, PhD
Project 2 Co-Lead

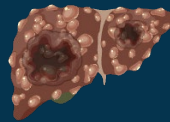
Relevance To Kuwait and the U.S. - NASEM Precision Medicine Symposium

Environmental and Public Health Parallels

PFAS exposure in Kuwait has been documented in soil, indoor dust, and human biosamples; similar to findings in U.S. urban and industrial areas.



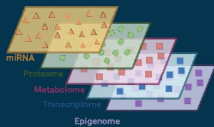
MASLD prevalence in Kuwait mirrors U.S. rates, highlighting the intersection of environmental exposures, lifestyle, and genetic risk.



Shared climatic challenges, may enhance PFAS transport and exposure risk.



Knowledge Exchange: Apply *translational exposomics* and *multi-omics* frameworks to Kuwait's population health datasets.



Capacity Building: Support laboratory infrastructure for PFAS biomonitoring and exposome analytics.



Joint Research & Policy Impact: Inform Kuwait's Plan on environmental health with lessons from U.S. remediation and policy.



Integrating environmental health into precision medicine can strengthen both prevention and policy—transforming Kuwait–U.S. scientific collaboration into actionable public health progress.



Follow Us For Our Research Updates!

Website



sharpcenter.usc.edu

Instagram



[@uscssharp](https://www.instagram.com/uscssharp)

LinkedIn



[linkedin.com/company/
sharpcenter](https://www.linkedin.com/company/sharpcenter)



ShARP
SUPERFUND PFAS ASSESSMENT,
REMEDIATION & PREVENTION

ACKNOWLEDGEMENTS

University of Southern California

- Max Aung, PhD
- Rob McConnell, MD
- David Conti, PhD
- Ana Maretti, PhD
- Jesse Goodrich, PhD
- Lucy Golden, PhD
- Zhenjiang Li, PhD
- Roselyn Tanghal, MPH
- Veronica Wendy Setiawan, PhD

Funding Sources

P42ES036506; R01ES029944;
R01ES030364; R01ES030691;
R01ES036253; U01HG013288
5P30ES007048-23; 5P30DK048522-24
USC President's Sustainability Research
Award

John Hopkins School of Public Health

- Tanya Alderate, PhD

Emory University

- Douglas Walker, PhD
- Dean Jones, PhD

NC State

- Sue Fenton, PhD

Yale University

- Vasilis Vasiliou, PhD

UCI

- Veronica Vierra, PhD
- Scott Bartell, PhD

Mount Sinai

- Damaskini Valvi ,
MD, PhD
- Vishal Midya, PhD

University of Texas

- Joseph McCormick,
MD, PhD

UNC

- Susan Sumner, PhD



Questions?

Lida Chatzi, MD, PhD

Professor of Population and Public Health Sciences

Director, Center for Translational Exposomics Research

Director, Southern California Superfund Research and Training Program for PFAS

Assessment, Remediation, and Prevention

Director, Southern California Environmental Health Sciences Center

Keck School of Medicine of **USC**
**Department of Population and
Public Health Sciences**



CTER