CALIFORNIA ENVIRONMENTAL CONTAMINANT BIOMONITORING PROGRAM

(BIOMONITORING CALIFORNIA)

SCIENTIFIC GUIDANCE PANEL MEETING

CONVENED BY:

OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

STATE OF CALIFORNIA

THE CALIFORNIA ENDOWMENT

LAUREL ROOM

2000 FRANKLIN STREET

OAKLAND, CALIFORNIA

WEDNESDAY, AUGUST 22, 2018

10:00 A.M.

JAMES F. PETERS, CSR
CERTIFIED SHORTHAND REPORTER
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A P P E A R A N C E S

PANEL MEMBERS:

Megan R. Schwarzman, M.D., M.P.H., Chairperson

Carl Cranor, Ph.D., M.S.L.

Oliver Fiehn, Ph.D.

Marion Kavanaugh-Lynch, M.D., M.P.H.

Ulrike Luderer, M.D., Ph.D.

Thomas McKone, Ph.D.

Penelope (Jenny) Quintana, Ph.D., M.P.H.

Veena Singla, Ph.D.

José R. Suárez, M.D., Ph.D., M.P.H.

OFFICE OF ENVIRONMENTAL HEALTH HAZARD ASSESSMENT:

Lauren Zeise, Ph.D., Director

Russ Bartlett, M.P.H., Senior Environmental Scientist

Sara Hoover, M.S., Chief, Safer Alternatives Assessment and Biomonitoring Section, Reproductive and Cancer Hazard Assessment Branch

Martha Sandy, Ph.D., Chief, Reproductive and Cancer Hazard Assessment Section

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH:

Kathleen Attfield, Sc.D, Research Scientist III, Exposure Assessment Section, Environmental Health Investigations Branch

Jennifer Mann, Ph.D., Research Scientist IV, Exposure Assessment Section, Environmental Health Investigations Branch

A P P E A R A N C E S C O N T I N U E D

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH:

Nerissa Wu, Ph.D., Chief, Exposure Assessment Section, Environmental Health Investigations Branch

DEPARTMENT OF TOXIC SUBSTANCES CONTROL:

Sabrina Crispo Smith, Ph.D., Senior Research Scientist, Biomonitoring Section, Environmental Chemistry Laboratory

Miaomiao Wang, Ph.D., Research Scientist III, Environmental Chemistry Laboratory

GUEST SPEAKERS:

Simona Balan, Ph.D., Senior Environmental Scientist, Department of Toxic Substances Control

Antonia Calafat, Ph.D., Chief, Organic Analytical Toxicology Branch, Division of Laboratory Sciences, National Center for Environmental Health, Centers for Disease Control and Prevention

Erika Houtz, Ph.D., Project Environmental Engineer and PFAS Analytical Lead, Arcadis

Darrin Polhemus, Deputy Director, Division of Drinking Water, State Water Resources Control Board

ALSO PRESENT:

Nancy Buermeyer, Breast Cancer Prevention Partners

Janet Nudelman, Breast Cancer Prevention Partners

Ernest Pacheco, Communications Workers of America

Anna Reade, Ph.D., Natural Resources Defense Council

Gina Solomon, M.D., M.P.H., University of California, San Francisco

Andria Ventura, Clean Water Action

I N D E X

I N D E X C O N T I N U E D

P R O C E E D I N G S

MR. BARTLETT: Good morning, everyone. So we'll be starting shortly. So go ahead and if you could find your seat.

(Thereupon an overhead presentation was presented as follows.)

MR. BARTLETT: Good morning again. Thank you all for coming. My name is Russ Bartlett. I'm with the Office of Environmental Health Hazard Assessment.

So today's meeting is also available -- I'll start the...

Okay. So today's meeting is available via webinar. So when you're speaking into the microphone, please introduce yourself before speaking. This is for the benefit of the people participating via the webinar and for the transcriber. So for those of you listening via the webinar, please keep you microphones muted at all times.

The materials for the meeting were provided to SGP Science Guidance Panel members and posted on the Biomonitoring California website. A small number of copies of the meetings materials are available at the table just outside the door, if you didn't see those.

We will break at 12:25 p.m. for lunch and take another short break at about 3:10 p.m.

Just some logistical things for...

So just a quick -- if you mute -- if you're on the phone, please go ahead and mute your phone and please keep it muted for the duration of the webinar presentation.

Thank you.

Thank you.

Is that better?

Excellent.

Just some logistics for restrooms, there are two doors to the restrooms...

MS. HOOVER: Hello. I'm Sara Hoover. I'm Chief of the Safer Alternatives Assessment and Biomonitoring Section. And the logistical issue that we're experiencing right now is that everyone joins the webinar muted. They have the ability to unmute themselves. So anybody on the webinar, you must remain muted. You get one -- one grace, where we re-mute you. And then if you don't stay muted, we're going to have to take you off the webinar. So just please be aware to keep yourself muted at all times. There's no participation via phone, or the webinar in terms of speaking. So if you're listening on the phone or via webinar, you must send your comments to the email address that you were provided and is on the screen right now.

Okay. So I'm not sure where -- you were at the materials, right, and the break?

MR. BARTLETT: (Nods head.)

MS. HOOVER: So we're going to break at 12:25 for lunch. I usually like to give everybody an hour and 15 minutes. But this time, because we have such a packed amazing agenda, one hour. So you have to do a real quick -- quick lunch break and be back by 1:25 for the afternoon session. We'll have another short break at 3:10.

Emergency exit and restrooms, I think you can actually get to the restroom back there too.

MR. BARTLETT: Indeed.

MS. HOOVER: And I'm pointing -- for those on the webinar, I'm gesturing and pointing.

And I think that is it. And now I am pleased to introduce Lauren Zeise who's Director of the Office of Environmental Health Hazard Assessment.

Lauren.

DIRECTOR ZEISE: Thanks, Sara. And good morning, everyone. I'd like to welcome you to this meeting of the Scientific Guidance Panel for the California Environmental Biomonitoring Program, also known as Biomonitoring California.

So thank you all for participating on the web, sharing your time on the panel and in the audience in the

room. We really appreciate your sharing your expertise with us.

I'll just recap a few things from the March 2nd meeting that we held in Davis. The Panel heard about ongoing program activities, including an update on the California Regional Exposures Study. And then in the afternoon, we delved into evaluating community exposures to air pollutants. Yana Garcia of CalEPA kicked off the session. And we heard from Heather Arias of the California Air Resources Board who talked about the Community Air Protection Programs established under Assembly Bill 617. And we also heard from Victor De Jesús of the Centers for Disease Control and Prevention, who described advances in biomonitoring methods for volatile organic compounds.

So we post a summary of the meeting and the input received from our guests, and the Panel, and the public on the Program's website at biomonitoring.ca.gov.

So very excited about today's meeting. We're going to be discussing perfluoroalkyl and polyfluoroalkyl substances, or PFASs, and asking for input on possible next steps for Biomonitoring California and measuring exposures in this very large class of chemicals. So we're going to be engaging our guests and representatives from other programs within CalEPA, the Panel, the audience, and

those on the webinar. So you're going to hear a lot more about this soon from Meg Schwarzman, our Chair -- the Panel's Chair.

So now, I'm just going to briefly turn to some Panel business. And most importantly welcoming our newest member of the Science Guidance Panel, Dr. Veena Singla. Welcome, Veena.

And before I swear Veena in, I just want to formally thank and acknowledge Scott Bartell of UC Irvine. We really appreciate his service, and all the input he offered in his support of the Program.

So please join me in welcoming Veena, who was appointed --

(Applause.)

DIRECTOR ZEISE: Veena was appointed by the Senate Rules Committee to fill the vacancy left by Scott. So she's an Associate Director of Science and Policy for the Program on Reproductive Health and the Environment, PRHE, at UC San Francisco.

Her research intro -- her research includes studying indoor environmental quality and how exposures to multiple chemicals affects heath outcomes, especially in vulnerable populations.

So Veena's work has led to groundbreaking policies to evaluate safer chemicals and promote

substitution of harmful chemicals in consumer products. Prior to joining PRHE, she worked as staff scientist for the Natural Resources Defense Council. Veena holds a Ph.D. in cell biology from UCSF.

So welcome.

And now we will formally swear in Veena.

So, Veena, if you could stand up, please.

And we'll share -- oh, maybe if you want to take your mic here and just turn it on.

Good. Okay.

So right hand. Okay.

I Veena Singla --

PANEL MEMBER SINGLA: I Veena Singla --

DIRECTOR ZEISE: -- do solemnly swear --

PANEL MEMBER SINGLA: -- do solemnly swear --

DIRECTOR ZEISE: -- that I will support and defend the Constitution of the United States --

PANEL MEMBER SINGLA: -- that I will support and defend the Constitution of the United States --

DIRECTOR ZEISE: -- and the Constitution of the State of California --

PANEL MEMBER SINGLA: -- and the Constitution of the State of California --

DIRECTOR ZEISE: -- against all enemies, foreign and domestic --

PANEL MEMBER SINGLA: -- against all enemies, foreign and domestic --

DIRECTOR ZEISE: -- that I will bear the true faith and allegiance to the Constitution of the United States --

PANEL MEMBER SINGLA: -- that I will bear truth faith and allegiance to the Constitution of the United States --

DIRECTOR ZEISE: -- and the Constitution of the State of California --

PANEL MEMBER SINGLA: -- and the Constitution of the State of California --

DIRECTOR ZEISE: -- that I take this obligation freely --

PANEL MEMBER SINGLA: -- that I take this obligation freely --

DIRECTOR ZEISE: -- without any mental reservation or purpose of evasion --

PANEL MEMBER SINGLA: -- without any mental reservation or purpose of evasion --

DIRECTOR ZEISE: -- and that I will well and faithfully --

PANEL MEMBER SINGLA: -- and that I will well and faithfully --

DIRECTOR ZEISE: -- discharge the duties upon

which I am about to enter

PANEL MEMBER SINGLA: -- discharge the duties upon which I am about to enter.

DIRECTOR ZEISE: Welcome to the Panel.

(Applause.)

DIRECTOR ZEISE: So now I'll turn the meeting over to Meg Schwarzman our Chair.

CHAIRPERSON SCHWARZMAN: Thank you. Thank you. And welcome, Veena. We're very pleased to have you on the Panel.

I am sick. And so I want to ask your forgiveness in advance for any mental or physical lapses --

(Laughter.)

CHAIRPERSON SCHWARZMAN: -- during the day.

I'm really glad to be here. This is an interesting meeting that OEHHA has arranged and organized, and I'm glad to be here for it.

My job is to announce the Panel goals for the meeting. As you've heard, we're focused on perfluoroalkyl and polyfluoroalkyl substances, PFASs. And I would direct you to this piece of paper, which is in all of your folders, because we're going to use the term PFASs throughout the day, rather than referring individually to their acronyms. But anyway, this piece of paper is very useful because it tells you full names, and lab analytes,

abbreviations, et cetera. So that's your crib sheet for the day.

In the morning session, we will hear our usual program update and some presentations from Biomonitoring California staff on -- we need someone muted on the website -- webinar.

So we're -- yeah.

MS. HOOVER: So just for those of you on the webinar, you must -- you enter muted. Do not unmute your line. You have to stay muted throughout the whole meeting. If you want to give comments, send an email. So please -- please make sure you keep your mics muted on the phone or your computer. Thank you.

CHAIRPERSON SCHWARZMAN: So after our Program update, staff will -- Biomonitoring California staff will present some updates on results from studies that include PFAS results. And then we'll have time, as we usually do, for questions and discussion from both the Panel and the audience before we break for lunch.

Then our afternoon session goal, and the charge for the Panel at this meeting, is to provide input to the Biomonitoring California Program on sort of priority next steps in measuring PFASs in California.

So we'll hear from some guest speakers and also discussants this afternoon. That will sort of help us

provide context for that conversation. And the discussion is meant to focus a few key sort of general topics. One is key exposure sources to PFASs in California, especially thinking about which groups might be particularly impacted and sort of how to focus resources, best approaches for expanding PFAS biomonitoring in California, and how the Program can focus on sort of highest priority public health issues related to PFASs in the State.

And in the way that the program typically does, they're always looking for ways to kind of partner or collaborate with other State agencies and programs in ways that have typically helped the Program get so much kind of bang for the buck in the past.

So one note about kind of how we're going to manage audience and Panel -- well, audience participation today. We're not going to be using comment cards because of some of the sort of freer flowing discussion times. What we would like is for you to please feel free to engage in the discussion, ask questions, and provide comments. But we want you to do that by coming up to the podium where there's a microphone. And so you can just form a line. And if at some point, it gets unmanageable, we'll take different steps. But please feel free to contribute. That's what we'd like to have happen, but let's do it just via the podium instead of with the

comment cards.

If you're joining via the webinar as -- excuse me -- Russ and Sara already said, you can provide comments via email to biomonitoring@oehha.ca.gov. And as relevant we'll read those comments allowed, paraphrasing them if necessary.

So do please keep your comments brief and focused on the items under discussion. We have, as usual, at the end of the day, an opportunity for open comment, public comment, but otherwise we'll be focused on the topics under discussion at the time.

Okay. So now I would like to introduce Nerissa -- Nerissa Wu, who is Chief of the Exposure Assessment Section in the Environmental Health Investigations Branch, EHIB, at the California Department of Public Health, CDPH. And she is overall lead for Biomonitoring California, and she's going to provide the update on current program activities.

(Thereupon an overhead presentation was presented as follows.)

DR. WU: Okay. Hi, everyone. Good morning. Welcome. It's good to see you, Veena, on the other side of the podium.

(Laughter.)

DR. WU: So we have a really great agenda. It's

very packed as Meg has already said with very extended and timely focus on PFASs.

But I am going to start with an overview of the Program, and a little bit of a progress report on the CARE Study.

Where am I pointing this thing?

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DR. WU: Not at me. Not at myself.

So here we are fiscal year 2018-19. We've been talking about our fiscal picture over some time. Here we are. The purple and green slices there indicate some limited term funding we've had over the past two years. But we have not had the opportunity to extend or add to that funding in this last budget cycle, and so those limited term positions have come to an end, as we've been projecting.

You also see that we are now finishing up the fourth year of our five-year CDC cooperative agreement. And that you see in the last slice there, the '19-'20 fiscal year. We have heard the CDC is planning to release a funding opportunity early in 2019. And, of course, we will intend to apply for that. But these opportunities are competitive, and there's no guarantee that we'll have that funding opportunity again.

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DR. WU: So the challenge for our Program, and our priority really is to stay as focused and as productive as possible -- and I've created this slide just to show what our sample collection activity has been over the life of the Program. And you see, despite the climate of reduced resources, we've been very active. We've ACE I and ACE II, which we've completed. We're in the process of returning results for the Foam Replacement and Environmental Exposure Study. East Bay Diesel is going to be out in the field collecting samples until mid-November. And we've just finished this large sample collection in Los Angeles as part of the CARE Study. And we're now poised to go into the field for CARE II. So lots of activity. And we'll -- we're going to do our best to continue this momentum despite the funding picture I've painted for you.

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DR. WU: So I want to turn to the California Regional Exposure Study. And for those people who haven't been following this closely, this is our statewide surveillance project. And as we've discussed, we've split California into eight regions and we move region to region, one per year, conducting sampling in each region with 300 to 500 people per region as our goal.

And we are biomonitoring both for metals and for

the -- for the perfluoroalkyl and polyfluoroalkyl substances, the PFASs, which will be the focus of today's meeting.

And we also take the opportunity to collect exposure data through surveying whenever we have participants. We do have the potential, in this modular approach, to include additional panels as resources and methods are available to us. And for region one, we were able to add on 1-nitropyrene, the biomarker of diesel exposure and environmental phenols for a subset of our participants. And we hope to be able to do so for region two as well.

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DR. WU: So last time we talked, we were out -- were just getting out in the field. We've been doing community meetings, getting the word out about the CARE Study, setting up a field office, and then getting our recruitment going. You see here just a collage of different activities associated with the CARE Study.

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DR. WU: And just an overview of the process, we have interested people filling out a pre-screening form. It tells us a little bit about them. It tells us that they're interested in the study. And then from that pre-screening pool, we select our study participants. And

then that way we're able to try to match our study population to the overall region population.

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DR. WU: We did notice -- let me go back a second. And last time we reported out, we were just starting to see people come into the study. And we noticed that our study population was starting to skew white and highly educated. And we were not equally successful in the different regions of Los Angeles County. So we started to really focus on our community partnerships to really up that recruitment effort. And we started to work in partnership with some organizations that were able to reach out specifically into those underrepresented areas, and into underrepresented demographics to recruit people into the study.

And then they held -- some of these community organizations held events where participants could come and do the whole process of the study, fill out their consent form, do their survey, and have their samples collected all at one time. And that helped us boost our participation across the board.

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DR. WU: So this is what we see represented here. We had 810 people fill out the pre-screen form. And this is after we've taken out ineligible people, people who

filled it out multiple times, people who put in fake names. Of that 810 interested individuals, we invited 639 people to participate. And I should mention this is on a rolling basis. So we invited in waves, and as people declined to enroll, we would continue to invite people throughout the process.

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DR. WU: Four hundred twenty-five of those invited participants actually enrolled and initiated participation. And about 75 percent of them completed the study steps. So 326 people from that recruitment effort completed the study steps.

From our community events, we had an additional 104 people sign up and complete the study. So we have 430 total participants from CARE L.A. I should note that of these, 428 of these participants asked for their results back. So that's almost everybody. And 408 of the 430 participants, again a very high percentage, consented to donate their samples for additional analyses in addition to metals and PFASs that we noted.

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DR. WU: So how do people find out about the CARE Study? And these numbers are based on the 326 people who we directly recruited, not through the community events. And it turned out that every type of our outreach was

successful to an extent. We had randomly mailed postcards. We had craigslist. We went and did networking events, going to workshops and community meetings. And then we had sort of an indirect recruitment through fliers that are posted at different places, word of mouth, and social media.

And each one of them were successful to an extent, particularly going to workshops and then to community meetings. And there was also a difference in how people made it through the study with postcards and sort of the indirect kind of recruitment being most successful in having people join the study and then make it all the way through. That was a significantly higher percentage than people who signed on through craigslist.

Of course, you have to see this in the context of how much it cost for each type of recruitment. A postcard, designing a postcard, producing it, and mailing it out is much more expensive than something like craigslist or social media, which is essentially free. So that is something we have to think of as a Program, in terms of where our resources are, but also the effectiveness of each of these, because, as I said, each of these -- each of these played an important role in our recruitment, and they reached a slightly different demographic. So we don't want to give up on any one of

these recruitment methods.

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DR. WU: And how representative was the CARE Study eventually?

Well, by race and ethnicity, I think we did a pretty good job of pulling in a representative sample. We did a pretty good job of matching L.A. County's racial breakdown. And not shown here, but we also tried to match the geographic distribution of the county. L.A. is broken down into service provider areas. And we use the population of each of those areas as a goal for our sampling in that area, and we were able to meet that.

The population did skew female. We had about 60 percent women in the study. And we didn't do as well with socioeconomic status as measured by highest education level attained. You can see we have a very highly educated study population. And that's not an issue that's unique to a biomonitoring study, but it is one of the things we are thinking about as we move to region two.

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DR. WU: So lessons learned on how we're trying to approach them. As I said, all forms of outreach were important, and we do want to continue all of them, particularly we're going into a region that's a lot less dense. So maybe things like the postcard will end up

being more important. The targeted outreach, which we saw, was very successful, particularly to diversify our participant pool. We really are working on our community relationships and forming partnerships.

We have heard from participants and also from people who declined to participate that the incentive we offered, $20, was really low. And that to ask people to take time off from work and maybe travel to sample collection, $20 isn't really adequate, so we are increasing that to $50 for this next phase. And we hope that helps us with our recruitment overall, but also for diversification of our population.

Just looking at how our participants flow through the system. We found that we lost some at two key points. One was at enrollment, some when we invited people to participate. Some people just didn't respond. They lost interest.

Once somebody enrolled, they generally went through the study doing the consent, and the survey, and even making an appointment. But then we tended to lose people at sample collection. Again, that's the hardest to get people to do. It's the least convenient. So again, we're working on the logistics to make these things more convenient, easy to fulfill, and the incentive I think will help with boosting participation at those spots.

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DR. WU: So now we move on to region two. And in some ways, it's kind of hard to apply the lessons from L.A. to this new region, because it's a really different region. And I'm starting to think of this as a pilot of our less urban regions, so -- and I'm hoping that not every region is its own little pilot.

But region two is Imperial, Inyo, Mono, San Bernardino, and Riverside. So as you see, it's a huge geographic area. The population is really concentrated as you can see from those pink dots. Very concentrated on the west side. It's easier to get around. Los Angeles is very difficult logistically, because it's so congested and hard to plan getting to different sites.

But there are many logistics involved here. How do we get to all these areas, and maintain our sample integrity, keep the samples cold, before we can get them to a centralized location to ship up to our labs.

There are fewer -- we have fewer community connections in this region, just our history of our work. There may actually be fewer community groups just because of the sparse population. So we're really working hard to be creative and think beyond our traditional partnerships to get to know the community.

It's also a difficult region. We're trying to --

this is a statewide study, but we also want to represent the region and we want to be representative of the counties. So we have to think about how do we create our sampling goals to be both representative, but also have enough samples in different populations, so that we can do some statistical analyses.

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DR. WU: So we have broken region two into these sampling zones, so that we can think about the logistics and recruitment and our sampling goals. We have zone A and B, which is the urban part of Riverside, and San Bernardino Counties. And we have zone C, which represents the suburban and rural areas of Riverside and San Bernardino. And zone D is Imperial County, and zone E is Inyo and Mono Counties.

And we've sent our initial sampling goals based roughly on the population of those zones, but we are going to oversample in some of the zones just so we can have representation. And we will oversample again in some race and ethnicity groups.

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DR. WU: And here's a timeline for finishing up region one and also preparing for region two. We are currently engaged in early notification of participants for region one. We have participants -- as results roll

in from the lab, we have people who have elevated levels of mercury, arsenic, lead, or cadmium. And calls are going out as soon as possible to those participants to let them know those results.

We're planning for a results return effort, and that's for all of the panels that I've mentioned, PFAS, metals, environmental phenols, and 1-nitropyrene. And we have that scheduled for December 2018. So just in a few months.

At the same time concurrently, we're in region two building up our community partnerships, starting to recruit. And then early 2019, we're out in region two starting our field work, and also finishing up in region one doing some report back to the communities.

So there's a lot of overlapping work, a lot of overlapping tasks. It is also a lot of overlapping staff. It is the same people doing all of these things, so we are very busy.

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DR. WU: And here we are back at the CARE map. Every step of the CARE project has potential challenges for us. We are creating materials, designing them and adapting them for each region. The logistic challenges of running a study remote from our office has presented quite a challenge. But while each region is unique and requires

adaptation, I do think that as we go through region by region, there are lots of lessons learned, and it will become easier as we go.

And I also hope that as the data starts coming in, the data is going to be very interesting, and I hope it starts to generate interest across the state, and boost our participation.

And then again after we cycle through the eight regions 2026 - this is a cyclical study - we will be back in L.A. County.

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DR. WU: So just in closing, I just want to give a shout-out to our staff. We're only able to accomplish this through their incredibly hard work and dedication.

And before I turn this over to Sara, I just want to say Amy Dunn is not longer on the slide. I'm going to throw it over to Sara to talk some more about that. But I want to actually express my personal thanks and appreciation for all the work she has done.

CHAIRPERSON SCHWARZMAN: We'll have a moment for questions in just a sec.

MS. HOOVER: Yeah. So obviously -- normally, we have a quick goodbye, but Amy has been with the Program since it started. Actually, before my section even started in 2008, Amy was with the Program. So she's been

there right from the beginning. So we want to give her a special thank you for everything she's done. And she recently transferred out of my section into a new role at OEHHA. She is acting as the scientific lead on a major department-wide effort to help plan for our future, including addressing our very difficult challenges in recruitment and retention of our new generation of scientists.

Some of her major accomplishments, while she was with the Program included drafting Biomonitoring California's Public Involvement Plan, and paying -- playing a pivotal role in working on the development of and improvements to the Biomonitoring California's website.

And we're lucky enough that during her transition, she's still been helping us with the website. So we're taking that over. And we just want to give a big thank you to Amy. She's listening, so let's give her a hand.

(Applause.)

(Cheers.)

MS. HOOVER: Thank you.

CHAIRPERSON SCHWARZMAN: Yeah. So thanks so much. We now have 10 minutes or so. And we'll start with questions for Nerissa from the Panel about the Program

update.

Yeah, Jenny.

PANEL MEMBER QUINTANA: Hi. I had some questions about recruitment. You gave some numbers about the percent recruitment by different methods.

DR. WU: Yes.

PANEL MEMBER QUINTANA: And I'm just wondering if you looked at education level by the type of recruitment method, because, as you said, it's a little of a concern that our population doesn't quite seem to mirror the population of L.A. in that particular area.

DR. WU: Right.

PANEL MEMBER QUINTANA: So did you see whether postcards, I would guess, would be more likely to be higher educated people?

DR. WU: Yeah. I think craigslist was the most successful in that -- in the lower education population. But they had -- do you want to -- and word of mouth. Why don't you come up here. Jennifer actually has run the statistics on all the recruitment methods. So I'm going to have her come up here and respond to this.

This is Jennifer Mann who is on my staff and who is going to be speaking in the next ten minutes about another project she is doing. But she has also been doing a lot of the evaluation work on the CARE Study. So why

don't you address this.

DR. MANN: Yeah, just to answer that question. It was word of mouth, and also the targeted outreach where we went to specific community organizations. Both of those worked in recruiting less educated people.

PANEL MEMBER QUINTANA: So another question --

DR. MANN: A lot of people were referred to the study by friends, family members, things like that that were less educated. That seemed to -- those seemed to be the two avenues by which people came to us who had lower education levels.

PANEL MEMBER QUINTANA: So it's great that it's effective to have word of mouth. But it also makes me wonder if you have so few samples to represent L.A., if you're getting people that live near each other, or they're friends with each other, are you getting representative samples? So I'm just kind of curious how many community events led to those community event recruited participants? Was it one event, ten events, 100 events? Like how many different events were held?

DR. WU: We had five different events. And again, it was two months into our recruitment, so it wasn't throughout the whole recruitment period that we held those events. And I think to us it illustrated the importance of being more -- having our -- having our

participation with our community partners be a little more robust. I mean at that point -- to that point, we had done a lot of networking through them. But I think after that point in April, we started -- we were more fully engaged with them asking them to do more active recruitment.

Just as an aside, I think something else we talked about at our last meeting was the messaging on our postcard, how it might not -- how the phrasing we use might not be -- might not translate into something meaningful to -- across the board. And so we have done a lot of work on the postcard. We ran some focus groups both in English and Spanish, and collected a lot of good feedback about the kinds of information we should include.

And so our recruitment information, both the mailed postcard, but also the flier that will be going out through community groups looked quite different this time around.

PANEL MEMBER QUINTANA: Okay. And I guess I have one suggestion, which is I think the community outreach and the community groups and being there, so they could do it all at once instead of having to take a bus and go get a sample is really a great idea. And you said you're trying to tap into existing efforts. And I was thinking about the AB 617 and the community air monitoring groups

that are kind of very active and maybe they could have a formal kind of connections and partnerships with those air monitoring groups, because -- and maybe talk about how some of this monitoring could pick up air pollution, such as the 1-nitropyrene might be one avenue.

And again, my comments are only -- I know you have limited resources, so they're just asking for information rather than any criticism.

DR. WU: We've also recently heard about CDPH's efforts in developing school site health centers. And that's another avenue we're looking into, because I think those are -- those are already developed community centers. So that's something we're -- we're -- we haven't accessed before.

PANEL MEMBER QUINTANA: I'm sorry, I had one more question. Just -- I think it's probably for your colleague. It's -- I didn't see the age breakdown of your participants.

DR. WU: Do you remember offhand?

I think the median age was 44, but I can't remember offhand.

DR. MANN: Yeah, that sounds right. She thought the median age was 44. That sounds right to me. It varied by the way that people came into the study. So people who answered to the postcard tended to be older.

People who did -- found out about it through craigslist tended to be younger. So there were patterns like that all the way through.

PANEL MEMBER QUINTANA: So it is a little more difficult if you have a very wide age range, especially with metals that tend to peak at certain ages. You know, so we had talked a long time ago about trying to recruit a tiny narrow age range and decided to go with adults, I think, at some point.

But I was just kind of curious. Keep an eye on that issue and how much we might revisit that.

DR. WU: Yeah. One of the challenges with designing this is that there's so many slices of the population we would like to take a closer look at. We would love to have a bigger sample. And I was looking back at the transcript from our last meeting where Meg said, well, what's your wish list? What can't you do?

And there are so many ways we could -- I mean, we could have done a much bigger study, and taking these little microcosms of the population. And we would love to do that if we ever had the budget to. But put that on our wish list.

CHAIRPERSON SCHWARZMAN: Other questions from the panel for Nerissa?

Yeah, José.

PANEL MEMBER SUÁREZ: Well, firstly congratulations on the progress you've done in L.A. Just to follow up on the questions here, could you just remind us how many postcards you sent out, and how you selected which households were going to receive them?

DR. WU: Okay. We sent out 65,000 postcards. They were selected based on mail codes. We divided the mail codes up by service provider area, and then segmented by quart -- income quartile and then randomly selected from each income quartile, so weighting towards the lower income quartile. So that was fairly evenly distributed among quartiles and by geographic area across L.A. with a slight weighting towards the lower two quartiles.

PANEL MEMBER SUÁREZ: Oh, I see. Okay. So the selection was -- so I'm looking here at the proportions across the different -- different sources. So 22 percent were from postcard. That would be from that 810, right? So we're talking about something like 380 households that were invited through the postcard. It would be CARE L.A. participation slide.

DR. WU: Yeah, can you move back to -- it's not working.

Well, that wasn't what I wanted to do.

I guess you can continue talking.

PANEL MEMBER SUÁREZ: Well, in any case, we

can -- we can talk about it, but -- so as long as I don't have you distracted. I don't know who's -- but in any case, so you sent out 63,000, and then you came down to 330 from that 63,000, right?

DR. WU: I'm sorry, let me -- I'm sorry. I am distracted.

PANEL MEMBER SUÁREZ: Yeah, the previous one. There we go. Right. So that 22 percent there in the postcard, that's 22 percent of the 810, I suppose, right?

DR. WU: Yes. Oh, actually, I'm sorry. It's 22 percent of the people who came in through pre-screen. So, yes, it is the 810 that finished.

PANEL MEMBER SUÁREZ: Okay. So that that would be from the 810, 22 percent of the 810?

DR. WU: No, I think it's of -- it's of -- no, sorry, this is of the pre-screen population.

PANEL MEMBER SUÁREZ: Right.

DR. WU: The first column is the pre-screen, so it is the 810.

PANEL MEMBER SUÁREZ: Okay.

DR. WU: Yes. And it comes up to a rate of about 0.3 percent. It's an incredibly ineffective rate when you look at it that way. Granted. We acknowledge that. And that was one of the -- that's one of the things we were trying to test in this population, like is it worth doing

a postcard? It's expensive. We all know we get a million postcards and throw them right out in the mail. We've done a lot of focus grouping on this. At the same time though, we're not really willing to throw it out yet, because we were able to get a certain segment of the population. And again, looking at region two where you have these, you know, very dense populations with lots of community groups, there are all these remote areas that we think the postcard actually might be more -- more effective, but we'll see.

PANEL MEMBER SUÁREZ: So I think you mentioned that you -- from the 63,000 that you sent out, what was the fraction that you actually got responses from?

DR. WU: It was 0.3 percent.

PANEL MEMBER SUÁREZ: Oh, 0.3. And then from there, did I hear that you randomly selected?

DR. WU: So as people came in through the pre-screening, and this is from all the different sources, there was -- there's a process -- and Kathleen could actually speak to this more effectively. There's a process by which we were selecting people into the study based on which bins were -- which racial and geographic bins were already filled.

And then as people either elected to participate or not, we would refill those bins from the pre-screening.

It was a rolling process. So if we found that, for example, white women, those bins filled up pretty quickly, so later on in the pre-screening process, we were no longer -- we were no longer pulling those from our pre-screening pool in certain areas of L.A.

PANEL MEMBER SUÁREZ: Got it. So it looks like by far this is the most expensive of all the different recruitment efforts, right?

DR. WU: It was the most expensive. Although networking events, if we have staff going down to Los Angeles, and there's a lot of travel involved, a lot of staff time, that is also quite expensive. So having effective partnerships, where we can have other people doing that networking for us would help.

Yeah, I mean, again this is balanced between our hands-on approach and our effective recruitment in specific areas versus giving up on some types of recruitment, and maybe giving up on those sectors of the population. So it's -- there are going to be trade-offs that we have to make.

And Kathleen points out, so the postcard is the only random recruitment effort, because everything else is targeted to particular communities.

CHAIRPERSON SCHWARZMAN: Other Panel questions?

Yeah, Carl.

PANEL MEMBER CRANOR: Just a quick -- just a quick question about your -- under region one, were you looking for metals or did metals show up? And if metals showed up, why -- what's your explanation for that? This is on the last page -- next to last page under task.

DR. WU: So elevated early notification is -- I guess, I'm not sure what your question is. But walking through the process, as we get results back from the lab, we -- part of our protocol is that we will let people know -- before the results return packets are available, we will call people, just because there might be some clinical significance to elevated levels of -- at least for metals I mentioned. So that is -- that's just always been our protocol.

We weren't -- I mean, we have certain expectations of what percentage of people have elevated metals just from our previous experience with the population, but we weren't targeting certain areas where we expected to see elevated levels.

PANEL MEMBER CRANOR: I guess I'm a little surprised that metals showed up. Do you have any explanation why they rose to the top as it were in your biomonitoring, as opposed to other possibilities?

Pardon. Oh, okay. Thank you. That was the question, were they targeted or did they show up

afterwards?

DR. WU: Well, we -- we chose to measure metals. I think we -- we talked about this also in our last panel, metals being sort of a universal health concern, and also something which is elevated in certain populations across California.

CHAIRPERSON SCHWARZMAN: We have just a couple minutes, if there's audience questions for Nerissa about the Program update?

MS. HOOVER: And I'll just clarify a couple things about the process. A little different than normal. So here's Nancy.

(Laughter.)

MS. HOOVER: So that's not different than normal --

(Laughter.)

MS. HOOVER: -- which is great. Welcome. Welcome.

(Laughter.)

MS. HOOVER: So I think the way we can do it -- so we're monitoring email. There's no public comment via email. If when you realize you're in a -- we're in a session with the ability to have public comment or questions, you should come up and stand here, and then that's a signal for Meg, because we don't have a lot of

spare time. So that will be like -- then you can just look over. If there's a line, you can call on them.

So I'll turn that over to Nancy.

MS. BUERMEYER: Thank you very much. Nancy Buermeyer with the Breast Cancer Prevention Partners. I just want to echo what a great job you guys have done and how exciting this statewide rolling effort is.

I have a question and an offer. We have also been doing outreach around communities around the state for a project we're working on. So to the extent we can help you with outreach to communities, we'd be delighted to partner with you on that.

And my question, and this may be obvious to the Panel, so I apologize if it is. But as you go through the different regions, are you going to look for different analytes or are you going to use the same set of analytes that you looked at. So like are you going to look at pesticides in the Central Valley for instance?

Thanks.

DR. WU: Thanks, Nancy. And we will take any offers of assistance from anyone. And if you have partnerships in region two, we'd be really happy to hear about them. Get to that.

MS. BUERMEYER: That's a stretch, but we'll try.

DR. WU: We will be looking at the PFAS and

metals panels across the state. As I said, we do have the ability to pop in different analytes. I mean, we are collecting -- when we take all the samples, we aliquot them and freeze them. And I alluded to the donation of samples for additional analyses. Most participants are really willing and very interested in seeing what else we can see in their samples.

We did some EJ listening sessions last year to ask what were the priorities in different regions, air quality, air pollutants rose to the top. So we hope we can add those on in a number of regions. Pesticides of course in agricultural regions. We're a little bit -- we're subject to the availability of the method and funding. But we would like to make some of this configurable to what is of interest and importance to the region.

CHAIRPERSON SCHWARZMAN: Thank you.

Ulrike.

PANEL MEMBER LUDERER: I just have a quick question related to what you were just talking about. And first of all, I did want to congratulate you also on the amazing creativity and effort that went into getting this statewide sample started.

The question that I have is have you gotten any feedback from the participants about other analytes that

they would be interested in knowing -- you know, having measured?

DR. WU: I think actually people -- there are people in the audience who had a lot more interaction with participants than I did. I think one of the things we did hear a lot, we had a lot of people who were concerned with fracking in L.A., who participated because they had learned about environmental pollutants through fracking. So some of the VOC methods that we talked about last time is interesting to us to add on. I can't think -- diesel, traffic, air quality, those are the things that have risen to the top and have been mentioned to us. A lot of people mentioned the traffic in L.A. and their exposure to air pollutants.

CHAIRPERSON SCHWARZMAN: We have just a minute left. Is that another question?

MR. PACHECO: Yeah, I have a question.

Ernie Pacheco, Communications Workers of America. Hi, Nerissa.

I was going to ask you this question at break, but I guess I'll ask now. So I'm continuing to work to try to get some of our people to participate. I haven't had much luck, but we're actual -- I'm actually seeing interest now, because we have a lot of people that are exposed to smoke and toxics from the wildfires around the

state. And I'm wondering whether or not that actually would screen them out, if you know that they have high...

DR. WU: Hi. That's a good question. Thank you so much. Ernie has been really helpful in region one, and we hope will be again in region two.

We do ask a question about wildfires. This was prompted by the fires in L.A. last year. But this is becoming a perennial occurrence, and we need to ask about it. We don't rule people out. And actually, we're very interested to hear if people have had -- whether it's been sort of just not inadvertent exposure to the study -- to smoke, or if they've been occupationally exposed to smoke, or if they've had to evacuate. So we do have a question which tries to get at how exposed were they to the wildfires. And through our own like just tracking of the news, we'll be able to figure out which fires they're talking about.

But that is something of interest to us. Separate from the CARE Study, we're actually really interested in looking at wildfire exposures particularly to firefighters, particularly with these wildland urban interface fires. And so at maybe a subsequent meeting we'll talk a little bit more about a little work that we're doing with firefighters.

CHAIRPERSON SCHWARZMAN: Thank you so much,

Nerissa for that update. And also on that issue, I would just add one thing because it was a topic at our last meeting. And I appreciate your raising it, Ernie, because I think the Program is looking for ways to do sort of a more rapid response ability to test in the case of fires. And the idea of just being able to incorporate that into some of the existing studies is interesting.

So we're going to transition to another set of talks. Presenting some of Biomonitoring California's results on PFASs from other studies. So Jennifer Mann and Kathleen Attfield are both Research Scientists in Nerissa's group at CDPH.

Jennifer came to CDPH this year, leaving my division at UC Berkeley after 15 years as an epidemiologist at the UC Berkeley School of Public Health. She holds a Ph.D. in epidemiology from the UC Berkeley.

Kathleen was stationed at CDPH as an Epidemiologic Intelligence Service Officer for the CDC, Centers for Disease Control and Prevention, in 2014. And then she joined State service in 2016. She holds a Doctorate of Science from the Harvard School of Public Health. So Jennifer is going to provide a brief overview of selected PFAS results from different Biomonitoring California studies. And then Kathleen will discuss her analysis of findings from the ACE Project that we've just

been talking about -- I'm sorry, from the ACE Project.

(Thereupon an overhead presentation was presented as follows.)

DR. MANN: So today I'm going to give a brief overview of per and polyfluoroalkyl substance, also called PFASs. I'm going to discuss the biomonitoring studies where PFASs have been measured in California. And finally, I'll propose ways we could track changes in PFASs over time with upcoming Biomonitoring California projects.

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DR. MANN: Here I show the definitions of perfluoroalkyl and polyfluoroalkyl substances. And I have examples of structures for each. So perfluoroalkyl substances are also known as perfluorinated chemicals, or PFCs. The acronyms will abound in this talk and other talks today.

Perfluoroalkyl substances are ones where all of the hydrogen atoms that attach to carbon atoms have been replaced by fluorine atoms. And all 12 of the PFASs on the original lab panel are PFCs. The expanded lab panel includes some of the newer polyfluorinated chemicals. And those are ones where the hydrogen atoms on at least one of the carbon atoms have been replaced by fluorine. And the entire class is on the designated and priority chemical list for Biomonitoring California.

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DR. MANN: So how are these used?

Well, manufacturing of some longer chain PFASs has been phased out in the U.S., but thousands of PFASs are still produced and used worldwide. And major uses include treatments and sprays to make a wide variety of materials resistant to stains, water, and grease, manufacturing and industrial applications, and firefighting foams.

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DR. MANN: I'm not going to give you a detailed background on the class, but here's a brief summary of our concerns. These chemicals are highly persistent in the environment, because the carbon fluorine bond is one of the strongest in nature, and some PFASs bioaccumulate. For example, the half-life of PFOS in people is about five years.

Furthermore, some PFCs are detected in a high percentage of biomonitoring samples. Our knowledge of health effects comes from studies of just a few PFASs, all PFCs. But so far, health concerns include effects on the developing fetus and child, potential damage to the liver, affects on the immune system, and increased risk of health -- of both thyroid disease and cancer. We still know very little about the toxicity of most PFASs,

including the polyfluorinated chemicals.

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DR. MANN: So this is a list of Biomonitoring California studies in which PFASs were or will be measured. So the 12 PFASs on the first panel are all PFCs. But the expanded panel includes additional PFCs and several polyfluorinated chemicals. And your handout actually designates which PFASs are on the original panel, and you can see the ones that are on the expanded panel.

So we measured the expanded panel of PFAS in -- sorry PFASs in MAMAS round two.

Let's see, how do I do this?

So MAMAS has three rounds. We've only completed the first round. So beginning with MAMAS round two, we look at that. And then also we use the expanded panel in both ACE studies, which Kathleen will talk a little bit -- will talk about right after me.

And then for CARE L.A., we actually looked at the original panel of those 12 PFASs. But in later studies, we may use -- we may use the expanded panels.

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DR. MANN: So these are studies that have been -- where data collection has been completed that had PFASs as part of them. And the first five studies, so going down the line from FOX all the way through to the Expanded BEST

study, we have data posted on the website so you can see it for PFASs.

ACE I and ACE II are also completed, but the data have not yet been posted, and we'll be hearing more about those two studies as I said earlier from Kathleen shortly.

The PFAS -- PFAS data for the second round of MAMAS has been collected. And laboratory work on PFASs is expected to be completed by late October, early November. And the results will be returned to participants in early December.

Care L.A. we are still analyzing the PFAS data.

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DR. MANN: I mentioned earlier that some PFASs, such as PFOS an PFOA, have been phased out. Despite that, these are two of six PFASs that have high detection frequencies in Biomonitoring California studies. Comparing detection frequencies is a bit tricky because the level of detection can vary occasionally by an order of magnitude in the seven studies with finalized PFAS data.

And the fluctuation and levels of detection sometimes means that one study has a much lower or higher detection frequency than the others. And for that reason, I calculated the average detection frequency for each PFAS in the original panel across the seven studies.

So all six of the PFASs that you see on this slide have average detection frequencies greater than 90 percent. And the first five on this list have detection frequencies of 95 percent or greater in at least six of seven studies.

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DR. MANN: And I just want to make a note that all but two of these PFASs are measured in drinking water as part of the third unregulated contaminant rule, MeFOSAA PFUA are not.

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DR. MANN: So we calculated geometric mean -- we can calculate a geometric mean when we have a detection frequency of at least 65 percent. For these PFASs, the detection frequency is low enough that we couldn't calculate a geometric mean in all or almost all studies.

Just a couple of notes, PFBS, which replaced PFOA in Scotchgard, has had very low detection frequencies in NHANES since it began being measured in 1999. Detection frequencies for PFOSA have fallen over time with each subsequent study having a lower detection frequency. And as of 2013, NHANES is no longer measuring it.

And the polyfluorinated compound measured in ACE I and ACE II as part of the expanded panel all had very low detection frequencies or were not detected.

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DR. MANN: So I'm going to shift a little bit here and talk about time trends in PFASs. So given the phase-out I mentioned earlier and the fact that replacement PFASs appear to be less bioaccumulative -- sorry -- tracking time trends in exposures are really important. So this study actually did that.

This -- our participants from the California Teachers Study in this slide is just showing what happens when we plot the concentrations observed in each participant by date of study. And they used that approach to look at the rate of decline between 2011 and 2015. And I should note that this was a lab collaboration with Biomonitoring California. And over the 10 to 12 year period, in the 10 -- sorry.

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DR. MANN: So this is another slide where we had a happy accident. We found -- there is a publication that just came out in 2018, which actually looked at perfluorinated chemicals from banked genetic screening samples that were collected in 2000 to 2003. So we can compare those with what we see in MAMAS.

So the green dot is the banked genetic screening samples. The red dots are the samples from MAMAS. And you can see that there's been pretty big declines -- sorry

about that.

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DR. MANN: There's been pretty big declines in four of the different five. And that's not surprising, given the timing of these data. But when we look at PFNA, there's no decline at all over this very long time period.

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DR. MANN: So where do we go from here?

MAMAS is a very useful way of analyzing temporal trends and exposure to PFASs in pregnant women. The PFAS data from the second round of MAMAS, 2015, are being finalized right now. And we plan to measure PFASs in MAMAS III, which includes banked samples from 2016. We have to remember that there's no questionnaire data, and that each round of data is from a different part of the state.

Furthermore, the handling of samples might not be ideal for PFASs. However, there are a lot of advantages of using this pop -- of using this population understanding what's happening in pregnant women. And we have the added advantage of being able to use untargeted screening of PFASs to understand what PFASs seems to be emerging in people.

And the CARE Study is also another opportunity for us to look at PFASs over time. As we mentioned

earlier, we just completed the first of eight regions, or hopefully we'll continue doing that study over time. And questionnaire data are available for that study.

So it promises to be a very good resource for understanding temporal trends. And now, I'm going to hand it off to Kathleen.

(Thereupon an overhead presentation was presented as follows.)

DR. ATTFIELD: All right. Good morning. And thank you, Jennifer, for introducing us to the Program's investigations into PFAS levels in California.

So today, I'm going to talk about serum PFAS levels and their predictors seen in our recent studies in the San Francisco Bay Area Asian and Pacific Islander communities.

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DR. ATTFIELD: So the Biomonitoring Program initiated the Asian/Pacific Islander Community Exposures Study, which we will call ACE from now on, in 2016 in response to seeing elevated levels of arsenic and mercury in these subgroups in our EBEST Study.

Because of the Program's desire and mandate to perform community investigations, the Program decided to build off of existing educational programs on safer fish consumption with Asian populations we were working with in

San Francisco, so that we could learn more about the patterns of metal and PFAS exposures. So PFAS were also seen to be elevated in the subgroups in EBEST.

So this became the ACE Study. And the project aims to address the data gaps related to specific subpopulations, and be able to address their specific exposure scenarios to learn more about those.

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DR. ATTFIELD: So we have two phases of ACE. ACE I was conducted in collaboration with APA Family Support Services and recruited Chinese-American participants, primarily in San Francisco. Samples were collected in 2016. Then in ACE II, we had -- we worked with the Vietnamese Voluntary Foundation recruiting Vietnamese-Americans mostly in the San Jose area. And these samples were collected last year in 2017.

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DR. ATTFIELD: So today what I'm going to walk us through is looking at the various distributions of the PFAS levels that are seen in these two groups and demographic characteristics that have -- seem to be associated with five of the most frequently detected compounds from our panel. And as Jennifer told us, the expanded panel was done on this study. And I have detection frequency slides for you, which is probably more

appropriate for the afternoon discussion, but they are in reserve should anybody be interested in bringing those up later on.

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DR. ATTFIELD: So ACE I and ACE II both recruited 100 participants. A few of the participants were unable to provide a blood sample, so we have 96 from ACE I and 99 from ACE II. The mean ages were pretty similar in the mid-40s for both. And they were just under about 50 percent male in both studies.

Our household income was a little different -- a little higher in ACE I than in ACE II. But the median levels are still much lower than what is typical for our region's median near San Francisco Bay Area.

Most of our participants were born outside of the United States with a mean of 51 percent of their life being spent in the U.S. in ACE I, and 36 percent of life spent in the U.S. in ACE II. Accordingly, many of our participants -- they participated in a language other than English, and even more spoke a different language at home. ACE II skewed more heavily towards recent non-English speaking immigrants than ACE I.

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DR. ATTFIELD: So for the five PFASs that I'm going to be talking about today, first, before we compare

to other populations, within ACE I and ACE II, we saw that levels were pretty similar for these three, for PFOS, PFUdA and PFNA. And they were a little higher for PFOA and PFHxS in ACE II. And all of these were detected in greater than 98 percent of our participants.

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DR. ATTFIELD: So it is rather difficult to compare levels between studies for PFAS levels, because there are time trends involved that Jennifer showed you the nice graph from the Teachers Study of, and age and sex can be different between studies and effect levels.

So I have a graph in the next slide to help you more than a -- you know, a table of numbers. But it includes both a comparison to NHANES Asian groups in 2013-2014, but I've also created an extrapolated number for us using the declines --

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DR. ATTFIELD: -- seen in the California Teachers Study to sort of give us a ballpark of maybe what we would expect for the similar ideas -- for the similar levels in the similar years.

So let's get to that graph.

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DR. ATTFIELD: So to walk from left to right, first, I'm going to compare to NHANES Asian populations.

Our gray and black are ACE I and ACE II. The light blue is our NHANES Asian 2013-2014 levels. And then the dark blue is the approximation of what we might expect for 2016-2017.

And it was really only straightforward to calculate that for the first three there. That's why there are only three with the dark blue.

Woops. Sorry.

So starting off from the left to the right, PFOA levels were pretty similar between ACE -- our ACE population and the Asians in NHANES, even when considering a time trend. PFOS levels are higher in ACE than in NHANES, especially if you consider that time trend, so the dark blue bar there.

PFHxS levels are pretty similar to NHANES. And PFUdA levels are a little higher than the NHANES Asians, especially if we're to think of a time trend. PFNA levels were pretty similar. So in addition within NHANES, we see differences between Asians and the general population. So that is in PFOS levels, those tend to be higher in Asians, and PFNA levels tend to be higher in Asians. So that's particularly interesting for our results for the PFOS that ours are higher than Asians, and Asians are higher than the general population.

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DR. ATTFIELD: So in beginning to look at what factors from our demographic characteristics are associated with PFAS, this is the list of variables that were seen to be associated with one or more of those five PFASs.

I'll let you read through them.

And then in my next slide, I started looking at --

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DR. ATTFIELD: -- which ones contributed the most when you put them together in statistical models.

So the analyses that I did at this point combined ACE I and ACE II data. And I'm just going to walk you quickly across this table before I start populating it with numbers.

So here, I'm going to be looking at the percent adjusted change. So, for example, our first variable here is sex, so contrasting males to females. So if a number of 50 was in there, that's a 50 percent increase seen in males over females in the serum levels.

Then we do, in some compounds, see differences by age in females versus males. So I've just broken those out into separate columns to make it easier for readability. Then contrasting non-English interview language to English, contrasting different birth countries

to the United States, and then portion of life in the United States as fraction from a zero to one, or you can think of it as zero to 100 percent.

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DR. ATTFIELD: So first, for PFOA, sex is highly associated with serum levels at 125 percent increase. This association with age is different for males and females. So we see female concentrations increasing with age, about one percent, while males are slightly decreasing. And in total, this explains about 13 percent of the variability of the model as can be seen in that right-hand column of the R^2.

So PFOS has a much, much less strong association with sex. It's barely affected by it, and there's not observed an interaction between sex and age.

We did see an association with the non-English interview language, sort of an indication of acculturation, and with birth country, with the strongest effects seen in those born in China, the 94 percent increase.

And just for reference, where there's an asterisk, those are the ones that are actually not statistically significant. Everything else will be at a P less than 0.05.

So moving on to PFHxS. Again, a substantial

increase, 368 percent, with male sex as observed. And the similar difference in affects on age by sex, as we'd seen in PFOA. So increases in the males -- the females, and just a slight decrease in the males.

Here we see an association with birth country again, though this time more with birth in Vietnam. And a greater portion of life spent in the United States was associated with a decrease in the PFHxS levels. And this explained about 49 percent of the variability in these models.

So PFUdA, no association with sex actually bears out in the complete model or with age. And the associations are more seen in the acculturation type variables. So with the non-English interview language, and with the portion of life spent in the United States.

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DR. ATTFIELD: And finally, PFNA returns to having a stronger effect of greater percent, 82 percent, adjusted change in males versus females, along with the sex-dependent increase in age. And only portion of life in the U.S. also remained in the model with a similar decrease with a greater portion of life spent in the U.S.

So everything together for reference.

And then to put this in context of what we see with other studies. So male sex is generally seen to be

higher in many of the PFAS levels. This is not unusual, except for -- sorry, I haven't advanced the slide.

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DR. ATTFIELD: -- PFUdA. Also, the age-sex interaction has been seen for those three compounds in NHANES in analysis in 1999 to 2008 data, as well as in Red Cross study of 2000 to 2015 samples.

Other studies have seen more of an effect of education and income. That did not bear out so much in this study. And for this study, we're able to look at birth country and time spent in the United States. And that's really not been previously investigated, though we may be able to look at it in our BEST data.

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DR. ATTFIELD: So, since a majority of our participants were born out of the country, we do need to consider if they can be bringing a body burden of PFAS with them when they immigrate to the United States.

So starting off with China, there is continued production of PFOS and PFOA in China. And there are these sizable areas of contamination of waterways. So this map is a map of waterways and sediments. And just for reference, the green bar is the PFOA, and water in there are levels that over 100 nanograms per liter.

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DR. ATTFIELD: So there are biomonitoring studies going on there. Not a national program, of course. But they have ranges of results, some of them are comparable to the United States and some of them have very high levels. So, an example, of very high levels, there's a study of employees of a contaminated fishery where the PFOS median level was 10,400 micrograms per liter. So if you can cast your mind back, we were looking at like seven in this study.

And in West Virginia and Ohio, where there was drinking water contamination, their levels were around 80 at the median. So it's quite a -- quite a contrast. And then residents near a fluorochemical industrial park with PFOA, median levels of 9.4. And ours were around two, so that's for contrast.

And currently, we do not have something to compare to for Vietnamese-Americans, there are no current PFAS biomonitoring studies in Vietnam.

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DR. ATTFIELD: For next steps for this study and for analysis. So we do have quite an extensive questionnaire that I've been plumbing. And we're going to be pulling out more interesting factors from that to learn about the participants.

One limitation of this is we -- lots of us are

very interested in drinking water contributions. And this is not the ideal study to look at that. For one, it's a very limited geography, so very limited variability, and inputs. And we don't have water consumption types of questions in this, though more in the CARE Study, which will have greater -- also greater geographic variability to make that a much more reasonable place to be looking at those contributions.

We will also be looking at trying to tease apart product use of imported products versus domestic products in thinking about acculturation and body burdens brought to the U.S. versus acquired here.

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DR. ATTFIELD: So takeaways from this work is that community studies can reveal more about subgroup populations within California, and that our regional immigration and racial ethnicity patterns may contribute to differences in PFAS levels and other contaminants that we may see across the state that might become evident in our CARE Studies as they're sort of different racial make-ups in our regions.

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DR. ATTFIELD: And moving on, I'd like to thank our participants, our community partners, and all the wonderful Biomonitoring California staff that have worked

on this study.

And that is the end of mine.

(Applause.)

DR. ATTFIELD: Are we moving directly on to her?

CHAIRPERSON SCHWARZMAN: Thank you to both Jennifer and Kathleen.

DR. ATTFIELD: Oh, I'm sorry.

CHAIRPERSON SCHWARZMAN: We have 10 minutes for Panel questions and audience questions. But I just want to point out that after our next talk, we have a half hour for discussion. So I want to keep this focused to questions for our -- these last two presenters, Jennifer and Kathleen.

Tom.

PANEL MEMBER McKONE: Just a little -- I have a question related to bioaccumulation. But, you know, one of the things chemically about the PFASs in these compounds is they'd be completely inert if we didn't put that sulfonic acid hook. And it's the hook that allows them to attach to your clothing or couch, and also to proteins.

Right, so one of the -- the really interesting things is unlike sort of the classic bioaccumulation from things like PCBs, and dioxins, and chlorinated pesticides, which is really driven entirely by lipid solubility. I

mean, it is explained by lipid solubility.

Here, it's really a different mechanism. It has to be some -- you know, getting that sulfonic acid hook has to attach to something. And it's not lipids, it's really something else. So the question I have is, you know, have -- how much are you really thinking about the implications of the mechanism of bioaccumulation, both in terms of what you're seeing and the implications for maybe how persistent these are, so that we can -- I mean, this whole issue of whether it's coming over with people carrying it in their bodies already or not is very tied to that.

So I don't know, are you investing a little time and effort into getting a little more understanding of bioaccumulation, because it's going to be important, I think, in the interpretation of results?

DR. ATTFIELD: Yeah, I think it's definitely going to be part of the interpretation as we work more with this data. And I think we might be talking a little bit about that in the afternoon panel, because it also bears out in what media we're looking for in the compounds, because some compounds are more persistent than others, and some are coming -- more enriched in serum and maybe urine is a better platform for looking at some of the shorter half-life chemicals -- the shorter chain ones.

So, yes, we'll be looking into that.

Is there any other comments?

PANEL MEMBER McKONE: It's a really good study, though, by the way. I should have started with that.

(Laughter.)

PANEL MEMBER McKONE: This is really useful --

DR. ATTFIELD: It's interesting.

PANEL MEMBER McKONE: -- and important. And, you know, this is going to be so valuable as we build this up, because these compounds are -- they are very persistent. I mean, fluorinated compounds are inert and very persistent. And the only thing we've got going for us is that they've got this hook on the end. And that may be the way to break them, but you're getting on the pathway to understanding at least what's in our population. So I do want to congratulate you on a really good study.

MS. HOOVER: Just to pipe in here for those on the webinar, someone tried to send a question through the chat. Please send your questions to the biomonitoring email address, biomonitoring@oehha.ca.gov. I think we caught the question. So I think I'm just going to say that right now. I think the question was if we asked about rice cookers in the ACE Study, so...

DR. ATTFIELD: Yes, we -- yes, that -- that analysis is not finalized, so it's -- I can't really go

into too much depth on it. But we did ask about not only what type of rice cooker you're using, but how long do you tend to store your rice in the rice cookers, because there are sort of different traditions of you use it right away, or you use it -- you leave it for several days. So that is one thing we are looking at.

CHAIRPERSON SCHWARZMAN: Other questions from the Panel?

Go ahead.

PANEL MEMBER FIEHN: I was really amazed about this very high concentration in -- measured in China in this environmental, you know, accident, I guess, in the fishery. Is there anything known about adverse effects of those employees?

DR. aTTFIELD: I think they're still studying them. I don't think there's acute effects that they've observed just yet.

CHAIRPERSON SCHWARZMAN: Go ahead, Ulrike.

PANEL MEMBER LUDERER: Yeah. Thank you both of you for your presentations, and the really great work that the program is doing.

I had a question about the first presentation where there were -- I think you made a comment that the banked samples from the -- I guess the biobank from the MAMAS study are not optimal for PFASs. And I was

wondering if you could say more about that.

DR. MANN: No, I didn't mean that. I meant they were collected for another purpose. So how they're stored over time and the length of time that they've been stored, that is -- and, you know, when they're analyzed, they're analyzed by us. But originally, they were handled by different people. So that's really more what I meant. They're not optimal. They're appropriate, but just not --

PANEL MEMBER LUDERER: So they may have been frozen and thawed and refrozen, or what is it that you're concerned about?

DR. WU: Well, we're advised by CDC guidelines when we're taking blood samples to advise our staff not to wear particular products, because there may be PFASs in our cosmetic products. And so there's some -- we have some control over our own sample collection. These samples are collected at, you know, just different clinician's offices, or Quests, or different offices around the state, by -- you know, thousands of these offices.

So there's very little control. They're looking at proteins and hormones. So there really is no consideration if this is appropriate for their program, whether or not there's environmental contamination.

CHAIRPERSON SCHWARZMAN: Yeah. Veena.

PANEL MEMBER SINGLA: My question is also for Jennifer. In terms of the expanded panel of PFASs, you mentioned you did see decreases in detection frequency over time for some of them. Were there any with increases?

DR. MANN: No, not that we saw, not statistically significant increases. I did show that slide that looked at the earlier banked genetic screening samples for PFNA. And they seemed to be looking a little bit higher or about the same 12 years later. So that's the one example I can think of sort of more possible increase, possible stability.

Right. And the -- the -- what I was referring to when I was talking about declined detection frequency was actually PFOSA, which is on our original panel. It's a PFC.

CHAIRPERSON SCHWARZMAN: Other questions from the Panel?

Carl.

PANEL MEMBER CRANOR: Quick question. You're looking mostly for the long-chain molecules as opposed to there -- there's -- a batch of new ones are short chain, all of them?

DR. MANN: Yeah. The original panel included more of the longer chain carboxylates sulfonic acids,

so -- but the expanded panel includes all sorts of PFASs.

PANEL MEMBER CRANOR: Thank you.

CHAIRPERSON SCHWARZMAN: Is that it from the Panel for now.

Okay. Please, Andrea.

MS. VENTURA: Hi. I'm Andria Ventura with Clean Water Action. And I was really excited about this, because I am currently working on subsistence fishing, particularly in San Francisco Bay, but protected subsistence fishers. And we know that we have PFAS in California waterways. Our understanding of what's out there is just emerging thanks to some of the scientists in the room.

What I'm wondering is as you look at people coming over with a body burden, are you -- or will your questionnaire also include what are their practices here around fishing and fish consumption out of California waters?

And my other question has to do -- and this will come up with drinking water later as well. One of the studies I was reading about short chain was that the half-life in the body may not be the issue. It may be the fact that we're constantly exposed to them. And I'm wondering if you're looking at that at all in relation to fish consumption and polluted waterways?

DR. ATTFIELD: So I can speak to what we were doing in the ACE Study, and a little bit of CARE Study on that. So we actually have quite a lot of questions about fish consumption patterns and fish purchasing patterns, both of -- did you sort of -- did you acquire it from your own fishing? I mean, we don't call it quite subsistence fishing, but different types of local fishing, so where you tend to purchase it, if it's from a store or from a market, et cetera, and the frequency with which you are buying it and consuming it.

And then we have a little bit about that on the CARE Study, but not quite in the same amount of depth. CARE we did have to pare things down to keep things efficient for our participants.

CHAIRPERSON SCHWARZMAN: Yes, next public.

DR. ATTFIELD: Yeah, since we are asking about the frequency of consumption, hopefully that can help. But we don't have any questions about sort of how long, you know, how many years have you been in the practice of eating -- or eating or purchasing in a particular pattern. But hopefully the frequency of consumption can help us think about sort of persistence of exposure versus -- you know, anything that's periodic for a short-chain substance is going to be very, very difficult to capture.

DR. READE: Hi. My name is Anna Reade. I'm with

Natural Resources Defense Council.

And I was actually going to follow up on Andria's question about fishing. Sorry. And we know that there's been some tests that show that PFOA, PFHxS, and PFBS have been found in fish. And I was wondering if you were able to look at the shorter PFBS or are you planning on doing it?

DR. ATTFIELD: Yeah. So the expanded panel was done on our ACE population, so that's 32 compounds. And as Sara is gesturing it's in the handouts and the checkmarks indicate -- the check marks are the expanded, and the little C's are the original, is that correct?

MS. HOOVER: Yes.

DR. ATTFIELD: Okay. So PFBS, yes, we are looking at that and some other short-chain compounds.

DR. READE: I'm sorry. I should have asked if it was in urine as well, or if you're just doing --

DR. ATTFIELD: We are doing serum. We do not have a urine method.

DR. READE: Okay. And then the other question I was going to ask is about if you were able to ask if they were breast feeding or -- at all in the questionnaire, because that tends to be an elimination route?

DR. ATTFIELD: So we actually don't have that in the ACE questionnaires, but we do have it in the CARE

questionnaire.

CHAIRPERSON SCHWARZMAN: Great. Thank you, both Kathleen and Jennifer for your excellent presentations.

Next, I want to introduce Sabrina Crispo-Smith from the Department of Toxic Substances Control. She's a Senior Research Scientist in the Biomonitoring Section of the Environmental Chemistry Laboratory there. And she holds a Ph.D. in chemistry from the University of British Columbia.

She's going to talk about biomonitoring results for the case study of firefighters heavily exposed to firefighting foam. And she'll also provide a brief update on other PFAS work at the Environmental Chemistry Lab.

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(Thereupon an overhead presentation was presented as follows.)

DR. CRISPO SMITH: Can everybody hear me okay?

No, not all.

Can you hear me now?

(Yeses.)

DR. CRISPO SMITH: Okay. All right.

Thank you for the introduction. As was stated, I work in the Environmental Chemistry Laboratory at DTSC. And I was asked to close out this session with an overview of what we are working in regards to the PFASs analysis.

Let me get situated here.

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DR. CRISPO SMITH: So I'm going to begin my talk with a quick overview of the current methods we have in our lab, both targeted and untargeted, which we've been using to analyze PFASs in human serum. And I'll continue with a discussion of a recent study that we have been working on, where we applied our three methods to three firefighters that were accidentally exposed to firefighting foam, and then finish up with covering some of the current and proposed work for our lab.

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DR. CRISPO SMITH: So since this is a lab talk, I'm going to start by showing you the method in which we use. So this is one of our -- I think it was referred to as traditional in Jennifer's talk -- traditional or classic method that we use for targeted PFAS method. This is the 12-component method that was done on the earlier studies. And here is a list of all of the components measured in this study. So actually, PFBS is listed in there.

This method was started in our lab around 2010 and contains the compounds that are -- were also included in the CDC NHANES studies during this time.

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DR. CRISPO SMITH: This is the new targeted method that we used for PFAS. And I meant to mention it last time. I'm using the word targeted, because these two methods are looking at specific compounds, so we're not going to find anything additional to what we're looking for. This method has been used on ACE I and ACE II, the data that Kathleen just presented.

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DR. CRISPO SMITH: And it includes both the classic list, and some additional -- sorry it's bouncing -- some additional shorter chain carboxylic acid groups, one additional sulfonic group, and then some replacement precursors, including some telomers, both carboxylates and sulfonates, and then some additional compounds that are used in other commercial products.

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DR. CRISPO SMITH: The third method that I'm going to speak about today is in-house is a non-targeted method. Sorry. And it can be referred to as non-targeted or semi-targeted, because we're looking at a specific group of compounds.

And it uses a time of flight mass spectrometer to scan samples for all measurable compounds found within a sample under certain conditions. This method produces a lot of data which needs to be screened through filters,

and then matched to a database to confirm compound identification.

Different levels of confirmation are possible for this method depending on the confidence of the identification. So I will now discuss these -- how these methods have been used in our limited study.

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DR. CRISPO SMITH: So first some background on the limited study. So in 2015, a physician -- a concerned physician requested that we do analysis on three firefighters who have been accidentally exposed to fire fighting foam. We weren't given much more information than that. So there are a lot of questions with this, which is why it's called a limited study. We didn't get to question the people who gave us the samples.

We don't actually know the specifics of the accidental exposure, what type of foam they were exposed to, or even the time between the exposure and the collection of the serum, and also any other information on possible PFAS exposure. So we now choose our method just to see what we could determine just from the serum above the exposure.

So we first ran the classic method, so the 12-component method.

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DR. CRISPO SMITH: We measured the compounds for these nine components here. The other three that are not listed were below detection limits for these three firefighters. Most of the levels listed here are -- fall below the 95 percentile of the NHANES -- the CDC NHANES results from 2013 and '14. But there were two exceptions.

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DR. CRISPO SMITH: The PFOS and hexa-sulfonate.

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DR. CRISPO SMITH: So when you compare the NHANES data from the 2013 and '14 for males only, because we do know males have slightly higher levels, the three firefighter concentrations are shown here in the blue diamonds. Two of them actually are above the 95 percentile with the PFOS levels for firefighter A and C being 20 to 40 percent higher than the 95 percentile for PFOS, and 20 to 60 percent higher for the hexa-sulfonate.

And the firefighter B serum - you can find it within the lines - falls within the range of the NHANES participants.

We then also compared the results to the FOX Study, which is one of the firefighter studies we did in 2010-2011. Now one thing to note is that levels have been decreasing over time. And although the participants' levels were higher than the median, which is that green

dot there, in the study - two times higher for PFOS and three to five times higher for PFHxS - they do not exceed the maximum value of the FOX Study. But as with our three firefighters, we do not know what the high -- what kind of ex-exposure the maximum person had and whether or not it was similar to the other firefighters within this study. So the meaning of the maximum value at this time is unclear.

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DR. CRISPO SMITH: So I'm going to just take an aside. Firefighting foam was mentioned earlier in Jennifer's talk, but I just want to give just a brief overview. So the aqueous fire -- film-forming foam, or AFFF, are proprietary mixtures which is are used to put out fuel-based fires mainly. And they contain fluorinated surfactants. And one of the interesting things is that there are two different manufacturing processes for these foams. There's an earlier one, which was one process, which is actually electric chemical fluorination that would end up producing some side-products of PFAS -- PFSAs, so the sulfonic acids, like the PFOS and the PFHxS.

But the newer telomerization process, which when 3M stopped using the electric Chemical in 2002 - sorry - the new method does not produce these PFSAs, but can possibly produce fluorotelomers and possibly the

carboxylates as degradation products. And this kind of gives us a fingerprint of what type of AFFF exposure could have happened.

And now another thing to note, and it was alluded to earlier as well, is that firefighter PFAS levels are higher than the general population. The factors that can affect the levels are whether or not the're male or female, the number of years on the job, the type of exposure, and actually the number of blood donations as well.

We don't know any of this information of our three firefighters in this study, but we were curious to see what we could find just from our methods to see how they compare.

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DR. CRISPO SMITH: So the next thing we did was we looked at the expanded method for these three firefighters. And we found detection frequencies for four of these compounds. Now, the two FtS compounds are interesting as they are -- have been found to be degradation products in environmental samples exposed to the firefighting foam. But we did find that the levels were similar to the levels found in ACE I and ACE II.

Although they were similar to the higher level, because as was stated in Kathleen's -- sorry --

presentation, the detection frequencies for all these four compounds within the ACE I and II were below 50 percent.

So we weren't really sure what this meant for the firefighting foam used by the firefighters. Does it mean that there's an older version of the firefighting foam, which is why we don't see the sulfonates very high, the FtSs, or did it mean the compounds were transformed or metabolized into compounds we were not targeting?

So at this point, we decided to test the samples for the semi-targeted method to see if there were additional compounds we were not targeting, but were measurable in these three firefighters.

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DR. CRISPO SMITH: So here are the -- I just want to start by saying, this analysis, the semi-targeted analysis, data analysis is still ongoing. So these will just be very preliminary results. So the initial analysis from a -- sorry -- the initial screening results 3,369 features, which I'm just going to point out, features that are kind of potential compounds that could be found in the study -- in the serum were extracted.

This number is similar in range of other serum samples that have been measured in the lab. But when we applied a mass filter for the -- to find the fluorine-containing structures within the firefighter's

samples, versus another study done within our lab on pregnant women, we found that approximately 15 percent of these could be fluorine-containing features, which is over two times higher than what we find in the pregnant women population that we've been -- yeah.

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DR. CRISPO SMITH: So after screening the data for the fluorine containing features, we then -- the non-targeted group, then compared these features to the library search results. So the in-house database that we have created from literature in the U.S. EPA market PFAS list contains over 13,000 -- 1,300 compounds combined. And from this review, we found the targeted analysis list, and they were at high confidence levels, although no compound -- other compounds or environmental breakdown products were found in the serum samples via the library search related to the AFFF expected breakdown products or compounds.

So that begged the question -- this poses two new questions. Were the compounds in the foam non-persistent in humans or were they transformed? Did the compounds from the firefighting -- did the compounds the firefighters were exposed to all end up as PFAS and hexasulfonate, or are there additional potential compounds to be found?

Sorry.

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DR. CRISPO SMITH: So as this process has just started, we do not have a definitive chemical fingerprint for the foam to which the firefighters were exposed. But some of the scan data has been suggestive. From a list of potential compounds and the scan data I just mentioned, the non-targeted group has proposed the following structure from one of the compounds. And this proposed structure was determined from the accurate mass of the compound, isotope patterns, and formula examination.

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DR. CRISPO SMITH: And this structure could be a breakdown product of one of these perfluoroalkyl sulfonamide amino carboxylates probably with N equals 4. And it actually is a product of the electric chemical fluorination process. And as I said earlier, the electric chemical fluorination process also can produce the PFASs that we also saw in the targeted analysis.

So as I stated, this is preliminary data. But as more information about the potential compound is analyzed, such as this fragmentation pattern, we may become more confident in our assessment.

Additionally, as the lab continues that detective work in the processing of the yet unknown other features

or potential compounds, additional information about the type of exposure could be determined.

So although the study isn't complete, it does show both the possible power of the non-targeted and semi-targeted analysis to find compounds that we aren't targeting but could be potential PFASs exposure, but there's still some work to be done.

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DR. CRISPO SMITH: Sorry.

So in the prior example, we moved from targeted to semi-targeted analysis as a way to look at exposure. This process could be applied to the current and future Biomonitoring California projects such as MAMAS, where we may be able to find additional PFASs that we are not currently targeting or can target based on the availability of certified standards.

Another one of our projects, a collaboration between DTSC, UCB -- UC Berkeley, and UCSF studying exposures in pregnant women is being performed in reverse. That is in this project, it's starting with the non-targeted analysis of the samples. Once completed, class or classes of compounds found to be detectable at high rates in the participants will be selected for targeted analysis. In this way, our laboratory will be able to focus on important exposures to Californians and

hopefully be able to detect, as new emerging chemicals of concern start to be measurable in California populations.

In addition to the current time of flight mass spectrometer set-up we have, which is a liquid chromatography system, we will be installing this fall another time of flight system connected to a gas chromatographer -- gas chromatograph that will aid in also monitoring exposure to compounds that are too non-polar for our current system to monitor.

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DR. CRISPO SMITH: So this is my second to the last side. I have no idea how I'm doing for time.

MS. HOOVER: You're doing great.

(Laughter.)

DR. CRISPO SMITH: Okay. So this just back to targeted analysis for a bit. A couple of our future work for our targeted analysis is to automate the on-line -- an on-line solid phase extraction for our expanded PFAS methods. One of the reasons that it doesn't apply to all studies is that at the moment our expanded method is a manual extraction, which takes a lot longer time and a lot more staff time.

Additionally, we're going to be adding some new compounds that have become available in the past year, expanding the current list of compounds that we have or

groups that we already have in our targeted analysis. And then also adding the new replacement PFAS compounds, which I think Antonia will be speaking about a bit this afternoon.

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DR. CRISPO SMITH: So I'm at the acknowledgments. So I'd like to thank Miaomiao Wang and also all of the group of the non-targeted analysis group for the results here, other staff within DTSC Biomonitoring staff, and also Biomonitoring California staff.

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DR. CRISPO SMITH: And there is some references.

Thank you.

(Applause.)

CHAIRPERSON SCHWARZMAN: Thank you, Sabrina. We have 10 minutes for questions, and then we'll have a broader discussion.

Yeah, Oliver.

DR. CRISPO SMITH: I knew you were going to be first.

PANEL MEMBER FIEHN: Thank you for your wonderful presentation and interesting results you have found confirming our suspicions that we should look more broader, but also, of course, that we find, you know, higher exposures in people who are actually exposed,

right?

(Laughter.)

DR. CRISPO SMITH: Yes.

PANEL MEMBER FIEHN: I mean that's good.

(Laughter.)

PANEL MEMBER FIEHN: So my question is a little bit -- or my comments, I guess, is a little bit be careful.

DR. CRISPO SMITH: Yes.

PANEL MEMBER FIEHN: And you know that you're careful.

DR. CRISPO SMITH: Yes, trying to be.

PANEL MEMBER FIEHN: In terms of the numbers of potential fluorinated products.

DR. CRISPO SMITH: Yes.

PANEL MEMBER FIEHN: The reason is, A, you did not show MS/MS -- or you did not use MS/MS. So I would encourage you to use so-called iterative MS/MS generation, and the newest of software release that's possible to get really exhaustive MS/MS spectra for all your features.

And secondly, the MGF software doesn't work. So it simply does not work. Don't use it. There are better software for that.

And, you know, there is further alternatives that you might want to explore. If you use methanol

extractions in plasma, you get like a boatload of lipids that get really into the depth of, you know, overshadowing everything else. Even with solid phase extraction, you still have, because they're lipophilic, you know, really problematic, you know, very abundant lipids. And then you look for very low abundant contaminants.

So there are sample preparation methods these days to take out the lipid fractions from different companies, but let through other non-lipophilic or other types of compounds.

DR. CRISPO SMITH: Okay. Like Phenomenex.

PANEL MEMBER FIEHN: There are different -- I can tell you maybe offline. I mean, that's something that we can do offline. I'm just saying that these are possibilities.

DR. CRISPO SMITH: Thank you.

PANEL MEMBER QUINTANA: Hi. I had a simple first question which is what was the period of time between their exposure and the time they gave you a sample?

DR. CRISPO SMITH: We were not given that. It was in one of the things we don't know. We -- we're not sure how long it was between the exposure and when the serum was collected.

PANEL MEMBER QUINTANA: And my second question is just arises from the fact that in our laboratory Dr. Eunha

Hoh in our faculty, we're doing non-targeted analysis of dust and of air samples from U.S.-Mexico border. And when you find these compounds, you know, it's really exciting that we're finding all these compounds for which there's no ChemMaps track number or there's -- there's all these new compounds.

But then how do you move towards targeted analysis if we're struggling with the fact you can't buy a standard? And so -- so we're trying to figure out how do we prioritize what we're going to try to focus on. Are you going to synthesize your own standards or what are you going to do?

So we're kind of struggling with that right now. And so I'm just curious about your comments.

DR. CRISPO SMITH: Yeah, that is one of the issues with the non-targeted analysis, I guess, looking back at my TOF group people. I do know that there are companies that are willing to synthesize compounds for you for an exorbitant price. I guess one of our hopes, as you start letting the scientific community know about either these groups or these possible structures that companies may kind of hop on the, you know, try to get ahead of what people will be wanting in the future.

But at this time, we don't have a synthesis group within our lab. So it is a question that is a good one.

And I don't have a perfect answer for you right now. But if we notice that we are finding certain structures that aren't -- okay. Sorry -- that aren't available for purchase for quantitation, then we may be willing to spend more money in that area, even if it does cost money to have these things synthesized than to continue just doing the targeted analysis that we are obviously missing things.

That's how I feel as a scientist in the lab. I know I don't get control over everything, but that's, I guess, one of the points.

PANEL MEMBER QUINTANA: Thank you.

CHAIRPERSON SCHWARZMAN: Other Panel questions?

Sara.

MS. HOOVER: Just one follow-up. That's a great question. And we're going to be talking about that this afternoon. That's one of the major purposes of this meeting is to figure out how should we go forward with PFASs. So great lead-in to the afternoon.

I wanted to say one thing about the morning comment that I saw flash in that was from Jen Jackson. I didn't identify her. So if Jen is still listening, could you please email us your affiliation and your comment, so we have a record of that.

And we have another question for Sabrina from

Carin Huset a research scientist at the Minnesota Department of Health. "When you measure PFOS and PFOA, do you quantitate the isomers separately, (e.g. linear isomer separately from branched isomers)? If so, is there a difference in the isomer profiles observed in your three firefighters?"

DR. CRISPO SMITH: All right. Hi. So -- this is Sabrina again. So we actually are just quantitating the -- well with the original method, the 12-compound methods, the isotopes are within the same peak. And then with the new method that we do separate them out, but we do quantitate them by integrating both peaks on the same calibration curve. I did actually look at this a little bit by just looking at the peak areas between the three firefighters and some of the ratios within ACE and I didn't find any specific like, oh, this is, you know, 50 percent versus like the three. I think one -- three to five percent -- or one to three percent the isomers versus the large peak.

I found the same within the ACE and the firefighters. So I didn't really bring that up in the talk, but I didn't see an isotopic signa -- sorry, an isomer signature in fire -- in the firefighters. That was different than the other populations.

CHAIRPERSON SCHWARZMAN: Other questions for

Sabrina?

Thank you so much for your talk.

(Applause.)

CHAIRPERSON SCHWARZMAN: So we now have until we break for lunch, which is at 12:25, to have a discussion based on the morning's talks. And we've heard a lab update just now, and discussion of those findings. We've heard a general program update, and then the really exciting study results on several biomonitoring studies that have looked at PFASs, and that can all be the subject for discussion now until lunch. And I'll open it up here. Tom looks like he's ready.

PANEL MEMBER McKONE: Hi. Thank you. There we are. So this may be something we pick up this afternoon too, but it's something that it kind of rises out of the PFAS kind of discussion, which is -- and I think it relates to a lot of what we do in the Biomonitoring Program, which is we do tend to look backwards. That is we look at the chemicals that have been used and not the chemicals that are going to be used. And I know one -- I mean, when we looked at the siloxanes, that was many years ago, we were kind of getting ahead of the curve.

So what I bring up is, you know, my meetings with environment -- I met with an environmental chemist in Europe who's working on clothing. And he said you know

what you have to understand is people expect certain functions from clothing, stain resistance, water resistance, brightness. You know, you've got to wash them. They have to stay bright. And he said there's hundreds of compounds that go into your -- he said, you know, nobody buys cotton pants. It's cotton pants with about a hundred other chemicals that go in there to make them function the way we want them to function.

And, you know, historically we got a lot of that function from, you know, compounds that we're now finding in the environment and everywhere else. The fluorinated compounds are really great at stain resistant, and in water resistance. I mean you can spill wine on your pants and it beads up and you just wipe it off, right.

(Laughter.)

PANEL MEMBER McKONE: So one of the things I think we have to be keeping an eye on in this program is not just the, you know, like the fluorinated compounds that are still out there somewhat, and definitely yesterday's issue, but also what's coming, particularly in Europe, where there's a real push there to really get away from anything that's persistent. And there's a lot of researchers in green chemistry and other areas really pushing. And so what we have to do is think function. And the functions that are going to be there, not chem --

not always chemicals.

I know we think chemicals, but -- and the depressing part of the conversation is people will not buy anything anymore that doesn't have -- we've gotten so used to or so much expecting our clothes to function the way they function that nobody is going to buy clothes that look dingy after you wash them. We expect them to look bright. We have to do that with chemicals. They don't just stay that way, and stain resistant, et cetera. So we have to keep an eye on what those chemicals will be.

Well, this is the fluorinated chemicals, but then another class there's all this same problem that people expect function and we have to find out how that function is going to be met.

So again, this kind of a -- I'm not -- I'm just raising this as a broad issue that we have to keep focusing on as we move forward in the program, so we aren't just looking at the present or looking backwards, but also looking a little bit into the future.

CHAIRPERSON SCHWARZMAN: Yeah, If I could take off on that for just a second. I think it's an interesting point to raise, because I think it's something that biomonitoring struggles with very publicly, you know, to -- it's benefit is how do you select compounds when you don't know where the market -- when there's no -- there's

no automatic source of information about where the market is headed, and the market gets some signal from regulatory or advocacy efforts to move away from something, but you don't know what they're moving toward. And so we have this perennial problem of kind of looking backward.

And I just wanted to extend the conversation a little bit about -- for ideas about how the staff can think about function, and solicit ideas from the Panel. One resource that I know of is that the Hazard Data Commons has added a function -- a search function that's still in its basically beta form and it's a little difficult to use still, but they're working on to search by function. And I wonder if that would be an interesting place to start, and then start querying people involved in the industries.

Like, for example, I'm thinking, you know, outdoor apparel industry has trade associations that may -- you know, you could have a conversation with that says well, here's some things that we're finding are getting submitted as labeled for this function. And a lot of those labels actually come from Europe I think in the -- in terms of the current data sources that the Chemical Data Commons uses for that search function, and start having some conversations around that. So that's one small idea that I have that I'd be curious to hear how

others might help the program think about function and find -- you know, it's easy to take that step from chemical to function, but then to figure out what else is serving that function is really the harder step that you're recommending.

But if we have -- if we as a panel or as an audience have ideas for how the Program might do that, I think that would be really welcome.

Yeah, Carl.

PANEL MEMBER CRANOR: This is just to echo your's and Tom's point. I do think we need to figure out and try to think through how we can anticipate some of the things that are coming. I think that's a real problem for biomonitoring, because if it's not out there very much, you're not going to detect it very much. And it's not a problem yet perhaps, but it might become a problem if something becomes widely used. But on the other hand, we know that -- well, for example, as I understand it, DuPont when it ran into problems with long-chained perfluorinated compounds quickly went to short-chain compounds. They're out there. Nobody seems to know very much about them. I think it's going to be difficult for biomonitoring, but what can we do to stay with the curve or perhaps ahead of it?

CHAIRPERSON SCHWARZMAN: Nancy.

MS. BUERMEYER: Nancy Buermeyer, Breast Cancer Prevention Partners. I think it's a really interesting question, and it's a real conundrum not just for the Biomonitoring Program, but for the entire movement, because there is so much secrecy through the chemical industry, not only about what the chemical is or the mere identity of a chemical, but where it's used.

We have so little use information for any products that it makes it extraordinarily difficult. I mean, we just got a bill passed last year to even tell us what chemicals are in cleaning products. I mean, like, that's pretty basic.

So I think it's a much broader problem than just the Biomonitoring Program. And, you know, we certainly would love to be as helpful as we can, but it's a basic problem with the way we don't regulate chemicals in this country.

CHAIRPERSON SCHWARZMAN: One other data source that I'll just interject that's not super helpful probably for perfluorinated compounds, but I think, you know, Biomonitoring California is all aware that there is just the -- CARB just released the new consumer products surveys from 2013 and 2014, which for at least volatile and semi-volatile compounds provides sales data. And there is an -- I've been working with the data a little

bit, and there's an indirect way to make a link between a CAS number and a -- a the linked CAS number and product category and then you can go to the sales data. So it's a little bit indirect and we have to connect the dots.

But I think there are ways to work with that data which are now provided not in PDF --

(Laughter.)

CHAIRPERSON SCHWARZMAN: -- in the latest iteration. So that's -- if you're looking at trends, that's difficult, because you still have to work with the PDF data. But in any case, that's one source potentially for some volatiles and semi-volatiles.

Yes, please.

DR. READE: Hi. Anna Reade with NRDC again. Thank you for the -- I'm really excited about the non-targeted testing. I'm wondering if we could possibly look at what's now being used or being tested for in food packaging, because the FDA did ban a group of long-chain PFASs, and possibly that could be a point in the direction of where other markets will go in terms of the types of new PFASs they're using in the market.

CHAIRPERSON SCHWARZMAN: Yeah, Veena.

PANEL MEMBER SINGLA: Adding -- adding -- kind of building off of -- off of that comment and thinking about how to understand which kinds of compounds are used for

various functions, I think product testing data that exists could be helpful for that, looking at what kinds of PFASs have been found in food packaging, versus clothing, versus cosmetics, versus stain-resistant treatments, and trying to understand which subgroup of PFASs those compounds belong to, and what some of the replacements within the subgroup might be being used.

And I also wanted to mention to the extent that it may be helpful, the chemical inventory reset under the Toxic Substances Control Act, which is now available on-line through U.S. EPA, is about 40,000 chemicals that companies have reported as being in active commerce. So that may be a source to look for both, which PFASs have -- are being reported as not being manufactured or used anymore and which new ones may have come on-line.

CHAIRPERSON SCHWARZMAN: Yeah, Sara.

MS. HOOVER: I actually have just a related question, which is relevant to Veena. I'm curious if anybody -- I haven't had a chance to delve into this, but if any -- any of the Panel members or anyone else have delved into this OECD data base that they just released with 4,730 unique CAS numbers. They're not necessarily unique PFASs. But just curious if anybody's delved into that or if anybody -- Tom, with your European connections, if anyone has a sense of -- we're always wondering -- you

know, we hand wave and say there's thousands of PFASs in use globally, but, you know, just playing off that point a little bit more, like what's happening in the U.S., versus Europe, versus China?

I think it is hard to get to the, you know, core of the story, which is what you were pointing to Tom. Just wanted to throw that out there as another talking point.

CHAIRPERSON SCHWARZMAN: Has anyone on the Panel delved into that?

I think we don't have an answer for you, Sara.

(Laughter.)

CHAIRPERSON SCHWARZMAN: There's an audience question or comment.

DR. WANG: There's a master list of PF -- I'm sorry. Hi. This is Miaomiao Wang from DTSC.

So for the PFAS master list, U.S. EPA just compiled a master list of PFAS. And they have 5,000 compounds of PFAS. They're not totally fluorinated. But there are chlorine and bromide, but most of this is the most up-to-date and the most complete list. So you can find the whole list, download it from the -- their website.

CHAIRPERSON SCHWARZMAN: Andria.

MS. VENTURA: Hi. Andria with Clean Water Action

again. I'm back to say something radical and completely politically unviable.

(Laughter.)

MS. VENTURA: But you have to put it out there sometime to get there in the decades to come.

It seems to me, as I've been working on PFAS chemicals and this issue that Dr. Malone brought up, and to build on what Nancy said before is that, you know, you're piecing together lists and trying to figure out what's out there, both the scientists, there's NGOs, all of us. And at some point, there needs to be a different paradigm where we look at a class of chemicals that we have -- you know, at least have the red flag on, even if we have not proven everything definitively.

And there has to be a place, whether it's in the United States or whether it's in California, where if those chemicals are used in products that come in to say the state, or are being used in processes in the state, that has to be registered with some agency in the state, or the country. You know, that would be ideal. Not going to happen in the near future.

And that I know is a crazy idea. It's -- you know, but what we need to start thinking about, and why I'm saying this crazy idea, is because one of the things biomonitoring and other issues -- you know, in other

processes in the state as we look at these chemicals, whether it's in water, whether it's through biomonitoring, whether it's through DTSC Safer Consumer Products, what we need to start doing is building the case for that paradigm for classes of chemicals.

That's something that I hope -- you know, I'd like to put in your thoughts as to a scientist how do we start building that case? We'll run with it as NGOs You know, we'll try to make that happen over the years. This is a long-term vision. I totally get that, but at some point we have to turn this around, because we can't -- we will never catch up.

And it's something our legislature doesn't understand. It's something that at the federal level I don't think we understand, but we can maybe start thinking in those terms.

So there's my crazy idea for the day.

CHAIRPERSON SCHWARZMAN: Thank you, Andria.

Tom, please.

PANEL MEMBER McKONE: I just want to make a comment that, you know, that -- that idea has -- has succeeded in one area in California, which is pesticide, where in California the pesticide use register -- I mean, if you're going to use a pesticide on your crop, or in any kind of house treatment, or anything, it has to be

registered with the State. And it's very useful. I've been involved in work, where we were doing biomonitoring in the Salinas Valley, right? And it was really, I mean, not perfect, but you could find out what pesticides were used. And then when you look in people and find that pesticide, you go, oh, it was used, and it's in the people, or you know what to look for, too.

And you see it now it is behind. I mean, it doesn't -- it isn't up-to-date, but, you know, it -- that's a nice model. And I don't know why we can't extend that.

MS. HOOVER: Closer to the mic.

PANEL MEMBER McKONE: I don't know why we couldn't extend that to like other areas of chemical use, because it makes life easy in the pesticide world.

CHAIRPERSON SCHWARZMAN: The other thing that I would add is, of course, you know what Andria has asked for, is to some degree provided in Europe -- is this okay -- through REACH registration. It's not use-specific obviously, but at least above. If a chemical substance is produced or imported over one ton per year per producer, that information, the fact of the chemical being used or imported, has to be reported to the -- to ECHA, to the European Chemicals Agency.

So that information should be available through

ECHA, even though the hazard data isn't very consequential until you get to higher tonnage bands. At least perhaps that's a way of starting to identify trends in categories of chemicals used within a class.

DR. WU: And we have seen some trends towards us with for brominated flame retardants are now labeling laws on furniture. It was a long fight, and, you know, I understand there's still lots of out-of-compliance furniture, but, you know, it's going in the right direction.

And I believe there's an Assembly Bill that has been proposed by Congressman Ting to label food packaging with -- oh, is it no longer. Okay.

MS. VENTURA: Not moving forward.

DR. WU: Okay. Well, there are attempts being made -- right, there are attempts being made. There are people who understand the importance of an informed consumer population. It's a long way to go.

I do want to just -- I think this is a great conversation. But just in terms of tools that Biomonitoring has, I mean, PFASs are just one part of our world. There are lots of other chemicals we need to try to keep up with. I think this work with a semi-targeted screening is really exciting, because it gives us a fighting chance to figure out what the world of chemical

is -- chemicals is, but also some of the work that OEHHA is doing in designating chemicals as classes. I don't know if that's something that could be done in terms of function as opposed to chemical classes.

But that allows us to be a little more flexible in looking for and measuring larger groups of chemicals, rather than having to go one by one. But in measuring some of the chemicals that we're looking for and projecting future use for, some of our results return -- it complicates some of our results return, because you want to be -- we want to be looking at sentinels for early use, you know, maybe increasing uses of new chemicals. But it's a hard message to convey to a population when you're measuring. We don't want to just be like randomly searching for stuff or giving back results that are very hard to interpret, because we don't know a lot about the toxicology. We don't know about -- a lot about the use.

But some of the samples that have been talked about by some of our speakers, the MAMAS samples, for example, where we're not obligated to give back samples, because we don't know anything about the participants. Those kind of anonymous samples can help us as just like early sentinels of chemical use. And I want to encourage continuation of that kind of work.

CHAIRPERSON SCHWARZMAN: Sara.

MS. HOOVER: Hi. A couple things. Sara Hoover OEHHA.

First, with regard to the group designation. So Gail Krowech is in the audience. And she and I with Gina Solomon's, and Lauren's, and Martha's input, we developed this approach for identifying chemical classes, and, yes, it indeed does include function sometimes.

So you'll see -- you know, we did brominated and chlorinated compounds used as flame retardants, because we didn't want every single brominated and chlorinated compound to be captured in that. In other places we use, you know, just the chemical class, like the PFASs. So we can definitely look at different types of categories.

The most important thing though is you need to understand the nature of the chemicals in the category, because really our lists are -- essentially, you know, we're not a regulatory program. We're a program that is about measuring exposures. So when we put a group of chemicals on the list, we want to have some handle on, you know, why is this important for exposures and could we measure it in biomonitoring. So that's a piece of what our criteria are.

I'd also like to do two public comments if I could right now.

The first comment is from Jessica Bowman, who's

the executive director of the FluoroCouncil. And I'm going to read her comment.

She says that, "A comment was made that there is not much data on short-chain PFAS. This is a misinformed comment, because regulators have required industry to develop significant data on these newer PFAS chemistries. We have a robust body of data on short-chains posted on our website fluorocouncil.com/health-environment/scientific-studies/. We also have a lot of information posted about uses of the chemistry.

"We are also looking into the OECD list of PFAS and have some concerns about it. It includes some substances that do not meet the technical definition of PFAS. It's also important to understand that most of the substances on that list are not commercially relevant. We are looking to improve the list to provide more context.

"I'll also note that the PFAS used in food contact applications are clearly posted on FDA's food contact notification database".

So thank you for that comment.

A second comment came in from Sharyle Patton, who's the Director of the Health and Environment Program at Commonweal.

And Sharyle says in terms of, "Identifying chemicals another concern has to do with chemicals that

might be created or may emerge when PFAS-containing products burn. Given wild land/urban fires occurrences increasing, these may be a source of exposure. PTFE, the polymer used in turnout gear can be a serious problem when high temperatures occur".

CHAIRPERSON SCHWARZMAN: Great. Thank you for those, Sara.

Other questions or comments from the audience or the Panel on this topic?

Yeah, go ahead.

PANEL MEMBER QUINTANA: Hi. This is Jenny Quintana. I wanted to change gears just a little bit and be a little less big picture and get down to some smaller picture. And that's going back to the L.A. CARE study and thinking about lessons learns for the next phase. I was thinking about this program. I have one big picture comment, which is why we're doing this program at all at California Biomonitoring. And one is there are a lot of uniqueness to people that live in California and exposures that could occur in California. And you really brought this out when you looked at some of your ACE Study with foreign-born population versus not foreign born, and acculturation issues.

And so letting me think about the study for the next phase, rather than just having a category of Latino

or Hispanic, should you also have targets that mirror the foreign born or not foreign born status as is found in the region? Or -- the categories look very, very basic, and not even current in the sense they don't have a mixed race category as high as I think it typically is.

And so it just made me think about in terms of lessons learned, do we -- in thinking about these unique populations in California, do you -- should we be really trying to target a more refined view of a population for the next study?

DR. WU: Well, I think the slide I presented was a simplification of the racial breakdown. We did collect multi-racial information on people who are multi-racial. I believe 11 percent of our study population checked off more -- one or more -- sorry, more than one racial category. So it was reflected in that sense of L.A. County. It matched pretty well with L.A. County's demographics.

We simplified their racial categorization for selection purposes. We had to assign them into one category or another just for the facility of selection purposes. It is -- I mean, race is a really complicated issue. For one thing, I mean, we are in part looking for -- looking at race as a surrogate for culture, and what your exposure -- how your exposures may be different.

And culture doesn't -- or race doesn't really adequately capture that.

So we know that it would be great to have more information on acculturation and background and what that means for your exposure. But that's really hard to do. I mean, in part a limited number of samples, and we're, of course, subject to who volunteers to be part of our study.

We do have information on the participants for things like what -- where were you born? And I -- do we have how long have you lived in this country? How long have you lived in this country as part of that. So we might be able to look at some of that once we have enough of a population in the CARE Study.

But in terms of trying to target specific countries of origin or residents in the United States, we have 300 to 500 people that we can include. And we have already many, many bins that we're tying to fill. And I think it's -- it just -- it leads us -- I mean, I think it would be very hard to recruit towards that kind of question with this kind of surveillance study.

But it does lead to -- I mean, if we could do more targeted studies and really look at these. For example, in ACE we were able to really drill down and look at a country of origin, and look at some acculturation issues. We had, you know, pages of questions on fish.

That's just not something we can do in the CARE Study.

And my hope is that the CARE Study would be useful for hypothesis building. But also, as other groups do studies, the CARE Study gives us a California representation, so we can say -- well, is this group high in this particular group of chemicals because they're Asian, or is it because they live in California. When we compare it to NHANES, we just don't have the ability to parse out those distinctions. But the CARE data will be able to help us to draw those distinctions.

PANEL MEMBER QUINTANA: Well, I guess I'm not -- I guess I'm still suggesting should we think about -- at least for a very large category like Latinos, you could target, if you're foreign born or not, you could target what language do you prefer to speak the questionnaire in? That's a very -- that's not a very big subcategory if you're filling in bins, you know. And it is help -- does help it be more representative of the population.

So that was just a -- I know that you might go really far down this pathway and be very difficult. But there might be some very simple measures that would help increase diversity and representation for California.

DR. WU: We did try to recruit across language. And we were not entirely successful at doing that. We had, I think, 54 Spanish speakers in the population. And

we were completely unsuccessful at getting other language speakers. I think that is also not unique to biomonitoring. It is difficult to reach across language barriers. People have other concerns other than participating in a biomonitoring study. And in the current climate, I think it is difficult to go in as a government group and collect information on people who might have other concerns about giving up their information.

But it is -- it is one of the things we are cognizant of for the next region, particularly it's a very heavy Spanish-speaking population.

CHAIRPERSON SCHWARZMAN: Go ahead.

PANEL MEMBER SUÁREZ: Kind of going back a little bit with a big picture view of the California Biomonitoring Program, or any biomonitoring program are really what are the objectives, right?

So one is really to understand what the exposures are in a population, which will help us get into targeting which groups are at greater risk. Now, some of the issues with that particular comment with a lot of the persistent compounds is that, well, we can't identify who is at greater risk, but we can't really do anything about it, which is one of the reasons why screening in this case -- this particular scenario would not be ideal, because

you've screened for things that you can't do anything about, at least at the individual level, which kind of takes us to a next stage probably a different objective of screening or the biomonitoring is to understand how good our policies are.

So that's why we have all these different time trends of exposure. We can see that certain chemicals are starting to decrease. After the ban on say DDT, we now are seeing with NHANES and just about anywhere that DDT concentrations have been going down at least here in the United States. And then not only the same thing with for PFAS and whatnot.

And this -- this is something that has me thinking as well with trying to get to what Tom was talking about with what are some of the views -- more proactive views of a Biomonitoring Program. So in a way, can we get -- we can never really stay ahead of the curve when we're talking about use. We're always behind the curve, right?

So there's a new chemical that's synthesized and introduced by industry for whatever purpose and then we're merely trying to catch up with that. But then the proactive or more progressive view is, well, how can we be not so far behind of that curve where we're not only studying those chemicals that were banned 20 years ago,

but we're trying to keep up with some of the newer ones.

And, of course, then the challenge becomes, well, what are the chemicals that we should be including there, given that we still don't know enough information about toxicology about those chemicals, first of all. We can at least look at the structure and say, well, they become -- belong to a certain class, and they could potentially have similar effects of -- as other chemicals in that same class, and whatnot.

So to not really digress too much, given the comment that you were -- that you mentioned that is a certain -- there are certain criteria about which chemicals should be thought of to be then included in the Biomonitoring Program. I would really like to hear a little bit more about what has been done. Maybe not right now, if it's not something that is really -- there's a method behind it specifically.

But it might be something worth discussing more about, to try to stay a little bit -- not too far behind that curve of the usage.

MS. HOOVER: Just to -- so this is Sara Hoover, and, yes, we're not going to talk about that today, but I will share offline our paper, where we go into our method. It's also laid out in the law. So if you read the law for bio -- establishing legislation, it explains the criteria.

So actually which I probably emailed to you when you -- in your orientation. So I'll re-send it, but along with the paper, which gives a little more details.

PANEL MEMBER SUÁREZ: Thank you.

PANEL MEMBER FIEHN: We have discussed a little bit of -- about privacy and access to information. And that is, of course, a very grave concern for everyone. And we have received comments from people who say there's, you know, a lot of information out there that it's maybe not correctly incorporated yet. And I'd like here to encourage everyone who is involved in analytical chemistry of, you know, these types of compounds and compound classes to release the information that you have, if you're working for the public.

So there is a lot of people who have databases. They call them in-house databases. They have protocols. They call them in-house protocols. You know, that is only so much helpful, because other people may face the same problems, and we should not try to reinvent wheels when it's not necessary.

So spectral libraries should be on-line and should be public. And data should be on-line and public, if it's possible to make them on-line and public. Sometimes you can't make them on-line and public, but there is lots of databases and repositories out there now

that people can, you know, look at those data, help in the analysis, confirm analysis, and also confirm identity of compounds, or even say, well, I have a different opinion on that.

So this is, I think, how we should go forward at least as when we're working for the public.

CHAIRPERSON SCHWARZMAN: Thank you.

Any other comments or questions before we adjourn for lunch?

Okay. In that case, I just want to mention a couple things before we adjourn. One is that staff have helpfully provided a little map of places that are within a five-minute walk as some suggestions for lunch. We have an hour for lunch. We'll be convening -- promptly reconvening at 1:25.

And finally, I need to provide the following informal Bagley-Keene reminder, which is that as -- that you need to comply with the usual Bagley-Keene requirements and refrain from discussing Panel business during lunch and the afternoon break. And that's only for Panel members.

Okay. So we will yeah -- 1:25, I said it. So we'll reconvene at 1:25, and we'll adjourn the morning session.

Thanks.

(Applause.)

(Off record: 12:22 p.m.)

(Thereupon a lunch break was taken.)

A F T E R N O O N S E S S I O N

(On record: 1:24 p.m.)

CHAIRPERSON SCHWARZMAN: Okay. We are going to reconvene the meeting.

Thank you all for finding your way back. And I'm going to -- the first thing I'm going to do is just turn it over to Sara Hoover. She's the Chief of the Safer Alternatives Assessment and Biomonitoring Section of OEHHA. And she is going to give us a brief overview of the afternoon session and introduce our guest speakers.

(Thereupon an overhead presentation was presented as follows.)

MS. HOOVER: Thank you, Meg. And thanks everyone for returning promptly. So you got a pretty good idea this morning about what we're trying to do here today. And I think we've made an excellent start in the morning session. So our focus this afternoon is to try to delve a little bit more into our discussion topics, which is measuring exposures to PFASs in California, next steps.

And this being the Biomonitoring California Scientific Guidance Panel, we really are looking for specific input to Biomonitoring California.

--o0o--

MS. HOOVER: Russ, advance.

A few technical difficulties here with the...

No, it's on. Weird.

Back. Two more slides back.

Okay. All right. I think this is the slide we were -- sorry, we're having some technical difficulties here.

So -- and these informal discussion questions that we came up with, we've actually been thinking about them and sharing them for months with our guest discussants, our guest speakers, with Biomonitoring California staff. So a lot of what we've already presented and what you will hear presented revolve around these questions too.

So one of the questions is what do we know from currently available data? Which of the newer PFASs are of greatest concern in terms of potential for exposure in California? Is there any information on that we can tap into? Do we know what some of the most significant exposure sources are to PFASs in California? And should we be focusing on particular groups that might be more heavily impacted?

I'll try again.

--o0o--

MS. HOOVER: Ah. Okay. Now, it's working.

All right. Now, we actually touched on this a little bit this morning already. Possible ways to expand

measurements of PFASs. I think most of us have a general sense of it's a good idea to look for more PFASs, but that's a question. Should we expand? Are our panels sufficient?

And if we do decide to expand measurement, what should we focus on? Should we expand and automate an expanded panel of PFASs for targeted measurement, so we're looking for specific chemicals and quantifying what we see?

Should we instead or in addition focus on semi-targeted analysis that Sabrina was talking about, which is a way to more broadly screen for fluorine-containing compounds, but you don't have the confidence of exactly what you're seeing? So if you really want to have that confidence, you have to follow up with targeted measurement.

And then another important point that we've discussed many times, and I think it's worth mentioning is, not just biomonitoring but in terms of looking for important chemicals to use environmental sampling as a complimentary approach. And we welcome your ideas on possible ways to move forward

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MS. HOOVER: The other really important point, and we're kind of following up what we did in March, where

we talked to the Air Resources Board about potential collaborative opportunities related to community exposure to air pollutants, we're doing the same thing today. So you'll see two of our guest discussants are colleagues of ours from CalEPA. And we really want to look at future opportunities to help tackle high priority concerns.

But we also want to look are there any near-term ways? So we all have talked about our limited resources of the program. That's a reality that we're always dealing with. But you also can see that we've done an amazing job with a small amount of resources. We have a lot of materials, expertise, interesting studies. So are there some near-term ways with existing resources to look at ways to help enrich exposure assessment and regulatory efforts by others in the state.

In terms of possible future opportunities, for example, it might be possible to conduct a targeted biomonitoring study in a community impacted by PFASs in drinking water.

Another example might be to conduct an intervention study related to PFASs in consumer products or foods. And again, we welcome other ideas, and other possible support opportunities.

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MS. HOOVER: So with that, I also want to say, as

always at these meetings, we have a limited amount of time for talking in the meeting. Although, I think we've had a lot of incredible feedback already. But I welcome people at any time to send input after the meeting to this email address.

And with that, I'd like to introduce our afternoon speakers. So we're really thrilled to welcome Antonia Calafat and Erika Houtz. Antonia is the Chief of the Organic Analytical Toxicology Branch at the Division of Laboratory Sciences in the National Center for Environmental Health of CDC. She earned a Ph.D. in chemistry from the University of the Balearic Islands. She leads CDC's Biomonitoring Program for assessing human exposures to a wide range of environmental chemicals, including pesticides, consumer product chemicals like phthalates, triclosan and parabens, flame retardants and PFASs and other persistent organic compounds.

Antonia is a world-renowned expert in biomonitoring science and has been a mentor and friend to our Program since its inception.

Erika is the PFAS analytical lead at Arcadis. And she joined Arcadis, which is a consulting company, in 2016 after two years as a research scientist at DTSC. She holds a Ph.D. in environmental engineering from UC Berkeley. She specializes in investigating the

environmental impacts of PFASs, including developing analytical methods for measurements in a range of media, and researching the fate and transport of PFASs in natural and engineered systems.

Some of her PFAS projects at Arcadis include developing guidance and conceptual models for characterizing contaminated sites, evaluating the efficacy of treatment, technologies, and working with laboratories to commercialize new analysis techniques.

So first, welcome to our speakers. Thank you so much for coming. And now I'm going to turn it over to Antonia. She will be talking about her recent work, developing a urinary biomonitoring method for PFASs, including some pilot results and the challenges of this approach.

After Antonia speaks, we'll have some time for questions. And then Erika will be discussing insights about exposures to PFASs gained through environmental measurements.

Antonia

(Thereupon an overhead presentation was Presented as follows.)

(Applause.)

DR. CALAFAT: Thank you, Sara. It's always a pleasure to be here speaking in front of the Panel. So I

want to thank you for the invitation to be here once again.

And I know we're pressed for time, so -- and being the first speaker before or after the lunch is kind of a challenge. So I hope I won't keep you -- just don't want to put you to sleep.

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DR. CALAFAT: Well, we don't start well.

So we heard this morning from Jennifer about different sources of exposure to PFASs. I call them PFASs, so just allow me this. And some of the -- one of the sources that has attracted quite a bit of attention recently is drinking water, contaminated drinking water.

And in this slide, I just wanted to say that we have known that these chemicals end up in water for quite a bit. Some of these papers go back to just 2003 with one of the first papers by Jennifer Field delivering in the field.

And -- but since probably the past couple of years oh so, then there has been more attention after EPA just went with the -- with their health assessment in -- for PFOS and PFOA, and the discovery of more and more PFASs in drinking water supplies throughout the United States.

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DR. CALAFAT: PFAS had a quite a diverse family. And we heard about this a little bit in the morning, so I'm not going to be talking much about it, but just to tell that there are hundreds of hundreds of chemicals, so it's thousands of chemicals. And what all of them have in common is that they possess this perfluoroalkyl moiety. And I'm a chemist by training, but I'm not going to bother you with chemistry, except just to say that I have put some of the main classes of chemicals for PFASs, for lack of a better term. And on the left side we have the ones that we have been monitoring in NHANES, and on the right side are the ones that we are monitoring right now.

So those within this family's, three are main -- the main families, and all of them are within your list -- your targeted list of chemicals in California: The carboxylic acids, exemplified by PFOA; the sulfonic acids by PFOS; the amides that MeFOSAA is one of them. And on the right side I'm including some that are the ones that have been attracting attention because they have been found in drinking water. And those are some of the species that have an ether, so they have this ether bond structure, if you want, of functionality in their -- in their structure.

And these are only just two examples. One is GenX, the other one is a DONA. And then we have -- some

of these are carboxylic acids, so kind of equivalent to PFOA but it's an ether functionality, and the sulfonic acids exemplified by this compound. And the truth is that there are many, many others.

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DR. CALAFAT: There are many properties in this, because there's such a light number of compounds, and that obviously they encompass a wide range of properties and functionalities. But in this light, I just wanted to show for the purpose of the talk then some properties that are common and some that are not common to these -- to these compounds. And I'm going to start by, you know, just saying that I'm going to be talking about, like I say, the legacy compounds. When I talk about legacy PFASs are going to be those that we have included in NHANES count from day one. That was NHANES 1999-2000.

And there are some that have a long alkyl chain, and there's -- just is defined by the number of carbons in the structure. And they have some with a short alkyl chain, again the number of carbons. And then there are some that I'll call them alternative and emerging, for a lack of a better term. So this is just a way to -- the nomenclature just to distinguish between the different compounds I'm going to be talking today.

What these compounds have in common is that they

all have been detected in the environment quite just by the spread detection in the environment, and that some of them have persistent in people. And this year, I'm talking persistent in people because when you do biomonitoring, then you're going to have to be looking at what matrix do you want to use for biomonitoring. And it's going to be largely, not exclusively, but impacted by the toxico-chemistry or the toxico-chemical properties of the compounds.

So, in general, the long alkyl chain PFASs have long half-life in humans. By contrast, the short alkyl chain and the alternative or emerging PFASs have a shorter half-life. The use of the long alkyl chains is decreasing, because many of them were discontinued -- production was discontinued of this CA chemistry, related chemistry, PFOS-related chemistry in the early 2000, 2002.

There were also changes in manufacturing for 2000 -- for PFOA that were implemented up to 2013, I believe. And this means that these compounds, they use -- at least on paper, are -- is going to be going down, when they use of other compounds to replace the functionality that these chemicals were providing and that you cannot use them any longer than are on the rise. And this pertains to the short alkyl chain and the emergency -- the alternative or emerging compounds.

We know quite a bit about human exposure to the legacy PFASs through our work in NHANES. And in here what I said less known for the short alkyl chain is because in NHANES we only had two of the short alkyl chain, compared to the long -- the many more long alkyl chain compounds.

But regarding with the alternative and emerging compounds, quite a -- there's no match known or regarding human exposure.

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DR. CALAFAT: So this is just a schematic view of what we have been doing in NHANES. After all, we started the PFAS program at CDC in the early 2000s. Our first method paper was published in 2004, so we're talking 14 years ago already. And we included these compounds in NHANES starting with the year -- the cycle 1999/2000. And that was before the changes in manufacturing practices. And we continued up to 2013 to 2014.

In 2001 and 2002, we had no serum available for NHANES to do the analysis. That's why there is this gap. You can see that we monitor two short alkyl chains since 1999-2000. One of them we started with 2003-2004. And for all the others, we have been monitoring them for several cycles. As mentioned earlier today, I can't remember now if it was Jennifer or Kathleen or Sabrina --

(Laughter.)

DR. CALAFAT: Anyway, the FOSA and EtFOSAA we discontinued measuring them in NHANES for the cycle 2013 and '14, because simply we were no longer detecting these compounds. In a world of limited resources, we just have to try to be as efficient as possible. And then so we decided to pull them out of the panel, and no longer monitor these -- are monitoring these compounds at least for NHANES.

In terms of the emerging and alternative PFASs, and I here include like GenX, then we do not have yet information on NHANES, but we're working on it, as you will see.

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DR. CALAFAT: And in this slide, I'm just talking -- seeing what NHANES data have shown us so far. In terms of the long alkyl chain PFASs, then we have, as I mentioned before, data from 1999-2000 before the changes in manufacturing practices and after.

And in all cases, we observed widespread exposure to the long alkyl chain PFASs, and in this graph -- and then cleary we have seen a reduction in concentrations and we assume related to reduction in exposures for all these different compounds beautifully illustrated, in my opinion, for PFOS, which is almost like a textbook graph that shows that, you know, like the chemical is removed

from the market and concentrations in people are going to start going down.

And I'm presenting here the geometric mean concentrations. And I'll tell you why.

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DR. CALAFAT: Because for the short alkyl chain compounds, and as I mentioned in only two of them that we have been looking at, Perfluorobutane sulfonate, or C4 -- the C4, PFAS, and perfluorooctanoic acid as C7. And in this compound -- for these compounds, what I'm showing in this graph is the 95th percentile. And I know there are many numbers, but there's -- the main point is that the 95th percentile these concentrations are fairly low -- fairly low concentrations, difficult to see whether there is even a clear trend, and very limited exposure -- I mean, detection frequencies. The LOD is were around 0.1 part -- 0.1 parts per billion. This is true for many of the other, the long alky chain compounds.

And then yet we were detecting like only like -- let's say, we can only Calculate the 95th percentile, because we have very little detection frequency. So we always were wondering why are we seeing so little of these compounds? Is this because there's limited exposure to these chemicals, or is it because serum is not the best biomonitoring matrix.

Remember, these are -- have relatively short half-life on the order of days or months compared to years for the long alkyl chain compounds.

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DR. CALAFAT: And for this reason then we decided to just say okay. They just go and develop a new method. And when you go and think about developing a new method for assisting exposure to this alternative and short chain PFASs, then you need to think about the matrix. And the choice of the matrix is really critical, and is largely based on the half-life of the chemicals in humans.

And then, in general, with some exceptions, we use urine for non-persistent chemicals and blood for persistent chemicals. This is because although analytically as an analytical chemist, we can measure pretty much anything as long as we have a standard -- an instrument and a good chemist, then we can measure many different compounds, but we need tradition information to demonstrate that these compounds are really valid exposure biomarkers.

So perhaps the perfluorobutane sulfonate and the perfluorooctanoic acid in serum were not good biomarkers. We need to look for those in urine because those are short-lived compounds.

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DR. CALAFAT: So most of us are chemists at CDC listed in my branch in our division. And then we decided to develop a method to look at these chemicals in urine. The method had to fulfill the requirements that CDC demands from biomonitoring methods that has to use the minimum amount of sample, include the maximum number of compounds -- relevant compounds I should say, and just -- I said -- and have the highest sensitivity. So we developed the method in just that -- woops. Sorry.

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DR. CALAFAT: -- that that looks at -- okay.

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DR. CALAFAT: Well, I'm going too fast. Sorry about that -- that uses 50 microliters urine. And we can use -- look at 18 PFASs -- different PFASs, includes short and long alkyl chain PFASs in addition to three of the alternatives.

And with this method that we just recently published in Chemosphere earlier this year, I'm just going to show this very nice chromatogram. This is of our QC sample that has been spiked with concentrations going from 0.5 to around 3 parts per billion of the analyte. And in here you can see that we have some of the short chain that obviously are going to be coming earlier in the chromatogram, because they're smaller and much more polar

and water soluble.

This is one of the alternatives, the GenX -- what is called GenX. This is the DONA. And then the last one eluting is the alternative sulfonate.

And in between you're going to have supreme match. All of these are short chain. And with the two alternatives, all of these are long alkyl chain compounds.

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DR. CALAFAT: SO having a method is great. But if you don't apply the method, then it doesn't do you any good. So we applied the method and to -- we purchased -- we bought 50 paired urine/serum samples from a commercial company. These were specimens that were collected from donors and adults. They were in 2016. We have no information about the demographics of those participants.

And then again this is a busy table, but I'm going to -- you know, I'm showing the frequency of detection, a median, a 90th, a 95th, and a maximum. And limit those detections, so the sensitivity of that method was for all compounds 0.1 parts per billion, or a 100 parts per trillion.

And what we could see -- so it's really okay to compare the frequency of detection, because for all the compounds we had the same LOD. So if you're seeing a low frequency of detection compared to something that you have

a high frequency of detection, then it means either again that you have higher exposure to one particular compound versus another, assuming that they are all good biomarkers.

This -- the results that we show from the -- in serum we're mimicking very much what we found in NHANES, high detection frequency for PFOA, and perfluorooctanoic acid, the C8 and the C9 carboxylates. And then the perfluorohexanesulfonate and the PFOS, the C6 and the C8 sulfonates. And hardly any of the short alkyl chain compounds were detected. And we also did not detect in serum any of the three alternative compounds.

In urine, to make a longer story short, we only detected one compound, perfluorobutanoic acid, the C4 carboxylate equivalent. And when we detect it, then we detect it in not even 60 percent of the samples. So if this was NHANES, we wouldn't be able to establish a geometric mean. And the medium concentration was only 0.2 parts per billion, only about twice the LOD. So the concentrations of these short alkyl chain compounds in urine were hovering the concentration -- I mean, around the LOD. Not too high.

We also have access at CDC to some samples that we collect periodically.

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DR. CALAFAT: I should say these are convenience samples of male and female adults. And I should say that these are all male and female adults from Georgia. So these are people that collect -- provide anonymously some samples, and then they're actually CDC workers that provide. So they may not live in Atlanta, per se, but they are all in Georgia.

And they -- we have no reason to believe that they are exposed to PFASs. So they're -- we use these samples for all our methods to just -- when it's time to do our QCs to do our work -- our first examination of trends, or whether the method is suitable or not.

And again, what we can see in here, then we had some samples that collected in 2001, and some samples collected up to 2015. The numbers are different. And in a way we're comparing apples and oranges. But again, just to show that we -- for these short alkyl chain compounds, including the C4 as carboxylate and sulfonic acid C5, C6, and C7 acids, then we do not seem to see much of these compounds, at least in these urine samples.

For the samples collected in 2015, we seem to see kind of an increasing concentrations for the perfluorobutanoic acid. But again, the 90th percentile is fairly low or is a little higher than the percentile that we had in those 50 samples.

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DR. CALAFAT: These data compare quite well with the data that had been published in other parts of the world. And this is -- I don't pretend that you will go and look at this table. This is just a table taken from this paper published in 2014 that look at the concentrations in urine and in serum in 120 children in South Korea.

And what they found was again that the short alkyl chain compounds, C5, C6, and C7 the concentrations in urine, were higher than the concentrations in serum, something that we would expect if these compounds are ended, short lived, or just have short residence in the body. And the long chain PFASs were not detected in urine exactly we found.

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DR. CALAFAT: So in order to interpret all these data I presented today, then I think very important to consider a few pointers. And then if you think about drinking water source of exposure to PFASs, then the levels of these PFASs in water tend to be in the parts per trillion range, at least for non-persistent chemicals.

Normally, when you do biomonitoring, the concentrations in the people are much lower than the concentrations in the environment. This means that if for

short alkyl chain PFASs, for the short-lived PFASs in drinking water, then exposures are episodic. They may happen with a certain frequency in your drinking water, but you're voiding your bladder also periodically. So these chemicals are not staying in the body very long.

Then the concentrations that you're expecting to find in the urine are going to be fairly low. So with our detection methods or our detection limit of 100 parts per trillion, we may not actually be able to detect much of these compounds in the urine for the short alkyl chain. Because if you think about it for the persistent compounds, for those that have high half-lives of years, PFOS/PFOA, we detected them in the serum, but the levels were parts per billion, and low parts per billion. So you would expect lower concentrations for the non-persistent chemicals. So in a way, the data that we are -- we are obtaining do make a lot of sense to me.

The NHANES serum data that we have since 1999-2000 again matches with these observations, because we have medians that are in the low parts per billion range for those long alkyl chain PFASs. And for the short alkyl chain PFASs, then we hardly detect them. And when we do, the concentrations are around, you know, 0.1, 0.2 parts per billion.

The pilot data that we have again suggests that

long alkyl chain PFASs are not going to be found in urine. Those are circulating in the body, and they're excreted in urine, it's true, but very low concentrations. So urine is probably not the way to look at those.

And at least in the samples that we have so far, we have very limited evidence that there is detection of any of the other short alkyl chain PFASs or those fluorinated alternatives.

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DR. CALAFAT: So if you need to remember something about what I said today, just remember the third bullet. And then based on the paired urine/serum data, I think that it would be -- you really should be looking at serum for the long alkyl chain PFASs or any of those PFASs that have a relatively long half-life in the body. And do not use serum for the short alkyl chain compounds. Just -- it probably is much better if you go and look at it -- look at them in urine.

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DR. CALAFAT: We are planning on continuing NHANES. Although, we're seeing those beautiful trends and decreased concentrations for some of these compounds. And we know that these PFASs are being produced in other parts of the world. And after all, several of those have been categorized as POPs.

And then so they can -- you know, who knows, they may just show up again, you know, some years from now. We don't know. And then we stop monitoring them, then we will never know.

We are actually in the process of finalizing the analysis of -- oops. I don't know if it was me that moved something -- in urine --

(Laughter.)

DR. CALAFAT: Oh, okay -- in urine that the NHANES 2013-2014, and that -- in which we are measuring PFAS and the alternatives. And what's beautiful about this data set is that we are -- these are matched urine/serum samples from NHANES participants.

So we already measured PFASs, our regular panel, the one that I showed in one of the first slides, in serum. We also measured some of those PFASs in one subset of samples of children 3 to 11 years of age. And now, we're going to have urine data from everyone three years of age -- I'm sorry, that's 2013 -- six year of age and above for -- in urine. And let's see what these data are going to show.

We are also planning on looking at some PFASs in paired urine/serum samples from exposed populations, and continue our R&D on alternative PFASs.

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DR. CALAFAT: And as one of the speakers mentioned before, then one wouldn't be able -- I wouldn't have the privilege of being here presenting the work done at CDC without the hard work of several of my colleagues. In particular, Zsuzsanna Kuklenyik who started the PFAS biomonitoring program back in the -- when I said she was a co-author in the 2004 paper.

Kayoko took over from Zsuzsanna when she moved somewhere else. And Xiaoyun Ye, who's untimely death last month just cut short her career, and a beautiful person who contributed tremendously to public health.

So I just want to acknowledge the contributions, the contribution of my co-workers in the branch, the Organic Analytical Toxicology Branch, and our peers at the National Center for Environmental Health.

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DR. CALAFAT: And I'll be happy to answer any questions.

(Applause.)

CHAIRPERSON SCHWARZMAN: Thank you so much, Antonia. We have ten minutes for questions for her before we move on to our next speaker.

Yes, Jenny.

PANEL MEMBER QUINTANA: Thank you for that.

I was happy to hear you mention you'll be looking

at urine of children because I was thinking that for many analytes, the concentrations are much higher for children due to their small stature and their intake. So have you had any preliminary data or have you had a chance to look at that at all?

DR. CALAFAT: I mean, the serum data we already have the data.

PANEL MEMBER QUINTANA: The urine.

DR. CALAFAT: And those were -- actually, the concentrations were quite similar to the concentrations in the adults. What was interesting is that many of the children -- this -- because remember this is 2013-2014, so children who were three to 11 years of age, many of the children were born after the changes in production and changes in manufacturing practices of these PFASs. Yet, we pretty much detected in serum -- this is serum. So PFOA, PFOS, the main four, PFNA and the perfluorohexanesulfonate in every single child.

It could, you know, like that there was -- we know that this -- the children are born, you know, like just through gestation. Then there is some tests. The children are born with already have some of those PFASs. Breast feeding, as well, we didn't have information to look into that. But the concentrations were quite similar.

In terms of the urine, I -- as you know, I cannot speak about data -- NHANES data that are not public yet. And actually, I have not even seen the final data that we would have -- because by now, I only have -- we only have like a sample ID. We don't know whether that sample is from a child or from an adult, but it's going to be interesting to see what happens later.

In terms of the long alkyl chain, I can tell you that there were not dramatic differences. It's not that the children had much higher concentrations. But again, let's just remember that many of the children were born after the concentrations in the environment are much lower than the concentrations that parents presumably were exposed to.

For the short alkyl chain, there was no difference. We didn't detect them in children. We didn't detect them in adults in serum.

PANEL MEMBER QUINTANA: So I guess I have another comment too that if something has short half-life, if the exposure is very constant like water, then the levels in the urine should be pretty constant even though the half-life is short. But if the exposure is infrequent -- let's say when you go out once a week for pizza and it's in the pizza box, then you'd have to get lucky when you took that sample to detect it. So there's some issue

about sources, and how often they're exposed, which is interesting.

DR. CALAFAT: Yeah. This is the challenge when you're talking about non-persistent chemicals, because sometimes people say non-persistent chemicals they have a short half-life. Short half-life is one aspect of why you may not detect them so readily, but it's not the only one. It's just the nature of the exposure. So exposures are not constant. We, for many of our work, the exposures that we're experiencing, at least the current use chemicals at exposures that are -- that just happen, you know, recurrently, they may not have the same intensity every time, and then you never know exactly how frequently they're going to happen.

So if -- the truth is though that with many of the other non-persistent chemicals, then you manage to get some detection in the urine compared to the detection in the -- in the -- if you're looking at urine. And you may remember I think the last time I was here, I was talking about phthalates. And then phthalates are non-persistent chemicals. Yet, you know, exposures are again happen from time to time. Many times, they're from diet. So we eat every day, but we don't eat the same thing every day, and we don't eat all the time, at least some of us, and then --

(Laughter.)

DR. CALAFAT: So then the -- but yet, we manage to detect those concentrations in urine, we've had very similar detection frequencies. So the fact that we're not detecting some of these compounds in the urine, some of the short alkyl chain PFASs, it just gives me some reassurance -- maybe perhaps -- I don't know reassurance is the right word, but some hope that maybe the exposures are -- I mean, they may be concerning the environment. These chemicals are very stable. They're going to be staying with us for a long time.

But maybe for human exposures, they may not be something -- the exposure may not be as high as we would have had anticipated, if we are looking at the right biomarker.

These compounds metabolized somehow, and we are not looking at the right biomarker is the same thing as looking in the wrong matrix. You have to have the right biomarker. So that's why I'm saying that we are continuing our work to just make sure that what we're looking at is actually what we should be looking at.

CHAIRPERSON SCHWARZMAN: Go ahead, José.

PANEL MEMBER SUÁREZ: So I have a question about -- so it's very interesting, at least for -- even for epidemiological studies, and, of course, for different

surveillance systems, the measurement of chemicals in urine, which especially for children, it's quite useful to have that matrix as an option, at least to measure potentially -- I think from your report, the ones that you saw were PFBS and some PFHpA, right? Do you know what the within individual versus the between individual variability of these compounds in urine?

DR. CALAFAT: For these compounds, we know very little, because we have only started the analysis in urine very recently. I say that as a chemist and all the chemicals tend to be -- I mean, they have different names, they have different structures, but they have something that makes it kind of -- that common.

So that -- for biomonitoring is kind of that half-life and the type of exposure. So if I assume that for the short -- the short-lived compounds and the type of exposures that they have. In general, when you have compounds that are coming from diet, the reproducibility in concentrations tend to be pretty poor, a least among adults. Because as I said, we eat every day, but we take to it something different every day.

However, if you have -- if the chemicals are coming from exposure that tends to be more like a personnel care product use, then that reproducibility is a little better, maybe because you tend to use the same

product day after day. It may not be good the reproducibility within a day, because you take the shower, let's say, in the morning, and then you collect the sample in the evening, so, you know, you're going to have some big changes.

So the way that people have moved in the field of nonpersistent chemicals to address this unavoidable variabilities in collecting multiple samples. So it's not a perfect situation, but multiple samples are much better in characterizing exposure to these non-persistent chemicals that a single sample would be.

PANEL MEMBER SUÁREZ: Right, so, but that hasn't been done. You haven't done that yet?

DR. CALAFAT: No, we are not even close.

CHAIRPERSON SCHWARZMAN: Yeah, veena.

PANEL MEMBER SINGLA: Thank you so much for that very informative presentation. You spoke about the diversity of PFASs as a chemical class. Could you speak a little bit about the 18 PFASs that were included in your method and kind of the coverage of the chemical class amongst those?

DR. CALAFAT: So, yeah, we went from a C3 to a C12, so -- in terms of the legacy compounds, so -- and they're as small as 3 as large as 12. We looked at the ethers, so those three -- the three alternatives -- this

new -- I mean, I don't like to say new chemistry, because maybe it's new for me, but these chemicals have been around for a while. So it's new for us, because we have not addressed them before, but -- so for this different chemistry, so to speak. So we had those three alternatives. Those were the ones that we had adequate access to standards.

As somebody mentioned earlier today, then, you know, when you're doing quantification, and biomonitoring is about quantification, then you need to have reliable standards, otherwise, then you can have everything else. The matrix, you have everything, but if your standards are not adequate, they don't work. And we also had three of the amides in all those legacy, but those we actually were not able to look them in urine, only in serum.

But -- so we did as much as we could in trying to make a method that would be -- provide reliable information with -- encompassing a wide range of chemistry at least in our view.

CHAIRPERSON SCHWARZMAN: I had one final question, which is maybe you said all you can already about this, but I was wondering if you could say any of your thinking about why the levels of -- why the detects -- the percent detect is so low for some of the shorter chain PFASs, which, as far as we know, is really

what a lot of companies have switched to from longer chain. And so it gets at this issue of, you know, persistence -- lack of persistence is one of the issues.

And yet, we see for other chemicals like phthalates or the phenols that also are not persistent but to which there's presumably relatively constant exposure that there are very high percent detect of those.

DR. CALAFAT: Yeah.

CHAIRPERSON SCHWARZMAN: And so what are your thoughts about why we're not really seeing them? And is it because of this issue of them -- the main exposure route being diet or --

DR. CALAFAT: So, I mean, I think that it may be multiple fold. But one thing that we need to keep in mind is NHANES is representative of the general population. So what this data suggests to me is that perhaps overall exposure to these chemicals is not as prevalent as to other nonpersistent chemicals.

Then in certain areas, there may be certain focal points, and that's why I think it's going to be very interesting for us to just have access to some of these samples from areas that have known contamination, and at least, let's say, for example, from drinking water, and then collect urine and serum and then just evaluate what we find to determine whether, okay, in these populations

that are -- that is known -- known to have exposure, can we just see -- can we detect these compounds? And if so, at least within the ones that we measure, can we detect them more than we do in NHANES.

If it's diet, again, I just think that perhaps this would mean that the presence of these chemicals in the various sources that are contributed into the levels that we're detecting are not as widespread distributed in the United States as would be for let's say some of the other chemicals like the phthalates just because -- just to stick to the same example.

CHAIRPERSON SCHWARZMAN: Thank you so much.

We're actually out of time in this segment. And if you have an issue, we're going to have a bunch more discussion time. So please just jot down your question or comment, and we'll return to them. And I want to turn it over to Erika.

(Thereupon an overhead presentation was presented as follows.)

DR. HOUTZ: Hi. I'm Erika Houtz and I work for an environmental consulting company called Arcadis. Most of my PFAS-related experience has been in the more environmental sample arena, so groundwater, wastewater, stormwater runoff, soils and. I did a little bit of work on human samples when I worked for DTSC. And so I'm going

to be talking about different things we might conclude about PFAS exposures from what we've seen in environmental data.

Is my volume good on this?

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DR. HOUTZ: A little bit closer. Okay.

I'll just skip the overview and go straight to the first slide.

So first, I wanted to discuss major locations of PFAS point source contamination, at least as we understand this right now. So these might be specific communities that are more highly exposed due to a high level of PFAS generation in their community. So primary manufacturing is possibly the most important source of exposure in some communities. It sort of depends on how it's getting out into the environment and potentially impacting people. But certainly in terms of environmental concentrations, we see much of the highest levels around the areas that are actually manufacturing these chemicals.

But we also see that in manufacturing sectors where they're applying PFASs to their products. So you might see that in the treatment of textiles or in the blending of firefighting foams, for example.

And then next on the list, we have two sources that are highly related to firefighting foams. In

particular, firefighting foams that are used to put out fuel-based fires. Usually, we're talking about aqueous film forming form or AFFF. There are some other PFAS-containing foams, but the AFFF foams are the most important.

And one of the things that's really use -- or critical to think about in terms of the use of foams is that they're released directly to the environment. They have a very direct pathway, by which they might get into groundwater or surface water that could be used as a drinking water supply.

And also sort of getting at a question that I think it was Meg just posed about why we're seeing, you know, not very high levels, PFASs, in general, are not used at very high amounts in most of the products they're found in. It's other kinds of POPs that we've maybe worried about in the past or potential use of percentage levels in certain products. That's really uncommon for how PFASs are used in most products.

But an exception to that is actually these firefighting foams. They're in the neat formulations at about one percent level according to the safety data sheets. They are blended with water before they're used, but -- so they're a relatively high concentration source of these chemicals.

And then other kinds of point sources that I would say we understand sort of less well in terms of how much of an issue they are, are again mostly related to firefighting foams, municipal fire training sites, refineries, large railyards, metal plating facilities. This came up earlier. PFASs are used as mist suppressants to -- I believe to protect workers from metal fumes. So it's kind of an interesting confluence of some of the things that we are concerned about.

Wastewater treatment plants and landfills can also be concentrators of PFASs, particularly if they're receiving some type of waste from manufacturing or another, you know, major PFAS product.

And I just wanted to talk about -- a little bit about where we see some of these different sources, particularly as we're thinking about California. And I must confess that honestly most of the -- my understanding of these PFAS point sources are not in California. I'm not entirely sure if that's just due to the types of projects that I've worked on or where in reality the contamination is occurring. But I think a lot of it is that some of the stuff is not going on in California.

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DR. HOUTZ: So primary manufacturing, I was told by the FluoroCouncil, typically occurs near where there's

some kind of a -- I think it's calcium fluoride source. So in North Carolina, we've heard a lot about GenX. This is a current primary manufacturing as in they're making GenX a North Carolina type of issue.

PFOS and PFOA were historically manufactured in Alabama and Minnesota. And PFOA in West Virginia and Ohio. That's where we have seen that C8 study come out of.

And then in terms of secondary manufacturing, where PFASs are applied to other products, there's been a big issue with PFNA in New Jersey, I believe, due to a PVDF manufacturing process. That's why PFNA is of interest in that state, but you don't usually see it come up in other places.

And then similarly, PFOS and PFOA have become issues due to different kinds of secondary manufacturing throughout the New England area and Michigan. And we see some types of PFAS-associated manufacturing in the southeastern U.S. related to furniture and carpeting manufacture.

I'm not familiar with any major secondary manufacturing locations in California. Although there might be. Military fire training in crash sites and airports, we know these are nationwide issues. We know that mainly from work the DOD has done investigating

potential PFAS releases associated with their use of firefighting foams.

And then I also wanted to highlight refineries. I haven't seen hardly any data on PFASs associated with them. But we know they have the same kind of need for the firefighting foams that some of these other entities have had.

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DR. HOUTZ: So just to summarize what some of these major potential sources in California might be military fire training and crash sites. There's a decent amount of data on that available related to work the Air Force has done, for example.

There could be secondary manufacturing. I am not personally familiar with any -- within the state, but there might be.

Airports, refineries, metal plating, and also just in terms of more broad exposure, not necessarily point source exposure, general consumer product use is another source of exposure for anybody. And wastewater treatment plants can sort of concentrate a lot of these different consumer product uses.

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DR. HOUTZ: Most of the environmental data available that's been collected so far is on the

perfluoroalkyl sulfonates and carboxylates. A couple different reasons for this. You can readily analyze for these compounds at commercial laboratories, and drinking water, ground water, soil, some labs can do fish. Air is a very uncommon matrix to find methods for. There's more toxicity data available for these compounds, which has led to the development of either standards or sort of guideline values, which then sort of creates the driver to actually collect this data. And as a result, state and federal requirements for sampling have focused on these compounds.

There are a couple of other compounds that there is a reasonable amount of data for, this methyl FOSAA ethyl FOSAA. They are part of the U.S. EPA drinking water method, also FOSA. And then 6:2 and 8:2 FtS are two compounds that are associated with firefighting foam used. There's a decent amount of data available on -- and they're also associated with other industries beyond firefighting groups.

Decent amount of data on GenX, particularly North Carolina. I would say the peer-reviewed literature is a good place to look, if you want to find out anything and everything that's been measured so far. A lot of it is through non-targeted methods, not using authentic analytical standards. So I'm not saying the data is not

legitimate, but it's important to understand that it's sort of tentative identification in measurement.

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DR. HOUTZ: So typically drinking water exceedances have driven PFAS environmental data collection efforts, meaning that if there's been some type of drinking water measurement of usually PFOS, PFOA above a threshold value, that sort of triggers the environmental investigation.

And certainly, the U.S. EPA's UCMR3 data collection effort that occurred from 2013 to 2015, it sort of revealed different large -- mainly large-scale drinking water systems that had detectable levels of six different PFASs. And then that was sort of the initiating event for a number of environmental investigations that followed.

Small scale private wells may have some of the highest PFAS levels, just because when you're talking about discharge to a surface waterbody, particularly if it's a large river, there's a lot more dilution. Whereas, you could have a groundwater drinking well, particularly a private well that is right in the middle of some major contamination source.

So certainly what we've seen in the environmental investigation community is that it's often private wells that require the most immediate attention, and have the

highest detections. And so it's also, I just want to point out, not always the government that is initiating drinking water testing. There have been a couple of notable events that have happened where private citizens have taken their water to get tested. And that has sort of led to cascading set of events, in terms of either drinking water treatment, or further environmental investigation.

I believe in Hoosick Falls that it's a private citizen that sort of kicked off understanding that there was a PFOA problem in that area. And then there was also a student project in Sweden where -- it was like a summer project where a high school teacher had a bunch of kinds bring in drinking water from their homes. And that was sort of how that particular region learned that they had a lot of PFAS contamination in their drinking water.

And then also the military is doing a lot of the PFAS investigations. And most of their environmental investigations are really focused on potential pathways to drinking water.

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DR. HOUTZ: This may be a map a few -- a few of you have seen a number of times. It's just sort of a summary of the U.S. EPA UCMR3 survey results. The black dots represent detectable levels of PFAS. The green dots

represent -- you know what, I think the black dots, I'm sorry, they represent sampling locations not detectable levels necessarily. The green dots represent values where greater than 70 parts per trillion PFOS, PFOA were measured. And most of those detections were groundwater sourced systems.

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DR. HOUTZ: I did briefly want to highlight on potential environmentally related non-drinking water exposures. And these are issues that come up a lot, particularly in community events, where, you know, some kind of communication about potential PFAS exposures has been -- has been issued.

Fish consumption is another non-drinking water exposure pathway that could be affected by some type of environmental release. Michigan recently issued a do not fish consumption advisory in a particular part of Michigan, Huron River I believe.

Sometimes crops, either just like a home garden or a larger scale agricultural system could be affected by PFAS releases. Actually, one thing that's been pretty serious occasionally with crops is when PFAS-impacted biosolids have been -- have been spread over an agricultural area.

Airborne exposure is possible. You really don't

see a lot about that, because most of these compounds are not volatile. Usually, it would be some type of particle associated exposure. And then soil ingestion is another potential, but typically not hugely concerning, way of ingesting these compounds.

And I did want to point out that the U.S. EPA health advisory for PFAS/PFOA in drinking water assumes that is a 20 percent relative source contribution, so 80 percent is coming from other sources.

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DR. HOUTZ: Other drivers of environmental data collection are academic studies or, in some cases, known or suspected major PFAS releases. I believe it was this work that was done through -- partly through EPA and partly through academic institutions in North Carolina that identified GenX and the Cape Fear Region.

And then there are a couple of regulations around groundwater that sometimes drive environmental data selection efforts. A few of them are noted here.

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DR. HOUTZ: Okay. So in terms of identifying new potential compounds or as Antonia was saying not necessarily new in the world of chemistry but new to us. A couple of -- I'll go over a couple of ways we might go about -- thinking about that and doing that.

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DR. HOUTZ: There's only one U.S. EPA method for PFASs and it is for drinking water. And it is validated for 12 of the perfluoroalkyl acids, and two of the polyfluorinated precursor compounds. Things get a little murkier when we're talking about groundwater and soil methods, because there are no standard EPA methods.

So most labs are offering methods that follow this Quality Systems Manual 5.0 -- sorry, 5.1. It is an agreed document between DOD and EPA, I believe that kind of guides environmental investigations. There's also two methods from ASTM for non-potable water and soil.

And so these methods, not the EPA method, but the other ones have the potential to add more analytes than just the 14 under 537. So if you have a particular compound you want to add, they might be potentially compatible with these two methods.

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DR. HOUTZ: I'm not going to talk about this in detail, but we could talk about it in the Q&A section. These are just additional tools where you can measure either PFAS mass or tentatively identify particular PFAS structures. So the top three methods are essentially surrogate methods for total organofluorine compounds. The top assay is specific for PFASs and it does provide some

information about the perfluoroalkyl chain length.

The total organofluorine methods are not necessarily specific for PFASs, but still could be useful in identifying a major concentration of organofluorine compounds.

And then high resolution mass spectrometry can be used to -- as Sabrina was discussing early, to identify other compounds that we don't have authentic analytical standards for. But I do just want to stress that it's going to depend a lot on how you prep the sample, what you might see on that instrument, and also whether it's GC or an LC.

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DR. HOUTZ: So I'm thinking about what new PFASs we may want to investigate and where to do so. I want to talk about three examples or three points of interest. One is domestic wastewater. This is likely to reflect PFASs that are currently in use. And the detection limits for most compounds are probably going to be too high to identify PFASs that are being contributed through non-point sources.

But this may be a way to percolate the samples that are highly concentrated to identify new current use PFASs. Another place you can look are the discharge points of known or suspected sources, assuming you have

access to that location, or at the point of exposure, or particular receptor.

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DR. HOUTZ: So this is a study that DTSC and San Francisco Estuary Institute did in 2014. The take-home point is that we were looking at domestic wastewater from different wastewater treatment plants around the Bay Area and comparing 2009 data to 2014. In both cases, there were six treatment plants tested, not necessarily the same six in both years.

And we did see statistically significant increases in two of the short-chain compounds PFBA and PFHxA. And we saw non-statistically significant declines in the average concentrations of PFOA and PFAS. So this is just to illustrate, even in a five-year period, we could see pretty -- pretty different trends in the wastewater effluent.

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DR. HOUTZ: This is an example of a conceptual site model, basically looking at different sources, and receptors, and identifying potential pathways --

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DR. HOUTZ: -- just in the context of where to investigate to identify new PFASs, because either you can do it at the source or somewhere along the pathway or at

the receptor.

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DR. HOUTZ: I would say there are pros and cons to identifying at either the source or the receptors. Some of the pros of identifying at the source of a release will be that you'll have higher detections. And from an engineering point of view, you also have the potential to manage the problem, if you identify one.

Plus, you'll be able to identify the compounds that were released potentially versus their transformation products, which could be useful depending on what your -- your goals are.

Some of the cons of identification of the source are that the compound may not actually end up resulting in an exposure. Maybe it's a Relatively immobile compound, and it's just not going to make its way to a receptor. So you may have to employ fate and transport prediction in modeling to kind of understand what's likely to get out of a receptor.

And then also, you know, as with anything, there can be multiple things impacting a receptor, so that's another disadvantage of identifying at the source.

Some of the pros of identifying at the receptor is that it's pretty reflective of current exposure. And in many cases, we may be more concerned about

transformation products and what was actually released. And also, this approach will screen out compounds that weren't getting to the receptor.

But some of the cons are that honestly the compounds may not be there at high enough levels to detect. I mean, in some ways that could be a probe, because perhaps if you can't detect it, it's not important any way. But, you know, different things impact a detection limit. Additionally, identification at a receptor may screen out certain compounds that may migrate there eventually.

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DR. HOUTZ: So a few concluding thoughts. When collecting new data, these are some of the things that certainly we think about.

Identifying compounds without authentic analytical standards or measuring them with non-standard methods may not stand up to public, regulatory, or legal scrutiny.

And if the data becomes publicly available, and you're collecting it more for exploratory purposes or potentially, you know, like you would do in an academic paper, an interested public will want to know what it means regardless of whether there are standards currently developed.

So I've seen this occur, for example, with somebody -- somebody gets a report back about the groundwater well, and they have PFBS, and say it's 80 parts per trillion, well, that's above the health standard for PFOS/PFOA and how do we interpret that for that particular compound? I'm not saying collecting too much data is necessarily a bad thing, but there can be drawbacks.

And another point, which is really important, particularly from a treatment point of view, but also from bioaccumulation, as the mobility of certain PFASs increase, they're usually associated with decreasing bioaccumulation, which is, you know, why we might think about looking at urine versus serum.

And so the compounds measured at the receptor may be more mobile, but potentially cause less concern, since they're less bioaccumulative. However, the really mobile PFASs are very challenging to treat in drinking water and other types of waters, just because they don't -- they don't adhere well to a lot of the treatment technologies like GAC and ion exchange that are currently used for treatment of these compounds.

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DR. HOUTZ: So in summary, California has some potential major PFAS sources. Manufacturing doesn't

appear to be one of the major ones in this state, but there are other potential large point sources. Most of the environmental data collection is on a small subset of compounds, so it can be a bit of a challenge to look to the environmental data to know what to look for next, unless you're really mining the academic literature.

Typically, drinking water exceedances drive what kind of environmental samples are collected. And there are a variety of methods that can be used to identify either a total PFAS, or total organofluorine concentration, or to tentatively identify individual compounds, and where you investigate will, you know, determine what you find.

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DR. HOUTZ: So thank you for your attention. And I also wanted to -- for those that are -- want to read more deeply about specific PFAS topics, the ITRC panel has a 250 person working group on their PFAS working group. And there are seven fact sheets that are ten pages or less at this website that are all peer reviewed among the community.

So I would recommend going there if you want to read more about fate and transport, or AFFF, those types of topics.

CHAIRPERSON SCHWARZMAN: Thank you very much,

Erika.

We have --

(Applause.)

CHAIRPERSON SCHWARZMAN: We have a little time for questions, about five minutes.

Yeah, Tom.

PANEL MEMBER McKONE: I have a brief question of clarification. On your earlier slide, you had a note about railyards and a picture of a railyard, but what's the source in railyards?

DR. HOUTZ: I think similarly firefighting foams.

PANEL MEMBER McKONE: Okay.

CHAIRPERSON SCHWARZMAN: Martha.

DR. SANDY: Thank you for your talk. I have a few questions about -- so I'm Martha Sandy, sorry, OEHHA -- the traditional, the PFOA and the PFOS, the old guard there. How common are they or ubiquitous are they in like environments -- indoor environments consumer products? Do you have a -- I'm just wondering, do you have a problem when you're doing measurements worried about background levels or do you have any problem with contamination in analytical laboratories with PFOA and PFOS?

DR. HOUTZ: Yes. So PFOA and PFOS, often one or the other, not typically both, does show up in certain --

so consumer products, I haven't seen frankly any real recent data on that. I've seen some historical publications on PFOS/PFOA presence in consumer products. And, yeah, you do see them in a variety of products that contain fluoro chemicals.

But in a laboratory setting, PFASs are kind of all over the place. So usually if you're analyzing PFASs, you have designated equipment kind of like clean areas to prevent cross contamination. So like, for example, low retention pipette tips that are desirable for the analysis of some kind of sticky POPs containing PFASs, And particularly if you're pipetting ethanol or another solvent that can desorb those compounds from the pipette, you know, that will introduce contamination.

And similarly, most LC-MSs, the instrument most commonly used to measure these compounds, contain a lot of PTFE tubing, which will leach fluoro chemicals seemingly forever based on my experience

(Laughter.)

DR. HOUTZ: So either the tubing is replaced or there are different things an analytical chemist will do to separate out the background contamination.

DR. SANDY: Thank you.

CHAIRPERSON SCHWARZMAN: Gina

DR. SOLOMON: Gina Solomon with UCSF. And thank

you for that talk. I was hoping you could talk a little bit more about some of those alternative methods, the TOP, the PIGE, and the organo -- total organic fluorine, and what you see as some of the pros and cons of those different methods, and also the degree to which some of those might potentially be useful as sort of a cross-check on some of the more targeted methods to see if you're kind of capturing the fluorinated universe with the more targeted methods?

DR. HOUTZ: Sure. I'm just going to go back to this slide, so we can -- so there are two methods of measuring just organofluorine. They both require isolating any organofluorine fraction from inorganic fluoride, for instance. So there's different ways you can do that, but one method is called PIGE, Photo[SIC] Induced Gamma Emissions Spectroscopy where you shine a -- here we go. You shine a beam of light on a product. The thing that's nice about this method is that you don't actually have to do much prep, because it measures fluorine on a thin surface.

And so that is a way of measuring total fluorine or hopefully total organofluorine, if you've been able to clean your sample. And then you can also extract PFASs using, for example, granular activated carbon, and then incinerate that carbon and measure the resulting fluoride

on an ion chromatograph.

So these are two methods in which you can measure organofluorine. I think that those two methods are -- yeah, they're kind of nice screening tools to see if you do have any organofluorine present. I would be careful deploying it with like wastewater, because there are a lot of other kinds of fluorine containing organic chemicals that are not, strictly speaking, PFASs.

For example, I think there are some x-ray compounds or compounds that are used some kind of medical screening that contain fluorine that you would -- you know, that would give you a signal for organofluorine even if it's not strictly PFAS.

So we've often seen these types of tools used for -- particularly PIGE, for commercial products just trying to understand if they contain, you know, like maybe your testing a paper plate to see if it has some type of organofluorine content.

TOP assay is a method that converts polyfluorinated compounds to compounds that we can easily measure.

And by mesh, you

(Microphone went out.)

DR. HOUTZ: Thank you.

And so by measuring the sample before and after,

you can get kind of a surrogate number for precursors present in that sample. That's a method that I worked on in grad school, and we've applied it to a number of environmental samples. And I would say we typically see that something like 20 to 70 percent of the PFAS fraction in most environmental samples that we looked, particularly ones that have been impacted by firefighting foams, contain these precursor type compounds.

It's pretty rare that we would see -- that we would look for a targeted list, not see anything, but then have a huge hit with one of these other techniques. I would say that, in my experience, analyzing a variety of environmental and human samples, it's pretty rare to not detect PFOS/PFOA or one of the shorter compounds, but then to get a huge measurement from something like TOP assay or AOF. But it also kind of depends on what the release is and how recent it is.

So one example that I would say would be really useful with one of these tools, say you're dealing with a spill of aqueous film-forming foam that was recently manufacturing. AFFF doesn't contain anything that we look for in these normal targeted analyte lists. So, you know, if you use one of these surrogate measurements, then you can actually have an understanding of how much contamination is there, particularly if you're trying to

clean it up.

CHAIRPERSON SCHWARZMAN: Thank you, Erika, very much. We're going to move on now to some guest discussants. I want to introduce Simona Balan and Darrin Polhemus. Simona is a senior environmental scientist at DTSC -- excuse me -- where she leads the Safer Consumer Products team working on PFASs. Before joining DTSC, she was a senior scientist at the Green Science Policy Institute managing international products on the -- international projects on the use of flame retardants and PFASs in consumer products. She earned a Ph.D. in Environmental Science Policy and Management from UC Berkeley. And I had the pleasure of having her in a class.

Darrin Polhemus is the Deputy Director of the Division of Drinking Water in the State Water Resources Control Board. His division administers the federal and California Safe Drinking Water Acts regulating over 7,400 public water systems throughout the state.

The Division also issues permits for recycled water usage, oversees the work of county health departments that are responsible for small water systems, and develops regulations pertaining to drinking water. Darrin has a BS in Agricultural Engineering from California Polytechnic State University.

So we'll start with Simona and then go to Darrin, and then we'll have time for questions.

(Thereupon an overhead presentation was presented as follows.)

DR. BALAN: All right. Good afternoon, everyone. And thank you for inviting me here to talk about how biomonitoring could help the Safer Consumer Products Program.

And I just want to start briefly for those of you who are not familiar with our program with just a quick intro.

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DR. BALAN: We are part of DTSC. And we are tasked with implementing the Safer Consumer Product Regulations. So we have a four-step process. We start with a list of about 2,500 entries of candidate chemicals. It's basically a list of lists from 23 other authoritative bodies, including the priority chemicals for biomonitoring in California.

And if we identify a consumer product that contains one of these candidate chemicals that we think is of concern because of exposure and adverse impacts, then we can call that product chemical combination a priority product, and add it to the California Code of Regulations. If we do that, manufacturers have to do an alternatives

analysis, and answer the question as to whether this chemical is necessary in the product, and if there's a way to do the product with a safer alternative, whether it's chemical or non-chemical.

And based on the results of the alternatives analysis, we then issue a regulatory response, which can range from no action, if none is needed, to a ban, or anything in between.

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DR. BALAN: So biomonitoring can be particularly important for the second step, the identification of priority products, because we have to address two factors in our regulations. We have to show that there are potential exposures to a candidate chemical in the product, and that one or more of these exposures have the potential to contribute to or cause significant or widespread adverse impacts.

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DR. BALAN: And because the universe of consumer products is so big, every three years we issue a priority product workplan, where we identify a smaller range of product categories that we will focus on, as well as some possibly priorities that will be guiding our work over those three years.

So because back in 2015, the Scientific Guidance

Panel voted to add the entire class of PFASs to the list Of priority chemicals, they have know become part of our candidate chemicals list. So we have been looking at the entire class of PFASs in the product categories in our 2015 and 2017 workplan.

And these are the product categories that were in that workplan, and all of them contain products with PFASs. So we've -- we've researched some of them, and we particularly focused our initial workshop on carpets and rugs, upholstered furniture, and cleaners and protectors, or care and treatment products for carpets and upholstery.

And following that, we decided to start by taking a closer look at carpets and rugs. And we have proposed to regulate carpets and rugs containing PFASs -- any PFASs as a class. So this is here a screen shot of our -- the cover of our technical document that talks about the rationale for choosing this product chemical combination.

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DR. BALAN: But it's -- the exposure is really not straightforward. So this is just one of our conceptual exposure model diagrams just to illustrate the complexity of assessing exposure from consumer products to PFASs, to humans, or biota. So humans, or animals I guess, could become exposed to PFASs from carpets and rugs by dermal contact. All right. That's probably not a

major source of exposure, but that's a direct source.

Inhalation as well of volatile fluorotelomer alcohols that are released from carpets in an indoor environment could be another source. And ingestion is probably the more complex one, because ingestion could be happening directly from dust that's contaminated with PFASs emitted from carpets and rugs inside a room, but it could also be indirect through environmental contamination, because carpets and rugs that at the end of their life end up in landfills could then be long-term sources of PFASs into the environment, including in groundwater and other drinking water sources.

And sludge or biosolids from wastewater treatment plants that treat landfill leachate could then also be applied to agricultural fields and make their way into the food chain. So there is direct and indirect routes of exposure to PFASs.

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DR. BALAN: As we were doing our research, we identified several key data gaps. Some of those are related to biomonitoring some not, but I thought it would be good to mention them.

And just to point out, none of these data gaps are precluding us from moving forward with our proposal to regulate carpets and rugs of PFASs, but they would

definitely be good to know as we move forward and for the scientific community.

So first of all, like other speakers have mentioned, publicly available data are limited to perfluoroalkyl acids and a few of their precursors, and mostly the longer chains. Yes, there is some data on short chains, but it's mostly environmental monitoring. And as Antonia is pointing out, some of that is serum data, so it's just probably not as relevant.

So we definitely could use more data. There's also not a very clear relationship between the environmental presence of these PFASs and actual adverse health impacts. Those links haven't been made very clear so far.

And even more importantly, we don't fully understand the effects of mixtures. We've looked at individual compounds, and there are now a few studies that show that mixtures of PFASs may cause adverse impacts, even at levels when the individual compounds don't, or PFASs may be exacerbating that adverse impacts of other contaminants, such as PCB 11, I believe, was one that was studied, including the short-chain PFASs.

There's also an unclear -- or less clear understanding of the relative importance of the different sources of exposure. So for a typical Californian is the

major source of exposure from drinking water, is it from food, is it from consumer products? I don't think we have a good answer to that so far.

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DR. BALAN: So here's how I see biomonitoring studies potentially helping support our program, and adding to the body of literature out there. I think we need more studies on short-chain PFASs in different matrices, even beyond urine to whole blood. So there was some studies that found short-chain PFASs in whole blood, even if they didn't detect them in serum, as well as other matrices. Like in nails and hair, there have been a couple of new studies from China that looked at perfluoroalkyl acids in nails, and found them to be a fairly good matrix for studying these compounds.

I also think we need to look at the intermediate degradation products. For instance, perfluoroalkyl acids are not added intentionally to the consumer products that we've looked at, but they are the final degradation products of those PFASs added. And the intermediate products include fluorotelomer carboxylic acids, fluorotelomer aldehydes. There was a recent study just published this year by FDA scientists that looked at the metabolism of 6:2 FTOH that eventually degrades to PFHxA. But 5:3 fluorotelomer carboxylic acid is an intermediate

fluorotelomer.

And they found that even those 6:2 fluorotelomer alcohol and PFHxA are not persistent. This 5:3 fluorotelomer carboxylic acid appears to be persistent inside cells and may lead to toxicity in there.

I also think we need studies that are focused on California's most vulnerable and sensitive subpopulations, including workers. For instance, we know that there are higher levels of fluorotelomer alcohols in retail -- in stores that sell carpets, and upholstery, and outdoor clothing or outdoor equipment.

But I haven't seen a study that actually biomonitored those workers and looked at their serum -- or their body burden of these chemicals and if that really has an impact to their exposure.

And lastly, I think it would be great to have some intervention studies before and after removal of specific consumer product exposures sources, but, of course, that's really challenging to do for the longer chain PFASs that have such a long half-life in the human body. But for the shorter chain PFASs, this may be -- this may be possible especially, you know, with the right matrix.

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DR. BALAN: So these studies would definitely

help us think about the next round of priority products that we may be selecting from the 2018-2020 priority product workplan. All but one of the product category in this new workplan contain products with PFASs, everything except for lead acid batteries. So this is the menu that we'll be analyzing over the next three years. So I look forward to hearing the results of future studies, and thank you for the opportunity to speak again. This will conclude my remarks. Thank you for listening.

(Applause.)

(Thereupon an overhead presentation was presented as follows.)

SWRCB DEPUTY DIRECTOR POLHEMUS: So good afternoon. I'm Darrin Polhemus. I'm Deputy Director for the Division of Drinking Water at the State Water Board, as was previously mentioned. And I was going to go quickly through what we've done at the Water Board for drinking water components of PFAS.

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SWRCB DEPUTY DIRECTOR POLHEMUS: So what do we know? Starting there. So U.S. EPA did collect the UCMR data, UCMR3, as was discussed. Those are the materials, the six PFASs that were in it. From that in California, there were 133 detections. And you can see how it broke out amongst the materials that were found.

Additionally, we had voluntarily reported to our data gathering system 297 other detections that were done through water testing, at water systems throughout California. And you can see how those were displayed there.

That amounts for a total of 430 samples that did come back with detections above the UCMR detection limit, which was 20 and 40 parts per trillion, depending upon PFOA, PFOS, and some of the other ones, so rather high detection limits in that first round.

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SWRCB DEPUTY DIRECTOR POLHEMUS: So following that, U.S. EPA issues their health advisory at 70 parts per trillion combined of the PFOA and PFOS only. They immediately called us after issuing that and took an unusual step. Usually, when they issue a health advisory, they don't do this. But in this instance, they did. They advised us to contact all the water systems that were above the 70 part per trillion health advisory level, and see if we could get them to reduce their source, either take them offline or address them.

There were six water systems in California that were -- fit that bill where they were serving water that was above the 70 parts per trillion. Four of them took those sources offline. One of them was discovered the it

had treatment trains afterwards that were likely removing the material. And they didn't see it in the actual distribution water. And one of them set up a blending mechanism to blend with a well that didn't have it, so it would drop below the 70 part per trillion level.

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SWRCB DEPUTY DIRECTOR POLHEMUS: I'm going to run through a quick series of maps just to give you a closer view of the U.S. -- United States of America map that had all of the UCMR data to show you kind of where we found it. This first one is -- I'm sorry, we can get you the full map later, but I'm just trying to do a screen shot of where it was at. You can see we had just a few Northern California -- or Central California sources, and then group of them in Southern California in the L.A. basin area, where there were some below and some above the 70 part per trillion. And particular map is for PFOA/PFOS only.

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SWRCB DEPUTY DIRECTOR POLHEMUS: This next slide is zoomed in then on Southern California. You can see the locations for the PFOA and PFOS detections.

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SWRCB DEPUTY DIRECTOR POLHEMUS: And then if we jump to another set of maps that then throws in all six,

you can see that there really wasn't any difference in spread between the first two. There's kind of more dots clustered in the same general areas, but it didn't broadly expand where they were at. So they seem to be co-concurring at least at the moment for the six materials that were part of the PFOA/PFOS.

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SWRCB DEPUTY DIRECTOR POLHEMUS: And the same thing here when you zoom in, you can see like I think the biggest change is there's a bunch more detections in the Camp Pendleton Marine Base southern -- very bottom right-hand corner of the map there.

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SWRCB DEPUTY DIRECTOR POLHEMUS: So based on this, I want to explain quickly what kind of our first regulatory response -- or step is. So under statutes for our authorities in the Division of Drinking Water, we can issue notification levels, which are non-regulatory, non-mandatory. Non-regulatory -- I'm going to say that a couple times -- advisory level that we issue, so that public water systems will understand that we have some concerns with that level, and should, you know, address it appropriately under their kind of own powers, but they're not required to.

So we set that for chemicals where there's no

MCL. This is kind of like a pre-first step maybe in arriving at an MCL, but not all notification levels do. There are numerous notification levels for materials that never made it all the way to a maximum contaminant level, regulatory setting level.

And from that, we also set a response level associated with that. That's usually a multiplier of generally it's been 10 times the notification level. In this instance, I'll explain that it was a little bit different for particular reasons.

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SWRCB DEPUTY DIRECTOR POLHEMUS: So there is -- as I mentioned before, the notification level is advisory to the drinking water system. The only requirement is is if they do voluntarily test -- I should go back to the slide. Sorry. It was on this part. It's the third bullet. If they do voluntarily test, and if they detect above -- or they detect a material above the notification level, then the statutes do say that they are bound then to both report it to us, so that we have that data at Division of Drinking Water, and that they are to notify their governing board of directors, so who -- if it's a city council that's over the water system, or a board of directors of a water system.

And that's the extent of it. They can then

choose, and we often suggest that they do advise the public, but they are not required to.

And the response level differentiates -- at that level, we again only recommend. It's up to them to take actually the source offline or treat the system.

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SWRCB DEPUTY DIRECTOR POLHEMUS: So there is a -- there is a slight change when you go to our regulations, in that we have put in our regulations for groundwater replenishment projects, where drinking water will be used from recycled products where the water is recycled, it's put in the ground, and it's extracted later as a drinking water source. We do in those instances are -- have our regulations require the monitoring for notification for any material that has a notification level. And so in this case, they would be required to test for PFOA and PFOS.

That same rule will end up in our Surface Water Augmentation Regs, which are going to be official as of October 1st. They're in the administrative approval process and will be coming on the books. And it's basically the same -- the same requirement. And I would anticipate that we would continue that trend with any type of scenario where we're using recycled water that's going to end up in a drinking water source. So that's

established by regulation not statute.

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SWRCB DEPUTY DIRECTOR POLHEMUS: So this is the first notification level issued by the State Water Board itself, since the Drinking Water Program was transferred from the Department of Public Health to the State Water Board for PFOA and PFOS. We issued them together. It was done with the help of OEHHA and some recommendations and review that they did for us, and helped us in going through the -- what health information there was associated with it.

In essence, we chose to issue notification levels at the two levels you see there, 14 parts per trillion for PFOA, 13 parts per trillion PFOS. These are consistent with also the State of New Jersey actions that have been taken previously.

So we basically have issued those. They're now standing. There are laboratories that are getting certified through or ELAP program so that they are qualified to test for these materials and we will wait to see what kind of data comes in. A lot of water systems do voluntarily test for these materials. They're concerned about their exposure of the public from those systems. So we do expect to get a fair portion of data. It will be a couple months, a year or so, before we actually expect to

see a bunch of it coming? But we'll standby and see what we get from that.

It will be luckily at lower levels than the UCMR3 data. So we did establish a revised testing method for this, 537, revision 1.1. It does have lower detection levels than was used in the UCMR3, so we'll see if we can get below the numbers and just get a better feel for what the overall level in the water systems are.

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SWRCB DEPUTY DIRECTOR POLHEMUS: Also, next steps are were we issued these two notification levels as initial notification levels just kind of a term I made up as we were pushing it out to be clear that we were continuing to look at it, and that we may revise our stance on it, as we and OEHHA continue to look a little deeper into it. So we can change that as we get a little farther along.

And we're -- you know, this first -- this is really the first step in helping us gather further data to see whether I will make a formal request of OEHHA to develop a PHG associated with that. And then that would be a precursor to establishing a maximum contaminant level.

And that's it.

(Applause.)

CHAIRPERSON SCHWARZMAN: Thank you very much. We have a comment -- a little time here for questions, sorry, for both our discussants. And then after a break, we'll have a big discussion time.

Did you have a question, Jenny?

PANEL MEMBER QUINTANA: Hi. Thank you for that talk. I had a quick question about the temporal nature of exceedances. Were these like a single sample that was over in a year, or would it be over every time the water was tested, or would it change over time? I know that for San Diego we have different blends of water depending on the different time of year. And I'm just curious about your exceedances, if that was a single one and many non-exceedances, because we were talking about temporal exposures earlier?

SWRCB DEPUTY DIRECTOR POLHEMUS: Right. You know the data set is all over the map on that. There are some of them that have just pulled -- some of the water systems pulled one sample for the UCMR, some of them followed up with other samples. And so, you know, when I mentioned there was 430 detects, some of those are one water system they kept testing, you know, every quarter or every month to try to see what was going on in their particular water system.

So you've got to look at kind of each data line

and see whether it represents a multiple set or not.

PANEL MEMBER QUINTANA: My other question is have they looked at this in reclaimed water or what's kind of tastefully called toilet to tap water?

SWRCB DEPUTY DIRECTOR POLHEMUS: Yeah, we don't use that term.

(Laughter.)

SWRCB DEPUTY DIRECTOR POLHEMUS: Let's ban it from the room. For highly recycled water, yes, that was what I was mentioning is that -- so whenever we issue permits associated with recycling water that will end up as drinking water, right now we only have indirect methods. You put it in the ground and it takes, you know, six months to actually be extracted as drinking water. We are just doing one where you can put it into a reservoir that has six months retention time as well.

You know, we are slowly building closer and closer to direct potable reuse, where there -- you know, the time will be hours to minutes from end of treatment to serving it in a water system. But that's a ways off. There's a lot of scientific studies underway at the moment before we get there. But we do require PFOA/PFOS, because now they have a notification level to be tested in indirect recycling projects at the moment. And that I'm sure will continue for the -- yeah.

PANEL MEMBER LUDERER: Thank you for that talk. That was really interesting. I was wondering whether for these exceedances, is there any kind of a requirement for investigation to kind of understand where these chemicals are coming from for a particular water system, or is that kind of on a more of a case-by-case basis, whether the system chooses to do that. As you mentioned that one where they did multiple samples.

SWRCB DEPUTY DIRECTOR POLHEMUS: Yeah, it I think, you know, the -- it's varied. Some of them are pursuing trying to figure out the sources, and some of the ones we're looking at as well along with them to try to understand what a potential source is, especially the ones in L.A., they -- you know, they don't seem to be near an airport. Maybe there's some manufacturing in the past that seemed to release it.

So there's -- you know some of them are curious, some of them are kind of like obvious. The Camp Pendleton ones are kind like, okay, well, you know, the military is looking all over, because they are finding that they used it a lot and it's showing up there. So it kind of varies.

At the moment, anybody that's exploring it is doing it on their own. There is none from our, you know, clean water, groundwater, regulatory side, and clean-up type programs. We don't have any active -- anybody

actively pursuing a clean-up case against someone that is known to have been a discharger in it. So we're way early in the game, kind of at the detection stage, and figuring out what it really means to the water system. And then, obviously they can move into to potential remedies as they get further long.

CHAIRPERSON SCHWARZMAN: I have one very brief question about the UCMR3. And that's just a single point in time 2013-2014, is that right?

SWRCB DEPUTY DIRECTOR POLHEMUS: Yeah, I was one -- basically, one pulled samples from multiple sources out of a water system they had. That also is really skewed to large water systems -- large water systems do test or -- under the UCMR, and then they select a very small number of small water systems to test. So it's not a really complete sample when it comes to that standpoint.

CHAIRPERSON SCHWARZMAN: And as far as you know, we don't have other sources of data over time about the presence of perfluorinated compounds in drinking water right, where, there's repeat tests at the same location.

SWRCB DEPUTY DIRECTOR POLHEMUS: No, the UCMR data is the very first stab at it. And then, like I say, some of them continue to do testing and reported that to us, so we have a very small trend in some instances, but it's a really small data set at this point.

CHAIRPERSON SCHWARZMAN: Thank you.

My other question is for Simona actually, because I know that a lot of work goes into this Safer Consumer Products selection process when looking at a particular product category, and then a -- the combination of a class of chemicals within the product category. And I was just wondering what you could tell us about kind of what you've learned about occurrence and use of PFCs in a variety of product categories, and how you settled on carpeting, and just the -- what you learned from that in terms of as -- as we try to think about where chemicals are coming from that people might be exposed to?

You know, we're thinking about drinking water and the firefighting foams. And then what did you learn about commercial products -- or, sorry, consumer products?

DR. BALAN: So we looked at the product categories in our 2015-2017 workplan. We looked at carpets and rugs, upholstered furniture, cleaners and protectors which fall under cleaning products, personal care products, and clothing.

The personal care products is complicated, because the PFASs that are used in personal care products have no toxicity data as far as we know. There are a couple studies that found perfluoroalkyl acids as impurities in those personal care products -- in some

personal care products, but it's not enough to justify for us to move forward.

So I think we need more studies to find out if perfluoroalkyl acids are impurities, more widespread in personal care products.

We chose -- so we looked more in detail at upholstered furniture and carpets because they are pretty big sources of exposure indoors. One of our policy priorities was chemicals that are in indoor air and dust. So that's why carpets and rugs really met that policy priority. They are very big sources indoors. As you can see it's a big surface indoors. And more approximately half of California households have carpets, and a lot of office spaces, a lot of commercial spaces.

So we thought that, you know, it's obvious a very widespread exposure source in California directly. Like most Californians are going to come in contact with carpets on a regular basis. And also they're a really major source of exposure indirectly through landfills. They're one of the big contributors to landfills. So that's why we chose to move with that, because it is a major source of exposure.

Now, that doesn't mean that we're not interested in the other product categories, but this made sense to start with, because it's so obvious.

CHAIRPERSON SCHWARZMAN: Can you say do you have a second choice?

(Laughter.)

DR. BALAN: Do I have a second choice?

(Laughter.)

CHAIRPERSON SCHWARZMAN: Sorry. I should have asked your boss.

(Laughter.)

DR. BALAN: Yeah, no. I mean we -- we looked at those three in the beginning. And now we move forward with this one. And I don't know if we're going to do another one, it was going to be -- I don't know. But for now carpets and rugs.

CHAIRPERSON SCHWARZMAN: Thank you. That's helpful. Thank you.

Yes, go ahead, Anna.

DR. READE: Hi. Anna Reade with NRDC again. I was wondering about the water data, if we know anything more about water systems around DOD sites, not just Port Hueneme. I think the DOD did a recent study, I think 2017, that showed really, really high levels of PFOA and PFOS being detected in some of these DOD sites up to parts per million in the water. And so I'm just wondering if we know more about those sites.

SWRCB DEPUTY DIRECTOR POLHEMUS: Yeah. At this

point, there's no data for the water systems immediately surrounding them. We did some looking, you know, after we saw the high levels from the military data set too. So that's something to future explore to see what we can find there. And most of the really high ones though I think results were in contamination clean-up wells, not in drinking water sources to my knowledge.

So I believe they're all the water sources that were -- not the parts per million levels, those were clean-up wells.

CHAIRPERSON SCHWARZMAN: Andria.

MS. VENTURA: So Andria Ventura again with Clean Water Action. So first of all, thank you to both of your departments. Thank you for the notification level and to OEHHA as well and for the Safer Consumer Products looking at these chemicals.

I just -- I'm going to express my ignorance here. I'm a little confused about the maps that we saw, because I know that there was a study in 2016 Environmental Working Group, UC Berkeley and a few others were involved, look -- trying to extrapolate drinking water sources that were considered contaminated, and wastewater treatment manufacturing sites, et cetera, like metal plating I think. I know some people are working on that. But the map doesn't look like we have a whole lot. And yet, my

understanding is that while California doesn't have the big major spills or legal cases, like we see in the Ohio River Valley or in North Carolina or Hoosick Falls, New York, we have the most detections. So I'm truly asking a question is I didn't understand the map, and if you could clarify that for me.

SWRCB DEPUTY DIRECTOR POLHEMUS: Sure, I'll try to. So the map only represents data from drinking water wells specifically. So I think it sounds like -- and I'm not familiar with the map you mentioned or the study, but it sounded like it included known environmental tests and environmental sites. So this was largely the UCMR data with a few other sprinkles in of just drinking water source wells that were submitted to us specifically or from the UCMR3 data.

So it's just limited to that, and definitely should not be representing -- it really only represents known water sources that had PFOA, PFOS, or the other four materials that were part of the UCMR3. It does not represent, in any stretch of the imagination, whether it my be environmental contamination, or other type of groundwater, or surface water exposures, or any of that stuff. It was really focused on just drinking water sources.

CHAIRPERSON SCHWARZMAN: Unless there are final

questions -- one more. Okay. Yeah, great.

DR. HOUTZ: One thing I wanted to say about the UCMR3 data. The reason why California -- I honestly am not sure if California had the largest number of systems with 70 ppt or more. I actually think they didn't. But many of the systems were tested like three or four times over that 2013 to 2015, period and individual intake wells within a system. So it could appear that California had the most detections if there were like more intake wells or their wells were tested more frequently in that period, but I'm not sure that would necessarily translate to more impacted drinking water terms.

There -- it may have been the most. I'm not sure. I know Alabama had like eight. California I can't remember off the top of my head how many systems were impacted above 70 ppt.

CHAIRPERSON SCHWARZMAN: So we are going to take a -- oh, did you have a follow up?

DR. READE: Do you have time?

CHAIRPERSON SCHWARZMAN: Yeah, we have a minute.

DR. READE: I think the map that you're referring to Andria is they retested Eaton Eurofins Laboratories retested a lot of their samples at -- so the reporting limits for the UCMR data was much higher than the ability to detect with their methods. And when they retested

their samples, which I think represented about a third of the UCMR data, showed that if you did reporting levels at 2.5 or 5 parts per trillion, that there was much higher levels of detection. And that if you extrapolate that out in California, you would get water systems instead of being like in the tens contaminated, more in the hundreds of water systems contaminated. That's my understanding.

MS. VENTURA: That's helpful.

MS. HOOVER: This is Sara. And all I want to say is it's time for a break, as Meg was saying. And also Nerissa very kindly brought some snacks for people. So not paid for by State funds. Help yourself.

(Laughter.)

CHAIRPERSON SCHWARZMAN: So we're going to take a break. And a reminder about the informal Bagley-Keene requirement. And we're going to reconvene exactly at 3:25

Thank you.

(Off record: 3:09 p.m.)

(Thereupon a recess was taken.)

(On record: 3:25 p.m.)

CHAIRPERSON SCHWARZMAN: Okay. I think we're going to start our -- the remainder of our afternoon session. From now through the end of the meeting, minus a little time at the end for some wrap-up, we actually have a open discussion period.

Maybe I should revisit briefly the key questions and discussion questions --

MS. HOOVER: I'll bring the slides up too, if you wanted to go through them.

(Thereupon an overhead presentation was presented as follows.)

CHAIRPERSON SCHWARZMAN: Great -- that the Biomonitor California Program has sort of put forward, that today's presentations were meant to inform.

One is -- let's see, these are summations --

MS. HOOVER: It' a slight paraphrase.

CHAIRPERSON SCHWARZMAN: Yeah. Okay. So we'll just go from the slide, because that's what people are looking at.

Number one, which of the newer PFASs are of greatest concern, thinking about exposure in California.

Number two, what are some of the most significant exposure sources of PFASs in California? And are certain groups, either by geographic area, community, or profession more heavily impacted than others, and should those be a target of studies?

Is there another slide -- of

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MS. HOOVER: Yeah, there's a few slides.

CHAIRPERSON SCHWARZMAN: How else can

Biomonitoring California expand?

Woops. Back one.

MS. HOOVER: It's -- that's pretty much in front of you the second one if you --

CHAIRPERSON SCHWARZMAN: Great.

MS. HOOVER: Oh, here we go. It's up. Sorry.

CHAIRPERSON SCHWARZMAN: Expand measurement of PFASs. Are there ways to expand or automate the panels in a targeted way? Should the Program be focusing on semi-targeted analysis to look more generally at fluorine containing compounds. And what about environmental sample monitoring to complement biomonitoring? And are there other approaches that the program should be considering?

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CHAIRPERSON SCHWARZMAN: And then finally thinking about collaborations with other State programs, either exposure assessment, maybe not necessarily in state, or regulatory efforts on PFASs. And what are possible future opportunities to tackle high priority concerns about PFASs?

So, for example, conducting a targeted biomonitoring study in a community that's impacted by high drinking water contamination levels or conducting an intervention study related to PFASs in consumer products or in foods, and, of course, any other ideas.

So I think you get a sense that the Program would -- about the areas that the Program would like input. And maybe just start -- since I don't see anyone just like jumping at the -- oh, Ulrike is. I'll turn it over to Ulrike, and then I have something up my sleeve.

(Laughter.)

PANEL MEMBER LUDERER: This is something that I was thinking about after Antonia's talk, this whole question of why so many of these short-chain PFASs are not being detected in the urine. And, you know, one -- and I'm wondering whether you have any ideas or any sense about whether -- how much that may be due to -- which is something that you mentioned, which is that maybe they're metabolized and we're not measuring the metabolites.

And then kind of related to that sort of thinking about Sabrina's talk this morning with the non-targeted methods, you know, whether that -- you know, that is potentially a way of getting at that question and trying to discover what some of these metabolites are that we maybe should be biomonitoring.

DR. CALAFAT: Okay. So I have no evidence that those -- the short chain do not seem to metabolize. I mean, it has been known for quite a while. I mean, those are -- I mean, as I said, they're not new. They may be new to us, but the short chain, then they're just known to

be excreted as they were and not metabolized. For the new chemistries or the alternative chemistries like those in those ethers, then what we have seen was that not -- not a metabolism in -- of the compounds, that the compounds would be excreted.

So it seems that we may be looking at the right biomarker. Nevertheless, sometimes, you know, like you find out something later as you go away. I should say that these -- the inclusion of those three alternatives was largely driven by the detection of GenX in -- with the paper from EPA in North Carolina, and then just saying, you know, okay, that this is something that is being found now. Then is there anyway that we can be looking at those in NHANES, so -- and the standards were available.

In terms of the non-targeted analysis, I guess that everything really depends on the purpose of the study on what you're trying to find out. Several of the speakers pointed out, the non-targeted analysis is very invaluable tool for exploratory purposes.

At CDC, we do have several of the non-targeted instruments, if you want. And we have been using those for many years to identify potential metabolites, and compounds that we would like to go and monitor.

Our mandate so far is quantitative, so that's why we have not gone into the -- into the non-targeted world.

As a chemist, non-targeted, untargeted has pros and cons. So eventually a non-targeted is going to be followed by a targeted approach.

And I do know that having thousands of PFASs in the market, having tens of thousands of chemicals in the market, our program at CDC only evaluates exposure to a handful of them. So we are not really just covering everything. So it's not that we're trying to have the most comprehensive approach.

I think that depending on the needs of the program and the intended use of the data, complementing, you know, like a non-targeted approach with a targeted approach with let's say, you know, if you want to identify sources and say, you know, like -- or think that you have a potential source of exposure, and you want to know what you're already looking at from that source that you know and what you don't know, then that approach would be great.

For a California-wide biomonitoring program, I don't know whether a non-targeted approach would be that valid in biological samples. I think it could be incredibly valuable in products, in environmental matrices that after all are some of the sources that we're all exposed to. So if you're finding something at quite high levels in the environment, is it of interest to look at

them in people? So I think that that combination of -- biomonitoring is very close to my heart, but is only one of the tools. And I don't pretend that can do everything.

DR. BALAN: I have follow up. So another reason why we may not be seeing as many -- as high levels of the short chains in urine may also be because the short chains could partition into other organs. There have been studies that show that the shorter chain perfluoroalkyl acids are in higher levels in certain organs, even higher than the longer chains.

So I don't remember exactly which organs, but the studies have looked at brain, kidney, liver. And, of course, that's not something you can do in biomonitoring, but cadaver studies have looked at that. So that's something to consider. I think one of my colleagues found a Ph.D. Thesis recently that was proposing that there seems to be a steady state of these shorter chains in the human body, and they partition in these organs. And we're only eliminating a little bit through urine, but there's a continued -- a constant amount that remains a steady state in different organs.

So that may be one explanation.

CHAIRPERSON SCHWARZMAN: Lauren.

DIRECTOR ZEISE: Yeah, I just have a -- sort of a follow-up question around this issue of detection levels,

because we're -- you know, for the long chains anyway, we have levels of concern in the low parts per trillion, but we're measuring them -- measuring them in humans in the sort of hundred parts per trillion level. So there's a -- the issue is, you know, what is our level of concern and the extent to which if we -- if we end up with a lower level of concern for some of these other chemicals, would it be -- how possible is it to sort of drive down the detection level?

DR. CALAFAT: And I guess that if we were thinking that looking at the -- let's say the short-lived compounds in the body, those that presumably have a low -- a short half-life, then, as I said, you know, our method included -- was from 3C -- 3C -- sorry, C3, if I say it, to C12. So obviously, there's probably no reason -- not probably. There's no reason to look at long chains in urine.

So if we were to develop a method in urine only for the -- through a short chain, or the short-lived compounds, then probably one can lower the detection limits, and then increase the sensitivity from the 100 parts per trillion to a lower level -- to higher -- you know, like let's say maybe 50 or 10.

I -- for liquid chromatography, those are pretty good detection limits using that small amount of sample.

Going much lower than that, you're probably going to face, you know, some other considerations the lab with some blanks levels that then they're going to render your analysis pretty much. Even if your detection limits can be much lower, then you're not going to be able to hold that low, because your blind values.

So to make a long story short, I think that probably you can have methods that have better sensitivity, so lower detection limits. However, you probably would want to really nail down what are the compounds you're interested in in order to give the chemist a better chance to develop the method. Otherwise, it's always going to be a compromise and may not reach the detection limits that are necessary.

DR. ATTFIELD: Can I slide in --

CHAIRPERSON SCHWARZMAN: Kathleen, sure.

DR. ATTFIELD: -- some extra information from the ACE study, which I didn't present earlier, but just because it's relevant to this conversation here.

So for our shorter chain ones that were in serum that the chemists worked very hard on, I think their limits of detection were a bit lower than perhaps what you were presenting today.

So the PFHxA, the six, was in greater than 98 percent of the ACE's participants, whereas I think what

you presented was zero, and PFBA was 60 -- around 65 percent and PFBS also is still very low, and PFHpA in about 25 percent. So we are seeing it in some of the serum samples.

DR. CALAFAT: But what were the median levels?

DR. ATTFIELD: Oh, sorry, I don't have that off the top of my head. But they would be -- they would likely be on low -- in low concentrations.

DR. CALAFAT: Okay. Yeah, because, I mean, obviously the lower is your level -- your sensitivity -- sorry, the higher your sensitivity, the lower your LOD, the higher is your detection frequency. That's why I always say given detection frequencies with our limit of detection doesn't say much, but also is what is your range of concentrations we're looking at.

DR. HOUTZ: And you may recall that Sabrina had mentioned the ACE samples were analyzed with an off-line extraction method, which I think that was something we started when I was at DTSC. And we did that because the online SPE method that CDC developed works really well down to a certain chain link, and then for like the C5 and the C4 carboxylates acids, it just won't retain them. So you have to go to like these more time intensive procedures like liquid-liquid extraction, in some cases, that only work for the short-chain compounds.

There are different kinds of SPE cartridges you could use for the on-line equipment, but I think that was why we ended up going that route.

CHAIRPERSON SCHWARZMAN: Carl had a question.

PANEL MEMBER CRANOR: I have a series of questions and comments in total ignorance. Okay. And it's not clear what comes first. You're concerned about detecting short-chain concentrations in people. But we don't know -- I'm not sure, but somebody in the room may know what the level of concern should be.

So aren't there ways to expedite that so that you have some sense of what detection level you're looking for. I'm thinking animal -- animal data, that takes awhile. But there's mechanistic data. Well, are the mechanisms in common between the long-chain and the short-chain that the studies will reveal and so forth and so on?

So I don't -- sometimes you don't know what comes first. Lauren and others may know what the level of concern is. But it seems to me these two go together, and they need to be somewhat solved together.

Comments. Total ignorance. I'm just asking.

CHAIRPERSON SCHWARZMAN: Does anyone want to respond to any of that?

MS. NUDELMAN: You know, can I just -- just tag

team to that question.

Yes, I will. So my name is with Janet Nudelman. I'm with Breast Cancer Prevention Partners. And I just wanted to tag team with your question there, and make it broader if that's okay. Because my question is, is the safety data or the understanding of safety generalizable to the perfluorinated chemicals as a class?

And I'm asking that question -- and I will profess my ignorance. I'm not chemist. I am a lobbyist. I do public policy. Because there is a movement afoot across the country where advocates within the environmental health movement are seeking to ban the perfluorinated chemicals as a class to avoid regrettable substitutes.

And so -- so I'm going to put that question out there. I know there's a -- as we learn more about some of these chemicals, and they start to be phased out of production, there are new perfluorinated chemicals coming in to production that no one knows anything about. And that's what I keep hearing we just don't have the science on them.

So the question is, is the safety data generalizable enough that we should be concerned about them as a class and just say, you know, let's get rid of them all?

CHAIRPERSON SCHWARZMAN: Yeah, go ahead.

DIRECTOR ZEISE: Maybe I could just make a comment that, you know, this is all -- this is dealing with the toxicity side of the question. And this issue of the extent to which we can generalize as an area of active research right now. NTP has a program looking at a series of perfluorinated compounds. EPA does as well.

And so it is an area of active research to try to sort out using some of the newer toxicology methods that don't take nearly as long as the long-term animal bioassays that are so familiar with us for -- that we have on -- well, we're going to have very soon on PFOA, but we do have insights from standard traditional toxicology studies. So it is an area.

But this issue between concern level and detection level is something that I think is really an important area.

MS. HOOVER: And, Meg, I want to just also tag-team with a public comment and question that came in for Darrin, because it's not exactly related, but it's -- it's related enough, I want to get it in here. So this is from Elmer Diaz, who is a toxicologist with the Washington State Department of Health.

And the question is do you have any recommendations for notification levels for other PFASs

detected in drinking water? So instead of just the PFOA and PFOS combined, if you find those are below 70 ppt, but what about others if you combine any -- there's a list of examples. But the general idea is if you have more PFASs and those total to above 70 ppt, would you take action?

Then it goes on to say that in Washington they are adding other PFAS chemicals in the advisory requirement, including PFHxS, PFNA, and PFHpA. As a result, we will notify water utilities and the public to take action and provide public notice to specific populations like pregnant and nursing women.

And I do want to note when I'm paraphrasing comments, the entire comment will go to our transcriber, and it will be appended to the -- to the transcript.

SWRCB DEPUTY DIRECTOR POLHEMUS: Yeah, so that's a -- I mean, that's an open question. Lauren and I often ask the same thing of each other. And I -- it's out there. We need to figure out whether we need to look at the other ones or not. We only have information at the moment to issue the notification level for PFOA and PFOS. And we're continuing to look at the other ones to see where and what we should do associated with those.

I should note too that we -- just for clarification point, in case it's confusing. So the health advisory for U.S. EPA was 70 parts per trillion

combined. We issued our notification levels separate. The notification level for PFOA and PFOS as 14 and 13. And they stand as single levels as we push them. We did then get complicated in that we said our response level, which then is when we recommend a water system really think about taking their water source offline or treating it.

We set that at the 70 combined to match what had already been put out by U.S. EPA instead of a different level to keep that the same. So our notification levels, when they need to notify their governing bodies are single on PFOA and PFOS at those lower levels.

CHAIRPERSON SCHWARZMAN: Yeah.

DIRECTOR ZEISE: Just OEHHA is continuing to look at the literature and more to come in terms of this question, the extent to which we can go beyond what we've already done.

CHAIRPERSON SCHWARZMAN: Yeah, I would just say that we suffer from, you know, in this tox side of the question, just the science being behind some other compounds like we have a National Academy of Sciences report that's been out for a while on, you know, doing sort of additive or looking at phthalates, you know, that have similar modes of action. We don't have that same level of science for the perfluorinated compounds,

especially the diversity of the perfluorinated compounds.

So I think we're -- it's relevant questions. We just don't -- we're not there yet, in terms of the level of science from making those kinds of recommendations.

And, Sara, did want to say something?

MS. HOOVER: And, Meg, I just want to say one thing, which is just reminding everyone that we have the luxury in Biomonitoring California to go forward without that information. And one of the things that the Panel is continually urging us to do is to try to catch things on the upswing, so to really go for emerging chemicals.

So again, sort bringing it back to the exposure question, and let's see if -- I don't know if I can reverse this or not, probably like in a few minutes it will reverse.

(Laughter.)

MS. HOOVER: The concept -- so just to refresh everyone's memory, we have the 12 PFASs, the traditional PFCs that we're continuing to measure, we're continuing to see. And then we have an expanded panel of 30. And you heard Sabrina talking about additional targeted PFASs that we're going to be looking at, and the interesting semi-targeted analyses. So this would be more in our wish list. But in terms of like looking forward, you know, we have these options of maybe looking at total fluorine,

maybe trying to look at periodically checking MAMAS samples to do semi-targeted.

You know, we have different options that we can just move forward on the entire class, because that's already on our list. So if you'd think about it, you know, from the exposure point of view, and any specific ideas.

I mean, I've offered a bunch of ideas, obviously, that we already have thought of, but think about it from the point of view just -- when we start work -- while I'm taking the next two days off, but when we start work on Monday --

(Laughter.)

MS. HOOVER: -- what would be -- what would we be focusing on or are we on the right track?

CHAIRPERSON SCHWARZMAN: I wanted to suggest something, or let -- at least explore something that's on your list, but to explore it a little bit more, which is I've always been interested in the concept of interventional biomonitoring studies. And so I just wanted to explore it a little bit and not necessarily say that that's the be all and end all in this place.

One thing that strikes me about an intervention biomonitoring study just to kind of explore the pluses and minuses a little bit with regards to PFASs is I think of

them, at least my way of thinking about them, is that they're to explore specific hypothesis, and that they're really useful for that.

Like, the study that showed that urinary bisphenol A didn't decrease with fasting time was tremendously helpful in -- you know in a -- in this one small group of people that was exploratory in starting to, you know, question the assumption that diet was the primary source of exposure to bisphenol A.

And I feel like that kind of -- when you have a very specific hypothesis that you want to prove or disprove, it's a very interesting tool. And maybe you want to -- it points also toward the downsides of intervention studies, which is that they're not as broadly applicable. So, you know, there's all of the work of creating and conducting a study. And if it's an intervention study, it's probably fairly narrowly focused, and you're not going to be testing -- probably less likely to be testing like metals, and 1-nitropyrene, and, you know, PFASs, right, because the same intervention wouldn't be relevant for all of those compounds.

So I just wanted to kind of put that out there as a point of discussion and hear other people's thoughts about whether there's a specific question with regard to PFASs that might be interesting to explore through an

intervention study, given the kind of pluses and minuses.

Carl, was that about this or did you have a separate question.

PANEL MEMBER CRANOR: Pardon.

CHAIRPERSON SCHWARZMAN: About this?

PANEL MEMBER CRANOR: Yeah, sort of.

CHAIRPERSON SCHWARZMAN: Yeah, great.

PANEL MEMBER CRANOR: It seems to me -- well, here's the question to go to another hypothesis related. Do the short-chain PF -- PFASs cluster? You could do some testing to find out if they're clustering in wherever, drinking water, or bodies, or whatever. And if they're clustering, then maybe that tells you something. It does tell you something important that they're going to together. And then you have a toxicological question when they cluster, does that raise more of a problem by some set of tests that could be perhaps moderately quickly done to give you a key to levels of concern.

So sort of a -- it's another way of thinking about perhaps intervention and finding out if they occur together.

CHAIRPERSON SCHWARZMAN: Go ahead, Veena.

PANEL MEMBER SINGLA: So I think the idea of an intervention study is really interesting. And I wonder if a study related to food and food packaging and the dietary

contribution to exposure may be an interesting place to look, because there is a number of policy initiatives, both, you know, locally within California, as well as in other states that are focused on food packaging as a source of PFAS exposure. So trying to design a study that -- to better understand the role of food and food packaging in exposure to PFASs generally and to specific PFASs, understanding the profile and if intervention is actually effective in reducing exposure could be very valuable.

CHAIRPERSON SCHWARZMAN: Gina.

DR. SOLOMON: Gina Solomon, Public Health Institute. Yes, I -- just responding to the suggestion of an intervention study, which I think makes a lot of sense. And I think that particularly for the shorter chains, which are not persistent, we can take advantage of that in these kinds of intervention studies by, you know, quickly seeing changes over time. So that's a big plus.

And food packaging would be a great one to do. There are a couple other possibilities. It appears that many of the major carpet manufacturers in response to the pending regulatory actions in California are already making some significant changes. And we're moving some PFAS chemicals from their products. And so there might be an opportunity because of what we're doing right here in

California to -- if we're able to mobilize fairly quickly see some changes there.

And then the other place where there's a lot going on in California is around chrome plating. The fume suppressants that used to be used were the long-chain, you know, chemicals. Those have been switched out. OEHHA actually did an evaluation and is -- and knows exactly which chemicals are in the formulations that are currently being used at these chrome platers, which of course tend to be in communities that are disproportionately impacted from other sources. There are people who live right next to chrome plating facilities, worker exposures.

And so there might be an opportunity there. And the Air Resources Board is in the process of doing an Air Toxics Control Measure for chrome platers, and the questions relate to, okay, should they use fume suppressant chemicals, or should they put in place other requirements such as enclosures or things like that, that would mean that no fume suppressant would be needed?

And so that policy decision, depending on which way it goes, could -- you know, it would be interesting to see what that -- how that relates to exposure.

CHAIRPERSON SCHWARZMAN: Ulrike, you wanted to -- okay. Nerissa and Ulrike.

DR. WU: I just had a couple of comments. One

about the clustering of different short-chain PFASs. Some of the work we're doing with biobank could help us look at whether there's some kind of pattern, the ratio between the different PFAS that is indicative of a regular, like just everyday background exposure, or if there are different signals in the ratio that might indicate a specific kind of exposure. So that's stuff that I hope we can use the biobank samples to get a better handle on.

In terms of intervention, I think those are always great. They tell a really good story, and provide compelling data. I'd say that just our experience with interventions, particularly like the foam replacement study, it's really good if you have an exposure that if it's a behavioral change, that's something that you have a very strong hypothesis about, and it's a change that's reasonably controllable, that people are going to adhere to, because it's very -- otherwise, you have very messy data, and it's very difficult to build a story out of that. But some of the ideas I've heard and some of the environmental interventions in particular might be a good candidate for that kind of study.

PANEL MEMBER LUDERER: Following up on the idea of the intervention studies too, and maybe thinking about an occupational environ -- intervention study, and we've heard quite a bit about firefighters, and the -- the

AFFF's exposures. And from I think it was the FOX study, there was actually some indication that firefighters who had their -- the PPE professionally cleaned more often had, you know, lower levels of certain PFASs in that -- that were biomonitored compared to those that didn't. And that might be an interesting intervention study that would look both at an occupation that seems to be at, you know, high risk of higher exposures from these chemicals, as well as an intervention that could be done to reduce exposures.

CHAIRPERSON SCHWARZMAN: Nancy.

MS. BUERMEYER: Nancy Buermeyer - excuse me - with the Breast Cancer Prevention Partners.

Just on the -- just anecdotally on the firefighter front, there is going to be some data coming out of UC Berkeley for the women's firefighter study done in San Francisco. And I know PFOS are one of the first set of chemicals that they've actually gotten some data sorted out for. So I'm assuming they're preparing publications as we speak, so -- and that compared office workers with women firefighters. And so it should be interesting to see.

In terms of looking at ways to design studies, just one of the issues I wanted to talk about was, you know, the issues around point sources, we have a

particular interest in consumer products. And one of the areas that we've been working more and more with is with a coalition called the Campaign for Healthier Solutions, which looks at products specifically from Dollar Stores.

And to the extent that we're looking at communities that have been highly impacted and get lots of different exposures from lots of different sources, adding that sort of consumer product piece, maybe in conjunction with Safer Consumer Products Program, might tell us some interesting information about the plethora of ways folks are exposed to this, and looking at that particular vulnerable population who weren't particularly overburden.

So I don't know if the data shows that there's more perfluorinated compounds in Dollar Store or not, but we also were thinking that Dollar Store locations might be an interesting place to look to recruit CARE Study participants as well, particularly if we're trying to get folks with -- from different economic perspectives and potentially from lower educational levels. Doing a little stand outside a Dollar Store might be something to think about.

Thanks.

CHAIRPERSON SCHWARZMAN: I'm going to encourage us to move away from intervention studies, even though I brought it up, just because it's --

(Laughter.)

CHAIRPERSON SCHWARZMAN: -- probably not the only thing that the program wants to hear about, but I just wanted to throw one more little thing out about it, which is just an idea that would connect biomonitoring intervention study with the Safer Consumer Products Program, which would be an intervention removing perfluorinated treated -- PFAS-treated carpets from day care centers or pre-schools.

And that could be an interesting -- confounded by home exposures, but anyway an intervention study could help look at that.

MS. HOOVER: Thank you, Meg, for that segue. So I wanted to just ask if Erika and/or Antonia could -- we had some conversations before the meeting. They were really helpful in terms of measuring the 12 versus measuring the 30, or how we might use non-targeted as a qualitative way to check things over time. I wonder if one of you could just comment on some of the conversation we had, just so we get, you know, into the meeting, and let other people hear about that. I could summarize it, but I think you'd do a better job than me.

DR. HOUTZ: Sure. So I think typically, at least in terms of, well, both environmental data and the serum data, some of the limited testing we had done at DTSC with

the expanded list, usually it's pretty rare that you won't see one of like the top six most frequently detected PFASs, but you would see something else. I would dare say we've almost never seen that, where we -- where we haven't found PFOS, PFOA, PFBS PFBA, but we saw some signals for another -- another -- yeah, anything else -- yeah.

So usually I think that in terms of like just understanding whether you have a PFAS source or not, particularly if we're talking about a more general kind of exposure and not an exposure that's, you know, maybe next to a manufacturing facility or something that's really turning out a lot of something different that you would -- you would expect to be able to identify that PFAS exposure through a more constrained analyte list. That's -- I guess that's kind of like my gut feeling from like the array of data that I have seen.

And in terms of like where you potentially want to deploy a total organofluorine method, or a top assay type of method, or non-targeted method, I think kind of what I was just saying, where you're dealing with a source that's like a really newly manufactured kind of thing that you would really expect a different kind of chemistry to be there than, you know, a more historical source, that might be an opportunity where you would want to use one of these alternative techniques.

And then I think we have a lot of use for screening methods in the environmental community. I won't go into that, since that's not the focus of our discussion here.

DR. CALAFAT: And just adding today is one thing that we discussed yesterday was looking at kind of like what I call exposure profiles. If you want -- it's really concentration profiles. But if you have data from NHANES, it gives you an idea. Again, these are all the potential sources, and I don't mean that we know the sources. But you'll get a general sense for what are the ratios between the different compounds or among the different compounds within the same class that you find. Let's say, for PFASs, NHANES, PFOS is the one found at the highest concentration.

Then it's followed by PFOA, and PH -- the hexanesulfonate, a little lower. Then it's perfluorooctanoic acid and the others are so much lower. So just looking at this ratio between these four. And again this is for sources in which these compounds are either the major components or can serve as sentinels, if you want.

So when you have a source that is overwhelming resulting in exposure that may be accidental, different, then those ratios are going to be totally off. So just

think about the C8 study, contamination, industrial contamination with PFOA, C8. So see the PFOA was high. All the others were NHANES like.

Hoosick Falls again was PFOA. You think about areas in which you have AFFF. So the perfluorohexane sulfonate tends to move up, and then you still have PFOA, and you have PFOS, but your ratios are totally off. So that gives you an indication that you have an unusual exposure. You may not be able to know what is the source. But if you have some additional information, you may be able to do some type of environmental testing, maybe you have some question on information, you have maybe water data, then you're going to be able to determine all products of what those exposures are.

So that's something that again you just would have to have some data about just general background exposures. And then in occupational settings, the ratios may be of two, but that may be because the pathway of exposure is different. So, you know, for some of these chemicals, we assume that the majority of the exposure is ingested versus if you're going into a manufacturing plant, perhaps is inhalation or is dermal and is going to be very little of congestants.

So you're going to have very different ways the chemicals are getting into the body. And that's something

that you also will have to be looking into.

So I guess that I always say in a perfect world, we would like to have all the answers to our questions. But I just think that little by little, we're just -- just finding some answers, and just better understanding exposure. And in this regard, they're being more capable to just improve public health.

So with this, I think I'm just to going leave it. I think did I miss anything of what we talked yesterday?

MS. HOOVER: No.

DR. CALAFAT: Okay.

CHAIRPERSON SCHWARZMAN: Veena.

PANEL MEMBER SINGLA: On this topic of thinking about additional analytes to potentially prioritize. And kind of building off I think what Sara had said a little bit earlier about thinking about trying to catch things on upswing, right, and not -- and not being behind, something useful to do might be to look at EPA's chemical data reporting information, and production volume trends for PFASs to understand which PFASs have production volumes that have been increasing over the previous reporting cycles, and that those may be PFASs that would be interesting to target for analysis.

I think looking both at EPA's chemical data reporting as well as REACH production volume time trends

would be interesting. I think it was mentioned earlier Europe is a little bit ahead in terms of phasing out some of the long-chain. So the replacements might be coming in earlier there.

CHAIRPERSON SCHWARZMAN: Other -- Sara, yeah.

MS. HOOVER: Well, we have a slight pause. So I do have a very long comment that I was saving that came in, and I will just quickly paraphrase it.

This comment is from Alex Franco, who is a graduate student at UC Berkeley, and was an intern at the Natural Resources Defense Council looking at PFASs in California.

First some very complimentary kudos to Biomonitoring California's efforts in measuring and quantifying environmental chemicals. And that Alex was using our data to look at levels of PFASs compounds that were detected in serum and comparing it to NHANES. Advocating for the use of urine as a matrix to look at some of the new PFASs that are also detected in various environmental media in California like urban runoff, household dust, consumer products, food packaging, and indoor air.

So again, bringing up the point we were talking about about trying to look at both environmental media to human biomarkers of exposure to compare that information.

And then last the Department of Defense has reported contamination in the hundreds, thousands, and millions ppt for an on- and off-base water systems. There's the suggestion of, you know, going along the lines of should we look at specifically impact communities, this recommendation is to try to do a targeted study around military sites and civilian airports to try to see if those with higher exposures potentially, if it's borne out with our information.

So again, applause for our efforts, excitement for the results of our future studies.

And back to you, Meg.

CHAIRPERSON SCHWARZMAN: Thank you. Just to reflect on that for one second. We certainly have seen in the maps clustering of -- at Camp Pendleton -- or in and around Camp Pendleton, San Diego area, if that's right. So it's a relevant question in California.

SWRCB DEPUTY DIRECTOR POLHEMUS: Yeah, I -- Camp Pendleton is where the map showed it from the UCMR. I know there's other high sites at other military bases in California that weren't displayed on that map. I didn't have data at the time the maps were done. I think like Edwards Air Force Base, and some of the other ones have shown pretty high values as well. So as we get those, we'll understand more. But I think that is definitely a

trend I've heard as well.

CHAIRPERSON SCHWARZMAN: Other?

DR. HOUTZ: Yeah. I have a remark I wanted to make. It's not really about an intervention type of study. And it would just be interesting to check in with what Minnesota is doing in this space, because they have a drinking water standard for PFOS and PFOA that is 400 ppt for each of them. They've proposed lowering them.

They also have one for PFBA and PFBS of 4,000 ppt. So a factor of -- I think that's right. Does that sound right? A factor of 10 higher, something like that. And they use -- I believe, you know, there are some manufacturing impacted water systems in Minnesota that used granular activated carbon to remove PFOS and PFOA.

And I would suspect that people who are drinking that water may be exposed to more elevated levels of some of these replacement compounds. And that might be an interesting community to understand if those higher levels of the short-chain compounds in their drinking water might lead to higher levels in urine or blood. Perhaps, the State is already doing something on that. They have a pretty great public health lab there.

Karen Husette was on the line at some point.

CHAIRPERSON SCHWARZMAN: Yeah, go ahead.

DR. BALAN: So another thing that we learned from

the consumer product research is that at least for the coatings, like the ones applied on carpets and rugs, the PFASs used right now, as of the mid-2000s, are side-chain fluorinated polymers. So there are no non-polymeric PFASs intentionally added.

I'm not sure about food packaging. That is probably similar, but I haven't looked into that yet. So the chemicals that the PFASs that you would be biomonitoring from that are the fluorotelomer compounds that are the intermediary degradation products as well as the perfluoroalkyl acids.

So I think that would be real interesting. The perfluoroalkyl acids are really the final degradation products. And even though this class of PFASs seems so big, the majority of PFASs eventually degrade to the perfluoroalkyl acids, so they can give a glimpse into the life cycle of the entire class.

So I think at least for consumer products focusing on biomonitoring for the fluorotelomer compounds, including the alcohols, the aldehydes, the carboxylates, and the perfluoroalkyl acids would be very useful and interesting.

CHAIRPERSON SCHWARZMAN: So we have less than 10 minutes left. So if anyone is sitting on a comment, now is your time. Yeah, go head Jenny.

PANEL MEMBER QUINTANA: I think that you asked for guidance about which direction to go, and I feel like we haven't quite got there yet.

MS. HOOVER: I mean, I think -- you know, we can definitely mine a lot of great information from the whole day. But, yeah, if you have specific suggestions that you haven't yet said, that would be -- this is actually great timing to run through and provide any specific input that you might have.

PANEL MEMBER QUINTANA: So I can't help but think of the graph that Nerissa showed with the budget going down.

(Laughter.)

PANEL MEMBER QUINTANA: So I think that one thing to think about for either direct intervention study, or documenting the results of a policy change, which is kind of like an intervention, we should perhaps focus on getting our hands on existing samples, because it's very expensive to recruit human subjects and get samples. That's a very expensive piece.

So I don't know if we should be trying to find existing samples. It sounds like we want to have blood samples before -- you were saying you have to be really careful how they were collected, if they're serum samples. So it may not be possible with archived samples from, I

don't know, alpha fetoprotein samples or whatever, from moms taken at whatever week that is, 14 weeks.

But I think we should be thinking about very cost effective ways to do it as part of this discussion, as well.

MS. HOOVER: I just want to chime in that as Nerissa pointed out, we're doing that with MAMAS. So that's our -- and we're doing -- we're measuring PFASs in MAMAS including the expanded panel. So one of the -- and, in fact, she also mentioned -- so I'm just throwing this in as our own recommendation to ourself, and you can see what you think, but we're planning on also using MAMAS potentially, because we do not have to return results. So we have more leeway on the analysis we can run. We can run semi-targeted non-targeted analyses on those samples, and we could do that over time. And that would be a way of trying to, you know -- and compare that to the targeted analyses and see how we're doing, you know if our --

(Phone busy signal through sound system.)

MS. HOOVER: That sounds -- okay. Can somebody go -- okay. So technical difficulties here.

PANEL MEMBER QUINTANA: Well, I guess my recommendation for that would be to use pooled samples, if you're doing non-targeted or semi-targeted, because then you get more bang for your buck so they wouldn't alter

your recommendation.

Maybe I don't understand what the MAMAS samples are. They're a subset of the other samples, right, but they're not -- like, how many -- like, what comprises that sample, I guess?

DR. WU: We get such a weird variety of noises in this room today.

(Laughter.)

DR. WU: This is just the latest thing.

I think just -- because we have talked about MAMAs samples in the past, but it was awhile ago. They are from the genetic disease -- they're from the Genetic Disease Screening Program Prenatal Screening Program. These are second trimester moms who have gone through prenatal screening. So they are -- it's about 70 percent of pregnant women in the state of California. Although that percentage is going down, is there other alternative screening technologies. It doesn't get older women. And it doesn't get artificial reproductive technology people.

So it's -- there are ways in which it's not representative, but it is 70 percent of pregnant women. It's a very small serum sample. And as we spoke about earlier, they are not collective with the intention of environmental contaminants. And so we -- there is some concern about what might be happening to those samples as

they're collected and are not preserved in the way we would want to preserve samples.

Does that get to your question?

PANEL MEMBER QUINTANA: I mean, all of them, right -- how do you select the ones that you do?

DR. WU: So when we started the MAMAs project, they were only available from certain counties. So the MAMAS I data that Jennifer presented, that was from San Diego and Orange County.

The MAMAS II batch, which we have not presented yet, those are from scattered counties around California. And then the 2016 samples are from another set of counties. So they are not consistently from the same region, because at that point, we're still trying to figure out how we could use them as a statewide surveillance surrogate. But I think as we start to hone in on how we want to use them for some of these, like looking forward into PFASs, or experimental and non-targeted screening, I think we will design our sampling a little bit differently and maybe pick one --

(Phone busy signal went off.)

DR. WU: Oh, God.

(Laughter.)

DR. WU: -- some specific geographic focus. But that is a -- they are -- they are available to us across

the state. And so we just need to think about how we want to stratify them, if we want to do it by race ethnicity or if we want to do it by geography. But there is not a lot of information available on the women who contribute them. So there aren't -- like, we don't have any exposure information. So they're not -- they're not -- there are not that many ways in which we can stratify our sample, aside from a couple demographic factors about the mother.

PANEL MEMBER QUINTANA: Well, my understanding was you did a subset of the moms in San Diego and Orange County, or did you do all of them?

DR. WU: No, we did -- how much was MAMAS?

PANEL MEMBER QUINTANA: It wasn't that many samples.

DR. WU: It was 200. It was about -- so it was 200 of the moms. Yeah, it's a very small subset.

PANEL MEMBER QUINTANA: Yeah, I was going to say it's like 49,000 births in San Diego County, so it's a year.

DR. WU: Okay. Martha reminds me to mention that we do have to pay for them. They are -- biobank is a program within genetic disease, and they are required to charge and cover their costs of the biobank, and so they are not free. They are much less expensive than to go out in the field to collect samples, but there is still a

cost.

But, yeah, we picked, I think it was, 200 for PFOS and 200 for POPs in our first round.

PANEL MEMBER QUINTANA: Did you stratify on any characteristic or age, ethnicity, or anything?

DR. WU: We picked by race and ethnicity. We divided it up, so that it was equal parts of four major --

(Webex voiceover came through sound system.)

DR. WU: Oh, my God.

(Laughter.)

CHAIRPERSON SCHWARZMAN: So we have one more question to fit in before we end, if I could.

DR. WU: Okay.

CHAIRPERSON SCHWARZMAN: So, José, please.

PANEL MEMBER SUÁREZ: Thank you.

I have a comment disguised as a question, mainly because I am -- this is not my area of expertise the perfluorinated compounds.

(Webex voiceover came through sound system.)

PANEL MEMBER SUÁREZ: Okay.

(Laughter.)

PANEL MEMBER SUÁREZ: So given that my understanding is that the budget for the Program is decreasing. So in other words, it becomes of great importance to start selecting which ones of the chemicals

we should be prioritizing more. Now, with -- my understanding with the long-chain perfluorinated compounds, say PFOA or PFAS, the main reason why, of course, they were phased out is because of their persistence, one; and then the other component are the health -- the adverse health effects that have been, endocrine disruption or reproductive and developmental problems, which then led to the substitution. The industry changing from the long-chain to the short-chain or different types, in which, I think the persistent component, from my understanding, has been removed, right? So the half-lives of these compounds are much shorter.

So from that check point, in a way -- I mean, not to sound cynical, but this is a success, right? So they've replaced these persistent ones with these newer ones. So my question really is posing as how much information do we know right now about the short-chain with having potential health effects, which is why we really should be monitoring these chemicals?

Of course, I'm a fair proponent of the precautionary principle, absolutely. But I'm just trying to bring in these questions more of a -- like a devil's advocate piece of it.

DR. WU: Well, I think, as Lauren mentioned before, the toxicology is still a work-in-progress. And

there are -- there's so much unknown about where we should be focusing that toxicology work, because we don't know what's really being used. It would be great if we could get a handle on this before everyone is exposed. I mean, our pattern of our work has been, oh, look, this chemical is in everyone. Now, we know how bad it is, and we have to kind of work retroactively to try to get it out of products.

So some of the work we're talking about today is to try to get a handle on this ahead of time and see those increases, and focus on those chemicals before they're ubiquitous, right?

PANEL MEMBER SUÁREZ: Well, yeah, to one extent. But at the same time, biospecimens are being collected, right? And they can't be stored. And there's so many chemicals that are being produced. I don't know what the estimate it now, but a few years ago, it was -- they were registering up to 1,200 new chemicals per year, the industry. And out of that, which ones are the ones that we should be concerned about, and which ones not? Well, you know, who knows really, because there's so many of them, and the toxicology is way behind.

So just my question is should we be focusing a lot of effort on this -- on the short-chain at this moment? We can still go back into future into the

specimen and look at that retrospectively, if that turns out to be of issue.

This is just a question that I'm posing. And I'm not being skeptical of the whole field, but I'm just trying to get some clarity.

DR. BALAN: I just wanted to clarify that persistence, in this case, refers to bio-persistence, right so the persistence inside organisms. Because environmental -- in terms of the environmental persistence, they're also extremely persistent in the short-chains as well. They have no non-degradation pathway in the environment. So we are faced with some chemicals that, you know, they don't degrade in the environment, and so we are continuously exposed to them, right? I think that's -- that's one of the concerns that just like I guess Meg was talking earlier about other compounds that are not persistent, but we have continuous exposure, so they're pseudo-persistent.

So they're persistent in the environment, but not in biological organisms. And I think studies are still trying to figure out the inherent toxicity of these compounds. There was a paper that was just published earlier this year by some -- by a group in Sweden, Gomis et al., where they found out that if you -- if you consider the differences in toxicokinetics, the shorter

chains, including PFHxA and GenX, one of the ethers are equally or more toxic to liver cells than the longer chain PFASs.

So there is some emerging evidence from modeling or from in vitro studies that there is some toxicity. And the fact that they still don't degrade into the environment could be of concern, if we keep having higher amounts.

CHAIRPERSON SCHWARZMAN: Thank you very much for that. We need to wrap-up it up, because the -- we lose access to the room, and I want to turn it over to Lauren for a moment who's going to offer some concluding thoughts.

DIRECTOR ZEISE: Well, I guess what I could do is just kind of wrap-up. I think we've danced around and actually focused on this issue of getting in front of emerging concerns throughout the day. In fact, it started this morning. And there were a number of suggestions for how we might do that by going into the chemical data commons, discussing connecting with trade associations, looking at CARB's new Consumer Products Survey, product testing, EPA's new reset of the chemical inventory, the Fluoro Industry Counsel website, and so forth.

So just how can we get in front of this whole issue of what chemicals should we actually focus on? And

that's kind of longer term, because we have the panel of 12 and the panel of 30 or 32 that's in front of us now, but that should inform what's important and what we look at.

We spent a fair amount of time thinking about why aren't we actually detecting these, and the CTC work. And lots of ideas were put forward. And there -- then there's this question of well, what about -- so we discussed possible migration and storage in organs of the shorter chain, whether or not we were looking at the right analytes, metabolites.

But all in all, I think coming out of the conversation, it seemed like, for the most part, there was an understanding they're probably pretty stable. So we might well have the right analyte in mind for the most part, but maybe there's this issue of detection. And it seems the Program is beginning to look for ways and actually has been successful in the way in which they've faced extract -- their extraction methods of actually getting at lower detection levels, so this whole issue of trying to go lower to be in front actually of what is of concern to everyone of what's the concern level. But absent that, it seems like there was pretty much a consensus of sort of moving towards lower levels made sense.

And then there was a discussion of intervention studies. And I think I heard pretty good support for the idea of the Program moving ahead with looking for opportunities. And some of the suggestions was around food packaging, the -- looking at carpets and working with the DTSC Safer Consumer Products Program, interfacing with CARB maybe in their efforts to reduce exposure to some of the long-term fume suppressants used in chrome plating, and that this had an interface with the disadvantaged communities. So there was this focus on communities that certainly want to pay attention to.

Firefighters and interfacing with the San Francisco -- looking at the results coming out of the San Francisco Firefighters Study, but that was another group.

And then this interesting idea of using Dollar Stores to kind of focus on communities where there could be disadvantage but maybe even increased exposure through a certain consumer products. So the idea of thinking of ways to focus recruitment in areas where we could target some vulnerable populations, so -- and I -- you know, then we had a very interesting sort of ending discussion, which we've all just heard. I won't go into that.

But anyway, I have to say I found it a very rich day, and want to thank everyone for, you know, all the input they gave the Program. So now just turn it back

over to Meg.

CHAIRPERSON SCHWARZMAN: Thank you for that Lauren. With that, I will move toward adjourning the meeting. I'm to announce that a transcript of the meeting will be posted on the Biomonitoring California website when it's available.

The next SGP meeting, if you haven't had enough today, will be November 8th in Richmond. And I want to thank --

MS. HOOVER: Just one little thing.

CHAIRPERSON SCHWARZMAN: Oh, yes.

MS. HOOVER: I want to make just one request for our transcriber. If you made a comment today, if you could make sure your name is written out with the correct spelling on the sign-in sheet or give it to directly to Jim, he would appreciate it.

CHAIRPERSON SCHWARZMAN: Thank you.

So thank you to all the Panel members and to Biomonitoring California staff, and all the participants today for the interesting discussion.

We'll adjourn the meeting.

(Applause.)

(Thereupon the California Environmental Contaminant Biomonitoring Program, Scientific Guidance Panel meeting adjourned at 4:28 p.m.)

C E R T I F I C A T E O F R E P O R T E R

I, JAMES F. PETERS, a Certified Shorthand Reporter of the State of California, do hereby certify:

That I am a disinterested person herein; that the foregoing California Environmental Contamination Biomonitoring Program Scientific Guidance Panel meeting was reported in shorthand by me, James F. Peters, a Certified Shorthand Reporter of the State of California, and thereafter transcribed under my direction, by computer-assisted transcription.

I further certify that I am not of counsel or attorney for any of the parties to said meeting nor in any way interested in the outcome of said meeting.

IN WITNESS WHEREOF, I have hereunto set my hand this 31st day of August, 2018.

JAMES F. PETERS, CSR
Certified Shorthand Reporter
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