

March 13th, 2019



Conflicts: Personalis, Genapsys, SensOmics, Qbio, January, Filtricine, Akna

Medicine

Presently



- Focus on **Illness**
- Reactive
- Measure very few things
- Infrequent
- Population based



Should be



- Focused on **Health**
- Proactive
- Measure many things
- Frequent?
- Individual based

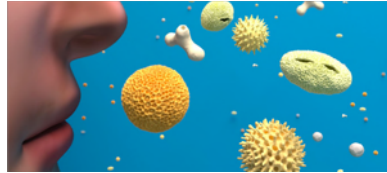
Precision Health

Health Is a Product of Genome, Exposome, Lifestyle

Genome



**Environmental
Exposures**



Stress

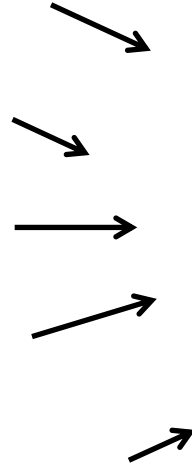


Lifestyle

Exercise

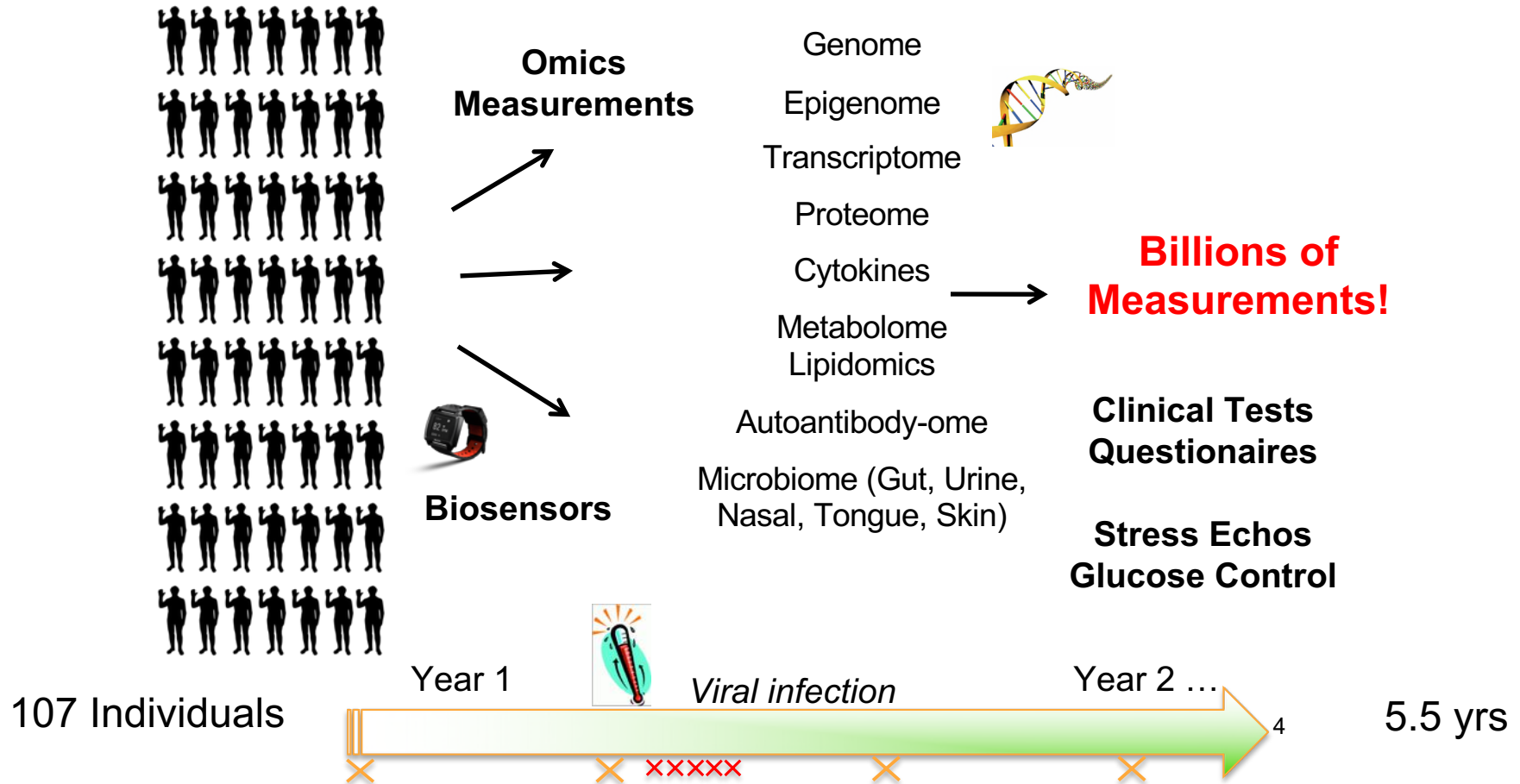


Food



Health

Longitudinal Personal Omics Profiling



49 Major Health Discoveries

Metabolic

- 1 MODY mutation (gene)
- 1 ABCC8 Mutation (gene)
- 14 New Diabetes

Cardiovascular

- 6 Carotid Plaques (imaging)
- 1 Atrial Fib. (wearable)
- 1 RMB20 mutation (gene)
- 1 Reduced LVEF/GLS (imaging)
- 3 Dilated L. Atrium (imaging)
- 1 Pharmagenomic (gene)

Other

- 1 Sleep Apnea (wearable)
- 1 SLC7A9 mutation
(cystinuria risk)
- 2 Macroalbuminuria

Heme/Onc

- 7 Oncologic Risk Genes
(Thyroid Cancer in 1)
- 1 Lymphoma (Imaging)
- 1 MGUS (IgM)
- 1 Smoldering Myeloma (IgM)
- 1 α Thalassemia (Clinical)
- 1 β Thalassemia (Gene/Clinical)
- 1 Pros1 Mutation (gene)

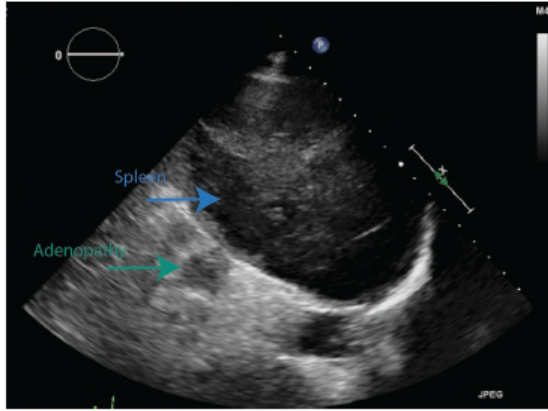
Infectious

- 1 Lyme Disease (wearable)

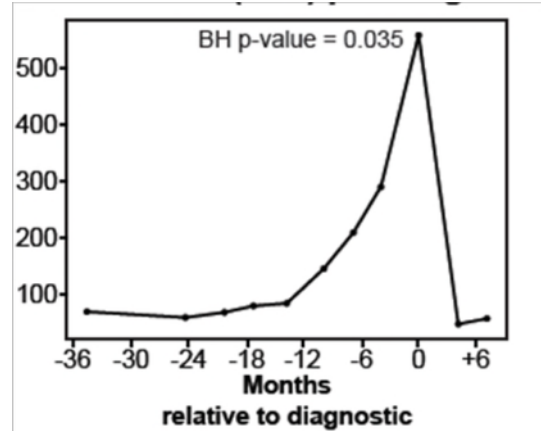
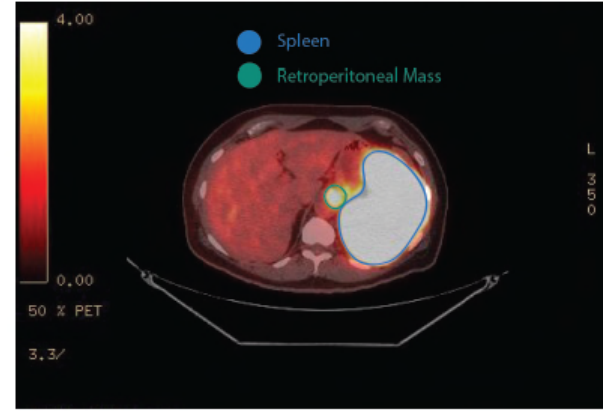


Discovery of B-Cell Lymphoma

a Abdominal ultrasound

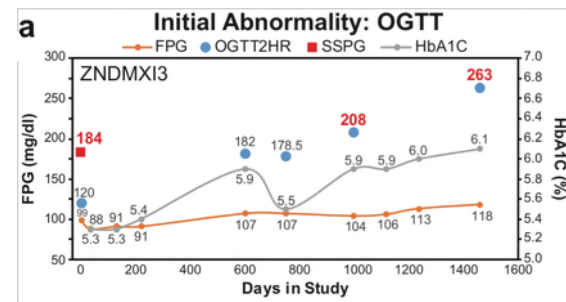
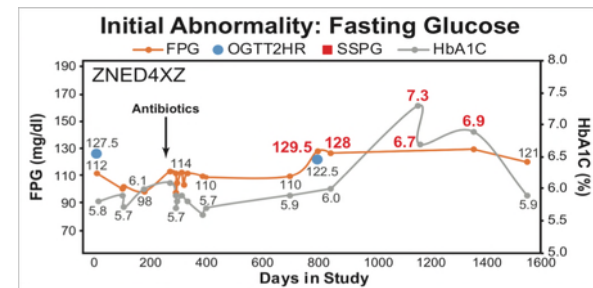
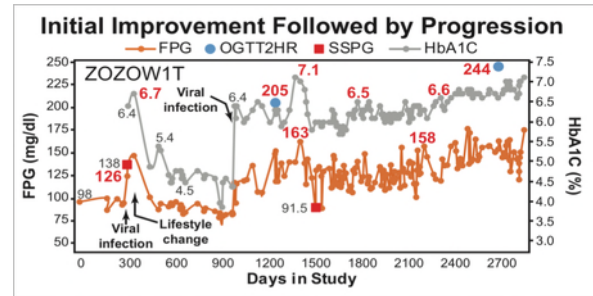
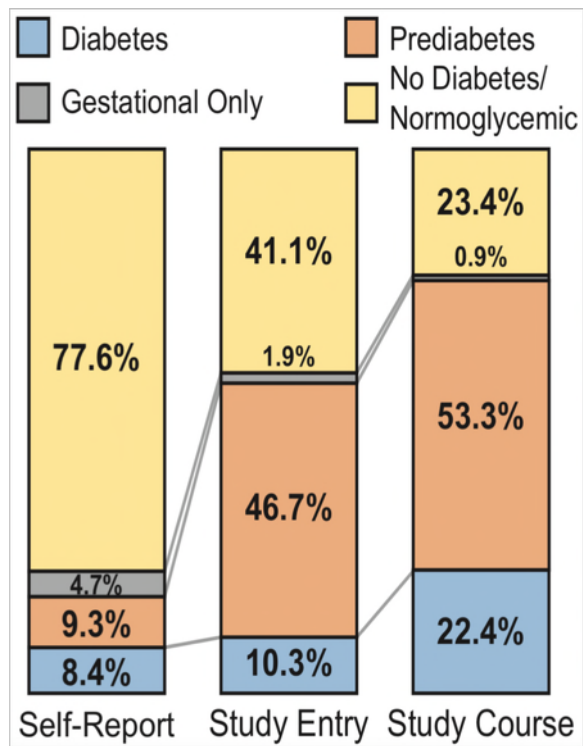


b Positron emission tomography imaging



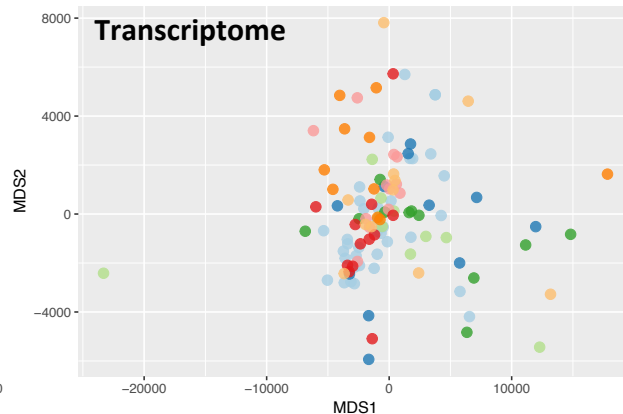
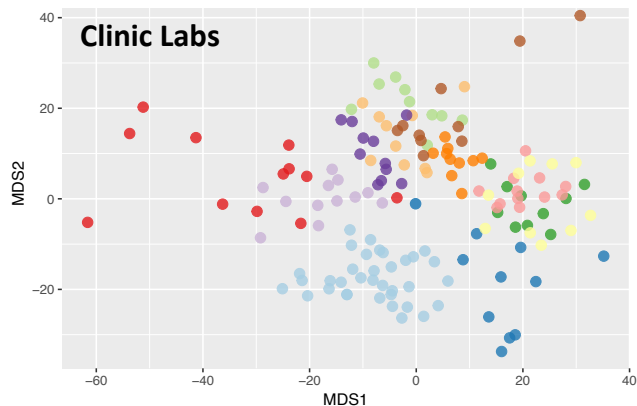
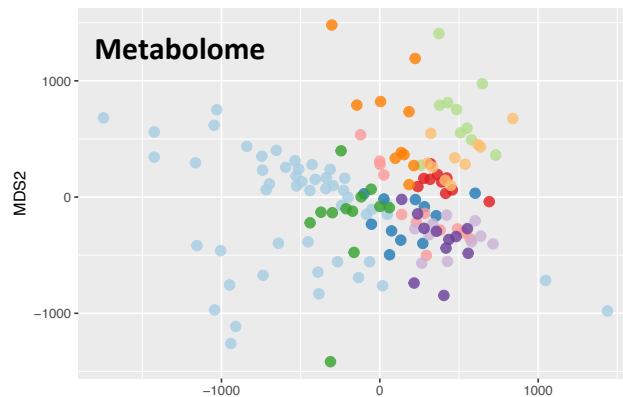
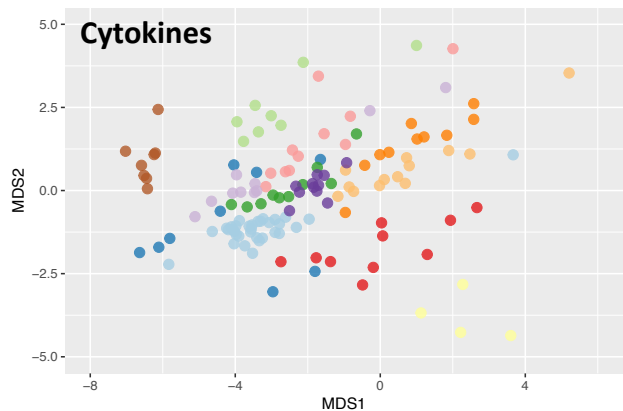
Rose, Contrepois et al.
Nat. Medicine, in press

Transitions in DM status



Strong Personal Characteristics

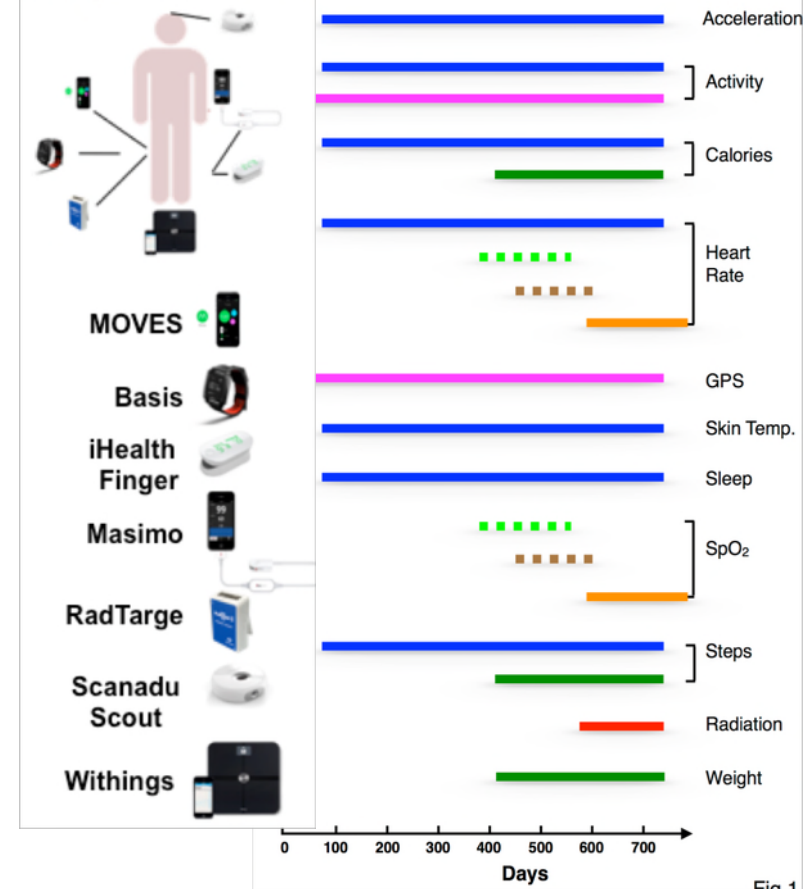
MultiDimensional Scaling for 12 subjects with at least 10 healthy baseline visits



Sensors: Over 900 Devices

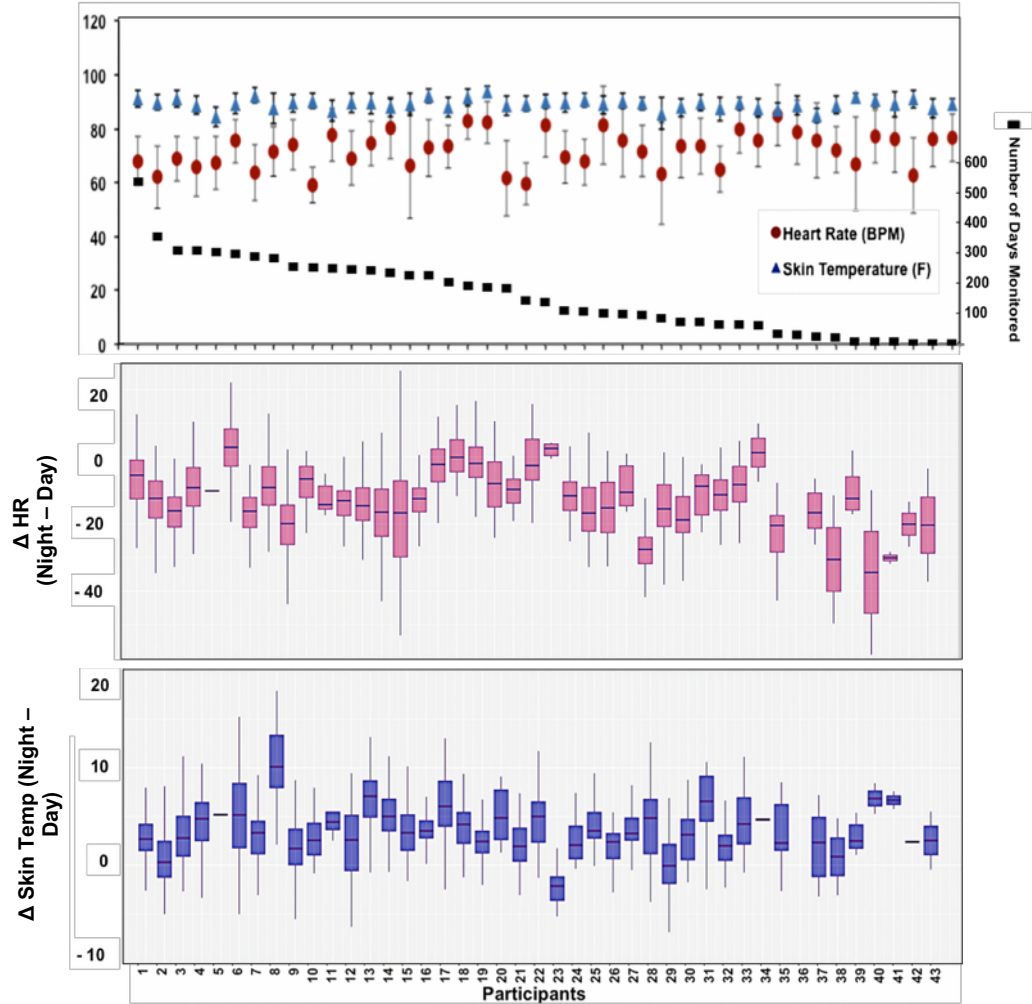


Many Parameters

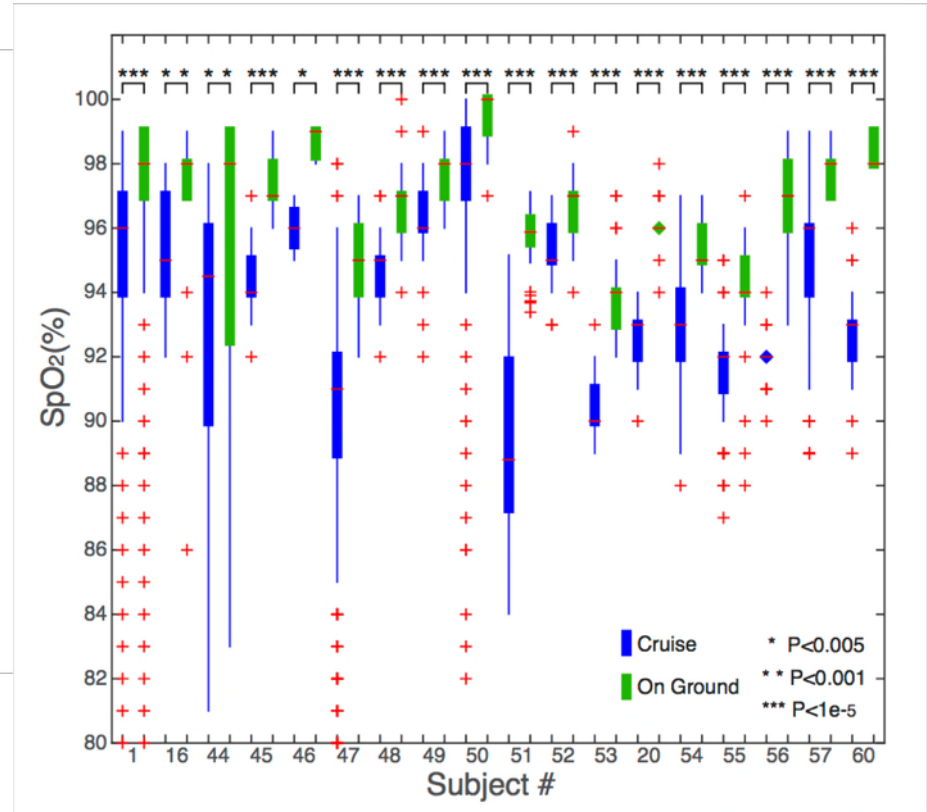
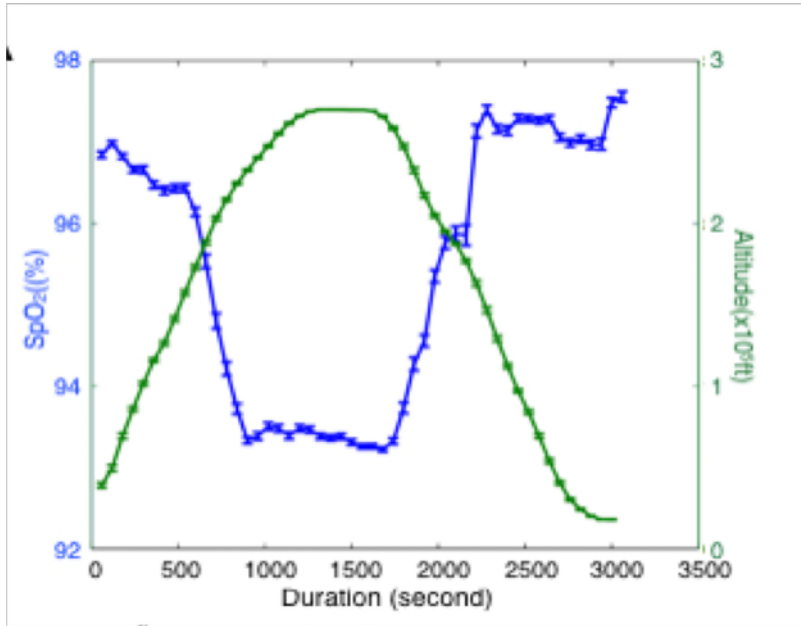


Li, Dunn et al.
PloS Biol 2017

**43 People:
All are
different**



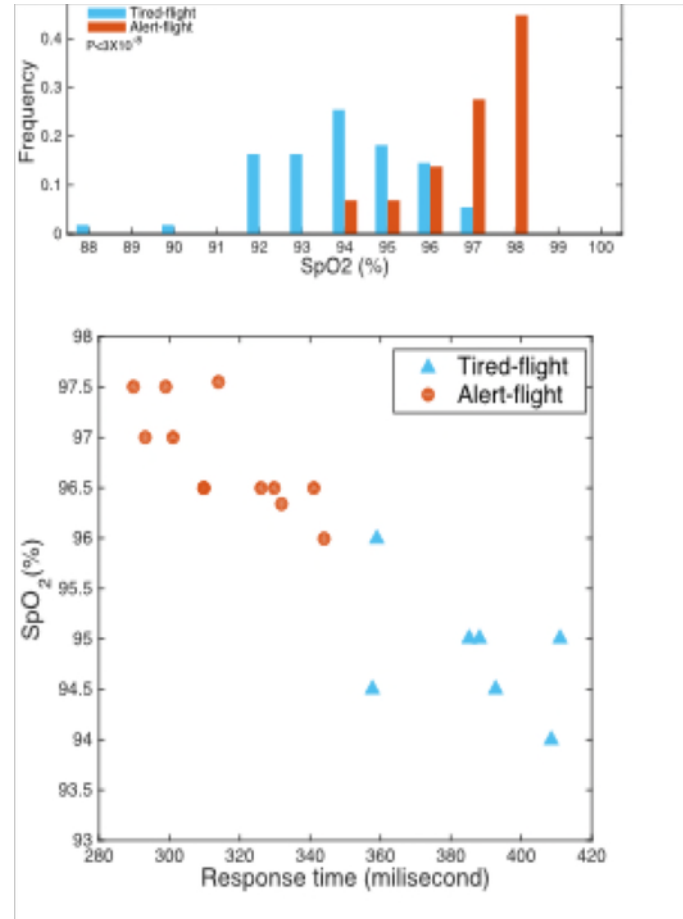
SpO₂ Levels Drop During Airline Flights



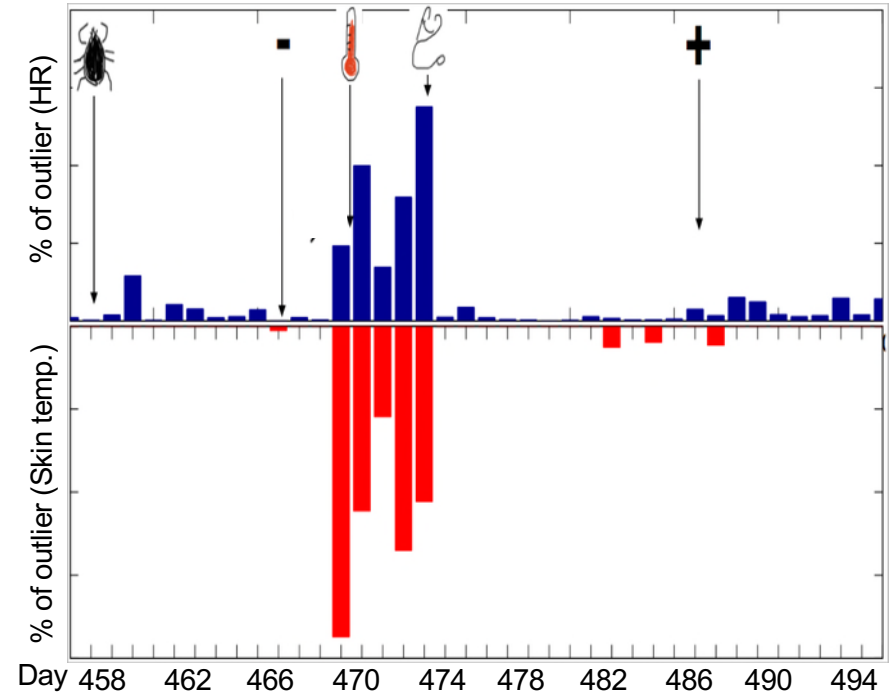
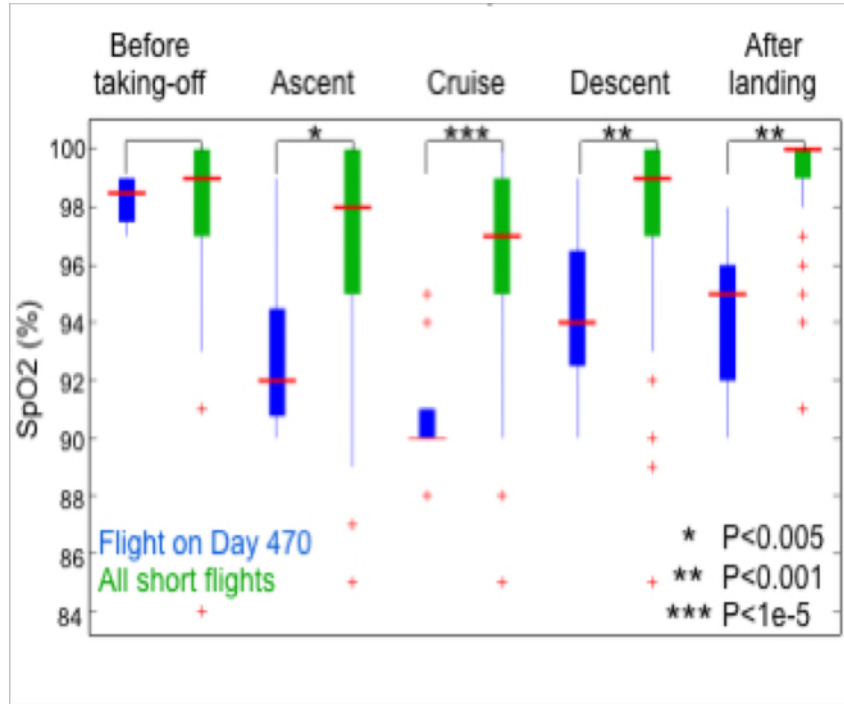
SpO₂ Measurements

Associated With Fatigue

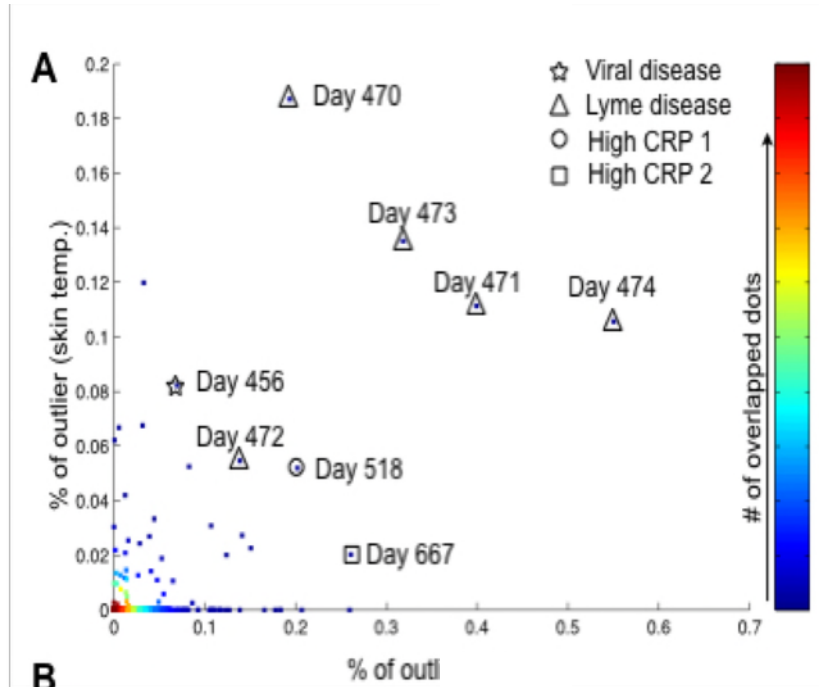
Li, Dunn et al. PloS Biol 2017



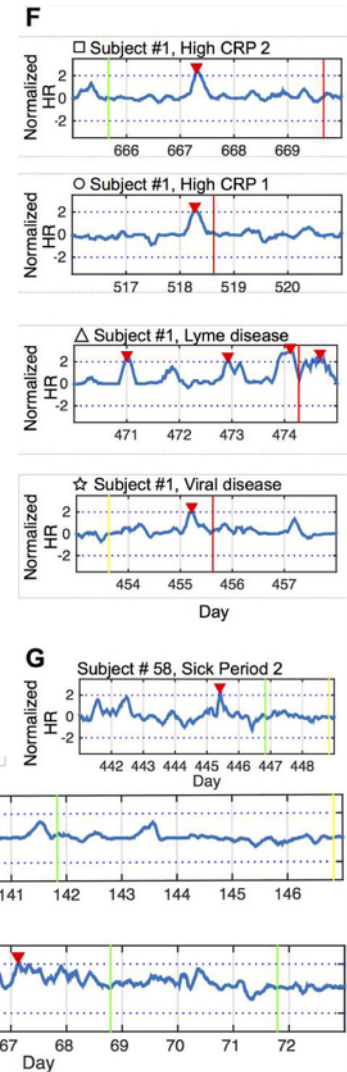
Early detection of Lyme disease



Detects All Days of Illness



Change-of-Heart Algorithm

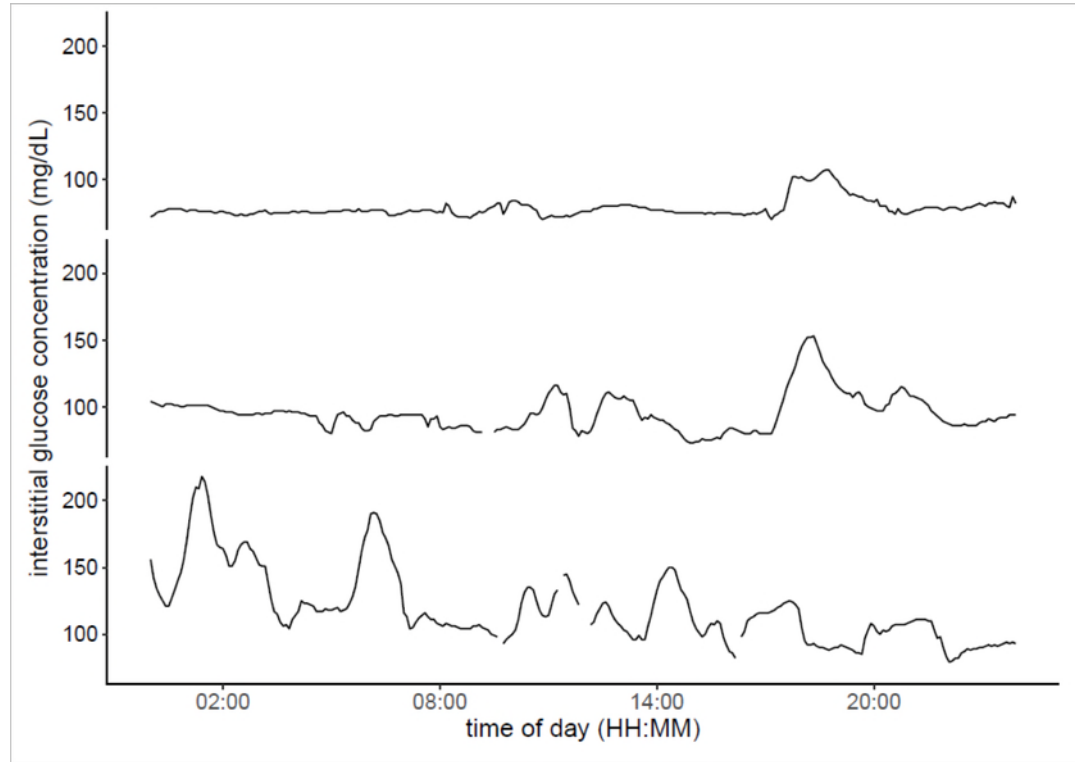


Continuous Glucose Monitoring: Lots of Spikers

2-4 weeks



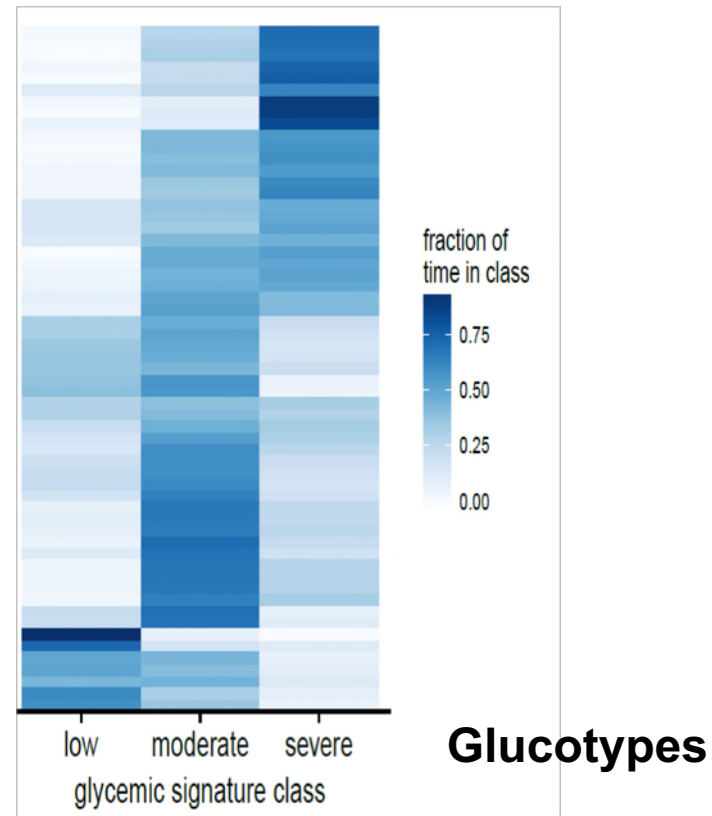
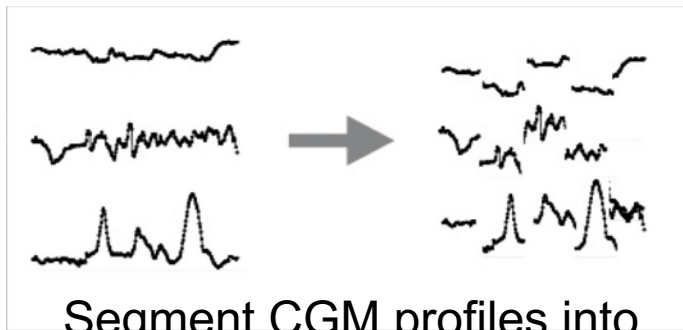
Dexcom G4



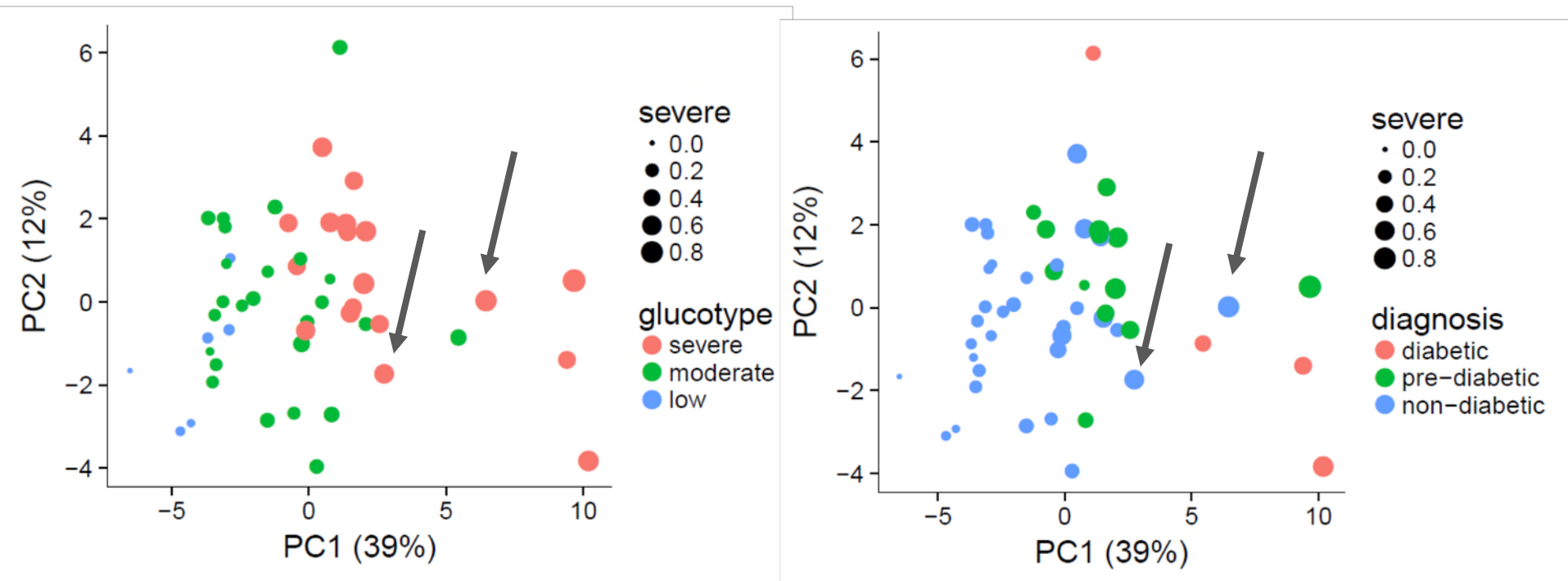
24 hours



Classification of People into Glucotypes Based on CGM Profiles



Glucotype classification may help find diabetes risk



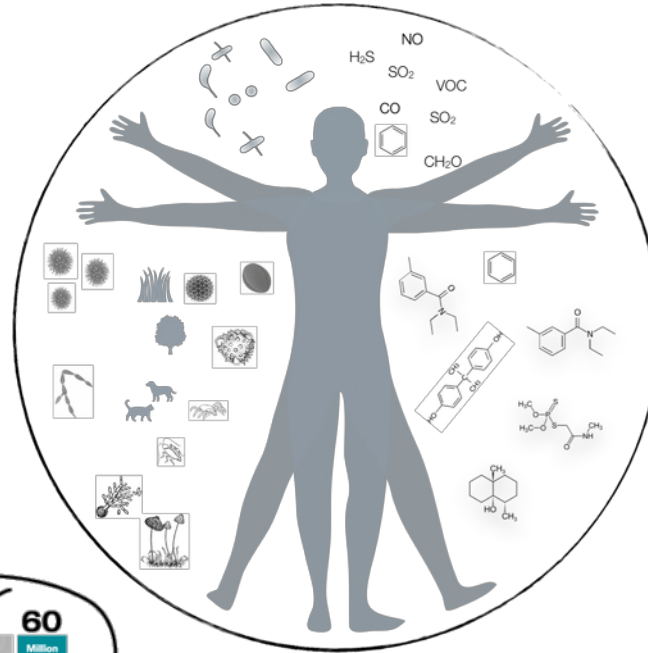
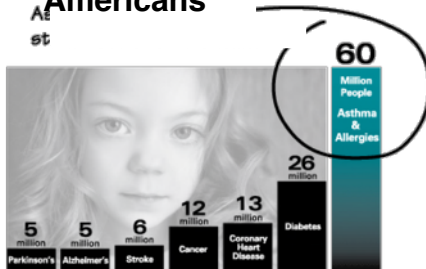
Clustering based n clinical and glucose data

Latest Wearable: Human Exposome

Biotics

Asthma & allergies
strike

1 out of 5
Americans



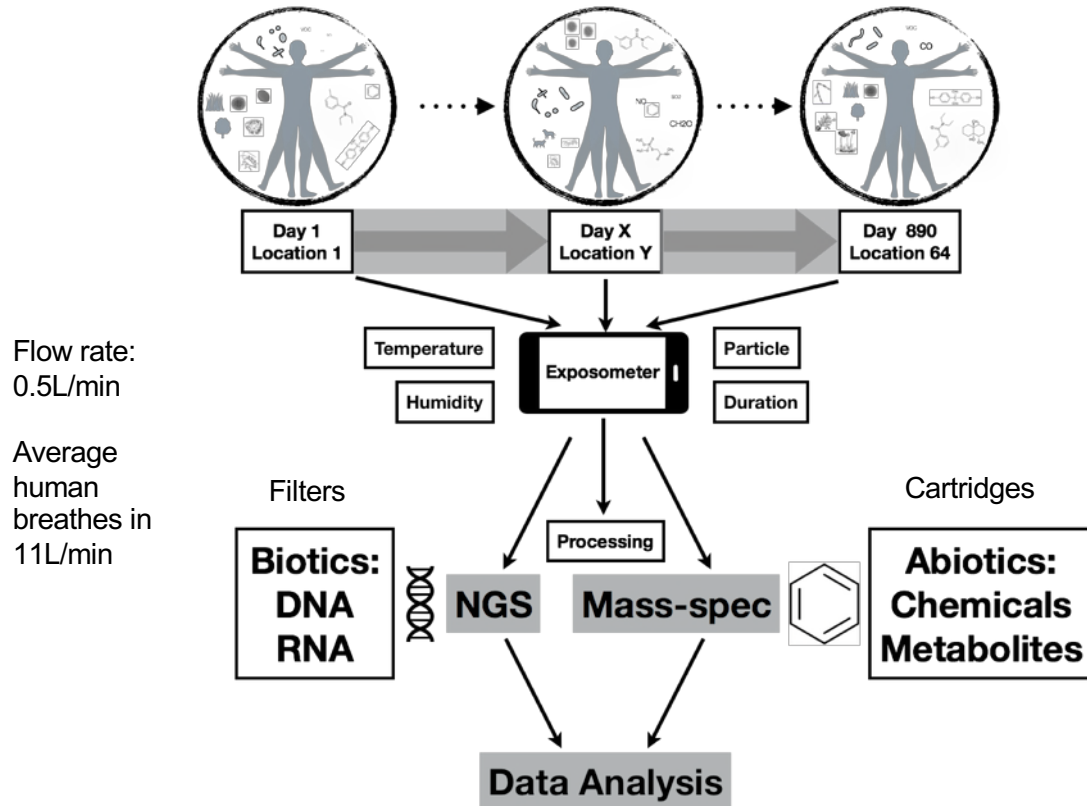
Abiotics

Carcinogens,
Pollutants,
Smoke

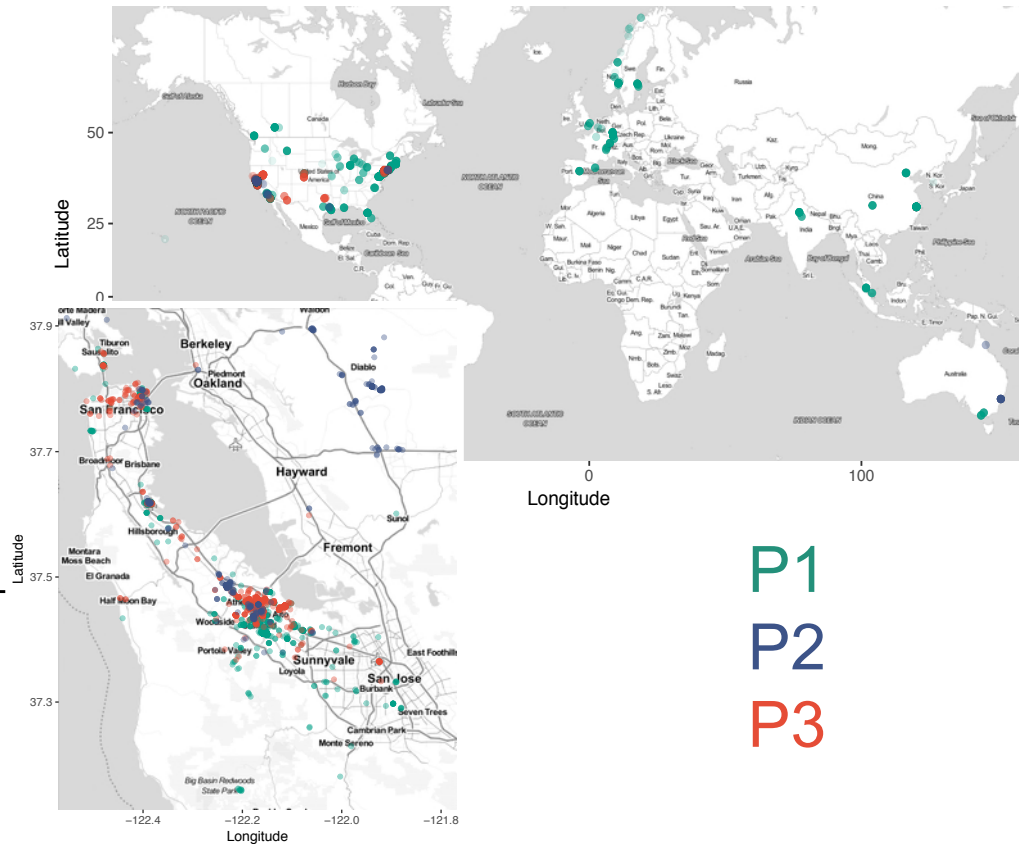
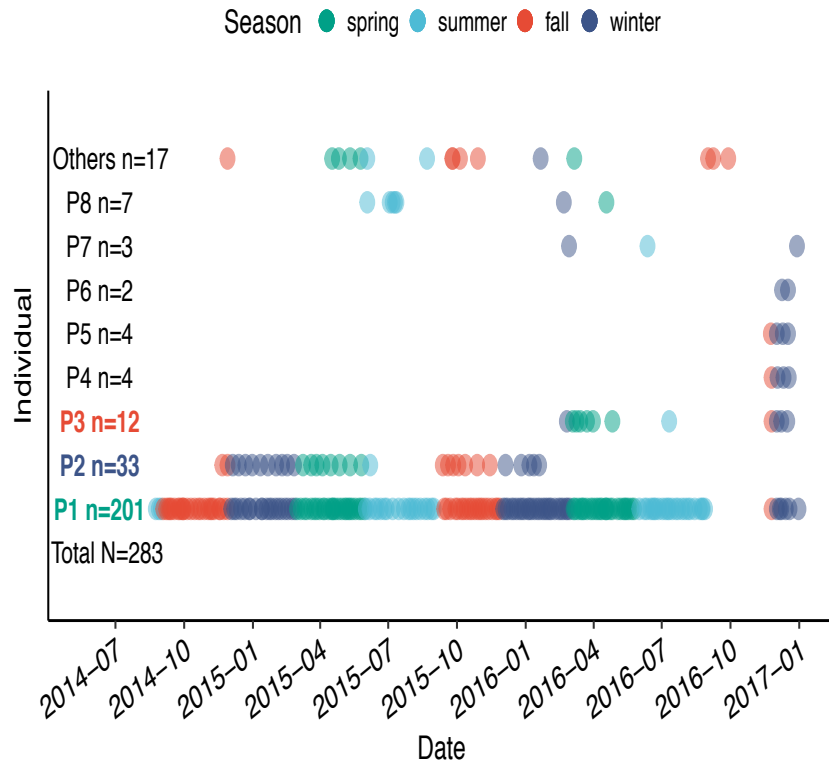


Identify Personal Exposomes:

Track individuals up to 890 days



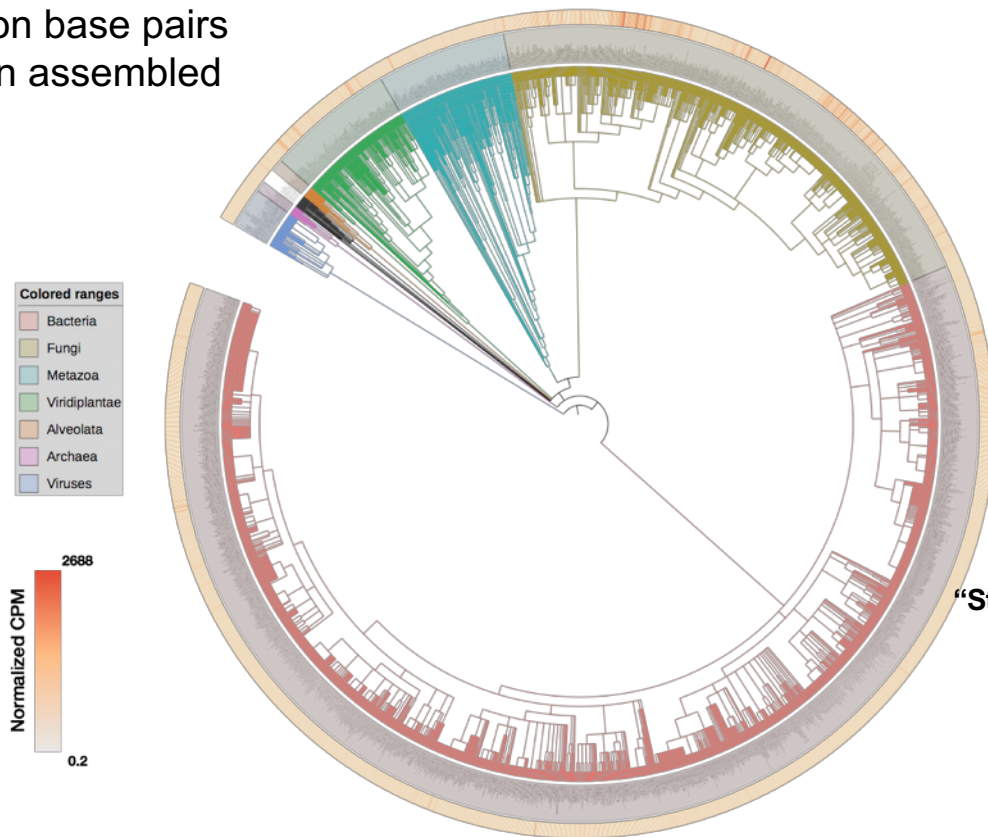
Timelines



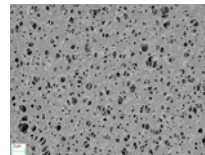
What can we capture? (Minus human reads)

>70 billion reads
>10 Trillion base pairs
> 7 million assembled
contigs

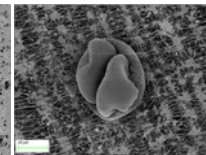
>2500 species
~300/sample



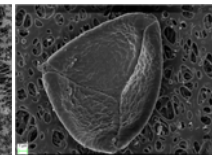
Empty filter



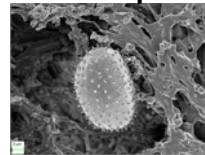
Pine Pollen



Eucalyptus Pollen

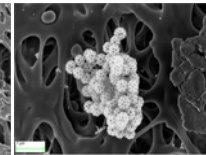


"Stem rust" spores



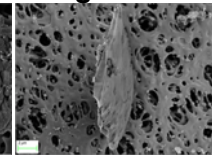
Puccinia graminis

Brochosomes

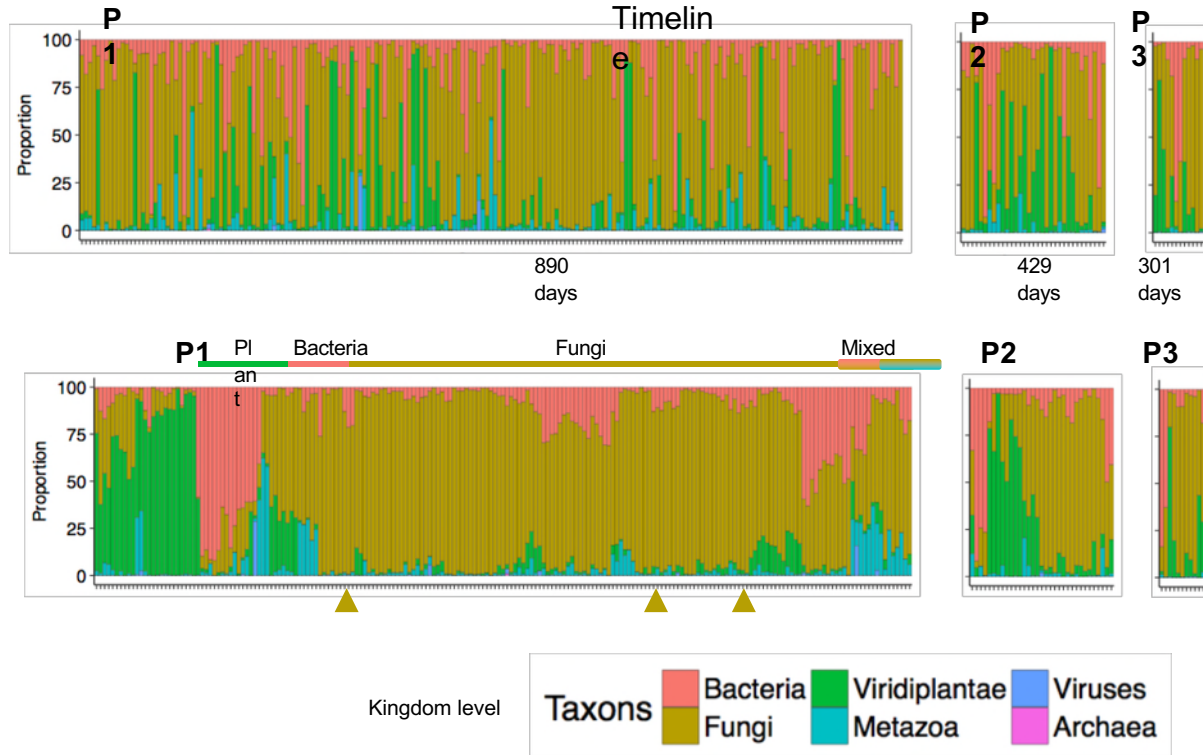


(water repellent
coating on
insects)

Inorganic materials

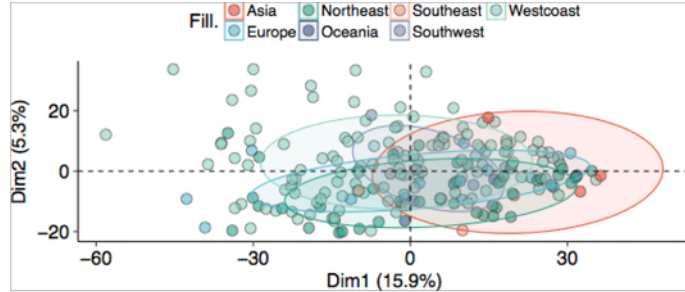


Dynamic exposome specific to individuals

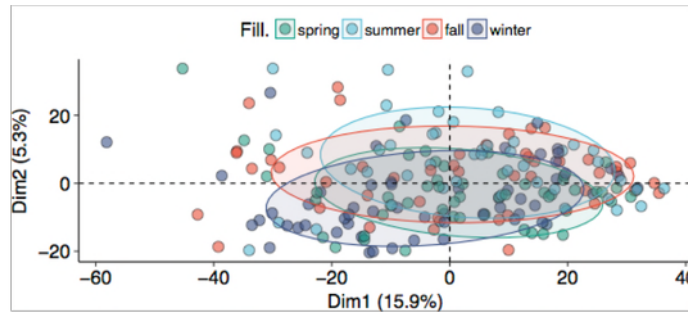


Season and location matter

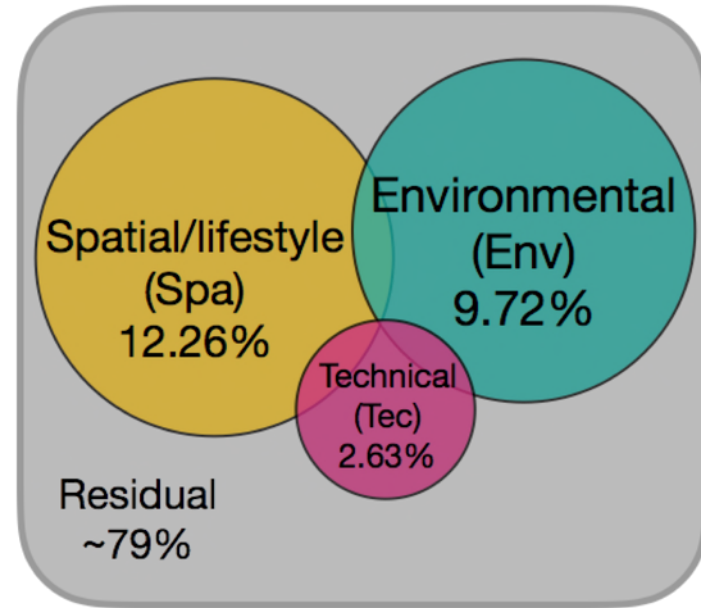
P1 Samples: Location



P1 Samples: Season



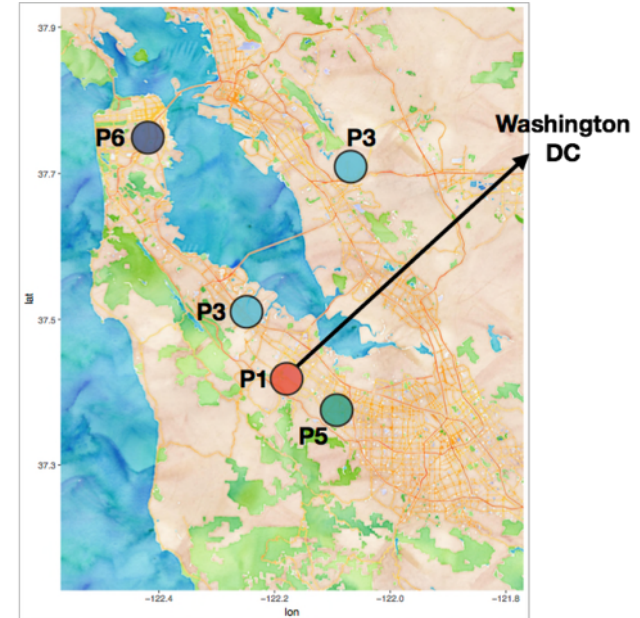
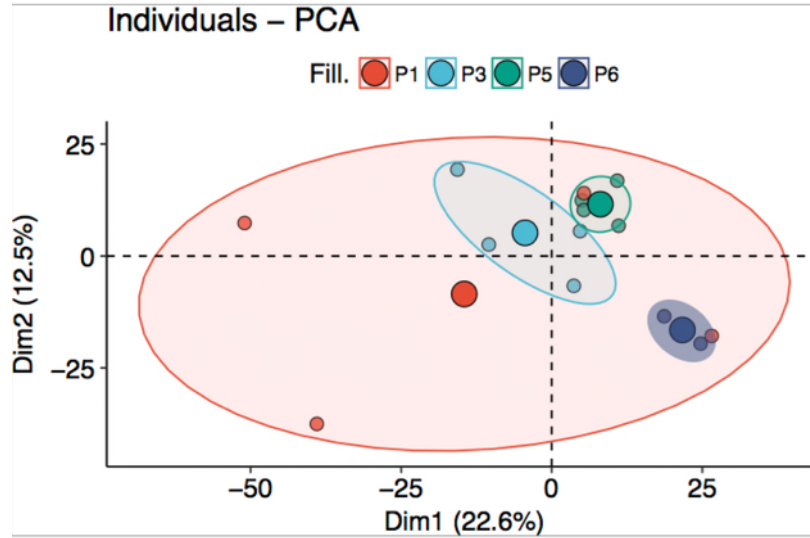
Partial dbRDA



Forward-selected variables from a collection of 64 meta-variables

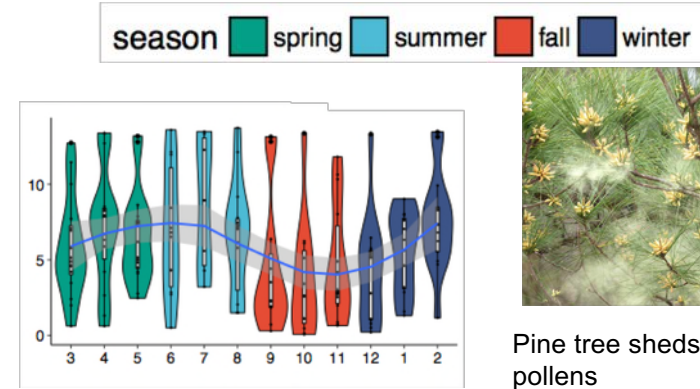
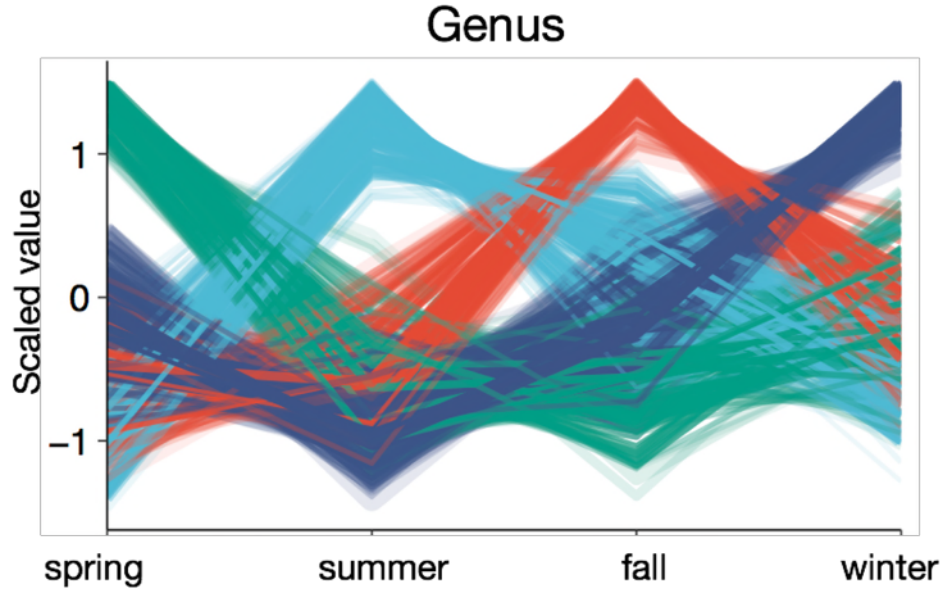
Location, location, location

Different persons, same month

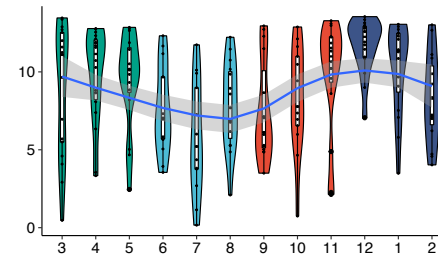


San Francisco
Alkanindiges: Sludge bacteria
Klebsiella: pneumonia pathogen

Seasonal influence on the genera



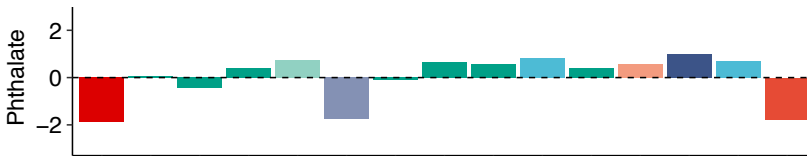
Pine tree sheds millions of pollens



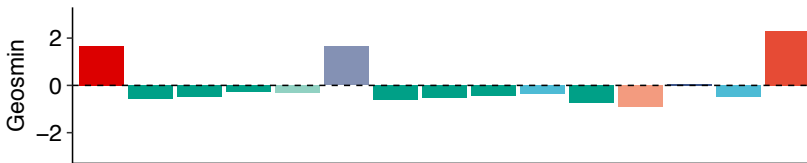
“False Turkey Tail”, spore season starts around fall

Chemicals are influenced by location

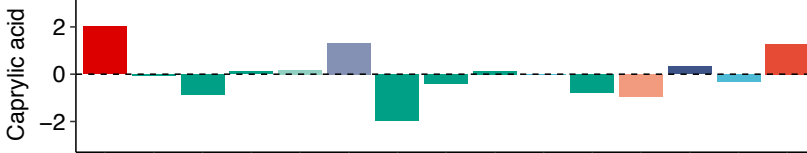
Plastic components



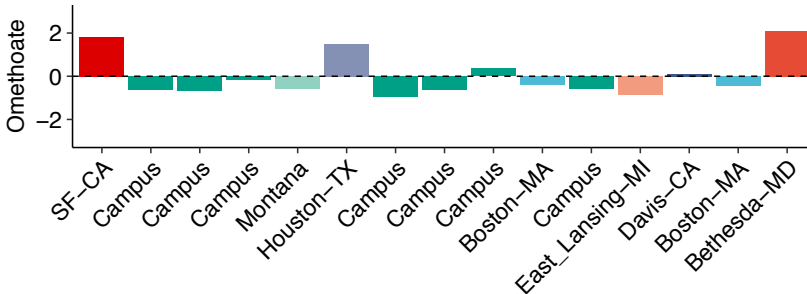
**“Earthy”
smell**



Body Scent

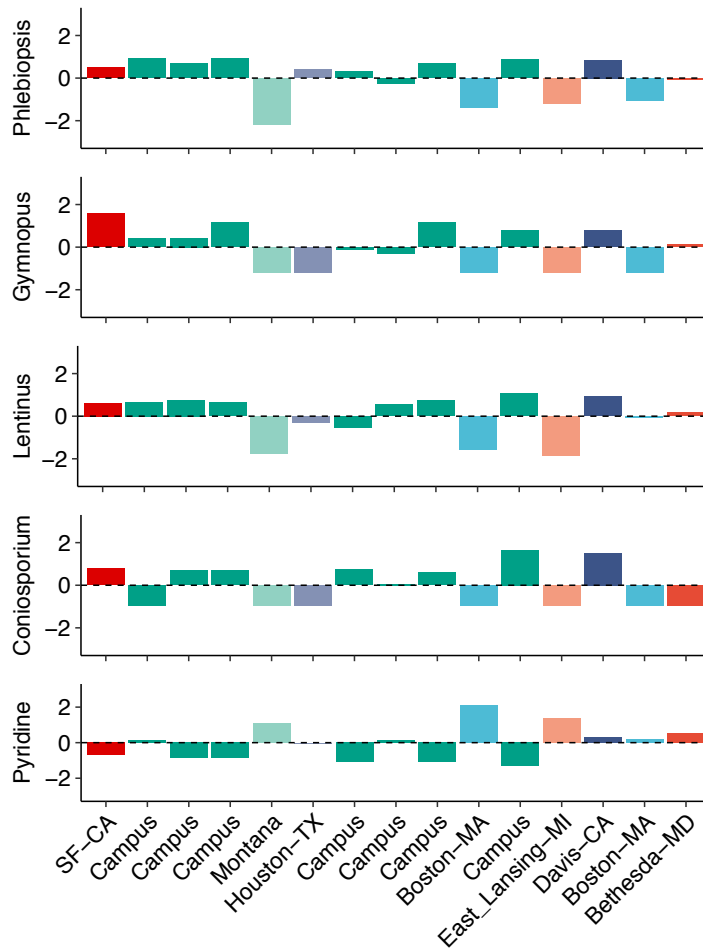


Pesticide



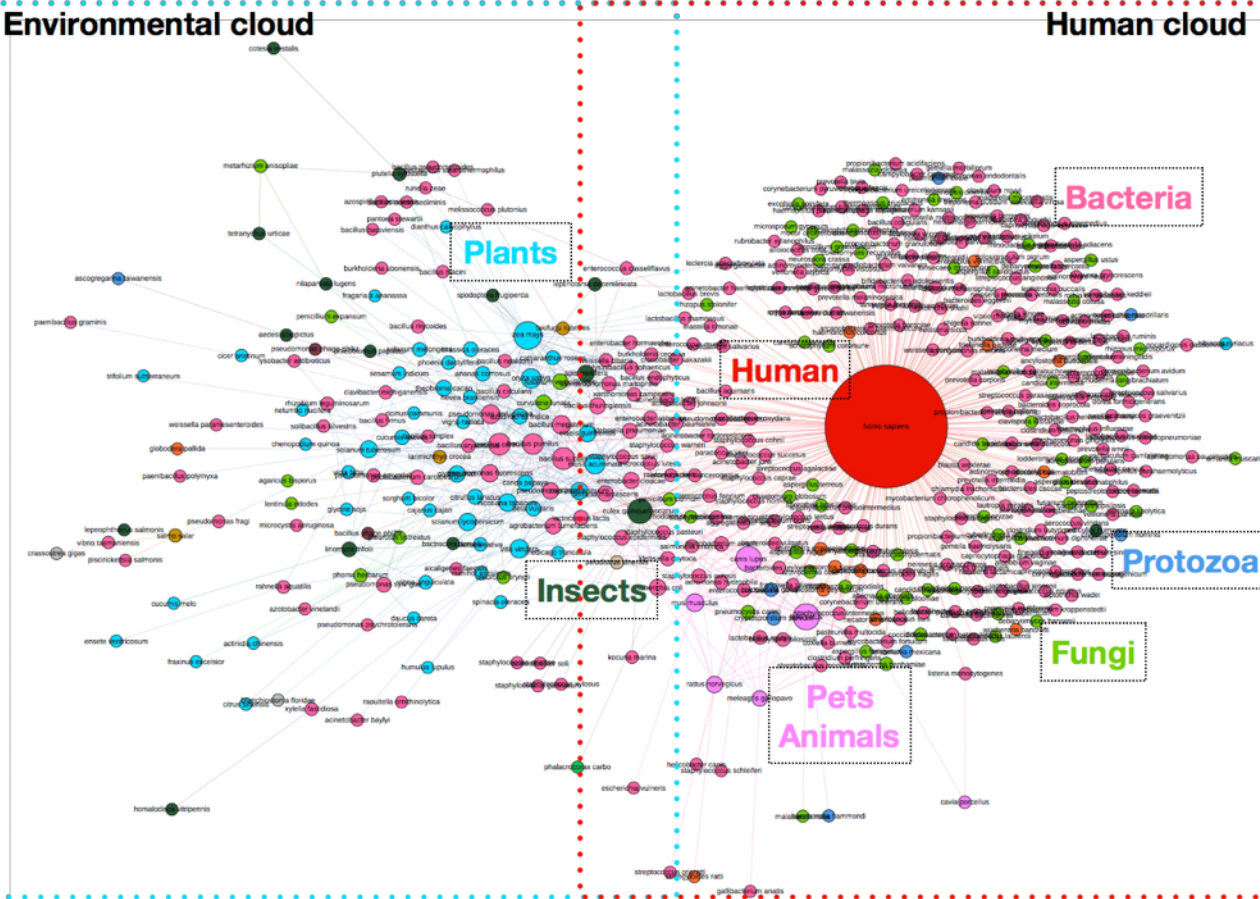
Chemicals are correlated with biologicals

Common
Fungal
genera



Organic
solvent,
used in
paint

Environmental cloud **Human cloud**



Smart Phone = Control Center



Acknowledgements

Snyder Lab

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Wearables

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Lei Chen
Benjamin Leopold
Sai Lek
Purva Vats

Jon Bernstein

McLaughlin Lab

Tracy McLaughlin
Colleen Craig
Candice Allister
Dalia Perelman
Elizabeth Colbert



NIH

Lita Proctor
Salvatore Sechi
Jon LoTempio
And other

Exposome

Chao Jiang
Xin Wang
Jingga Inlora
Ting Wang
Xiyan Li

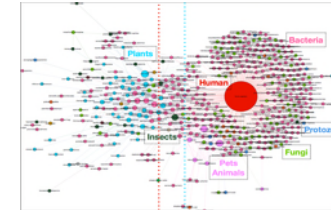
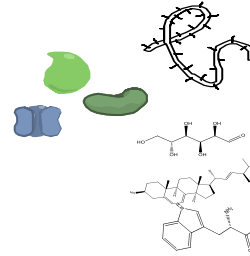
The Future?

Genomic Sequencing



GGTTCCAAAAGTTTATTGGATGCCG
TTTCAGTACATTTATCGTTGCTTT
GGATGCCCTAATTAAGTGACCCT
TTCAAAC TGAAATTCATGATACACC
TTGGATATCCTTAGTCGATAAAAT
TTGCGAGTACTTTCAAAGCCAAATG
TAATTATCTATGGTAGACAAAACAT
TACCAATTCATATCGATCCTCCT
TATTTATTGGCGTTAGACACAGTT
TATATTTA...

Omes & Sensors: Personal Devices



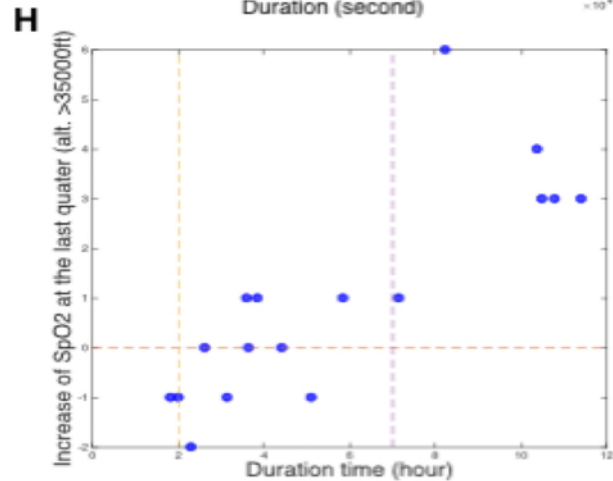
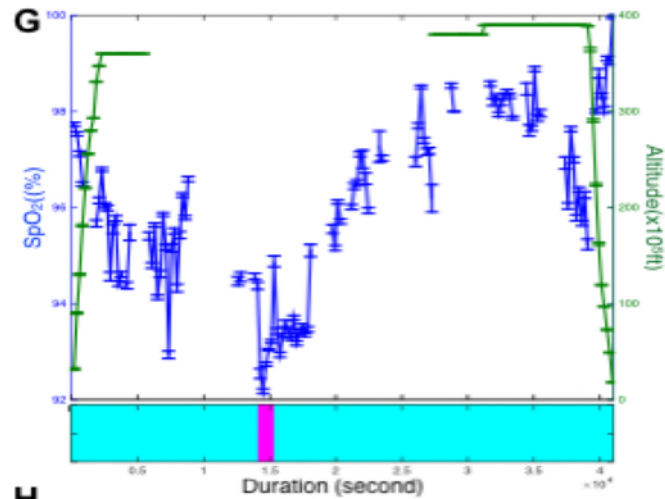
1. Predict risk
2. Early Diagnose
3. Monitor
4. Treat



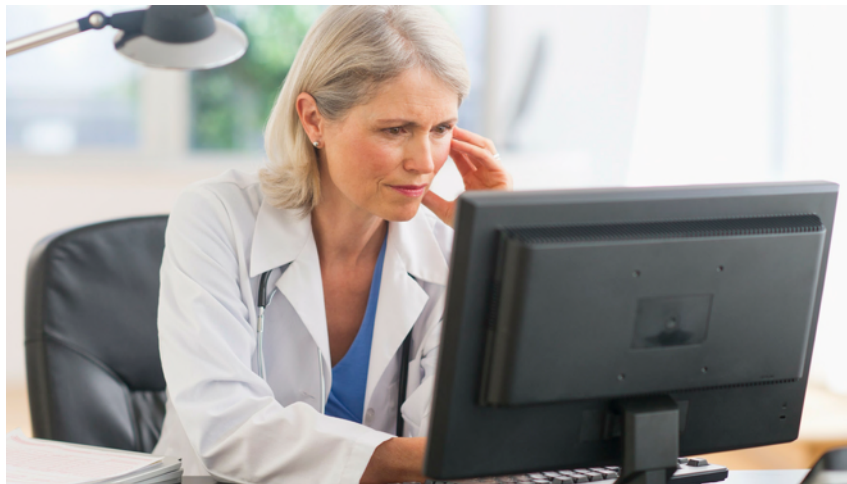
Amanda Mills

SpO₂ Measurements

Can Adapt on
Flights >7hrs

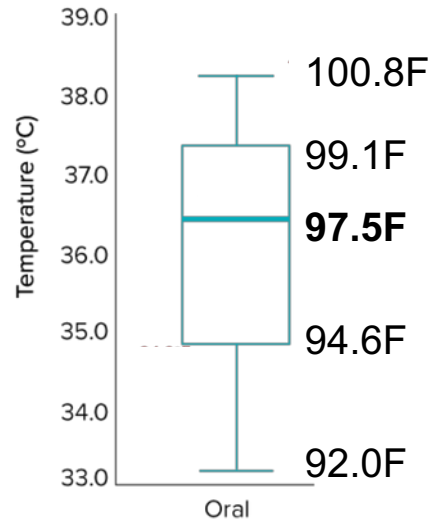


Share Information With Physician

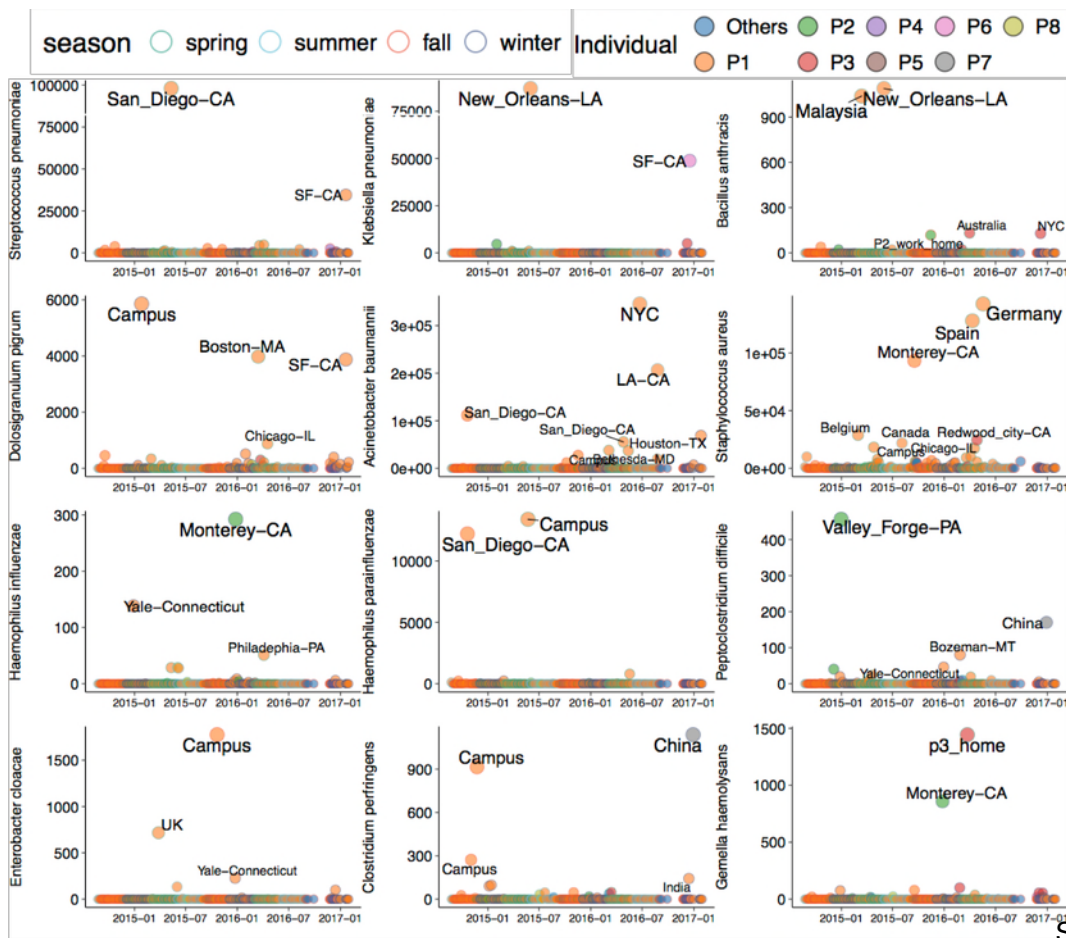


Importance in Individual Variation from “Normal”

Oral temp in 2749 healthy individuals



Sequences related to pathogens: rare

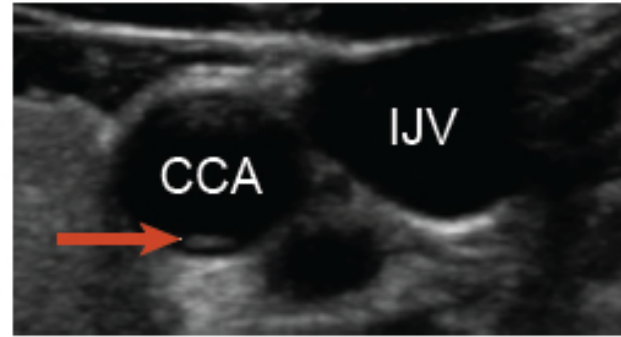


Species level

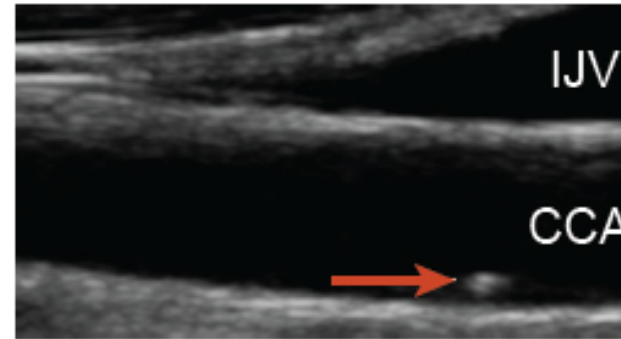
6 people with Carotid Plaque

→ Carotid plaque

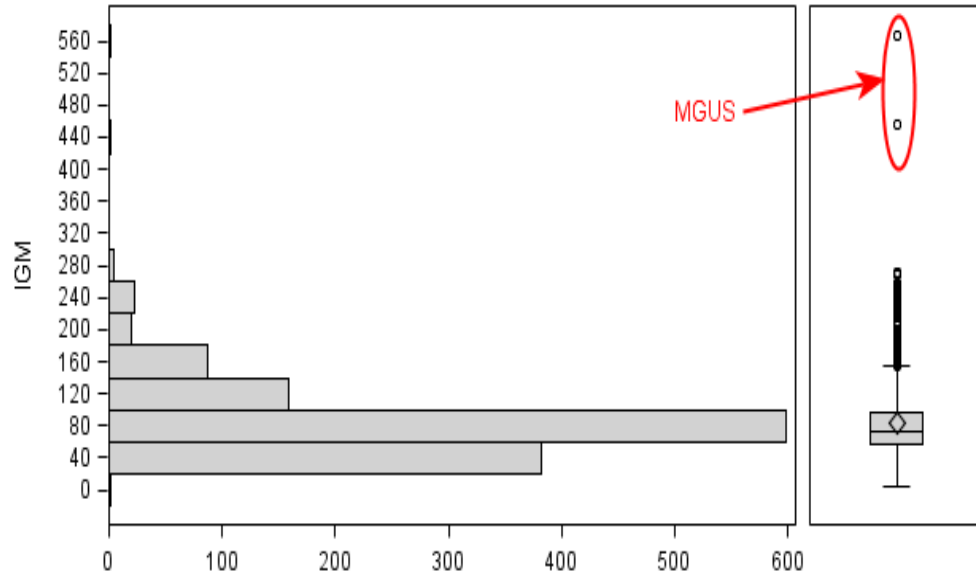
Common carotid artery - short axis view



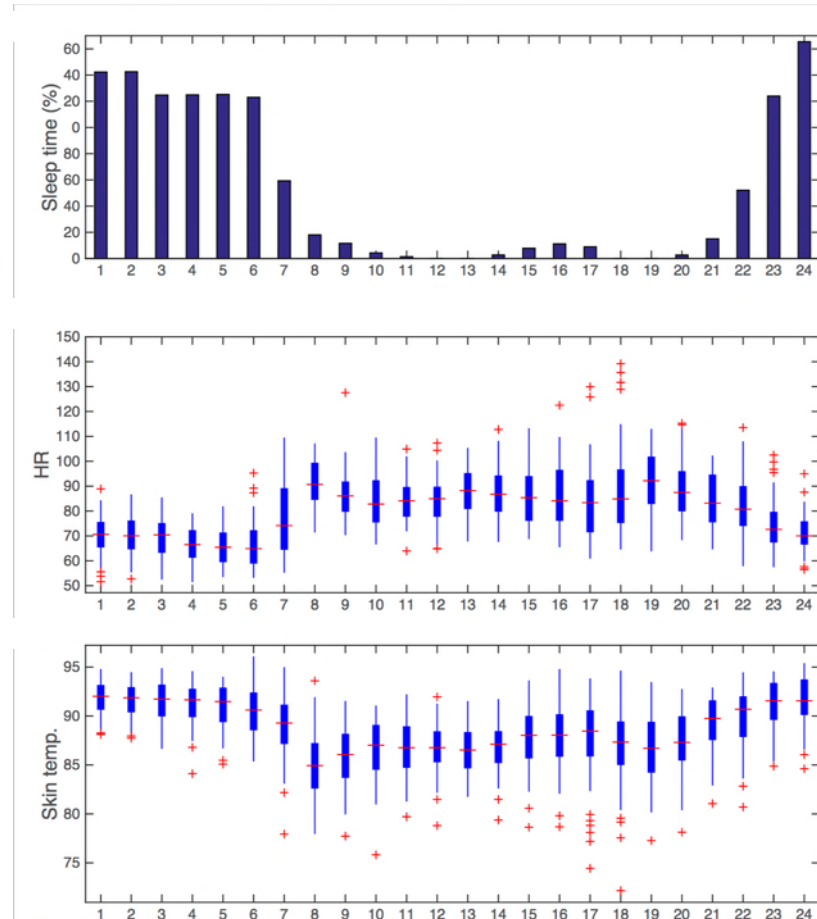
Common carotid artery - long axis view



MGUS PreCancer: High IgM



Circadian and diurnal patterns



Li, Dunn et al.
PloS Biol 2017