

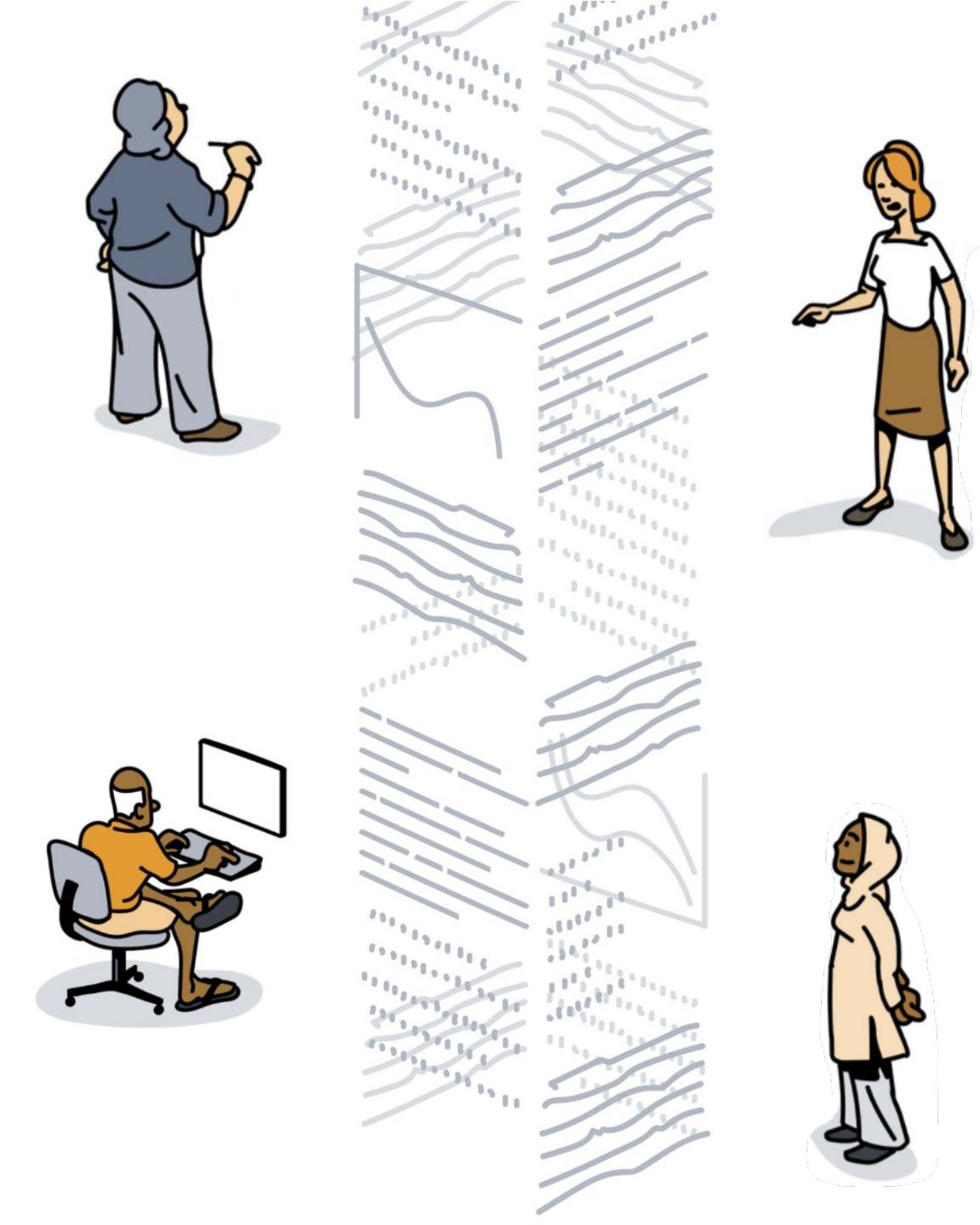
Data Viz & Chemistry & Art & Public Health

Making Sense of Street Drugs

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Nabarun Dasgupta

University of North Carolina at Chapel Hill

Aug 29, 2024 • DataBytes



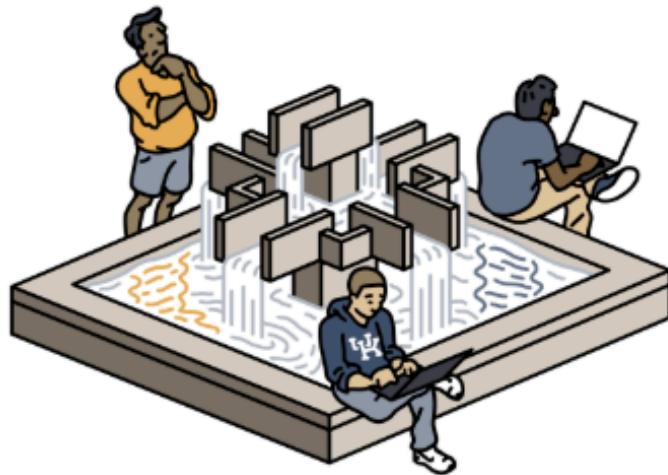


Opioid Data Lab





Theory



Practice



Foundational Studies

Biostatistics
Epidemiology methods
Psychology of communication
Pharmacology

Lived Experience



Applied Research

Pharmacy
Medicine
Vital statistics
Harm reduction

Practical Applications

Drug checking
Sociology (qualitative)
Evidence-making interventions
History of asylums

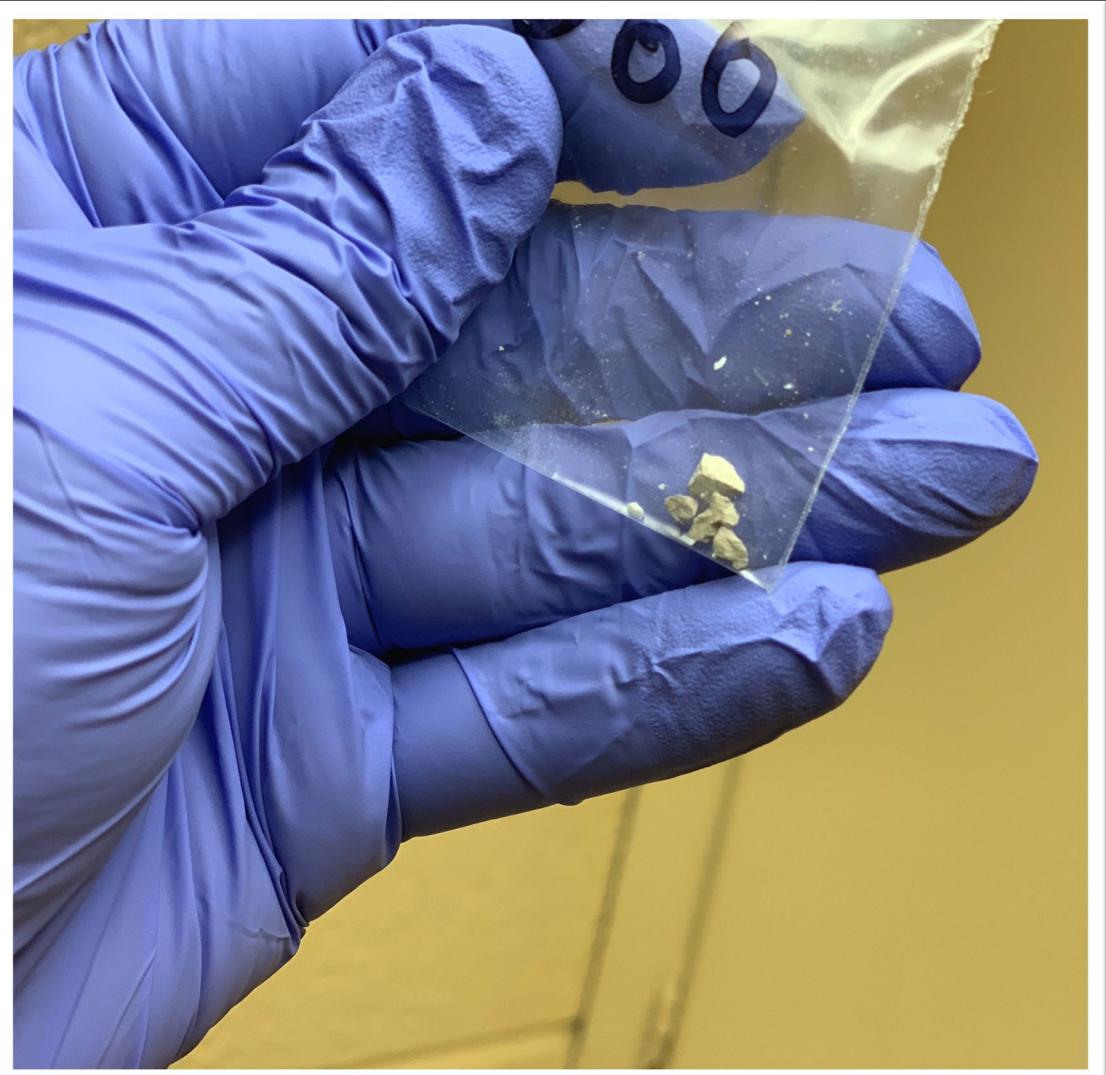


Our Approach is Different.

Science

in

Service



Street drugs change constantly.



In our lab on campus



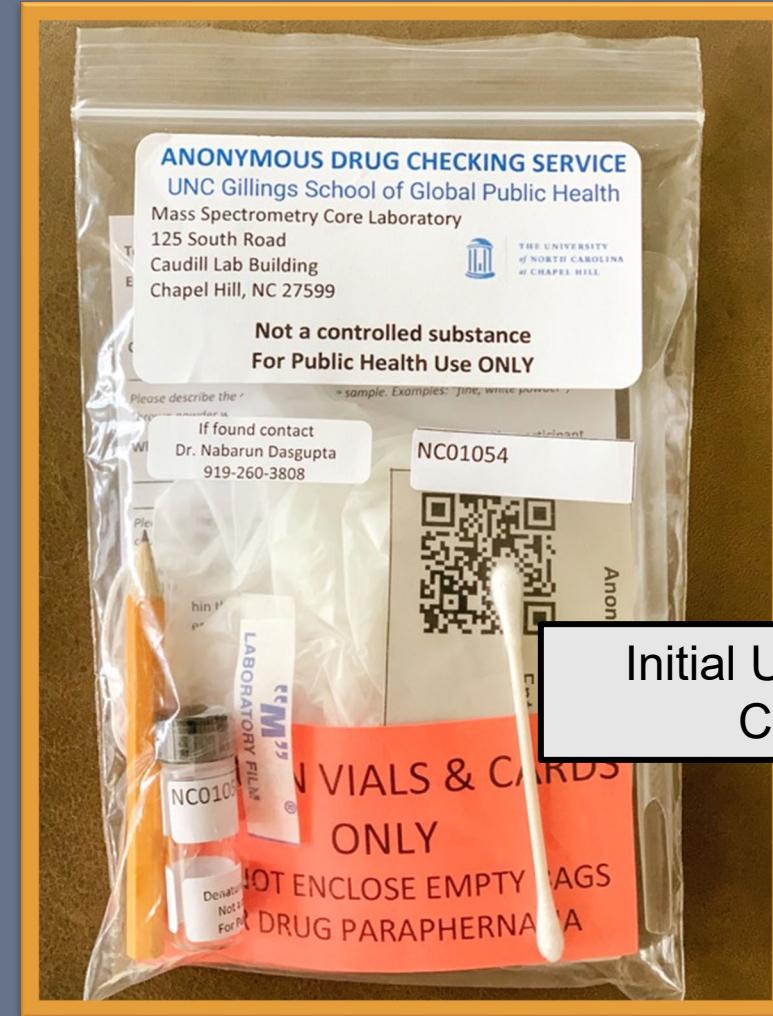
we monitor street drugs

as a public service.



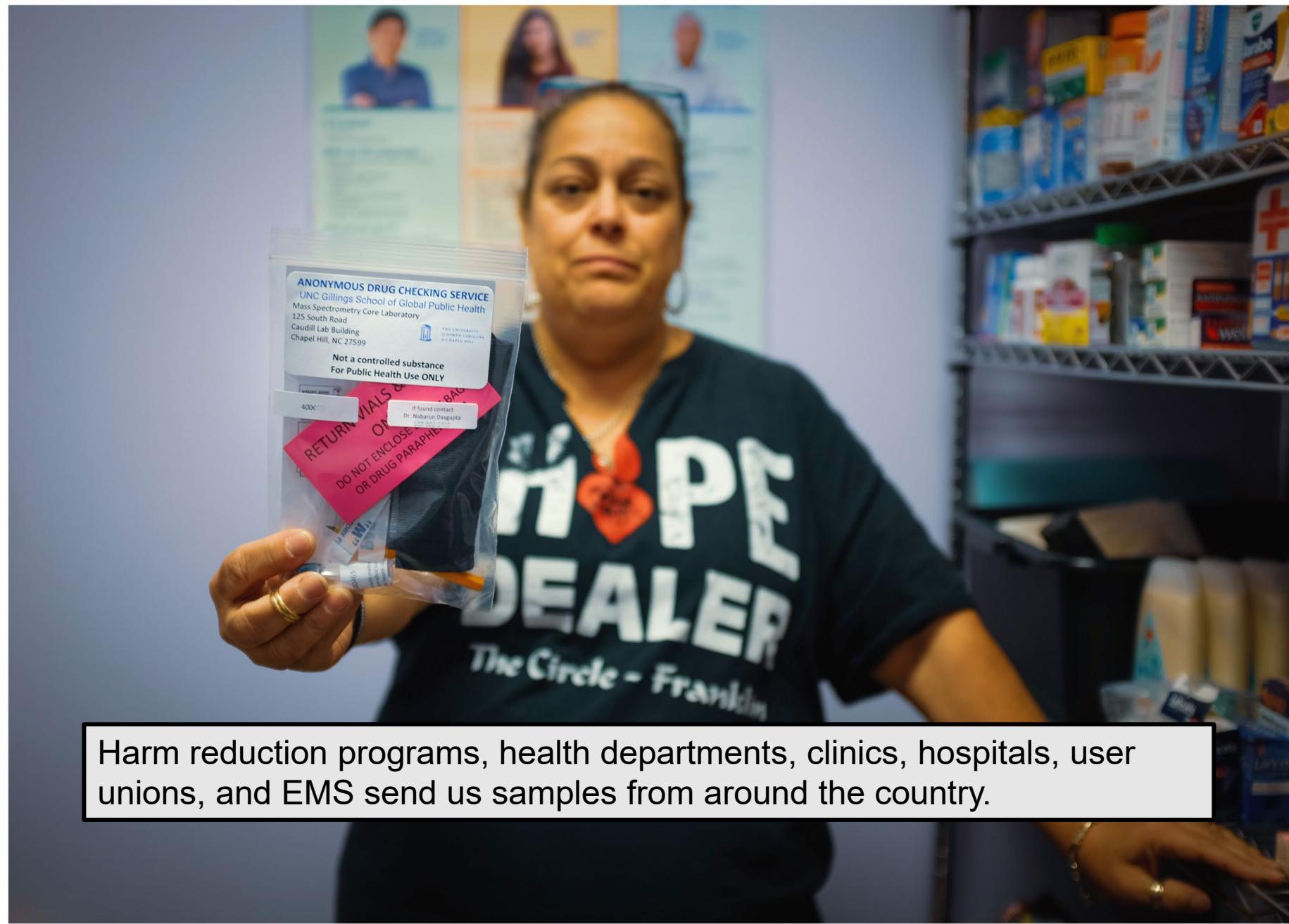


COVID-19 PCR kits



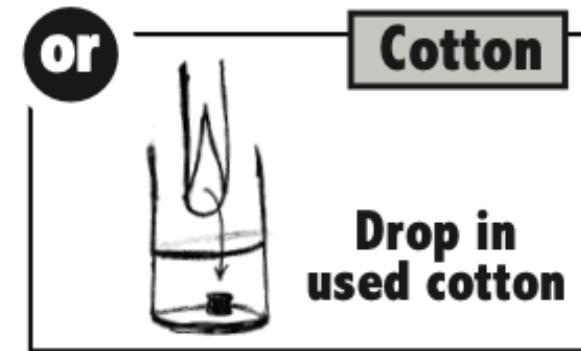
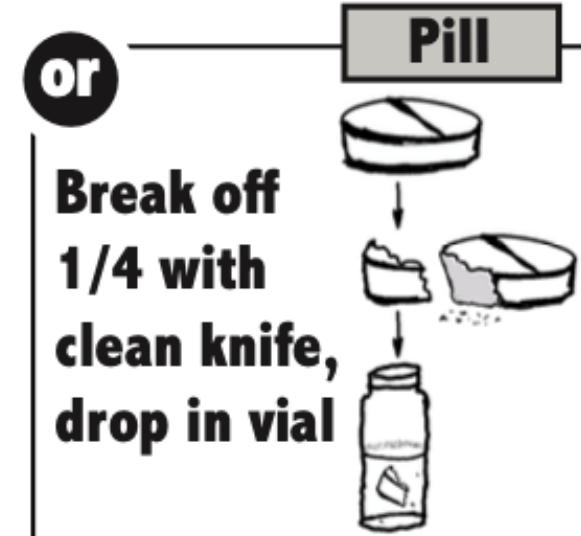
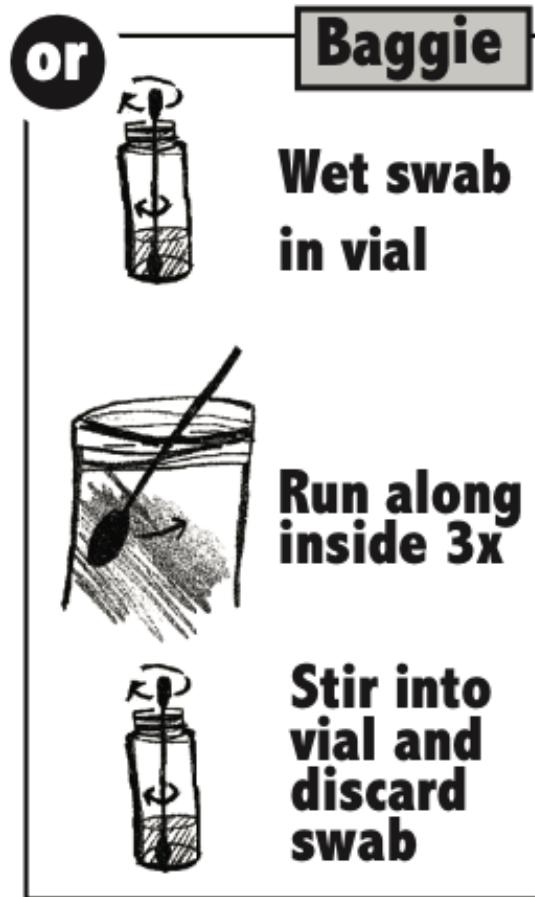
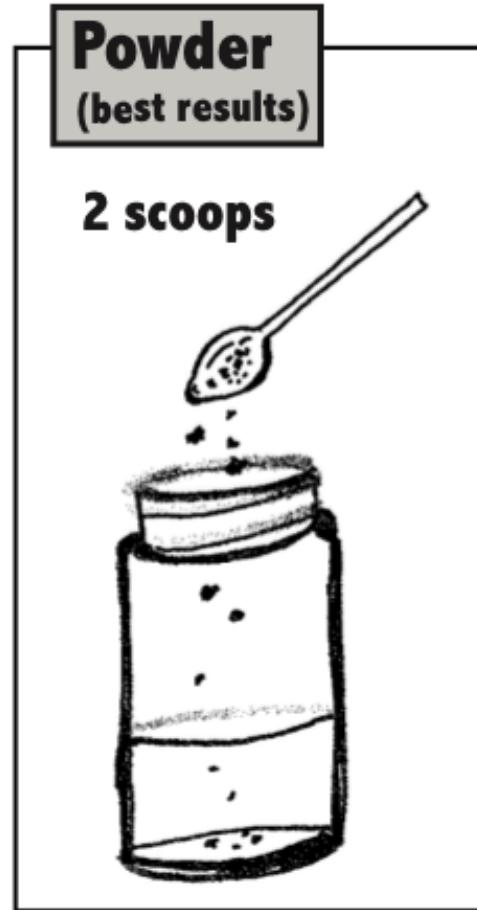
Initial UNC Street Drug Checking kit





Harm reduction programs, health departments, clinics, hospitals, user unions, and EMS send us samples from around the country.

Samples can be collected via scoop, residue swab, pill fragment, or used cotton.



Samples are given voluntarily.



The tests are anonymous.





to give human context beyond molecules.

Programs share health information with us

Completely Anonymous

These questions help us figure out how to analyze the sample in our lab at UNC.

circle

spatula	swab	pill	cotton
↓ residue?			
syringe	pipe	foil	

today's date

month _____ date _____

circle if involved in overdose

yes no don't know

describe the overdose to warn others:

overdose

v7

describe color and markings

circle expected drugs

heroin	fentanyl	xylazine
cocaine	crack	meth
ketamine	weed	M30
benzo	other:	
MDMA		
unknown		

circle textures

crystals	pill	fake pill
powder	edibles	oil/wax
↓		
chunky	plant/leaf	tar
shiny		
flaky		
dull		

other:

city or neighborhood

circle & describe sensations

normal nice weird
weaker stronger long
more up unpleasant
more down hallucinations
sedating unusual taste
describe:

sensations

sample number

Packages arrive on campus



in compliance with drug and postal laws.



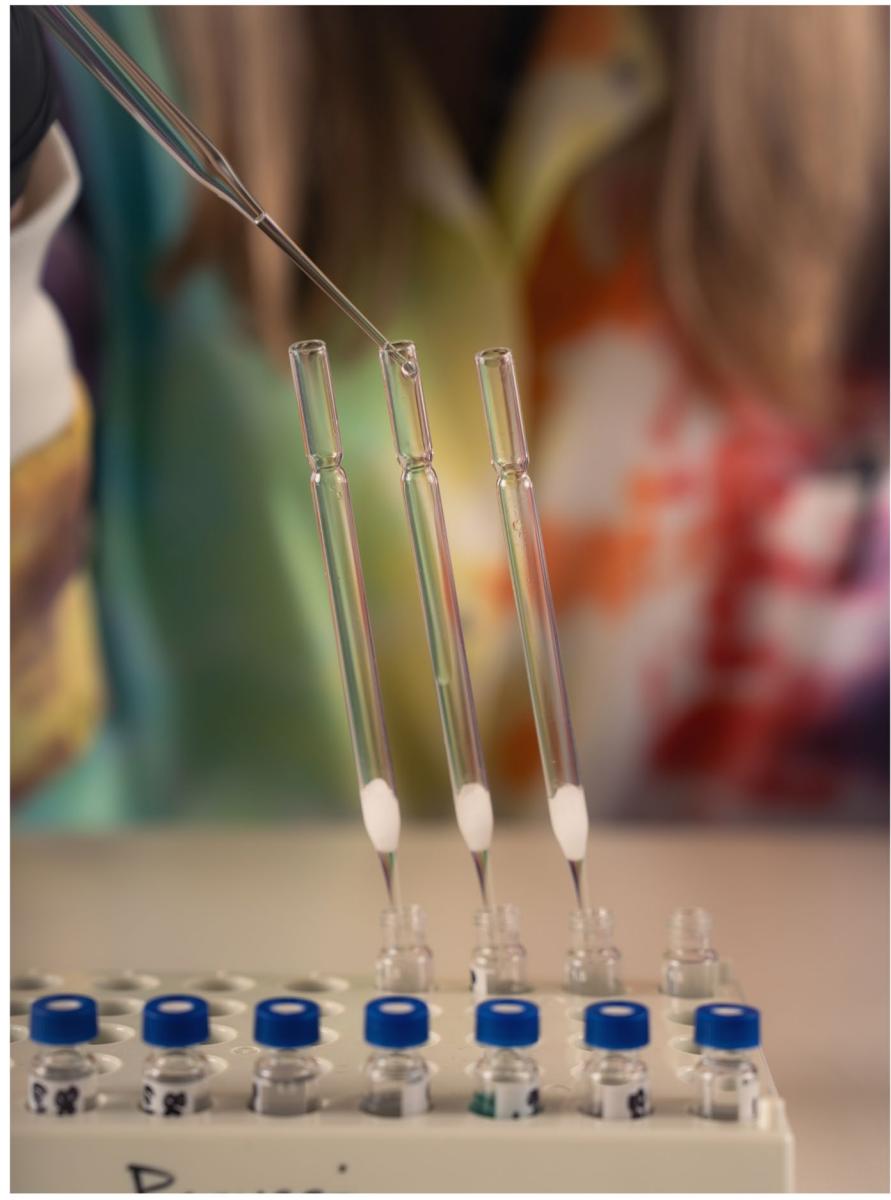
We record the information



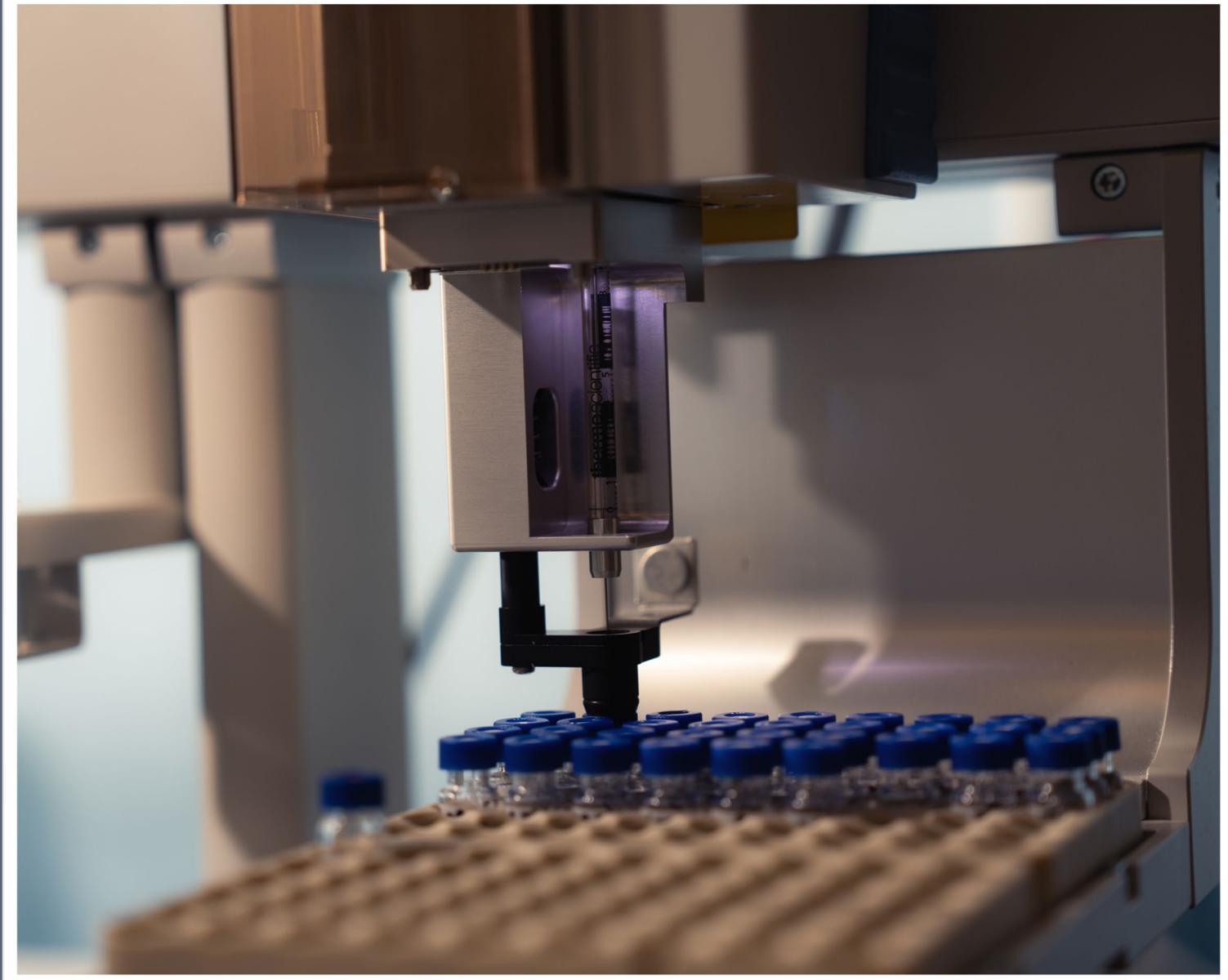
and catalog the samples.



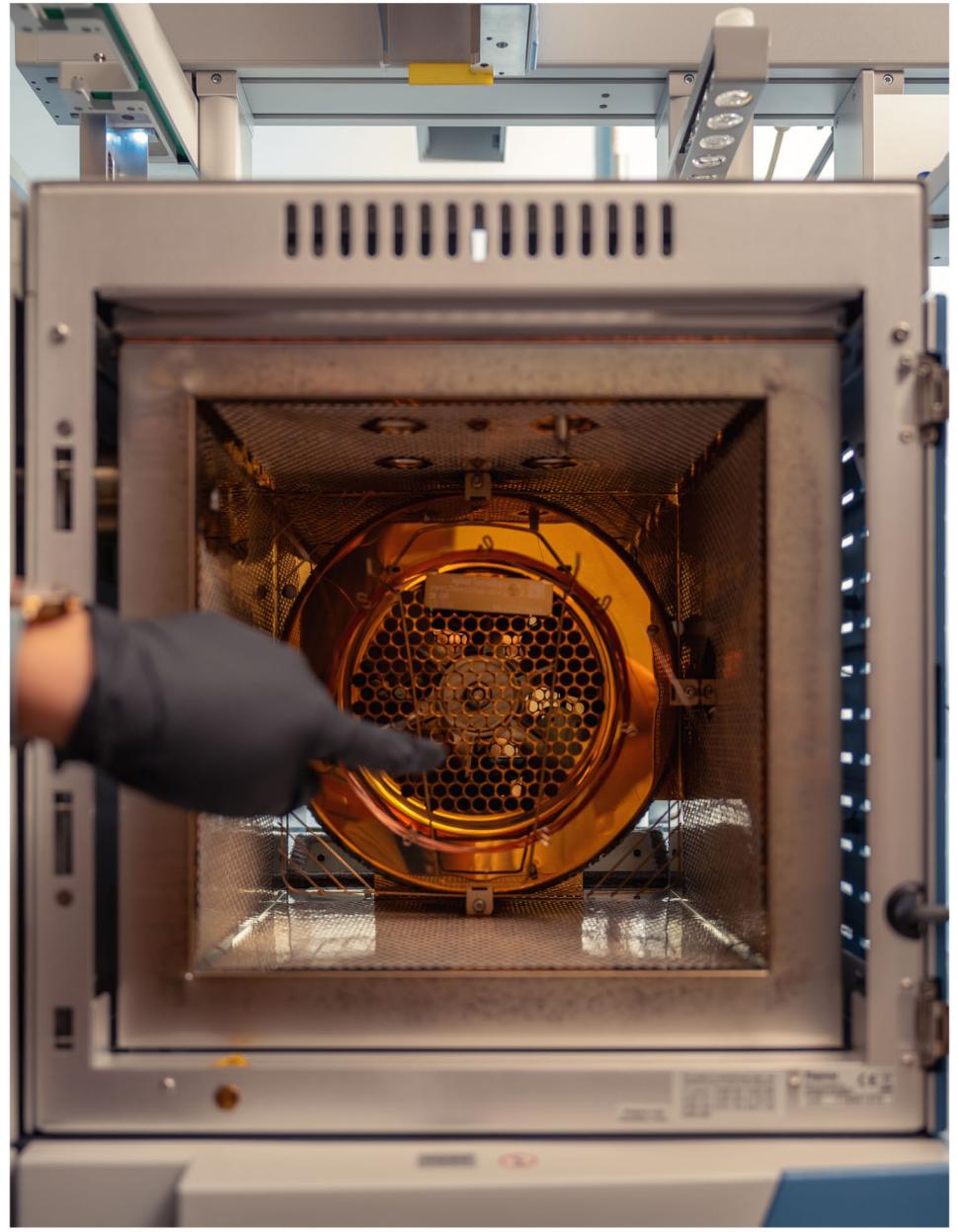
We prep the samples



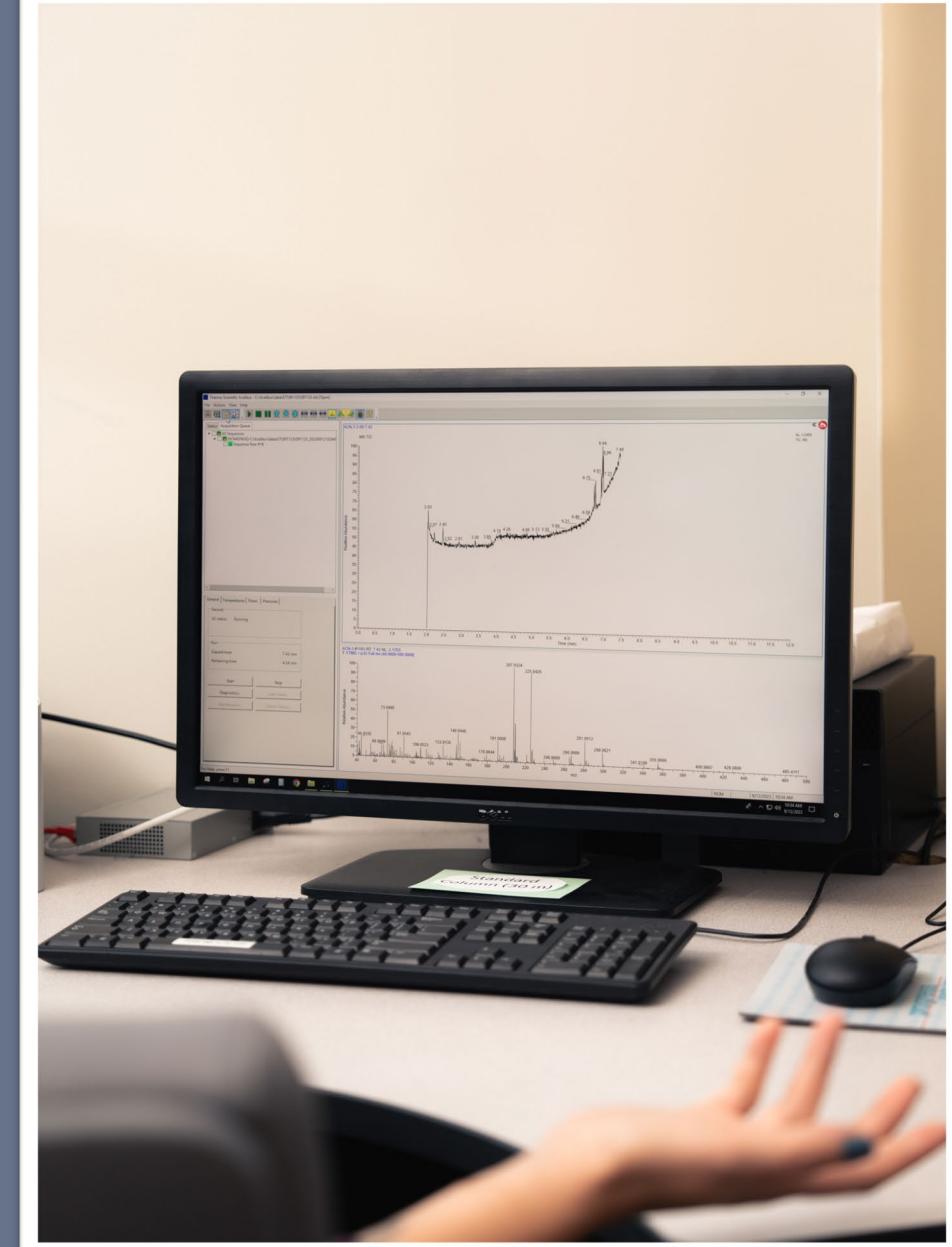
and load them on a GCMS (mass spec).



We interpret the high resolution results,



to determine exactly what's in the sample.





March 2022 to August 27, 2024

USA

N = 7,205 drug samples

141 programs

36 states

212 counties

We've detected a multitude of substances in drug supply.





Most importantly, we provide timely results back to the individual.

1. Helping Individuals



Questions we have helped answer

Is there fentanyl in black tar heroin?

Are nitazenes causing these overdoses?

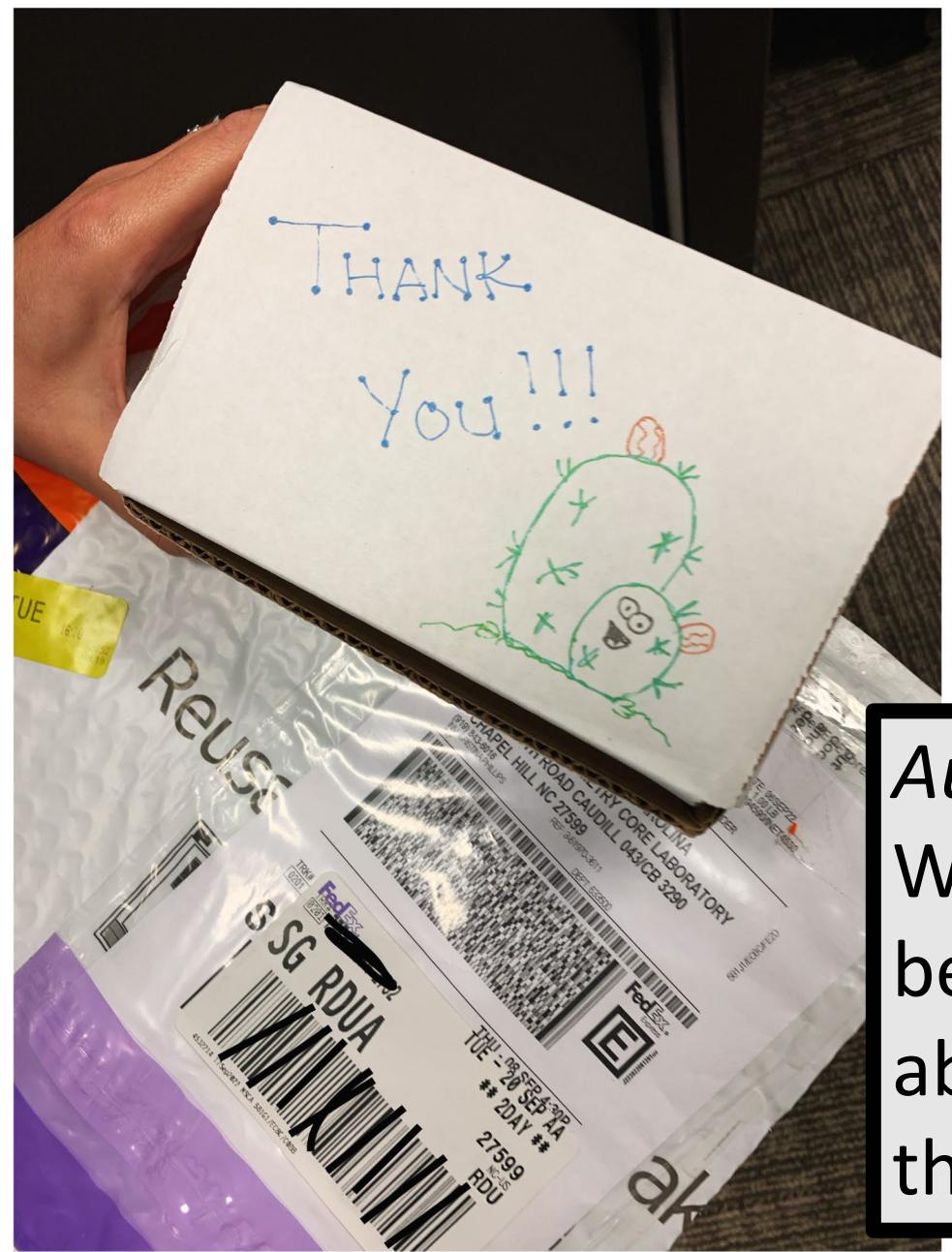
What killed my husband?

Can xylazine explain these skin wounds?

How accurate are test strips?
Handheld machines used by police?

Can black lights identify xylazine and nitazenes?

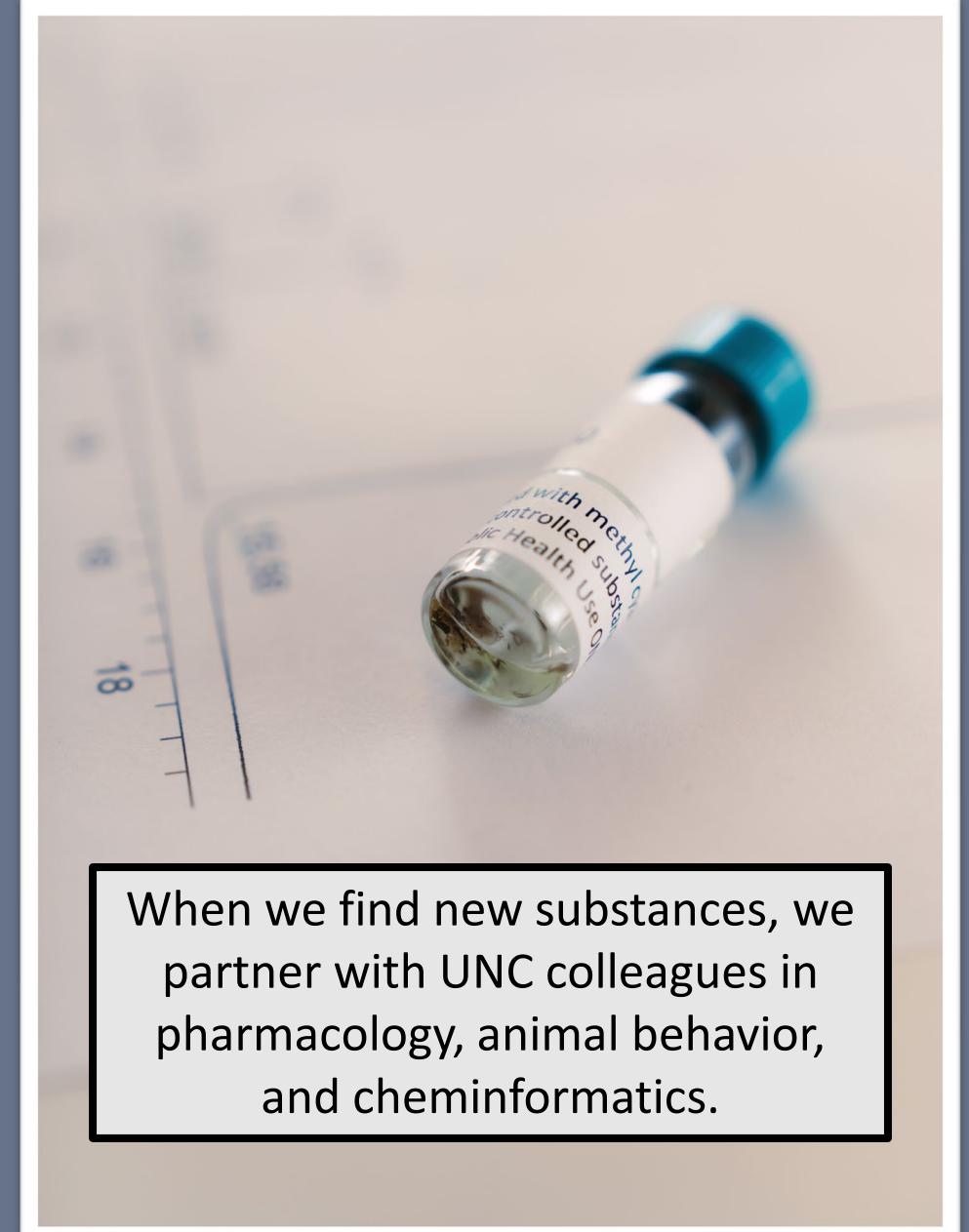
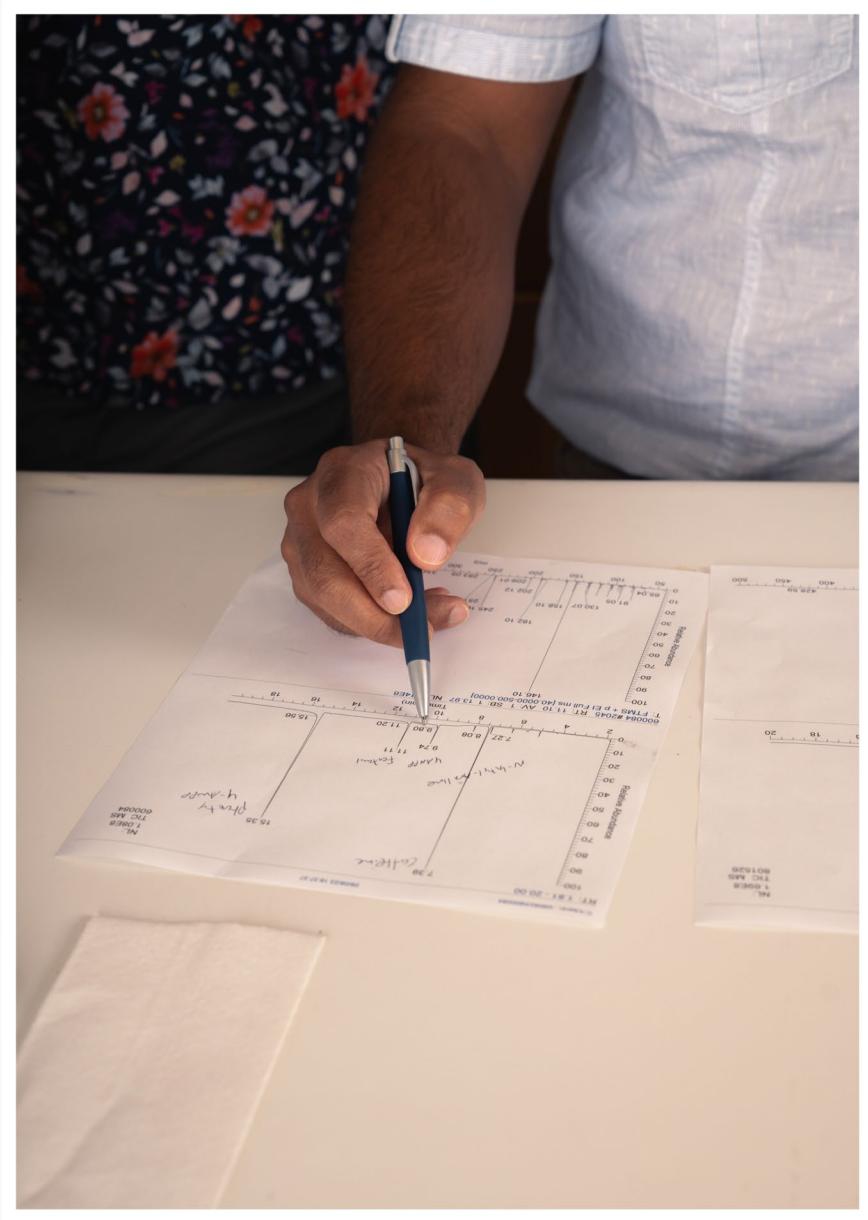
MDMA used by psychedelic therapy patients?



Autonomy
We help people make
better decisions
about what to put in
their bodies.



We make our data public daily.



When we find new substances, we partner with UNC colleagues in pharmacology, animal behavior, and cheminformatics.

300731

From Asheboro, North Carolina on
11/2/2022

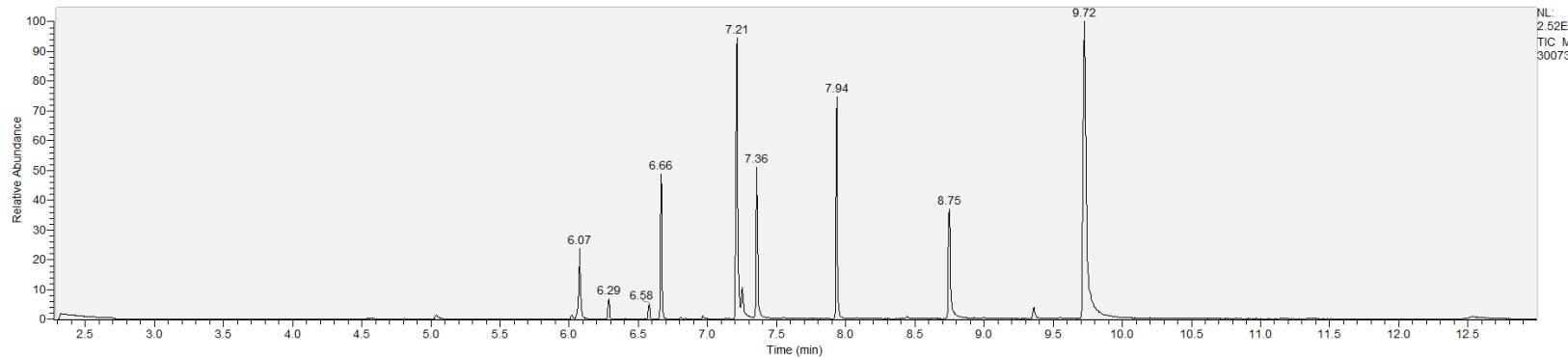
Assumed to be heroin

This is a messy brew of 10 major substances:

- phenacetin
- caffeine
- procaine
- meconin
- hydrocotarnine
- fentanyl
- levamisole
- 4-ANPP
- xylazine
- cocaine

But we found lots of contaminants too, with traces of acetaminophen + N-phenylpropanamide + melatonin + noscapine + heroin + dimethyl sulfone (methylsulfonylmethane MSM). Trace substances in small quantities can sometimes be harmless, but other times can cause health problems. If you have unexpected sensations, it may be due to these.

Messy Brew of 16 Substances



Medicine: phenacetin, acetaminophen, melatonin

Veterinary medicine: levamisole, xylazine

Numbing agents: procaine

Stimulants: caffeine, cocaine

Organic origin: **noscapine**, meconin, hydrocotarnine, heroin

Synthetic opioids: fentanyl

Byproducts: 4-ANPP, N-phenylpropanamide, MSM

From GCMS Output to Harm Reduction

The Problem:

- Chemical names are *intimidating* and *arcane*
- Site users copy and paste into search engines when they see substance they don't know, returning *complicated* or *ineffective* information.
- In data analysis, we have only rudimentary capabilities to identify classes of molecules, and existing taxonomies are not built-for-purpose.

noscapine X |

All Images Shopping Videos News Forums Maps More Tools

Noscapine is a phthalide isoquinoline non-narcotic alkaloid derived from the opium poppy *Papaver somniferum*, with mild analgesic, antitussive, and potential antineoplastic activities. Noscapine exerts its antitussive effects through the activation of sigma opioid receptors.

National Institutes of Health (NIH) (.gov)
<https://pubchem.ncbi.nlm.nih.gov/compound/Nosca...> ::

Noscapine | C22H23N07 | CID 275196 - PubChem

Chemical structure of noscapine, showing a complex polycyclic system with a phthalide core fused to an isoquinoline ring system, featuring multiple oxygen atoms and methyl groups.

Chemical structure of noscapine, showing a different perspective or form of the molecule.

We need harm-reduction *specific* translations

What information will support communities to have safer interactions with drugs?

Our solution: The Chemical Dictionary

Google's Output:

phthalide

isoquinoline

non-narcotic

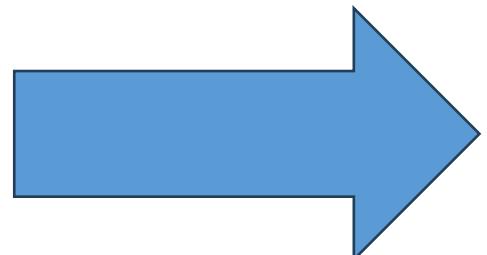
alkaloid

papaver

somniferum

?

Input of "noscapine"



Chem Dictionary's Output:

heroin impurity

weak opioid

anti-cough

downer

established

Uncommon cough
medicine; From
opium poppy

It lacks significant hypnotic, euphoric,
or analgesic effects affording it with
very low addictive potential

Building The Chemical Dictionary

Features

- 270+ unique substances
- Keys (PubChem, CAS)
- synonyms, vernacular, pronunciation
- sixwords
- notes
- categorization
- tags

Fentanyl synthesis leftover, rotting fish smell

Classic upper in coffee and pills

Bitter taste, used in rubbing alcohol

Tagging System

- Tags allow for flexible labeling as the *context for use* of substance changes
- Allows for nuance in the automated categorization process
- Curated by our wonderful team of chemists, physicians & epidemiologists!

noscapine tags:

PLANT GROWN ESTABLISHED
WEAK OPIOID OPIOID
HEROIN IMPURITY DOWNER

Categorization

Opioid
Cannabinoid
Sedative
Stimulant
Psychedelic
Steroid
Other

2. Helping Frontline Public Health Orgs

Top 10 Substances Identified

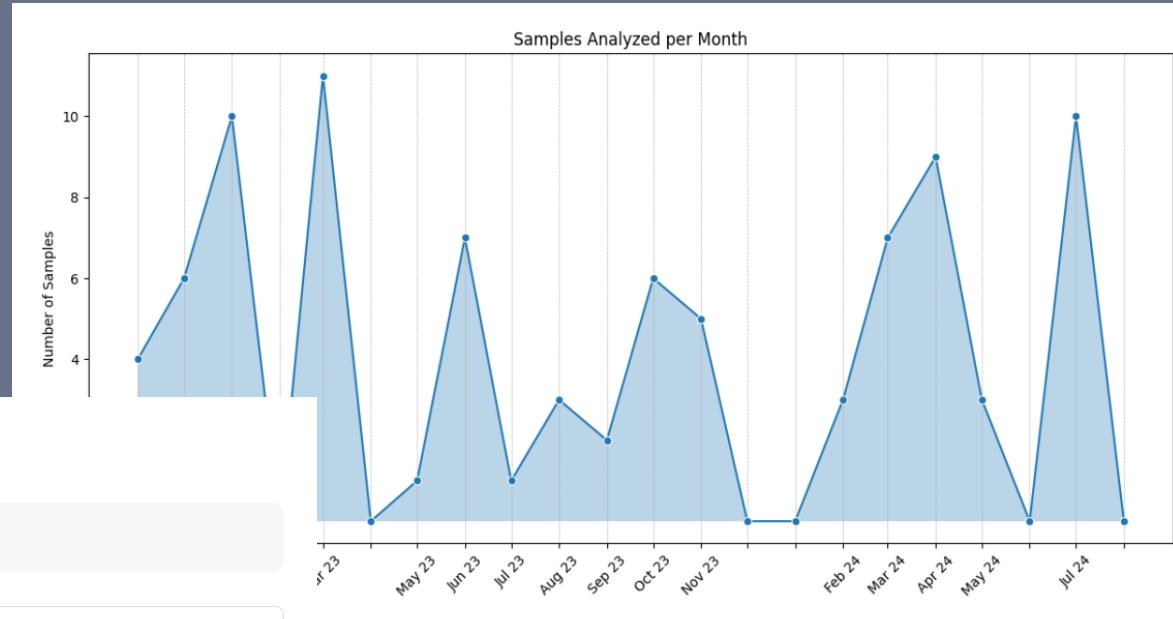
Rank	Substance	Samples	Description
1	fentanyl	39	Potent opioid, prescription uses, potentially lethal
2	4-ANPP	36	Leftover/inactive part of fentanyl production
3	methamphetamine	27	Description pending, currently unavailable
4	cocaine	21	Classic upper, coke or crack forms
5	p-fluorofentanyl	10	Fentanyl-analog, likely more potent and deadly
6	ketan		
7	xylazi		
8	lidoca		
9	despr		
10	dimet (meth		

OD Drug Combos

💡 Combinations of substances in overdose reports.

Total number of samples involved in overdoses: 9

Collection Dates	Frequency	Combination of Substances
2024-Feb-15		
2024-Apr-17	3	4-ANPP; fentanyl
2023-Apr-29		
2022-Nov-25	1	methadone
2023-Feb-14	1	4-ANPP; ethyl-4-ANPP; fentanyl; lidocaine; p-fluorofentanyl; tramadol; xylazine
2023-Feb-01	1	4-ANPP; despropionyl p-fluorofentanyl; fentanyl; lidocaine; p-fluorofentanyl; t
2023-Jun-27	1	4-ANPP; N-phenylpropanamide; fentanyl; mannitol
2024-Feb-29	1	4-ANPP; fentanyl; methamphetamine
2024-Feb-29	1	4-ANPP; fentanyl; xylazine

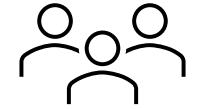


Live reports application project created by student researcher Bryn & Nab!





3. Seeing Patterns: Public and Scientists



Let's zoom out even more...

- Our vision is to make the drug supply seem knowable – to anyone & everyone
- We want a conversation starter, an eye-catcher!

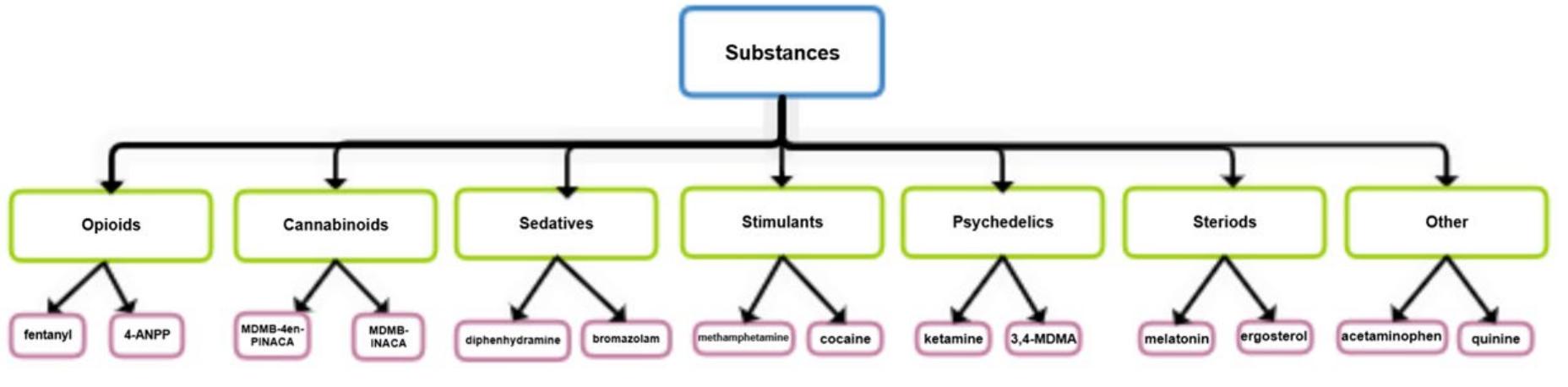
The drug supply is “not this massive, lethal, heaving beast,” Dr. Green said. “It is something that we’re coexisting with.”

-quote from [NYT article](#) about our lab, by Traci Green, a friend and collaborator

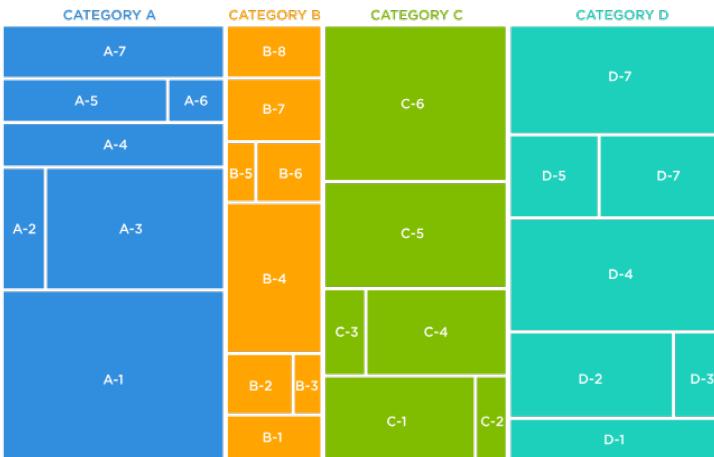
Our audience:



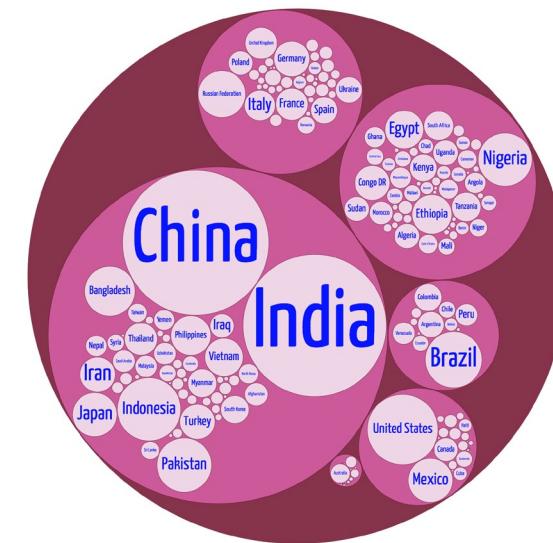
Hierarchical Tree Structure



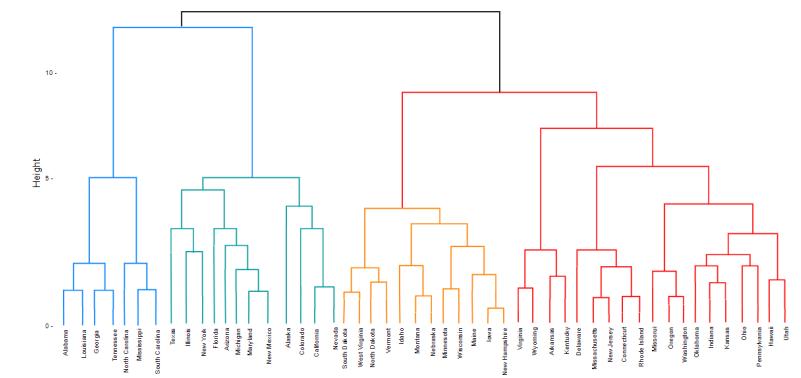
Tree Diagram



Circle Packing/Enclosure Diagrams

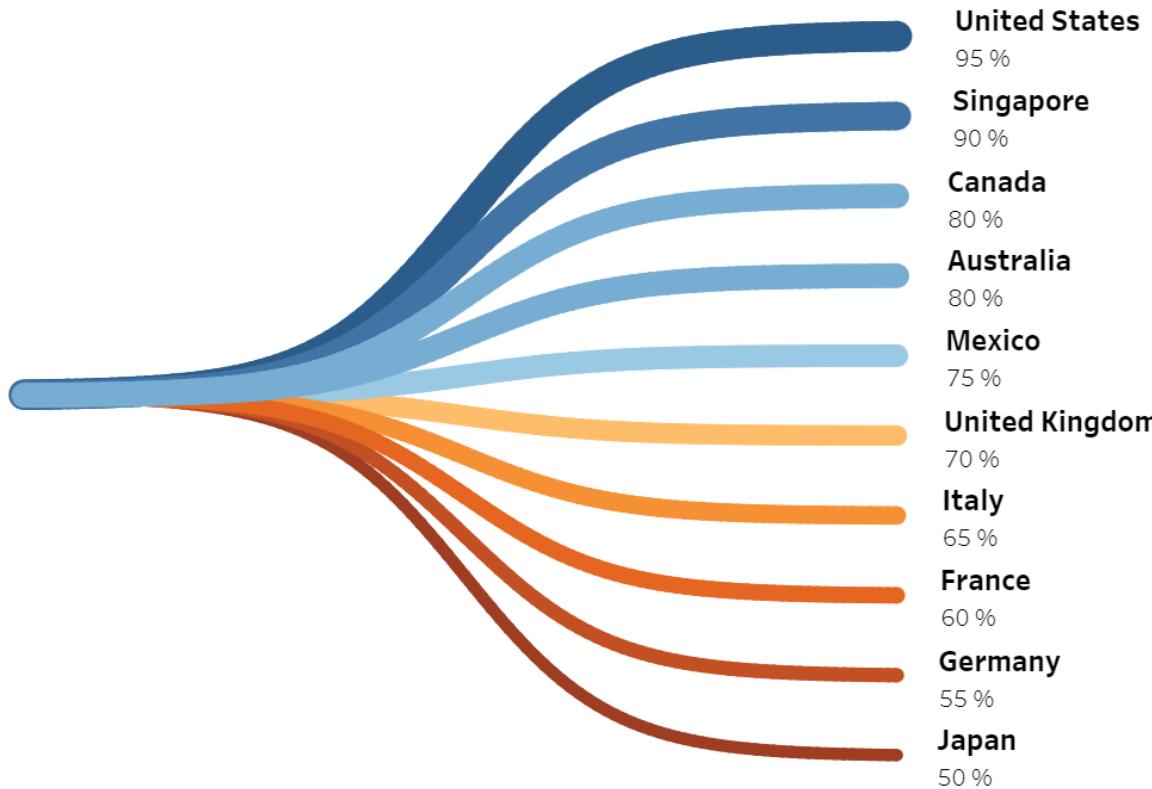


Tidy Trees

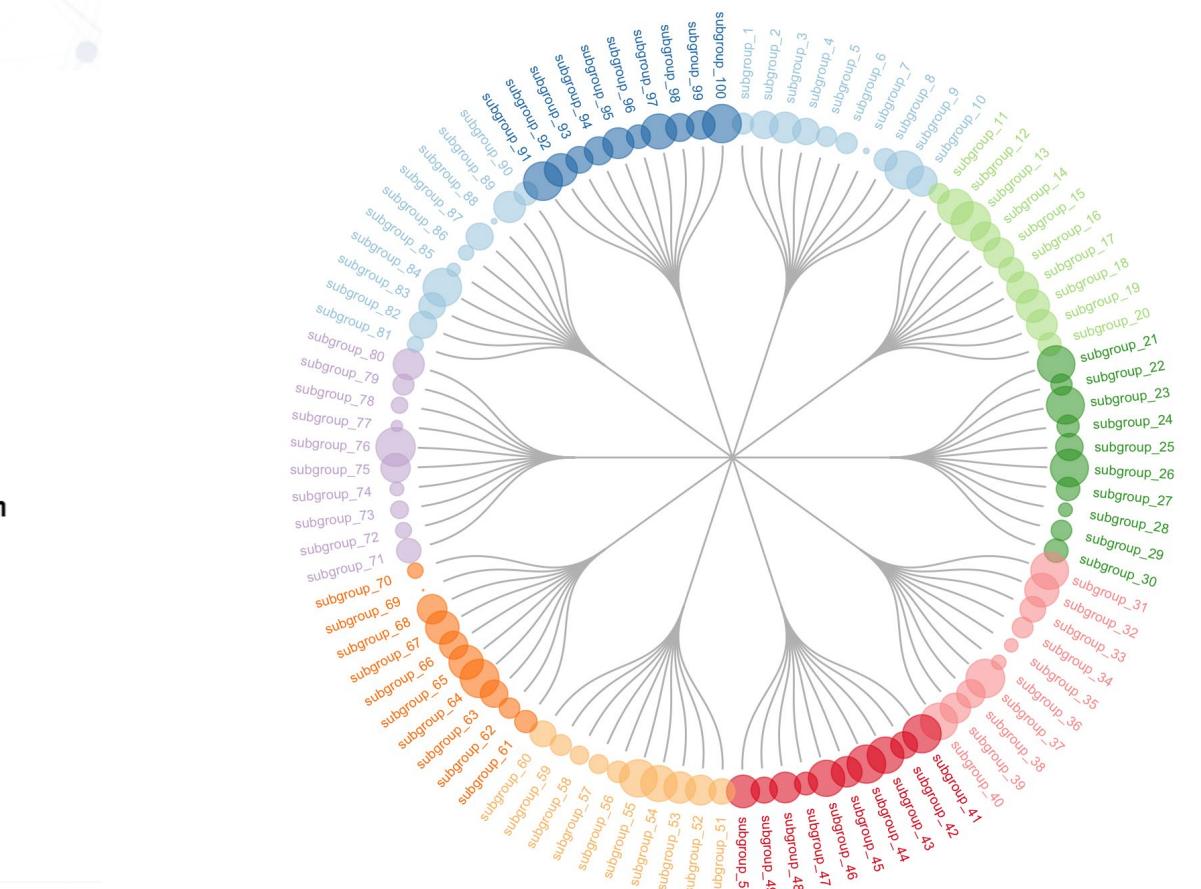




Dendograms (Single Level Tidy Trees)

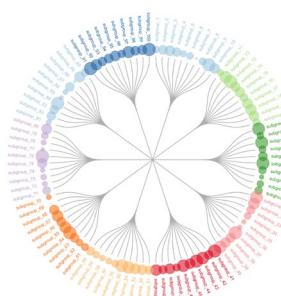
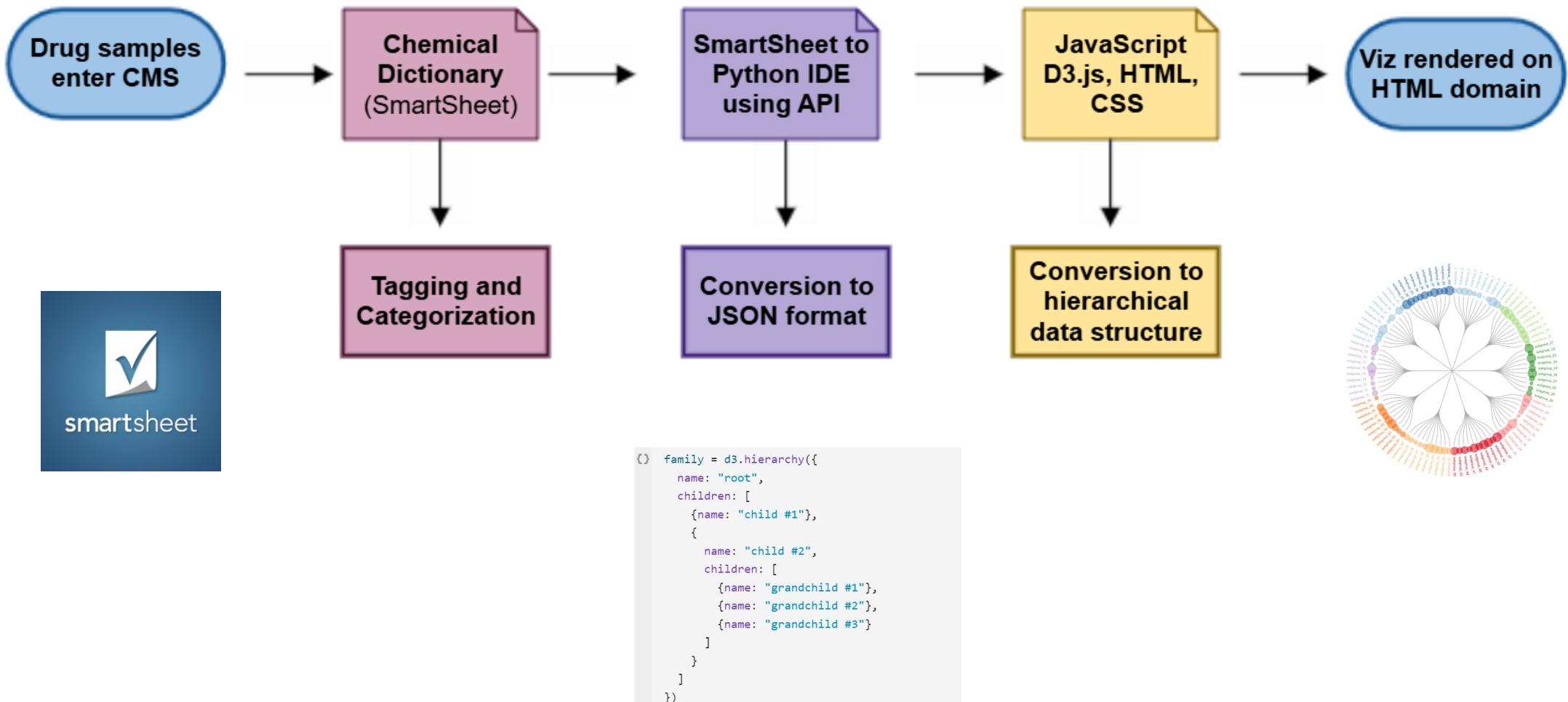


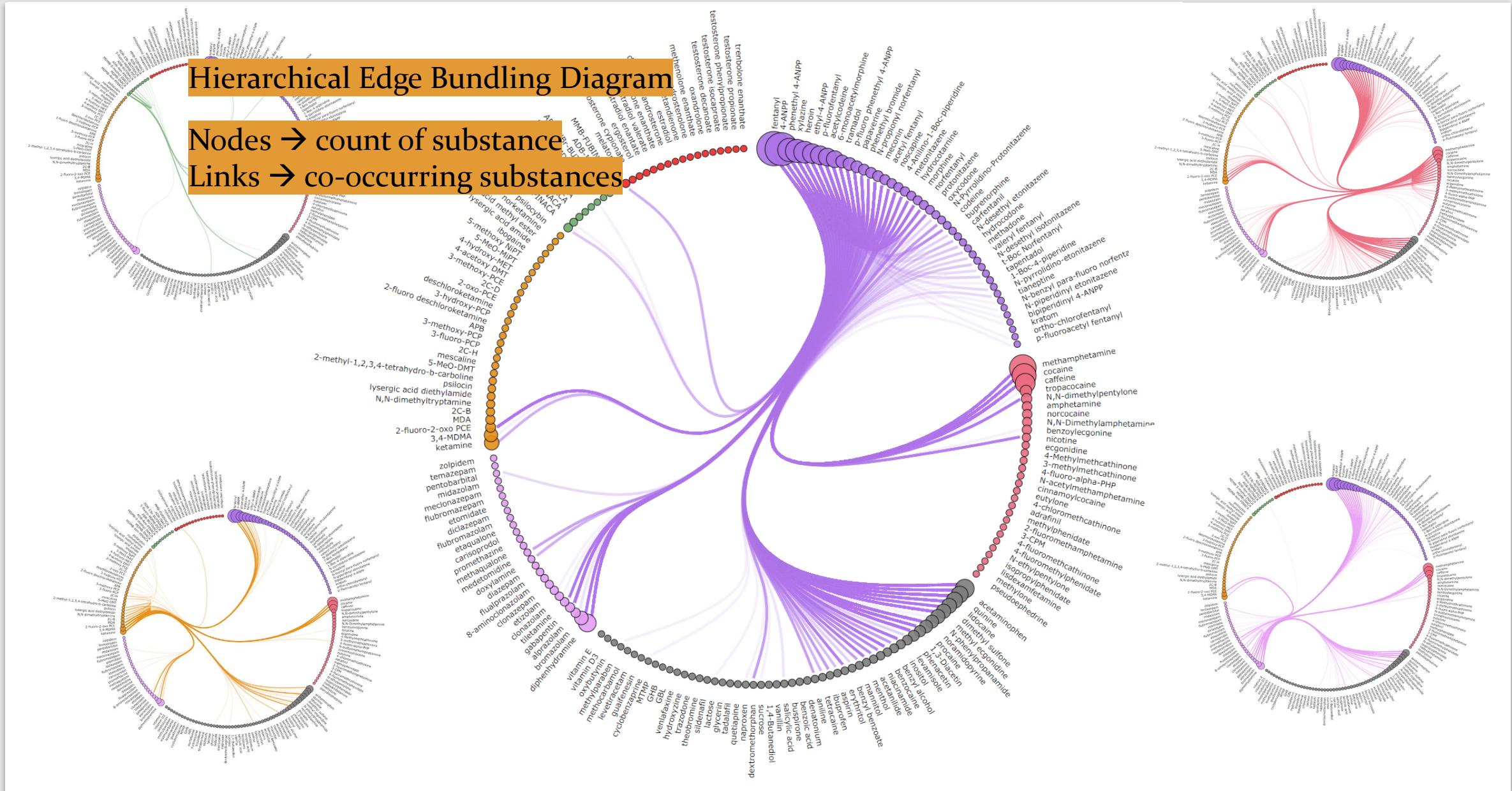
Cartesian Coordinates



Radial Diagram using Polar Coordinates

Data Processing Pipeline

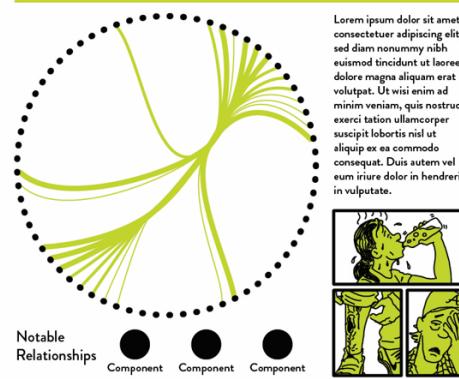




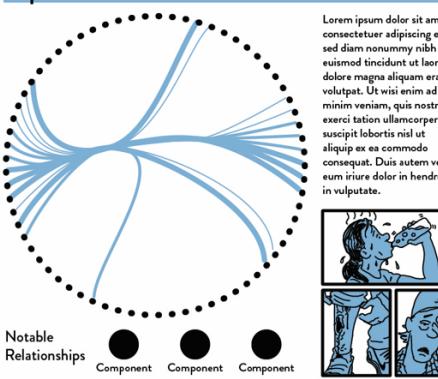
Sampling of the National Street Drug Supply

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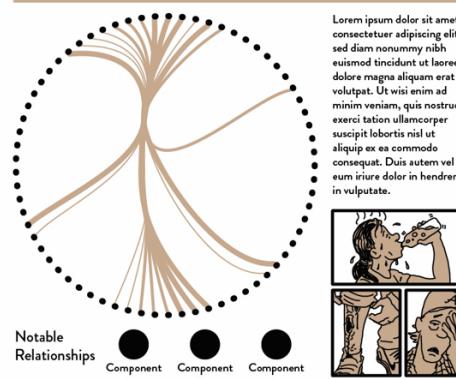
Cannabinoid



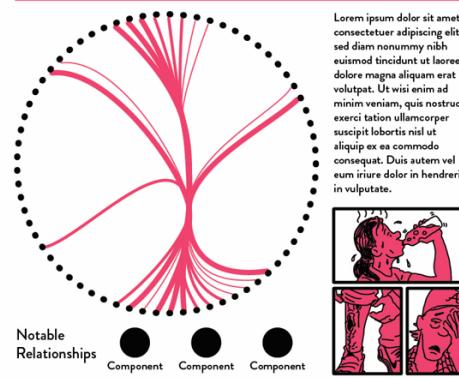
Opioid



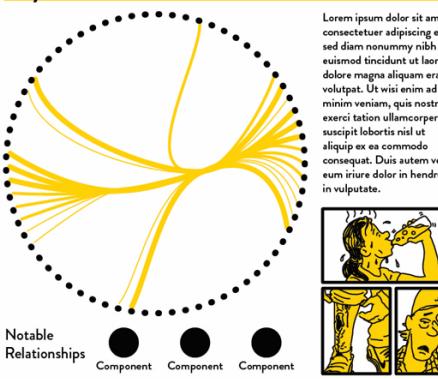
Sedative



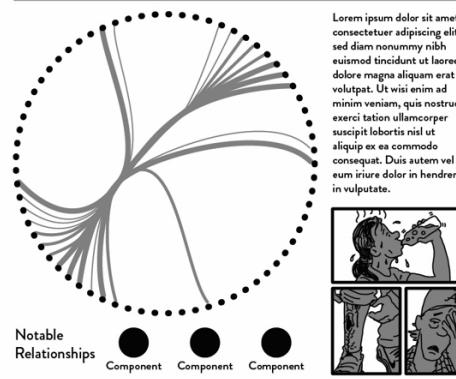
Stimulant



Psychedelic



Other

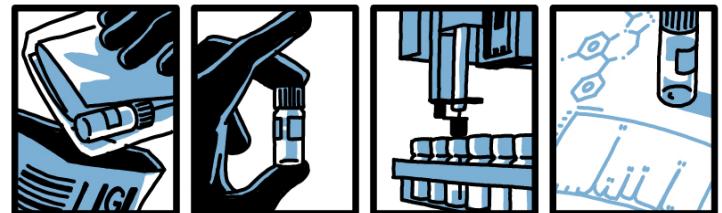
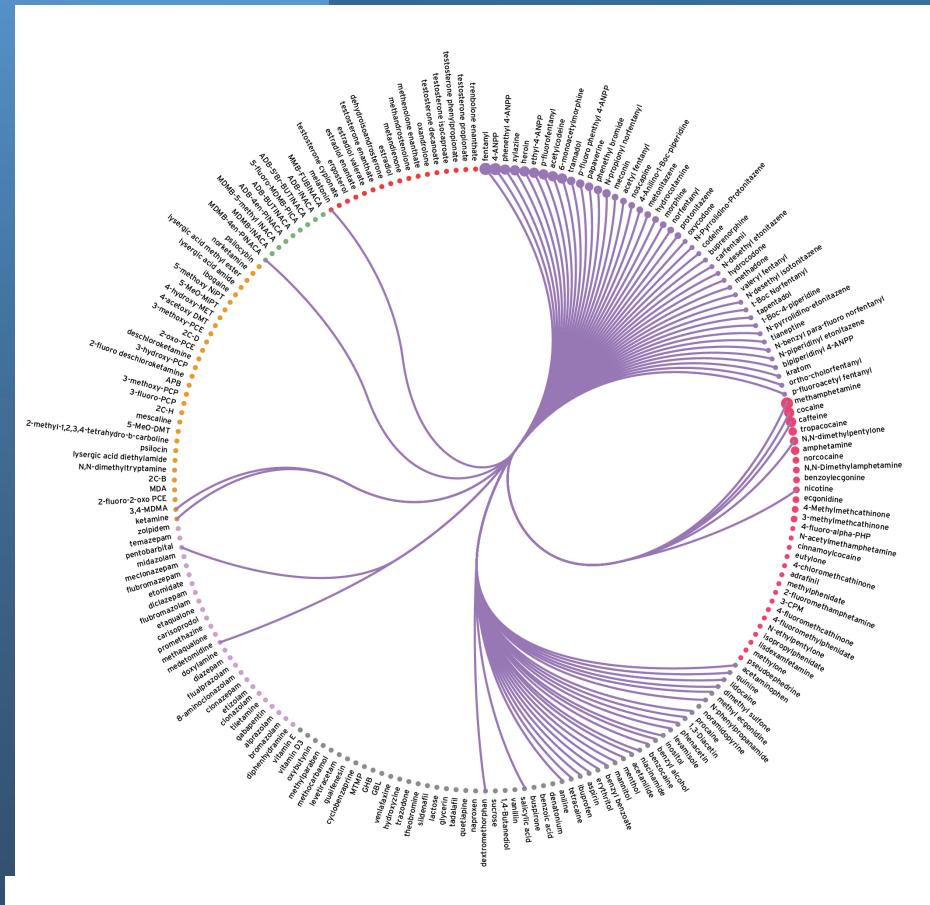


Component Categories



OPIOD DATA LAB
Street Drug Analysis Lab @ UNC

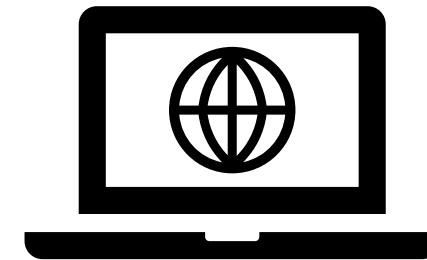
The poster outline & graphics were created by Brittain Peck, our incredible graphic designer!
@brittainpeck



OPIOD DATA LAB
Street Drug Analysis Lab @ UNC

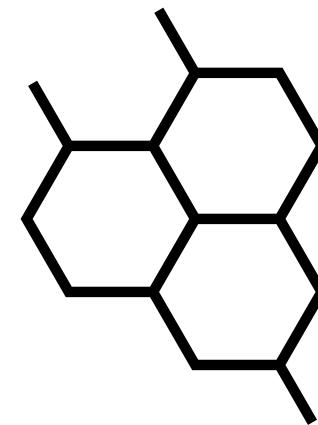
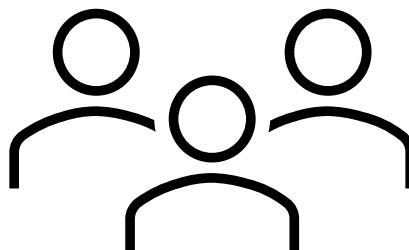
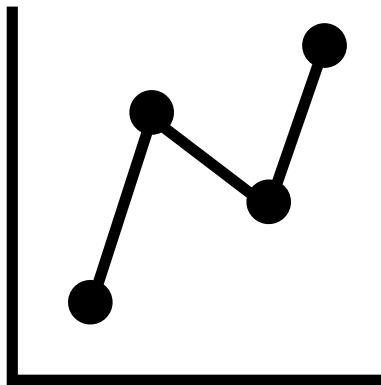
Where we can take this...

- D3.js allows for dynamic & interactive user experiences
- Viz can be hosted on our lab website
- Central location for the audience to dive deeper into data nuances



Takeaways

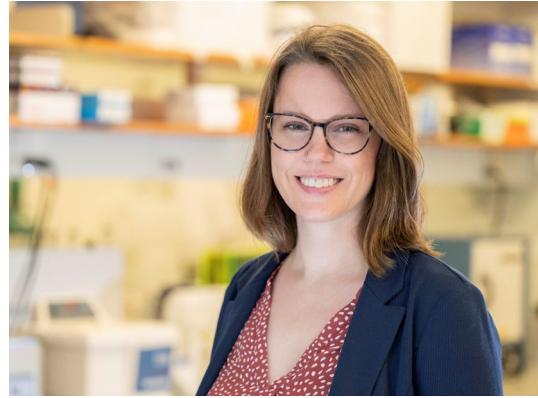
- The drug supply is vast, but it's knowable
- Data techniques can shorten the knowledge gap and provide community partners with effective, real-time solutions.
- Art and data viz can draw audiences into start conversations



Our Chemical Dictionary Team!



Nabarun Dasgupta,
PhD, MPH
Pharmaco-epidemiologist



Erin Tracy, MS
Chemist @ IPRC



Nathaniel Erskine, MD



Meredith Niess, MD, MPH



Anuja Panthari, MPH Candidate

"Love is a research value." - LV

Shelby
Bridgette
Shay
Tushar
William
David
Natalie

Anuja
Erin N.
Elijah
Bryn
Adams
Matt **



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Newsletter



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