

A Comparative Assessment of SVOC Exposures in Domestic Dogs and Their Owners Using Silicone Passive Samplers

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NICHOLAS SCHOOL
OF THE ENVIRONMENT
DUKE UNIVERSITY

forging a sustainable future



Pets & People: A Shared Environment

- People, and our pets, spend most of their time indoors
- Building materials and products we bring into our homes are often chemically treated, and can emit chemicals to the indoor environment
- Indoor air and dust particles contain a complex mixture of chemicals, some of which are potentially harmful

Chemical Applications in Building Materials and Common Household Items



Dyes in synthetic (polyester) upholstery/textiles?

Stain-repellant upholstery treatments (PFAS)?

Flame retardant chemicals in the cushions and upholstery backcoating?

- Insulation
- Drywall/Wallboard
- Flooring
- **Furniture**
- Electronics
 - TVs
 - Computers
 - Electrical cords

What type of samples are best to characterize chemical exposures?

Serum



Ideal for chemicals with long half-lives
in body
(months to year)

Urine



Ideal for chemicals with short half-lives
in body
(hours to days)

What type of samples are best to characterize chemical exposures?

To support the “exposome” we need **cumulative** measures of exposure



www.dohadfordoctors.com

Radiation Badge



www.med-pro.net

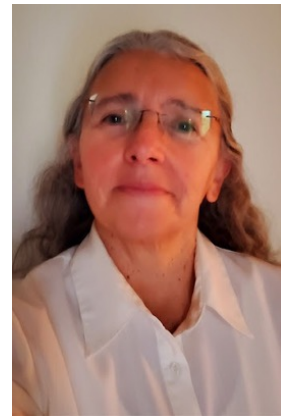
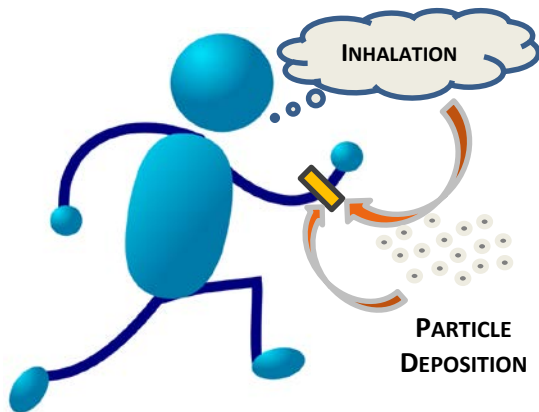
What About Wearable Samplers?

The Silicone Wristband

- Wristbands first introduced as personal passive sampler to measure ambient exposure in occupational settings and in general population (O'Connell et al., 2014)



Polydimethylsiloxane (PDMS)

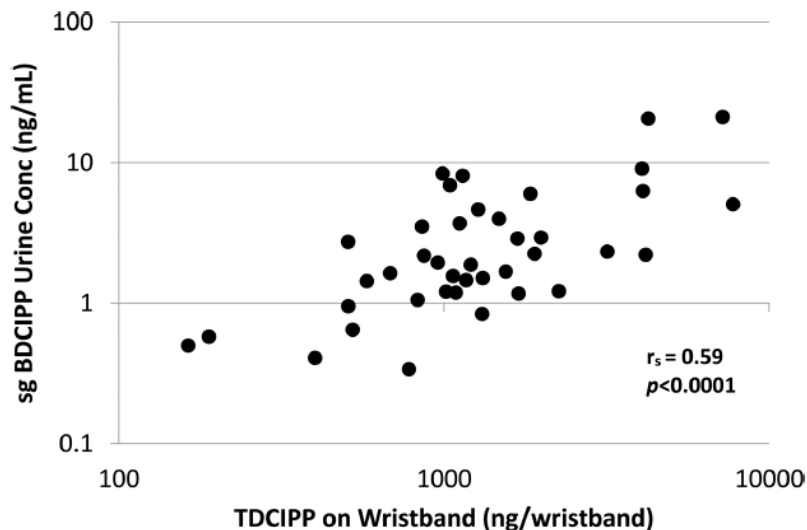


Dr. Kim Anderson
Oregon State Univ.

Validating Wristbands for Exposure

Measuring Personal Exposure to Organophosphate Flame Retardants Using Silicone Wristbands and Hand Wipes

Stephanie C. Hammel,[†] Kate Hoffman,[†] Thomas F. Webster,[‡] Kim A. Anderson,[§] and Heather M. Stapleton^{*,†}

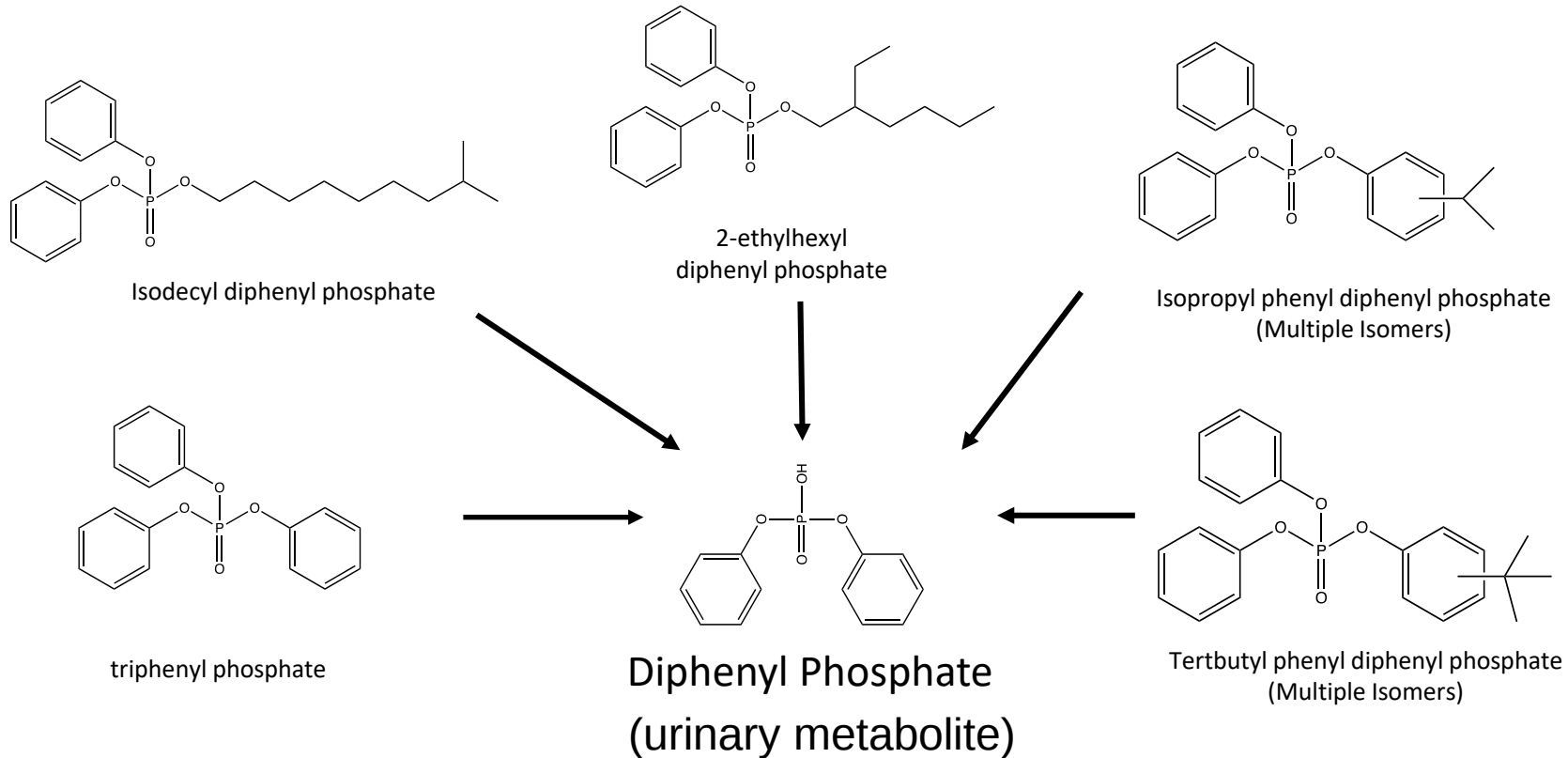


- 40 participants
- Wore a pre-cleaned wristband for 5 days. (24 hours a day; while sleeping and bathing/showering)
- Provided first morning void urine:
Days 1, 3, 5
- **Wristbands can provide several advantages in supporting environmental health studies**

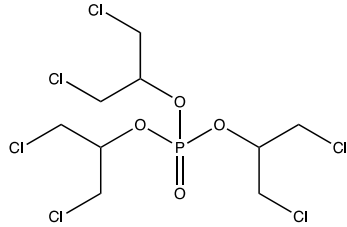
Potential Problems with Using Spot Urine in Epidemiological Studies



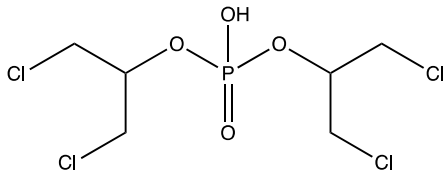
Problem 1: Who is the parent?



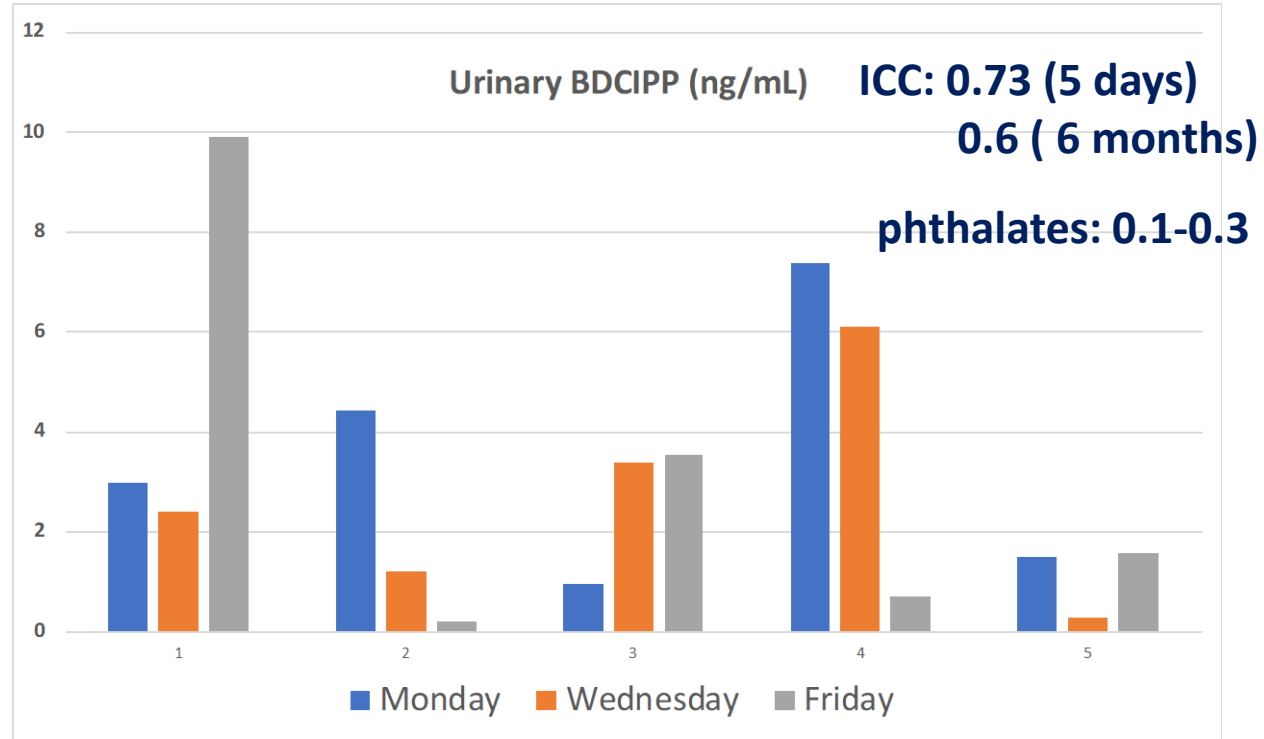
Problem 2: Variability over time



Tris (1,3-dichloro-2-propyl) phosphate
(TDCIPP)



Bis (1,3-dichloro-2-propyl) phosphate
(BDCIPP)



First morning urine samples collected from five individuals on Monday, Wednesday & Friday

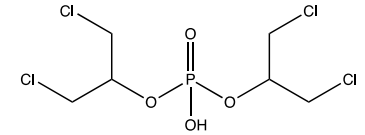
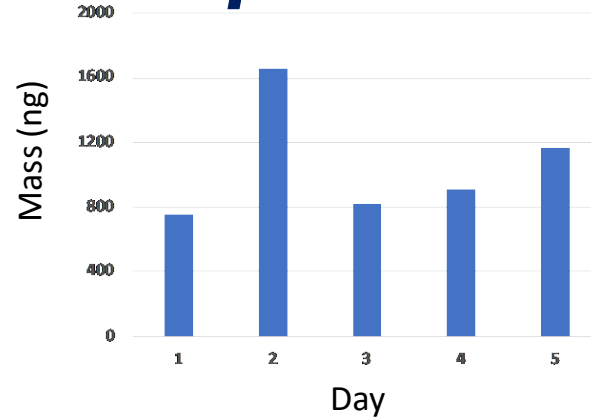
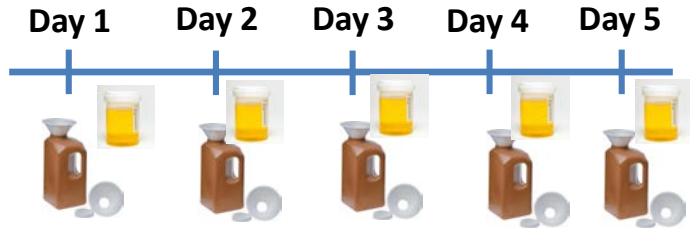
Are Wristbands Better Than Relying on a Single or Spot Urine Sample?



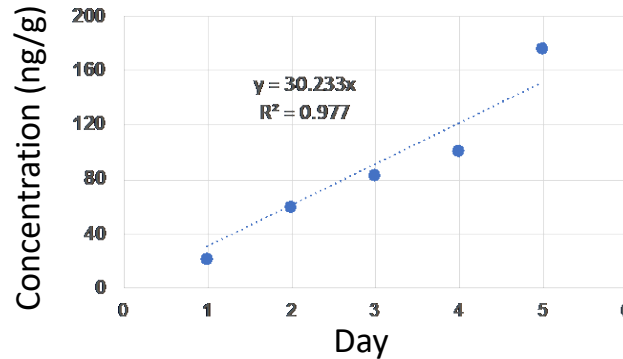
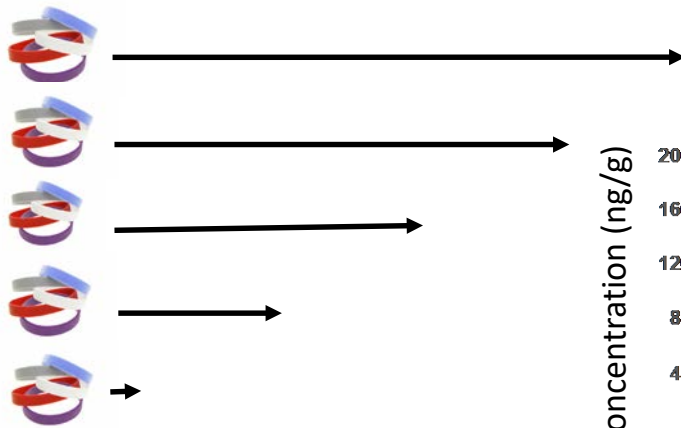
OR



Wristbands or Spot Urine?



Urinary Metabolite



Major Findings:

Wristband's ability to predict the total mass excreted (over 5 days) was equivalent or better than a spot urine sample for some OPEs

Can Wristbands Be Used to Characterize Exposures in Pet Dogs?



Matthew Breen, PhD
NC State Vet School



Cathy Wise, PhD
Postdoctoral Researcher
Duke

Objectives:

1. Determine if wristband samplers predict internal dose in dogs
2. Determine if dogs and their owners share similar exposure profiles

Research Study Design

n = 30 pairs



Wristband



Dog-tag



PDMS Analyzed
by
Duke Laboratory



Urine

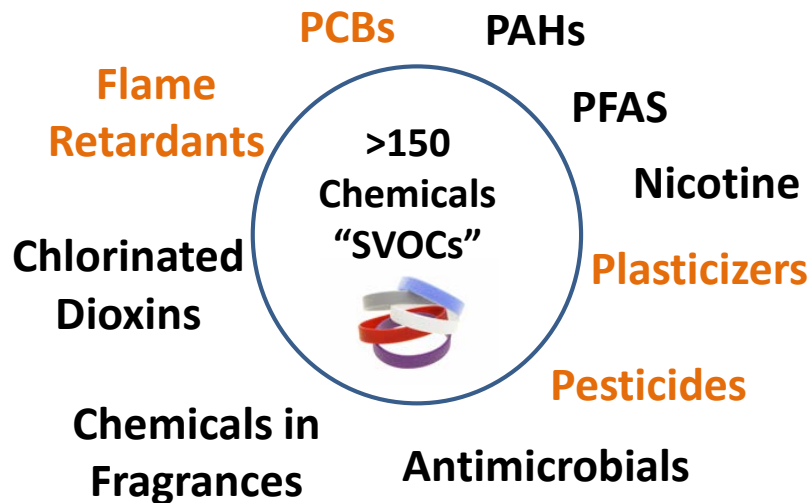


Pooled
Urine



Duke Laboratory

Analytical Details



- PDMS Samplers and Wristbands extracted and analyzed using high resolution gas chromatography high resolution mass spectrometry (GC-HRMS)
 - Targeted analysis
 - Suspect screening

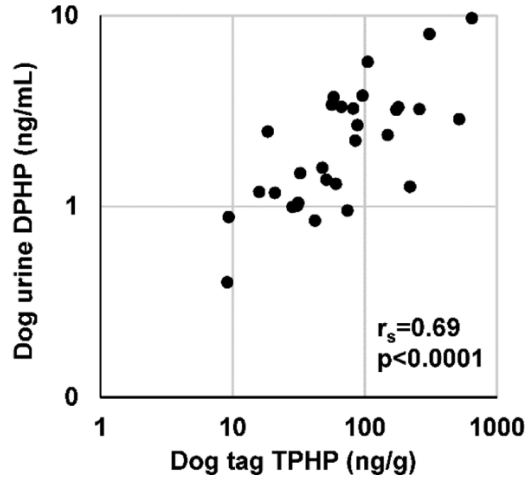


Thermo Scientific™ Q Exactive™ GC Orbitrap™ GC-MS/MS

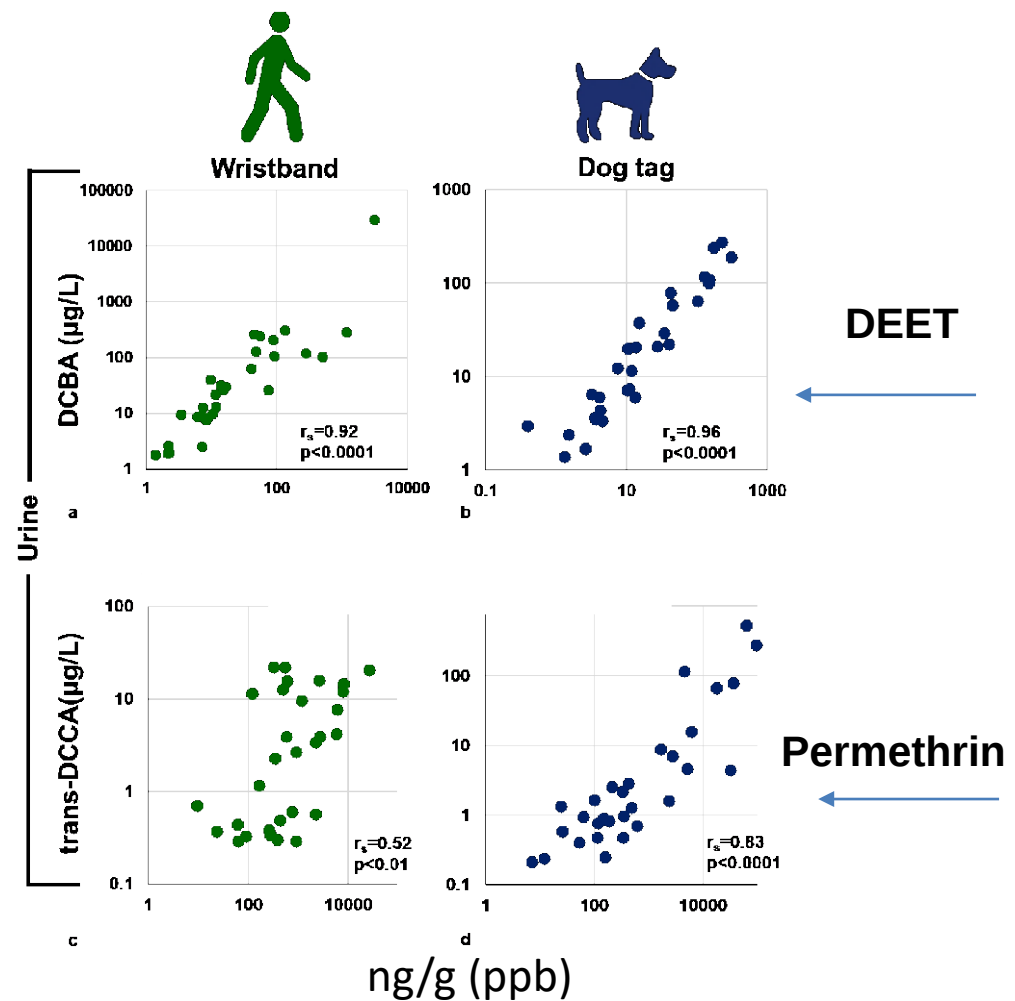
Results

Question 1:

Do wristband samplers predict internal dose?



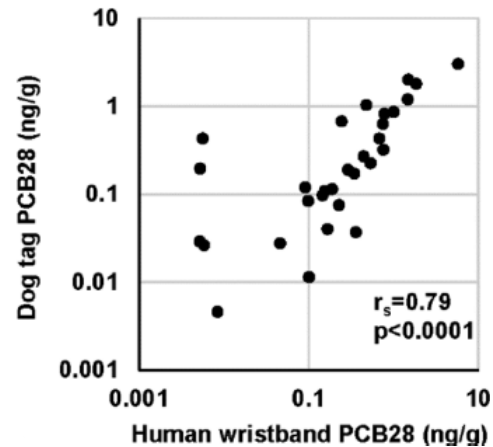
* Of the 14 OPE exposures evaluated, 12 were significantly correlated between PDMS and urine



Question 2:

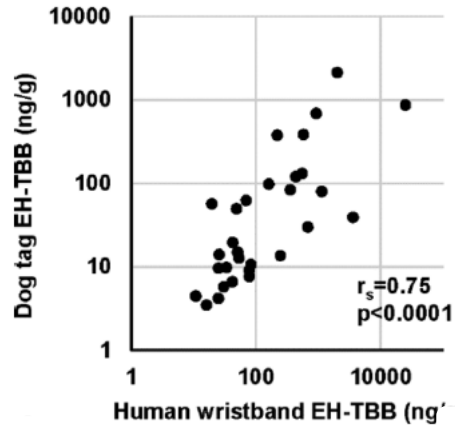
Do dogs and their owners have similar chemical exposures?

Dog & Owner Shared Exposures



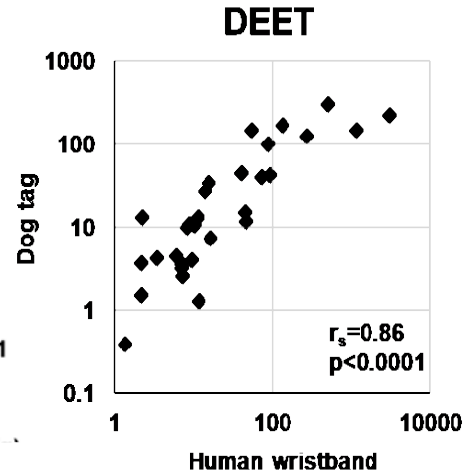
PCB 28

A Legacy Contaminant

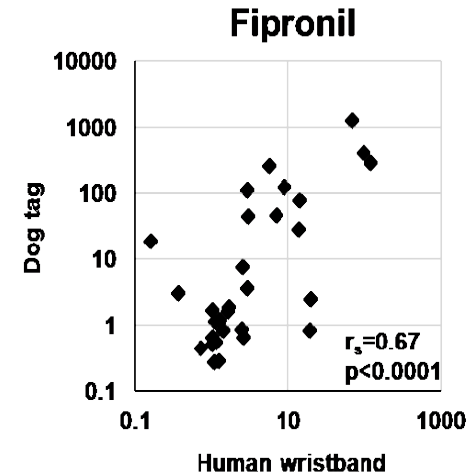


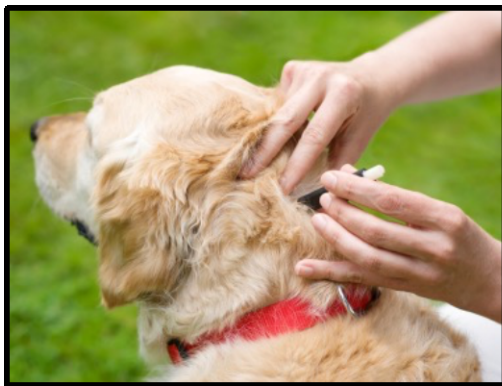
EH-TBB

A Novel BFR



Pesticide Exposures





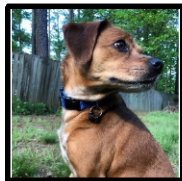
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Fipronil Exposure

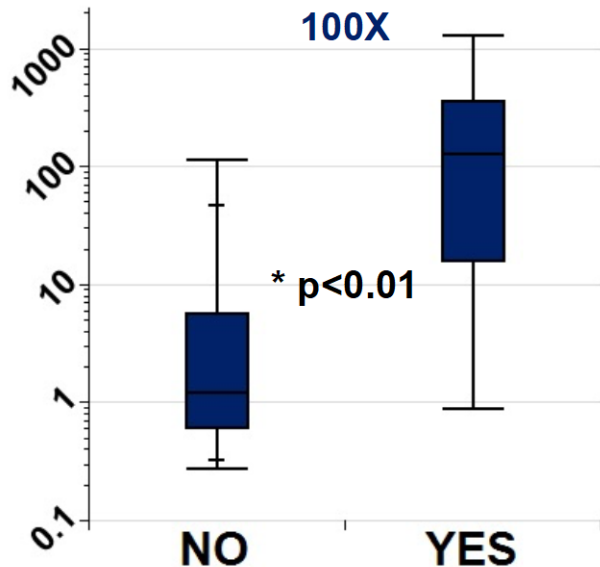
Reported use of flea and tick product containing fipronil

YES n=9

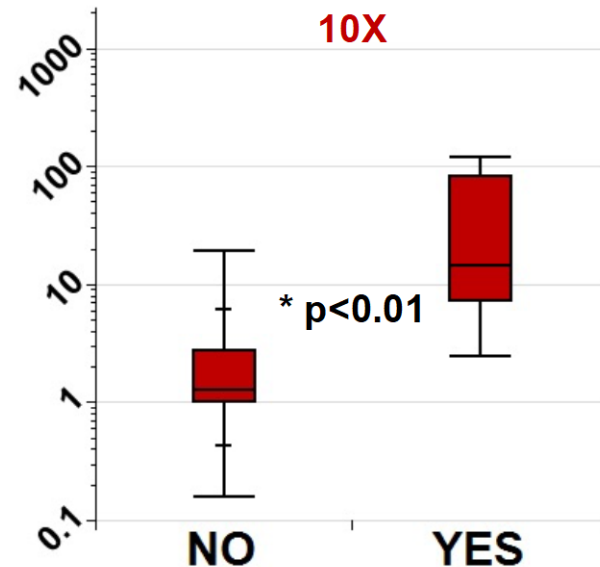
NO n=21



Dog tag



Human wristband



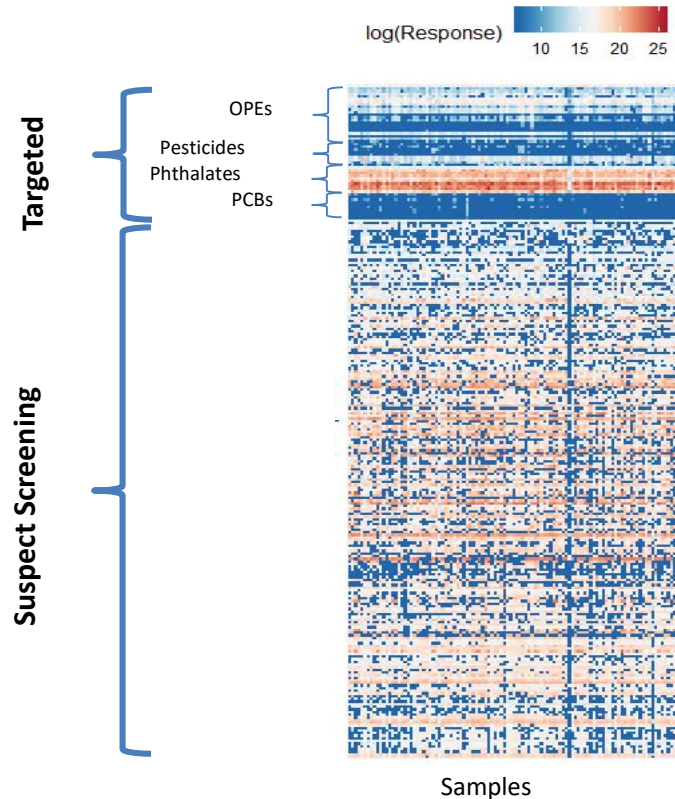
Advantages of Using Silicone Samplers to Support Comparative Animal Research

- Silicone samplers are a non-invasive tool for measuring exposure to hundreds of chemicals.
- Can be easily mailed back and forth (no clinic visit!)



Advantages of Using Silicone Samplers to Support Comparative Animal Research

- Can include targeted and nontargeted approaches
- Data presented is from a cohort of 110 pregnant women in NYC (Herkert et al., In draft)



Advantages of Using Silicone Samplers to Support Comparative Animal Research

- Have been used successfully in both dogs and cats



Poutasse et al. 2019

Advantages of Using Silicone Samplers to Support Comparative Animal Research

- Provide a measure of integrated average exposure over time; can support prospective study designs and complement biomonitoring
- **However**, they do not capture dietary exposure and do not provide insight into differences in toxicokinetics

Future Research & Goals

- With funding from the V Foundation, our research team (Duke & NC State Universities) is currently conducting a case-control study using silicone samplers:

“A Canine Model for Human High-Risk Non-Muscle Invasive Human Bladder Cancer: Molecular and Environmental Considerations”

- Results coming soon.....





NC STATE UNIVERSITY

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Rachel Smith

Duke Medical Center

Brant Inman

Centers for Disease Control and Prevention

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*Antonia Calafat



Breen Laboratory

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National Institute of Environmental Health Sciences

*Alison Motsinger-Reif



Funding



Internal Medicine

Shelly Vaden

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Tonya Harris

Veterinary Hospital

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Gabriela Seiler

Eli Cohen

Michael Mastromauro

Nathan Nelson

Joanne Intile

Owners & Canine Participants

