EWG x GWSPH: Data Visualization

Sydney Evans, M.P.H., Senior Science Analyst, Data Science Research (EWG)
Varun Subramaniam, M.S., Science Analyst (EWG)

Quick Introduction

- Varun Subramaniam, Science Analyst at EWG
- B.S.P.H. from UNC-CH, Gillings School of Global Public Health
- M.S. in Health Data Science (Bioinformatics) from GWU, Milken Institute School of Public Health
  → I took this course in Fall 2023 with Dr. Pramita Bagchi!
- Research Focuses: tap water contamination, PFAS, pesticide usage on produce, data science/machine learning
- Hobbies: cooking, playing with Nugget →, street food, coffee, all things sports

Quick Introduction

- Sydney Evans, Senior Science Analyst at EWG
- B.A. Chemistry from the University of Virginia
- M.P.H in Environmental Health from Indiana University Bloomington School of Public Health
- Research Focuses: exposure analysis for contaminants or additives in water, food, and consumer products
- Hobbies: collecting hobbies

EWG's Mission and the Role of Data

Databases
Utilizing public data
Collecting testing data

Our Mission

Our mission is simple: To empower you with breakthrough research to make informed choices and live a healthy life in a healthy environment.

FOCUS AREAS

- Food & Water
- Farming & Agriculture
- Personal Care Products
- Household & Consumer Products
- Energy
- Family Health
- Toxic Chemicals
- Regional Issues

CONSUMER GUIDES

Tap Water Database

Across the U.S, we found dozens of contaminants at levels that are perfectly legal. The bad news? Scientists say those levels may still pose health risks to us, like cancer.

EWG VERIFIED®

Shopping for personal care products? The EWG VERIFIED® mark signals the product in your hands meets our strictest criteria for transparency and health.

Skin Deep®

Since 2004, EWG's Skin Deep® cosmetic database has helped people protect themselves from potentially toxic chemicals in personal care and beauty products.

EWG's Guide to Sunscreens

Sunscreen safety ratings that help you make the right purchase.

Guide to Healthy Cleaning

EWG's Guide to Healthy Cleaning provides you with easy-to-navigate hazard ratings for a wide range of cleaners and ingredients.

EWG's quick tips for reducing your diet's climate footprint

The way we eat has a direct impact on the climate crisis, and there are steps everyone can take to rethink their diets in order to reduce greenhouse gas emissions.

RESEARCH

FOOD | ULTRA-PROCESSED FOODS | FOOD CHEMICALS

EWG evaluation of food chemicals: BHA

JUNE 5, 2026

EWG's recommendation

BHA is an ingredient of concern. EWG suggests limiting consumption of foods with this ingredient.

The National Toxicology Program in 1991 classified BHA as "reasonably anticipated...

Drinking water of almost 1 in 5 Americans contains nitrates linked to cancer and birth defects

APRIL 23, 2026

Roughly 18% of the U.S. population relied on drinking water from...

PESTICIDES | PARAQUAT

For decades, regulators knew paraquat was harmful but failed to address the risks

APRIL 16, 2026

Paraquat is a highly toxic agricultural chemical that has been sprayed on fields for decades. Its value as a herbicide was discovered in 1955. It was introduced for commercial use in 1962 and the...

FOOD | FOOD CHEMICALS

EWG evaluation of food chemicals: Sucralose

APRIL 15, 2026

Sucralose is an ingredient of concern. EWG suggests avoiding or limiting consumption of products with this ingredient or using sucralose as a sugar substitute. This recommendation is specific to...

FOOD | FOOD CHEMICALS

EWG evaluation of food chemicals: TBHQ

APRIL 15, 2026

TBHQ is an ingredient of concern, and EWG suggests limiting consumption of foods containing this ingredient.

MIDWEST | FARM POLLUTION

Flooded fields, polluted environment

APRIL 3, 2026

Over 4.2 million acres of flood-prone cropland in four major Corn Belt states of Illinois, Iowa, Minnesota and Wisconsin likely generate nitrous oxide emissions that contribute to climate change, and...

PFAS CHEMICALS | PESTICIDES | CALIFORNIA

'Forever chemicals' contaminate nearly 40% of non-organic California-grown produce

MARCH 11, 2026

California is renowned for producing more than half of the nation's fruits and vegetables, and they're often contaminated with residues from dozens of synthetic pesticides. Some of those pesticides...

FOOD | FOOD CHEMICALS

Secret GRAS: How 100+ food chemicals bypassed government safety review

MARCH 3, 2026

Thousands of everyday food products potentially could contain substances that carry unknown health risks, a new EWG analysis finds.

Although Congress intended for most food chemicals to be rigorously...

V

EWG Science in the Media: Press Responsibilities

"Being exposed to a cocktail of pesticides is often a lot more dangerous than being exposed to each of them in the same amounts individually."

- VARUN SUBRAMANIAM, M.S.

A surprising percentage of produce from the nation's largest supplier contains ...

MARCH 11, 2026 | CNN

CNN

"Things that are grown in California tend to spread across the country."

- VARUN SUBRAMANIAM, M.S.

Nearly 40% of California produce contains PFAS 'forever chemicals,' report finds

MARCH 11, 2026 | SEATTLE TIMES

The Seattle Times

"But if you can't find organic versions of blackberries, for example, we know any washing is better than none."

- VARUN SUBRAMANIAM, M.S.

2026 'Dirty Dozen' produce: Nearly 100% tested positive for pesticides, includi...

MARCH 24, 2026 | CNN

CNN

"We're not only flagging produce with the most pesticides, we're also highlighting those with potential health hazards."

- VARUN SUBRAMANIAM, M.S.

Avoid these new 'Dirty Dozen' food items while shopping in Georgia

JULY 16, 2025 | THE ATLANTA JOURNAL CONSTITUTION

The Atlanta Journal-Constitution

"Consumers have a right to know what's on their food,"

- VARUN SUBRAMANIAM, M.S.

These fruits and vegetables found to have most, least pesticides

MARCH 24, 2026 | USA TODAY

USA TODAY

"Not every filter is good for everything."

- SYDNEY EVANS, MPH

Do you really need a water filter? Here's what experts say

MARCH 11, 2026 | ASSOCIATED PRESS

AP Associated Press

"We need to disinfect drinking water so that people don't get different pathogens."

- SYDNEY EVANS, MPH

The truth about American drinking water: Report shows widespread presence of ha...

FEBRUARY 26, 2025 | FORTUNE

FORTUNE

"All of those same properties that make them really resistant to water, it also makes them pretty indestructible in the environment. They are almost impossible to break down."

- SYDNEY EVANS, MPH

The Dangers of PFAS

AUGUST 14, 2023 | US NEWS & WORLD REPORTS

U.S.News & World Report

"Babies and young children are particularly vulnerable to the health risks posed by pesticides in food – and food is the way most children will be exposed to pesticides."

- SYDNEY EVANS, MPH

Nearly 40% of conventional baby food contains toxic pesticides, US study finds

OCTOBER 23, 2023 | THE GUARDIAN

The Guardian

"The end goal is people wouldn't have to buy a water filter... but that's just not the reality."

- SYDNEY EVANS, MPH

Are water filtration systems an effective way to get rid of PFAS? Here's what a...

JULY 12, 2023 | USA TODAY

USA TODAY

"We need strong new state and federal actions to eliminate sources of PFAS pollution."

- SYDNEY EVANS, MPH

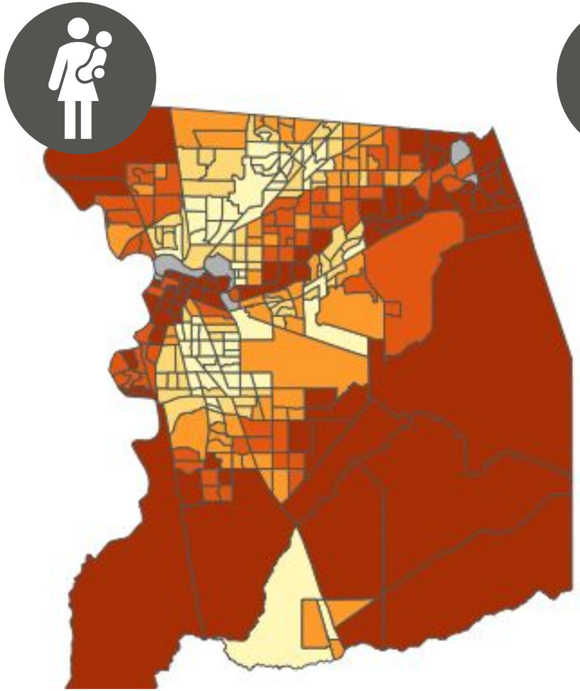
Most US pet food contaminated with 'forever chemicals', study finds

NOVEMBER 3, 2023 | THE GUARDIAN

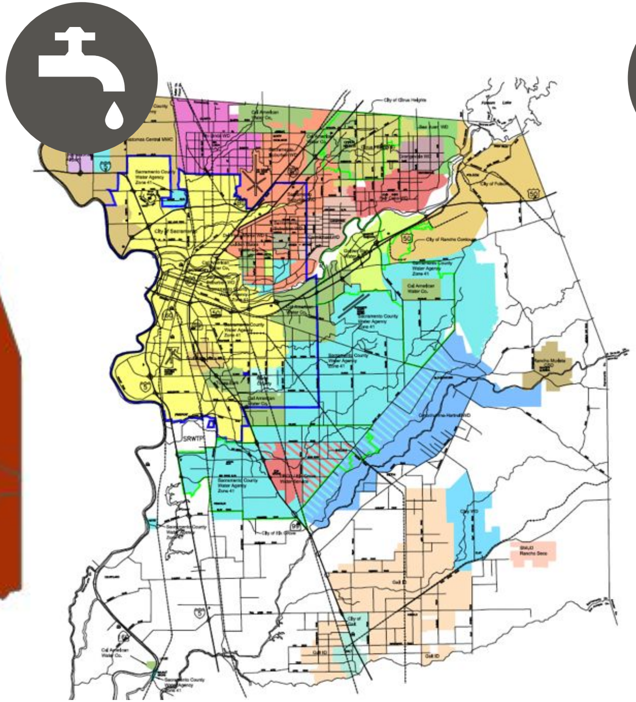
The Guardian

Live TV, recorded interviews, radio segments, quotes, background, press conferences, testimonies, etc.

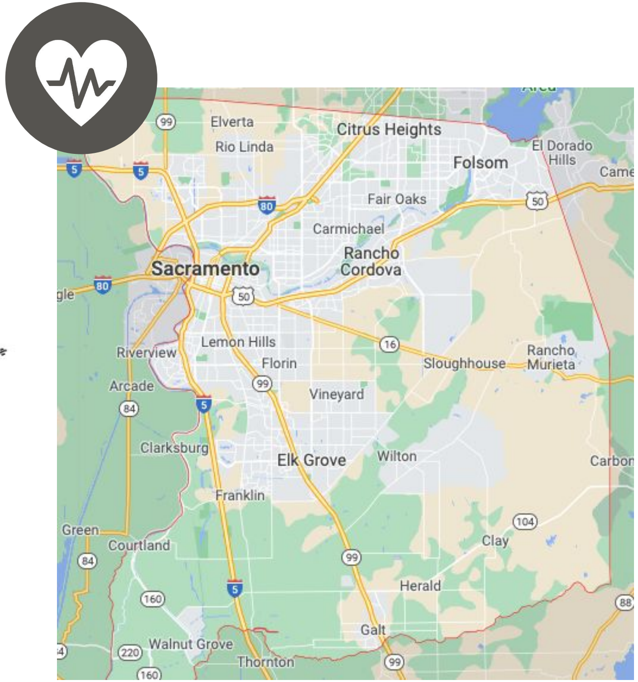
Analyzing public data



Census Tracts, Sacramento, CA
crd150.github.io/lab5.html



Water Service Areas, Sacramento, CA
waterresources.saccounty.net/pages/maps.aspx



County Boundaries, Sacramento, CA
google.com/maps

EWG databases

CONSUMER GUIDES

You have questions. We have answers.

We built our consumer guides to help you learn about the hidden health dangers in your food, water and everyday products to make better decisions.

WATER

Tap Water Database

Across the U.S, we found dozens of contaminants at levels that are perfectly legal. The bad news? Scientists say those levels may still pose health risks to us, like cancer.

FEBRUARY 26, 2025

SUNSCREEN | NANOMATERIALS

EWG's Guide to Sunscreens

Sunscreen safety ratings that help you make the right purchase.

MAY 20, 2025

FOOD | PESTICIDES | CHILDREN'S HEALTH

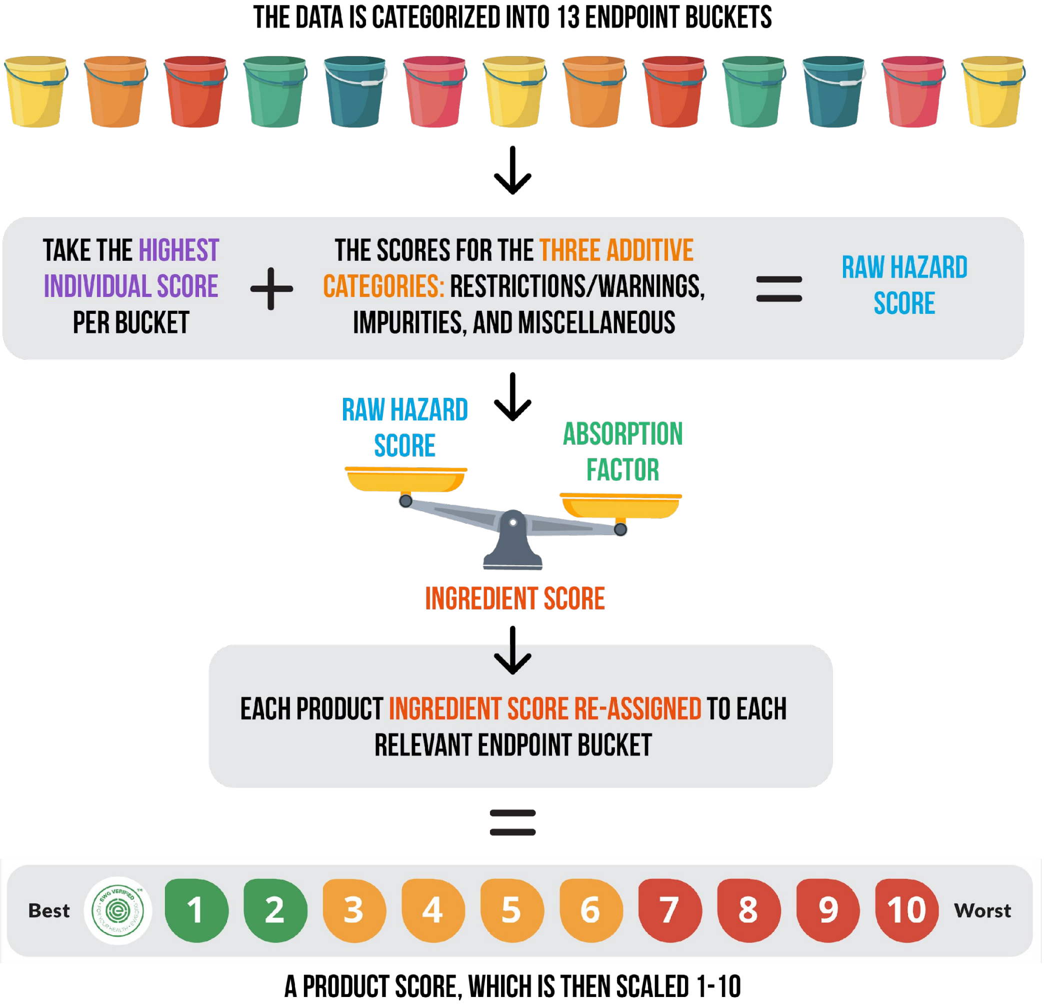
EWG's 2026 Shopper's Guide to Pesticides in Produce™

Almost 60% of samples of conventionally grown fruit and vegetables on the Clean Fifteen™ list in the Environmental Working Group's new Shopper's Guide to Pesticides in Produce™ had no detectable...

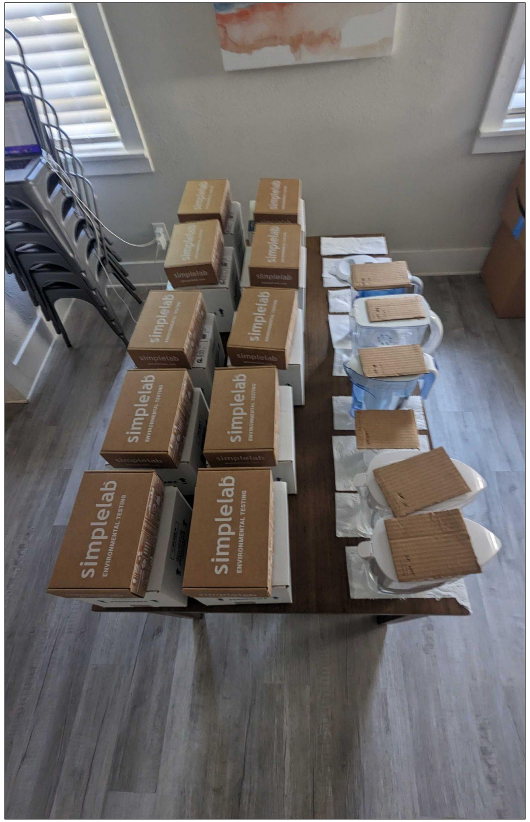
MARCH 24, 2026

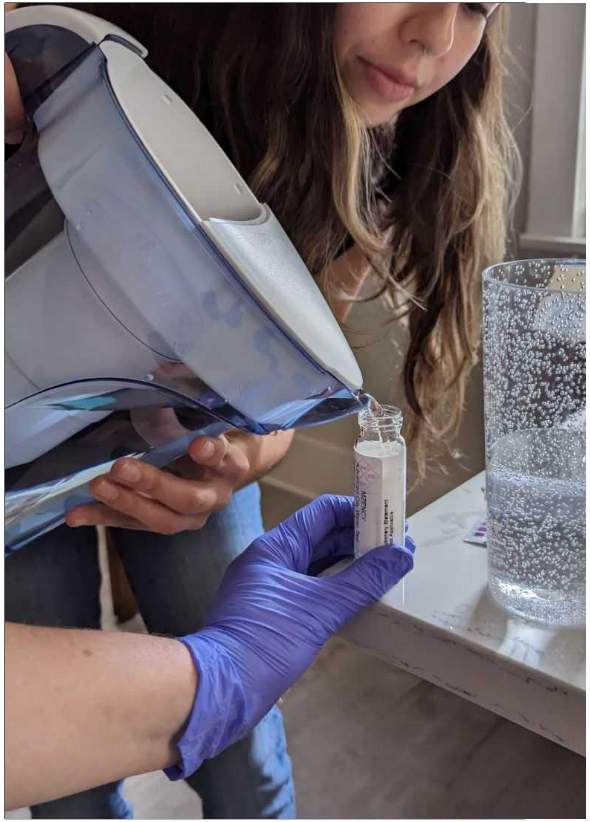
ALL CONSUMER GUIDES

EWG databases



Primary data collection





EWG's Data Science Toolkit and Workflows

Independent vs team coding
Working with graphics teams
Documentation for non-(data) scientists

Documentation: not everyone can read your code

(and sometimes you can't understand your code either)

REPRODUCIBILITY

QUALITY CONTROL

TRANSPARENCY

Documentation: not everyone can read your code

(and sometimes you can't understand your code either)

- 2026_food_database.Rproj
- archived_outputs
- archived_scripts
- dirty_dozen_analysis.html
- dirty_dozen_analysis.qmd
- figures
- food_additive_regex.R
- food_scores_category_review.rds
- label_insight_import.R
- notes
- nutrition_analysis.html
- nutrition_analysis.qmd
- qaqc
- qaqc_foodscores_categories.html
- qaqc_foodscores_categories.qmd
- qaqc_foodscores_drift_June12.html
- qaqc_foodscores_drift_May28.html
- qaqc_foodscores_drift.qmd
- qaqc.qmd
- README.md
- source_data
- sweetener_reference_data.R
- sweeteners_analysis.qmd
- tables
- testing_file.R
- utils.R

```
This repository supports two related but distinct workstreams, both built on
EWG's Food Scores database:

  1. QUALITY ASSURANCE / QUALITY CONTROL (QAQC) for Food Scores database
     updates. Scripts and supporting files here are used to validate ingredient
     flag logic, review score changes between database versions, audit product
     categories, and confirm that updates from the tech team are behaving as
```

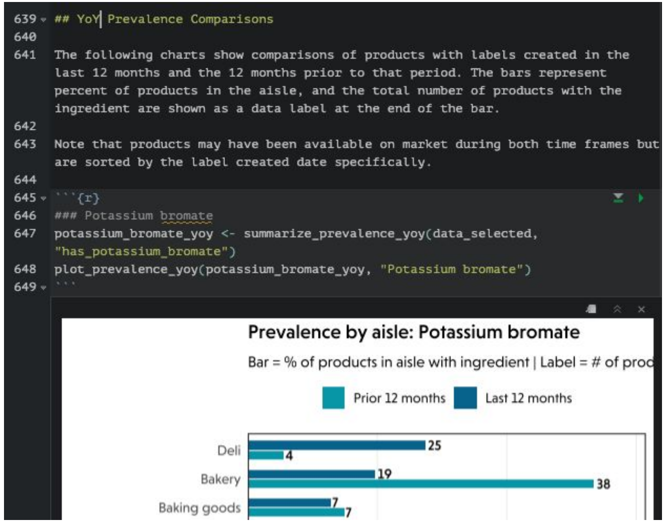
Clear file structures and README files ensure that your methodology is transparent and accessible to others.

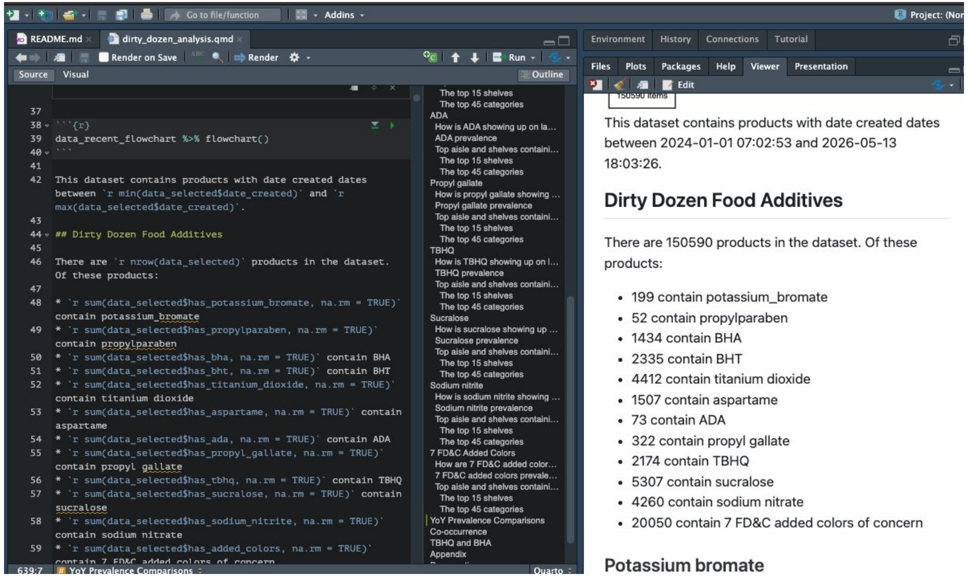
This documentation serves as a guide for both the current team and your future self.

```

------------------------------------------------------------------------------
REPOSITORY STRUCTURE
------------------------------------------------------------------------------

Root directory
  Contains all R scripts (.R) and Quarto documents (.qmd), along with their
  rendered HTML outputs. Each script or .qmd file is self-contained: if it
  depends on another script, it calls source() internally. You do not need to
  run scripts in a particular order before opening an analysis file — just open
  and render.

  notes.txt
    A personal scratchpad for miscellaneous notes, reminders, and thoughts
    captured during analysis. Not a formal deliverable.

  testing_file.R
    A scratch script used for ad hoc code testing and experimentation. Not
    part of any analysis pipeline.

subfolders/
```

Documentation: not everyone can read your code

(and sometimes you can't understand your code either)





Fully document all code and repositories

Lots of code, cleaning, and decisions made at each step

Maintained a GitHub repository with only primary data analysts (Sydney and Varun) having admin access

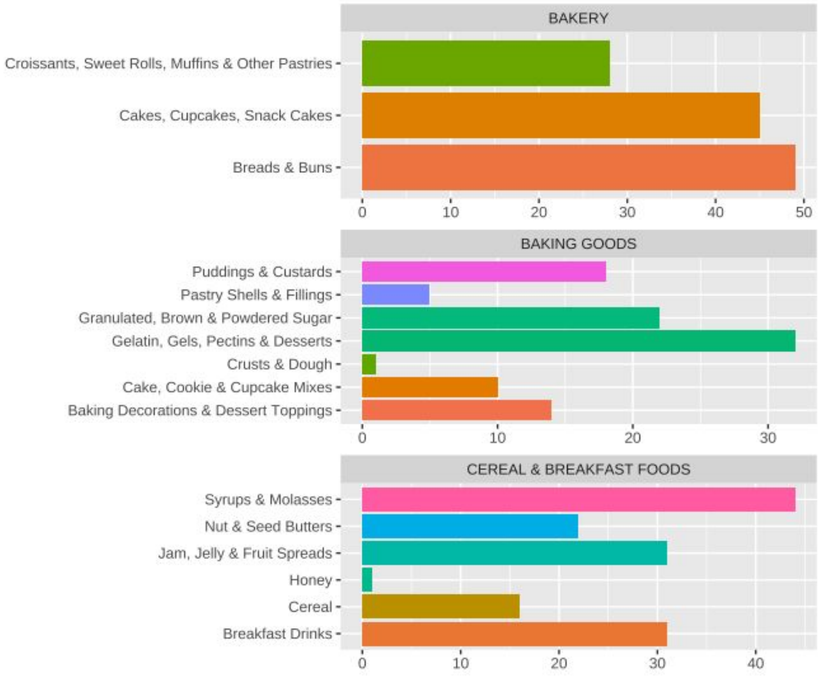
Weekly pushes via GitHub Desktop + constantly updating documentation in RScripts

Once manuscript submitted: converted full RScript to Quarto Markdown

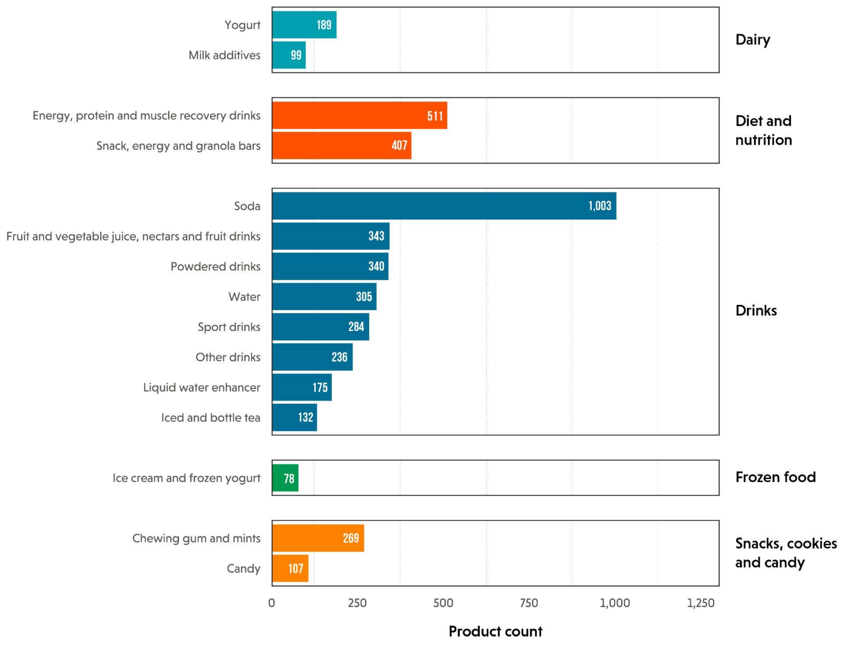
2026 → Tried asking Gemini and Claude to convert a script to a Qmd, for fun, and it was VERY inaccurate!! Recommend doing this manually for now, until LLMs catch up :)

Standardizing visualization for recognizable branding

Default R/*ggplot2* (8 lines of code)

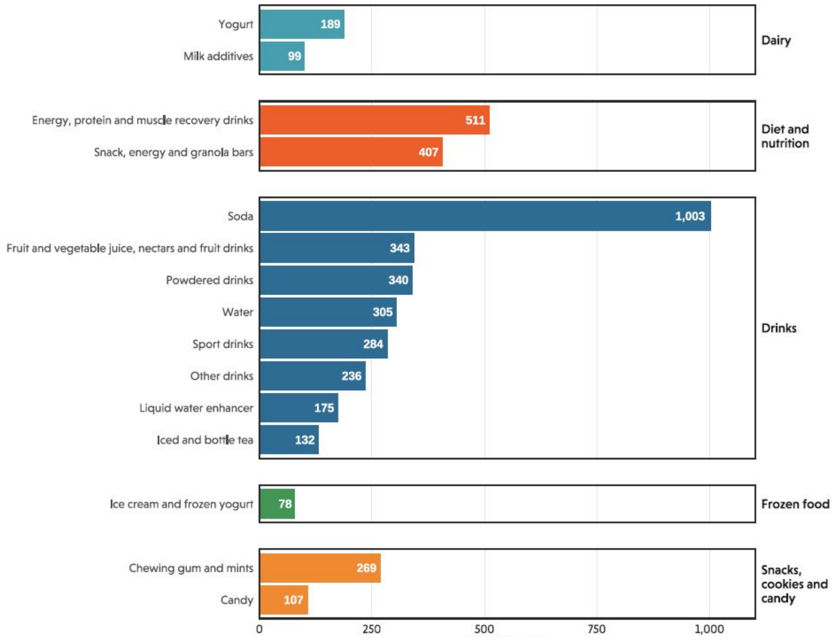


EWG graphics team redesign

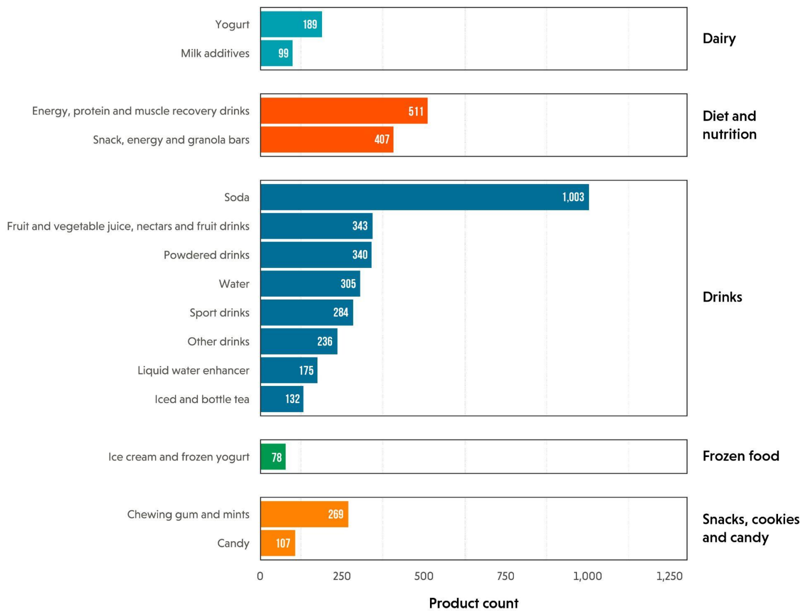


Standardizing visualization for recognizable branding

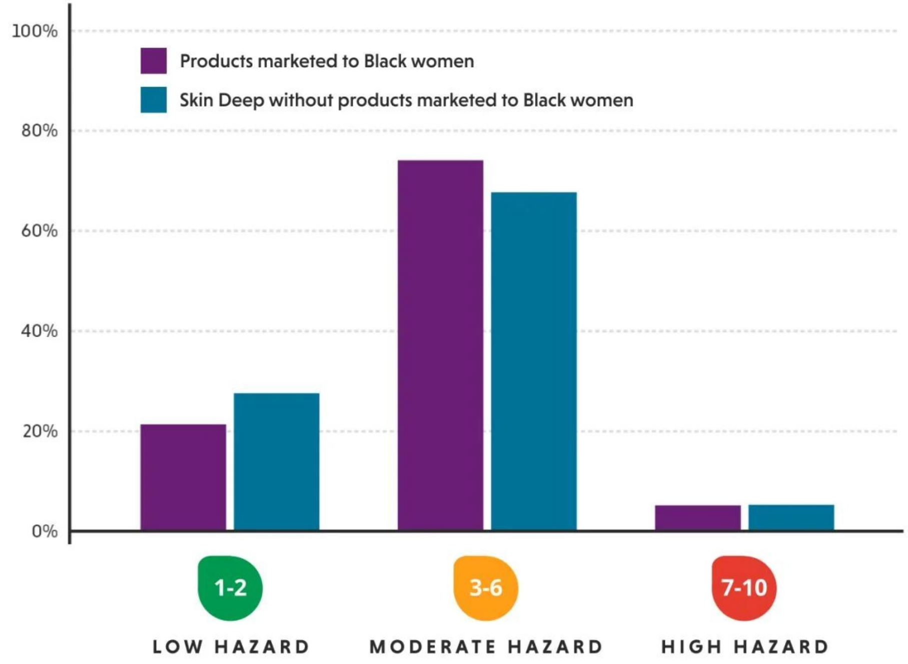
Custom styled R output (*ggplot2* themes)



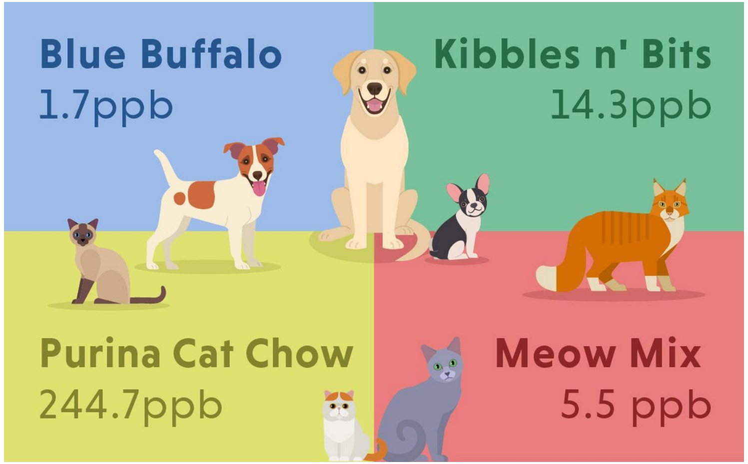
EWG graphics team redesign



Messaging and communication: when less is more

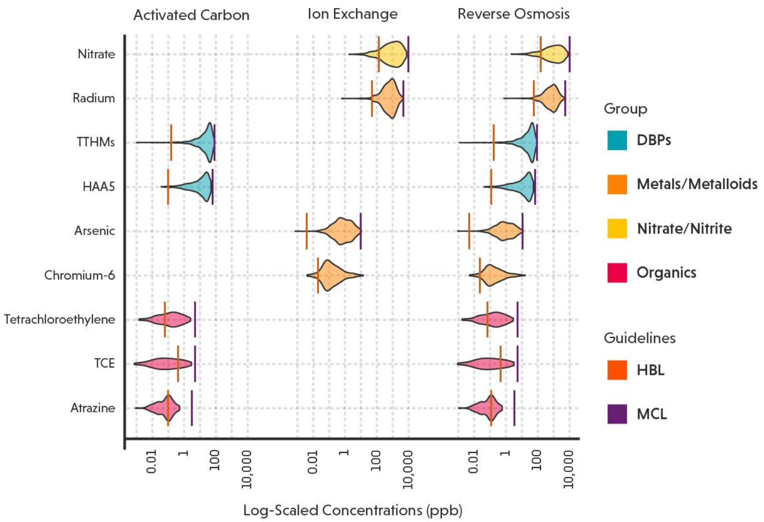


Bar charts can feel basic, but sometimes they are the best and clearest way to make a statement.

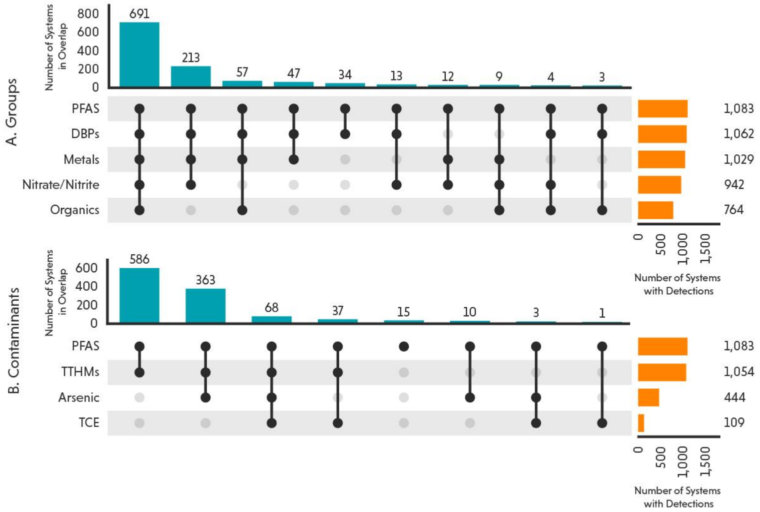


A clear and concise table of results is an EWG staple.

Messaging and communication: know your audience



Log-scaled concentrations and distribution plots provide deep technical insight for expert stakeholders.



Ensure your audience is familiar with specialized viz types before increasing complexity to avoid confusion.

S

Sample Project Walkthrough

PFAS Treatment as an Opportunity for Broader Drinking Water Improvements:

Evidence from U.S. Water Systems

EWG's Tap Water Database

- Updated annually, first released in 2005
- Comprehensive, searchable resource for utility-level contaminant concentration information (n = 50K)
- Compiles water testing data from states and SDWIS
- EWG has published multiple papers on TWD; several others use/cite it
- Search your zip code and see what's in your tap water! →

A Deep Dive: 2024 U.S. EPA PFAS MCLs

- **MCL** = Maximum Contaminant Level; used to regulate contaminants of interest; legally enforceable when set by EPA (federal)
- In 2024, EPA announced MCLs for six PFAS contaminants – first federal limit in decades
  - **Trump EPA reversed PFHxS, PFNA, HFPO-DA, and Hazard Index MCLs in 2026**
- MCLs are based on cost-benefit analysis, with feasibility for water systems considered in costs
- Major driver of the adoption of the rule was disinfection byproduct co-reduction estimates
  - Disinfection byproducts = contaminants that emerge from disinfection (e.g. bond cleavage results in two distinct byproducts)
- Concurrent reduction in DBPs from PFAS treatment → drop in cancer cases
- EPA only considered trihalomethanes (THMs) for co-removal benefits

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Research Questions

1. How does EPA's estimated co-reduction in THMs compare to estimates from EWG's TWD?

2. What contaminants commonly co-occur in systems with high PFAS levels?

3. How do PFAS filtration technologies compare in their potential to remove co-occurring (non-target) contaminants?

Introducing our Paper

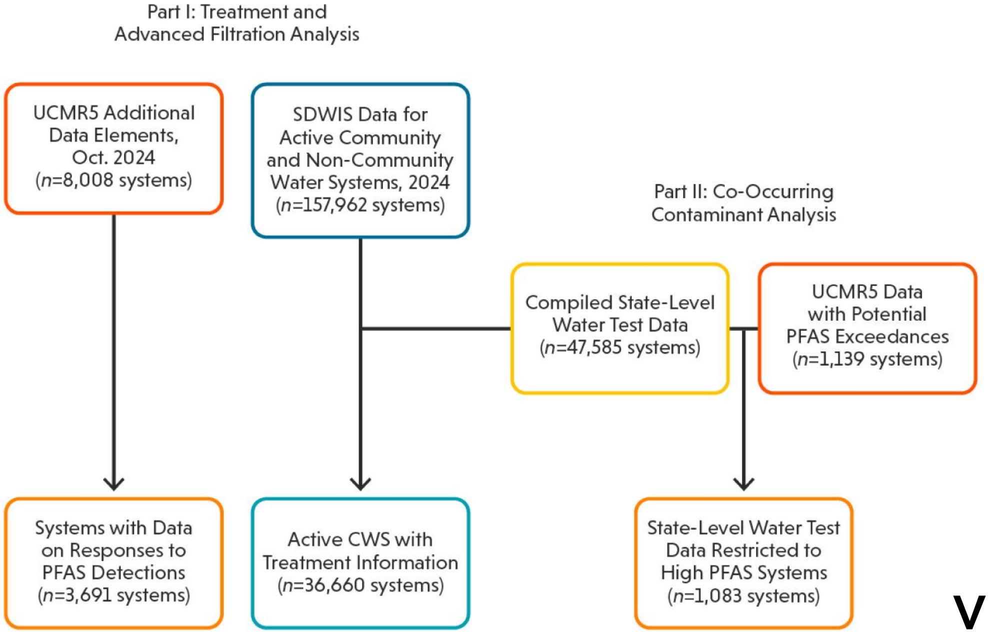
- Published in ES&T Water (ACS) on Sep. 4, 2024
- Compared EPA's estimated THM co-reductions to TWD-derived estimates
- Compiled water testing data from SDWIS, UCMR5, and TWD to assess treatment types, frequencies, and objectives
- Analyzed contaminant co-occurrence

Read our paper! →

ACS ES&T Water > Vol 5/Issue 9 > Article
Cite Share Jump to Expand
Open Access
ARTICLE | September 4, 2025

PFAS Treatment as an Opportunity for Broader Drinking Water Improvements: Evidence from U.S. Water Systems

Sydney S. Evans*, Varun Subramaniam, Anna Cullen, Chris Campbell, Olga V. Naidenko, and David Q. Andrews



Data: Sources, Cleaning, and Compiling

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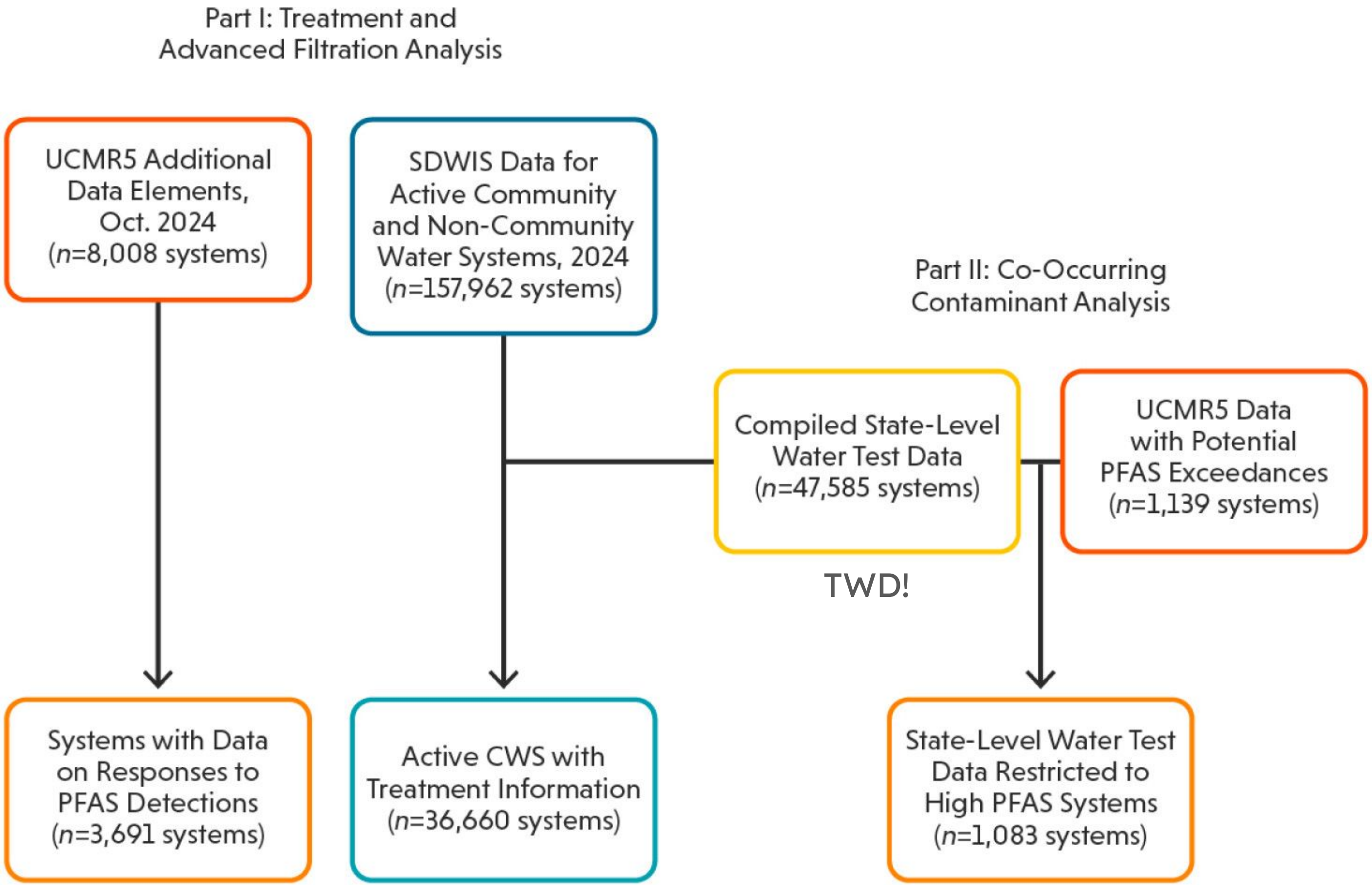
Dataset compilation workflow: a graphical abstract



What does each dataset capture?

EWG TWD

Contaminants in tap water

Concentrations for each contaminant

Water system metadata

"What's in our tap water?"

SDWIS

How systems are treating water

Objectives for treatment to compare goals with outcome

"How are water systems treating contamination in general?"

UCMR5

Whether systems have responded to PFAS detections

What advanced filtration has been installed to reduce PFAS

"How is PFAS currently being treated?"

Key Findings

Disparities in water treatment by system size

Table 1. **Use of Granular Activated Carbon, Ion Exchange, and Reverse Osmosis Technologies in Community Water Systems with Available Treatment Data According to Size of Population Served**[a]

Population	System Size Description	Total Number of Active CWS with Available Treatability Information in SDWIS	CWS with GAC, RO, or IX	Percent of CWS with GAC, RO, or IX	CWS with GAC or RO	Percent of CWS with GAC or RO
<500	Very Small	18,197	1,350	7%	392	2%
500–3,300	Small	10,562	700	7%	262	2%
3,301–10,000	Medium	4,143	373	9%	193	5%
10,001–100,000	Large	3,341	467	14%	308	9%
>100,000	Very Large	417	116	28%	97	23%
Number of CWS		36,660	3,006	8%	1,252	3%
Total Population, Millions		277	87	31%	65	23%

[a]Data source: U.S. EPA SDWIS treatment database.[28]

GAC, IX, and RO can filter out PFAS ***and*** several other contaminants

Smaller systems cannot afford to install them or cover upkeep

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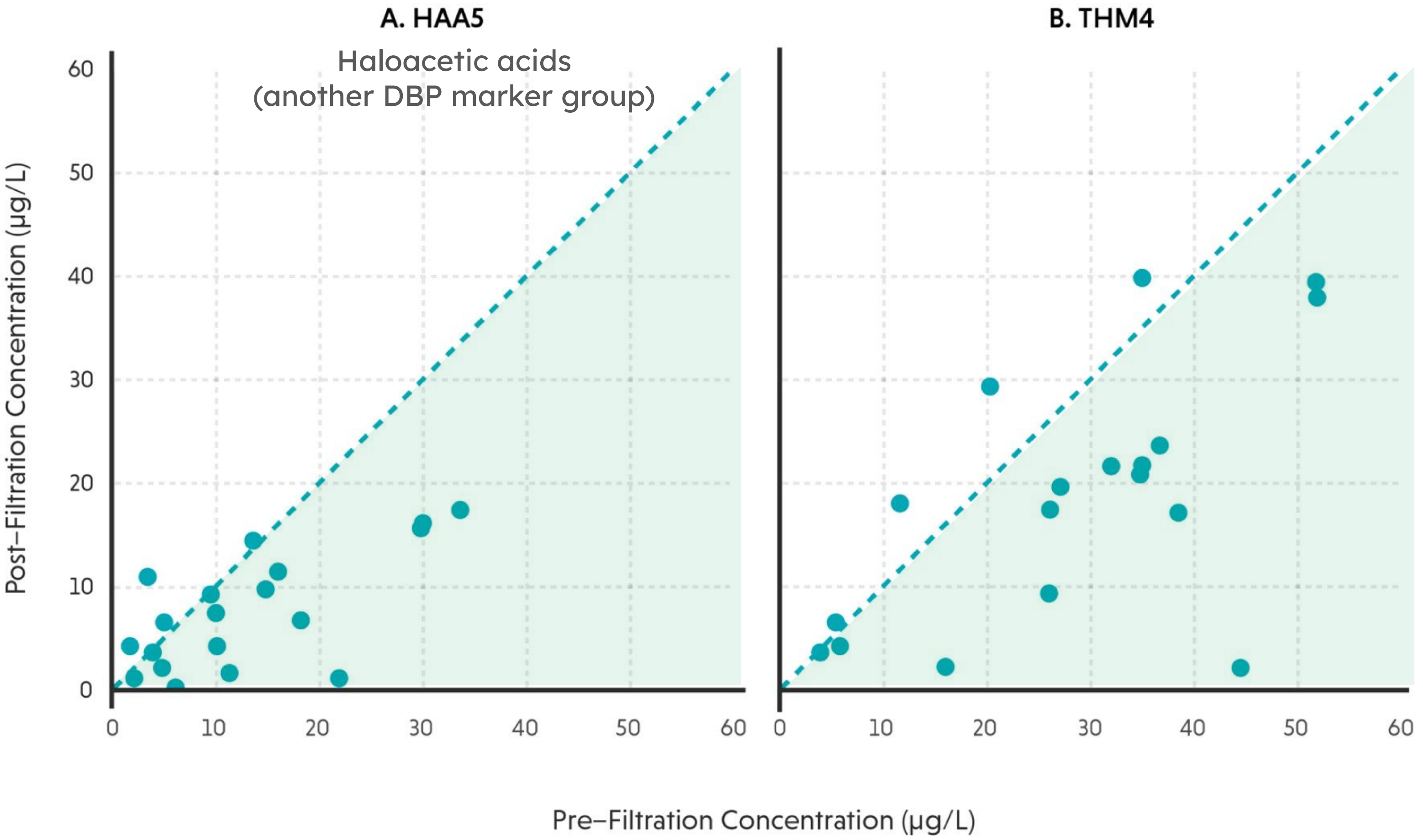
Most systems aren't specifically addressing PFAS

Table 2. Information Listed by Community Water Systems in the U.S. EPA UCMR5 Data Set of PFAS Test Results regarding Installation of Treatment Technologies for Targeted PFAS Removal [a]

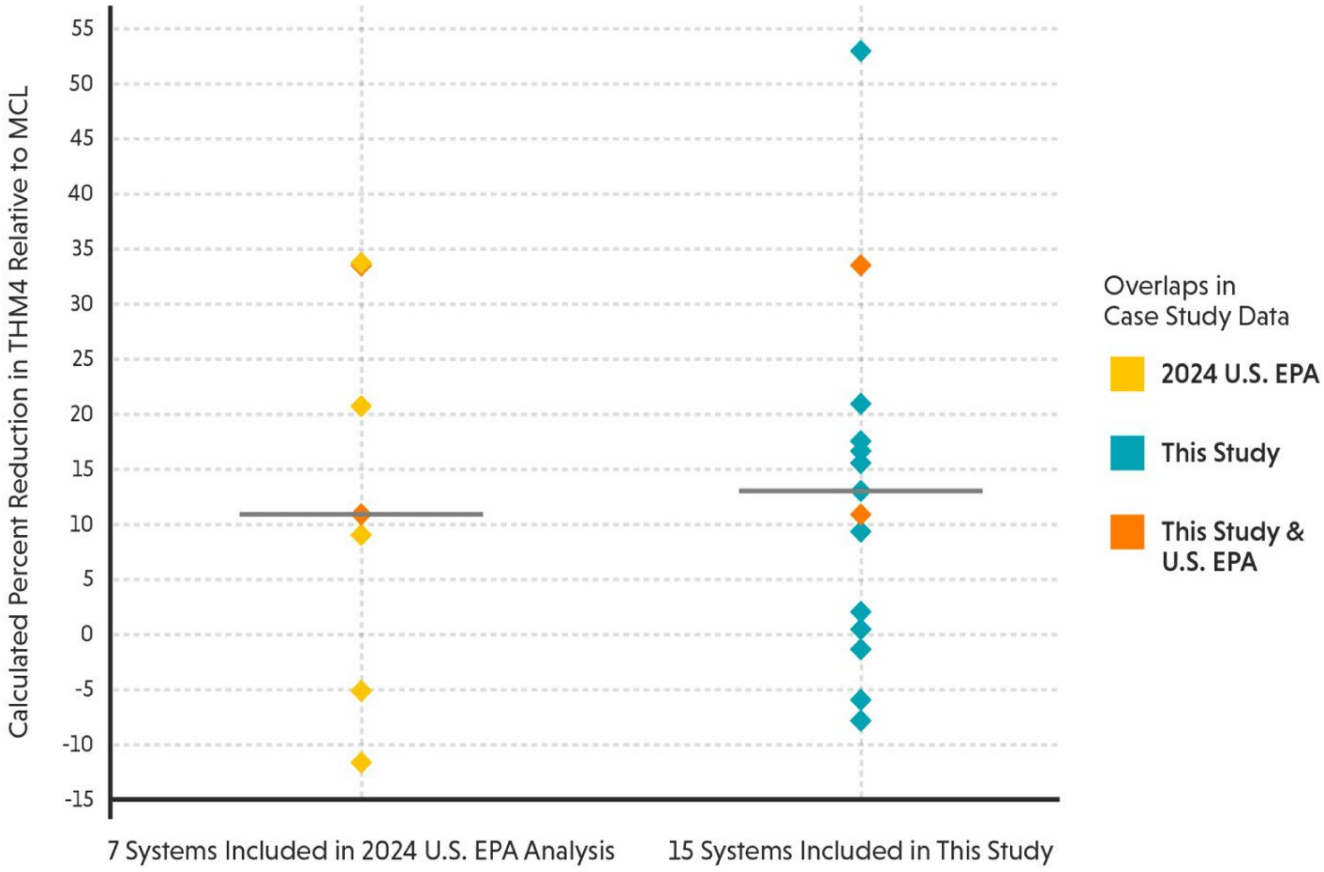
Reported Response to PFAS Detections	Number of CWS with Available Data	Total Population, millions
Not Modified	3,614 = 98%	181
Granular Activated Carbon	139	7
Ion Exchange	52	4
Powdered Activated Carbon	14	0.9
Reverse Osmosis	12	0.5
Biologically Activated Carbon	7	0.3
Total	3,691	

[a] Data for 3,691 systems with reported PFAS responses are shown.

PFAS-targeting systems observe DBP co-reductions



EPA undervalued DBP co-reduction estimates

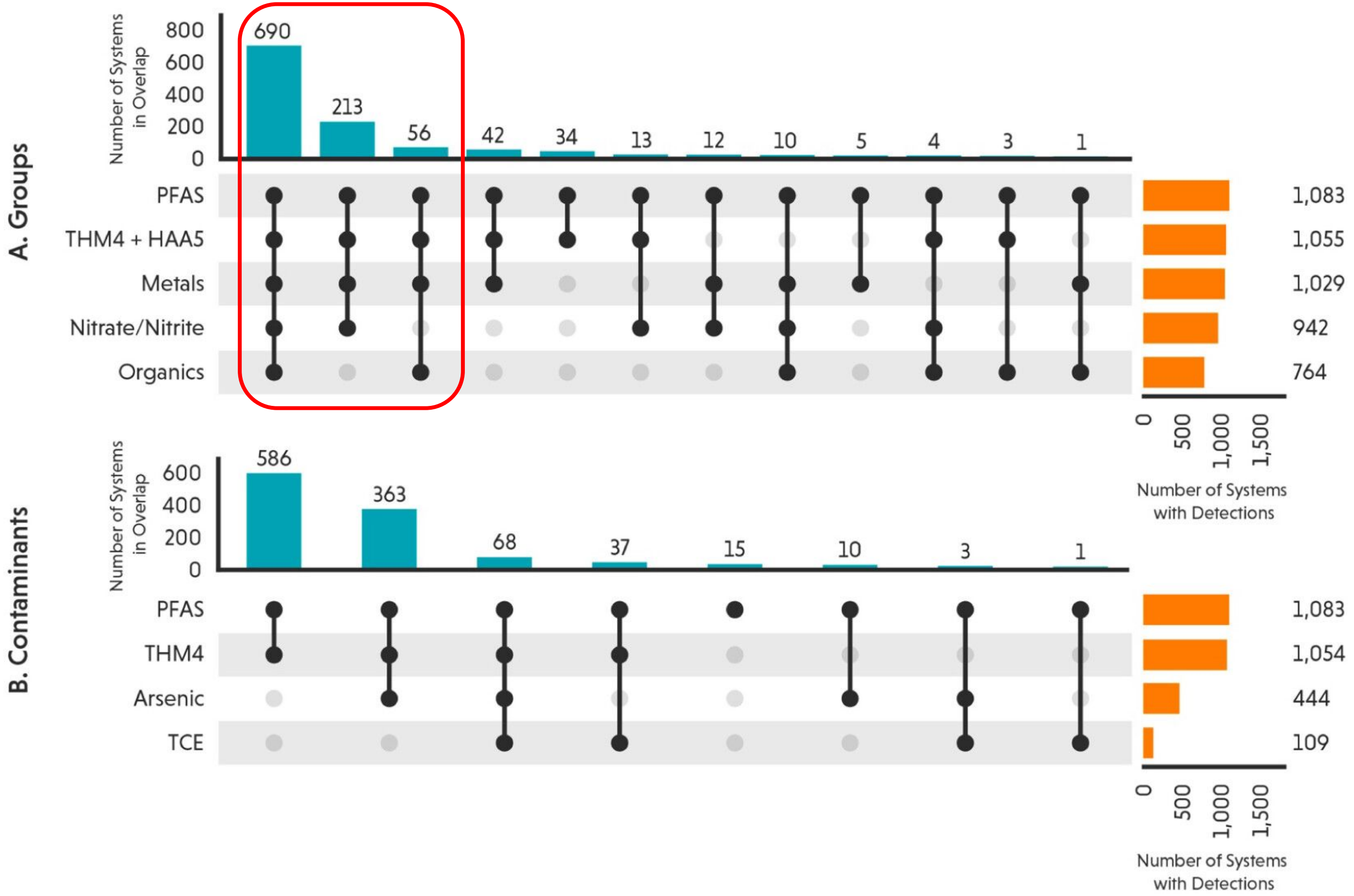


Similar THM reduction distributions in TWD vs EPA calculations

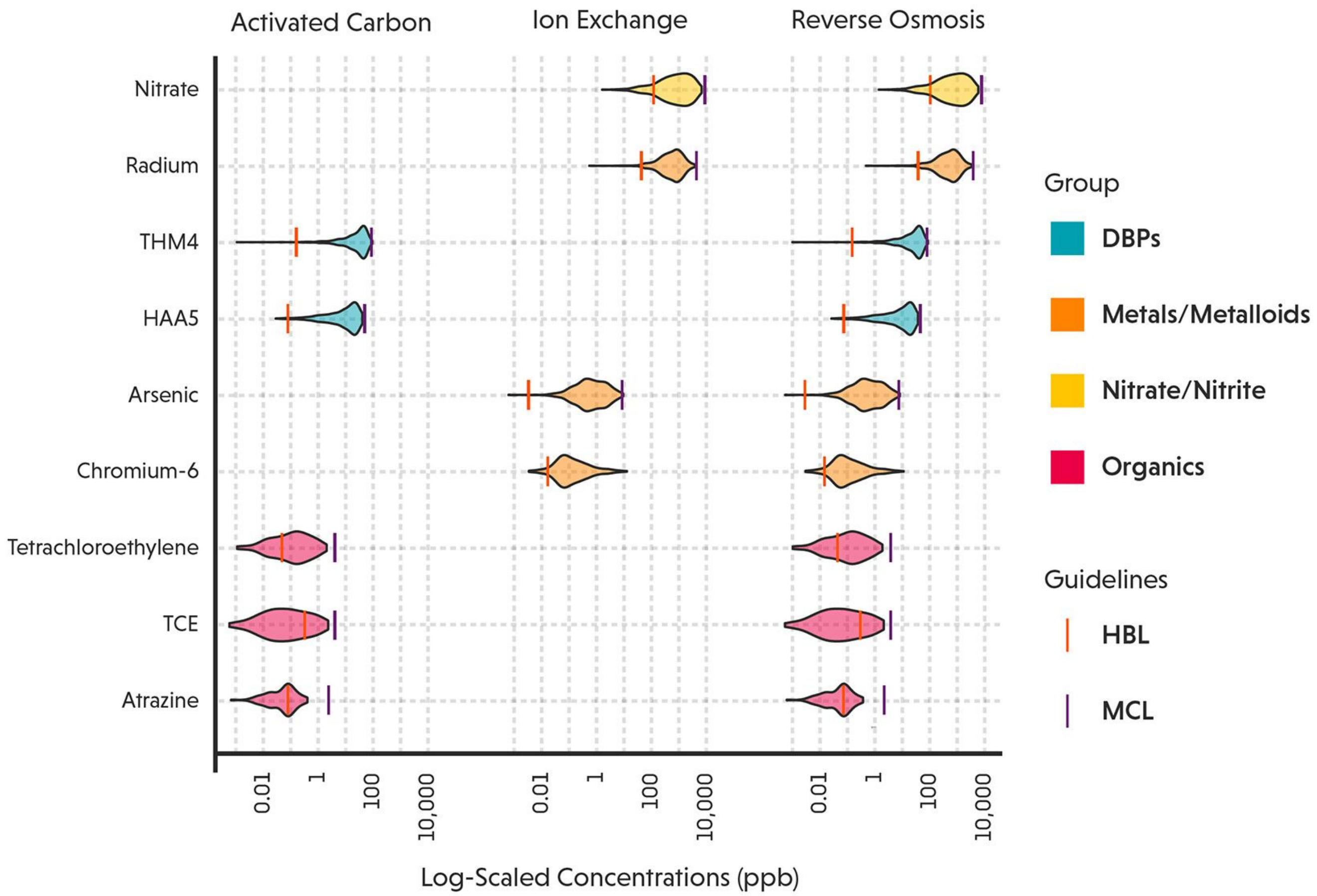
Higher median (13.0% vs 10.9%) and maximum (53.0% vs 33.7%) in TWD estimate

EPA did not account for HAA5 or any non-DBP when calculating CBA

PFAS are never detected alone in high-PFAS systems



PFAS filtration can remove other contaminants too



All PFAS-filtration technologies can remove other contaminants

RO is ideal but costly; GAC more affordable but less effective

LEGAL ≠ SAFE!

Synthesis

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Benefits of PFAS filtration go beyond PFAS removal

- Most systems are not currently addressing PFAS pollution but PFAS is ubiquitous
- PFAS filtration can greatly reduce DBPs beyond just trihalomethanes
- PFAS is almost always found with several other contaminant types...
- ...PFAS filtration can potentially remove those contaminants too!
- Institutional support is vital for smaller systems → textbook EJ issue
- Regulations like the 2024 EPA MCLs for PFAS are crucial to ensure testing and to cast filtration nets wide → 2026 rollbacks will compromise public health

BREAK!

PFAS Treatment as an Opportunity for Broader Drinking Water Improvements:

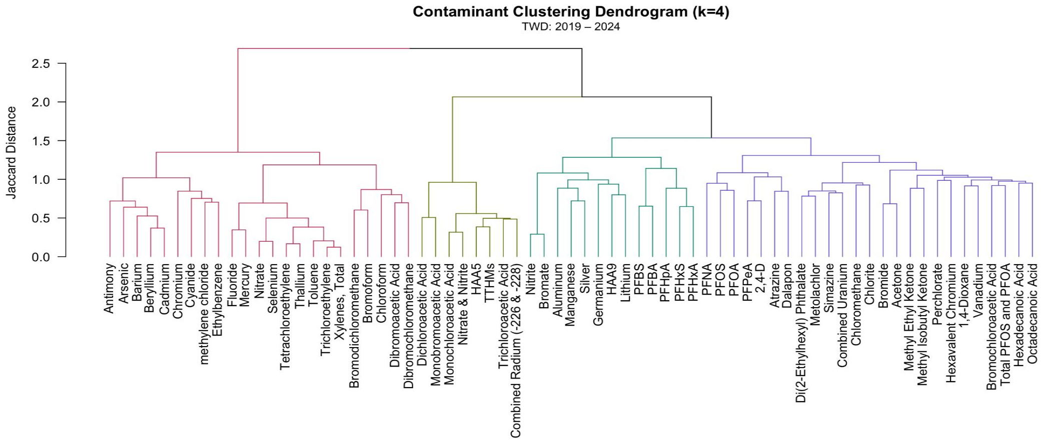
Evidence from U.S. Water Systems

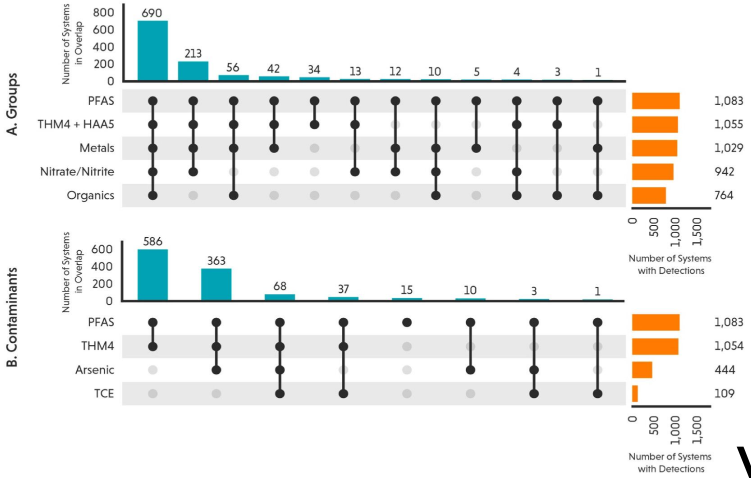
Lessons Learned on Data Visualization and Management

Balance information density with accessibility

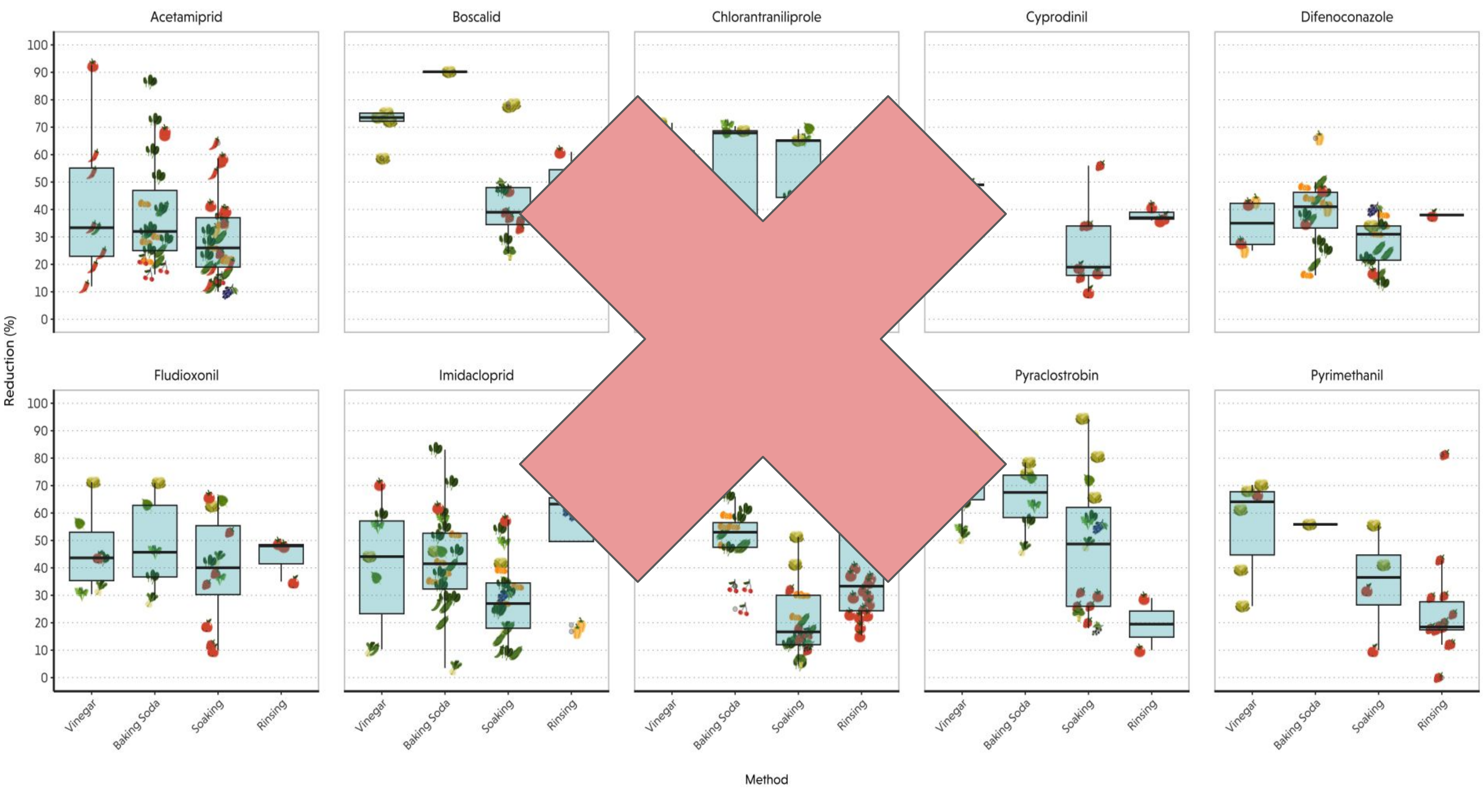
Clusters were too complicated to visualize

But UpSet plots were much simpler → required decisions on what to present and what to omit



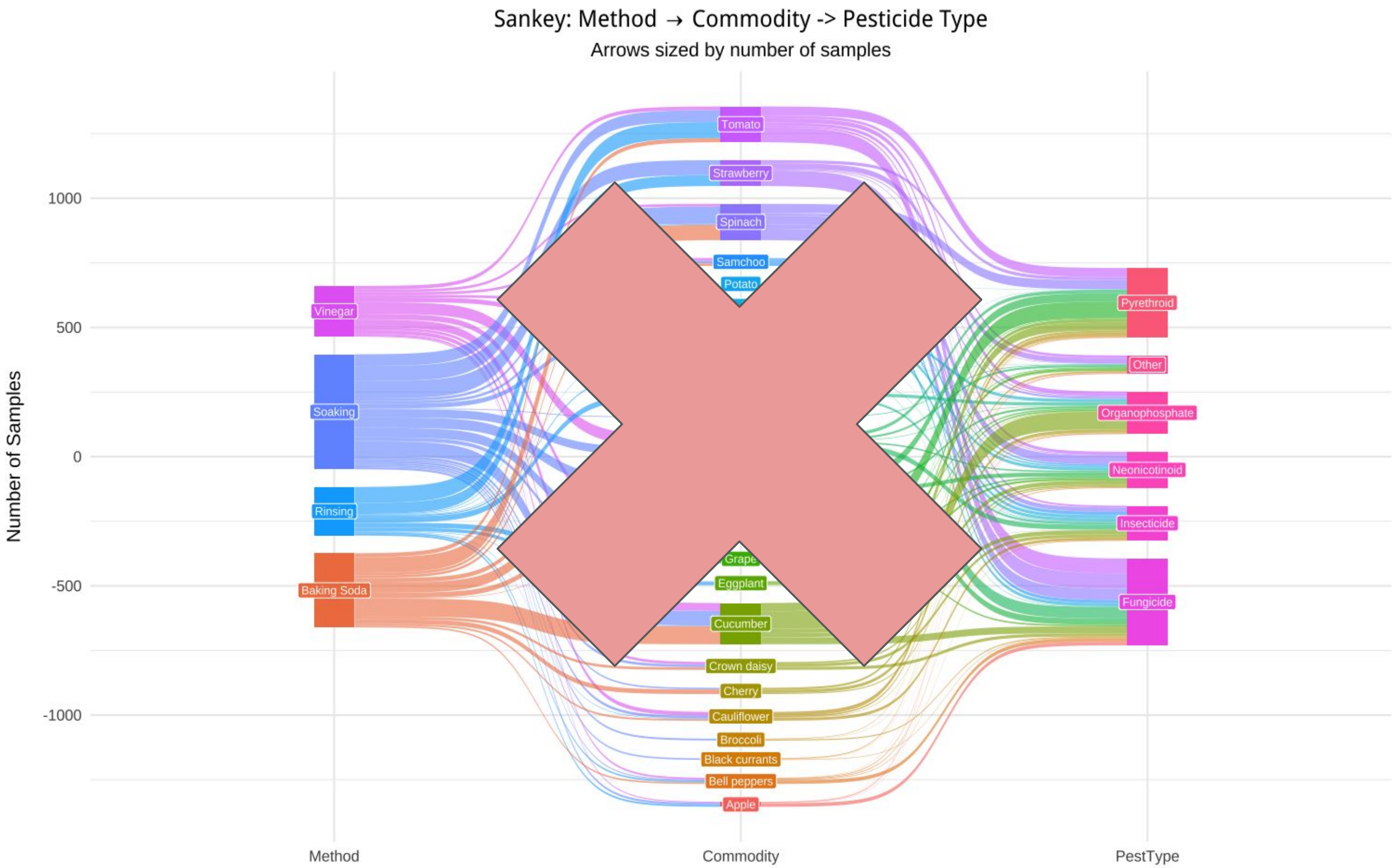


(CONTINUED): Examples of Simplified Viz



SI TABLE!

(CONTINUED): Examples of Simplified Viz



Added Methodology Text!

Leverage supplemental or supporting information!

In developing this paper, we produced 100++ visuals and 33 tables

Several weeks of discussion on which should be in main text vs supplement vs omitted altogether

Main: Subsetted plots and tables that directly support our message

SI: Full plots and tables that underlie our calculations/estimates

Omitted: Redundant, overly complex, or heavy-stat (e.g. K-Means clustering from prev. slide) things; **kept some for later!**

AI at EWG

EWG policy
Responsible and ethical use

Recognizing the environmental costs of AI

- AI technologies require significant computing power and energy.
- Our approach includes:
  - Acknowledging those impacts
  - Favoring more efficient and responsible technologies when possible, and
  - Incorporating sustainability considerations into how and when we use AI tools.

What AI should not be used for

- Creating full drafts of written content (news articles, reports)
- Replacing expert review in legal, scientific, policy, or technical work
- Bypassing fact-checking or editorial standards
- Making automated decisions without human review
- Creating public-facing brand assets without appropriate design review.

Tips to use AI effectively

AI output is only as good as input: Critical thinking is still **critical**

- Context first, question second and repeat prompts (Leviathan et al.)
  - Significant jumps in accuracy (70% ↑ accuracy for prompt repetition; 30% for Context-Query)
- Omit unnecessary context (Kiwi weight example)
- Multiple short queries that build on each other >> one long query
- Designated chats (Shopper's Guide Example)
- Don't rush to Gemini/Claude!! Google is still superior for simple queries
- **VERIFY EVERYTHING!!!** Especially sources (made up literature examples)

V

AI pitfalls: it gets things wrong

- AI can make up facts, figures and more – always independently verify anything factual, don't rely entirely on what the LLM says
- Avoid using AI for math (Example: "9.11 > 9.9" because of num. characters)
    - Inverse ordered list for SG did not work after multiple attempts!
- If using AI for sources, make sure they exist! Click the links, read the articles → "Find me a peer-reviewed source…" is frequently incorrect!
- Avoid biased language (e.g. "shouldn't…" or "isn't…" in queries => YES)
- Avoid image generation: much bigger environmental load + IP issues

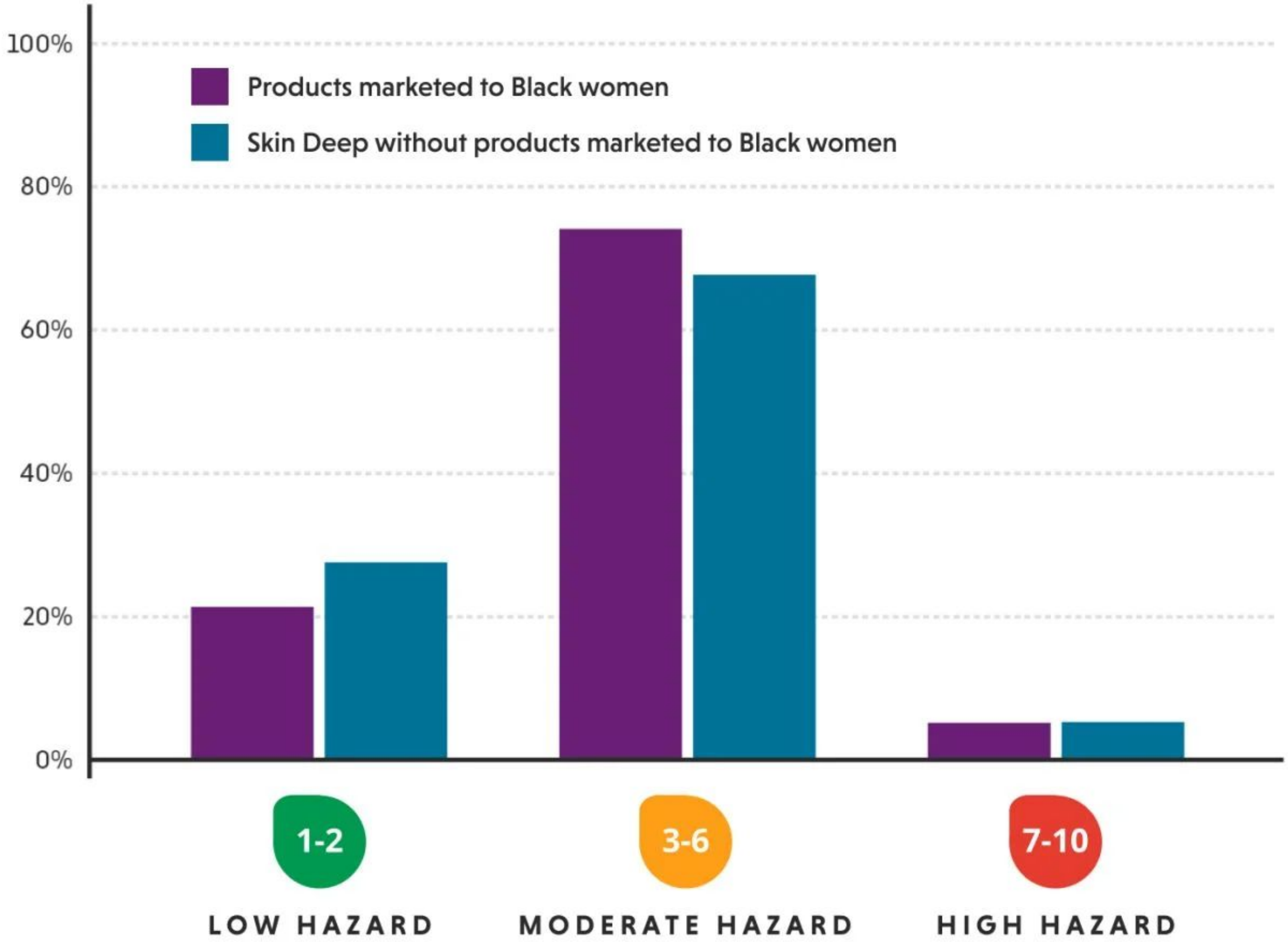
Interactive Examples

Interactive Example 1: QuickScan!

You’ll see each of the following data viz examples for 10 seconds

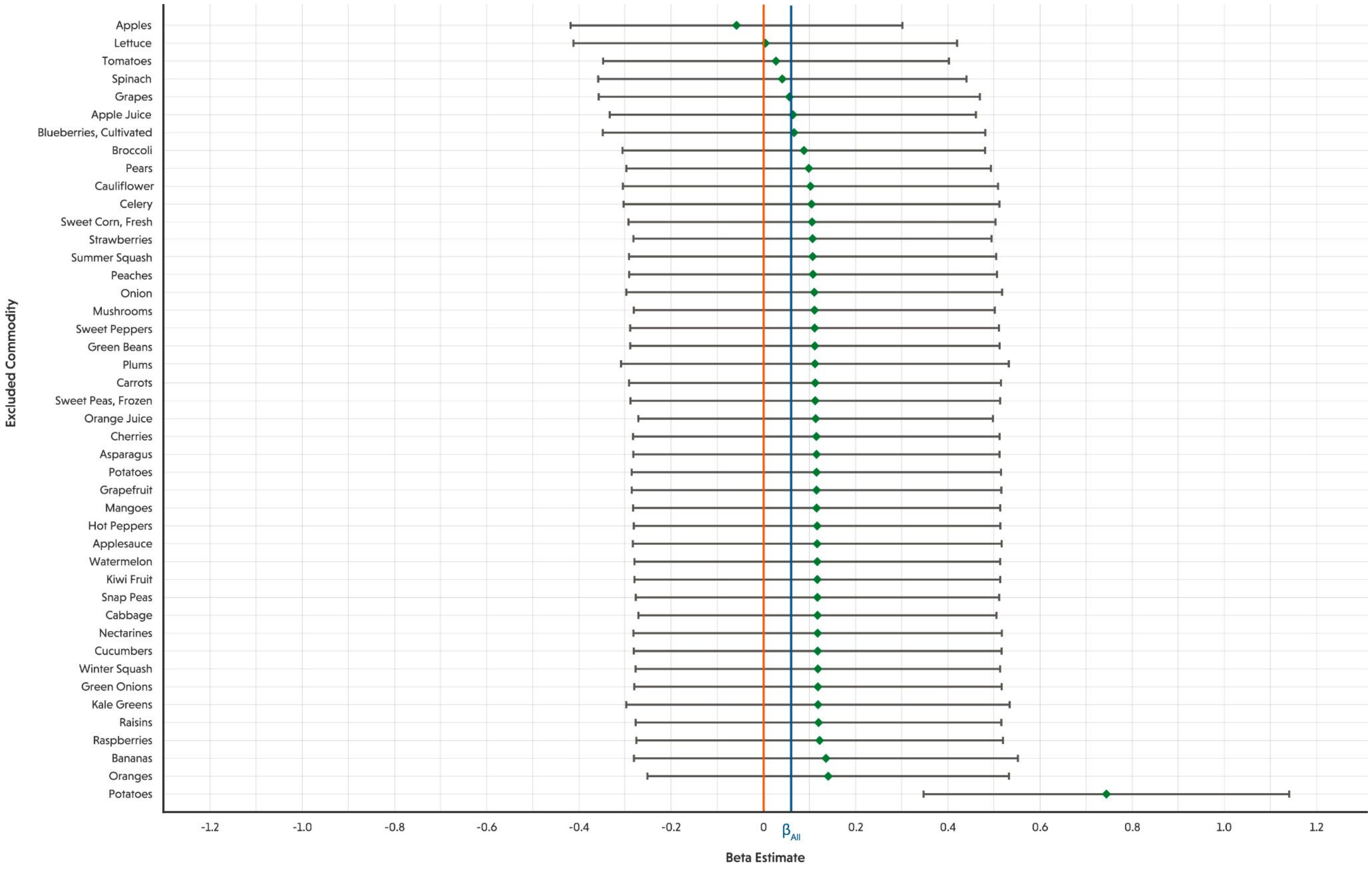
After 10 seconds, share what you think the main takeaway is from the viz

Goal: identify if the most important information is the most prominent (B.L.O.T)


100%
80%
60%
40%
20%
0%
Products marketed to Black women
Skin Deep without products marketed to Black women
1-2
LOW HAZARD
3-6
MODERATE HAZARD
7-10
HIGH HAZARD

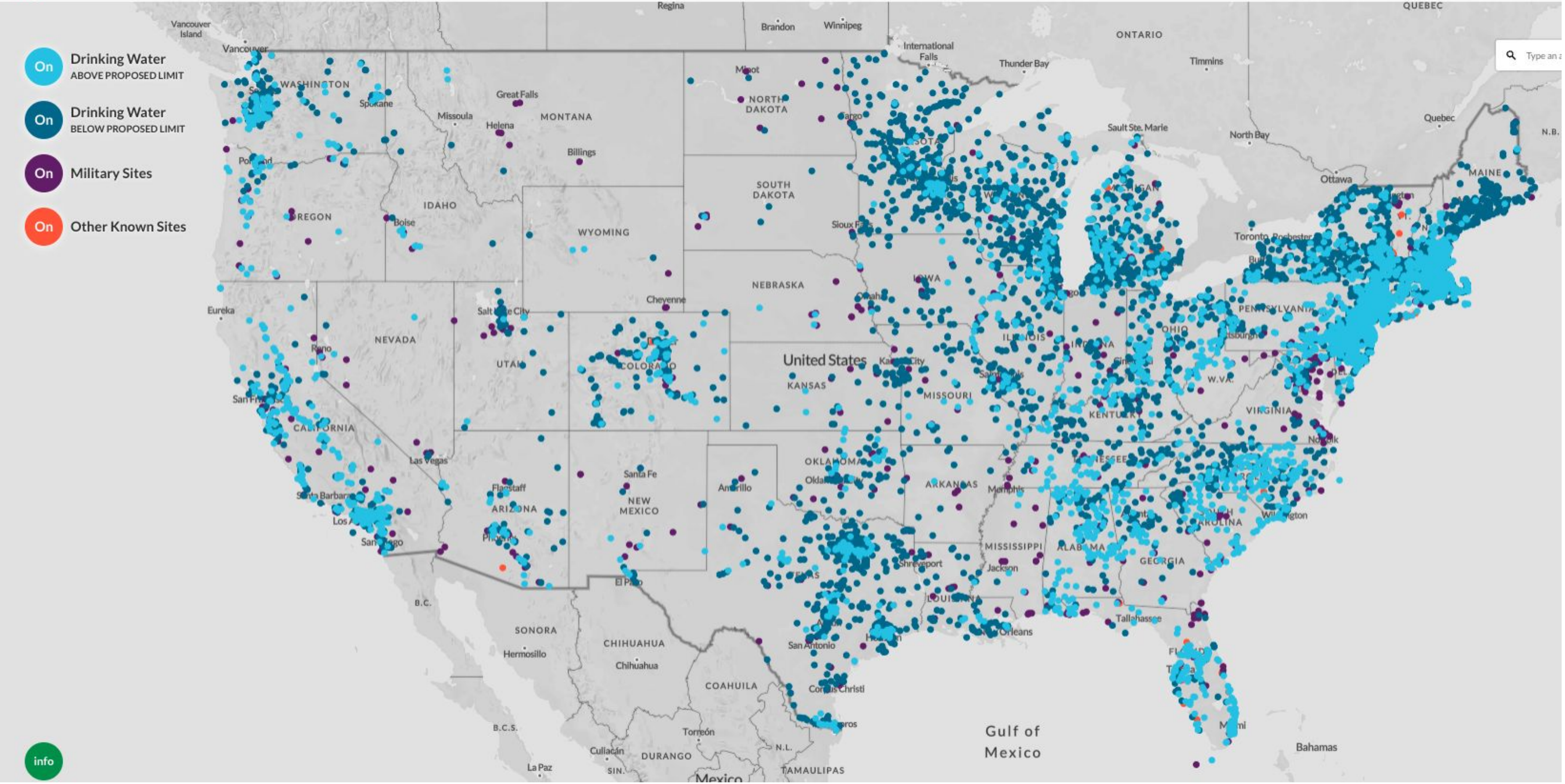
V

What did you take away from this bar chart?


Apples
Lettuce
Tomatoes
Spinach
Grapes
Apple Juice
Blueberries, Cultivated
Broccoli
Pears
Cauliflower
Celery
Sweet Corn, Fresh
Strawberries
Summer Squash
Peaches
Onion
Mushrooms
Sweet Peppers
Green Beans
Plums
Carrots
Sweet Peas, Frozen
Orange Juice
Cherries
Asparagus
Potatoes
Grapefruit
Mangoes
Hot Peppers
Applesauce
Watermelon
Kiwi Fruit
Snap Peas
Cabbage
Nectarines
Cucumbers
Winter Squash
Green Onions
Kale Greens
Raisins
Raspberries
Bananas
Oranges
Potatoes
Excluded Commodity
-1.2
-1.0
-0.8
-0.6
-0.4
-0.2
0
β_{All}
0.2
0.4
0.6
0.8
1.0
1.2
Beta Estimate

What did you take away from plot?

PFAS contamination in the U.S. (March 5, 2026)



What did you take away from map?

Interactive Example 2: BrandID!

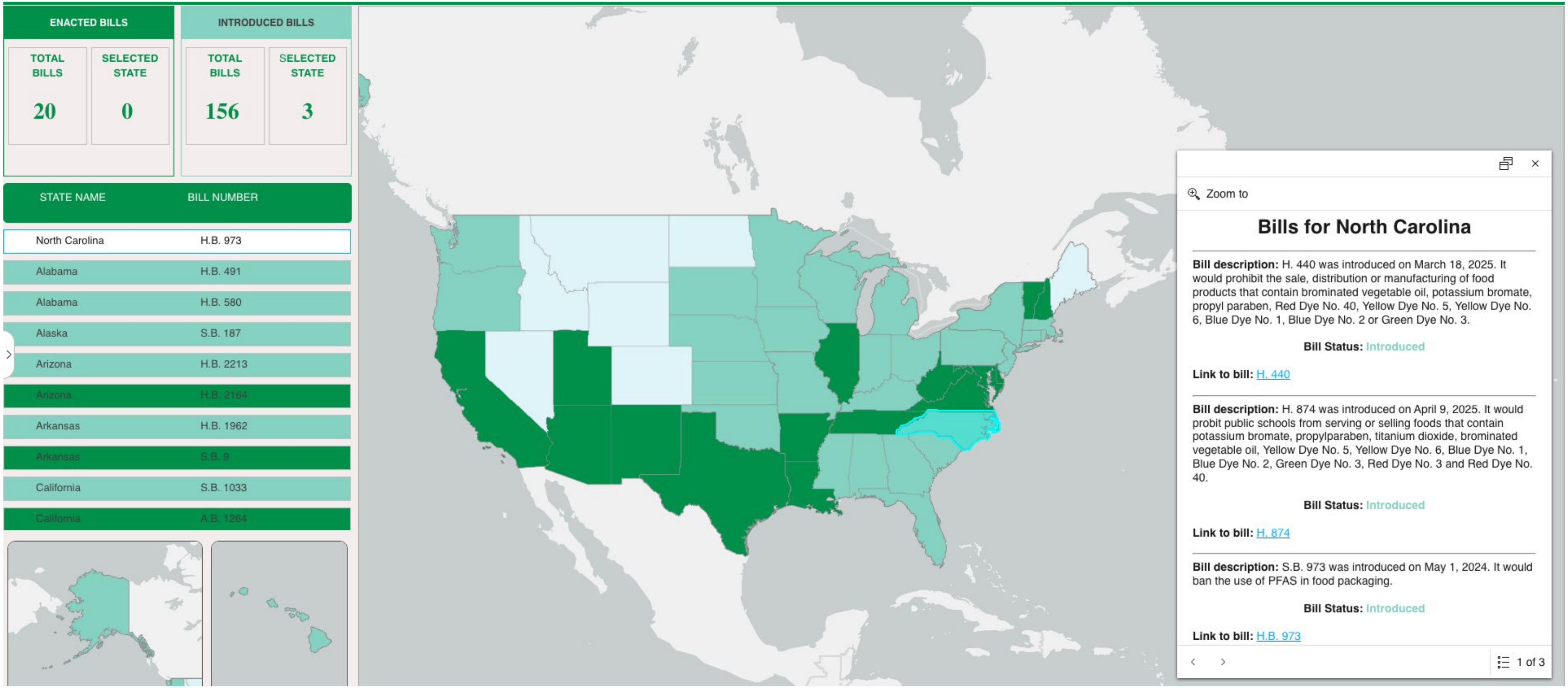
You'll see a few data viz examples

Can you identify which one(s) were generated by EWG? Why?

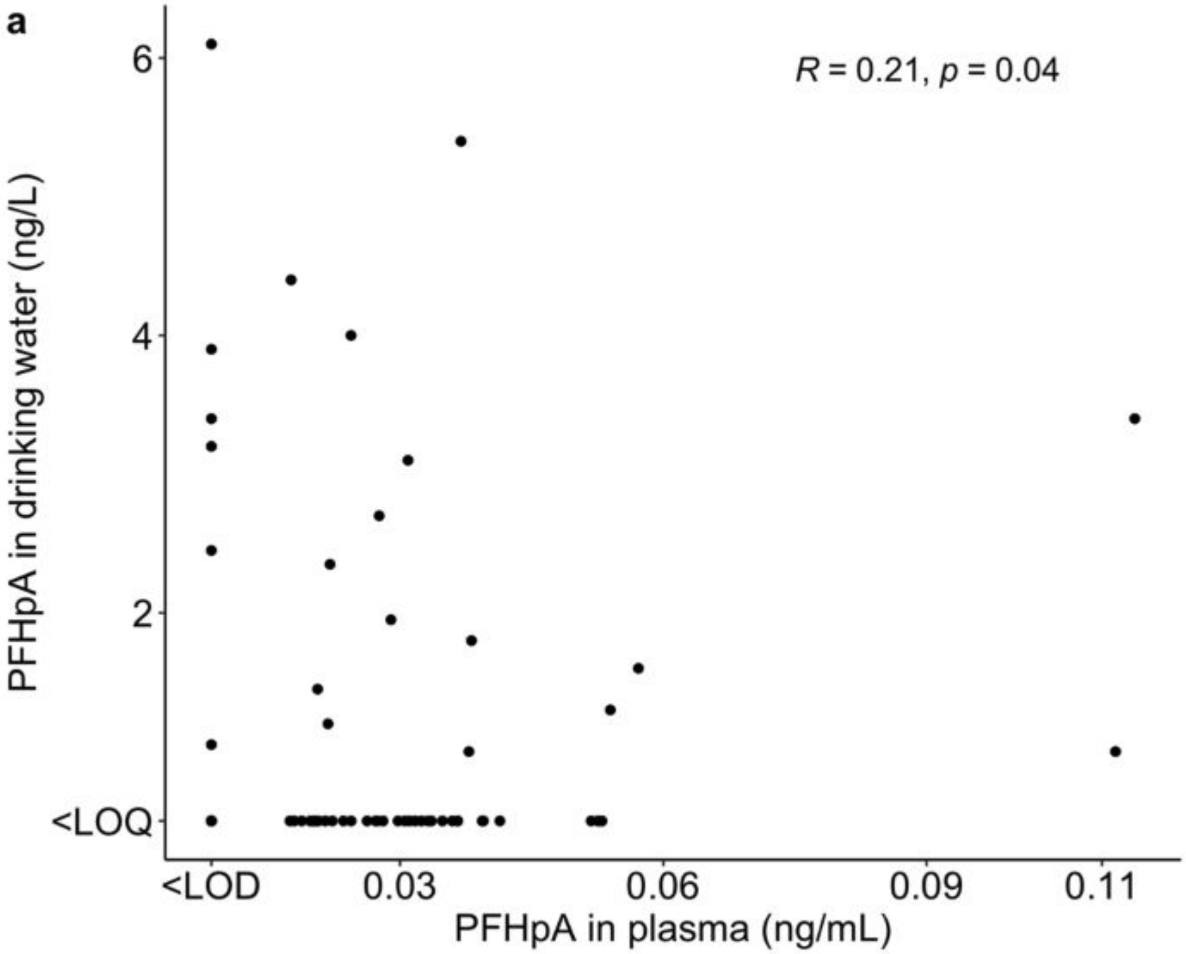
Goal: identify characteristics of successful branding

Hu et al., 2019
Figure 1
(Dr. Cindy's paper!)

S

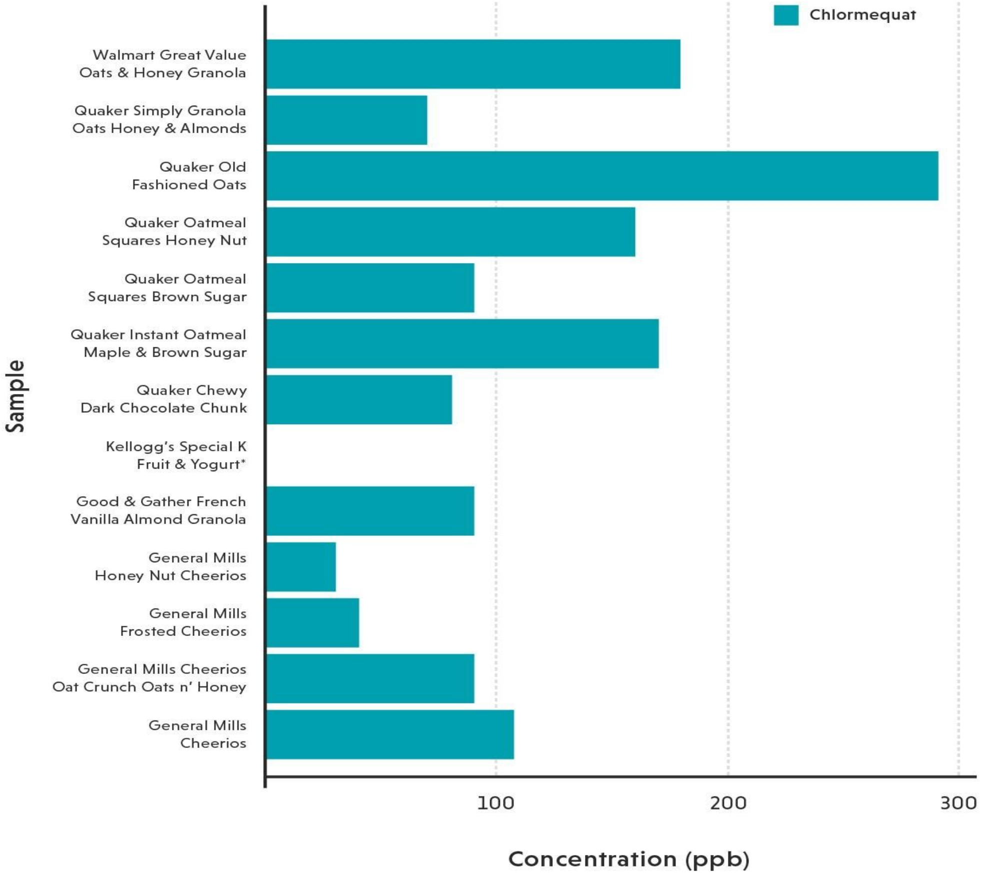


EWG’s Interactive Food Chemical Policy Map



Cserbik et al., 2024 Figure 2A

S



Limit of detection/limit of quantification for chlormequat: 10/100 ppb.

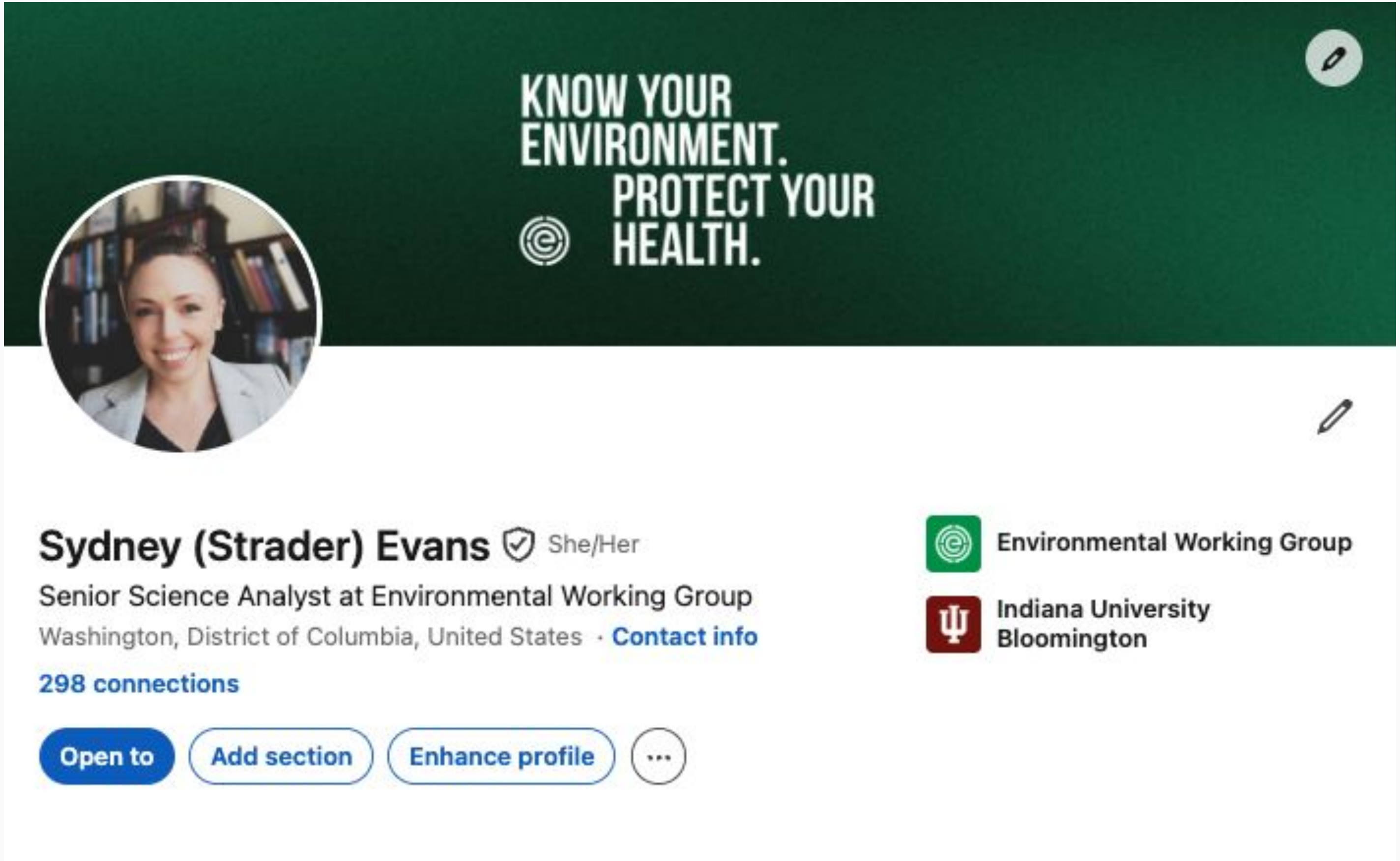
* *Numerical detection value reported by the lab as Below the Limit of Quantification.*

EWG's testing of chlormequat on oats

S

Career Pathways and Q&A

Professional evolution and academic foundation



Professional evolution and academic foundation

University of Virginia, B.A. in Chemistry

Focus in biochemistry, and elective classes on environmental science

Indiana University, MPH in Environmental Health

Exposure assessment, occupational health, biostatistics, epidemiology, risk assessment

CVS Pharmacy Technician

HIPPA, problem solving, customer service, chemistry and interactions

eBroselow Clinical Developer

Research, eye for detail, QAQC, queries

Research Assistant

Grant writing, project planning, statistical analysis (SPSS), authorship

Monroe County Health Department

Program planning, regulation, community

Environmental Working Group (EWG)

Senior Science Analyst & Science Analyst

Professional evolution and academic foundation

Data Management & Analysis

- Advanced statistical analysis (SPSS) & biostatistics
- Relational database management (Access, SQL)
- Large-scale data curation and formal analysis
- Data visualization and dashboard development

Communication & Speaking

- Science communication and public health education
- Academic guest lecturing and presentations
- Focus group leadership and management
- Patient communication and assistance

Research & Administration

- Grant writing and research project administration
- Peer-reviewed manuscript authorship and review
- Exposure and risk assessment methodology
- Conceptualization and literature investigation

Planning & Creative Thinking

- Program development and digitization strategies
- Emergency logistics and coordination
- Event planning and organizational management
- Technical problem-solving and QA/QC

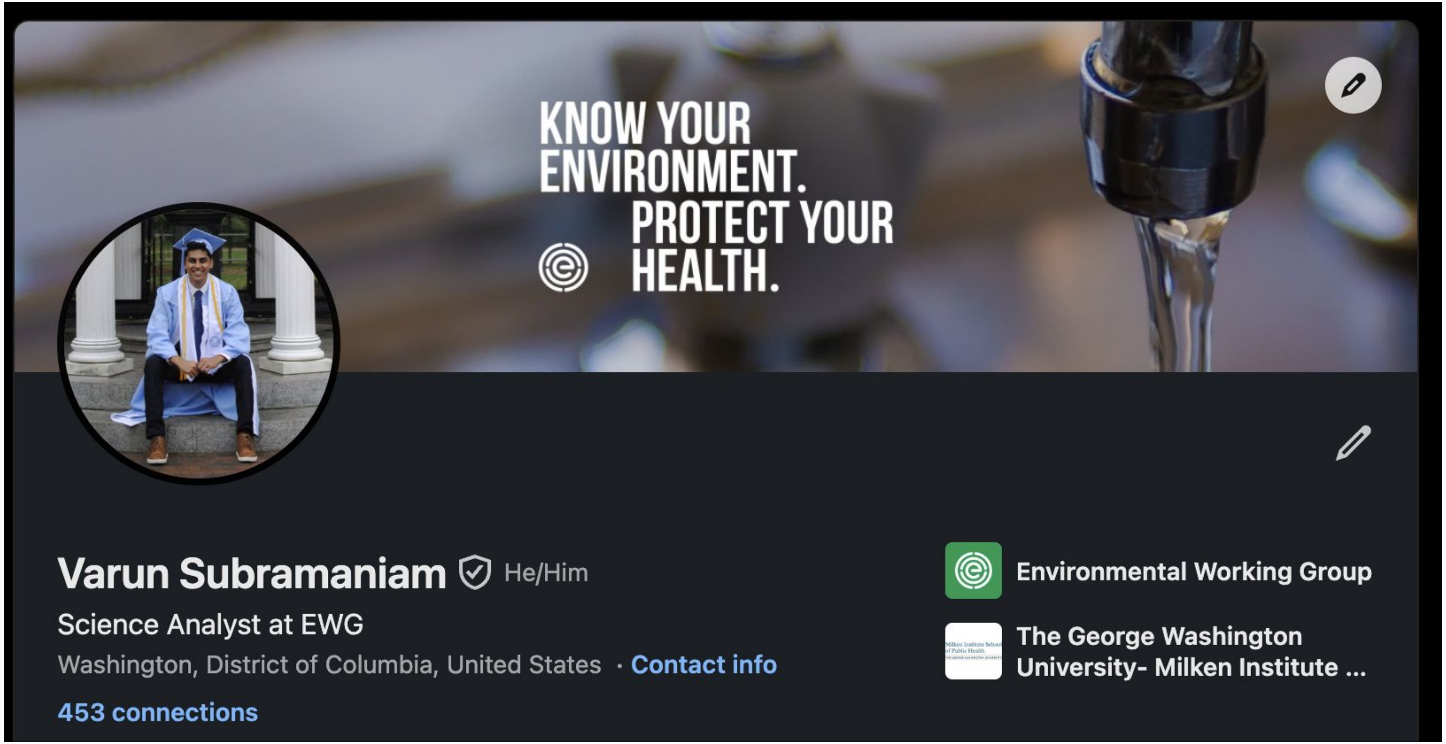
Supervision & Management

- Project administration & scientific team oversight
- Mentoring and experience planning for interns
- Organizational requirement management

Reporting & Deliverables

- EWG report investigation and promotion
- Accreditation and document retention
- Public health policy and regulation reporting
- Plan updates and organizational compliance

Professional evolution and academic foundation



2006-2018

2018-2022

We're on it!
UNC GILLINGS SCHOOL OF GLOBAL PUBLIC HEALTH
EST. 1940

DATA
DRIVEN
ENVIROLAB

RHI
REFUGEE HEALTH INITIATIVE

2022-2024

GW

Milken Institute School
of Public Health
THE GEORGE WASHINGTON UNIVERSITY

Computational
Biology Institute
THE GEORGE WASHINGTON UNIVERSITY

2024-

ewg

AREAS OF FOCUS

Toxic Chemicals

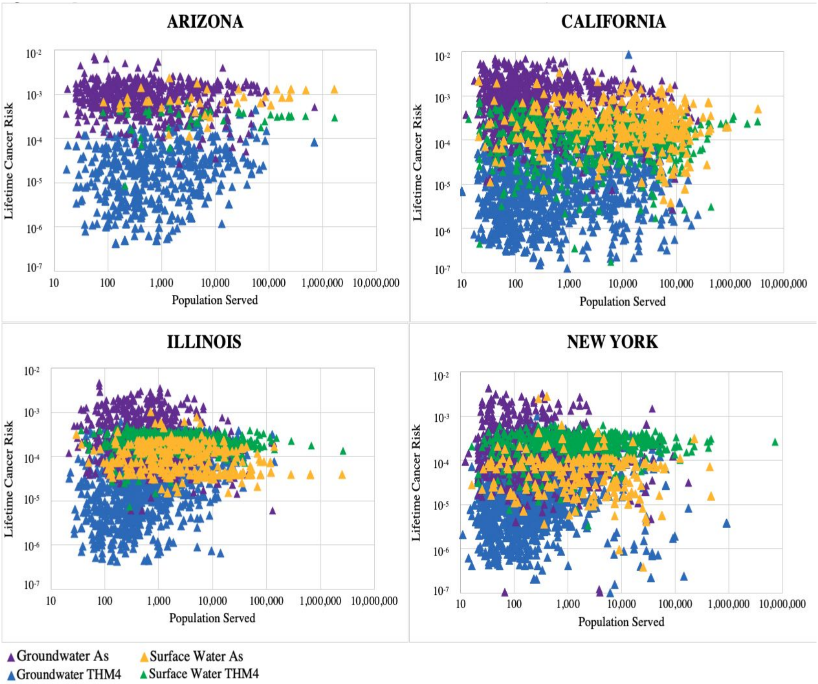
Nanomaterials

Pesticides

PFAS Chemicals

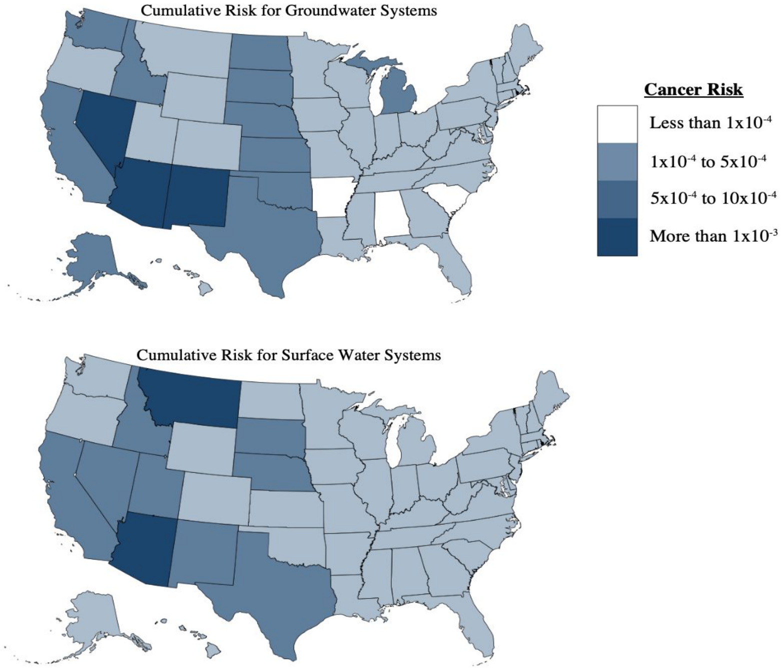
Appendix/Data Visualizations

Cumulative risks vary by… water source

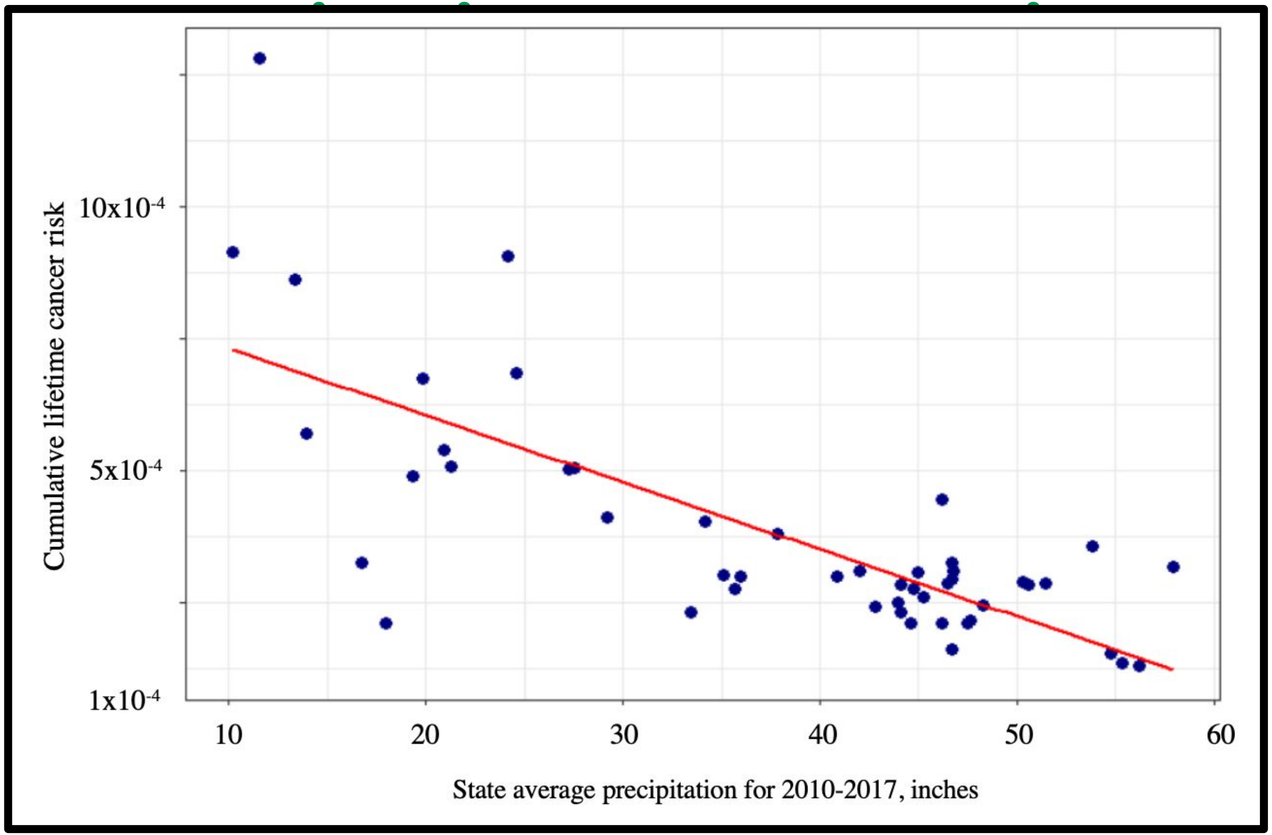


Evans et al. 2019, Figure 1

Cumulative risks vary by… region

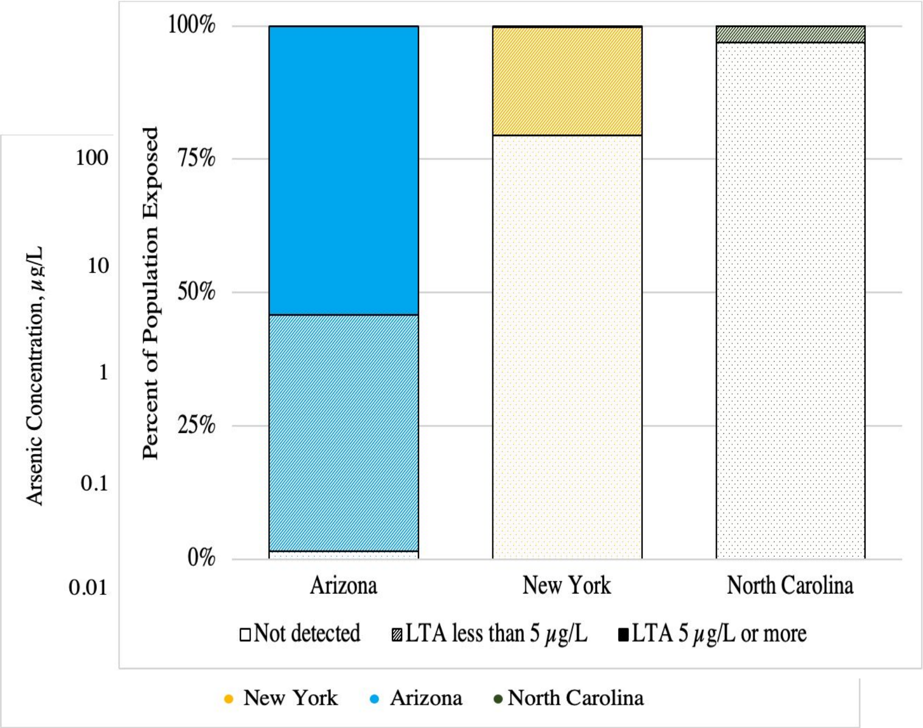


Evans et al. 2019, Figure 2



Evans et al. 2019, Figure 3

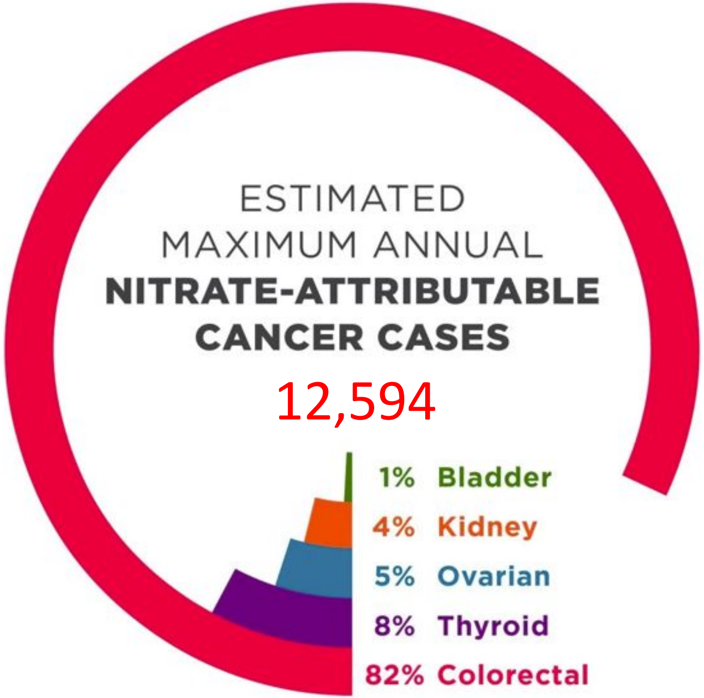
Cumulative risks vary by… region



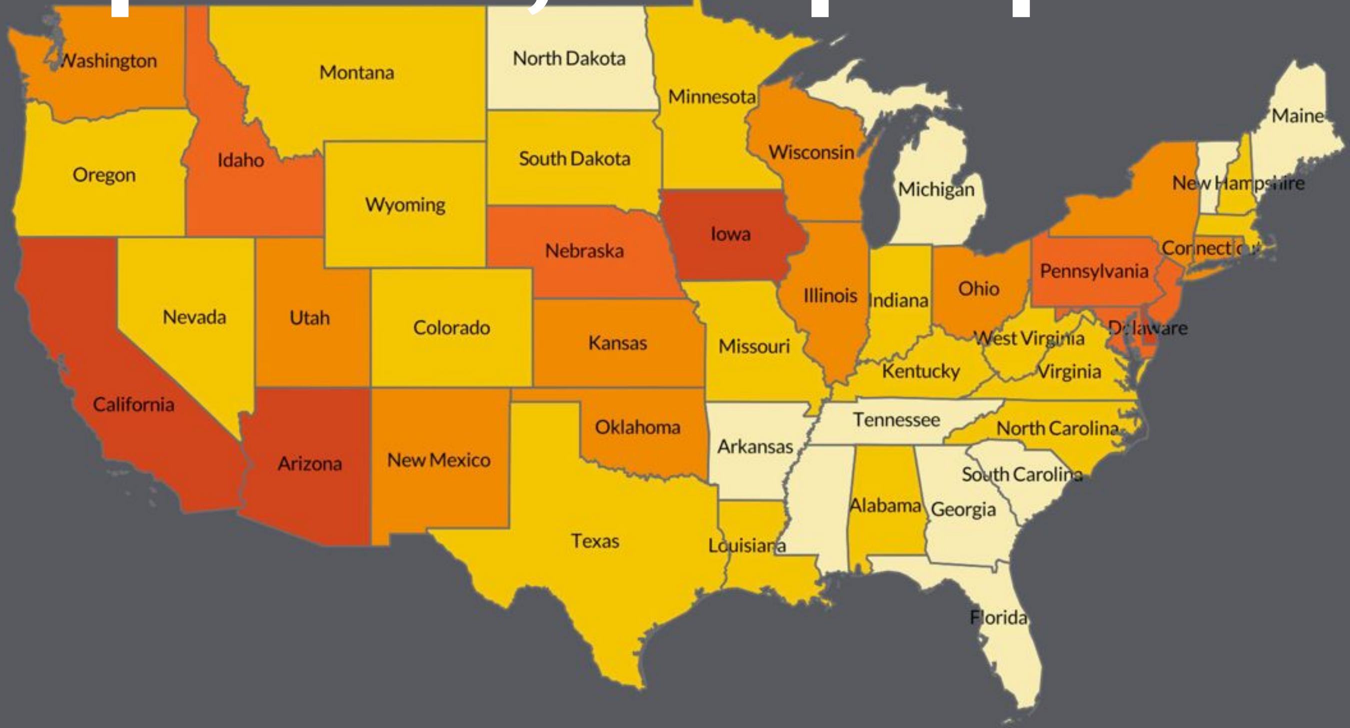
Evans et al. 2019, Figure 4

Estimated annual nitrate-attributable **cancer cases**

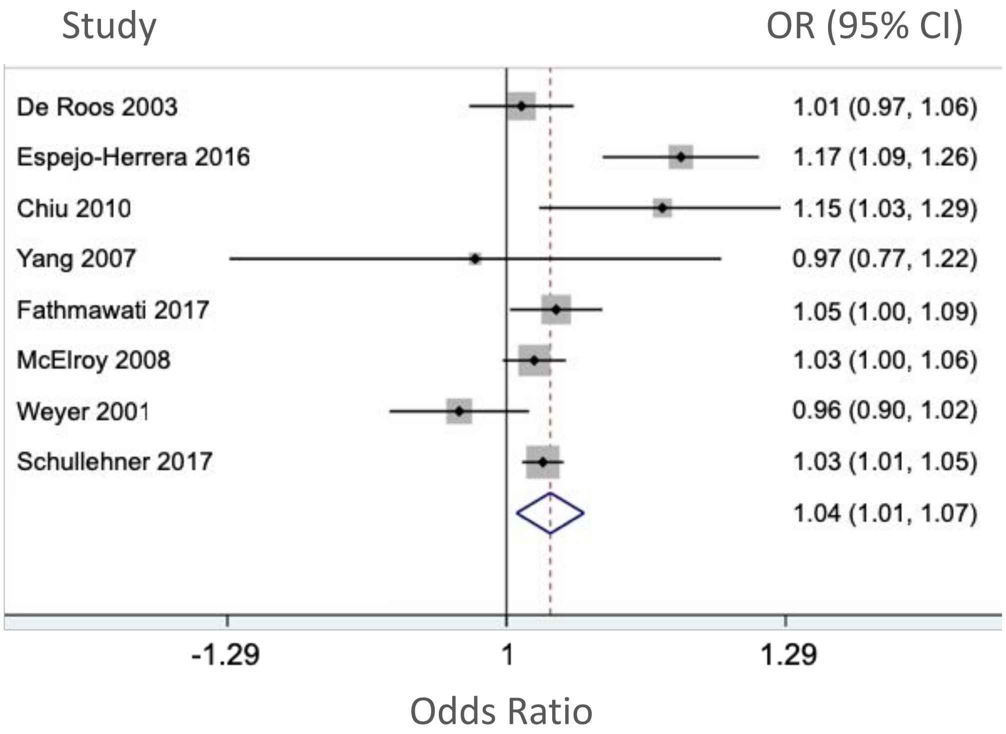
Cancer Type	Estimated **MINIMUM** number of cancer cases	Estimated **MAXIMUM** number of cancer cases
Colorectal	1233	10,379
Ovarian	110	580
Thyroid	369	1,047
Kidney	454	454
Bladder	134	134

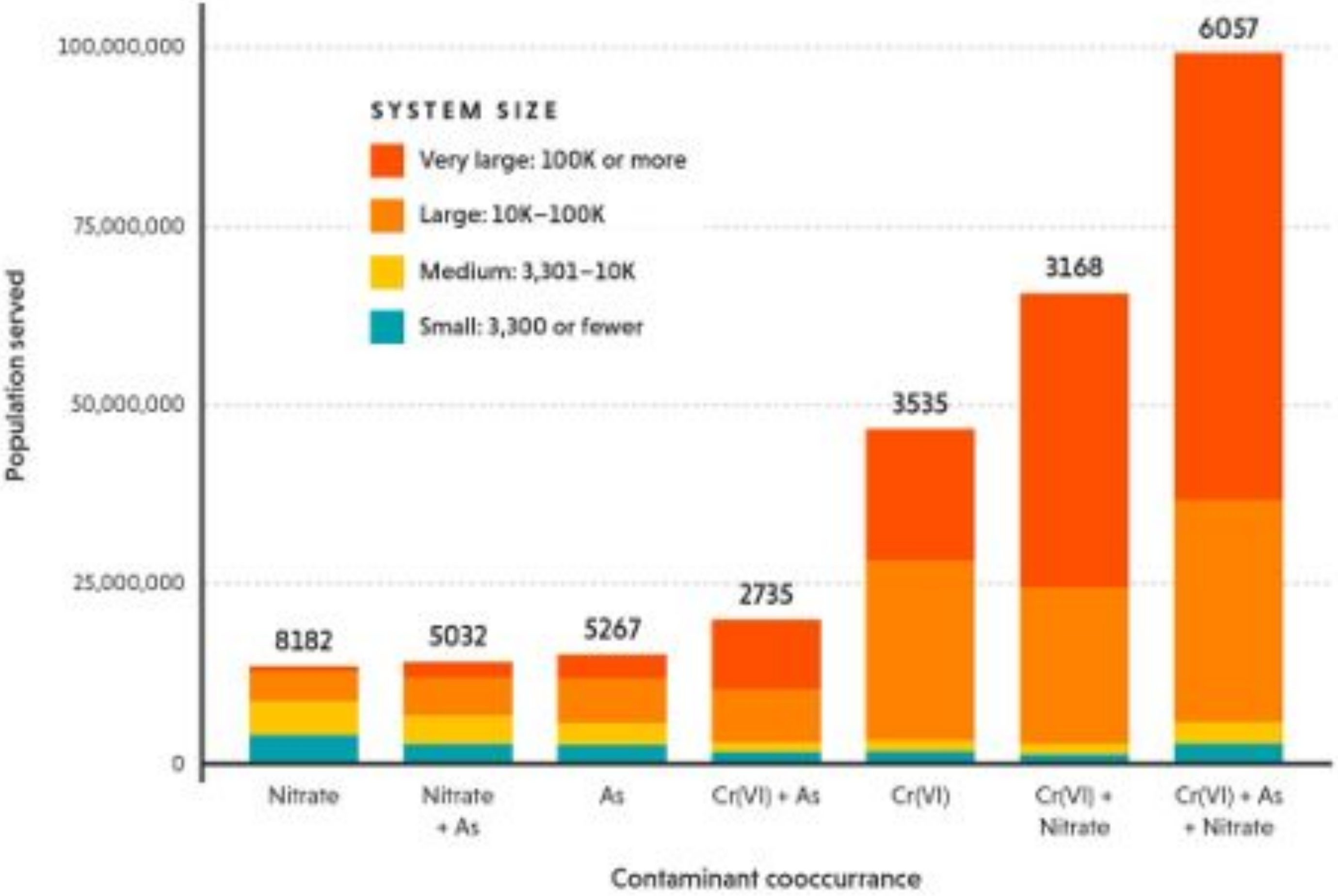


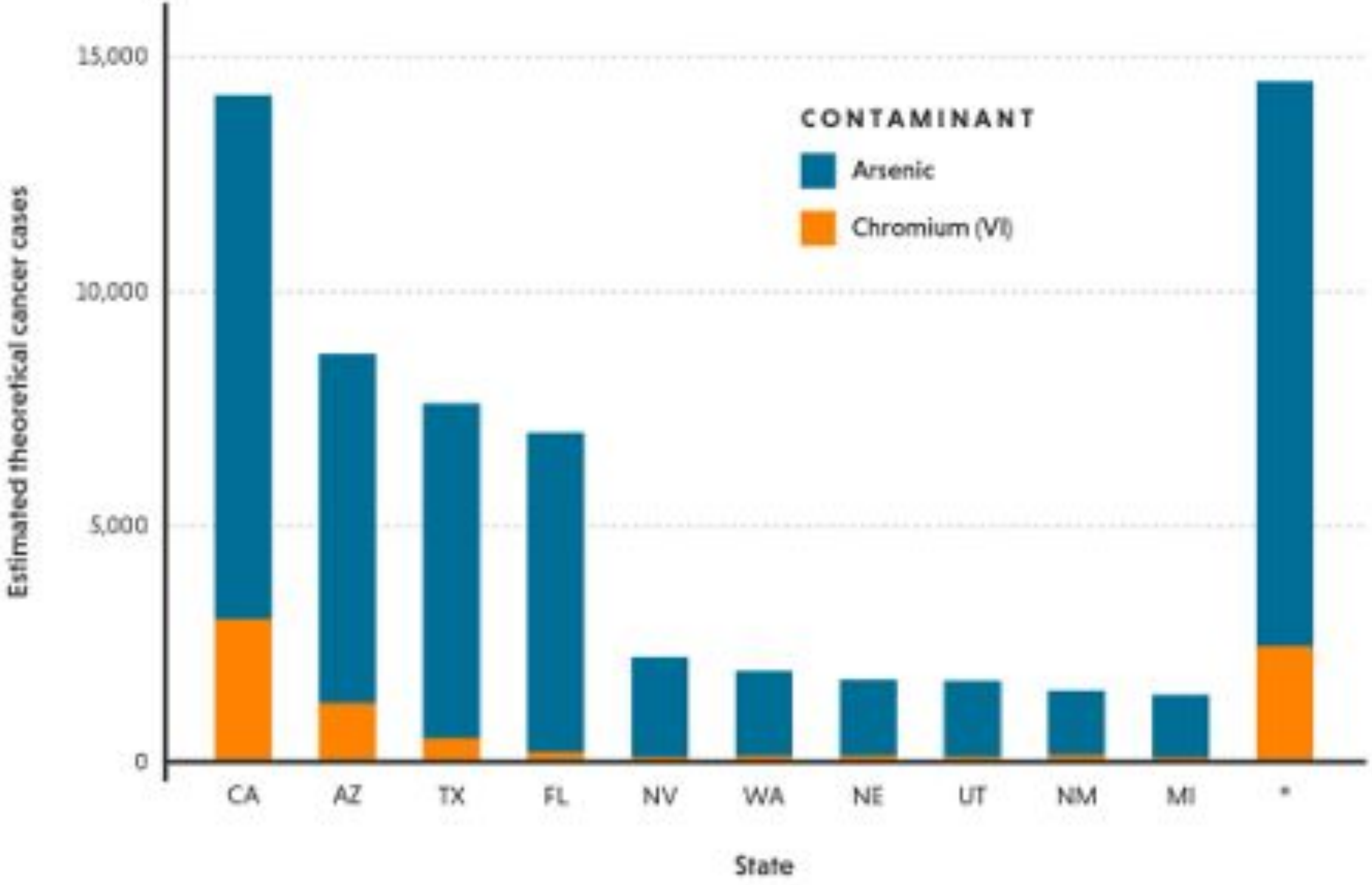
Estimated nitrate-attributable cancer cases for **each state per 100,000 people**



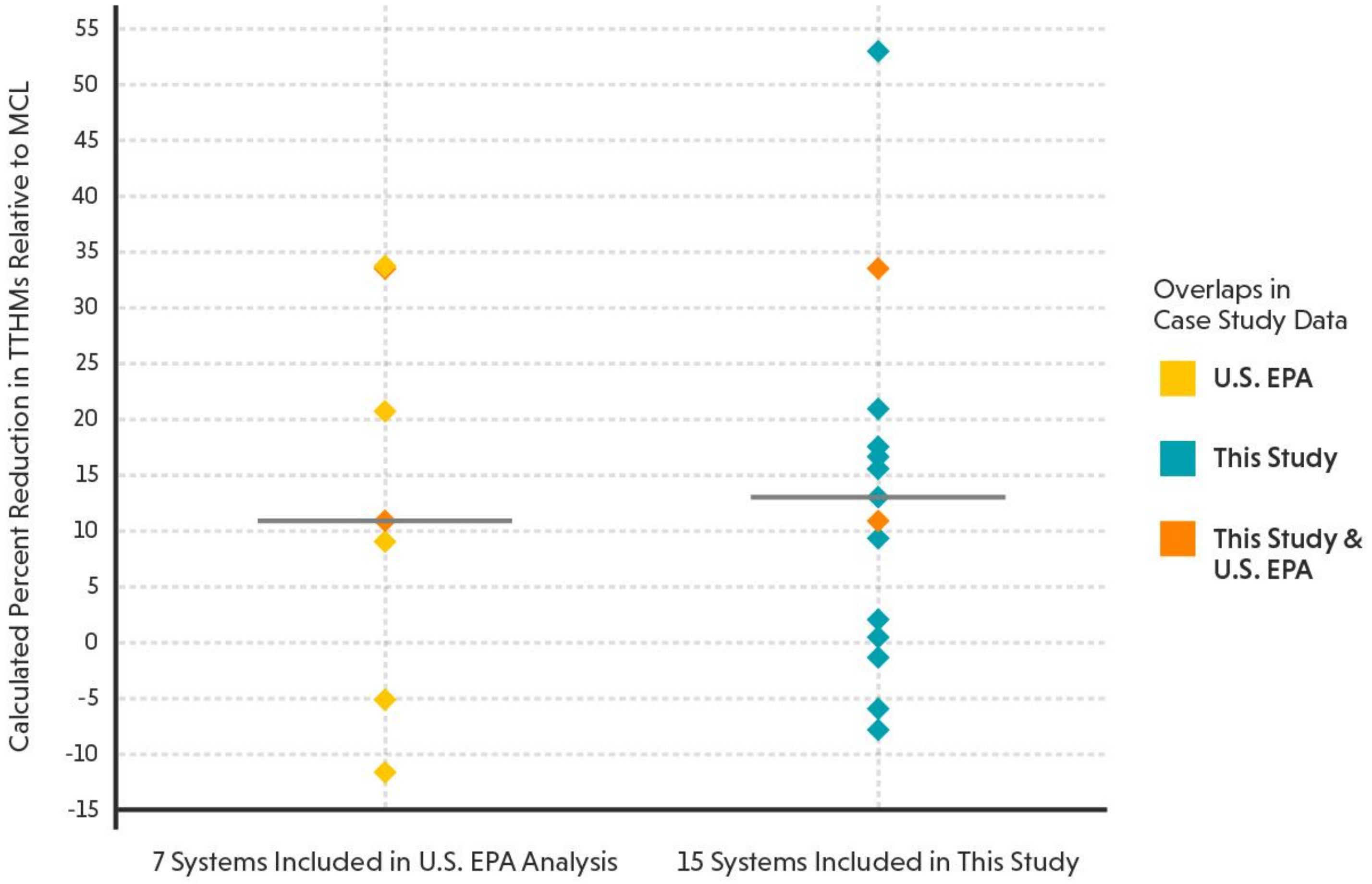
Meta-analysis of **Colorectal Cancer Risk** and Nitrate in Drinking Water



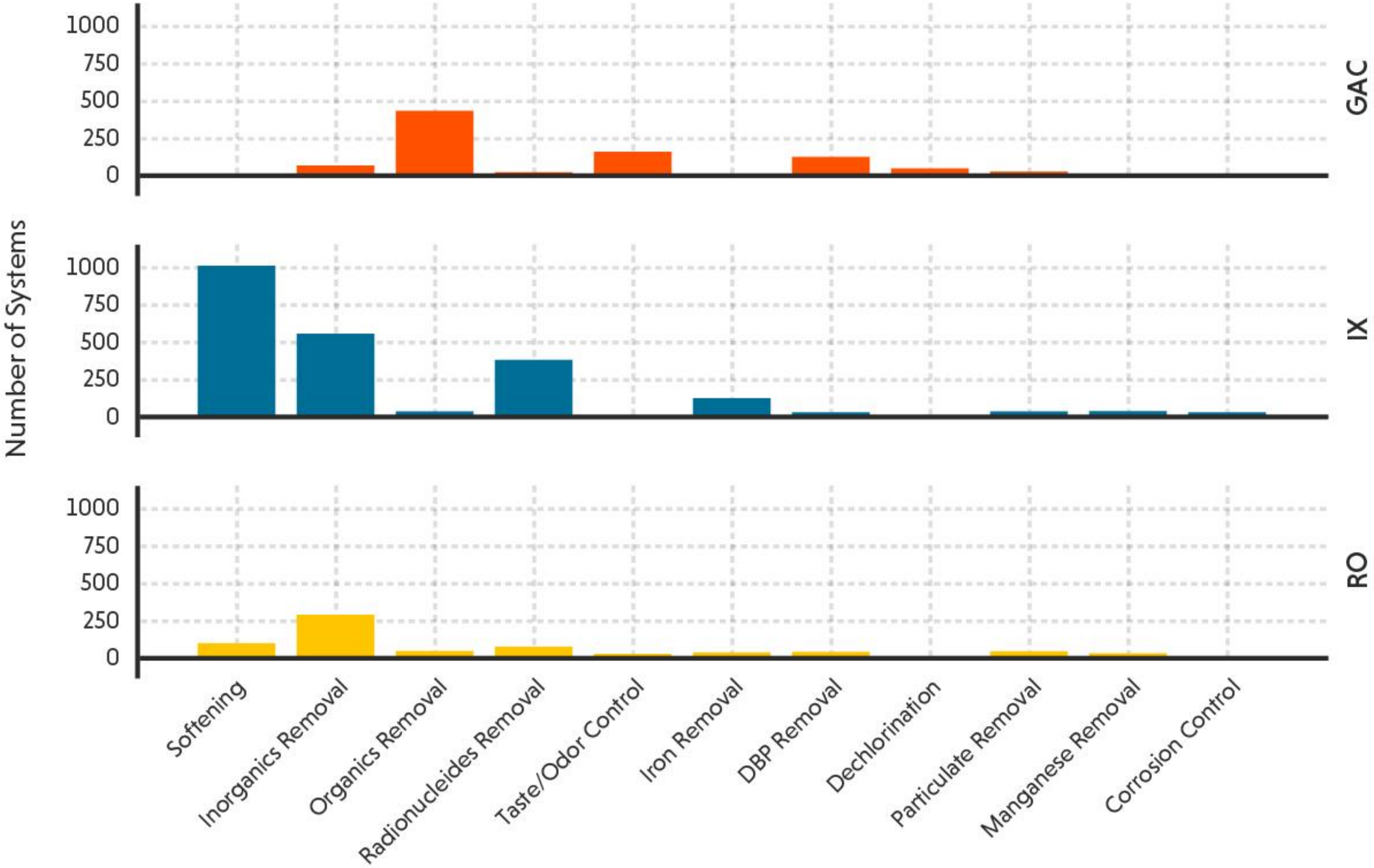

SYSTEM SIZE
Very large: 100K or more
Large: 10K–100K
Medium: 3,301–10K
Small: 3,300 or fewer
Population served
100,000,000
75,000,000
50,000,000
25,000,000
0
8182
5032
5267
2735
3535
3168
6057
Nitrate
Nitrate + As
As
Cr(VI) + As
Cr(VI)
Cr(VI) + Nitrate
Cr(VI) + As + Nitrate
Contaminant cooccurrance

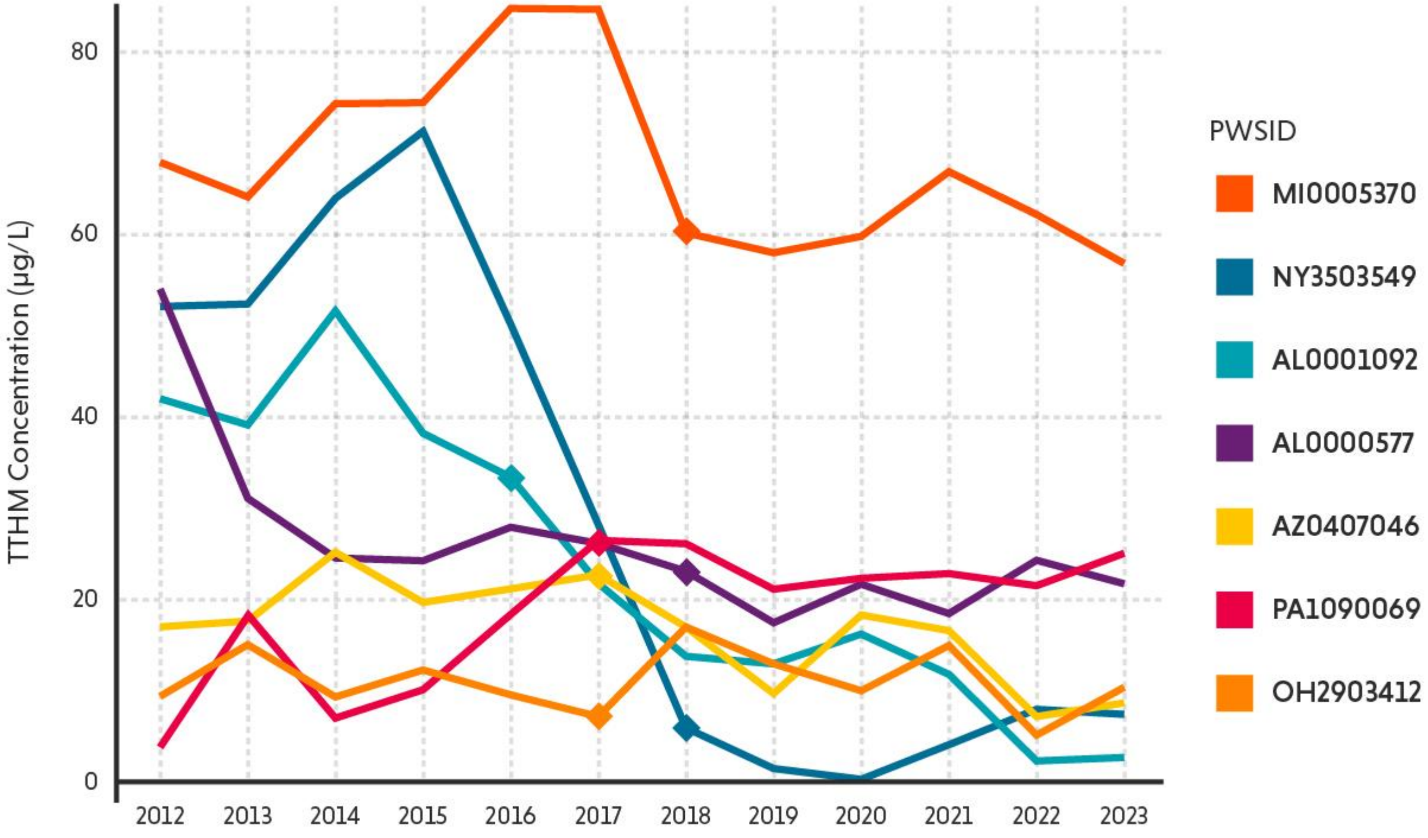


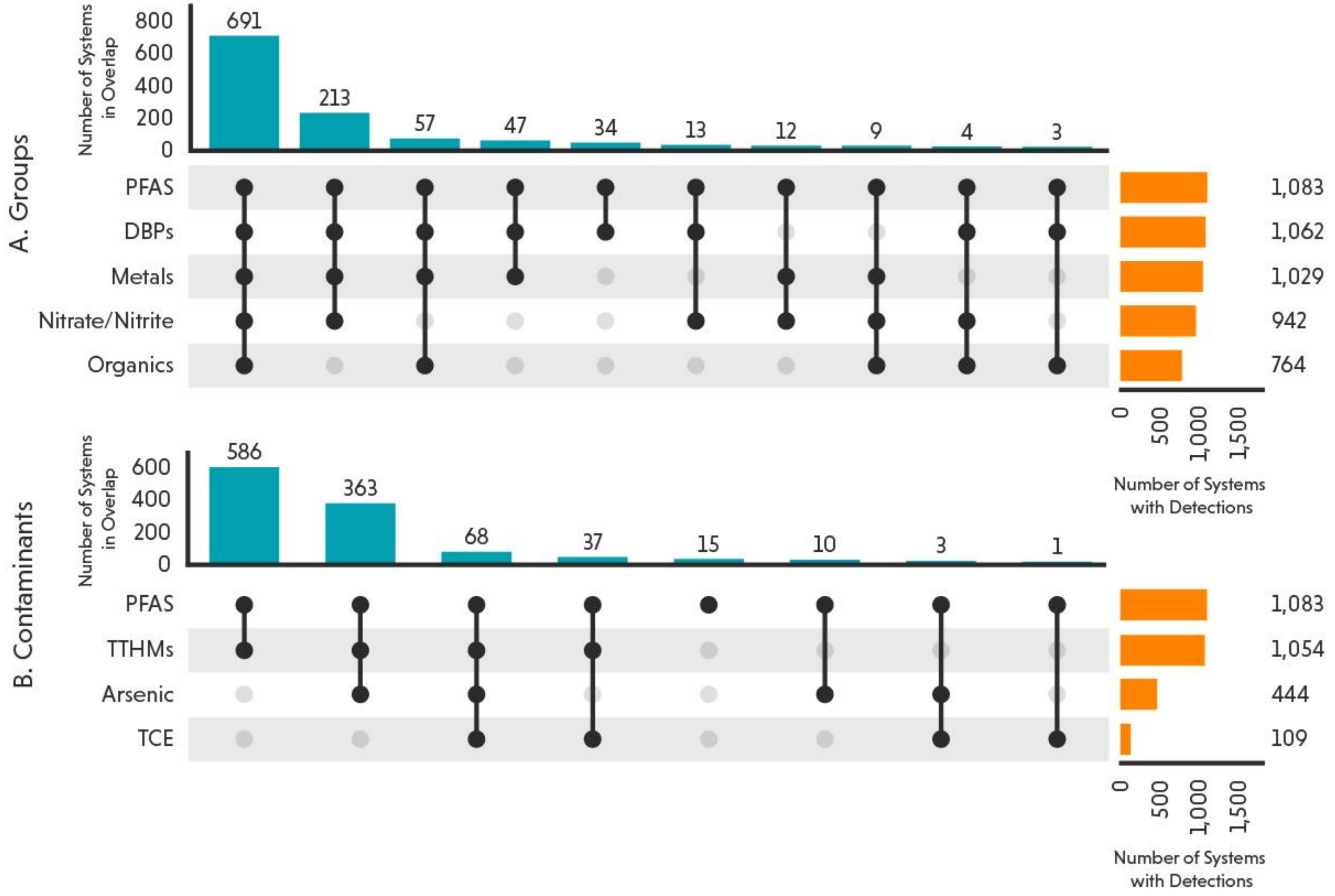
15,000
10,000
5,000
0
Estimated theoretical cancer cases
CONTAMINANT
Arsenic
Chromium (VI)
CA
AZ
TX
FL
NV
WA
NE
UT
NM
MI
*
State

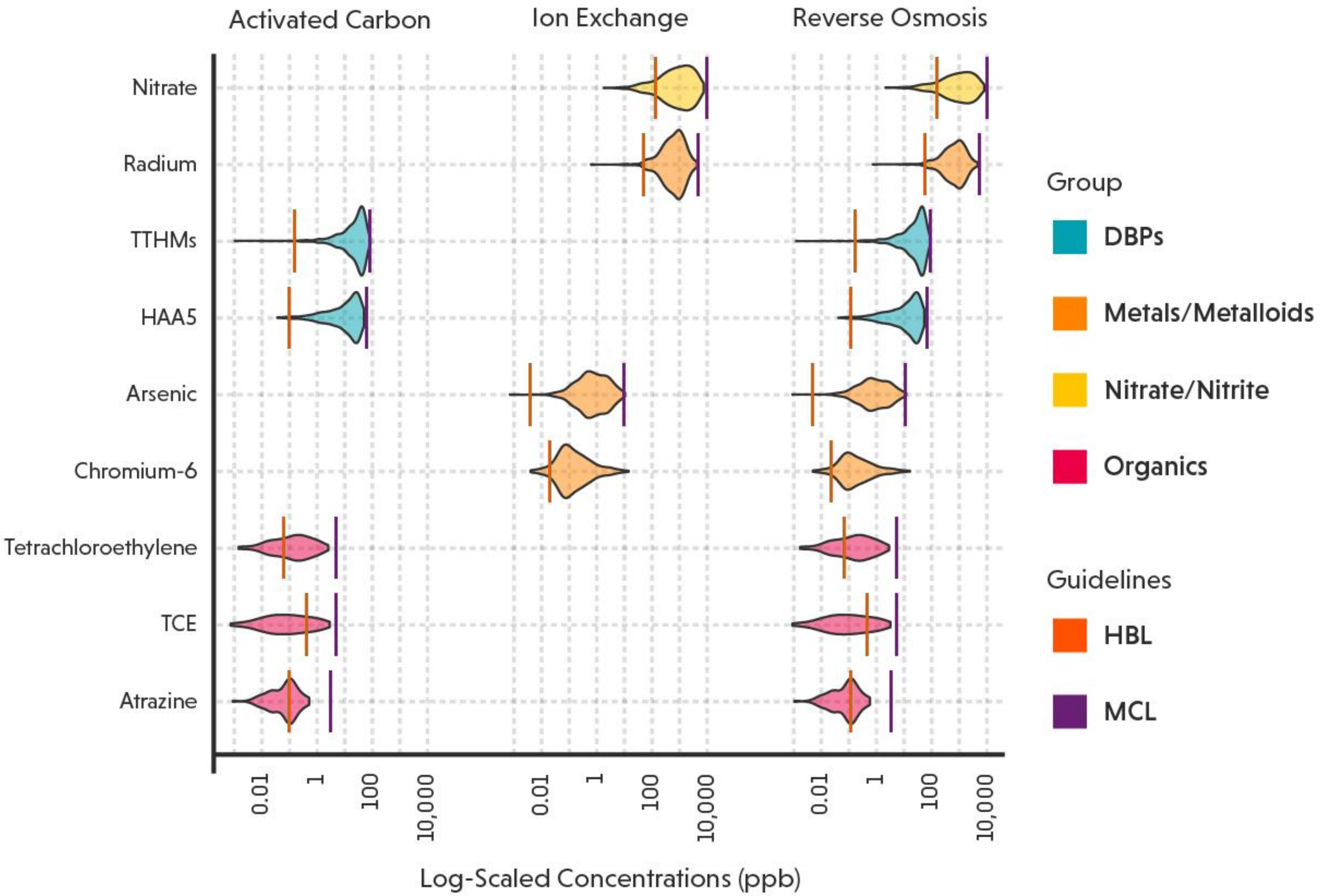


Calculated Percent Reduction in TTHMs Relative to MCL
55
50
45
40
35
30
25
20
15
10
5
0
-5
-10
-15
7 Systems Included in U.S. EPA Analysis
15 Systems Included in This Study
Overlaps in Case Study Data
U.S. EPA
This Study
This Study & U.S. EPA


Number of Systems
1000
750
500
250
0
GAC
IX
RO
Softening
Inorganics Removal
Organics Removal
Radionucleides Removal
Taste/Odor Control
Iron Removal
DBP Removal
Dechlorination
Particulate Removal
Manganese Removal
Corrosion Control


TTHM Concentration (µg/L)
0
20
40
60
80
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2023
PWSID
MI0005370
NY3503549
AL0001092
AL0000577
AZ0407046
PA1090069
OH2903412

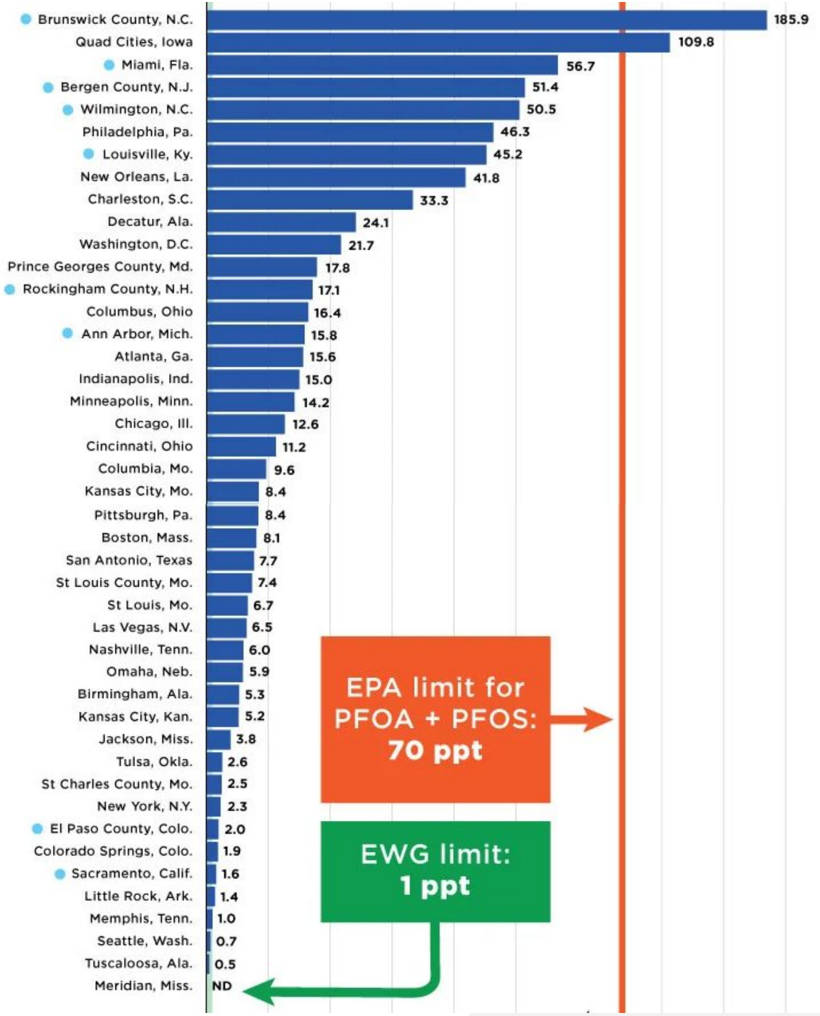

A. Groups
Number of Systems in Overlap
800
600
400
200
0
691
213
57
47
34
13
12
9
4
3
PFAS
DBPs
Metals
Nitrate/Nitrite
Organics
1,083
1,062
1,029
942
764
0
500
1,000
1,500
Number of Systems with Detections
B. Contaminants
Number of Systems in Overlap
600
400
200
0
586
363
68
37
15
10
3
1
PFAS
TTHMs
Arsenic
TCE
1,083
1,054
444
109
0
500
1,000
1,500
Number of Systems with Detections


Activated Carbon
Ion Exchange
Reverse Osmosis
Nitrate
Radium
TTHMs
HAA5
Arsenic
Chromium-6
Tetrachloroethylene
TCE
Atrazine
0.01
1
100
10,000
Log-Scaled Concentrations (ppb)
Group
DBPs
Metals/Metalloids
Nitrate/Nitrite
Organics
Guidelines
HBL
MCL

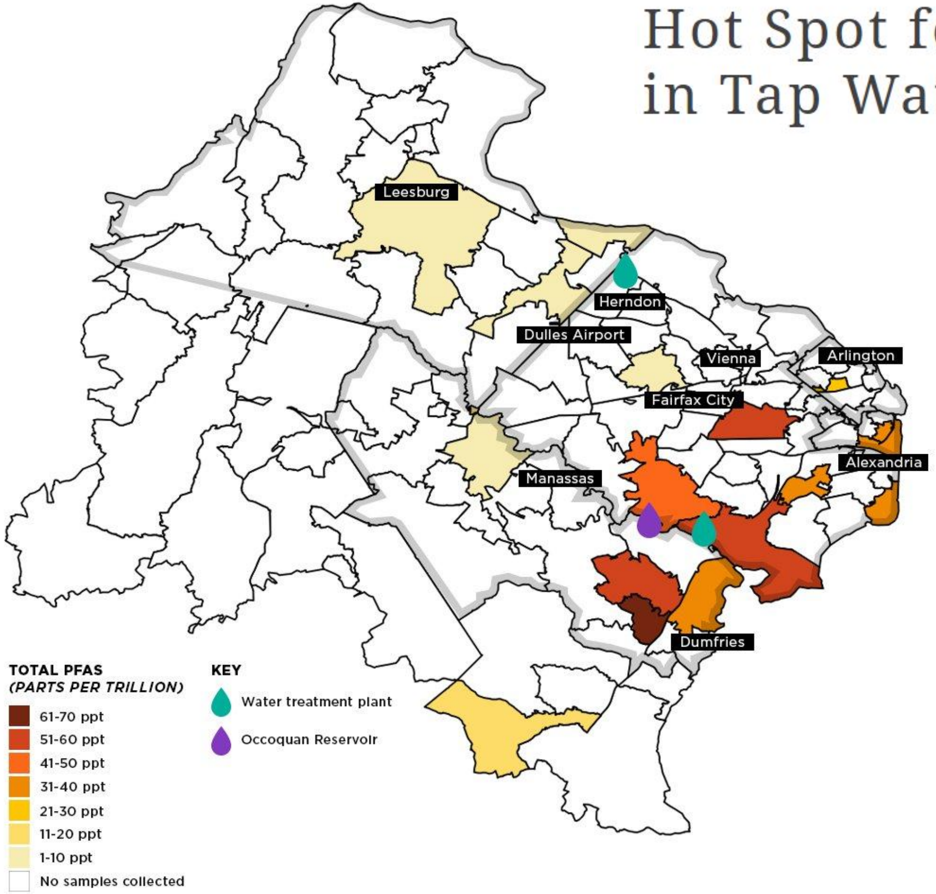
PFAS & EWG

PFAS Contamination of Drinking Water Far More Prevalent Than Previously Reported

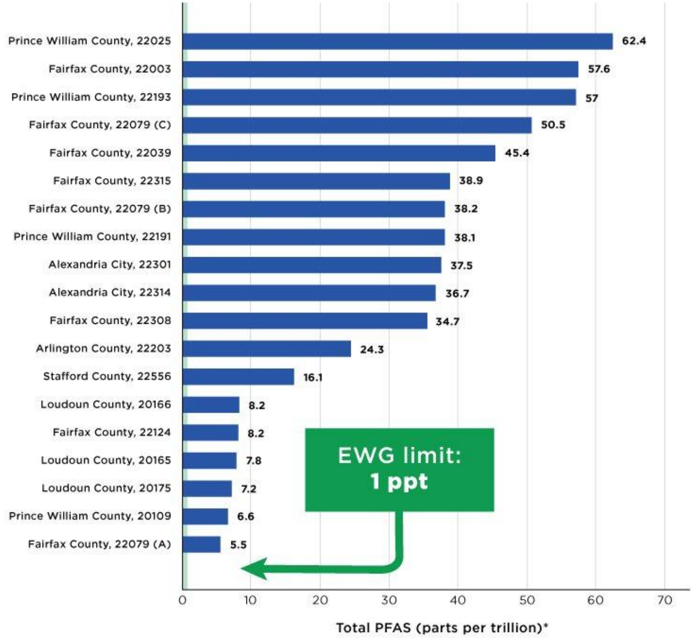
New Detections of 'Forever Chemicals' in New York, D.C., Other Major Cities



Is Northern Virginia a D.C.-Area Hot Spot for 'Forever Chemicals' in Tap Water?



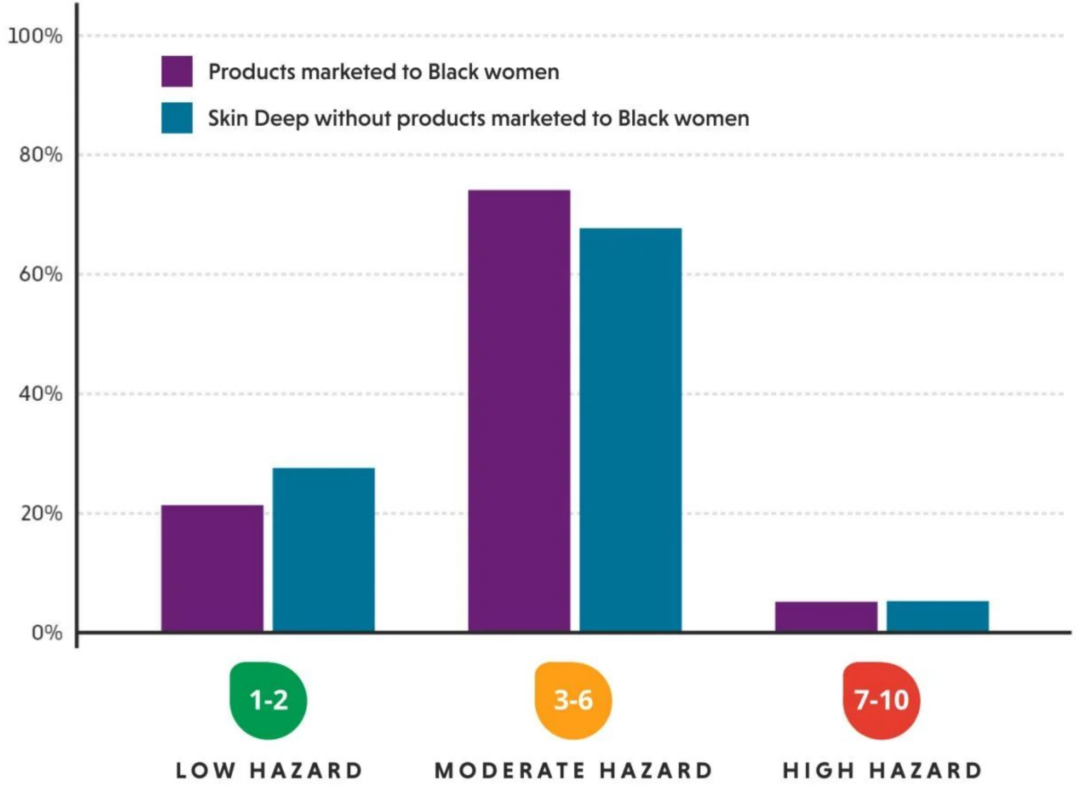
PFAS LEVELS DETECTED IN NORTHERN VIRGINIA BY COUNTY AND ZIP CODE



Source: EWG, from samples taken in January and February 2021.

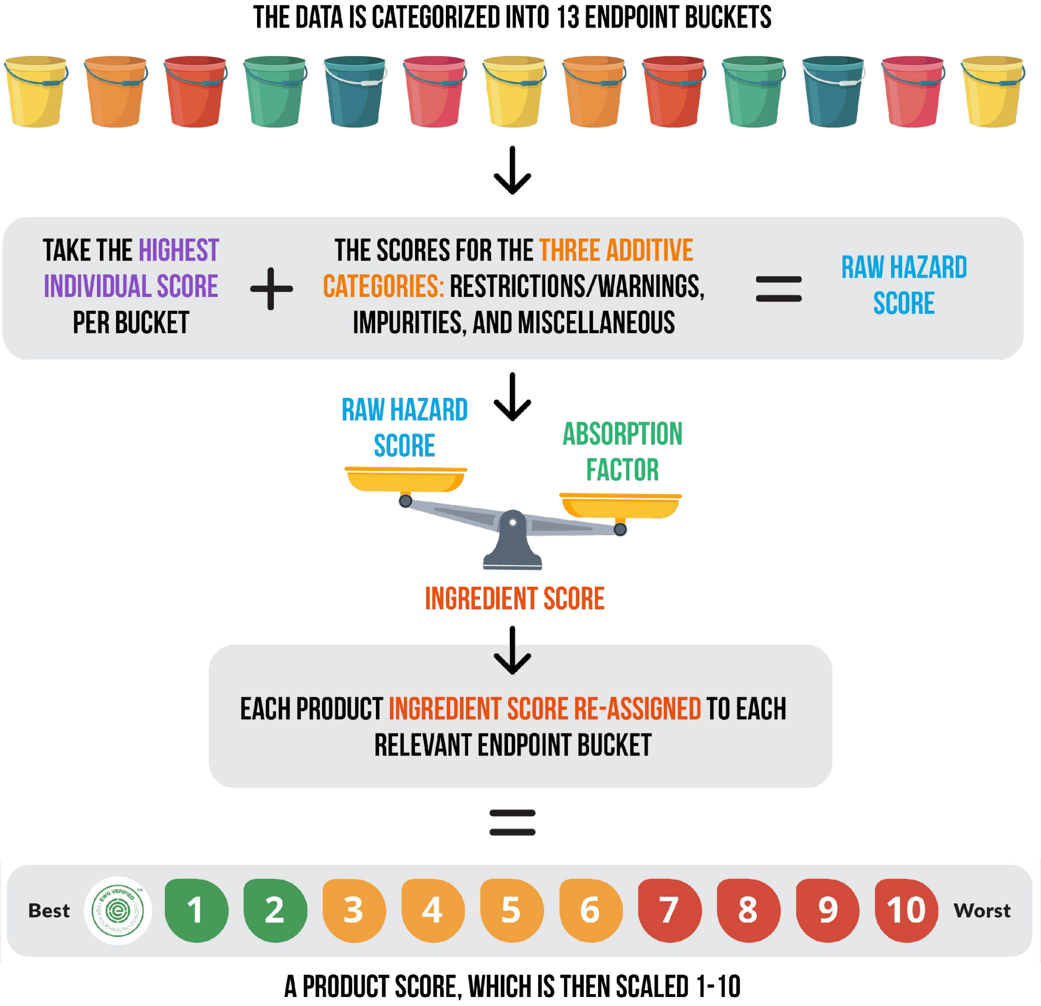
** Sum of detection of all PFAS analyzed.*

There are fewer low hazard products marketed to Black women compared to products without demographic marketing



Health Endpoints

- Cancer
- Reproductive/ developmental toxicity
- Neurotoxicity
- Endocrine disruption
- Allergies/immunotoxicity
- Organ system toxicity
- Mutations
- Cellular/biochemical changes
- Occupational hazards
- Ecotoxicity



39-23

Advancing Public Access to Drinking Water Contaminant Data: The EWG Tap Water Database

Tasha Stoiber, Sydney Evans*, Chris Campbell, Olga V. Naidenko and David Q. Andrews, Environmental Working Group
*presenting author

Abstract

Objective: Access to reliable, transparent data on drinking water quality is essential for public health protection and informed decision-making. The Environmental Working Group (EWG) developed the Tap Water Database, the most comprehensive publicly available resource on drinking water contaminants in the United States.
Methods: Here we will highlight the methodology behind the database, including data collection, interpretation of health risks, and comparison of contaminant levels to both federal legal standards and health-based standards. The database examines the gaps in current drinking water regulations and emphasizes the need for stronger health-protective limits and increased transparency in water quality reporting.
Results: The database compiles water quality data from nearly 50,000 utilities nationwide, assessing contaminants against health-based benchmarks and documenting their prevalence and potential health risks from long-term exposure over a lifetime.
Discussion: The EWG Tap Water Database serves as a critical resource for researchers, policymakers, and the public to identify disparities in water quality and advocate for improved regulatory safeguards. By democratizing access to drinking water data, this initiative empowers communities to demand cleaner, safer water and supports the push for science-driven policy reforms. The database is a tool for leveraging data for environmental advocacy, risk communication, and regulatory improvements in drinking water standards.

Methods

Drinking water monitoring data were collected from state health or environmental health offices or downloaded directly from some states.

The most recent update of the data included data from 2021 to 2023 for most contaminants and data from UCMR programs from 2013-2024 for unregulated contaminants. EWG calculated arithmetic mean averages of the contaminant concentrations for each community water system for the analyzed data period. Test results reported as "non-detects" were assigned a value of zero and included in the calculation of averages.

EWG compared average contaminant concentrations to the federal legal limits and health guidelines published by government agencies and those from peer-reviewed research.

Table 1
EWG Developed health-based water standards based on peer-reviewed literature, California public health goals, and 10-6

[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]

Results

EWG's Tap Water Database was released with updated data in 2025, its 6th updated since the first release in 2005. Since the release in February 2025, over 1.5 million users have visited the database.

EWG has published 112 health-based standards for both regulated and unregulated contaminants, including 17 PFAS. The database includes information on 324 contaminants, including 231 that are unregulated, detailing their sources, detection in utilities, associated health concerns and what filtration technology is effective for reduction.

As of July 2025, EWG published 11 peer-reviewed journal papers based on data from the Tap Water Database.

Figure
An interactive map was developed to display water systems with co-occurring contaminants with hexavalent chromium that can be removed by similar treatment.

Actions needed

- Consider contaminants as groups to optimize removal of multiple contaminants, not just one contaminant at a time. Health benefits of multi-contaminants removed should be considered.
- Review of outdated Maximum Contaminant Levels that are not protective of health.
- Review of the inefficient process for development new standards for unregulated contaminants.
- Uphold the standards developed for PFAS and mixtures of PFAS.
- Invest in drinking water monitoring, treatment and infrastructure.

ewg

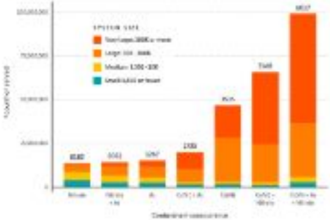
39-22

Simultaneous Removal of Co-occurring Contaminants Reduces Drinking Water-Attributed Cancer Risk: A United States Case Study

Tasha Stoiber, Sydney Evans*, Chris Campbell, David Q. Andrews, and Olga V. Naidenko
Environmental Working Group

Removal of co-occurring contaminants produces significantly greater potential benefit estimates compared to evaluation of one contaminant at a time. Here we present a framework for calculating avoidable lifetime cancer cases from simultaneously reducing hexavalent chromium and arsenic concentrations in drinking water using U.S. data as a case study.

Detection and co-occurrence above health-based benchmarks of Cr(VI), arsenic, and nitrate in community water systems.



Analysis of decreased cancer risk associated with the simultaneous reduction of co-occurring drinking water contaminants provides information for establishing new frameworks for mitigating contaminants and protecting public health from pollution. Consideration of the health and economic benefits associated with removal of co-occurring contaminants may help underscore the value of regulations that encourage the use of such technologies. It could also support the development of more efficient approaches for drinking water treatment.

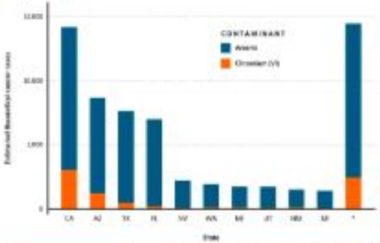
Estimated lifetime cancer cases avoided for Cr(VI) reduction scenarios in

Hypothetical Cr(VI) MCL	Estimated number of systems impacted	Estimated lifetime cancer cases avoided
0.02 µg/L	1,305-2,526	3,724-4,454
1 µg/L	756-886	2,633-2,809
2 µg/L	544-567	2,034-2,093
5 µg/L	250-252	1,114-1,131
10 µg/L	87	455-459

This is a simplified version of the full results that appear in Table 1. For complete data and statistical details, please refer to the original table in the published paper.

For the entire U.S., an estimated 7,410 lifetime cancer cases from Cr(VI) exposure and 43,418 from arsenic exposure could be avoided if drinking water concentrations were reduced to their respective one-in-a-million cancer risk levels in systems with Cr(VI) detections. For hypothetical maximum contaminant levels of Cr(VI) at 10 and 5 µg/L, estimated avoidable lifetime cancer cases for the entire United States are 575 and 1,320 respectively. At these same hypothetical limits for Cr(VI), simultaneously reducing arsenic by 42% and 28% would double the number of lifetime cases avoided.

Number of theoretical cancer cases potentially avoided with improved water quality scenarios.



National analysis of the percent reduction in arsenic needed to increase lifetime cases avoided.

Hypothetical Cr(VI) MCL	Lifetime cancer cases avoided *	Percent reduction of arsenic to double cases avoided	Percent reduction of arsenic to quadruple cases avoided
10 µg/L	575	42%	(Not possible)†
5 µg/L	1,320	28%	84%
2 µg/L	2,865	27%	80%

This is a simplified version of the full results that appear in Table 1. For complete data and statistical details, please refer to the original table in the published paper.

ewg

89

alysis of cumulative cancer risk associated with disinfection byproducts in United States drinking water

Sydney Evans, Chris Campbell, and Olga V. Naidenko

Introduction

- Hundreds of disinfection byproducts (DBPs) form in drinking water following treatment, which can increase the risk of cancer.
- Few disinfection byproducts are regulated in drinking water.
- Risks assessments can be based on epidemiological data or animal toxicology studies.

Methods

- A side-by-side comparison of two cancer risk assessment methodologies using an existing nationwide dataset of regulated DBPs and a new occurrence dataset for unregulated haloacetic acids (UCMR4).

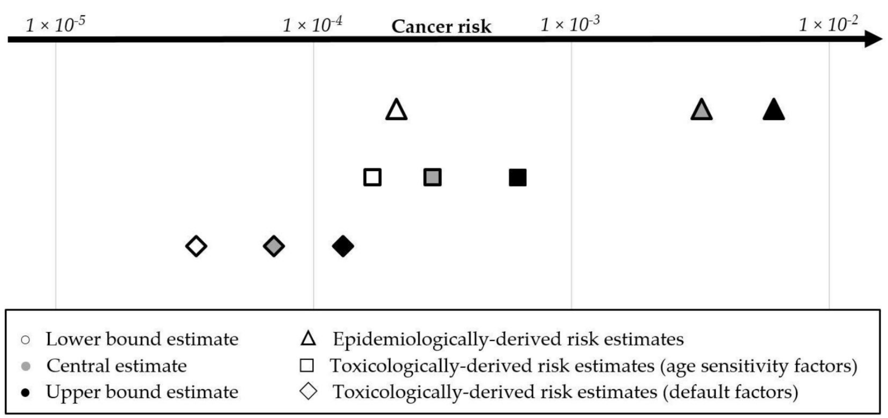
Results

- A cumulative risk assessment for regulated DBPs based on animal toxicology studies estimates a lifetime cancer risk of 7.0 x 10^{-5}.
- Accounting for age sensitivity and elevated risk in infants and children increases the risk estimate to 2.9 x 10^{-4}.
- A risk assessment based on human epidemiological studies using regulated trihalomethanes (THM4) as a marker of exposure estimates a lifetime cancer risk of 3.0 x 10^{-3}.

Discussion

- Toxicological assessment indicates haloacetic acids (HAAs) have overall greater cancer potency than trihalomethanes.
- The inclusion of age sensitivity factors brings toxicological risk estimates closer to epidemiological risk estimates.
- Even with age sensitivity factors, risk calculations based on animal data may not capture the full range of susceptibility of the fetus, infant, and young child to carcinogens.
- The authors recognize a number of scientific uncertainties associated with the calculation of health risks from both animal toxicology and epidemiology data.

Side-by-side comparison of **toxicological and epidemiological estimates of cancer risk from drinking water disinfection byproducts** offers a compelling argument for conducting cumulative risk assessments for both regulated and unregulated contaminants.



Cumulative assessment of lifetime cancer risk due to disinfection byproducts in drinking water using epidemiologically derived risk estimates based on human studies of disinfection byproducts and bladder cancer and toxicologically derived risk estimates based on animal studies of disinfection byproducts.

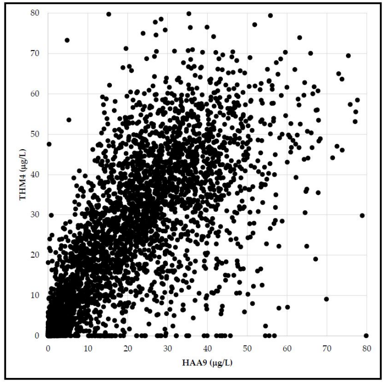
SCAN ME

Regulated disinfection byproducts constitute just a portion of the contaminants that form during the disinfection process.

Both methods estimate that DBPs in drinking water present risks in excess of the "*de minimus*" acceptable cancer risk of one-in-a-million.

This analysis highlights the value of incorporating human data in health risk assessments, which are currently primarily based on animal studies.

Figures & Tables



The average concentration of trihalomethanes (THM4) in community drinking water systems according to compliance testing results for 2014 to 2017, and the average concentration of haloacetic acids (HAA9) as reported in the EPA Unregulated Contaminant Monitoring Rule 4 occurrence dataset. (left)

Benchmark doses and cancer risk concentrations for haloacetic acids and trihalomethanes. (below)

Disinfection Byproduct [a]	Benchmark Doses from Animal Bioassay, 5% Excess Cancer Risk (mg/kg-day)	Concentrations Corresponding to One-in-a-Million Cancer Risk [c] (µg/L)	Source of the Risk Benchmark
Bromochloroacetic acid	1.0 (0.7–1.6) [b]	0.02	Calculated in this study
Chlorodibromoacetic acid	Not Available	0.02	Applied by read-across from bromochloroacetic acid
Bromodichloroacetic acid	2.8 (1.6–9.1) [b]	0.04	Calculated in this study
Dibromoacetic acid	2.2 (1.4–3.8) [b]	0.04	Calculated in this study
Tribromoacetic acid	Not Available	0.04	Applied by read-across from dibromoacetic acid
Trichloroacetic acid	8.1 (4.4–28.8)	0.1	OEHHA 2020 [30]
Dichloroacetic acid	32.7 (7.9–40.2)	0.2	OEHHA 2020 [30]
HAA5 group	Not applicable	0.1	Calculated in this study
HAA6Br group	Not applicable	0.03	Calculated in this study
HAA9 group	Not applicable	0.06	Calculated in this study
Bromodichloromethane	11.1 (3.9–21.9)	0.06	OEHHA 2018 [42]
Dibromochloromethane	26.2 (7.5–39.1)	0.1	OEHHA 2018 [42]
Chloroform	33.4 (14.1–51.6) [d]	0.4 [e]	OEHHA 2018 [42]
Bromoform	31.0 (18.7–82.7)	0.5	[42]
THM4 group	Not applicable	0.15	Evans et al. [16]

Toxicological estimates for attributable lifetime cancer cases and cumulative cancer risks due to haloacetic acids and trihalomethanes. (below)

Chemical Group	Cancer Estimates Using Default Parameters [a,b]	Cancer Estimates Using Age Sensitivity Factors [a,c]
Lifetime cancer cases calculated using the national tap water dataset (thousands)		
THM4 [d]	3.1 (1.7–10.2)	19.1 (10.2–57.2)
HAA5	4.0 (2.0–8.4)	18.5 (8.6–40.1)
Lifetime cancer cases calculated for systems in the UCMR4 program (thousands)		
HAA5	2.9 (1.5–6.1)	13.4 (6.2–29.1)
HAA6Br	8.6 (4.4–12.8)	32.1 (21.4–42.8)
HAA9	10.9 (5.4–17.5)	41.4 (25.3–76.0)
THM4 [d] and HAA9	12.8 (6.5–24.1)	53.7 (31.9–112.8)
Lifetime cancer risk calculated for systems in the UCMR4 program		
Cumulative cancer risk estimates for THM4 [d] and HAA9	7.0×10^{-5} (3.5×10^{-5}–1.3×10^{-4})	2.9×10^{-4} (1.7×10^{-4}–6.2×10^{-4})