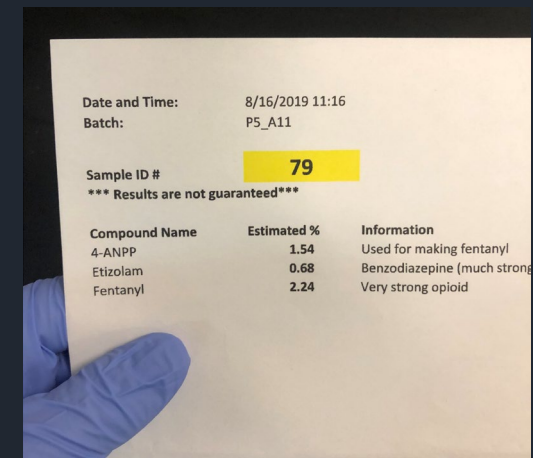


Paper Spray Mass Spectrometry as a New Quantitative Drug Checking Technology for Harm Reduction and Drug Surveillance

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¹Applied Environmental Research Laboratories, Vancouver Island
University, Nanaimo, BC, Canada

²Chemistry Department, University of Victoria, Victoria, BC, Canada



Date and Time:	8/16/2019 11:16	
Batch:	P5_A11	
Sample ID #	79	
*** Results are not guaranteed***		
Compound Name	Estimated %	Information
4-ANPP	1.54	Used for making fentanyl
Etizolam	0.68	Benzodiazepine (much strong
Fentanyl	2.24	Very strong opioid



Presentation Outline

- 1** Background + Opioid Overdose Crisis
- 2** Drug Checking for Harm Reduction
- 3** Paper Spray Mass Spectrometry
- 4** Pilot Test: Vancouver, BC, Canada
- 5** Vancouver Island Drug Checking Project
- 6** Conclusion + Acknowledgements

Opioid Overdose Crisis

Background

- Overdose deaths are by far the leading cause of unnatural death in British Columbia
- Close to 90% of overdose deaths involve fentanyl or fentanyl analogs
- Overdose deaths have consistently outpaced COVID-19 deaths

Deaths in B.C., Jan–Dec 2020

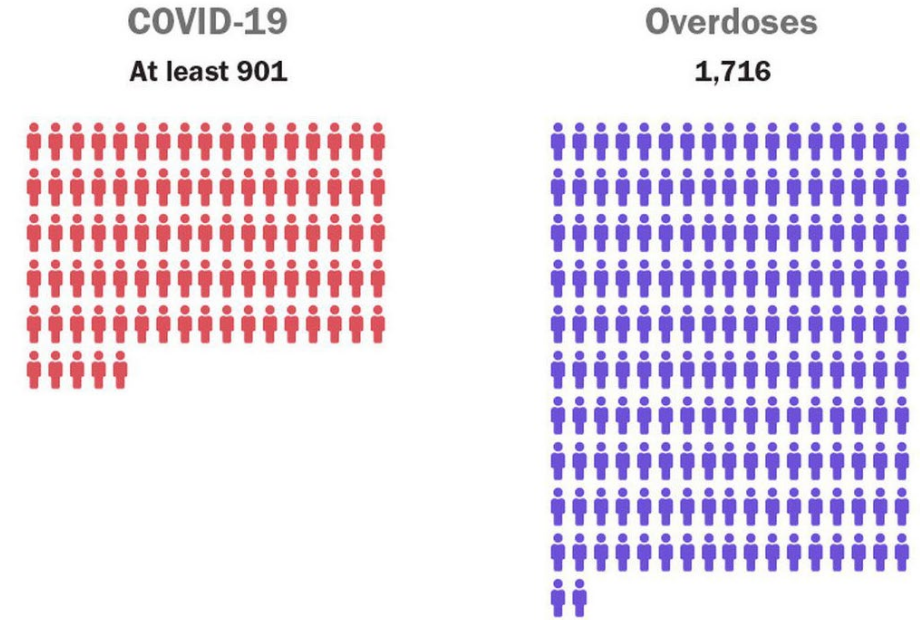


Figure 2: Major Causes of Unnatural Deaths in BC

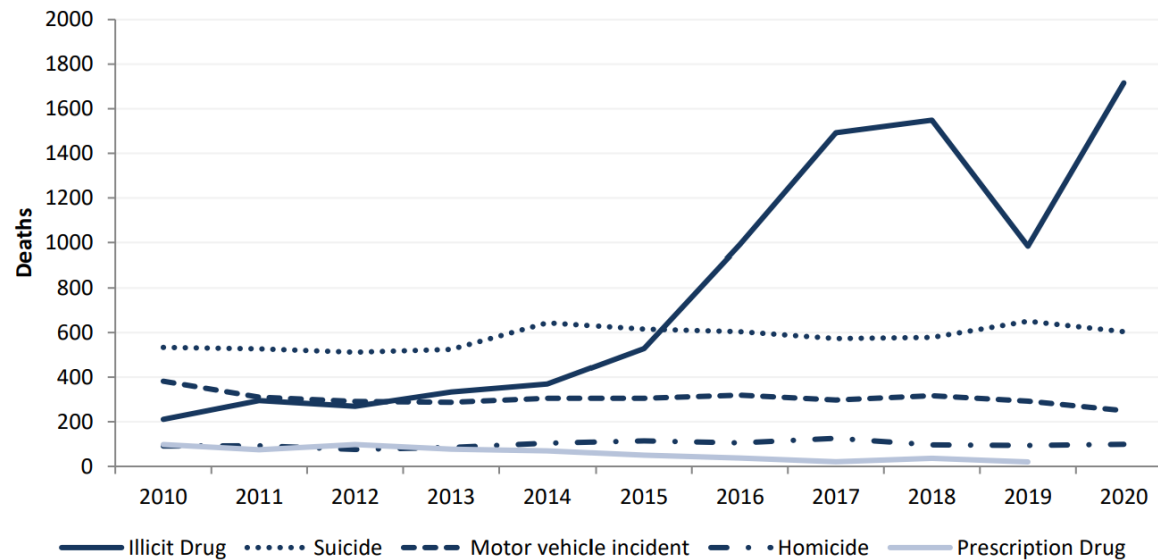
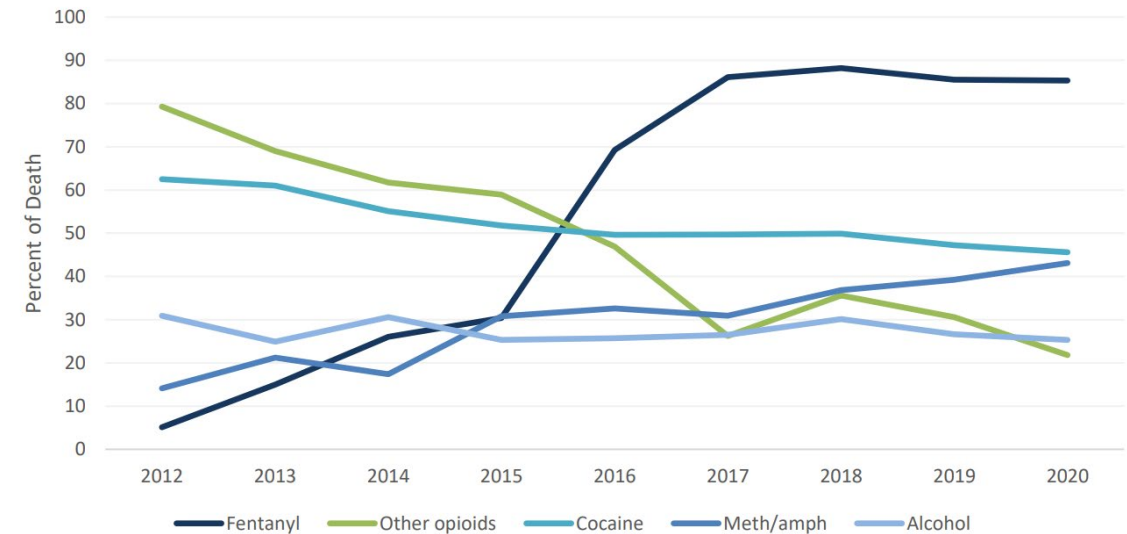


Figure 3: Drug Types Relevant to Death, 2012-2020



Overdose Prevention Sites (OPS) + Supervised Consumption Sites (SCS)

Excellent health and care, for everyone,
everywhere, every time.



Background

- Sites where people who use drugs use illicit drugs in a supervised setting without being prosecuted for drug possession or use
- Exempted under Section 56.1 of the Controlled Drug and Substances Act
- Our laboratory was designated as an OPS on June 24th, 2020
- 20 OPS and 11 SCS operating in British Columbia, 550,000 visits within the first year these sites were established
- Wide range of services offered, including drug checking

Notice of Designation

as an

Overdose Prevention Site


Pursuant to the December 12, 2016, Minister of Health directive on the establishment of Overdose Prevention Sites, I as a Medical Health Officer in the province of British Columbia, designate the following premise as an Overdose Prevention Site for the purpose of:

Testing drug samples

Premise location

Applied Environmental Research Laboratories,
Department of Chemistry,
Vancouver Island University
Room 490, Building 210,
900 Fifth Street,
Nanaimo, BC, Canada, V9R 5S5

DATED THIS DAY June 24th, 2020



Paul Hasselback, MD, MSc, FRCPC
Medical Health Officer

Medical Health Officer

Located at: 3rd Floor 6475 Metral Drive | Nanaimo, BC V9T 2L9

Tel: 250.739.6304 | Fax: 250.755.3372

viha.ca

Drug Checking for Harm Reduction

Wish List

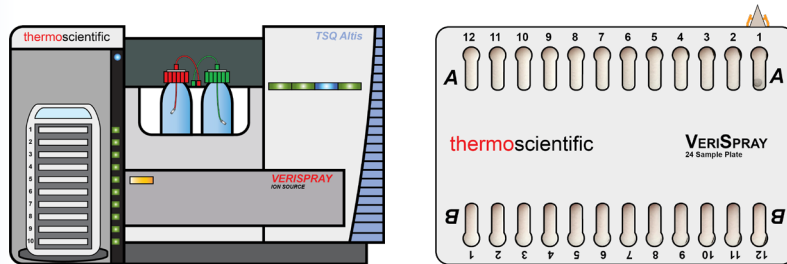
- Rapid results
- Selective
- Low false positives and negatives
- Sensitive enough for trace components
- Quantitative
- Adaptable
- Easy to use
- Cost effective

D4D			C&H		
CANNABIS	5 seconds		NO REACTION	5 seconds	
AMPHETAMINES	20 seconds		COCAINE	5 seconds	
PCP	90 seconds		PHENOBARBITAL	5 seconds	
NO REACTION	30 seconds		COCAINE BASE	5 seconds	
METHAMPHETAMINES	30 seconds		METHAMPHETAMINES	5 seconds	
KETAMINE	15 seconds		KETAMINE	5 seconds	
EPHEDRINE	15 seconds		EPHEDRINE	5 seconds	
HEROIN (PURE)	30 seconds		HEROIN (PURE)	5 seconds	
METHADONE	25 seconds		METHADONE	5 seconds	
LSD	25 seconds		LSD	5 seconds	
BUPRENORPHINE (HCL)	30 seconds		BUPRENORPHINE (HCL)	5 seconds	
OPIUM	30 seconds				

Colourimetric Test Solutions



Drug Test Strips



Paper Spray Mass Spectrometry



Infra-Red Spectroscopy

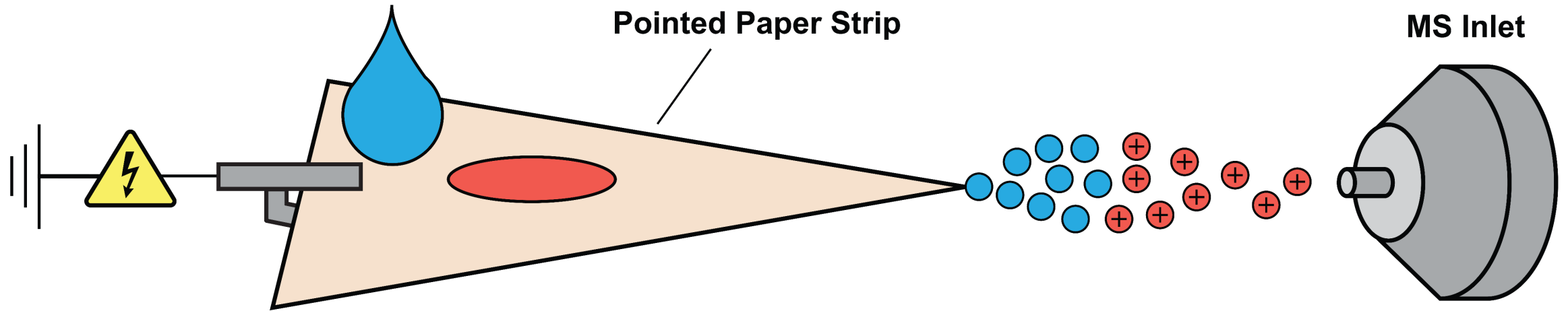


Raman Spectroscopy

Paper Spray Mass Spectrometry

Introduction

- No sample preparation
- Cheap, paper substrate
- Rapid (1-2 min) direct analysis
- No carryover
- No gases
- Minimal solvent and sample consumption



1 Apply Sample **2** Apply Solvent and High Voltage **3** Ionization and Detection

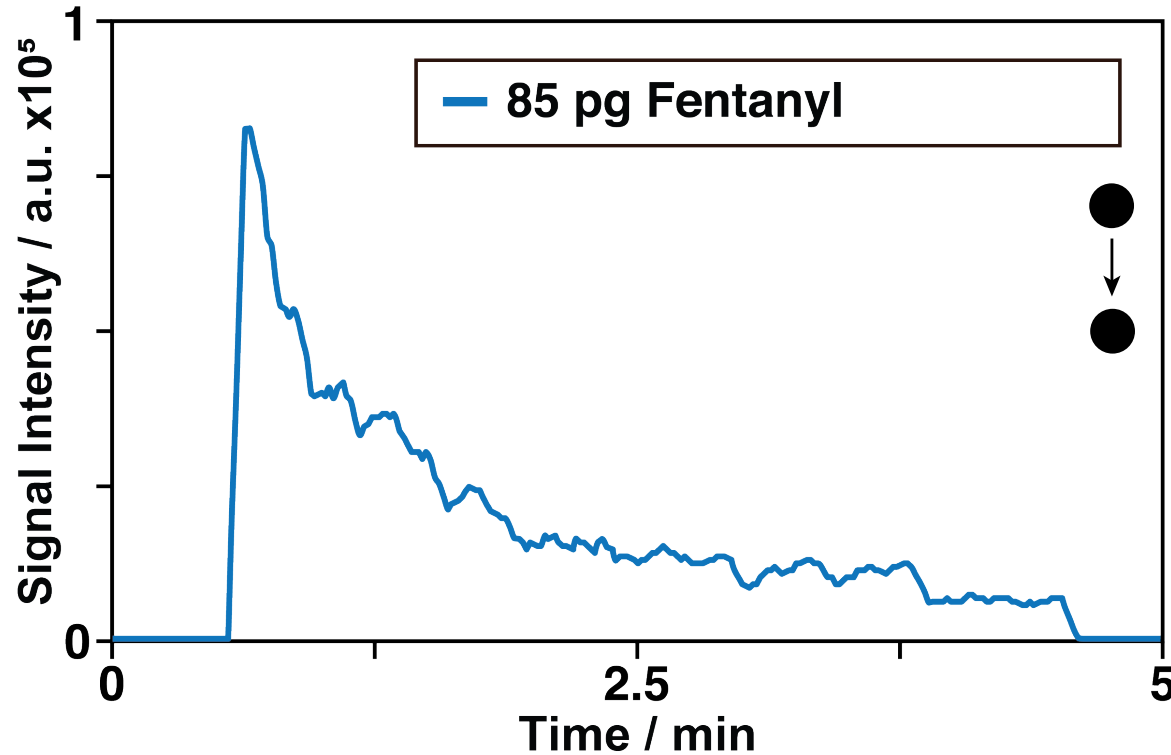
 Sample Spot

 Charged Droplet

 Gas Phase Ion

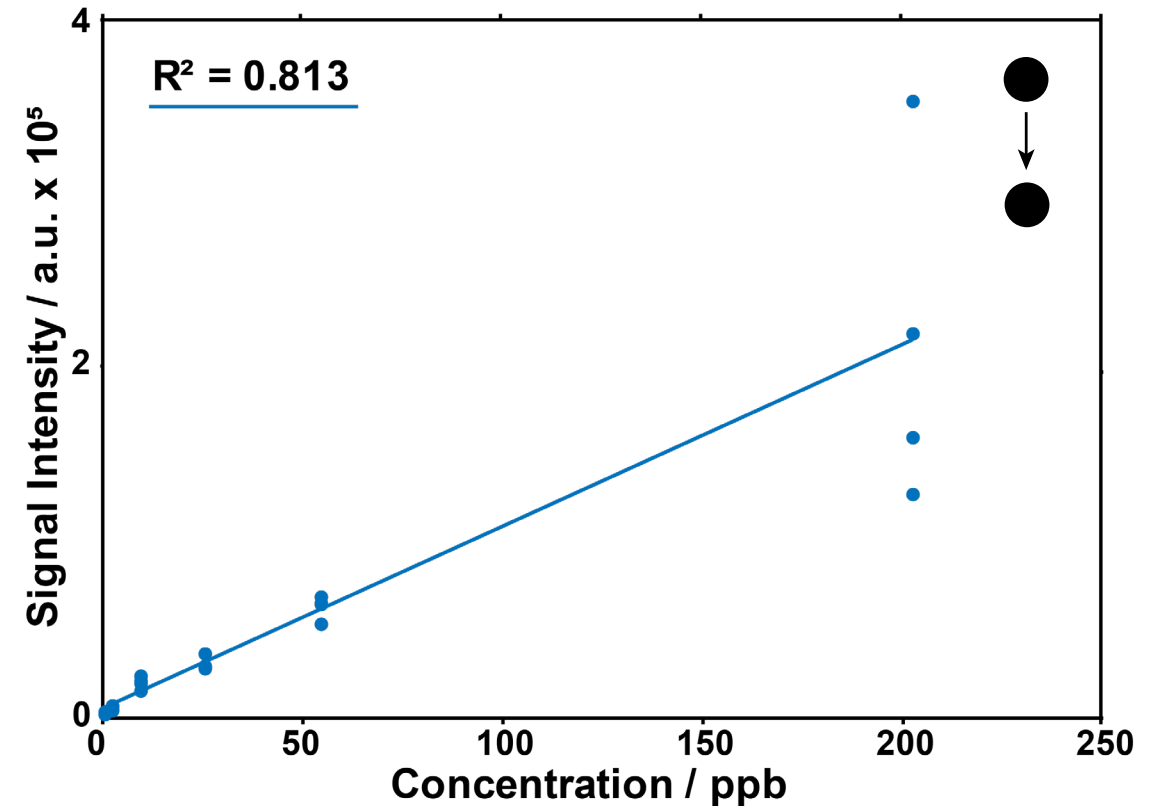
Paper Spray Mass Spectrometry

Signal Area Ratios + Internal Standards



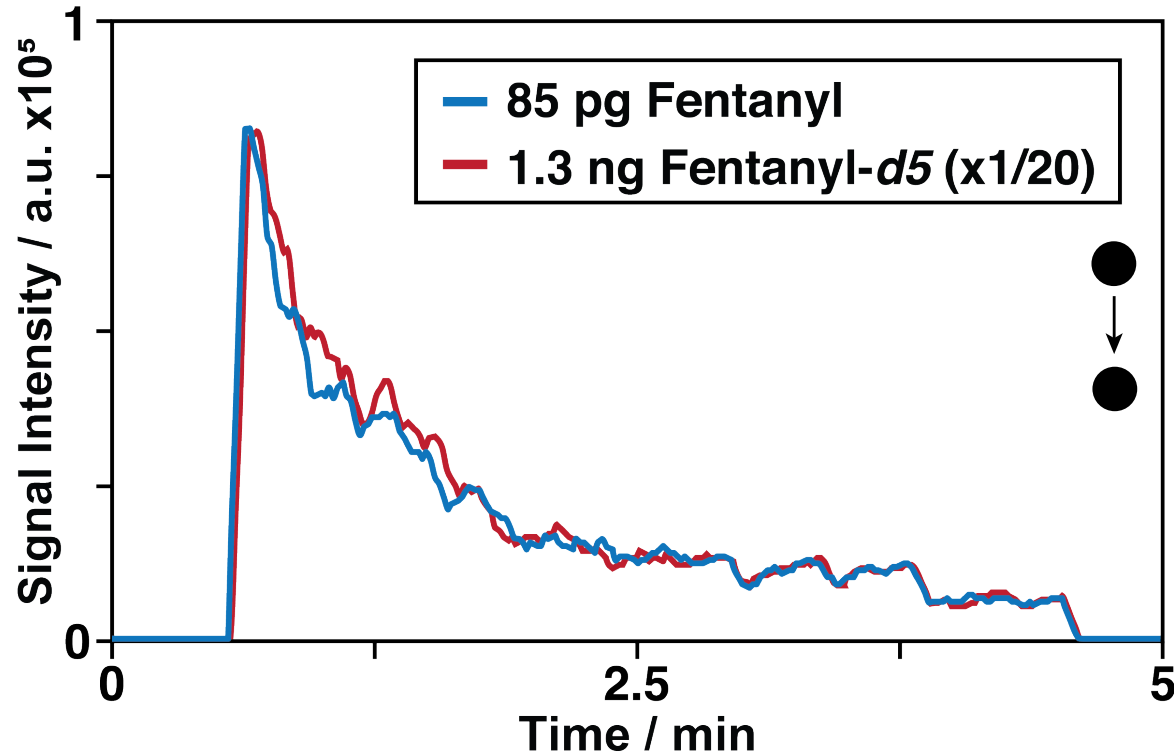
Vandergrift GW, Hessels AJ, Palaty J, Krogh ET, Gill CG. Clin. biochem. 2018;54:106-11.

Fentanyl Calibration by Area



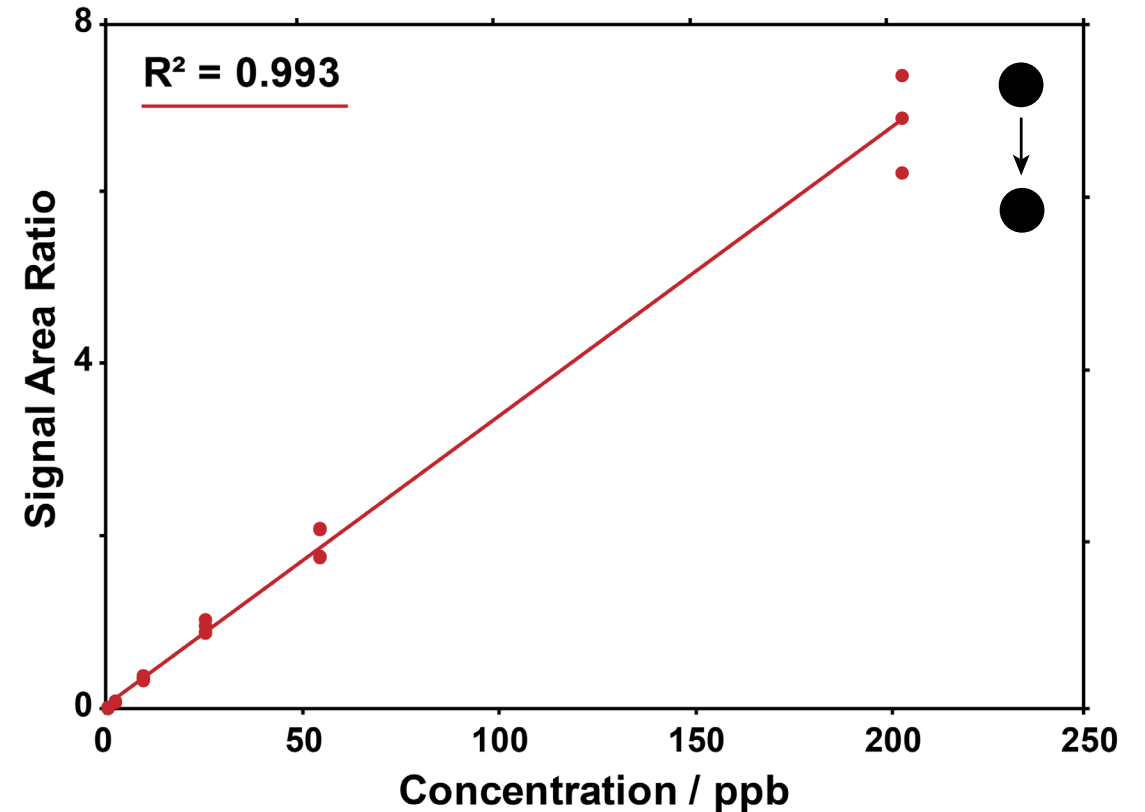
Paper Spray Mass Spectrometry

Signal Area Ratios + Internal Standards



Vandergrift GW, Hessels AJ, Palaty J, Krogh ET, Gill CG. Clin. biochem. 2018;54:106-11.

Fentanyl Calibration by Signal Area Ratio



Pilot Test: Downtown Eastside, Vancouver

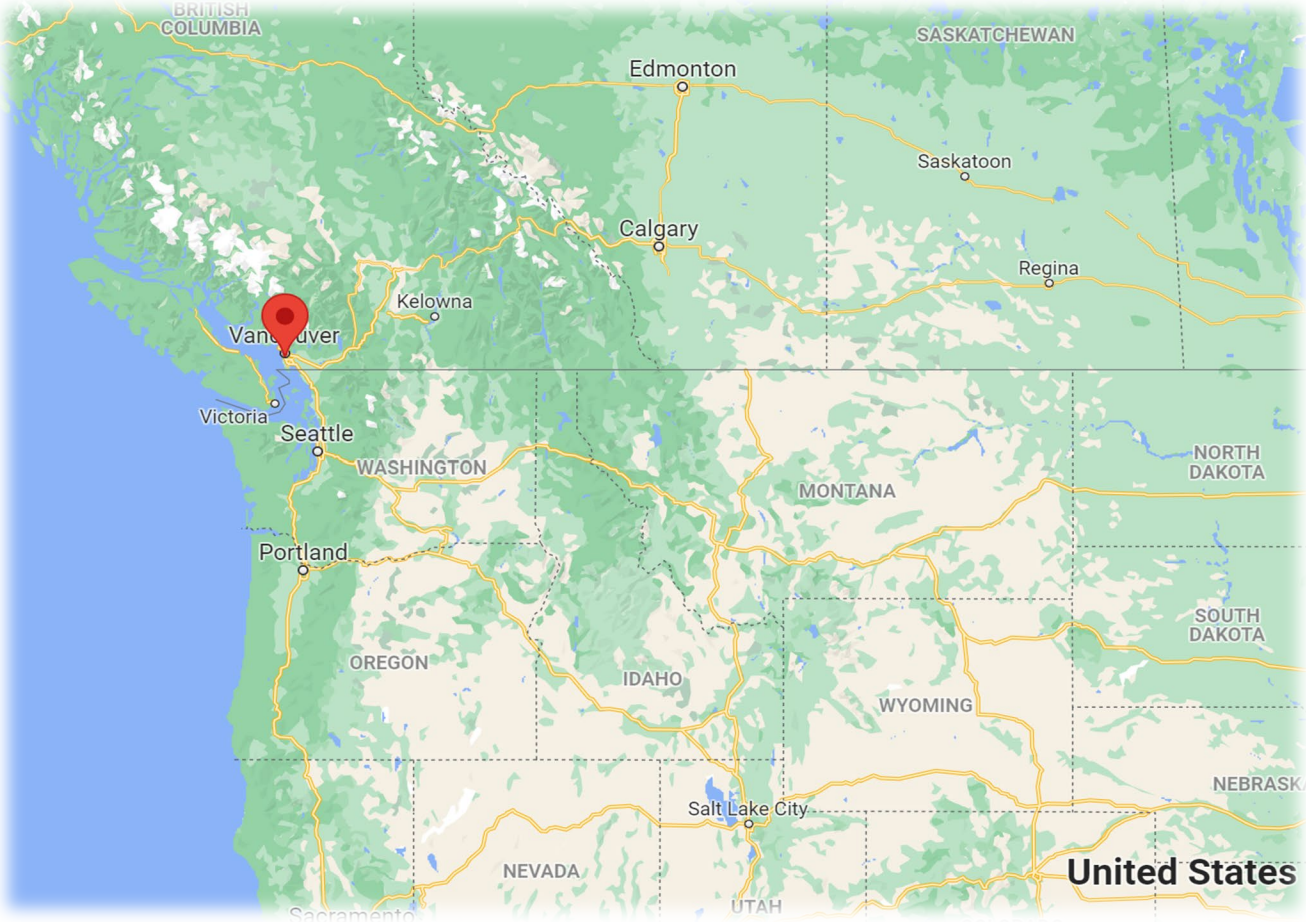
Location



CBC

British Columbia

New illicit drug testing machine undergoes real-world trial

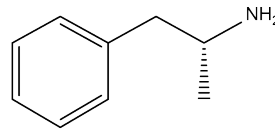


Pilot Test: Downtown Eastside, Vancouver

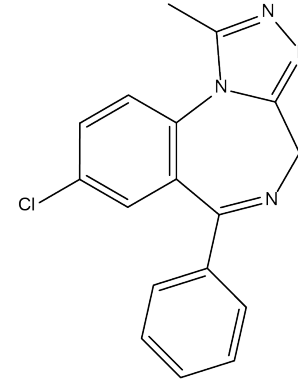
Summary

- Two-day pilot test
- 119 samples analyzed
- 0.8 minute instrumental method with targeted SRM analysis and non-targeted full scan
- Quantification
- Ion ratios for additional confirmation

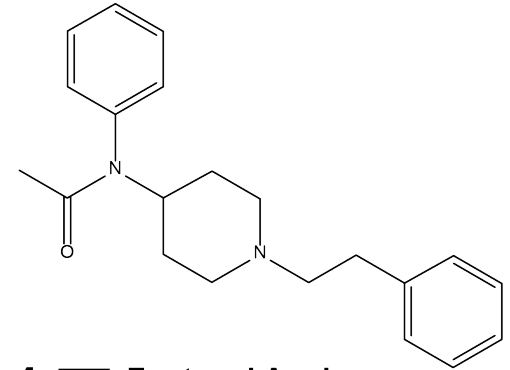
55 Drug Targets



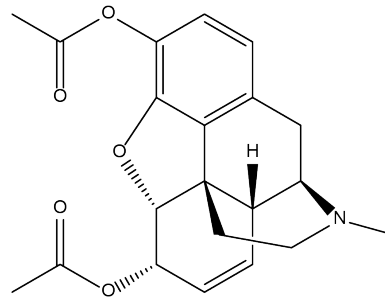
8 Amphetamines +
Synthetic Cathinones
(Shown: Amphetamine)



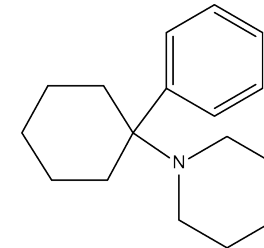
9 Benzodiazepines +
Thiabenzodiazepines
(Shown: Alprazolam)



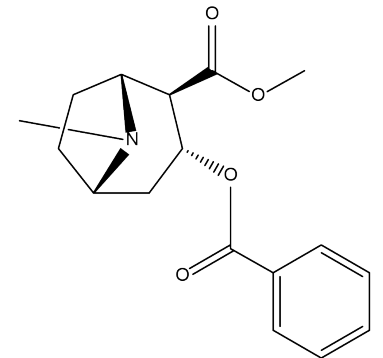
17 Fentanyl Analogs
(Shown: Acetylfentanyl)



16 Opioids
(Shown: Heroin)



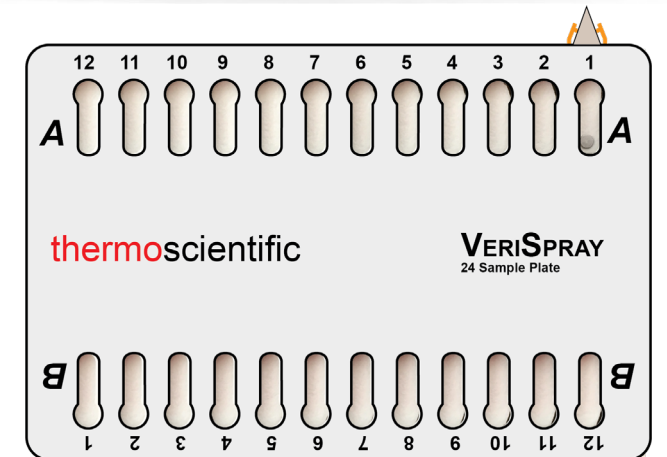
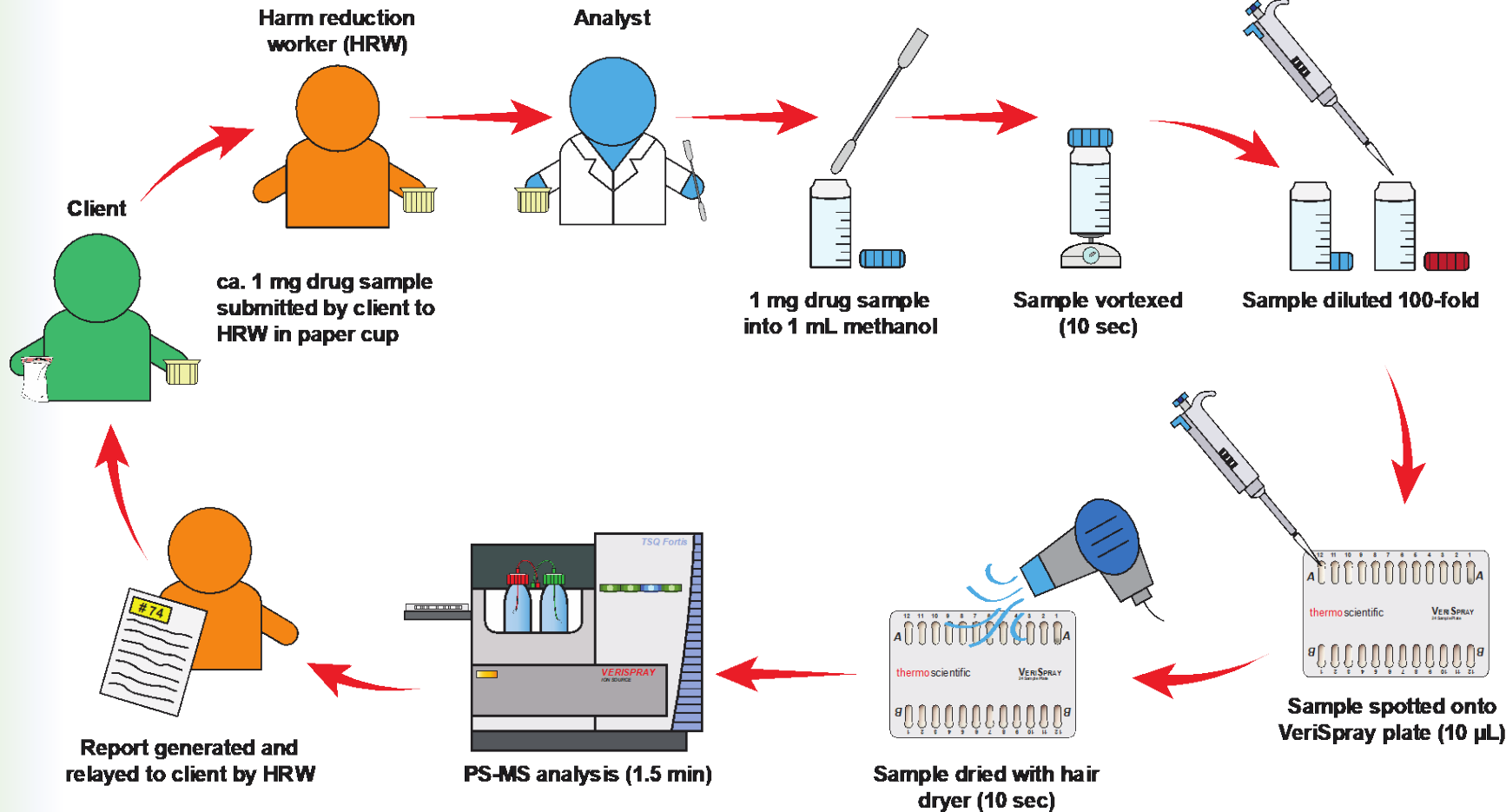
4 Hallucinogens
(Shown: Phencyclidine)



1 CNS Stimulant
(Shown: Cocaine)

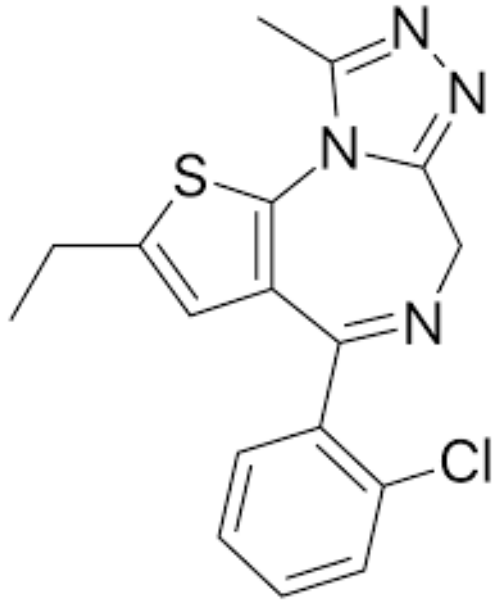
Pilot Test: Downtown Eastside, Vancouver

Sampling Workflow + Instrumentation



Pilot Test: Downtown Eastside, Vancouver

Etizolam



B.C. harm-reduction sites, doctors struggling with new type of overdose

British Columbia



New drug mix causing harder-to-revive overdoses, sparking panic in Vancouver

- Detected in 12 expected opioid samples
- 0.7 - 8.9 w/w % (Avg 3.9%)
- Resistant to Naloxone

Date and Time: 8/16/2019 11:16

Batch: P5_A11

Sample ID #

79

*** Results are not guaranteed***

Compound Name	Estimated %	Information
4-ANPP	1.54	Used for making fent
Etizolam	0.68	Benzodiazepine (muc
Fentanyl	2.24	Very strong opioid

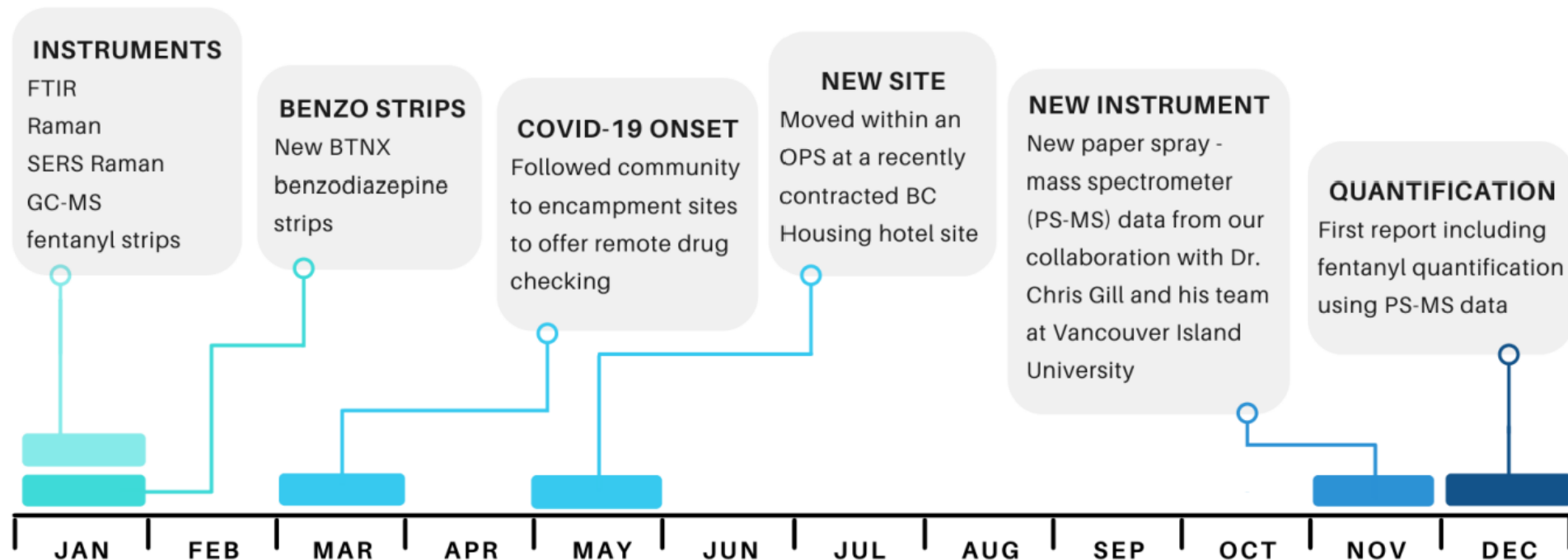
Collaboration: Vancouver Island Drug Checking Project

Timeline

- Approx. 2,500 samples analyzed by PS-MS since joining the project in September 2020

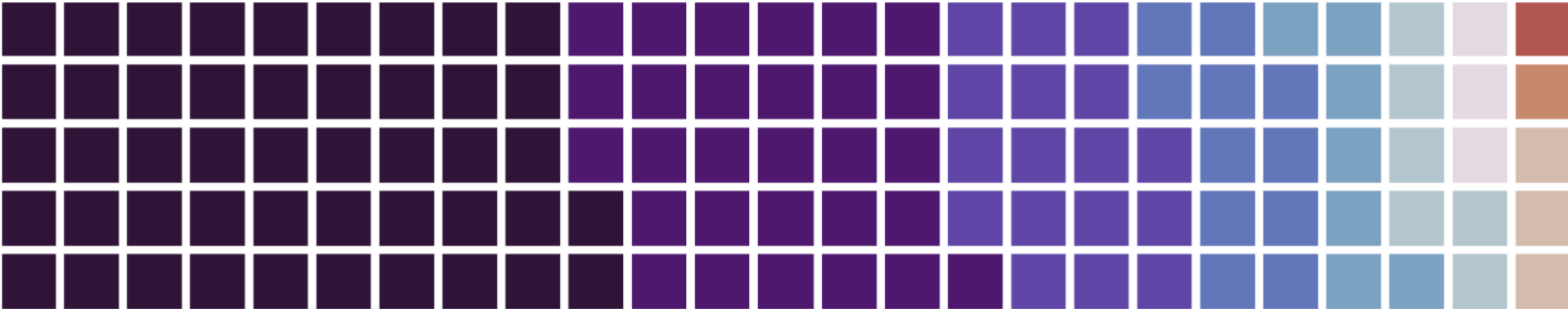
Substance 2020 Timeline

Our project was happy to remain active throughout the entire year and to adapt our service to meet the needs of the community.



Collaboration: Vancouver Island Drug Checking Project

Sample Types Submitted in 2020

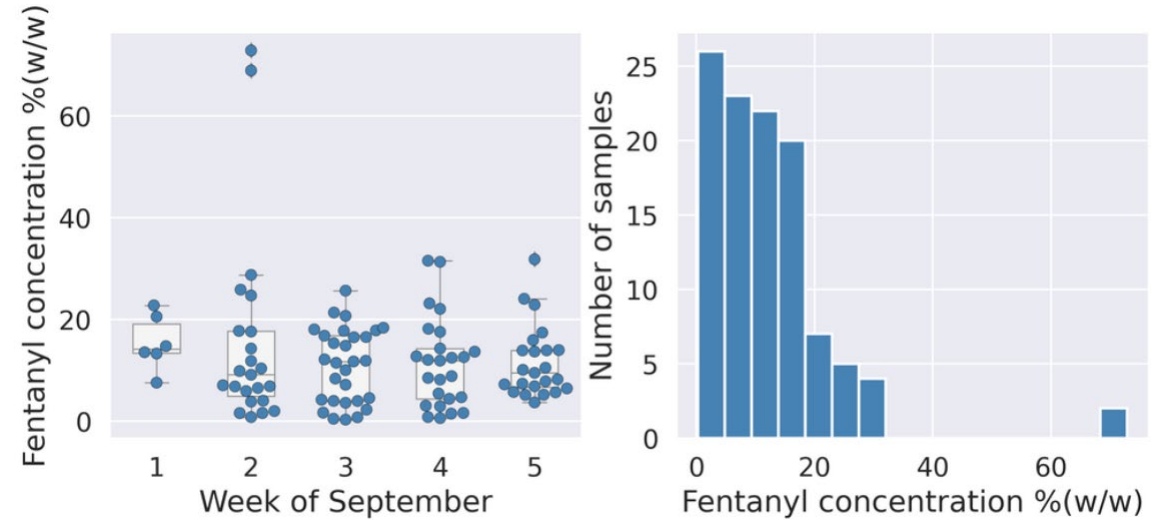


- Opioid- Down (n=482)
- Stimulant (n=300)
- Psychedelic (n=174)
- Unknown (n=113)
- Dissociative (n=69)
- Benzodiazepine (n=59)
- Missing (n=34)
- Opioid- Other (n=26)
- Other (n=15)
- Polysubstance (n=7)
- Depressant- Other (n=5)²
- Stimulant- Other (n=4)²

Collaboration: Vancouver Island Drug Checking Project

September 2021 PS-MS Results

- 106 / 123 expected down samples contained fentanyl
- Range of concentrations quantified from 0.3% to 72.9%
- Carfentanil and fluorofentanyl detected in 5 cases by PS-MS, missed by all other drug checking techniques due to low levels



substance	# quant	median	min	max
fentanyl	106	10.4 %	0.3 %	72.9 %
etizolam	61	6.0 %	0.1 %	64.4 %
heroin	7	42.9 %	28.3 %	60.0 %
carfentanil	5	0.2 %	0.2 %	0.4 %
fluorofentanyl	5	0.6 %	0.2 %	3.1 %

Collaboration: Vancouver Island Drug Checking Project

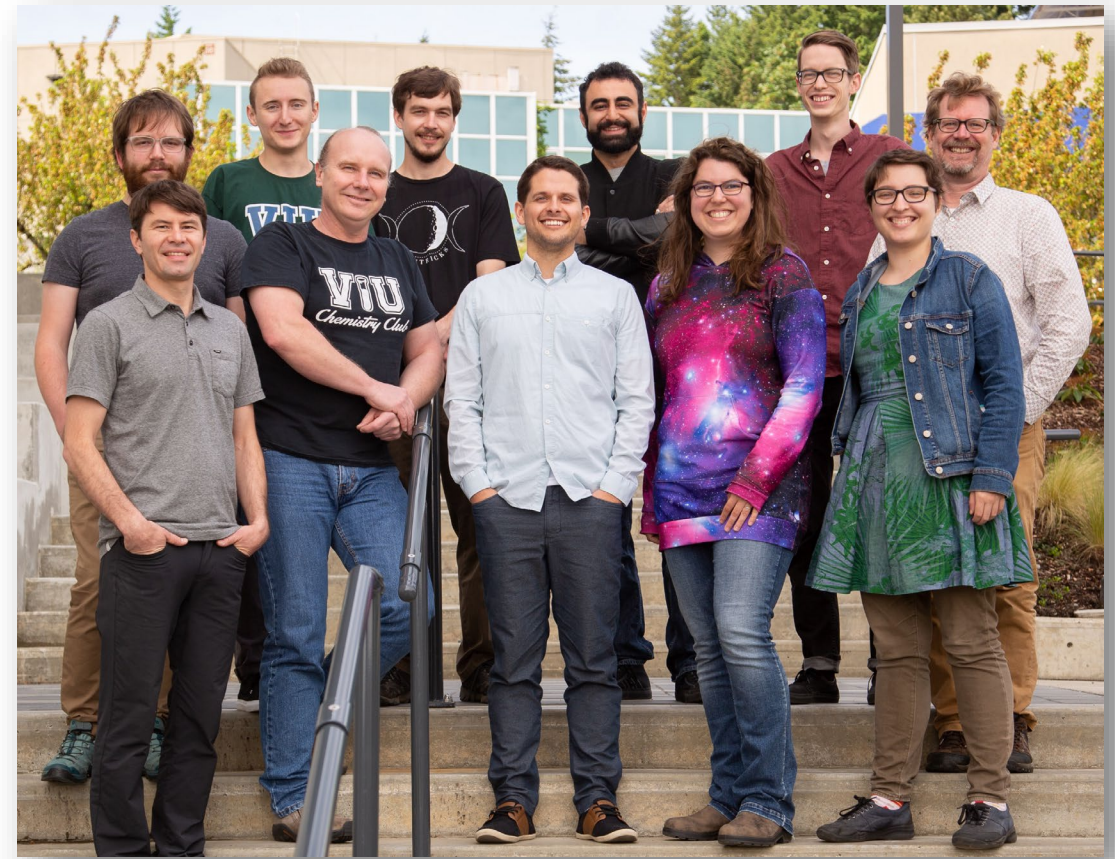
Instrument Moved from Lab to On-site → October, 2021



Acknowledgements

Armin Saatchi, MSc Candidate
Dr. Chris Gill, co-director, AERL
Gregory Vandergrift, PhD
AERL Group Members

Dr. Neloni Wijeratne, Thermo Fisher Scientific
Dr. Jan Palaty, LifeLabs
Dr. Paul Hasselback, Island Health
Dr. Mark Lysyshyn, Vancouver Coastal Health



ThermoFisher
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**DRUG CHECKING
TECHNOLOGY
CHALLENGE**
LAUNCHED OCTOBER 2018
IMPACT CANADA INITIATIVE HEALTH CANADA



**University
of Victoria**