BRITISH COLUMBIA CENTRE ON SUBSTANCE USE

*Networking researchers, educators & care providers*

# New Drug Checking Instruments in Canada

## A Summary of Drug Checking Technology Developments

## BCCSU Drug Checking Project

## Suggested Citation

British Columbia Centre on Substance Use (BCCSU). New Drug Checking Instruments in Canada: A Summary of Drug Checking Technology Developments. 2024. https://drugcheckingbc.ca/wp-content/uploads/sites/2/2024/04/BCCSU_New_drug_checking_technologies2_2024.pdf

## Publisher

**British Columbia Centre on Substance Use (BCCSU)**
400-1045 Howe Street, Vancouver, BC, V6Z 2A9
inquiries@bccsu.ubc.ca

## Publication Date

January 2024

# Land Acknowledgement

The British Columbia Centre on Substance Use would like to respectfully acknowledge that the land on which we work is the unceded territory of the Coast Salish Peoples, including the territories of the xʷməθkwəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), and səlílp lwətaɬ (Tsleil-Waututh) Nations.

We recognize that the ongoing criminalization, institutionalization, and discrimination experienced by people who use drugs disproportionately harms Indigenous peoples and that continuous efforts are needed to dismantle colonial systems of oppression. We are committed to the process of reconciliation with Indigenous peoples and recognize that it requires significant and ongoing changes to the health care system.

# Authors & Contributors

## Authors

**Lizzy Matzinger**, MPH
Project Manager, Changemark Research + Evaluation

**Keira St. George**, RN, BN, MPH
Medical Writing Consultant, Changemark Research + Evaluation

**Jennifer Matthews**, BA, BSW, MSc (Health Promotion)
Drug Checking Implementation Lead, BCCSU

## Reviewers

**Jen Angelucci**, BA
Drug Checking Research Data Coordinator, BCCSU

**Matthew Bonn**
Knowledge Translation Specialist, Changemark Research + Evaluation

**Hannah Crepeault**, MSc
Research Coordinator, BCCSU

**Marie Ferraro**
Knowledge Translation Specialist, Changemark Research + Evaluation

**Richard R. Liang**, MSc
Manager Strategic Research and Science Development, Drug Analysis Service, Health Canada

**Antoine Marcheterre**, BSc
Regional Drug Checking Lead, Interior Health Authority

**Karen McDonald**
Lead, Toronto Drug Checking Service

**Angus Quinton**
Manager & Technician Supervisor, Get Your Drugs Tested

**Hayley Thompson**
Manager, Toronto Drug Checking Service

# Acknowledgements

The authors gratefully acknowledge the below individuals for their contributions to their respective sections.

**Malcolm Eade,** BSc
Co-Founder & CEO, Spectra Plasmonics

**Ari Forman**, BSc
CEO & COO, Scatr

**Chris Gill**, PhD, P.Chem
Director of the Applied Environmental Research Laboratories (AERL), Department of Chemistry, Vancouver Island University; Collaborating Research Scientist, Canadian Institute for Substance Use Research, University of Victoria

**Leah Gozdzialski**, PhD candidate
University of Victoria

**Sara Guzman Castro**, PhD candidate
Portable Robotic HPLC co-lead, Hein Lab, University of British Columbia

**Dennis Hore**, PhD
Co-Lead, Vancouver Island Drug Checking Project; Professor, Department of Chemistry, University of Victoria; Professor, Department of Computer Science, University of Victoria; Collaborating Scientist, Canadian Institute for Substance Use Research

**Dr. Peter Krygsman**, PhD
Regional Sales Manager, Bruker Ltd.

**Dr. François Lagugné-Labarthet**, PhD
Professor of Chemistry, Western University; Lead, Western University Scatr Pilot Project – Health Canada SUAP grant #2223-HQ-000095

**Daniel Werb**
Co-founder & Director, Centre on Drug Policy Evaluation; CEO, DoseCheck Technologies

# Disclaimer

Most of the information on drug checking technologies described in this report is provided directly by the respective instrument's developers and may not be externally validated. Where it exists and is available, empirical evidence to support developer reports is provided, as is anecdotal evidence from Drug Checking Technicians who have used the instrument for drug checking purposes.

# Contents

# Glossary of Terms

| | |
|---|---|
| **BCCSU** | British Columbia Centre on Substance Use. |
| **Binary result** | Indicates the presence or absence of a specific drug (yes or no). |
| **Buffs** | Chemically inactive ingredients used to bulk or add size to a final product. |
| **Byproducts** | A secondary component or substance resulting from a chemical reaction or production process. |
| **BZD** | Benzodiazepine(s). |
| **Cuts** | Psychoactive or pharmacologically active ingredients intended to mimic or enhance effect(s) of a drug. |
| **DART** | Direct analysis in real time: a mass spectrometry technique that uses gas and an electrical discharge to vaporize and ionize molecules, creating a spectrum to identify compounds. |
| **DAS** | Drug Analysis Service: a Health Canada service that provides scientific and technical drug checking for law enforcement agencies. |
| **DCS** | Drug Checking Service. |
| **False positive** | Identifying a substance is present when it isn't (i.e., incorrectly identifying the presence of a substance). |
| **False negative** | Identifying a substance is absent when it isn't (i.e., incorrectly identifying the absence of a substance). |
| **FTIR** | Fourier transform infrared spectroscopy: a technique used to gather infrared spectrum of absorption or emission of a substance to identify compounds. |

| | |
|---|---|
| **GCMS** | Gas chromatography mass spectrometry: a technique used within mass spectrometry that uses capillary chromatography to separate components for individual analysis and identification. |
| **HPLC** | High performance liquid chromatography: a technique used to separate, identify, and quantify components within a sample. |
| **IR** | Infrared radiation: a technique used in spectroscopy to measure the intensity of radiation transmitted at different wavelengths to identify a compound. |
| **Limit of detection** | The lowest concentration of an analyte in a sample that can be consistently detected with certainty. |
| **MS** | Mass spectrometry: a technique used to measure the mass-to-charge ratio of molecules within a sample to identify compounds. |
| **NIR** | Near-infrared: a technique used in spectroscopy that measures light near the infrared region of the electromagnetic spectrum to identify a compound. |
| **NMR** | Nuclear magnetic resonance: a spectroscopy technique that uses magnetic fields to create radio wave signals to identify the structure of a compound. |
| **Precursors** | Compounds that participate in a chemical reaction to produce another compound; used in the manufacture of unregulated drugs. |
| **PSCI** | Paper capillary spray ionization: a technique used within mass spectrometry to create ions from a sample for analysis by dissolving in alcohol and applying an electric charge to create flow through a capillary tube onto a paper surface. |

| | |
|---|---|
| **PSMS** | Paper spray mass spectrometry: a technique used within mass spectrometry to create ions from a sample for analysis by dissolving in alcohol, then applying to a specialized piece of paper and exposing to high voltage. |
| **Qualitative result** | Indicates which compounds are detected in a sample and not the amount. |
| **Quantitative result** | Indicates how much of a detected drug is in the total sample being tested. |
| **RS** | Raman spectroscopy: an analytical technique that uses scattered light to measure vibrations of molecules to identify their structural fingerprint. |
| **Semi-quantitative result** | An estimate of purity based on whether there is more or less of a compound than other compounds in the sample. |
| **Sensitivity** | The proportion of instances a test correctly detects a substance (i.e., how well a test can identify true positives). |
| **SERS** | Surface enhanced Raman spectroscopy: a technique used within Raman spectroscopy that enhances Raman signals of molecules adsorbed on metallic surfaces to improve low concentration analyte detection. |
| **Specificity** | The proportion of instances a test correctly does not find a substance (i.e., how well a test can identify true negatives). |
| **Technician** | Drug checking technician. |
| **XTS** | Xylazine test strip(s). |

# Introduction

## Purpose and Scope

This report summarizes and consolidates available descriptive information on new drug checking instruments applicable to drug checking services in Canada. This report is not an evaluation of technologies, nor is it a technical document: it is intended to support informed conversations and decision-making around new drug checking instruments and related services.

The reviewed instruments and service models are neither endorsed nor recommended by the BCCSU. Individuals or organizations considering investing in any of the reviewed drug checking instruments are advised to conduct independent research and analysis to gather complete and accurate information related to situation-specific decisions.

## Background

Although many drug checking technologies and instruments have been thoroughly reviewed and evaluated in existing literature (see Appendix A – Existing Drug Checking Instruments Resources), recent research has resulted in the expansion of drug checking instruments available in Canada. At the same time, the unregulated drug supply has continued to evolve, with novel synthetic contaminants contributing to the persistence of complicated and unusual drug poisoning presentations—particularly in BC. Drug checking remains a relevant and useful harm reduction intervention that offers service users and public health professionals an opportunity to prevent drug poisonings and respond to contaminants in the unregulated drug supply.

Launched in 2018, Impact Canada's Drug Checking Technology Challenge invited organizations to help reduce drug-related harms by creating rapid, accurate, easy-to-use and low-cost technology for drug checking. This yielded several developments in drug checking technologies, largely related to instrument improvements in efficacy, portability, affordability, quantification, and limit of detection. Details of these developments are reflected in this summary report.

Recent research on the utility of drug checking instruments has determined that both service users and providers require drug checking instruments to be highly accurate

and provide quantitative information if they are to be maximally useful.[1] Beyond this, an ideal drug checking instrument is fast, sensitive, and portable; easy to use with minimal training; requires small samples; and has a low fiscal cost.[2] While no single instrument is able to meet each of these requirements, multi-instrument approaches may offer the most effective way to meet the needs of both service providers and users.[2,3]

# Methodology

## Instrument Selection and Information Collection

**The information for this report was obtained by three sequential processes:**

1. In June 2023, a list of new drug checking instruments was developed by the BCCSU Drug Checking team. This list was based on information from drug checking service providers and the wider drug checking community. White and grey literature related to each of the identified instruments was reviewed for product details and performance information. Additional articles listed in the references from reviewed literature were appraised and included where relevant.
2. The authors connected directly with each drug checking instrument developer to confirm literature-based information and gather additional product details.
3. Drug checking service providers were consulted for any experiential information on the named drug checking instruments. These anecdotal reports represent initial reflections based on subjective experiences using an identified instrument, and are not systematic evaluations.

## Information Categories

An overview of each instrument provides information on the developer, as well as the type of technology used (e.g., IR, MS, immunoassay) and how the instrument works. Subsequent instrument information is categorized according to:

1. Instrument details, which describes general product elements that include:

    - physical dimensions (i.e., size and weight) and portability,

- materials required to conduct a test,
- training requirements, and
- fiscal cost, including initial purchase and ongoing fees (e.g., software subscription).

2. Drug analysis information, which describes the instrument's capabilities with respect to:

- required sample consistency (e.g., powder, liquid),
- sample preparation requirements (i.e., dilution),
- sample destruction (i.e., if the test destroys the sample),
- test speed (i.e., how long it takes for the instrument to analyze a sample),
- substance(s) that can be detected,
- limit of detection, and
- sensitivity and specificity.

3. Data and reporting, which summarizes aspects of produced data, including:

- result type (e.g., binary, quantitative),
- result availability (e.g., point of care, online),
- software and data storage requirements, and
- reference library (e.g., proprietary).

4. Stage of development, which provides insight into the degree to which an instrument has thus far been assessed. Because all instruments described in this report have been recently developed, they have not been formally evaluated for implementation and scale-up, and subsequently are not considered validated. Given this, each is classified according to one of the below stages of development. Because there are no standardized stages of development for drug checking instrumentation, these stages were independently developed by the BCCSU Drug Checking team for the purpose of this summary report.

- *Research and development: gathering information to create or refine design and performance. This may involve building a reference library or machine learning algorithms, troubleshooting logistics, or developing the technology itself.*

- *Field testing:* using an instrument at a drug checking service or music festival to see how it performs in a real-world situation, using samples from the unregulated drug supply (i.e., not lab standards). This stage identifies usability issues and unexpected challenges, and helps refine and adapt the instrument to meet service user and provider needs.
- *Evaluation:* structured, rigorous assessment against predefined criteria. This provides in-depth, non-biased understanding of an instrument's strengths, weaknesses, and overall performance. This requires defining performance indicators; collecting, analyzing, and comparing data; assessing limitations; and documenting and reporting the evaluation process, which may include publication of findings.

Not all drug checking instruments available for purchase have been validated. Because drug checking instruments are considered consumer products in Canada, not medical instruments or technologies, there is no requirement to undergo stringent regulatory evaluation.[4] Validation by way of evaluation is critical to building the evidence base needed within drug checking to promote the development of increasingly effective and efficient instruments.

# New Instruments

## Bruker Mobile-IR II

Unless otherwise indicated, all information in this section is provided by Dr. Peter Krygsman, Regional Sales Manager at Bruker.

### Overview

Bruker is a private company that develops scientific instruments and solutions used in laboratories for chemical analyses. Bruker produces the stationary Alpha II FTIR spectrometers currently in use in many drug checking sites across Canada. Building off the technology of the Alpha II stationary model, Bruker developed the Mobile-IR II to provide mobility, reliability, and durability for first responders and forensics requiring portable labs, quality control in a warehouse or on a production line, polymer recycling outside docking areas, and harm reduction at music festivals.[5]

The Mobile-IR II applies the same principles as the Alpha II except it has the option of being battery powered, and comes as a single unit rather than component parts that are assembled, to prevent the introduction of dust or dirt into the instrument.[5] The technology is the same as the Alpha II: it uses broad-spectrum infrared light to illuminate a sample, then measures the amount of light absorbed by the sample to generate a spectral fingerprint. Software compares this fingerprint to a reference library to determine which substances are present in a sample.

To test a sample, a small amount of a substance (roughly 5 mg) is loaded onto the diamond Attenuated Total Reflectance (ATR) sampling surface. The affiliated software (OPUS) provides an on-screen reading of the sample and runs a spectrum search to detect the components of the sample. This is the same software that is used with the Alpha II. Spectral files are automatically saved in the OPUS file directory, and accessible to download.

| Table 1. Bruker Mobile-IR II Instrument Details | |
|---|---|
| **Technology** | Fourier transform infrared spectrostopy. |
| **Size** | 21 cm x 33 cm x 20 cm. |
| **Weight** | 10.5 kg. |
| **Portability** | Intended to be portable. Internal battery able to run for approximately 6 hours. |
| **Materials required** | Stainless steel chemistry spatula, laptop, alcohol wipes, Kimwipes, paper medicine cups. |
| **Instrument training** | 10 minutes, plus additional training on software and reference libraries. |
| **Cost** | Quote for complete package (including built-in battery, OPUS Touch Release 5, OPUS Drug ID Wizard, and typical reference libraries such as TICTAC or Pharma ATR) available from Bruker. Anticipated at >CAD$70,000. |

| Table 2. Bruker Mobile-IR II Drug Analysis Information | |
|---|---|
| **Sample type** | Powder, crystal, liquid. |
| **Sample preparation** | None. |
| **Sample destruction** | No. |
| **Speed of test** | 2-3 minutes. |
| **Substance(s) detected** | Dependent upon reference library. Includes some fentanyl analogues and other opioids, benzodiazepines, psychedelics including dissociatives and synthetic cannabinoids, stimulants, CNS depressants, precursors and byproducts, cuts and buffs. |
| **Limit of detection** | Expected to be similar to the Alpha II: about 5% for fentanyl by weight of sample, depending on degree of overlap with other components of the mixture.[6] |
| **Sensitivity and specificity** | No published evidence. Expected to be similar to other FTIR spectrometers, although the higher signal-to-noise ratio5 (considered a measure of sensitivity) may render it more sensitive than the Alpha II. |

| Table 3. Bruker Mobile-IR II Data and Reporting Details | |
|---|---|
| **Result data type** | Semi-quantitative. Quantitative capability dependent upon sample composition. |
| **Results availability** | Point of care. Community-level reports can be downloaded through OPUS. |
| **Software and data storage requirements** | Proprietary: OPUS Touch Release 5 or OPUS Drug ID Wizard. Compatible with any laptop with an ethernet port (e.g., RJ45). User retains full control over acquired data. Data can be stored locally or using a cloud-based service. |
| **Reference library** | Additional libraries can be added. |

## Stage of Development

**The Mobile-IR II is in the field testing stage.** It was piloted by Interior Health and ANKORS at two large 2023 music festivals: Bass Coast and Shambhala. Anecdotal reports from these events suggest performance is similar to other FTIR spectrometers, with the TE-MCT detector yielding a much faster testing speed. Reported challenges relate to sample retrieval from the dimpled plate and related cleaning, lack of ability to adjust the anvil pressure, and the unit running very warm. If preferred, a flat plate is available. Additional field testing of the Mobile-IR II by existing Alpha II users in Montreal is planned.

# DoseCheck

Unless otherwise indicated, all information in this section is provided by Dr. Daniel Werb, CEO of DoseCheck Technologies.

## Overview

DoseCheck Technologies is a private company consisting of harm reductionists who seek to end the drug poisoning crisis by increasing access to drug checking services—particularly in underserved rural, remote, northern, and Indigenous communities. DoseCheck were finalists in Impact Canada's Drug Checking Technology Challenge, and the technology is being jointly commercialized by the Centre on Drug Policy Evaluation and the University of California San Diego.

DoseCheck uses technology that combines different pulse voltammetry (electrical impulses), electrochemical analysis, machine learning, and smartphone technologies to detect compounds in drug samples. The instrument is a biosensor controlled by a dedicated smartphone app connected via Bluetooth. An electrical impulse of increasing voltage is sent through the electrochemical sensor, which is in a vial that contains the sample. Compounds react to different voltage levels by producing a unique signal that is transmitted from the instrument to the app. The app then analyzes the data using machine learning analyses that are continually updated to improve accuracy.

Each test uses one consumables kit that includes a blister pack of phosphate-buffered saline, a 1 mg micro-scoop, and a vial that contains an embedded disposable electrochemical sensor. The app guides the service user through the process, including how to add the saline solution to the vial, how to place the vial

in the instrument, and how to use the micro-scoop to mix 1 mg of the sample into the vial. It also provides an opportunity for the user to enter information about the sample, such as the expected drug, colour, texture, associated adverse events (e.g., drug poisoning), and images. Service users are given the option to anonymously upload results to a network, allowing others in the region with the app to be notified of potentially harmful contaminants.

| Table 4. DoseCheck Instrument Details | |
|---|---|
| **Technology** | Voltammetry and electrochemical analysis. |
| **Size** | 10.15 cm in length. |
| **Weight** | 80-100 mg. |
| **Portability** | Highly portable. |
| **Materials required** | DoseCheck sensor, salt water, pipette. |
| **Instrument training** | None. |
| **Cost** | Not currently available for purchase. Designed to be low cost, anticipated around CAD$200-$300. This does not include the cost of the consumables kit, which is estimated at CAD$3/kit. No cost for DoseCheck app. |

| Table 5. DoseCheck Drug Analysis Information | |
|---|---|
| **Sample type** | Powder or crystal. |
| **Sample preparation** | Dilution in a saline solution. |
| **Sample destruction** | Semi-destructive (due to sample dilution). |
| **Speed of test** | 2 minutes. |
| **Substance(s) detected** | Carfentanil, cocaine, fentanyl, heroin, ketamine, MDA/MDMA (unable to distinguish). Currently exploring detection of benzodiazepines and methamphetamine. |
| **Limit of detection** | Indications for trace level detection of fentanyl at <1% of the sample, using pharmaceutical reference standards. Additional drug classes and analogues are being assessed. |

| | |
|---|---|
| **Sensitivity and specificity** | No published evidence. Initial developer reports state sensitivity and specificity are high. Data with F1 scores (a composite measure of accuracy) anticipated to be available in the coming year. |

| Table 6. DoseCheck Data and Reporting Details | |
|---|---|
| **Result data type** | Qualitative. Quantification currently under development. |
| **Results availability** | Via DoseCheck app. App users can share results with other app users in their region. Regional information can be viewed by anyone with the app even in the absence of DoseCheck sensor. Option to anonymously upload results about unexpected compounds detected. Unclear whether aggregated data will be available for public health reporting. |
| **Software and data storage requirements** | DoseCheck iOS app. No internet access required once downloaded. |
| **Reference library** | Proprietary database. |

## Stage of Development

DoseCheck is in the research and development stage. Field testing with service providers in Toronto and Vancouver is anticipated to begin in late 2023.

DoseCheck partnered with Toronto's Drug Checking Service and Health Canada's Drug Analysis Service to test their instrument with samples from the unregulated drug supply.[1] This involved: 1) using the instrument to check an unregulated drug sample, 2) checking that same sample using lab-based GCMS or NMR, and 3) comparing the results to inform the instrument's detection capability (i.e., what compounds) and limit of detection. These results are not publicly available.

1 Toronto's Drug Checking Service and DAS are publicly funded programs that are not involved in determining the validity of an instrument, nor do they endorse the DoseCheck instrument.

# Hein Lab Portable Robotic HPLC

Unless otherwise indicated, all information in this section is provided by Sara Guzman, co-lead for the Portable Robotic HPLC at UBC Hein Lab.

## Overview

The Hein Lab is a research group at the University of British Columbia (UBC). The group has developed a robotic sample preparation attachment that is being tested for use with miniaturized high-performance liquid chromatography (HPLC) instruments. Their robotic component is currently being used with a portable HPLC developed by the U.S.-based company Axcend. The aims of this technology are to 1) develop a portable robotic version of the HPLC to detect and quantify pharmaceutically active compounds at concentrations below 5%, and 2) improve consistency and turnaround time of sample preparation with a robotic attachment.

The robotic component weighs and dilutes 10-15 mg of a sample in a specific solvent, then injects the sample into the portable HPLC. Once in the HPLC column, the sample's components are separated for analysis based on retention time (how much time each component spends in the column) and UV-VIS (amount of light absorbed). The components are then identified individually. Individual components can be quantified as long as the component has been previously analyzed and has been added to the reference library. If a component is not in the reference library, a technician can send the sample to the Hein Lab for confirmatory analysis (using NMR and MS) and add it to the reference library. The service user receives the result via email, or from a trained staff person at point of care where the sample is being tested. An online platform was developed by the Cloud Innovation Centre (CIC) at UBC for users to view results online.

| Table 7. Hein Lab Portable HPLC Instrument Details | |
|---|---|
| **Technology** | High-performance liquid chromatography. |
| **Size** | HPLC unit: 35 cm x 60 cm x 32 cm.<br>Robotic component: 29 cm x 70 cm x 48 cm. |
| **Weight** | 8 kg. |
| **Portability** | Designed to be portable. Undergoing field testing. |
| **Materials required** | HPLC solvent and tubing, vials, syringe filters. |
| **Instrument training** | Required for HPLC operation. Future models with full robotic components will be standalone with no required training. |
| **Cost** | Not currently available for purchase. Anticipated cost for entire instrument (portable HPLC and robotic component) estimated at CAD$85,000. This does not include solvents (approximately CAD$1.00/week) or software and database costs. |

| Table 9. Hein Lab Portable HPLC Data and Reporting Details | |
|---|---|
| **Result data type** | Quantitative. |
| **Results availability** | Online portal. Unclear whether aggregated data will be available for public health reporting. |
| **Software and data storage requirements** | Proprietary Agilent Drive through Axcend, compatible with Windows 10 or higher. Additional cost for software license. |
| **Reference library** | Internal library currently under development. |

## Stage of Development

The portable robotic HPLC is in the field testing stage. It operated at the 2023 Shambala music festival and is in use at the UBC Harm Reduction Drug Testing fixed site. Some of the samples collected thus far have been sent to DAS for confirmatory testing,[2] which involved: 1) using the instrument to check a controlled substance

2 The DAS is a publicly funded program that is not involved in determining the validity of an instrument, nor do they endorse the Hein Lab's portable robotic HPLC.

sample, 2) checking that same sample using lab-based GCMS or NMR, and 3) comparing the results to inform the instrument's detection capability (i.e., what compounds) and limit of detection. These results are not publicly available.

# NIRLAB Fieldlab

Unless otherwise indicated, all information in this section is provided by NIRLAB.

## Overview

NIRLAB AG is a private, ISO 17025 certified[3] Swiss-based spin-off of the University of Lausanne, established in 2018. NIRLAB developed a mobile and portable near-infrared (NIR) spectrometer, called Fieldlab, for drug analysis by law enforcement. Its use has since expanded to food, chemical, pharmaceutical, and safety industries.[7]

FieldLab applies the principles of NIR light—the light adjacent to visible light on the electromagnetic spectrum—to illuminate a sample, then measure the amount of light the sample absorbs and scatters to generate a spectral footprint. NIRLAB's proprietary software compares the spectral fingerprint to a reference library to determine which substances are present, with a maximum of 3 compounds per test being reported.

Fieldlab consists of several components. NIRLIGHT is the wireless analyzer (i.e., spectrometer), and comes in a protective case alongside two attachments: a sapphire glass window protector and a white calibration reference mirror. It is connected via Bluetooth to the NIRApp, which is a cloud-based app (for iOS and android) that controls the NIRLIGHT, provides user directions, and displays results. NIRWeb is a desktop app and browser-accessible platform for user and data management, and NIRCloud is the high-speed server hosted on the University of Lausanne's secure data centre, where prediction models are trained and stored alongside results.

To test a sample of any size, the user removes the cap from the NIRLIGHT and attaches the sapphire glass window protector. The instrument is started via the NIRApp. NIRLIGHT calibration is required when the app is first used, and periodically thereafter as instructed by the app. To calibrate, the user removes the cap from the NIRLIGHT and

3 The ISO 17025 was created by the International Organization for Standardization and the International Electrotechnical Commission to improve lab processes.[8] Certification means that a lab's quality management system and technical competence has been evaluated against international lab testing and calibration standards by a third party, and the lab has been deemed technically competent to produce calibration and testing results.[8,9]

attaches the white calibration reference mirror. Calibration takes a few seconds, with completion confirmed via the app. If the user has a small sample, containing it within an aluminum cup is recommended, as aluminum has a neutral effect on the spectrum and won't interfere with the reading. The user points the NIRLIGHT directly at the sample to perform a scan. Direct measurement (i.e., nothing in-between the NIRLIGHT and the sample) is recommended for optimal results, although analysis can also occur through thin plastic (i.e., if the sample is in a baggie) or glass. The user chooses from one of two types of analysis: a rapid analysis via a single scan (Screening Mode), or Standard Mode, which takes several scans to produce an average. Standard Mode is intended to improve analysis accuracy. The NIRApp provides an on-screen reading of up to three compounds, using a database of >5000 unregulated samples collected internationally. The window protector is wiped clean after each use using ethanol on a tissue. Data stored in NIRWeb can be exported and downloaded, and allows users to see geographic data and trends.

**Table. 10 NIRLAB FieldLab Instrument Details**

| | |
|---|---|
| **Technology** | Near-infrared spectroscopy. |
| **Size** | 47 mm diameter, 194 mm length. |
| **Weight** | 250 grams. |
| **Portability** | Intended to be portable. Full charge lasts ≥10 hours with continuous use. Operates in -20°C to +40°C. |
| **Materials required** | NIRLIGHT and attachments, ethanol, tissue, aluminum cup. |
| **Instrument training** | None. |
| **Cost** | €10,800 for the instrument. €1200 annual software subscription per application area or library (e.g., narcotics, polymer). |

**Table 11. NIRLAB FieldLab Drug Analysis Information**

| | |
|---|---|
| **Sample type** | Powder, flower, crystal, liquid, tablet. |
| **Sample preparation** | None. |
| **Sample destruction** | No. |
| **Speed of test** | 2-5 seconds. |

| | |
|---|---|
| **Substance(s) detected** | >250 psychoactive substances, precursors, and cutting agents identified during algorithm training.[10] Does not detect all components present in a sample: analysis of ≤3 compounds from one sample at a time. Identification targeted to active ingredients (i.e., heroin identified before cutting agents, regardless of quantity). |
| **Limit of detection** | Approximately 3%.[10] |
| **Sensitivity and specificity** | Sensitivity and specificity for cocaine, heroin, and cannabis were evaluated using samples containing 182 mixtures of pharmaceuticals and cutting agents of various concentrations.[10] Of the 2046 samples containing cocaine, 12 false negatives were produced (99.4% sensitivity).[10] Of the 182 samples without cocaine, none were incorrectly identified as containing cocaine (100% specificity).[10] For samples containing heroin, there was 1 false negative out of 600 tested (sensitivity of 99.8%).[10] Of the 182 samples without heroin, none were incorrectly identified as containing heroin (100% specificity).[10] Sensitivity and specificity for cannabis is reported at 100%: all 244 THC-type and 195 CBD-type samples were correctly identified, with no false negatives or false positives detected.[10] It is unclear if samples with a mix of THC and CBD were tested. Validation of all results occurred against reference data sets from lab-based GC-MS and unregulated samples.[10] Data on other substances is not available. |

| Table 12. NIRLAB FieldLab Data and Reporting Details | |
|---|---|
| **Result data type** | Quantitative. Quantification of substances within existing detection models used to train the algorithms[10]: up to 3 of 22 substances per test, including cannabis (THC, CBD, CBN), cocaine (base and salt form), heroin, ketamine, and phenethylamines (MDMA, methamphetamine, amphetamine). Common cutting agents are estimates.[11] |
| **Results availability** | Point of care via NIRApp. Internet connection required. Results management via NIRWeb. Community-level data is available. |
| **Software and data storage requirements** | NIRApp (iOS or Android), NIRWeb, NIRCloud. |
| **Reference library** | Proprietary database. Continually updated for improved detection. |

## Stage of Development

NIRLAB's FieldLab is in the field testing stage. It has been evaluated by NIRLAB against lab standards,[10] and in 2021 it was used at 6 music festivals and 1 safe injection site in Switzerland.[11] Of the 131 samples tested at festivals, 70 were sent for confirmatory lab analysis by GC-MS: 86% were confirmed, with 2 samples having been incorrectly identified, and the remainder being unknown substances.[11] At a Swiss safe injection site, 87 drug samples were obtained, and 53 sent for lab analysis: 73% were confirmed by GC-MS, with 2 having been incorrectly identified and the remainder being unknown substances.[11]

There is reference to FieldLab being implemented by law enforcement across Switzerland and other countries, however no further information on this is available.

# Paper Spray Mass Spectrometry

Unless otherwise indicated, all information in this section is provided by Dr. Chris Gill of Vancouver Island University.

## Overview

The applicability of PSMS technology to drug checking was introduced in 2017 by Drs. Chris Gill and Gregory Vandergrift, from Vancouver Island University, and implemented in partnership with Vancouver Coastal Health as part of Impact Canada's Drug Checking Technology Challenge. This led to a partnership with Substance Drug Checking, which offers storefront drug checking services using PSMS in Victoria, BC.

In PSMS, a small amount of a sample (≤ 10 µL) is applied to a triangular-shaped piece of filter paper, to which a small amount of solvent is applied.[12] The solvent wicks to the tip, passing through the sample, carrying analytes to the paper tip.[12] High voltage is then applied to the paper, creating ionization in the form of electrospray, and subsequent MS detection as components are separated based on their unique masses and structures.[12,13]

In this application of PSMS, 1 mg of a sample is dissolved into 1 mL of methanol. This is then vortexed (spun to agitate the sample) and diluted into 1 mL of methanol to lower the analyte concentrations into the calibration range.[12] Finally, 10 µL is spotted onto a VeriSpray PSMS sample plate, dried, and analyzed by the PSMS instrument.[12]

| Table 13. PSMS Instrument Details | |
|---|---|
| **Technology** | Paper spray mass spectrometry. |
| **Size** | PSMS used at Substance Drug Checking is 60 cm x 60 cm. Size and dimensions vary by manufacturer. |
| **Weight** | Several hundred pounds. |
| **Portability** | No. |
| **Materials required** | Paper strips, alcohol solvent, internal standard mix. |
| **Instrument training** | Extensive. |
| **Cost** | Dependent upon manufacturer, model, and desired configuration. Typically over CAD$300,000, including software.[12] |

| Table 14. PSMS Drug Analysis Information | |
|---|---|
| **Sample type** | Powder, liquids, crystal, surface residue. |
| **Sample preparation** | Dissolved in solvent (alcohol). |
| **Sample destruction** | Yes. |
| **Speed of test** | 5 minutes. Capable of multicomponent analysis. |
| **Substance(s) detected** | Natural and synthetic opioids such as fentanyl (and analogues) and nitazenes; benzodiazepines; psychedelics including dissociatives and synthetic cannabinoids; stimulants; entactogens; CNS depressants; precursors and byproducts and cuts and buffs. |
| **Limit of detection** | In the picogram range (~0.01% or ~0.005 mg/mL).[13] Reducing sample dilution can lower limit. |
| **Sensitivity and specificity** | Very high, even in complex samples.[14] For fentanyl analogues, PSMS correctly detects at concentrations between 3.6-7.4 ng/g.[15] The pilot at a Vancouver-based supervised consumption service during the Drug Checking Technology Challenge confirmed the instrument's high sensitivity.[12] As PSMS provides information about the isotopic composition of different compounds and their molecular masses, it can be used to identify the structure of a sample as well as detect substances outside of the existing reference library, including previously unknown compounds and adulterants.[16] This means that PSMS can be used to detect new substances in the unregulated drug supply that have not yet been added to a reference library. |

| Table 15. PSMS Data and Reporting Details | |
|---|---|
| **Result data type** | Quantitative: can determine precisely how much of a compound makes up a sample. |
| **Results availability** | Point of care and online. Population-level and community data from Substance Drug Checking PSMS available in weekly, monthly, and annual reports. |
| **Software and data storage requirements** | Dependent upon manufacturer. Software controls the instrument and is used to build quantitative methods and analyze data. Substance Drug Checking developed unique software that interfaces with the PSMS manufacturer's software to produce results. This indicates the potential to build custom software that interfaces with other PSMS manufacturers' software. |
| **Reference library** | Not tied to subscription libraries. Substance Drug Checking uses Thermo Fisher Scientific's Tracefinder Clinical Software. Can use free online libraries and add new substances directly to library as they appear. |

## Stage of Development

The PSMS is in the evaluation stage. Substance Drug Checking's PSMS was piloted at the Powell Street Getaway supervised consumption service in Vancouver in 2018,[13] and is currently used at Substance's storefront location in Victoria BC, which has tested over 10,000 samples to date.

# PSMS - Miniature Mass Spectrometry System

Unless otherwise indicated, all information in this section is provided by Dr. Chris Gill of Vancouver Island University.

## Overview

Dr. Gill and a team of researchers have been exploring the adaptation of PSMS to a portable mass spectrometry system to facilitate mobile approaches to drug checking. Because the size of typical mass spectrometers and supporting infrastructure impedes widespread use as a drug checking tool, the research team is exploring a tandem mass spectrometry method using a portable ion trap mass spectrometer system for quantitative drug checking with the Mini B from PURSPEC Technology Ltd.[17]

The Mini B uses paper capillary spray ionization (PCSI), a derivative of PSMS that is simple to use with no remaining residue between tests.17 When compared to PSMS, PCSI offers improved ionization efficiency due to the characteristics of the capillary emitter embedded in paper sampling substrate.[17]

To test a sample using the Miniature Mass Spectrometry System (MMSS), 1 mg/mL solution of a sample is prepared in methanol, then diluted to a sample of 4000 ng/mL total drug, with 10 µL spotted onto a PCSI cartridge.17 With the intention of improving quantitative measurements, the research team constructed a spray solvent delivery system that delivers a continuous solvent spray to the PCSI cartridges via a small hole drilled into the cartridge to improve signal stability.[17]

**Table 16. MMSS Instrument Details**

| | |
|---|---|
| **Technology** | Paper capillary spray ionization. |
| **Size** | 55 cm x 24 cm x 31 cm. |
| **Weight** | 20 kg. |
| **Portability** | Yes. Requires 100W and operates with 115 V AC. |
| **Materials required** | Paper capillary spray inserts and cartridges, alcohol-based solvent, spray solvent delivery syringe pump, mechanical pipette. |
| **Instrument training** | Extensive. |
| **Cost** | Available for purchase. Requires significant software development for use in quantitative drug checking. Estimated to be comparable to other PSMS, around CAD$200,000-$300,000. |

| Table 17. MMSS Drug Analysis Information | |
|---|---|
| **Sample type** | Powder, liquid, crystal, surface residue. |
| **Sample preparation** | Diluted in solvent (alcohol). |
| **Sample destruction** | Yes. |
| **Speed of test** | 1-2 minutes. |
| **Substance(s) detected** | Natural and synthetic opioids such as fentanyl (and analogues) and nitazenes; benzodiazepines; psychedelics including dissociatives and synthetic cannabinoids; stimulants; entactogens; CNS depressants; precursors and byproducts and cuts and buffs. |
| **Limit of detection** | From 0.001-0.24% weight for weight in original solid drug samples. Using methanol solvent, 0.92 ng/mL for fentanyl, 0.057 ng/mL for fluorofentanyl, 3.27 ng/mL for carfentanil, and 9.65 ng/mL for etizolam. The acidified solvent system (90% methanol, 10% water, 0.1% formic acid) demonstrated improved sensitivity for etizolam.[17] |
| **Sensitivity and specificity** | Samples from Substance Drug Checking that were analyzed using fentanyl and benzodiazepine test strips, FTIR spectroscopy, and MMSS show high specificity.17 Successful quantification of etizolam in 73% of samples (n=15).[17] Analytical sensitivity can be adjusted by changing dilution factor.[17] |

| Table 18. MMSS Data and Reporting Details | |
|---|---|
| **Result data type** | Quantitative: up to 20% weight by weight in original solid sample is possible.[17] |
| **Results availability** | To be determined. |
| **Software and data storage requirements** | Modified software from PURSPEC Technology. |
| **Reference library** | Unknown. |

## Stage of Development

The MMSS is in the research and development stage. It has not yet been field tested. It has been tested for an initial proof-of-concept study that did not assess its applicability to drug checking services.

# Scatr Series One

Unless otherwise indicated, all information in this section is provided by Ari Forman, CEO and COO of Scatr Series One, and Dr. François Lagugné-Labarthet, Professor of Chemistry at Western University.

## Overview

Scatr is a private company that develops user-friendly drug checking instruments. Scatr received $1 million as the winners of Impact Canada's Drug Checking Technology Challenge.

The Series One is a dual spectrometer that uses both Raman and near-infrared spectra.[18] Roughly 0.5 mg of a sample is loaded directly into a Stericup cooker or a Scatr chip (the area a sample is loaded onto), which are contained within a unit connected via Bluetooth to the Scatr Dashboard. The dashboard is a proprietary web platform through which the service user controls the Series One.[19] Results display on the dashboard in real time. The sample is compared to those stored in the cloud-based database. The Scatr database is continuously updated as samples are uploaded,[18] although it is unclear if confirmatory testing is conducted before they are added to the library. Test results and additional notes can be shared with others.[19]

| Table 19. Scatr Series One Instrument Details | |
|---|---|
| **Technology** | Raman spectroscopy, near-infrared spectroscopy. |
| **Size** | 30 cm x 30 cm x 30 cm (instrument).<br>3.8 cm x 2.5 cm (Scatr chip). |
| **Weight** | Unknown. |
| **Portability** | Designed to be easily transported. Requires standard 110V plug. |
| **Materials required** | Scatr chip or Stericup cooker, instrument, scoop. |
| **Instrument training** | 1 hour. |
| **Cost** | Not available for purchase. Estimated around CAD$120,000. Additional annual subscription fee for maintenance, training, software updates, and data access (subscription to dashboard) estimated at CAD$10,000. |

| Table 20. Scatr Series One Drug Analysis Information | |
|---|---|
| **Sample type** | Any non-liquid. |
| **Sample preparation** | None. |
| **Sample destruction** | No. |
| **Speed of test** | 5-15 minutes, dependant upon type of analysis (e.g., 5x5 spectral pattern versus 25x25). |
| **Substance(s) detected** | Natural and synthetic opioids including fentanyl (and analogues) and nitazenes; benzodiazepines; psychedelics including synthetic cannabinoids and dissociatives; stimulants; entactogens such as MDMA; CNS depressants; precursors and byproducts and cuts and buffs. |
| **Limit of detection** | Under evaluation. Initial indications of trace level detection (i.e., substances that make up <5% sample concentration) using pharmaceutical reference standards. |
| **Sensitivity and specificity** | No published evidence available: under evaluation. |

| Table 21. Scatr Series One Data and Reporting Details | |
|---|---|
| **Result data type** | Semi-quantitative. |
| **Results availability** | Via web-based dashboard. Functionality being developed to enable downloadable reports that provide data related to public health indicators. |
| **Software and data storage requirements** | Proprietary. |
| **Reference library** | Proprietary database built on samples received from field testing. Theoretically, other libraries may be applied, however there is no evidence to support this. |

## Stage of Development

The Scatr Series One is in the evaluation stage. It is being evaluated at a Western University lab. At the time of writing, it was being piloted at 7 supervised consumption services across Canada: 6 in Ontario and 1 in BC. Four additional sites are anticipated to be added in the coming months.

# Spectra Plasmonics Amplifi ID™

Unless otherwise indicated, all information in this section is provided by Malcolm Eade, Co-Founder and CEO of Spectra Plasmonics.

## Overview

Spectra Plasmonics was founded in 2017 at Queen's University, with the aim of creating cost-effective, high-quality chemical analysis technology without lab-related complexities. They were one of the finalists in Impact Canada's Drug Checking Technology Challenge.

Amplifi ID™ is a proprietary sensing platform that uses portable Raman Spectroscopy (RS) and Surface Enhanced Raman Spectroscopy (SERS) to detect unique scattered light signatures from drug samples.[20] The software uses machine learning algorithms and a proprietary database collected from drug samples to determine the composition of the sample and provide simple-to-read results.

Both bulk and trace scans can be conducted.[20] Trace scans require 5 mg of a sample to be dissolved in an alcohol-based solvent that is pipetted into an attachment cartridge, which is loaded into the Amplifi IDTM reader.[20] For bulk scans, a translucent bag containing a sample is placed on the sensing platform where it is directly scanned. Bulk scans require minimal sample preparation, can detect high concentrations (> 5% weight value), and, because testing is not destructive, it allows the sample to be returned to the service user. While trace scans can detect low concentrations (< 5% weight value), they are destructive: the sample cannot be returned to the service user because it is required to be put into a solution to be analyzed. Together, bulk and trace scans provide semi-quantitative information, meaning it is possible to deduce if a component makes up more or less than 5% of the sample's weight value (e.g., if fentanyl appears in the bulk scan, it can be assumed it makes up more that 5% of the weight value, whereas if it appears in the trace scan, it can be assumed to make up less than 5% of the weight value).[20]

**Table 22. Spectra Plasmonics Amplifi ID™ Instrument Details**

| | |
|---|---|
| **Technology** | Raman spectroscopy, surface-enhanced Raman scattering. |
| **Size** | 33.3 cm x 16.2 cm x 6.7 cm. |
| **Weight** | 2.2 kg. |
| **Portability** | Designed for portability. Requires 12V, 5A DC adapter.<br><br>Portable rechargeable battery allows for operation up to 48 hours on a single charge. |
| **Materials required** | Instrument, attachments for trace and bulk analyses, solvent in a vial, pipette scoop.[4] |
| **Instrument training** | 3 hours. |
| **Cost** | Estimated at CAD$25,000-$30,000. Includes proprietary software, reference library, and rechargeable battery. |

4 All included with instrument purchase.

| Table 23. Spectra Plasmonics Amplifi ID™ Drug Analysis Information | |
|---|---|
| **Sample type** | Powder, crystal, liquid. |
| **Sample preparation** | Dissolved in solvent (alcohol) for trace scan, none for bulk. |
| **Sample destruction** | Yes for trace scans, no for bulk. |
| **Speed of test** | 10 minutes or less. |
| **Substance(s) detected** | Synthetic opioids like fentanyl, carfentanil, and nitazenes; benzodiazepines like etizolam, flualprazolam, and flubromazolam; methamphetamine, cocaine, xylazine, fillers, cuts and buffs. Early findings indicate capacity for precise identification of a single analogue and for pure substances. Technological capacity exists to differentiate analogues by spectral characteristics.[10] For mixed analogues, the analogue at the higher concentration will be detected. |
| **Limit of detection** | Under evaluation. Initial indications of trace level detection (i.e., substances that make up <1% sample concentration) using pharmaceutical reference standards.[21] |
| **Sensitivity and specificity** | Preliminary evidence suggests sensitivity to fentanyl and analogues is 92.6%, with 100% specificity. Sensitivity and specificity for cocaine reported at 100%. For methamphetamine, sensitivity reported at 95% and specificity at 94.4%. Data on other substances will be made available following additional testing, as samples from testing partners becomes available. |

| Table 24. Spectra Plasmonics Amplifi ID™ Data and Reporting Details | |
|---|---|
| **Result data type** | Semi-quantitative. |
| **Results availability** | Via online Amplifi ID™ dashboard: accessible to the organization operating the device. Aggregated data may be used for public health reporting at the discretion of device and program stakeholders. |
| **Software and data storage requirements** | Proprietary software. |
| **Reference library** | Proprietary database built on samples received from field testing. Theoretically, other libraries may be applied, however there is no evidence to support this. |

## Stage of Development

The Amplifi ID™ is in the field testing stage. It was field tested at the Kingston Community Health Centre's supervised consumption site as part of Impact Canada's Drug Checking Technology Challenge. An Innovative Solutions Canada (ISC) testing stream pilot was conducted in partnership with Health Canada, Substance Drug Checking, and Parkdale Queen West Community Health Centre in Toronto to assess the instrument's hardware and trace scan effectiveness.

# UVic Substance Kiosk + Distributed Service model

Unless otherwise indicated, all information in this section is provided by Dr. Dennis Hore, co-lead of the Vancouver Island Drug Checking Project.

## Overview

Substance Drug Checking is a Substance Use and Addictions Program (SUAP) and publicly funded project. It consists of a team of interdisciplinary professionals based out of the University of Victoria who develop, evaluate, and improve drug checking technologies. The distributed service model was designed to increase drug checking accessibility for people in rural or remote areas, as well as those less likely to access existing harm reduction services, by removing the need to have technicians at all drug checking sites.[22]

The distributed service model works by having a central hub site (located in Victoria, at Substance's storefront drug checking service) that hosts harm reduction workers, technicians, and a suite of drug checking technologies. The hub is linked to drug checking kiosks (a touch-screen laptop, printer, and FTIR spectrometer) at geographically distanced "spoke" sites, which allows hub site technicians to remotely analyze data from the kiosk.[22] The kiosk conducts automated FTIR analysis via machine learning algorithms trained on IR spectral data and associated PSMS results,[23] which provides an immediate preliminary result at point of care.[23]

The kiosk provides distributed site staff with step-by-step prompts on how to load a sample onto the FTIR and receive the measurement, as well as information on resources available to the service user.[22] A technician at the hub is alerted to a kiosk measurement and completes data analysis and results interpretation. This information is viewable at the kiosk (in up to around 45 minutes, depending on hub technician availability) or via an online web portal.[22] If desired, the kiosk provides instructions for distributed site staff on how to send the sample to the hub for further analysis by immunoassay test strips, IR absorption spectroscopy, RS (bulk scan and SERS) and PSMS.[22] These additional results are not provided at point of care: once the sample has been processed at the hub (a number of days, depending on transport time), results are available online via a unique code given to the service user at their initial kiosk interaction.[22]

Automated FTIR analysis at the kiosk aims to reduce technicians' subjective interpretation of IR spectral patterns that may affect consistency, accuracy, and precision of reported results. It is not intended to replace technicians (and thereby lose experiential and co-produced knowledge); rather, it is intended to assist and speed up analysis and alleviate the requirement for experienced technicians at point of care.

| Table 25. UVic Substance Kiosk + Distributed Service Model Instrument Details | |
|---|---|
| **Technology** | Fourier transform infrared spectroscopy. |
| **Size** | Kiosk is approximately the size of a shoebox and screen[5] |
| **Weight** | 8 kg. |
| **Portability** | Current size of kiosk prototype renders it somewhat portable. Intended to be applicable to various settings. |
| **Materials required** | Spatula, drug crushing instrument, cleaning supplies, laptop. |
| **Instrument training** | Training for distributed site staff provided by Substance on: FTIR, software, test strips, and packaging a sample to send to the hub. Extensive training for hub site technicians on a range of drug checking technologies, including automated FTIR and distributed model process. |
| **Cost** | No available estimate. |

| Table 26. UVic Substance Kiosk + Distributed Service Model Drug Analysis Information | |
|---|---|
| **Sample type** | Powder, crystal, liquid. |
| **Sample preparation** | None. |
| **Sample destruction** | Yes. |
| **Speed of test** | Immediate at point of care for drug class information. Differentiation within drug classes dependent upon technician availability at hub site: around 2-45 minutes. |
| **Substance(s) detected** | Automated classification into one of: ecstasy, stimulant (methamphetamine, cocaine, cocaine base), dissociative (ketamine), opioid (cut), opioid (uncut), and unknown. Ability to further differentiate via automation under evaluation. Samples may be sent to hub for analysis with PSMS. |
| **Limit of detection** | Similar to other FTIR-based analysis: typically, around 5% by weight, dependent upon specific compound. |
| **Sensitivity and specificity** | No published evidence available. Under evaluation. |

5 Kiosks are envisioned to have various sizes, including fixed and portable options, to meet the individual needs of distributed sites.

| Table 27. UVic Substance Kiosk + Distributed Service Model Data and Reporting Details | |
|---|---|
| **Result data type** | Qualitative. |
| **Results availability** | Individual-level data available at point of care and via web-based platform. Population-level and community data available in weekly and monthly reports. |
| **Software and data storage requirements** | Distributed model software that connects kiosk to hub designed by Substance. |
| **Reference library** | In-house library developed from samples collected at all Substance locations. Shared by the BCCSU, SWGDrug, and The Loop. |

## Stage of Development

The UVic Substance Kiosk + Distributed Service Model is in the evaluation stage. At the time of writing, the kiosk and distributed service model were being piloted at Overdose Prevention Sites in four communities on Vancouver Island north of Victoria, as well as AVI Health & Community Services (which offers a range of harm reduction and social services) in Victoria.

# Xylazine Test Strips - BTNX Inc Rapid Response®

Unless otherwise indicated, all information in this section is provided by BTNX Inc.

## Overview

Rapid Response® Xylazine Test Strips (XTS) are produced by BTNX Inc, a Canadian biotechnology company with a focus on rapid, point-of-care diagnostics. BTNX XTS use rapid lateral flow immunoassay testing to confirm the presence or absence of xylazine.[24] Like fentanyl and benzodiazepine test strips, these are intended and approved in Canada for testing urine samples for clinical purposes, although widely accepted in off-label use for drug checking purposes.[24]

A sample is tested by diluting 5-10 mg of a substance in 5 mL of water. A test strip is then dipped into the mixture for 10-15 seconds and left to stand for 5 minutes. The strip is then compared to the results interpretation card to indicate a positive or negative result for the present of xylazine.[25]

**Table 28. BTNX XTS Instrument Details**

| | |
|---|---|
| **Technology** | Immunoassay test strip. |
| **Size** | 12 cm x 7.5 cm. |
| **Weight** | Negligible. |
| **Portability** | Highly portable. |
| **Materials required** | Water, scoop, clean container. |
| **Instrument training** | None. |
| **Cost** | CAD$349.00 per unit (100 strips).[6] |

6 Alternative pricing may be available for some non-profit organizations.[26]

| Table 29. BTNX XTS Drug Analysis Information | |
|---|---|
| **Sample type** | Non-liquid. |
| **Sample preparation** | Dissolution in water. |
| **Sample destruction** | Semi-destructive (due to dissolution). |
| **Speed of test** | 5 minutes. |
| **Substance(s) detected** | Xylazine. |
| **Limit of detection** | 1000 ng/mL.[7] |
| **Sensitivity and specificity** | Highly sensitive: reported at 97.4%27 to 100%.28 Cross-reactivity with lidocaine (a common cutting agent for stimulants) consistent at concentrations ≥ 10 mg/mL,[27,28] indicating possible false positives when lidocaine is present.[26] Higher concentrations studied for cross-reactivity produced false positives for lidocaine (≥ 0.5mg/mL), levamisole<br><br>(≥ 1mg/mL), diphenhydramine (≥ 2mg/mL) and methamphetamine (≥ 5mg/mL).26 Anecdotal data using same dilution for FTIR found 85% sensitivity, with Direct Analysis in Real Time (DART) MS used for confirmatory testing. Anecdotal reports suggest few false positives with stimulants.<br><br>High specificity: reported at 85%[27] to 100%.[28] When using same dilution for FTIR, anecdotal data shows 100% specificity, confirmed by DART MS with only one false negative. Anecdotal reports suggest high rates of specificity may be attributed to diminished prevalence of xylazine in the local drug supply, meaning specificity testing using an unregulated supply with a higher prevalence of xylazine is necessary. Reports also indicate challenges acquiring enough of a sample from the service user to ensure a valid test. Insufficient sample size may yield a false negative result. |

7 Studies have consistently found the limit of detection to be higher than BTNX reports, with the most consistent performance at concentrations of 2000 ng/mL or more.[27,28]

| Table 30. BTNX XTS Data and Reporting Details | |
|---|---|
| **Result data type** | Binary. |
| **Results availability** | Point of care. |
| **Software and data storage requirements** | N/A |
| **Reference library** | N/A |

## Stage of Development

The BTNX XTS are in the field testing stage. While they have been piloted in Philadelphia—the epicentre of xylazine adulteration of the unregulated drug supply in North America—there is no available evidence of BTNX XTS utility in the unregulated drug supply in Canada. At the time of writing, BTNX XTS were being field tested by Interior Health, Fraser Health, and at sites on Vancouver Island.

# Xylazine Test Strips - DanceSafe W.H.P.M. Inc

Unless otherwise indicated, all information in this section is provided by DanceSafe and W.H.P.M Inc.

## Overview

DanceSafe is a harm reduction non-profit that offers drug checking services, products, and information. In collaboration with W.H.P.M. Inc—a California-based immunoassay manufacturer—DanceSafe developed XTS, available to wholesale customers since June 2023.

The W.H.P.M. XTS indicate the presence or absence of xylazine in opioid samples only. To test a sample, 10 mg of an opioid in powder form is diluted in 5 mL of water.[29] The test strip is then dipped into the mixture for 15 seconds, left to stand for 5 minutes, then compared to the results interpretation information.[29] While a positive result indicates the presence of xylazine, a negative result does not rule out the possibility of xylazine, which may be present below the limit of detection.[29] The XTS can also be used to test pressed opioid tablets that contain binder material, with varying dilution instructions according to how much of the tablet is crushed.[29]

**Table 31. W.H.P.M. XTS Instrument Details**

| | |
|---|---|
| **Technology** | Immunoassay test strip. |
| **Size** | Unknown. |
| **Weight** | Negligible. |
| **Portability** | Highly portable. |
| **Materials required** | Water, scoop, clean container. |
| **Instrument training** | None. |
| **Cost** | Not currently available for individual purchase: institutional wholesale only. USD$0.89 per strip, minimum purchase 1 unit (100 strips).[29] |

**Table 32. W.H.P.M. XTS Drug Analysis Information**

| | |
|---|---|
| **Sample type** | Non-liquid. |

| | |
|---|---|
| **Sample preparation** | Dissolution in water. |
| **Sample destruction** | Semi-destructive (due to dissolution). |
| **Speed of test** | 5 minutes. |
| **Substance(s) detected** | Xylazine. |
| **Limit of detection** | 1000 ng/mL.30,[8] |
| **Sensitivity and specificity** | 100% of five lab samples of 2000 ng/mL xylazine hydrochloride (HCL) were correctly identified.[31] Less sensitivity found as concentration of xylazine decreased: correct identification in 3/4 lab samples containing 1500 ng/mL xylazine HCL, and only 1/3 containing 1000 ng/mL xylazine HCL.31 Cross-reactive with levamisole and ketamine: false positives produced in samples with 1 mg/mL and 10 mg/mL of levamisole, and 1mg/mL and 10mg/mL of ketamine.[32,33] No demonstrated cross-reactivity with fentanyl, methamphetamine, MDMA, lidocaine, diphenhydramine, phenacetin, procaine, or quinine.[32,33] |

| **Table 33. W.H.P.M. XTS Data and Reporting Details** | |
|---|---|
| **Result data type** | Binary. |
| **Results availability** | Point of care. |
| **Software and data storage requirements** | N/A |
| **Reference library** | N/A |

## Stage of Development

W.H.P.M. XTS are in the research and development stage. The XTS have been assessed in lab settings only: there have been no samples tested from the unregulated drug supply, nor of any non-opioids.[30]

8 Additional research indicates the strips perform most consistently at concentrations at or above 2000 ng/mL.[32,33]

# Conclusion

This report summarizes new drug checking instruments being developed or piloted in Canada, with the aim of supporting informed conversations and decision-making around the applicability and implementation of drug checking instruments and related services. Information provided includes each instrument's detection capabilities, as well as practical details such as instrument dimensions and portability, and software and data requirements. As there is little evidence of formal evaluation for most of these new instruments, a purpose-developed definition of the instrument's stage of development was created to elucidate the breadth of assessment an instrument has thus far undergone. These stages consist of research and development, field testing, and evaluation.

While much of the innovation discussed in this report stems from Impact Canada's Drug Checking Technology Challenge as well as Health Canada's Substance Use and Addictions Program funding, private companies not funded by these sources are also investing in the drug checking field. This indicates an increasing demand for lab-caliber analytical instrument availability within community-based drug checking settings, and holds promise for the ongoing development of more accurate, user-friendly, and affordable options that can be applied to a variety of service delivery models.

While this report offers a level of detail that is sufficient to promote critical thinking about instrument applicability to differing drug checking contexts, it also reveals an overall lack of rigorous, independent, and comparative evaluation that speaks to instrument validity and suitability for prospective program planners. As such, drug checking providers are encouraged to consider the limitations to existing information, and how further evaluation may strengthen and support this knowledge. Existing drug checking services continue to be the most valuable tool for developers to access field testing and evaluation of novel instruments.

# Appendix A – Existing Drug Checking Instruments Resources

- Gozdzialski, Wallace, and Hore's 2023 journal article Point-of-Care Community Drug Checking Technologies: An Insider Look at the Scientific Principles and Practical Considerations *discusses some common drug checking methods, technologies, and considerations related to choice of drug checking instrument.*
- *Published in 2023, Toronto's Drug Checking Service's* one-pager offers information on drug checking service and technology limitations.
- The TEDI Guidelines: Drug Checking Methodology*, published by the Trans-European Drug Information (TEDI) network in 2022, details technologies used by drug checking services across Europe. Information offered includes considerations related to cost and technical capabilities, as well as guidance on legal considerations for drug checking services and settings.*
- *Published in 2022,* Chapter 3 Drug Checking Technologies & Procedures of The Drug Resource & Education Project's manual provides practical, experience-based information on providing drug checking services. It includes case studies, pro tips, and technology processes and capabilities.
- In 2020, the BCCSU published Detection of Etizolam, Flualprazolam, and Flubromazolam by Benzodiazepine-specific Lateral Flow Immunoassay Test Strips*. This document details an evaluation of benzodiazepine test strips to detect specific benzodiazepines.*
- The BCCSU's 2019 A Field Assessment of Fourier Transform Infrared (FTIR) Spectroscopy and Fentanyl Immunoassay Strips as Point-of-Care Drug Checking Technologies *provides an examination of the efficacy of FTIR spectroscopy and fentanyl test strips.*
- Drug Checking as a Harm Reduction Intervention: Evidence Review Report, published in 2017 by the BCCSU, provides a detailed review of drug checking technologies, including an evaluation of their efficacy as a harm reduction intervention in the context of an unregulated drug supply in BC.

# Appendix B – Summary Table of New Drug Checking Instruments

| Instrument | Technology | Size (in cm) | Speed of Test (in mins) | Result Type | Sample Destruction | Cost (in CAD) | Instrument Training | Stage of Development | Field Testing Sources |
|---|---|---|---|---|---|---|---|---|---|
| **Bruker Mobile-IR II** | FTIR | 21x33x20 | 5-10 | Semi-quantitative | No | Anticipated at >$70,000 | 10 mins + software, libraries | Field testing | Interior Health & ANKORS: Bass Coast & Shambhala |
| **DoseCheck** | Voltammetry & Electrochemical Analysis | 10.15 (length) | <2 | Qualitative | Semi (sample diluted) | ~$200-300 + $3/test for consumables | Minimal | Research and development | Planned for 2023/24 |
| **Hein Lab Portable Robotic HPLC** | HPLC | 35x60x32 | <2 | Quantitative | Yes | ~$85,000 + solvents, software, database | Yes. None when fully robotic. | Field testing | Shambhala |
| **NIRLAB Fieldlab** | NIR | 4.7x19.4 | 0.08 (5 secs) | Semi-quantitative | No | No | Unavailable | Field testing | 6 festivals, 1 DCS (not in Canada) |
| **Paper Spray Mass Spectrometry (PSMS)** | MS | 60x60 | <2 | Quantitative | Yes | ~$300,000 | Extensive | Evaluation | Substance DCS |
| **PSMS - Miniature Mass Spectrometry System** | MS | 55x24x31 | <2 | Quantitative | Yes | ~$200,000-$300,000 | Extensive | Research and development | N/A |
| **Scatr Series One** | RS | 30x30x30 | 5-15 | Semi-Quantitative | No | $120,000 + $10,000 annually | 1 hr | Evaluation | Western University & 7 SCS |
| **Instrument** | Technology | Size (in cm) | Speed of Test (in mins) | Result Type | Sample Destruction | Cost (in CAD) | Instrument Training | Stage of Development | Field Testing Sources |
| **Spectra Plasmonics Amplifi IDTM** | SERS | ~34x16x7 | <10 | Semi-quantitative | Yes - trace No - bulk | ~$30,000 all inclusive | 3 hrs | Field testing | Kingston SCS, Substance, Parkdale Queen West CHC |
| **UVic Substance Kiosk + Distributed Service Model** | FTIR | ~33x25x12 + 38 for laptop screen | <2 @ kiosk 45 @ hub | Qualitative (kiosk), semi-quantitative (hub) | Yes | Unavailable | Minimal @ kiosk, extensive @ hub | Evaluation | 4 OPS & 1 HR site |
| **XTS - BTNX** | Immunoassay test strips | ~5 (length) | 5 | Binary | Yes | $349/box (100) | Minimal | Field testing | Interior & Fraser Health, Vancouver Island |
| **XTS - W.H.P.M.** | Immunoassay test strips | ~5 (length) | 5 | Binary | Yes | ~$123/box (100), wholesale only | Minimal | Research and development | N/A |

# Appendix C – Onsite Drug Checking Technology Purchase and Partnership Considerations

Toronto's Drug Checking Service offers guidance to help community-based organizations make informed decisions around partnership with drug checking services or when considering purchasing point-of-care drug checking instruments. Below is the full document.

# Onsite drug checking technology purchase and partnership considerations

v4 | April 2023

Onsite (i.e., point of care) drug checking technologies are emerging with the intent to improve service accessibility, turnaround times for results, and detection of drugs in very small amounts. For the most part, these technologies are being developed by for-profit companies from outside the harm reduction space. Increasingly, these companies are approaching community-based organizations to promote or seek partnership to pilot their technologies.

**The purpose of this document is to equip community-based organizations to make informed decisions about partnering with a for-profit drug checking venture or purchasing an onsite drug checking technology. As we learn more about these emerging technologies, this document will evolve to include advice on what ideal answers to many of these questions may be.**

It is important to remember that drug checking as a response to the toxic drug supply crisis is in its infancy. Incredibly sophisticated and sensitive technologies continue to be required to effectively check highly contaminated drugs that are most likely to contribute to overdose. At this time, there is no perfect drug checking technology or model. All have trade-offs in terms of quality of results, turnaround times, and cost.

Here is a list of **questions you may choose to ask for-profit companies that approach you to purchase or pilot their technology**:

| | |
|---|---|
| Company-related | • Describe your organization's mission, motivation, management team, legal structure and ownership, and revenue model.<br>• What experience does your organization have in the field of harm reduction, if any?<br>• How does your organization give back to the community of people who use drugs? |
| Technology-related | • Describe how your technology works in lay terms.<br>• How has your technology been validated? Describe validation using reference standards (i.e., pharmaceutical grade known compounds in |

| | |
|---|---|
| | known amounts), as well as drugs from the unregulated supply, if applicable. Provide reports, peer-reviewed publications. **Please note that drug checking technologies are considered consumer products in Canada and are not assessed by Health Canada to determine their safety, effectiveness, or quality before being authorized for sale in Canada (something that is a requirement for medical devices). For this reason, it is critically important that claims made about what a drug checking technology can do (specifically, which compounds it can detect) are backed by concrete evidence.**<br>• Provide detailed limitations for your technology.<br>• Has your technology been piloted in the community? If so, how, where, and could you provide a community contact we could connect with to learn about their experience?<br>• Is your technology new or does it build upon a technology already used for drug checking?<br>• How much does your technology cost? What are upfront and ongoing costs related to subscriptions and supplies?<br>• How is your technology serviced? What are anticipated service and maintenance costs?<br>• How do we access instrument support? How long do we have to wait for instrument support? Are there costs associated with accessing instrument support?<br>• What qualifications or training are required of those that conduct drug checks using your technology?<br>• How much physical space does your technology require? Is your technology portable? How durable is your technology (i.e., could it be used outdoors or in a vehicle)? |
| Sample-related | • What sample types can be checked using your technology? E.g., substances (powder, crystals, rocks, pills, blotter, liquid), residue on used drug equipment.<br>• Are samples checked in raw form or are they diluted? If diluted, with what?<br>• What expected drugs can be checked using your technology?<br>• Does your technology destroy the sample that is checked? |
| Results-related | • How long are turnaround times for results?<br>• Which drugs can your instrument detect? |

| | |
|---|---|
| | • Can your instrument detect non-drug fillers and other types of compounds? If so, which ones?<br>• How well does your instrument differentiate between drugs that have very similar chemical structures? E.g., fentanyl-, benzodiazepine-, high-potency opioid-related drugs, by-products, etc.<br>• Does your technology report information about how much of a compound is found in a checked sample (i.e., quantified results)? If so, within what range of precision (i.e., how accurately)?<br>• What is your technology's limit of detection (i.e., the smallest amount of a compound that can be detected with confidence)? **The limit of detection for a Fourier-transform infrared spectrometer (FTIR), which is currently the most used onsite drug checking technology for opioid overdose prevention in North America is 5%**. This means substances present under 5% are likely to be missed by the instrument. For this reason, FTIR is paired with test strips, which are more likely to pick up certain drugs in trace amounts. **Emerging drug checking technologies that prioritize opioid overdose prevention and claim to be improvements to existing onsite technologies should therefore have a limit of detection less than 5%**.<br>• How often are "new" compounds added to your technology's database or library of drugs it can detect? |
| Data-related | • What data, if any, does your technology collect from service users? How is that data stored? Where is that data stored? What does your organization do with that data? Are we free to do what we want with that data?<br>• Do you plan to share your drug sample analysis data with existing networks of publicly funded drug market monitoring systems for public dissemination? |
| Partnership-related | • What benefits do community partners receive (e.g., free or discounted instruments)? |

**Please note that the most important compounds drug checking services for opioid overdose prevention can identify are what we call "noteworthy drugs"**. Noteworthy drugs are drugs that (i) are linked to overdose or other adverse effects, (ii) are highly potent or related to highly potent drugs, or (iii) may not be desired by some service users. **Emerging drug checking technologies that prioritize opioid overdose prevention and claim to be improvements to existing onsite technologies should ideally be able to identify many of the noteworthy drugs found by Toronto's**

**Drug Checking Service**: fentanyl and related drugs (4-Fluorobutyrylfentanyl (4-FBF)/4-Fluoroisobutyrfentanyl, acetyl fentanyl, benzyl fentanyl, bromofentanyl, butyryl fentanyl, carfentanil, fentanyl, fluorofentanyl, furanyl fentanyl, furanylethyl fentanyl, n-methyl norcarfentanil, ocfentanil, valeryl fentanyl), non-fentanyl synthetic opioids (5-Aminoisotonitazene, etodesnitazene, etonitazene, etonitazepyne, isotonitazene/protonitazene, metonitazene, n-desethyl isotonitazene, furanyl UF-17, U-51754), benzodiazepine-related drugs (adinazolam, alprazolam (Xanax), bromazolam, clonazepam, clonazolam, desalkylflurazepam, desalkylgidazepam, deschloroetizolam, diazepam (Valium), etizolam, flualprazolam, flubromazepam, flubromazolam, flunitrazepam, flurazepam, lorazepam (Ativan), meclonazepam, oxazepam, temazepam), synthetic cannabinoids (4F-MDMB-BUTINACA, AB-FUBINACA, ACHMINACA, AMB-FUBINACA, BZO-HEXOXIZID), other (levamisole, phenacetin, xylazine).

Our **advice to for-profit companies promoting or seeking partnership for their technologies** is to:

1. Be honest about what your technology can achieve at its current stage. It is understood that checking drugs is complex and challenging. Transparency builds trust.
2. Focus your time and energy on building a solid technology. Leave program delivery and translation of results to harm reduction and drug checking experts.

**We are here to help!** We appreciate you may be new to drug checking and the answers to these questions may be overwhelming. We are learning too but are a resource to the community and could attempt to assist with translation if that would be helpful to you. You can reach us at **drugchecking@cdpe.org**.

---

***Toronto's Drug Checking Service*** *is a public health service that aims to reduce the harms associated with substance use and, specifically, to prevent overdose by offering people who use drugs timely and detailed information on the contents of their drugs. Beyond educating individual service users, results for all samples are combined, analyzed, and publicly disseminated every other week to communicate drug market trends and inform care for people who use drugs, advocacy, policy, and research.* ***Sign up*** *to receive reports, alerts, and other information on Toronto's unregulated drug supply.*

(e) **drugchecking@cdpe.org** | (t) **@drugpolicyctr** | (f) **facebook.com/centreondrugpolicyevaluation**

# Appendix D – Instrument Developer Contacts

| Product | Name | Position | Contact |
|---|---|---|---|
| **Bruker Mobile-IR II** | Dr. Peter Krygsman, PhD | Regional Sales Manager | peter.krygsman@bruker.com |
| **DoseCheck** | Daniel Werb | Co-founder & Director, Centre on Drug Policy Evaluation | daniel.werb@unityhealth.to |
| **Hein Lab Portable Robotic HPLC** | Sara Guzman | Co-lead for Portable Robotic HPLC & PhD candidate, Hein Lab, UBC Department of Chemistry | sguzman@chem.ubc.ca |
| **NIRLAB FieldLab** | NIRLAB | General Inquiries | contact@nirlab.com |
| **Paper Spray Mass Spectrometry (PSMS)** | Chris Gill, PhD, P.Chem | PhD, P.Chem, Co-Director of the Applied Environmental Research Laboratories (AERL), Department of Chemistry, Vancouver Island University; Collaborating Research Scientist, Canadian Institute for Substance Use Research, University of Victoria | Chris.Gill@viu.ca |
| **PSMS - Miniature Mass Spectrometry System** | Chris Gill, PhD, P.Chem | PhD, P.Chem, Co-Director of the Applied Environmental Research Laboratories (AERL), Department of Chemistry, Vancouver Island University; Collaborating Research Scientist, Canadian Institute for Substance Use Research, University of Victoria | Chris.Gill@viu.ca |
| **Scatr Series One** | Ari Forman | CEO & COO | ari@scatr.ca |
| | François Lagugné-Labarthet | Ph.D., Professor of Chemistry, Western University | flagugne@uwo.ca |
| **Product** | Name | Position | Contact |
| **Spectra Plasmonics Amplifi IDTM** | Malcolm Eade | Co-founder & CEO | malcolm@spectraplasmonics.com |

| | | | |
|---|---|---|---|
| **UVic Substance Kiosk + Distributed Service Model** | Dennis Hore, PhD | Professor, Department of Chemistry, University of Victoria; Professor, Department of Computer Science, University of Victoria; Co-lead, Vancouver Island Drug Checking Project; Collaborating Scientist, Canadian Institute for Substance Use Research; Affiliate Researcher, Island Health | dkhore@uvic.ca |
| **XTS - BTNX** | BTNX | General Inquiries | 1-888-339-9964 ext. 800<br>1-905-944-9565 ext. 800<br>sales@btnx.com |
| **XTS - W.H.P.M.** | Emanuel Sferios | General Inquiries | 1-888-636-2411<br>eman@dancesafe.org |

# References


1. Wallace B, van Roode T, Pagan F, Phillips P, Wagner H, Calder S, Aasen J, Pauly B, Hore D. What is needed for implementing drug checking services in the context of the overdose crisis? A qualitative study to explore perspectives of potential service users. *Harm Reduct J*. 2020;17(29). https://doi.org/10.1186/s12954-020-00373-4

2. Gozdzialski L, Wallace B, Hore D. Point-of-care community drug checking technologies: an insider look at the scientific principles and practical consideration. *Harm Reduct J.* 2023;20(39). https://harmreductionjournal.biomedcentral.com/articles/10.1186/s12954-023-00764-3

3. Wallace B, Hills R, Rothwell J, Kumar D, Garber I, van Roode T, Larnder A, Pagan F, Aasen J, Weatherston J, Gozdzialski L, Ramsay M, Burek P, et al. Implementing an integrated multi-technology platform for drug checking: social, scientific, and technological considerations. *Drug Testing and Analysis*. 2021;13(4):734-746. https://doi.org/10.1002/dta.3022

4. Thompson H, McDonald K. Considerations for purchasing drug checking technologies: perspectives from Toronto's Drug Checking Service. *Int J Eniron Res Public Health.* 2023;(15):6486. https://doi.org/10.3390ijerph20156486

5. Bruker. Mobile-IR II FT-IR Spectrometer. 2023. Accessed September 14, 2023. https://www.bruker.com/en/products-and-solutions/infrared-and-raman/ft-ir-routine-spectrometer/mobile-ir-ii-ft-ir-spectrometer.html

6. BC Centre on Substance Use. *Drug Checking: Operational Technician Manual Version 2.* 2022. Accessed September 14, 2023. https://drugcheckingbc.ca/wp-content/uploads/sites/2/2022/03/BCCSU_Technician_Manual_Version2.pdf

7. Apptitude. *The Mobile Application for Real-Time Spectrometric Analysis.* 2023. Accessed November 09, 2023. https://apptitude.ch/en/portfolio/mobile-application/nirlab/

8. Safety Culture. *A Guide to Understanding ISO 17025.* December 09, 2022. Accessed November 09, 2023. https://safetyculture.com/topics/iso-17025/

9. Campbell Scientific. *What is ISO 17025 Accreditation?* 2023. Accessed November 09, 2023. https://www.campbellsci.ca/why-is-iso17025-calibration-important

10. Coppey F, Bécue A, Sacré P, Ziemons EM, Hubert P, Esseiva P. Providing illicit drug results in five seconds using ultra-portable NIR technology: An opportunity for forensics laboratories to cope with the trend toward the decentralization of forensic capabilities. *Forensic Science International.* 2020;317:110498. https://doi.org/10.1016/j.forsciint.2020.110498

11. Gianola E. The implementation of ultra-portable devices for analysis of illicit drug in drug checking service of the Canton of Vaud (Switzerland, CH). Presented at Lisbon Addiction 2022; November 23, 2022; Lisbon, Portugal. https://www.lisbonaddictions.eu/lisbon-addictions-2022/presentations/implementation-ultra-portable-devices-analysis-illicit-drug-drug-checking-service

12. Borden S, Saatchi A, Vandergrift G, Palaty J, Lysyshyn M, Gill C. A new quantitative drug checking technology for harm reduction: pilot study in Vancouver, Canada using paper spray mass spectrometry. *Drug Alcohol Rev.* 2022;41(2). doi: 10.1111/dar.13370

13. Vandergrift G, Gill C. Paper spray mass spectrometry: a new drug checking tool for harm reduction in the opioid crisis. *J Mass Spectrom.* 2019;54(9). doi: 10.1002/jms.4431

14. Vandergrift G, Hessels A, Palaty J, Krogh E, Gill C. Paper spray mass spectrometry for the direct semi-quantitative measurement of fentanyl and norfentanyl in complex matrices. *Clinical Biochemistry.* 2018;54:106-111. https://doi.org/10.1016/j.clinbiochem.2018.02.005

15. Borden S, Saatchi A, Krogh E, Gill C. Rapid and quantitative determination of fentanyls and pharmaceuticals from powdered drug samples by paper spray mass spectrometry. *Anal Sci Adv.* 2020;1(2):97-108. doi:10.1002/ansa.202000083

16. Bhuiyan I, Tobias S, Ti L. Responding to changes in the unregulated drug supply: the need for a dynamic approach to drug checking technologies. *Am J Drug Alcohol Ab.* 2023;0:1-6. https://doi.org/10.1080/00952990.2023.2226312

17. Laxton J, Monaghan J, Wallace B, Hore D, Wang N, Gill C. Evaluation and improvement of a miniature mass spectrometry system for quantitative harm reduction drug checking. *International Journal of Mass Spectrometry.* 2023;484. https://doi.org/10.1016/j.ijms.2022.116976

18. Government of Canada. *Government of Canada Announces the Grand Prize Winner of the Drug Checking Technology Challenge*. 2021. Accessed September 11, 2023. https://www.canada.ca/en/health-canada/news/2021/07/government-of-canada-announces-the-grand-prize-winner-of-the-drug-checking-technology-challenge.html

19. Scatr. *Our Mission.* Accessed September 14, 2023. https://scatr.ca/

20. Wilson NG, Raveendran J, Docoslis A. Portable identification of fentanyl analogues in drugs using surface-enhanced Raman scattering. *Sensors and Actuators B: Chemicals.* 2021;330. https://doi.org/10.1016/j.snb.2020.129303

21. Spectra Plasmonics. *Drug Checking: Bulk and Trace Scan Explainer.* March 28, 2023. Accessed September 14, 2023. https://www.spectraplasmonics.com/post/bulk-and-trace-scan-explainer

22. Wallace B, Gozdzialski L, Qbaich A, Shafiul A, Burek P, Hutchison A, Teal T, Louw R, Kielty C, Robinson D, Moa B, Storey M, Gill C, et al. A distributed model to expand the reach of drug checking. *Drugs, Habits and Social Policy.* 2022;23(3). https://doi.org/10.1108/DHS-01-2022-0005

23. Gozdzialski L, Hutchison A, Wallace B, Gill C, Hore D. Toward automated infrared spectral analysis in community drug checking. *Drug Test Anal.* 2023. doi: 10.1002/dta.3520

24. BTNX Inc. *Rapid Response Xylazine Test Strip (Liquid/Powder).* 2023. Accessed September 14, 2023. https://www.btnx.com/Product?id=2019

25. Sisco E, Nestadt D, Bloom M, Schneider K, Elkasabany R, Rouhani S, Sherman S. Understanding sensitivity and cross-reactivity of xylazine lateral flow immunoassay test strips for drug checking applications. *ChemRxiv.* 15 June, 2023, Version 2. https://chemrxiv.org/engage/chemrxiv/article-details/6489cfca4f8b1884b74a247d

26. Shuda S, Lam H. *Characterization of Xylazine Test Strips for Use in Drug Checking*. Centre for Forensic Science Research and Education. 2022. Accessed September 14, 2023. https://www.cfsre.org/images/content/reports/drug_checking/CFSRE_Xylazine_Report-Rev-1-18-23.pdf

27. Krotulski A, Shinefield J, Teixeira da Silva D, Logan B. *Evaluation of Xylazine Test Strips (BTNX) For Drug Checking Purposes.* Centre for Forensic Science Research and Education. 2023. Accessed September 14, 2023. https://www.cfsre.org/images/content/reports/drug_checking/Evaluation_of_BTNX_Xylazine_Test_Strips_for_Drug_Checking_230322.pdf

28. Jones S, Bailey S. CADTH horizon scan: xylazine test strips for drug checking. Canadian Journal of Health Technology. 2023;3(7). https://www.cadth.ca/sites/default/files/pdf/htis/2023/EN0049%20-%20Xylazine%20strips%20Final.pdf

29. DanceSafe. *Xylazine Test Strips*. 2023. Accessed September 14, 2023. https://dancesafe.org/xylazine-test-strips/

30. W.H.P.M. INC. *Xylazine Test User Instructions.* 2022. Accessed September 14, 2023. https://www.whpm.com/xylazine

31. Liberman M. *Data from New BTNX and WHPM Xylazine Test Strips Collected by Dr. M. Lieberman, U. Notre Dame, May 19 and 20, 2023.* 2023. Accessed September 14, 2023. https://docs.google.com/spreadsheets/d/1sbhH41PMa3Lv7R7O3llU_z8msMDknlu9HuF2wilfUnE/edit#gid=984435783

32. University of Notre Dame. *DanceSafe Testing the Tests*. Paper Analytical Instrument Project. 2023. Accessed September 14, 2023. https://padproject.nd.edu/partners/dancesafe/

33. W.H.P.M. INC. *Xylazine Test Strip – Substance Test Performance Characteristics White Paper.* Draft 3.2. May 2023. Accessed September 14, 2023. https://static1.squarespace.com/static/5e433381dd97e66de3df5d89/t/647911410a3af40c7c20220d/1685655873840/XTS+Performance+Characteristics.pdf

BRITISH COLUMBIA CENTRE ON SUBSTANCE USE

*Networking researchers, educators & care providers*

## BC Centre on Substance Use (BCCSU)

400-1045 Howe St,
Vancouver, BC
V6Z 2A9 Canada

Phone: (778) 945-7616
Fax: (604) 428-5183
Email: inquiries@bccsu.ubc.ca

*For media enquiries or to set up an interview with someone from the BCCSU, please contact Kevin Hollett, Communications Lead, at kevin.hollett@bccsu.ubc.ca or (778) 918-1537.*

**www.bccsu.ca**

If you would like more information about drug checking services in BC, please visit:

**www.drugcheckingbc.ca**

or email **drugchecking@bccsu.ubc.ca**