NC STATE UNIVERSITY

Center for Human Health and the Environment

GenX Exposure Study

GenX Exposure Study

PFAS results for blood samples collected 2020-2021

October 18, 2022

Webinar: October 18, 2022

- Welcome
- Introduction to PFAS and GenX Exposure Study
- Overview of community-level results
- Structure of individual results letters
- Next steps

If you have questions during the presentation, please use the Q&A function

NC STATE UNIVERSITY

ECU

NIH National Institute of Environmental Health Sciences

Today's Speakers

Carolyn Mattingly, PhD, NC State

Superfund Center Director

Moderator

Jane Hoppin, ScD, NC State

Nadine Kotlarz, PhD, NC State

Today's Presentation

Overview of 2020-2021 PFAS blood findings

Letters are in the mail

Overview of what to expect

Thank you for participating in the GenX Exposure Study

Please put your questions in the Q&A

We'll answer questions at the end

In-person meetings

Pittsboro, NC, on Wednesday, Oct 19, 2022 (Tomorrow)
6-8pm
Chatham County Agriculture & Conference Center

Hope Mills, NC, on Wednesday, Nov 2, 2022
6-8pm
Grays Creek Community Center

Fayetteville, NC, on Thursday, Nov 10, 2022
6-8pm
Cedar Creek Baptist Church

Wilmington, NC, on Wednesday, Dec 7, 2022
6-8pm
Cape Fear Community College

Second webinar to answer your questions

Wednesday, Nov 9, 2022

6-8pm

Contact our study office

phone (855-854-2641)

email (genx-exposure-study@ncsu.edu)

"PFAS" stands for per- and polyfluoroalkyl substances

Human-made chemicals with carbon-fluorine bonds

Resistant to heat, water, grease

Used in consumer products, industrial processes, fire-fighting foams

Can last in environment and human body for a long time

Where did PFAS in the Cape Fear River Basin come from?

Textile and furniture manufacturing

Sludge from wastewater treatment plants used as fertilizer

Use of fire-fighting foams at airports

Fayetteville Works facility near Fayetteville, NC

GenX Exposure Study:2017-2019

Not just about GenX

Multiple PFAS

Answered questions about

What chemicals were in people?

What chemicals were in the environment?

How long do these chemicals stay in people's bodies.

Public water users in New Hanover County, NC, in 2017-2018

Private well users in Fayetteville area, NC, in 2019

What we learned
New Hanover County, NC, 2017-2018

Public water users

Three PFAS from Fayetteville Works detected in almost all 344 participants in 2017-2018

Nafion byproduct 2

PFO4DA

PFO5DoA

Some PFAS in tap water (GenX) were not detected in blood

Higher blood levels of PFOS, PFOA, PFHxS, and PFNA than the United States national averages

What we learned
Fayetteville area, NC, 2019

Private well users

PFOA, PFOS, PFHxS, PFNA found in almost all 153 participants

Higher blood levels of PFOS, PFOA, PFHxS, and PFNA than the national average

Detected Nafion byproduct 2 in ~60% of participants

Detected PFO5DoA in ~40% of participants

PFAS results of blood samples from 2020-2021

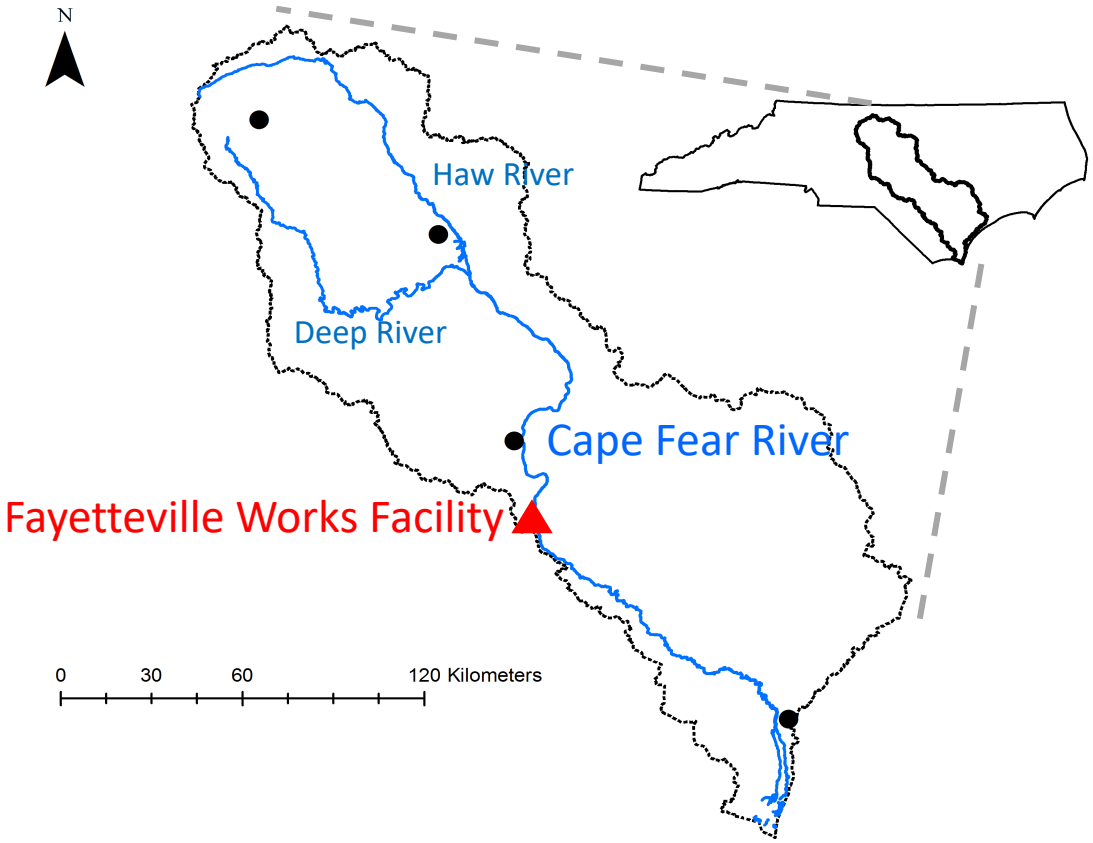
PFAS results of blood samples from 2020-2021

Reporting on all results together or community-level results

Similar formats today as what you'll see on your letter

What did we do in 2020-2021?

Collected **blood** from **1,020 people** across **3 communities**



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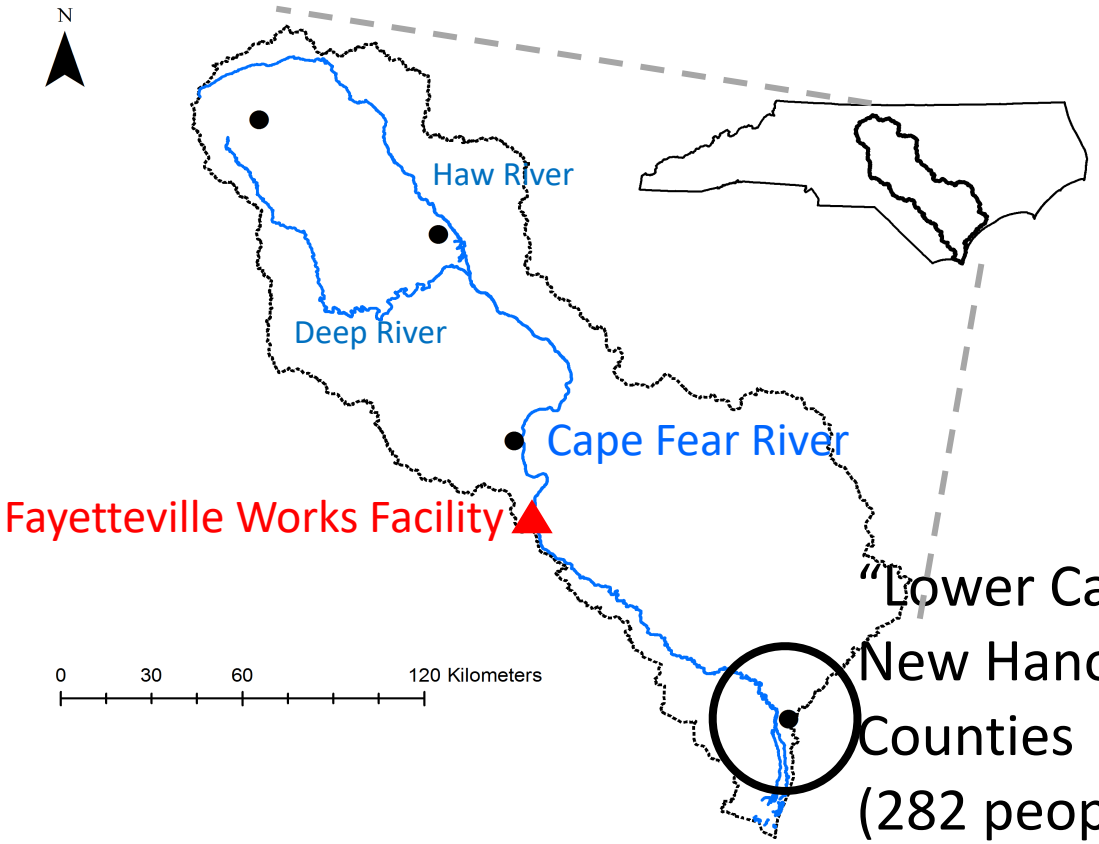

"Lower Cape Fear Region"
New Hanover and Brunswick Counties
(282 people in 2020)
(232 people in 2021)

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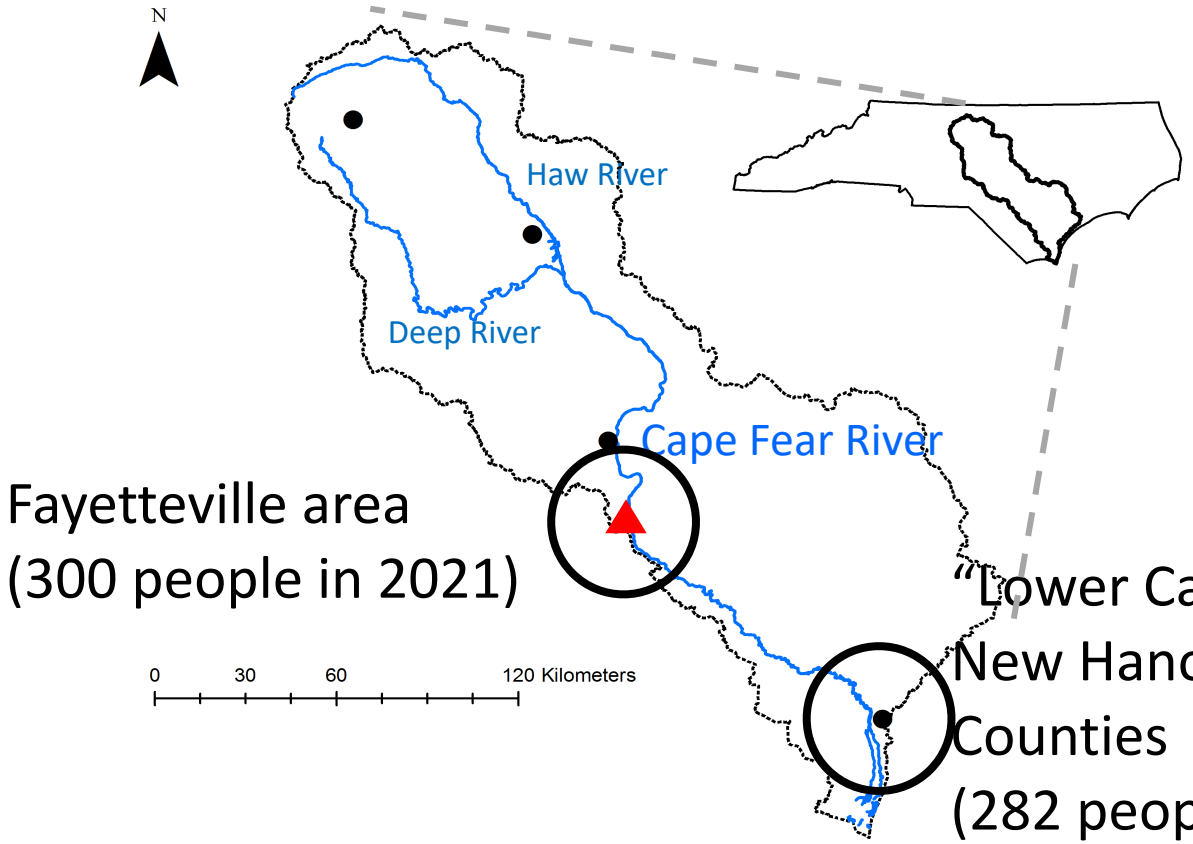

Fayetteville area
(300 people in 2021)

"Lower Cape Fear Region"
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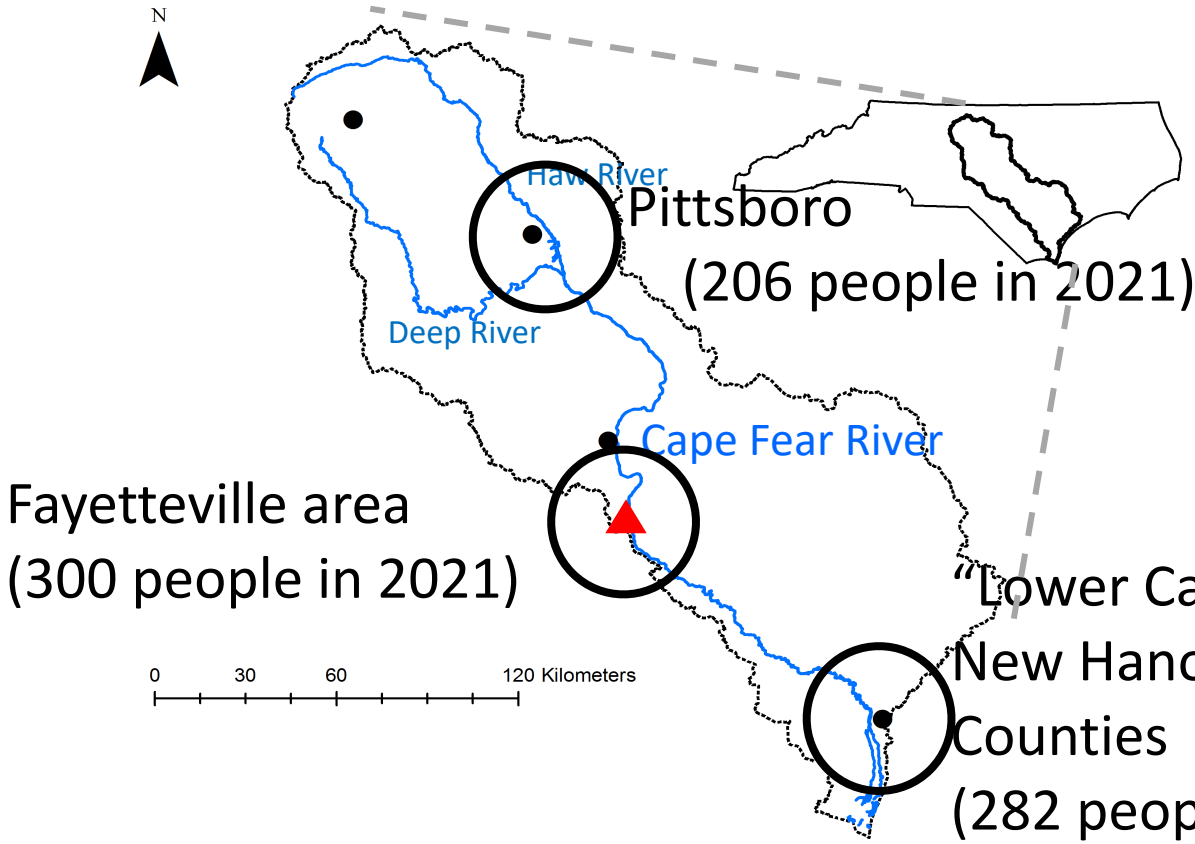

Pittsboro
(206 people in 2021)

Fayetteville area
(300 people in 2021)

"Lower Cape Fear Region"
New Hanover and Brunswick Counties
(282 people in 2020)
(232 people in 2021)

Enrollment criteria

Enrolled new and former participants

- 1020 total
  - 222 participants who gave blood 2017-2019

Ages 6 and older

Up to 4 people/household

Lived at current address for at least one year

- On municipal water
  - New Hanover, Brunswick, Pittsboro
- On private wells
  - Fayetteville area

Blood PFAS Results from 2020-2021 Key Findings

1. Found 4 PFAS (PFOS, PFOA, PFHxS, and PFNA) in almost everyone
2. Higher levels than the United States national averages
3. Nafion byproduct 2 and PFO5DoA in most people in New Hanover/Brunswick Counties, and some people in Fayetteville area
4. Did not find GenX in any blood samples

Tested blood samples for 44 PFAS

7 PFAS found in most people in US

- PFOS
- PFOA
- PFHxS
- PFNA
- PFDA
- PFUnDA
- MeFOSAA

Other perfluoroalkyl carboxylic acids

- PFBA
- PFPeA
- PFHxA
- PFHpA
- PFTrDA
- PFDoA
- PFTeDA
- PFHxDA
- PFODA

Other perfluoroalkyl sulfonic acids

- PFBS
- PFPeS
- PFHpS
- PFNS
- PFDS

Perfluoroether carboxylic acids

- PEPA
- GenX
- PFO3OA
- PFO4DA
- PFO5DoA
- NaDONA

Perfluoroether sulfonic acids

- Nafion byproduct 1
- Nafion byproduct 2
- F53B Major (9Cl-PF3ONS)

Perfluoroalkyl sulfonamides

- 6:2 FTS
- FHxSA
- FOSA
- MeFOSA
- F53B Minor (11Cl-PF3OUdS)
- FBSA
- NEtFOSAA

Fluorotelomer carboxylic acid

- 7:3 FTCA

Fluorotelomer sulfonic acids

- 10:2 FTS
- 8:2 FTS
- 4:2 FTS

Zwitterions

- N-TAmP-FHxSA
- N-CMAmP-6:2FOSA (6:2 FTAB)
- N-AP-FHxSA

PMPA	NOT MEASURED
PFO2HxA	NOT MEASURED
NVHOS	NOT MEASURED
HYDRO-EVE	NOT MEASURED

Focus today on these PFAS

7 PFAS commonly found in people

- PFOS
- PFOA
- PFHxS
- PFNA
- PFDA
- PFUnDA
- MeFOSAA

Other perfluoroalkyl carboxylic acids

- PFBA
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- N-AP-FHxSA

PMPA	NOT MEASURED
PFO2HxA	NOT MEASURED
NVHOS	NOT MEASURED
HYDRO-EVE	NOT MEASURED

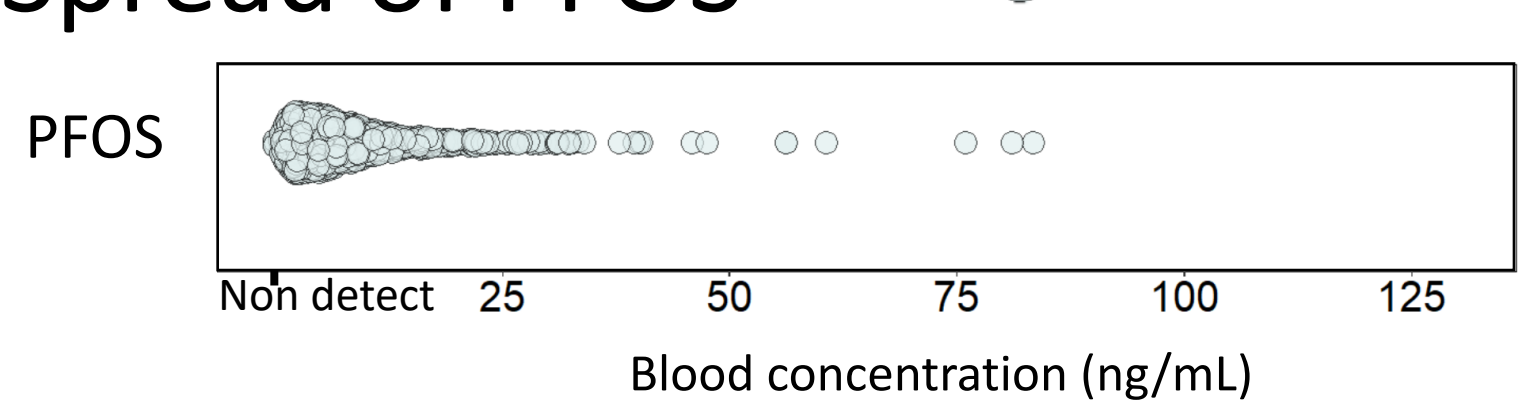
Which PFAS were found most often in blood samples?

PFOS	99.6% of people
PFOA	99% of people
PFHxS	99% of people
PFNA	96% of people

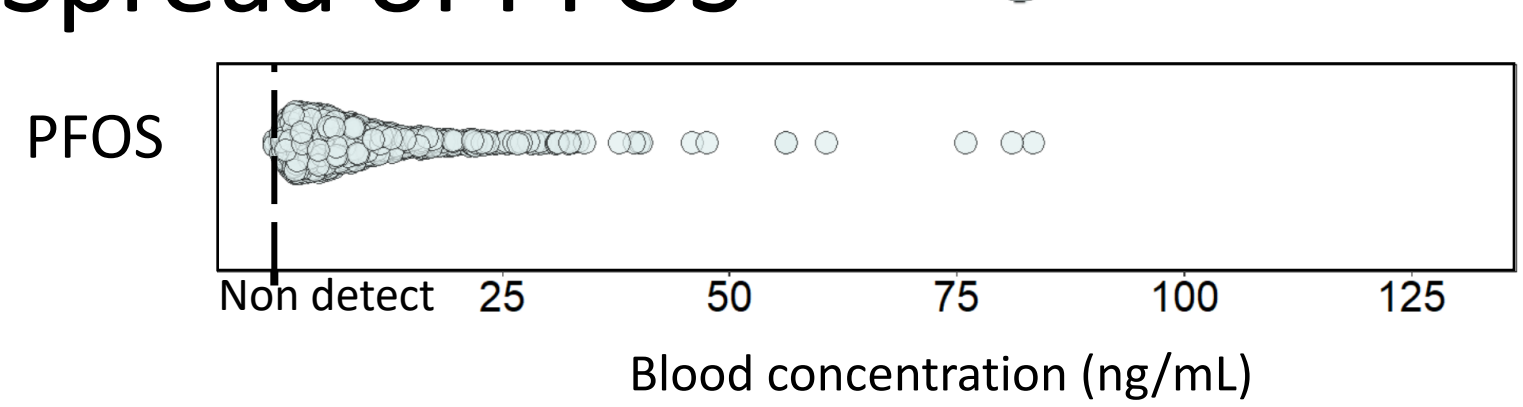
Total 1020 people

Stripcharts show spread of results

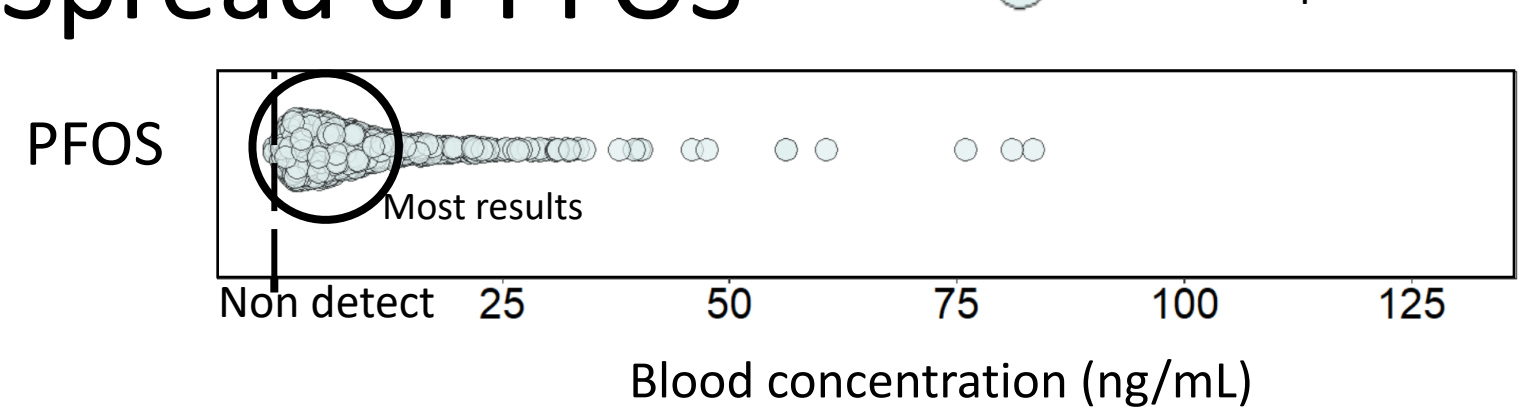
Spread of PFOS



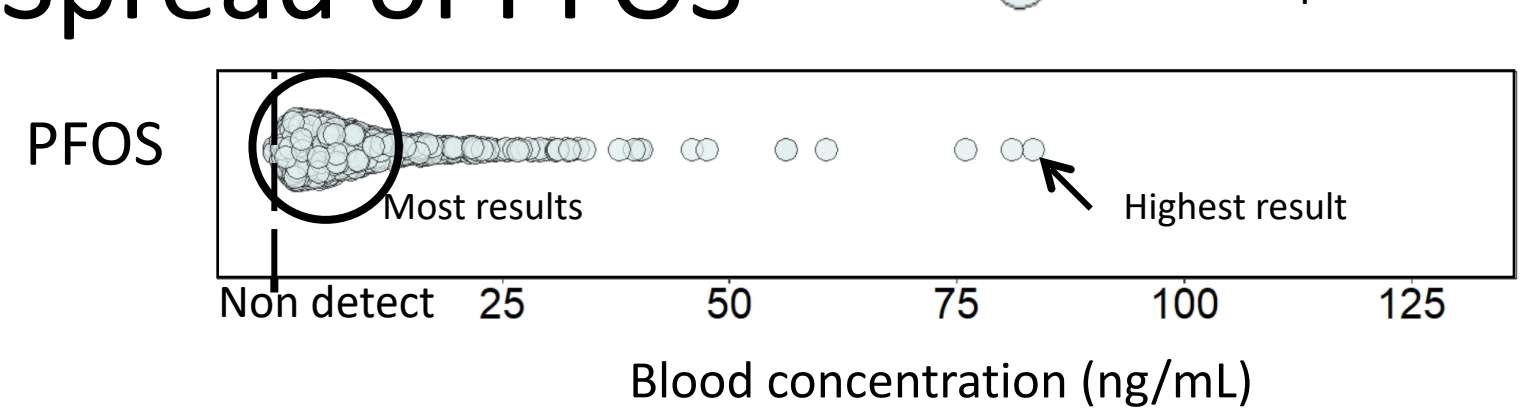
Spread of PFOS



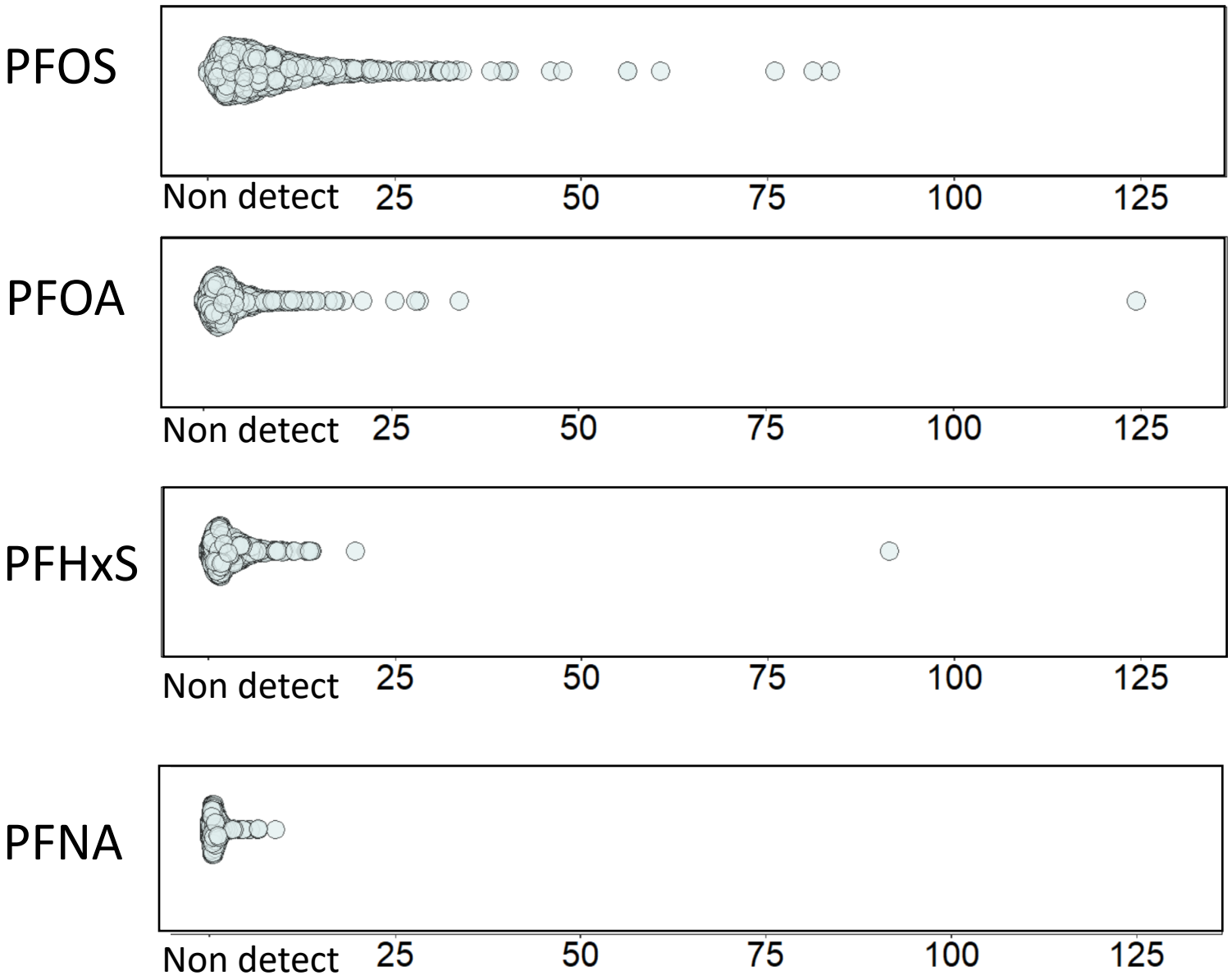
Spread of PFOS



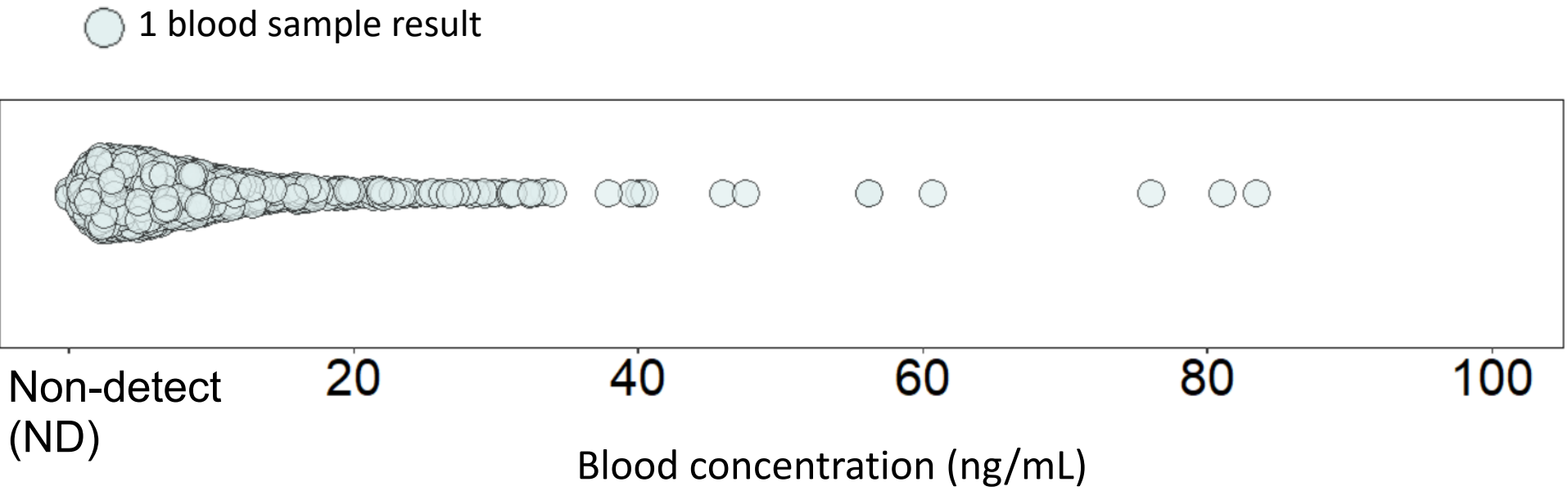
Spread of PFOS



Spread of PFOS, PFOA, PFHxS, PFNA



Closer look at PFOS levels



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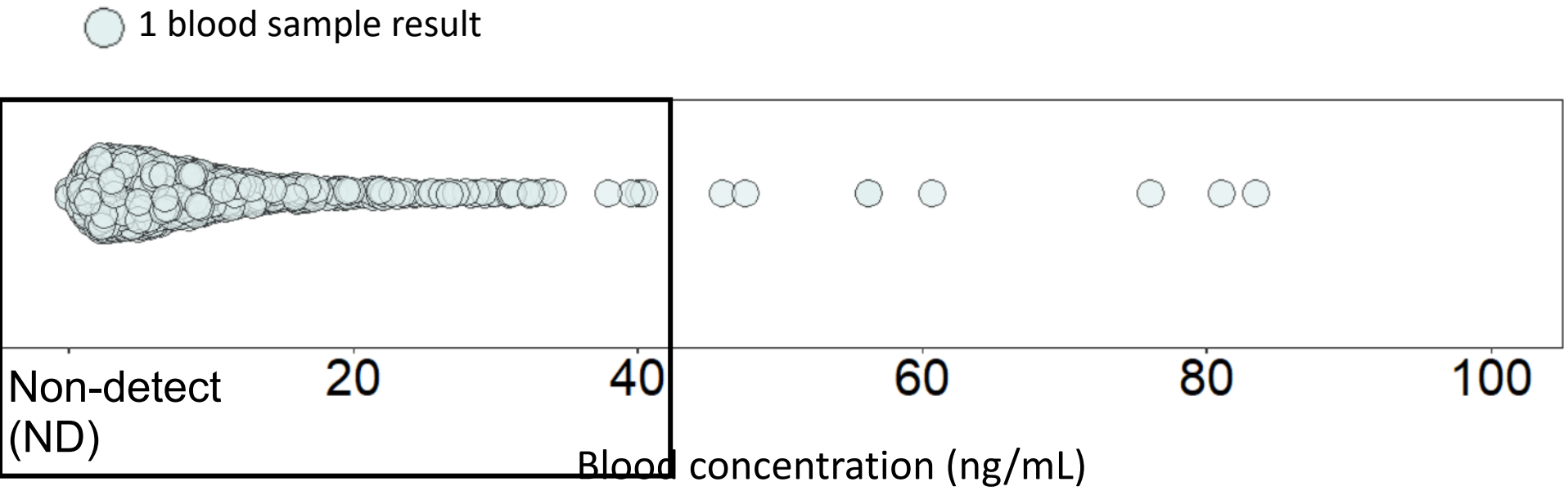

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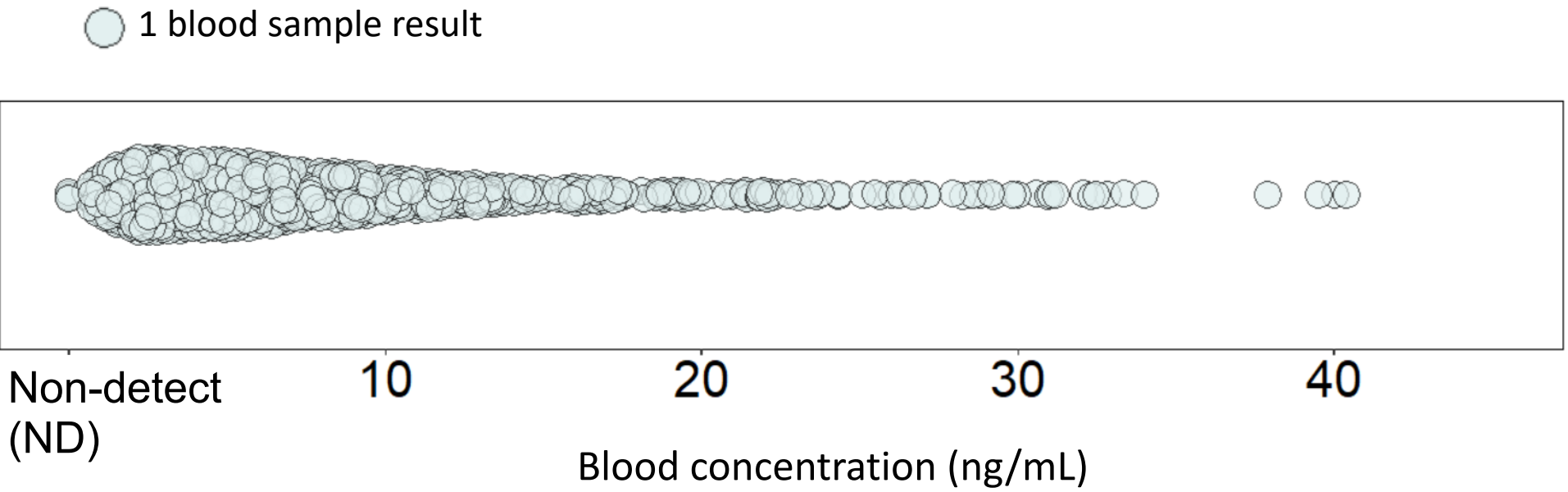
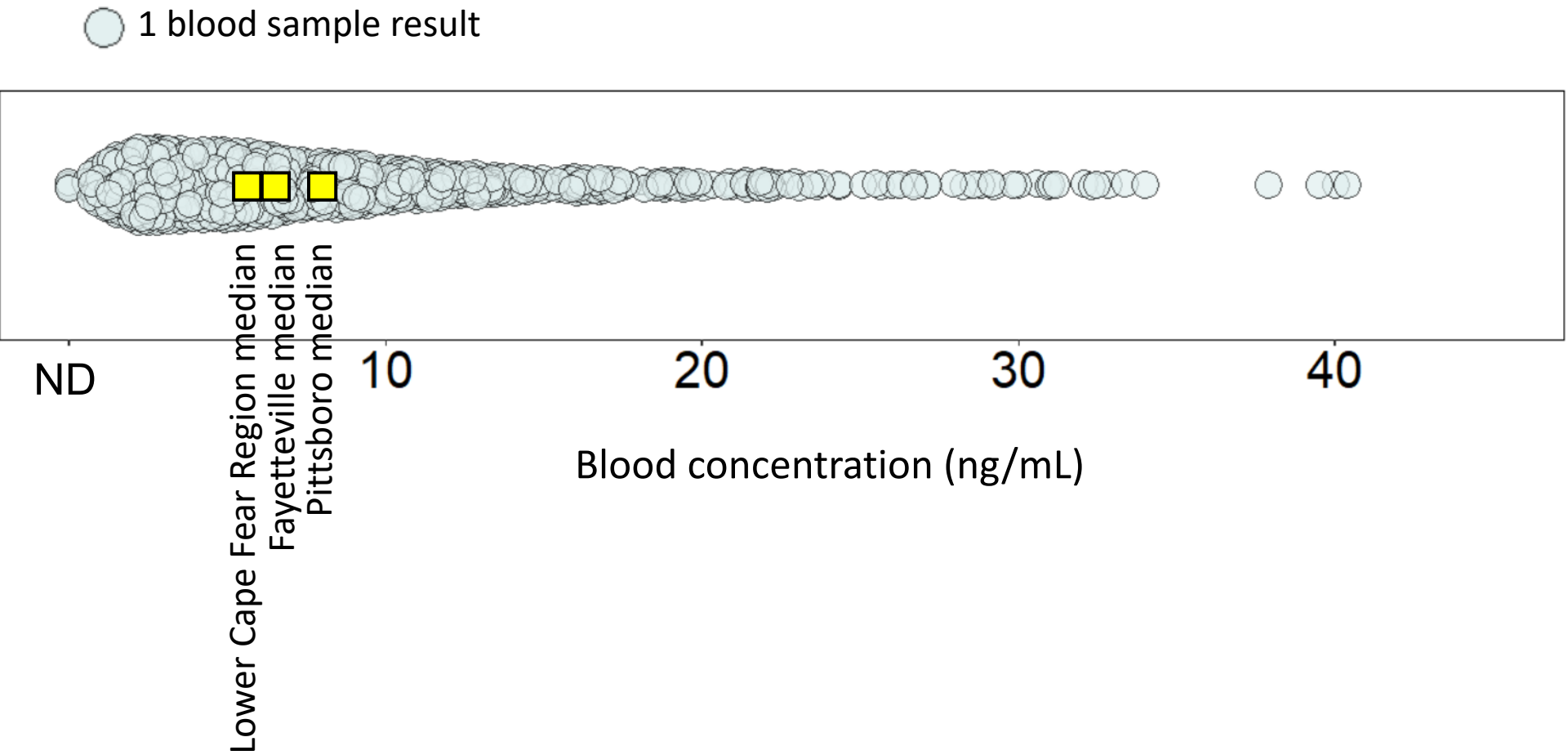


Compare 2021 community medians



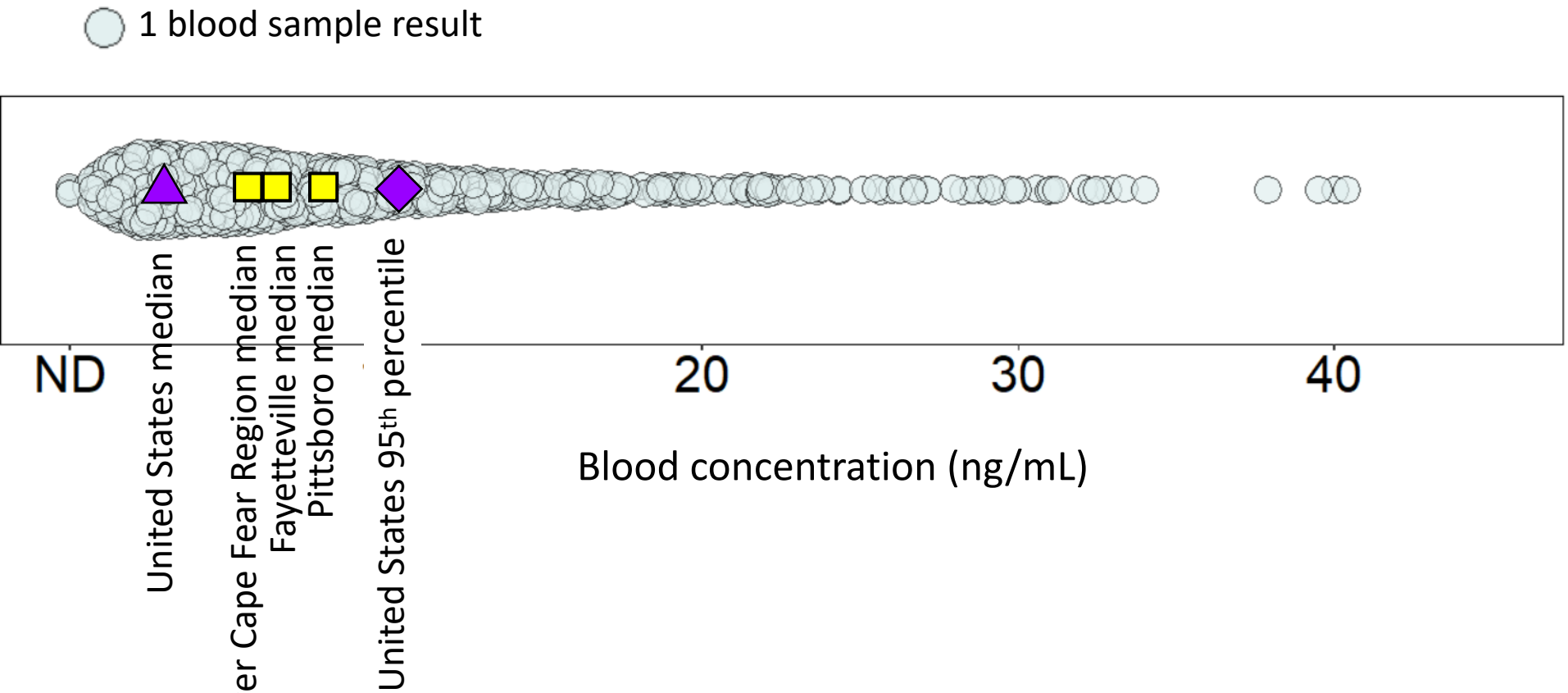
Can we compare your communities with United States population?

Yes

Centers for Disease Control and Prevention's National Health and Nutrition Examination Survey (NHANES)

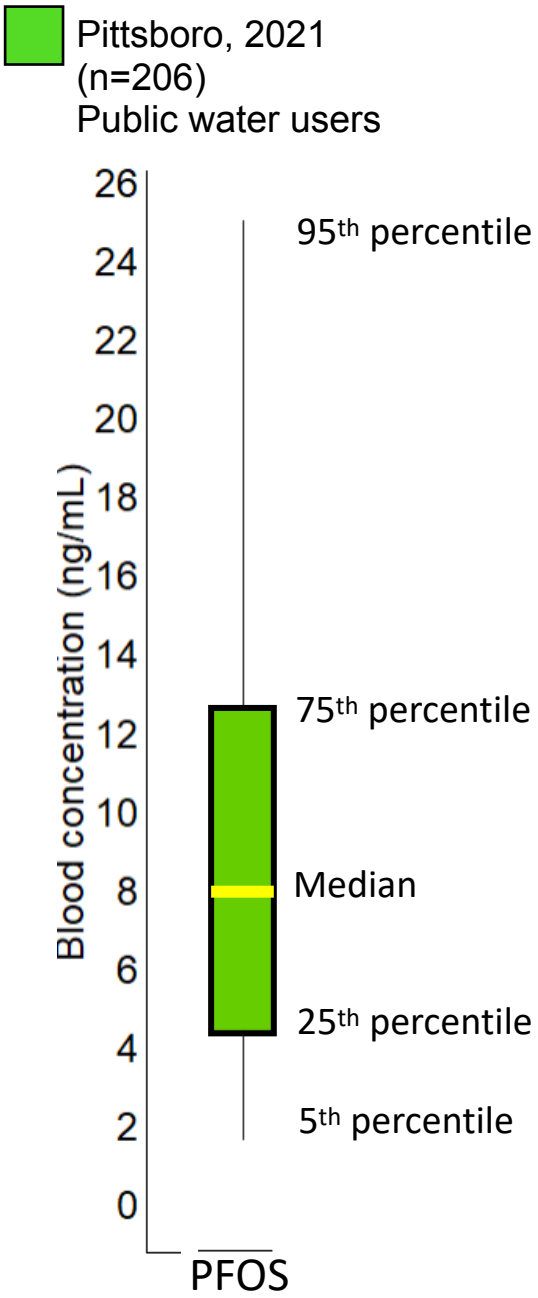
- Survey of people in the United States every 2 years
- Measure blood for several chemicals, including PFAS
- Results for PFOS, PFOA, PFHxS, PFNA, PFDA, PFUnDA, MeFOSAA are publicly available
- Results from 2017-2018 are latest available data

Compare with U.S. population



What about PFOA, PFHxS, and PFNA?

PFOS, PFOA, PFHxS, and PFNA in communities and U.S.

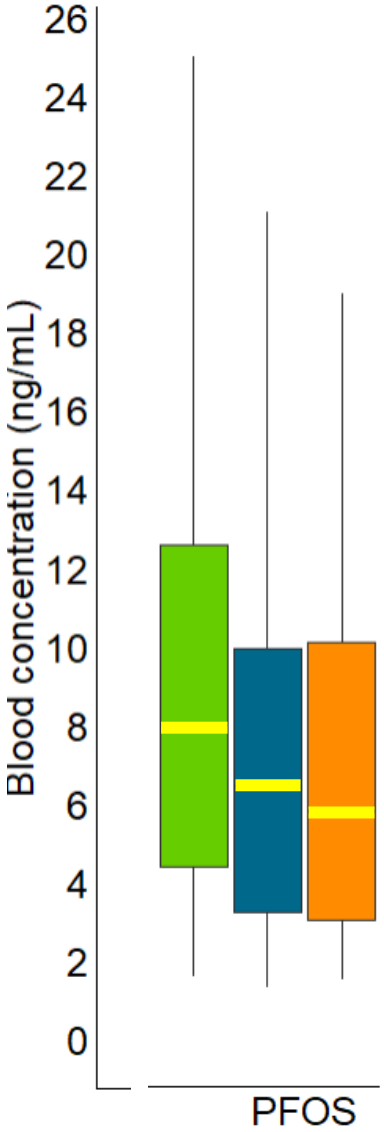


PFOS, PFOA, PFHxS, and PFNA in communities and U.S.

Pittsboro, 2021
(n=206)
Public water users

Fayetteville, 2021
(n = 300)
Private well owners

Lower Cape Fear
Region, 2021
(n = 232)
Public water users



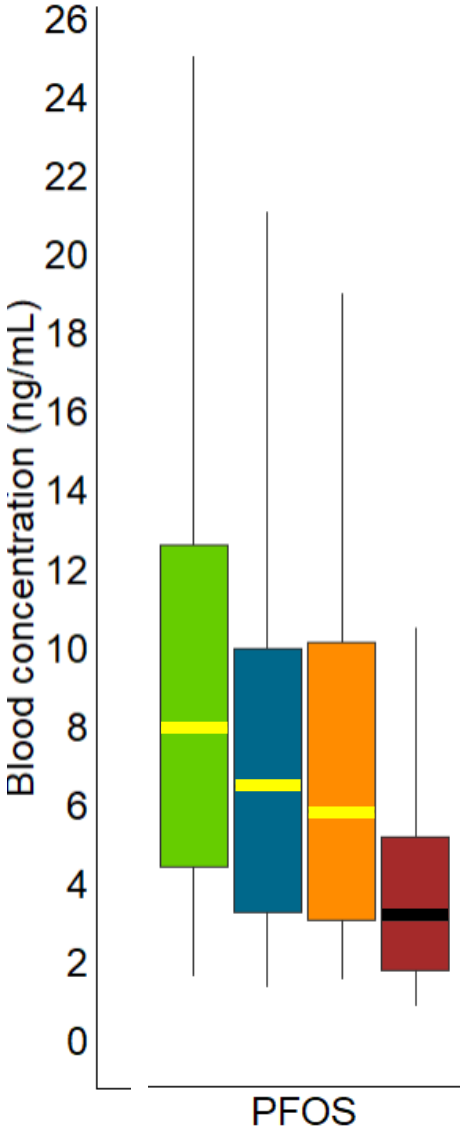
Comparison of communities and US for PFOS, PFOA, PFHxS, PFNA

Pittsboro, 2021
(n=206)
Public water users

Fayetteville, 2021
(n = 300)
Private well owners

Lower Cape Fear
Region, 2021
(n = 232)
Public water users

US population, 2017-2018
(n = 1,862)



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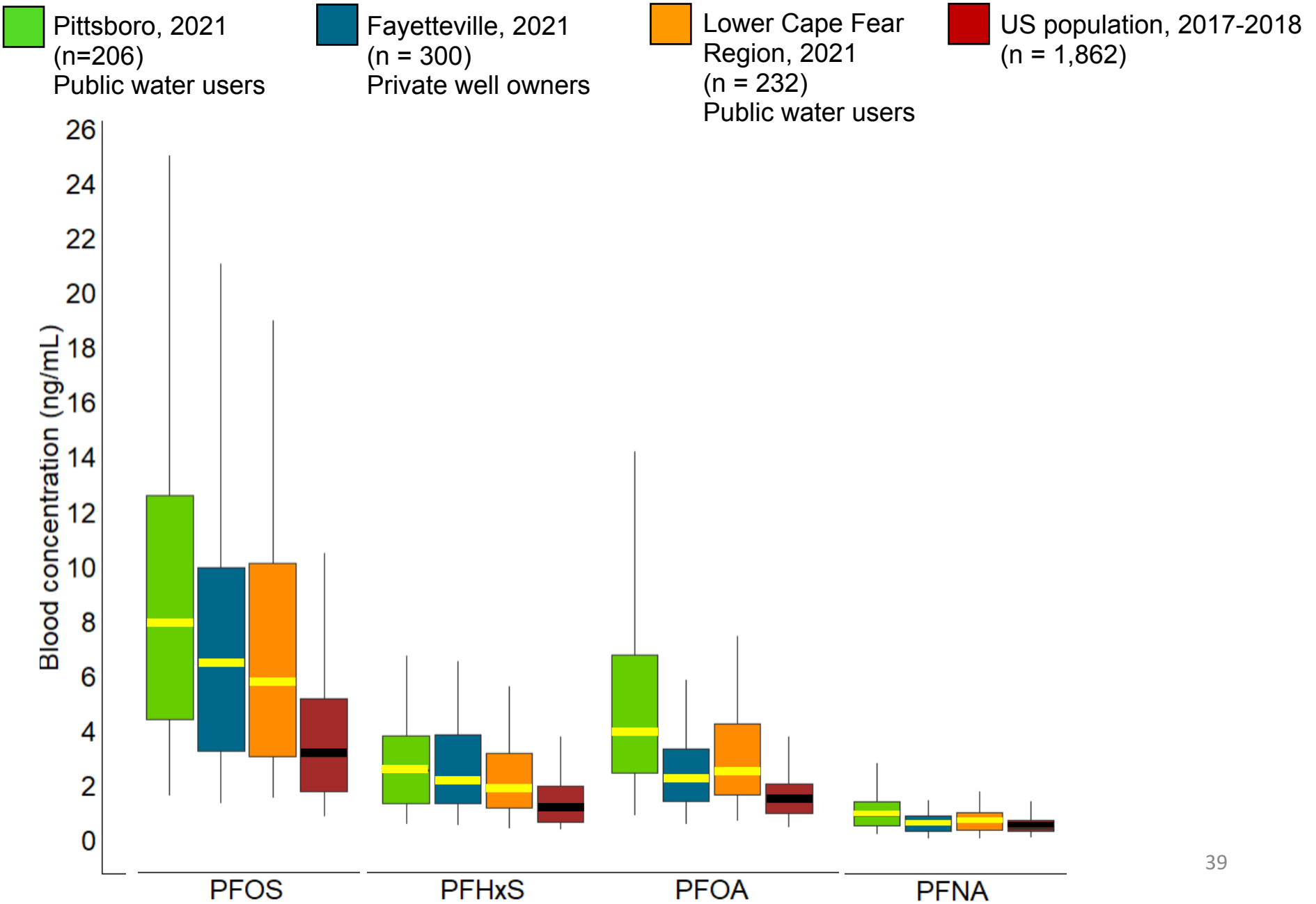

Blood PFAS Results from 2020-2021 Key Findings

1. Found 4 PFAS (PFOS, PFOA, PFHxS, and PFNA) in almost everyone
2. Higher levels than the United States national averages
3. Nafion byproduct 2 and PFO5DoA in most people in New Hanover/Brunswick Counties, and some people in Fayetteville area
4. Did not find GenX in any blood samples

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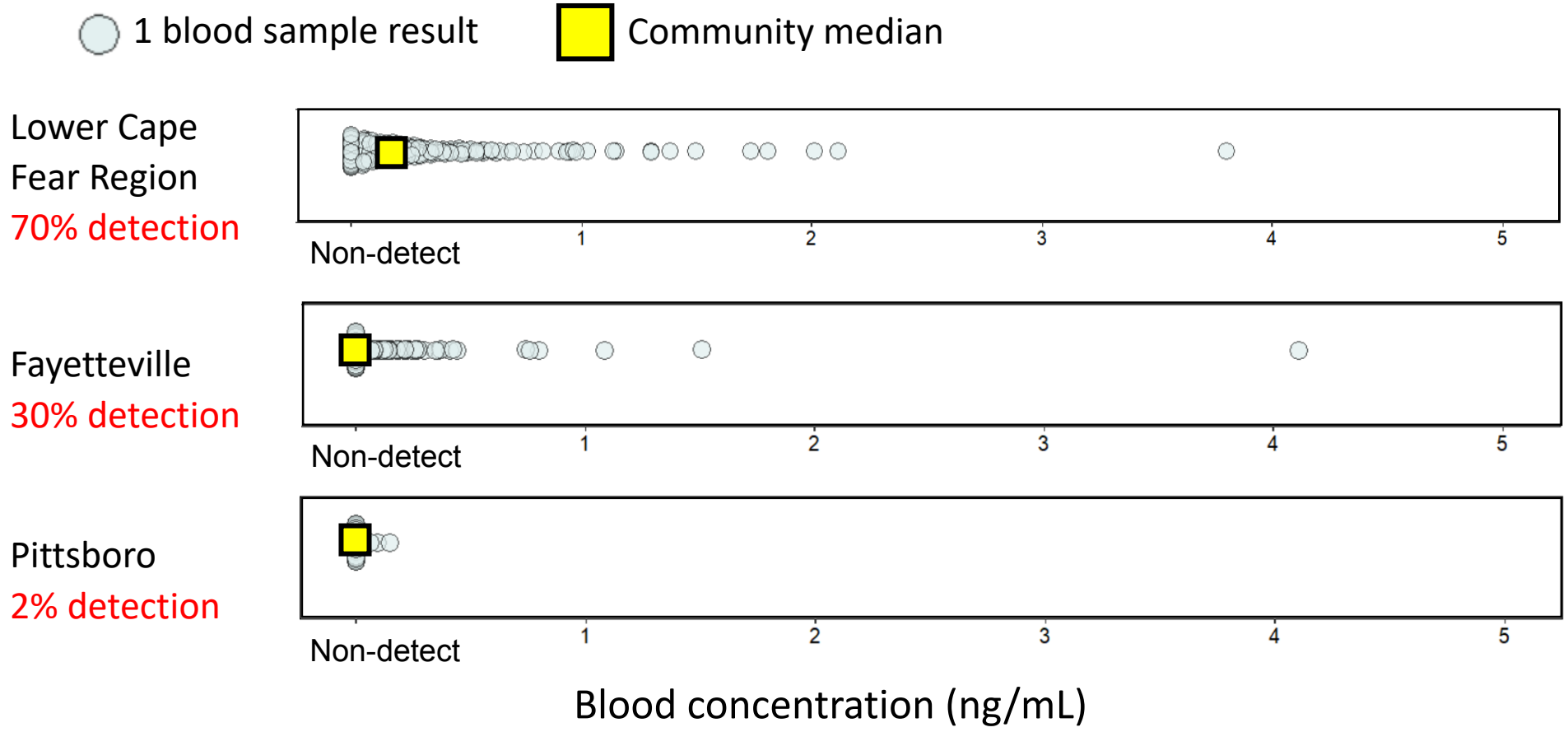
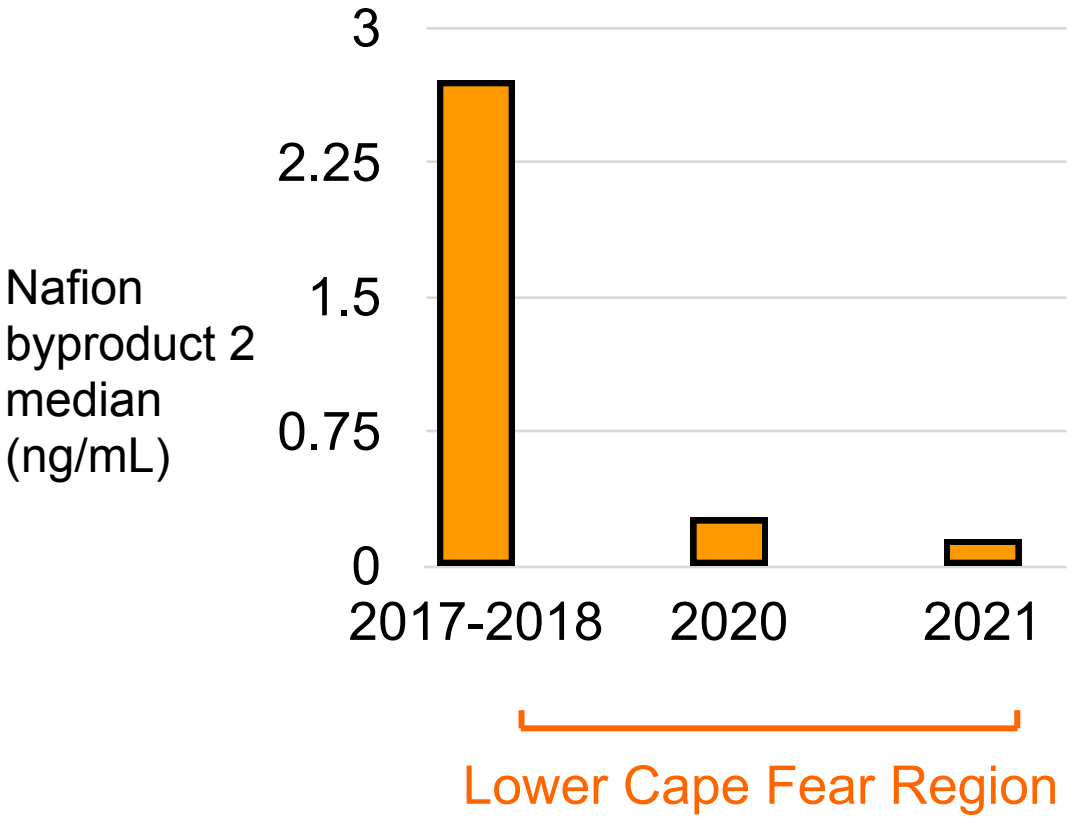
Spread of Nafion byproduct 2 levels by community in 2021



Median blood levels Nafion byproduct 2 by community, year



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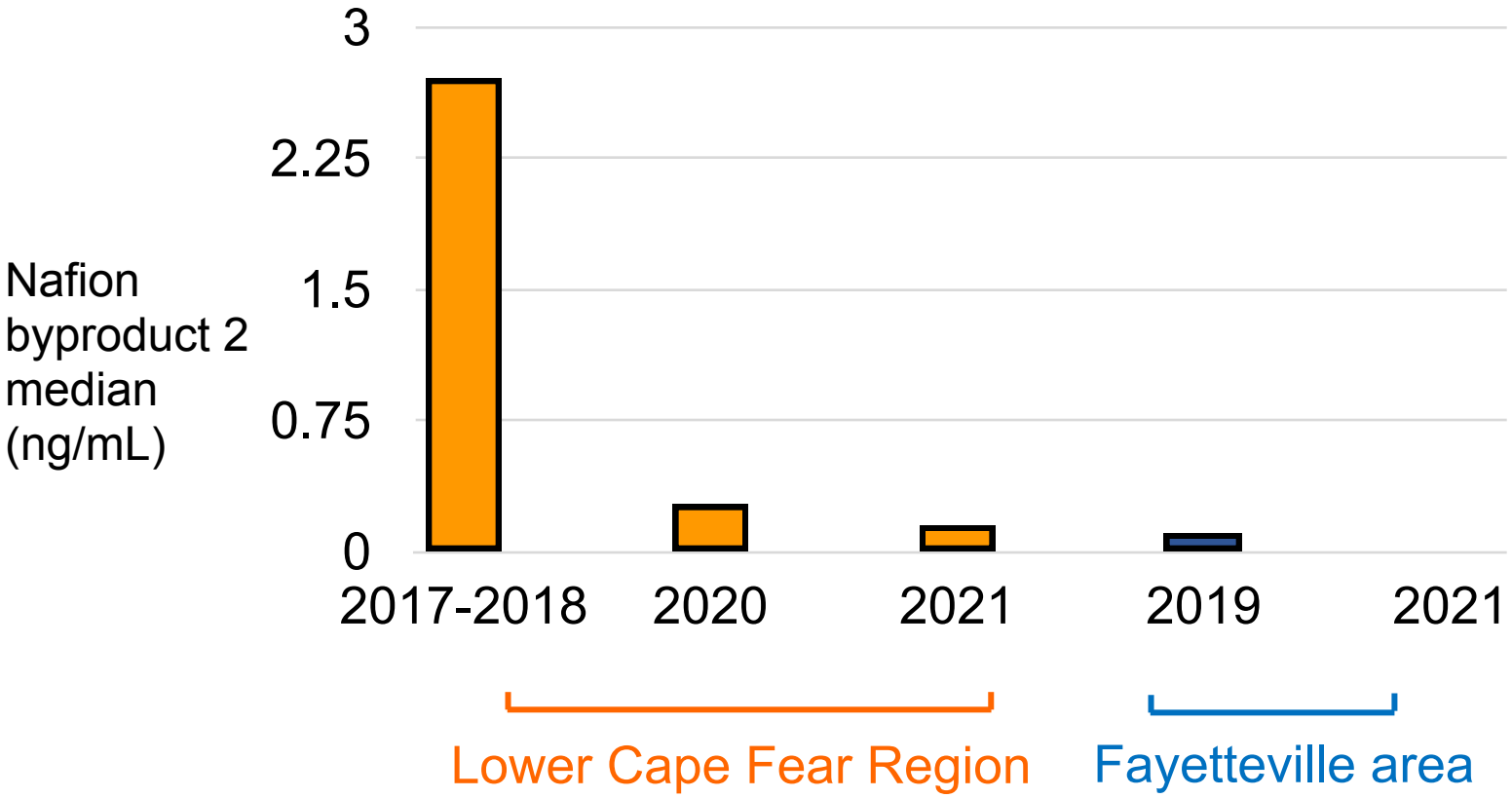

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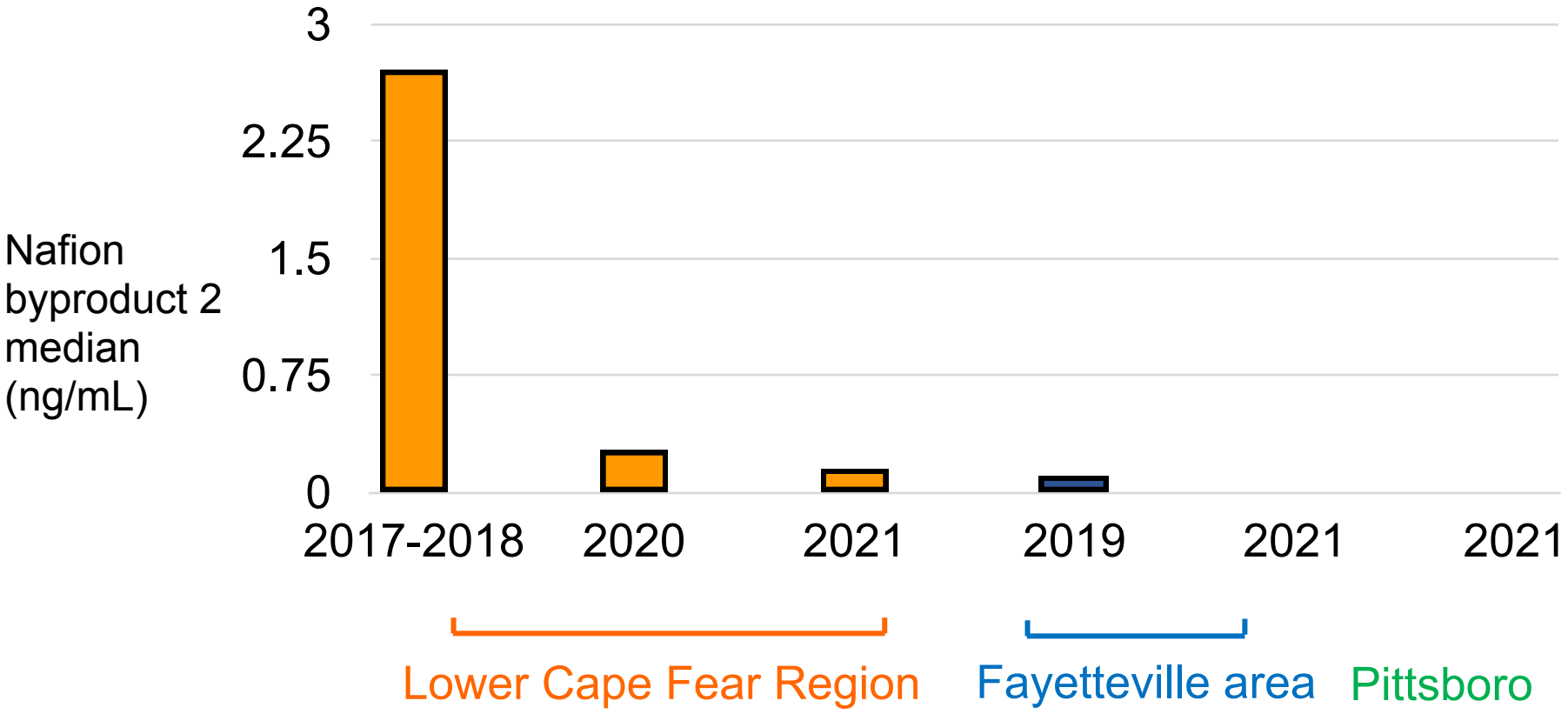
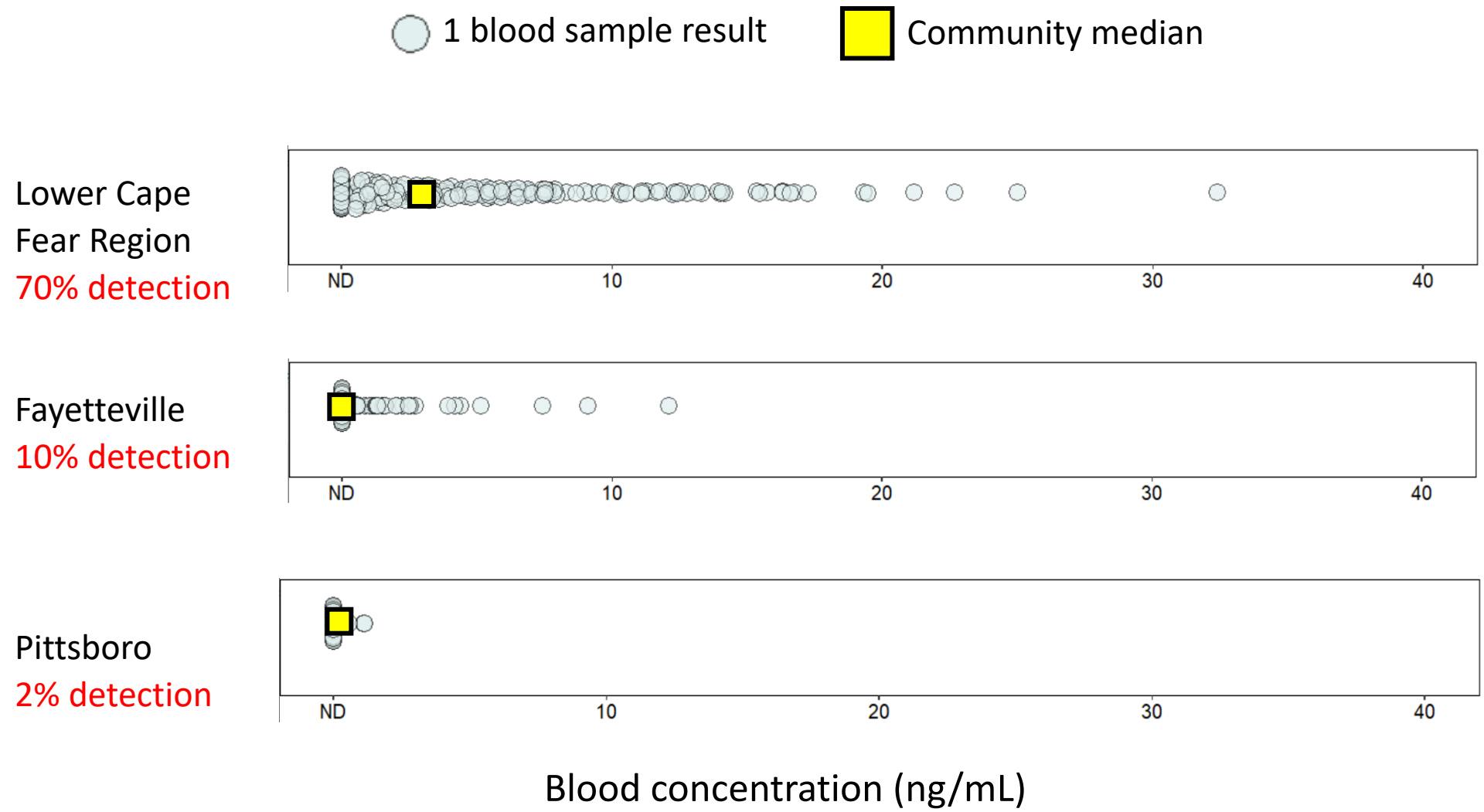
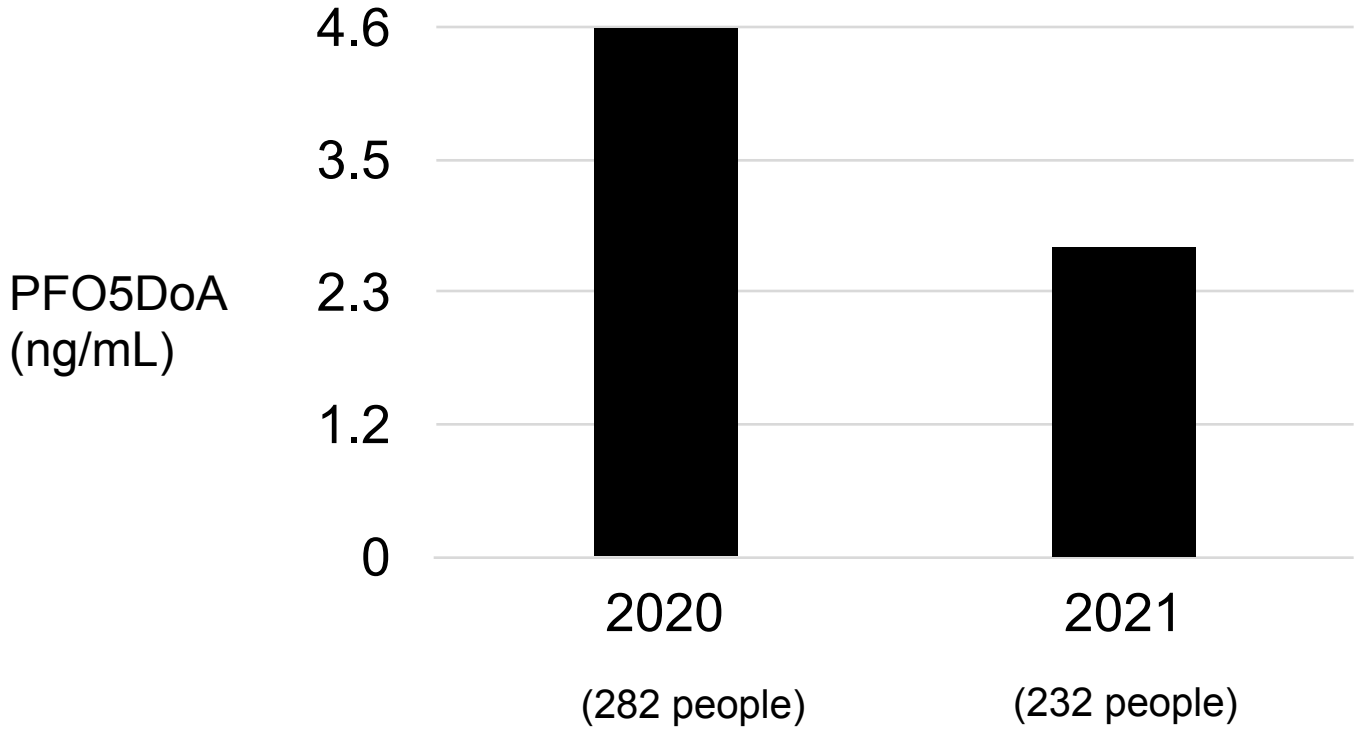


Spread of PFO5DoA by community in 2021



PFO5DoA levels decreasing in Lower Cape Fear Region over time



Which PFAS were not found in blood?

GenX
F53B Minor (11Cl-PF3OUdS)
FBSA
7:3 FTCA
N-AP-FHxSA
N-CMAmP-6:2FOSA (6:2 FTAB)
NaDONA
Nafion byproduct 1
PFODA

Blood PFAS Results from 2020-2021 Key Findings

1. Found 4 PFAS (PFOS, PFOA, PFHxS, and PFNA) in almost everyone
2. Higher levels than the United States national averages
3. Nafion byproduct 2 and PFO5DoA in most people in New Hanover/Brunswick Counties, and some people in Fayetteville area
4. Did not find GenX in any blood samples

What do these results mean?

1. Found 4 PFAS (PFOS, PFOA, PFHxS, and PFNA) in almost everyone
2. Higher levels than the United States national averages

Widespread PFAS exposure throughout Cape Fear River Basin

Higher exposure than average person in United States

Pittsboro had highest blood levels of PFOS, PFOA, PFHxS, PFNA

What do these results mean?

1. Found 4 PFAS (PFOS, PFOA, PFHxS, and PFNA) in almost everyone
2. Higher levels than the United States national averages
3. Nafion byproduct 2 and PFO5DoA in most people in New Hanover/Brunswick Counties, and some people in Fayetteville area

   Residents nearby or downstream of Fayetteville Works exposed to PFAS from the facility

   Blood levels of these PFAS are decreasing over time

Blood PFAS Results from 2020-2021 Key Findings

1. Found 4 PFAS (PFOS, PFOA, PFHxS, and PFNA) in almost everyone
2. Higher levels than the United States national averages
3. Nafion byproduct 2 and PFO5DoA in most people in New Hanover/Brunswick Counties, and some people in Fayetteville area
4. Did not find GenX in any blood samples

   GenX doesn't last a long time in blood

   We will have to estimate people's blood GenX levels to study possible health effects

Steps from blood collection to results reporting

Nov 2020-Nov 2021	1,020 blood samples collected
Nov 2021	Lab developed method/comparison study
Dec 2021	Delivered blood samples to the lab
Jan 2022	Reviewed first batch of data with lab
Feb 2022	Lab proceeded to run rest of 1,020 samples
Aug 2022	Discuss ~70% of results with lab and team
Sept 2022	Sample reruns to confirm results
	Drafted letters
Sept 19	Submitted letters to Institutional Review Board (IRB)
Sept 28	Received last batch of data
Oct 4	Received IRB approval
Oct 6	Provided ~1000 letters to FedEx

How could PFAS impact your health?

NATIONAL ACADEMIES Sciences Engineering Medicine

Guidance on PFAS Exposure, Testing,

and Clinical Follow-Up

July 2022

https://www.nationalacademies.org/our-work/guidance-on-pfas-testing-and-health-outcomes

Focused on Seven PFAS measured in NHANES

1. PFOS
2. PFOA
3. PFHxS
4. PFNA
5. PFDA
6. PFUnDA
7. MeFOSAA

Does not discuss all PFAS (e.g., Nafion byproduct 2, GenX not included)

Health Effects of PFAS: Conclusions

Sufficient evidence of an association

- Decreased antibody response (in adults and children)
- Dyslipidemia (in adults and children)
- Decreased infant and fetal growth
- Increased risk of kidney cancer (in adults)

Limited suggestive evidence of an association

- Increased risk of breast cancer (in adults)
- Increased risk of testicular cancer (in adults)
- Liver enzyme alterations (in adults and children)
- Increased risk of pregnancy-induced hypertension (gestational hypertension and preeclampsia)
- Thyroid disease and dysfunction (in adults)
- Increased risk of ulcerative colitis (in adults)

Summed serum PFAS levels for adverse health effects

Sum = PFOS + PFOA + PFHxS + PFNA + PFDA + PFUnDA + MeFOSAA

≥ 20 ng/mL summed PFAS

Higher risk of adverse effects
Reduce exposure
Also test for thyroid function, kidney and testicular cancer, ulcerative colitis

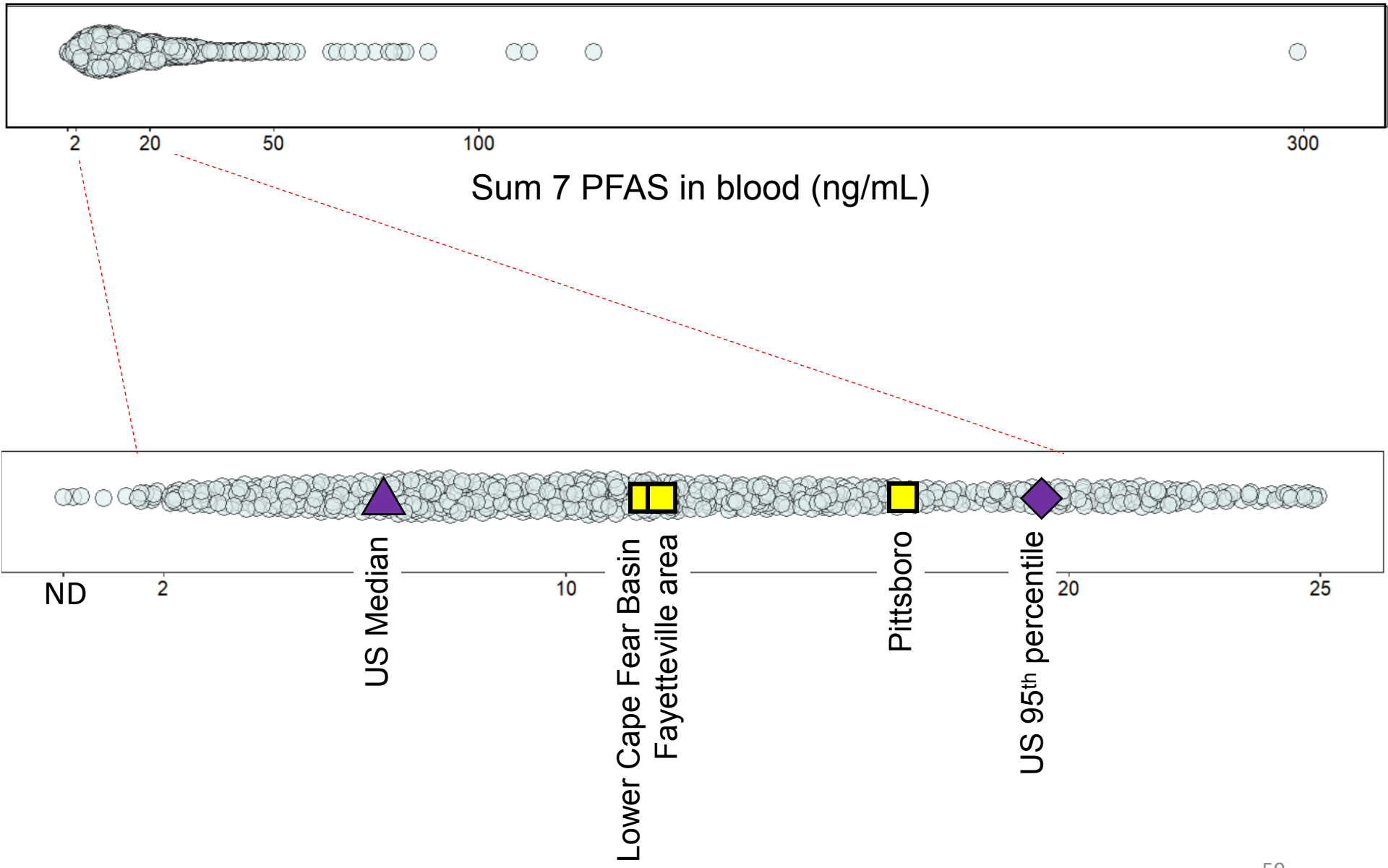
2 - <20 ng/mL summed PFAS

Potential for adverse effects in sensitive populations
Reduce PFAS exposure
Screen for dyslipidemia, hypertensive disorders of pregnancy, and breast cancer

< 2 ng/mL summed PFAS

Adverse health effects not expected.
Recommend usual standard of care.

Sum 7 PFAS in 2021



Summed serum PFAS levels for adverse health effects

≥ 20 ng/mL summed PFAS

Higher risk of adverse effects
Reduce exposure
Also test for thyroid function, kidney and testicular cancer, ulcerative colitis

29% of participants in 2020-21 in this group

2 - <20 ng/mL summed PFAS

Potential for adverse effects in sensitive populations
Reduce PFAS exposure
Screen for dyslipidemia, hypertensive disorders of pregnancy, and breast cancer

68.5% of participants in 2020-21 in this group

< 2 ng/mL summed PFAS

Adverse health effects not expected.
Recommend usual standard of care.

1.5% of participants in this group in 2020-21

How is the GenX Study looking at health effects?

The GenX Exposure Study is Transitioning into a Health Study

STEP 1

UNDERSTAND EXPOSURE

The GenX Exposure Study found new chemicals and high PFAS levels

STEP 2

MEASURE HEALTH OUTCOMES

Clinical measures and questionnaires to identify changes in health

STEP 3

ENROLL ENOUGH PEOPLE TO BE ABLE TO ANSWER STATISTICAL QUESTIONS

Grew from ~500 people for GenX Exposure Study to over 1,000 people

STEP 4

FOLLOW PEOPLE FORWARD OVER TIME

Plan to follow people for up to 20 years; Want to identify changes in health

Participants in the GenX Exposure Study are part of a long-term health study to understand the health effects of PFAS

We want to understand how PFAS exposure influences a wide range of health outcomes

PFAS blood measurement is one part of the process

Statistical analysis focuses on the whole group, not just individuals

Thank you for being a part of the GenX Exposure Study

How do we share information?

- Individual results
  - Participants get their individual results
    - Clinical measures
    - PFAS results
  - Some measurements take longer because PFAS measurement is challenging
- Community meetings
- Newsletters
- Website
  - All presentations are included on our website
- Through our community partners to try and share information in a timely fashion
- Scientific presentations and publications

What will your letter look like?

Pages 1-4 Summary of what we did and what we found

Pages 5-11 Individualized results pages

Your sum of 7 PFAS

NASEM recommendations

Stripcharts for several PFAS in your community

Table of PFAS results

Pages 5 and 6 NASEM guidance

NC STATE UNIVERSITY

Center for Human Health and the Environment

GenX Exposure Study
North Carolina State University
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Raleigh, NC 27695
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https://genxstudy.ncsu.edu/

Clinical Guidance for PFAS Exposed People

In July 2022, the National Academies of Science, Engineering, and Medicine (NASEM) published recommendations for medical monitoring based on the total (sum) concentration of 7 specific PFAS in blood.

The table below shows the levels of 7 PFAS we measured in your sample from [year], and the sum ofthese 7 PFAS in the blood. On the right, current NASEM recommendations based on the sum PFAS are shaded with a **bold box** around them.

PFAS	Your blood result (ng/mL)
PFOS	2.0
PFOA	2.0
PFHxS	3.0
PFNA	0.3
PFDA	0.1
MeFOSAA	0.1
PFUnDA	0.0
Your sum	**7.5**

2022 Guidance on PFAS from the National Academies of Sciences, Engineering, and Medicine

Sum PFAS More Than 20 ng/mL

Associated with higher risk of adverse effects. You should...

- Reduce PFAS exposure (see other side of page)
- Speak with your medical provider and ask them to check cholesterol levels, hypertensive disorders of pregnancy, breast cancer, thyroid function, kidney and testicular cancer, and ulcerative colitis, as per NASEM guidance.

Sum PFAS Between 2 and 20 ng/mL

Associated with potential for adverse effects in sensitive populations. You should...

- Reduce PFAS exposure (see other side of page)
- Speak with your medical provider and ask them to check cholesterol levels, hypertensive disorders of pregnancy, and breast cancer, as per NASEM guidance.

Sum PFAS Less Than 2 ng/mL

Health effects not expected at this time. You should...

- Maintain usual medical care.

What can you do with this information? You can discuss these PFAS blood results and the NASEM recommendations with your clinician to decide whether you would benefit from specific medical tests.

If your clinician has questions about PFAS, they can refer to the NASEM report (bit.ly/PFAS-guidance) or to a memo from the North Carolina Department of Health and Human Services (https://bit.ly/DHHSMemo). If you would like us to email you a copy of the NASEM report, please contact our study office. These recommendations do not mean that insurance will pay for any additional PFAS or clinical testing at this time.

If you are underinsured or noninsured and are seeking primary care services, please contact one of the following resources.
For Lower Cape Fear River Basin Region, NC, contact Cape Fear Health New (Phone: 910-399-2751; Website: http://www.capefearhealthnet.org/getting-care/). Note that Novant outpatient clinics have assistance places for low-income and uninsured people.

For Fayetteville area, NC, contact Stedman-Wade Health Services, Inc., 7118 Main St., Wade, NC, 28395 (Phone: 910-483-6694).

For Pittsboro, NC, contact Siler City Community Health Center, 224 S. Tenth Ave., Siler City, NC, 27344 (Phone: 919-663-1744) OR Moncure Community Health Center, 7228 Moncure-Pittsboro Road, Moncure, NC, 27559 (Phone: 919-542-4991).

What about other PFAS, besides these 7? The 2022 NASEM recommendations are based on the sum of 7 PFAS in blood. These 7 PFAS have been monitored by the Centers for Disease Control and Prevention in Americans for the past 20 years. Health screening recommendations for people exposed to PFAS may change as scientists learn more about the health effects of PFAS.

How can you reduce your PFAS exposure? The PFAS in your blood tells you about the PFAS that you are currently exposed to and what you were exposed to in the past. Many people in the Cape Fear River Basin have been exposed to PFAS through contaminated drinking water. Recently, municipal water suppliers have worked to remove PFAS from drinking water. The Sweeney Water Treatment plant in New Hanover County, the Brunswick County's Northwest Water Treatment Plant, and the Town of Pittsboro have installed treatment technologies to remove PFAS from drinking water sources.

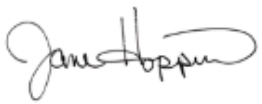
If you use well water, you may want to have your water tested for PFAS and, if PFAS are detected, install filtration at your sink to reduce PFAS exposure. Private well owners in the Fayetteville area may be eligible for water testing and remediation (https://bit.ly/DEQGenX).

To learn what more you can do to reduce PFAS exposure, please visit this website (https://bit.ly/ATSDRPFAS). You can also contact our community partners: Cape Fear River Watch for Lower Cape Fear River Basin (https://capefearriverwatch.org/; phone: 910-762-5606), Sustainable Sandhills for Fayetteville area (https://sustainablesandhills.org/; phone: 910-484-9098), and Haw River Assembly for Pittsboro (https://hawriver.org; phone: (919) 542-5790).

What if you have more questions about the GenX Exposure Study?
Please contact our study office by phone (855-854-2641) or email (genx-exposurestudy@ncsu.edu) and visit our study website (genxstudy.ncsu.edu).

We thank you for your participation in the GenX Exposure Study.

Sincerely,



Jane Hoppin, ScD
GenX Exposure Study, Principal Investigator

In-person meetings

Pittsboro, NC, on Wednesday, Oct 19, 2022 (Tomorrow)
6-8pm
Chatham County Agriculture & Conference Center

Hope Mills, NC, on Wednesday, Nov 2, 2022
6-8pm
Grays Creek Community Center

Fayetteville, NC, on Thursday Nov 10, 2022
6-8pm
Cedar Creek Baptist Church

Wilmington, NC, on Wednesday, Dec 7, 2022
6-8pm
Cape Fear Community College

Second webinar to answer your questions

Wednesday, Nov 9, 2022

6-8pm

Contact our study office

phone (855-854-2641)

email (genx-exposure-study@ncsu.edu)

Acknowledgements

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GenX Exposure Study

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Community partners

New Hanover County Health Department

Chatham County Health Department

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Cape Fear River Watch

Sustainable Sandhills

Haw River Assembly

New Hanover County NAACP

UNCW Latino Alliance

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Thank you

Questions? Please put them in the Q&A