

# METHODS OF MONITORING EMERGING DRUG USE

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# CLASSICAL DRUG MONITORING: DAWN

- RELIED UPON “MENTIONS”
  - IF A DRUG WAS “MENTIONED”, THEN IT WAS INCLUDED IN MONITORING REPORTS
- WHETHER OR NOT THE DRUG WAS INVOLVED IN ANYTHING WAS IRRELEVANT



# CLASSICAL DRUG MONITORING: ADAM

- URINE DRUG TESTING WAS PERFORMED ON EVERYONE WHO WAS ARRESTED.
- THE PROBLEM WAS THAT ONLY DRUGS DETECTED BY URINE DRUG SCREENS WERE REPORTED.



# COMMUNITY EPIDEMIOLOGY WORK GROUP

- GROUP OF EPIDEMIOLOGIST MET TWICE A YEAR  
REVIEWED DATA FROM EPI SOURCES  
NO CLINICIANS IN THE GROUP



THIS GROUP MISSED THE  
CRACK EPIDEMIC FOR 4  
SOLID YEARS



THE UPSHOT WAS THAT NO  
GOOD METHOD FOR  
MONITORING EMERGING DRUG  
USE TRENDS EXISTED



# DRUG MONITORING: REQUIREMENTS

- MUST DETECT THE UNDETECTABLE
  - DON'T KNOW WHAT THEY ARE LOOKING FOR
- MUST BE GEOCODED
  - DRUG OUTBREAKS ARE PURELY LOCAL PHENOMENA
- MUST BE TIMELY
  - NOBODY WANTS TO MISS AN OUTBREAK FOR 4 YEARS



FINALLY, SOMEBODY HAS TO  
BE WATCHING THE DATA



# 1. DIGITAL METHODS



# SOCIAL MEDIA AND MACHINE LEARNING

- USERS TWEET, CREATE REDDIT OR BLUELIGHT POSTS, AND USE OTHER SOCIAL MEDIA
- CONTENT IS ABSTRACTED
  - DRUG OUTBREAKS ARE PURELY LOCAL PHENOMENA
- MATHEMATICS RECOGNIZE NEW DRUG USE
  - ALLOWS GEOLOCATION AND DIRECTION OF SPREAD



SHORTCOMINGS: YOU NEED A  
LEXICON OF DRUG USE TERMS;  
CONFIRMATION OF FINDINGS IS  
HARD



SUCCESS: DETECTED LOPERAMIDE  
ABUSE, ALSO DETECTED EXTENT OF  
“DAB” ABUSE



## 2. ANALYTICAL METHODS



# PAST ANALYTICAL METHODS

- QUALITATIVE SCREENS OF URINE FOR DRUGS OF ABUSE
- GAS CHROMATOGRAPHY/QUADRUPOLE MASS SPECTROSCOPY



# HI-RES MASS SPECTROSCOPY

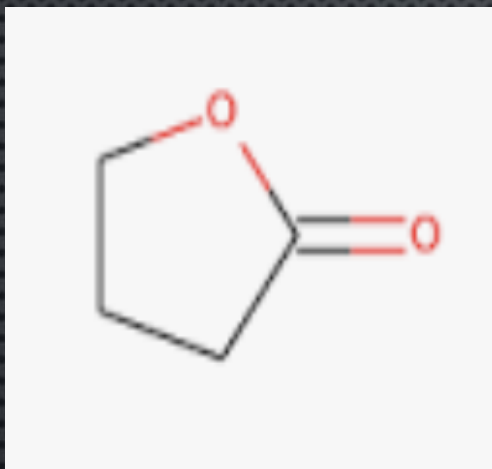
- EACH CHEMICAL ELEMENT IS MADE UP OF ISOTOPES
- EACH ISOTOPE HAS A DIFFERENT ATOMIC WEIGHT
- FOR EXAMPLE, CARBON HAS SEVERAL DIFFERENT ISOTOPES—C12, C13 C14—BUT NOT ALL ARE PRESENT IN EQUAL AMOUNTS
- CARBON HAS AN AVERAGE ATOMIC WEIGHT OF 12.0169



# HI-RES MASS SPECTROSCOPY

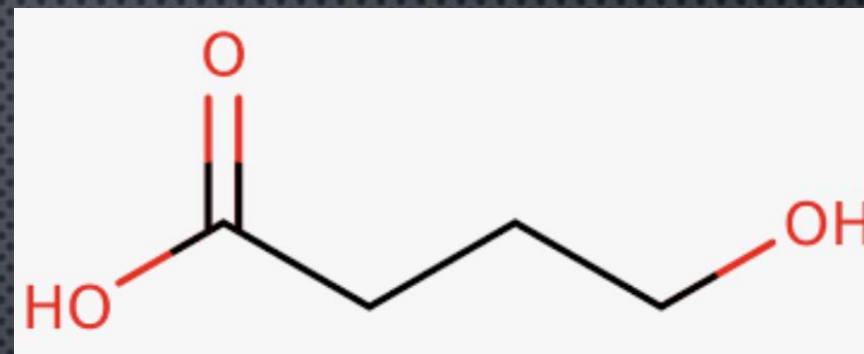
- IF YOU KNOW THE FULL RANGE OF CHEMICAL STRUCTURES, YOU CAN PREDICT THE MOLECULAR WEIGHT





γ-BUTYROLACTONE

$C_4H_6O_2$   
MW=86.09006



γ-HYDROXYBUTYRATE

$C_4H_8O_2$   
MW=88.10594



# HI-RES MASS SPECTROSCOPY

- DETECTION REQUIRES REVERSING THE PROCESS
- IF YOU RUN A HI-RE MASS SPEC AND GET A MOLECULAR WEIGHT OF 86.09006.....
- YOU KNOW YOU HAVE A BUTYROLACTONE EXPOSURE



SHORTCOMINGS: YOU MUST HAVE  
SOME DEGREE OF CLINICAL  
KNOWLEDGE.



SHORTCOMINGS: ALSO,  
INCREASING COMPLEXITY OF THE  
CHEMICAL STRUCTURE MAKES THE  
MATHEMATICS MORE DIFFICULT



SUCCESS: DETECTED A HOST OF  
NEW FENTANYL DERIVATIVES



### 3. WASTEWATER



SOMETIMES POLICYMAKERS WANT  
TO KNOW POPULATION-LEVEL  
DRUG USE DATA



TO DO THAT, YOU HAVE TO GO TO  
WHERE POPULATIONS USE DRUGS



# WASTEWATER ANALYSIS

- THESE STUDIES SITED AT MUSIC FESTIVALS
- THEY RELY UPON PORT-A-POTTIES



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# WASTEWATER ANALYSIS

- URINE IS COLLECTED FROM THE PORTABLE TOILETS
- SUBJECTED TO ANALYSIS
  - USUALLY QUALITATIVE SCREENS OF URINE
  - PROBLEM: SCREENS DO NOT DETECT THE TYPES OF DRUGS USED A MUSIC FESTIVALS.



SHORTCOMINGS: THE ISSUES WITH  
WASTEWATER ANALYSIS ARE THE  
SAME AS FOR URINE SCREEN



SUCCESS: PROVED THAT YOUNG  
PEOPLE AT MUSIC FESTIVALS USE  
DRUGS



## 4. CONTINUOUS WASTEWATER SURVEILANCE



# CONTINUOUS SURVEILLANCE

- IT IS GREAT TO HAVE POPULATION-LEVEL DATA
- POLICYMAKERS OFTEN WANT PRECISE GEOCODED DATA
- POLICYMAKERS OFTEN WANT ONGOING MONITORING



# MICROFLUIDICS



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- LIQUID CHEMICALS BEHAVE DIFFERENTLY AT THE INTERFACE WITH A SOLID
- MAXIMIZING THE SURFACE AREA THAT A LIQUID CAN CONTACT ALLOWS NEW CHEMISTRY TO BE DONE
- MICROFLUIDICS ALLOWS GREATER CONTACT
- GREATER CONTACT ALLOWS SORTING OF CHEMICALS



# MIT APPROACH

- CREATE A SMALL DEVICE SUSPENDED IN THE LIQUID FLOW OF A SEWER
  - CONTAINS MICROFLUIDIC CHAMBERS
- PERIODICALLY REMOVE THE DEVICE
- ANALYZE THE LAYERS OF CHEMICAL DEPOSITED ON THE MICROFLUIDIC CHAMBER



THIS ALLOWS DETECTION OF  
DRUGS ELIMINATED IN  
REGIONS OF A CITY



THIS CREATES THE OPPORTUNITY  
TO FOCUS INTERVENTIONS ON  
PRECISE LOCATIONS