CHAPTER 03

DRUG CHECKING
TECHNOLOGIES & PROCEDURES

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September 2022

A HOLISTIC APPROACH TO DRUG CHECKING

THE DRUG RESOURCE & EDUCATION PROJECT

CHAPTER THREE: DRUG CHECKING — TECHNOLOGIES AND PROCEDURES

by Jarred Aasen, Chlöe Sage & Julie-Soleil Meeson
September 2022

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We also need to say thanks to all our friends, loved ones and drug checking partners who have given valuable input to this project.

Land Acknowledgement

We acknowledge that the lands from which we are writing this chapter include the traditional territories of many Indigenous nations. The authors recognize that many injustices experienced by the Indigenous peoples of what we now call Canada include colonial, racist and classist drug laws and policies. The authors see the need to not only support people who use drugs individually but to actively work to disrupt or dismantle unjust systems that continue to negatively and disproportionately impact Indigenous communities.

Disclaimer

We do not condone or condemn substance use. The information contained within this chapter is not meant to be definitive, to replace healthcare advice, or to act as legal counsel. Drug checking is a growing topic of interest nationally and beyond, and the authors' hope is to provide a new lens with which to view it.

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Website for this Manual

The Drug Resource and Education Project
dredproject.ca

GLOSSARY & ACRONYMS

The glossary of terms is at the end of this chapter. All words within the text that are defined in the glossary are **highlighted,** these words are clickable links to the definition.

Throughout the chapter, acronyms will be used to replace commonly used words and phrases, as demonstrated below. It is also important to note that the words "drug" and "substance" are used interchangeably.

BCCSU: British Columbia Centre on Substance Use
DAS: Drug Analysis Service
DC: Drug Checking
FTIR: Fourier-Transform Infrared Spectroscopy
GC-MS: Gas Chromatography-Mass Spectrometry
GHB: Gamma-hydroxybutyrate
HPLC: High Performance Liquid Chromatography
HR: Harm Reduction
LSD: Lysergic Acid Diethylamide
NPWUD: Networks of People Who Use Drugs
OPS: Overdose Prevention Site
PS-MS: Paper Spray-Mass Spectrometry
PWLLE: People With Lived and Living Experience\Expertise
PWUD: People Who Use Drugs
qNMR: Quantitative Nuclear Magnetic Resonance
SCS: Supervised Consumption Site
SERS: Surface Enhanced Raman Spectroscopy
TEDI: Trans-European Drug Information Network
UHPLC-UV: Ultra High Performance Liquid Chromatography-UItraviolet
UPHNS: Urgent Public Health Needs Site

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INTRODUCTION

THE VISION OF THIS MANUAL* IS TO:

- Provide practical guidance on the constantly evolving best practices for performing drug checking (DC) in regards to harm reduction (HR), as well as program implementation and messaging in a variety of settings.

- Reflect DC practices that are guided by people's observations and experiences — hence the importance of input from many contributors.

- Serve as a reference for drug checkers, trainers, organizers, and anyone interested in learning more about DC.

What This Manual Is

- **Chapter 1: Creating Safer Spaces with Harm Reduction in Drug Checking Settings** — Creating a safer space; respectful language; reducing stigma; dismantling oppression; harm reduction tools and supplies; sexual health.

- **Chapter 2: Drug Checking: Implementation of Services** — Defining DC; logistical and legal considerations; locations of DC; research and data collection; human resources; collaborating with other HR Services.

- **Chapter 3: Drug Checking: Technologies and Procedures** — Choosing technologies and protocols (including disclaimers and working with samples); procedural flows when testing in a DC service; tips for Fourier-Transformed Infrared Spectroscopy (FTIR) and test strips.

Image courtesy of Jessica Lamb

- **Chapter 4: Messaging Results in Drug Checking** — Delivering results; explaining limitations; sourcing and assessing reliable drug information; the three S's (Substance, Set, and Setting).

- **Chapter 5: Guide on Substances** — Effects and risks; dosages; common mixes; adulterants; harm reduction tips.

What This Manual Is Not

- This manual does not offer basics on how to use specific technologies for DC.

- This manual is not a definitive authority on the topic as information is constantly changing and adapting to what is actually happening.

*When refering to "this manual", we are referring to the five chapters mentioned above

FEATURES

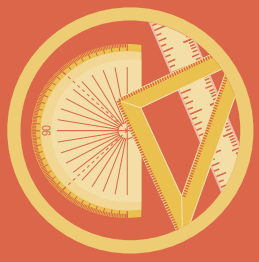
In the following chapter, different features will be integrated throughout:

CASE STUDIES

A detailed examination of a real-life situation to give practical insights on how to manage these potentially tricky scenarios.

TOOLS

Practical resources to further knowledge on a topic. This includes booklets, cards, websites, videos, etc.



PORTRAITS

Dives into the lives of some individuals or organizations who are influencers in this field.

CONCEPT CHECKS

Exercises to test understanding of the information presented.

PRO TIPS

Quick tips from experts, learned from experience.

TARGET AUDIENCE

There are multiple cross-sections of people who could potentially benefit from this manual. This includes: drug checkers who will be doing the work; individuals facilitating training events; event and community organizers; health care workers who are facilitating support for patients and clients who use drugs; and general readers, including people who use drugs (PWUD) and people who do not use drugs (PWDNUD). This manual also applies DC taking place in an event (**on-site**) or community (**fixed site**) context.

Drug Checkers

A "Drug Checker" is a volunteer or staff who will carry out drug checking at an event or in the community, and who may be involved in talking about DC. This is an umbrella term for both the technician (the operator of DC **instruments**) and the HR worker (the person giving results and information).

Drug checkers have a unique opportunity to help create safer spaces and discuss sensitive topics with a population that may be stigmatized and criminalized, and not have access to open and safe opportunities to discuss drugs as a result. The knowledge obtained from this manual will support drug checkers to perform all roles, including creating safe spaces, performing DC professionally, and providing **service users** with information about the drugs they have brought for testing. Drug checkers will be able to help people make informed decisions about their substances (i.e., increasing knowledge of the substance, safer use strategies, or safe disposal).

Liam is a man who lives in Edmonton, Alberta who has been a regular attendee of many music festivals throughout the past three summers. He has taken an interest in the group ANKORS, which provided HR at a festival that he attended in BC. He recently put in his application to be a volunteer drug checker next year, and to his surprise, his application was accepted. Liam realizes he knows some things surrounding the topic but wants to sharpen his knowledge in preparation for the upcoming in-person training before the festival. The training organizers forwarded Liam this manual to read, encouraging him to familiarize himself with some of the language that should be used and enhance his knowledge surrounding substances so that he can be more prepared for his shifts.

Trainers

A "Trainer" is a volunteer or professional who delivers training to the drug checkers around DC and related topics. Ideally, trainers provide in-person or online training in addition to at-home reading. This manual can also function as an on-site reference for troubleshooting the various scenarios, questions, or concerns that will inevitably arise.

Vlad has been working as a drug checker in an outreach organization in town. There has recently been an increase in demand for this service, and Vlad's outreach organization has decided to hire two additional drug checkers that Vlad is responsible for training. Vlad realized that DC is a complex topic to articulate to someone new. After a few Google searches, Vlad came across this manual. He is grateful that this reference exists, as it will help expedite the process as well as ensure that the training is complete and somewhat structured. With this manual as a map for the training, Vlad feels confident in his ability to train the two new drug checkers.

Event or Community Organizers

An "Event or Community Organizer" is a person who is involved in putting together a HR service for an event or walk-in community service and wishes to have a more in-depth understanding of HR (and/or integrate DC services). Practically, this manual hopes to provide organizers with a concept map on the logistics surrounding setting up the space and technologies, and operating the instruments. (Other resources will be required for more complete technical information.) Providing a service like DC requires informed legal considerations and proper protocols to limit the risk and liability created by a criminalized drug market.

Serena is involved with an organization that has been hosting a music festival in rural British Columbia for a number of years. The festival organizers have expressed interest in including more HR services to increase safety at the festival. Their new services include a chill zone or psych-crisis support space, outreach teams, a women's safe space, and DC. Serena has been appointed to organize the DC service. She doesn't know much about DC but knows that it would be a great way to help people become better informed about the substances they're consuming. Serena was referred to this manual and has been reading about various HR principles and what logistical hurdles might arise while providing such a service. After reading the manual, she feels confident that she understands how long it takes to set up a DC service, which will lead to a smoother implementation process.

Health Care Workers

A "Health Care Worker," such as mental health and substance use counselors, social workers, nurses, pharmacists, and doctors, can play an important role in supporting PWUD. When a health care worker has a good understanding of HR and knowledge of DC services (specifically, what they entail and how they work), they can be a bridge to help PWUD get connected to these services. Some community settings have DC integrated into healthcare services, and these services are occasionally managed by health care workers directly.

Dr. Rose Carleson is the Opioid Agonist Therapy (OAT) doctor at an OAT clinic that is held once a week at a local health unit site. She understands that many of her clients top up their prescriptions with drugs they buy on the street and is worried about the inconsistency of the street supply. Dr. Carleson asks a local DC service provider to come in and offer the service to her clients. She assures them that there is a private space and that they won't be penalized. She lets clients know a week ahead and encourages them to bring samples to their appointment to test.

General Readers

This is a catch-all group for other people who are interested in learning about DC and HR principles, which includes those who do and do not use substances. These individuals want to learn more about the substances (which they may or may not be taking themselves), understand safer use practices, and develop an understanding of DC. They are personally interested in DC, and may want to volunteer or work in DC services in the future.

Rosalie is a criminology student researching her paper on the social impacts of criminalization of PWUD. She inadvertently came across this manual and it piqued her interest. Outside of coffee and alcohol, she also occasionally uses MDMA with her friends at social gatherings. She has many questions regarding this field. Most of her knowledge about drugs comes from movies, music, and the news. Rosalie did not realize that there is a whole community of substance users out there who are looking to support each other. She feels that they represent a lot of the values she is writing about in her paper.

TIME INVESTMENT

The time investment required to maximize this manual is variable depending on the reader's experience and knowledge, both academic and experiential. For a reader who is already familiar with HR principles, this manual may simply require skimming and refamiliarization. Someone who has zero prior knowledge of substances will take a longer time to read through these ideas and concepts. They will likely be pushing up against their own biases and preconceptions surrounding substance use. Examples of bias include: people only use drugs because they have trauma; men who have sex with men only use drugs for sex, etc.

This manual hopes to shed some light on the complexity surrounding substance use, and leave the reader with a nuanced understanding of the topic. It should challenge common misconceptions that drug use is inherently bad. HR recognizes bodily autonomy and supports individuals making informed decisions about their health and well-being. The authors of this manual acknowledge the many different kinds of relationships that people have with substances, both problematic and beneficial, that range from from abstinence to daily use.

CHAPTER 03 LEARNING OBJECTIVES

REFLECT ON...

the considerations that go into selecting appropriate technologies for a DC service, including the three tiers of technologies.

BECOME FAMILIAR...

with various DC projects throughout Canada, including what technologies they are using.

DEFINE...

terminology related to DC including qualitative, semi-quantitative and quantitative.

UNDERSTAND...

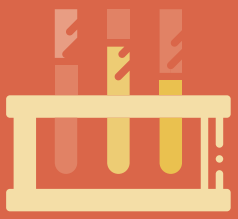
the flow of DC — intake, testing and results — including setting up a workstation with appropriate supplies, how to handle samples, and accurately label samples.

LEARN...

FTIR testing techniques for a variety of challenging substances to get an accurate reading and how to properly run both fentanyl and benzodiazepine (benzo) test strips.







This chapter is written from the authors' and their colleagues' first-hand experience as DC project coordinators and technicians. The focus on FTIR procedures merely reflects that experience and by no means do the authors see FTIR as the only or best choice when it comes to technologies. The field of drug checking is fast developing, with new technologies, methods and procedures being validated and implemented.

Please note: "Drug testing" refers specifically to chemically analyzing the component(s) of a substance, whereas "drug checking" refers to the service as a whole which includes intake and messaging the results.

TECHNOLOGIES

> Are you ready for science?!"
>
> *Doctor Science, drug checking innovator*

CHOOSING TECHNOLOGIES

A key component of DC is the technology itself. For many years, the only feasible option was colorimetric reagent testing. However, with the improvement of technology, increase of funding for DC projects and the inclusion of DC in exemptions of possession laws, the availability of options has significantly increased. There is no silver bullet and every technique has its own set of strengths and limitations. This section will explore these options, and will provide practical considerations for choosing the technology that might best fit specific needs.

When choosing different technologies there are many considerations:

What is the budget available?

- There is a wide range of prices for varying levels of technology.
- Aside from the initial cost of the instrument there may be ongoing per test or maintenance costs.

What are the physical requirements of the technology?

- Some technologies are very portable and rugged, whereas others are extremely sensitive to being moved and exposure to dust in the air.
- If testing is happening outdoors, it will affect the technology choice.
- Determine the size of the space required, some technologies have a small footprint while others have large ones.

What is the model of the DC service? On site, off-site, mobile, mail-in or fixed site? (See *Chapter 2: Implementation of DC Services for models of DC*). How fast will the results be needed? Is it an in-person service, or is the sample dropped off for testing at a later time or transported to another site for **analysis**?

- If it is in-person DC that means results must be ready in a short amount of time, as the service user will be waiting around for them.

What substances is the service most likely to be checking?

- Technologies all have advantages and disadvantages for checking different substances (see tools section below).

What is the utility of results and the **limit of detection** of **active ingredients**?

- Depending on what substances are being tested, having the ability to identify trace contaminants may be important (e.g., opioid-down).

Is providing quantitative information important?

- For some substances, receiving information on the percentage of an active ingredient in a sample is very important (e.g., the amount of fentanyl in opioid-down).

What training is required to operate the technology?

- Some technologies are very simple to use (reagent, test strip) whereas others require extensive training (mass spectrometers).

Does the technology require **sample preparation**?

- This can affect the choice based on the legal landscape (e.g., are staff permitted to handle the substances?)

Does the project have access to technical expertise?

- Some instruments like gas chromatography-mass spectrometry (GC-MS) or high-performance liquid chromatography (HPLC) require ongoing maintenance and **calibration**. **Having technical expertise and the funding required for maintaining high upkeep technology is essential**.

Is the project using the same technologies as other DC services?

- Being connected to the DC community is helpful for knowledge exchange, troubleshooting and getting second opinions. The DC community is very open and welcoming.
- Using already proven technology means practical expertise is available.

Is further analysis available?

- Further analysis can provide valuable feedback on the accuracy of results, as well as identifying complicated samples and giving accurate quantification.

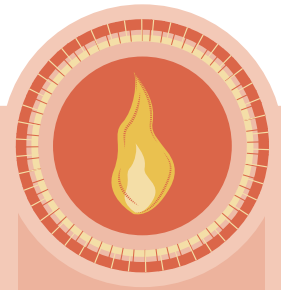
Does the technology chosen need to have **pharmaceutical standards** (laboratory tested pure samples) of substances on hand?

- Although it is challenging to get the permissions required, it is very helpful for confirming the performance of the technology (if needed).

Can the technology identify substances not in the library? How hard is it to add more substances to the library, to adapt to the ever-changing landscape of unregulated markets?

When choosing a technology, the most comprehensive and up-to-date guide on technologies currently, is the Trans-European Drug Information's 2022 (TEDI) TEDI Guidelines Drug Checking Methodology.

"The guidelines are primarily meant to help organizations navigate the many intricacies of setting up a drug checking service. Based on the experience of TEDI members, we have sought to highlight the limitations and benefits of each commonly used technique, the settings they have been used in and how they have worked" (TEDI, 2022, p. 4).



PRO TIP

Many instruments compare the **signal** they get from the sample with a **library** of known ingredients. There are many libraries out there. **A great free and accessible library for FTIR is SWG Drug.** There are other FTIR libraries being created and shared open source by the BCCSU and The Loop. Some libraries are proprietary and must be purchased and updated yearly for a fee — such as the TICTAC library.

TOOLS

- British Columbia Centre on Substance Use. (2022). What's in my drugs? YouTube video.

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TIERS OF TECHNOLOGY

These are just a few examples of each tier.

TIER 01.
CHEAP & ACCESSIBLE

Immunoassay Strip Tests

Fentanyl — sensitive to detect trace amounts of fentanyl in substances

Benzodiazepine — can detect benzodiazepines in substances like Xanax bars or benzos in down

Chemical Reagent / Colorimetric Testing

Helps point towards identity of substance, but is NOT a definitive test

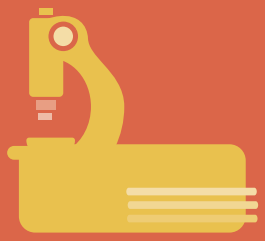
TIER 02.
GENERAL PURPOSE

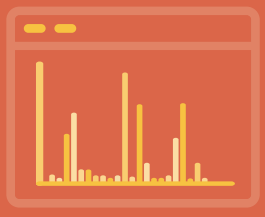
Fourier Transform Infrared Spectroscopy (FTIR)

Limit of detection ~5%
Can confirm bulk ingredients and major cuts
Quantitative models possible

Raman Spectrometry +/- Surface Enhanced Raman Spectroscopy (SERS)

Currently able to identify bulk ingredients and major cuts
Potential to be vastly improved, miniaturized and cost effective





TIER 03.
HIGH PRECISION / DETECTION

Paper Spray-Mass Spectrometry (PS-MS)

Very high sensitivity (<0.2%)
Consistent quantification
Targeted and untargeted analysis

High Performance Liquid Chromatography

Very high sensitivity
Quantitative methods available
Can differentiate isomers

TIERS OF TECHNOLOGY

This tier system categorizes technologies in a manner that is straightforward to understand and remember. There are a variety of technologies available that a DC service can choose to implement which vary on how much they cost, depending on the level of information they can provide and what is required for training, operation, and maintenance. There is no one size fits all approach to technology. Each technology has its strengths and weaknesses, and often one technology complements another. *This section is here to give some examples of some of the technologies being used in Canada for drug checking right now. This is NOT an exhaustive list.*

Fentanyl Test Strips from BTNX — Image courtesy of BTNX

Tier 1 Technologies

These technologies provide yes or no answers as to whether or not the presumed substance is present. These technologies are considered basic compared to Tier 2 or Tier 3 technologies. They are low barrier, inexpensive, and relatively simple to be trained to use for service providers and PWUD testing their own drugs at home. To identify multiple ingredients and to quantify, Tier 1 technologies are combined with higher tier technologies.

Immunoassay Test Strips
(includes fentanyl, benzo, LSD, ketamine and others)
These single-use **immunoassay** strips test a small amount of substance dissolved in water. They are fast, simple and portable. They give binary results (yes/no) and are NOT quantitative. However fentanyl strip tests are VERY sensitive to the presence of fentanyl. They can detect trace amounts of fentanyl, and are more sensitive than Tier 2 technologies. These strips have simple procedures to learn, and it takes under one minute to perform the test. They cost $1–3 per test.

Fentanyl strip tests can detect fentanyl down to 20 ng/mL but >2 mg/mL of amphetamines (meth, MDMA, MDA, diphenhydramine) can trigger false positives (Lockwood 2021). When testing substances in which fentanyl is not expected (e.g., ketamine, cocaine, MDMA, methamphetamine), no matter the concentration of fentanyl present, a positive result is critical information. Although fentanyl strip tests can detect some fentanyl **analogues**, they are not sensitive enough to detect carfentanil in most cases.

Benzo strip tests are useful for confirming the presence of benzos in Xanax® tablets and opioids-down. Benzo strips can detect benzos down to 200 ng/mL, however false negatives are common, as benzos are not very soluble in water and some benzo-like analogues do not

PRO TIP

It is important to note that fentanyl test strips are VERY sensitive to the presence of fentanyl, and are a cheap and effective way to screen for fentanyl adulteration in non-opioid samples such as MDMA, ketamine, cocaine and methamphetamine..

trigger the strip and they are not always detected. It is important to note that benzo test strips procedures vary slightly from fentanyl test strips.

Please see the Procedures section of this manual for instructions to use both fentanyl and benzo strip tests.

Note: there are a variety of companies that sell test strips, however, not all of them perform the same. Be sure to research which companies' strips have been studied and validated.

Reagent / Colorimetric Testing
Reagents test substances by dropping a few drops of liquid reagent onto a pinhead size amount of sample, which makes the liquid change colour due to a chemical reaction between the reagent and the sample. To interpret the result, compare these colour changes to a reference table. This technology requires relatively little training due to simple easy-to-follow protocols. It should be noted that reagents contain potentially harmful chemicals like sulphuric acid, hydrochloric acid, and formaldehyde. Gloves, ceramic wells and careful technique are required. This technique is destructive, fast, simple, portable, takes under 5 minutes and costs under $0.50 per test.

It should be strongly noted that reagents are the least sensitive of all techniques. This test is qualitative, which can lead to subjective interpretations. They are easily thrown off by mixtures, lack definitive confirmations, and cannot pick out multiple ingredients. This technique can be useful to identify MDMA, MDA, LSD, and GHB. However they are not accurate for identifying cocaine or opioids like fentanyl.

It is important for the drug checkers to understand which reagents to use for which substances, and how to interpret the results and the limitations of the technology. For more info on reagent testing including procedures, colour mappings, and testing flow see Dance Safe's testing instructions and Drug Checking at Music Festivals: A How-To Guide.

A variety of reagents including Marquis, Mecke, Simon A, Simon B and Mandelin — Image courtesy of Dancesafe

Tier 2 Technologies

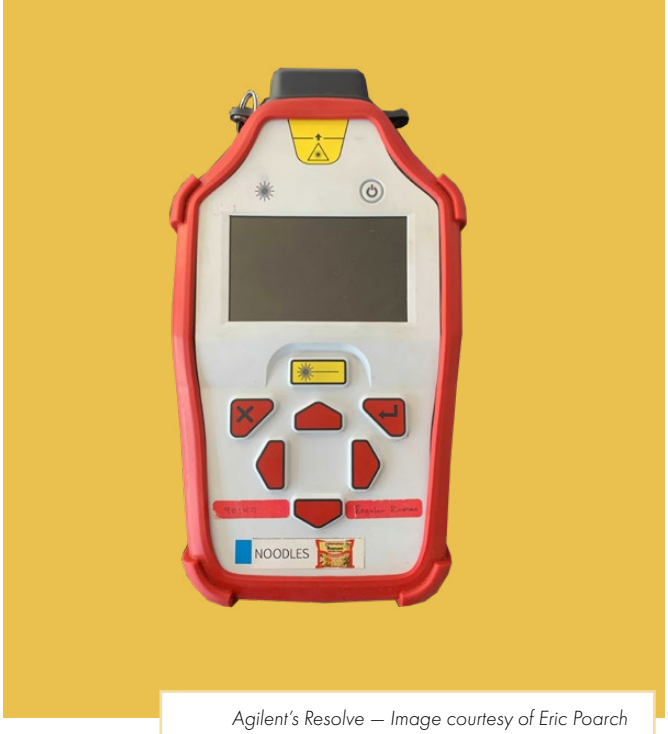
Tier 2 technology provides much more utility to a DC service over simply using Tier 1 technology because this tier can accurately identify multiple major ingredients in a sample, can identify multiple minor ingredients in concentrations greater than about 5% (for the FTIR), and can give approximate quantifications. Tier 2 technologies are not sensitive enough to reliably detect highly potent actives like etizolam, carfentanil and some other fentanyl analogues when heavily diluted such as in a pill or in a mixture. Being connected to a Tier 3 technology for **further analysis** can allow for a more complete picture of the substance, especially if testing opioid-down.

Fourier Transform Infrared (FTIR) Spectrometer
FTIR spectroscopy gives a spectral readout based on infrared light absorption from a sample. This spectrum is then compared against a library of known substances to identify the unknown component. It is able to identify multiple ingredients from a single spectrum. Moderate training on the instrument is required to be able to interpret the results accurately. A trained technician can reliably and accurately identify major ingredients, and give results in about 5 minutes. The cost of this technology is about $40,000 for the instrument plus $10,000 – $20,000 for the necessary libraries and software. Is non-destructive.

This technology can give rough proportionate estimates of mixtures (e.g., this cocaine is cut with one third benzocaine, or the methamphetamine contains one quarter MSM). Although quantitative models are available, due to the considerable margin of error, results must be reported out in a range — e.g., fentanyl present in a concentration between 8 and 13%. FTIR spectrometry is unable to detect trace ingredients (<5%), which can be problematic for substances like opioids-down.

This technology is quite versatile when paired with strip tests, and has been the choice of many DC services in BC and across Canada, the United States and the United Kingdom in both festival and community settings. With proper training, people with no formal chemistry education may be able to operate on this instrument.

Bruker's ALPHA II — Image courtesy of Julie-Soleil Meeson



Agilent's Resolve — Image courtesy of Eric Poarch

Raman Spectrometer +/- Surface Enhanced Raman Spectroscopy (SERS)
Raman spectroscopy involves shining a laser on a substance and collecting the scattered light which provides a chemical signature. This spectra is then compared against a library of known spectra to determine the identity of the substance. This technology is non-destructive and requires simple instrument operation required to get accurate readings of major ingredients and fentanyl in concentrations higher than 5% (Gozdzialski 2021). Raman can also detect etizolam in opioid-down samples (Gozdzialski 2022). Currently, there is limited software for drug checking purposes which does not allow for further analysis and determining multiple ingredients. Another limitation of this technology is that it cannot analyze opioids and dark coloured samples reliably.

Surface Enhanced Raman Spectroscopy (SERS) is a technique used to increase the ability of Raman to detect and analyze opioids. The technique involves preparing the substance in a solution before analyzing it. This technique is destructive to the substance.

Raman spectroscopy (+/- SERS) has potential to be a low cost and accurate method for DC but needs further development for this purpose.

PORTRAIT
Technology at Shambhala Music Festival

At Shambhala Music Festival 2019, ANKORS DC service had five testing stations which used fentanyl, benzo and LSD test strips and FTIR spectrometers as the Tier 1 and Tier 2 technologies, respectively. Each station consisted of a harm reduction (HR) worker and a technician, who as a team tested the sample and provided results. All points of care testing was done with the service user in attendance. People loved being a part of science and wanted to learn everything they could about how it worked while the testing event happened. ANKORS offered on-site Tier 3 testing using a more sensitive technique for samples that were difficult to identify. In 2019, ANKORS had access to Perkin Elmer's portable GC-MS Torion T-9, with the University of Victoria's team running it. Samples could be sent away for off-site further analysis using GC-MS, LC-MS (liquid chromatography-mass spectrometry) and/or qNMR (quantitative nuclear magnetic resonance) through Health Canada's Drug Analysis Service (DAS), with results provided in two weeks. This DC project has become a place where new DC technologies can be trialed out in the field for a variety of non-opioid samples, as ANKORS tests around 3,000 samples annually over the five-day festival.

ANKORS Drug Checking Tent, Shambhala Music Festival 2021 — Image courtesy of Chlöe Sage

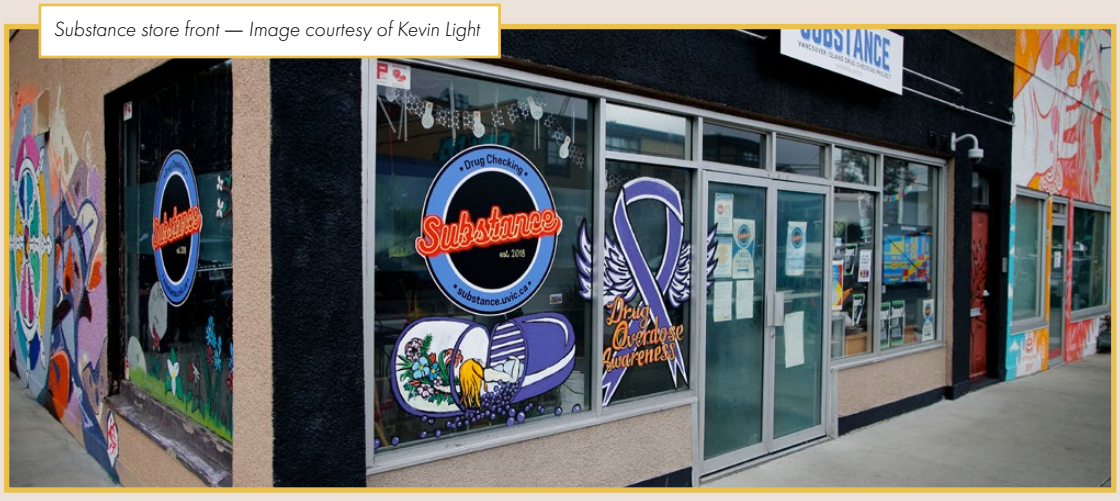
PORTRAIT

Vancouver Island Drug Checking Project — Substance

The University of Victoria has established the Vancouver Island Drug Checking Project which is a collaboration between the Departments of Social Work, Chemistry and Computer Sciences.

This project is unique in that it undertakes research and provides DC services to the community. The project has been integrated within Overdose Prevention Sites (OPSs) and offers DC services to the general public six days a week. The unique mashup of disciplines has allowed for expanding research into the area of DC, as well as the development of DC tools such as **electronic data capturing software** and fentanyl quantitative models for Fourier-Transform Infrared (FTIR) spectroscopy. The instruments used in this project are fentanyl and benzodiazepine strip tests, FTIR, Raman spectroscopy and Surface-Enhanced Raman Spectroscopy (SERS). In addition to this, Substance has worked in collaboration with Dr. Chris Gill and his team at Vancouver Island University to run samples on their **method** for Paper Spray-Mass Spectrometry (PS-MS) called HarmCheck. This has led drug checkers to more accurately quantify fentanyl and carfentanil, as well as benzodiazepines such as etizolam. Visit the Substance blog to learn more about this collaboration and to read the project's monthly reports, and visit their Research section to see a current list of publications. The plethora of instruments is unique in Canada, and future method development and analytical comparisons will inform decisions of drug checkers across Canada and the world.

This project has also launched their DC community of practice called Community of Substance, which hosts the BCCSU's technical training on using the FTIR and OPUS software. It also hosts DC tools and resources.



Substance store front — Image courtesy of Kevin Light

Tier 3 Technologies

Tier 3 technologies provide the highest level of analysis. These technologies can detect and quantify multiple ingredients in a sample at much lower concentrations than Tier 2 technologies. Due to their considerable technical and financial barriers, these technologies are generally reserved for laboratories. Tier 3 technologies are often used for further analysis for other DC services. Having access to these technologies in the community provides an extra layer of information that can be relayed to the service user. The distributed model of drug checking is a great way to increase the reach of Tier 3 instruments (Wallace 2022).

When testing opioids-down, Tier 3 technologies offer much more utility than Tier 2 technologies for identifying trace contaminants such as xylazine, fentanyl analogues, nitazenes, and various benzodiazepines. The accuracy of the quantification methods of these technologies is the only way to accurately report the concentrations of the ingredients in opioid-down as well as in complex mixtures.

e.g., mass spectrometers (PS-MS, GC-MS, LC-MS), HPLC, qNMR

Paper Spray Mass Spectrometry (PS-MS)

Liquid chromatography-mass spectrometry (LC-MS) and gas chromatography-mass spectrometry (GC-MS) use liquid or gas phase respectively to **chromatographically** separate the sample into its individual components. PSMS takes a reading from the **bulk mixture**. First, the sample is dissolved in a **solvent** containing an **internal standard** and dropped onto a piece of filter paper. It is because of the internal standard that highly accurate qualifications are possible. High voltage is applied to the paper, producing a spray of charged droplets that **ionize** target molecules allowing transport into the vacuum system of the mass spectrometer. A report from the mass spectrometer is then generated for the technician to verify.

A paper spray mass spectrometer — Image courtesy of Jarred Aasen

Quantification requires calibration of a given substance and many substances are quantifiable to a limit of >1% by mass. Able to undergo non-targeted analysis which allows the identification of previously unknown substances. Methods are developed for opioids-down that can quantify the amount of fentanyl, carfentanil and benzos present within a sample.

Examples of detection ranges are as follows:

- 0.06% – 80% fentanyl (>80% is reported as HIGH)
- 0.05% – 10% carfentanil (>10% is reported as HIGH)
- 0.2%-25% etizolam (>25% is reported as HIGH)

PSMS is a large immobile benchtop instrument that costs about $300,000-$400,000. Similar to other mass spectrometry technology, a highly trained technician is required for technical oversight, including troubleshooting and maintenance to ensure its proper functioning. Methods for this technology are being developed so that sample preparation and running of samples can be done by a lightly trained technician, making it possible for greater community uptake.

PORTRAIT

Toronto's Drug Checking Service

Toronto's Drug Checking Service is a community-based public health service coordinated by the Centre on Drug Policy Evaluation at St. Michael's Hospital in Toronto.

Launched in October 2019, and offering off-site drug checking, Toronto's Drug Checking Service is free and anonymous and offers people who use drugs timely and detailed information on the contents of their drugs, helping them to make more informed decisions.

Samples, which could include a small amount of a substance or drug equipment after it has been used, are collected at five community health agencies offering supervised consumption in downtown Toronto. Five days per week, samples are transported by bike courier to a nearby clinical laboratory where they are analyzed using gas chromatography- or liquid chromatography-mass spectrometry. Results are returned to the community health agency that collected the sample within a day or two and communicated to service users, along with tailored harm reduction support, guidance, and referral to services. Results include which drugs are found in each sample and some information about how much of each drug is present.

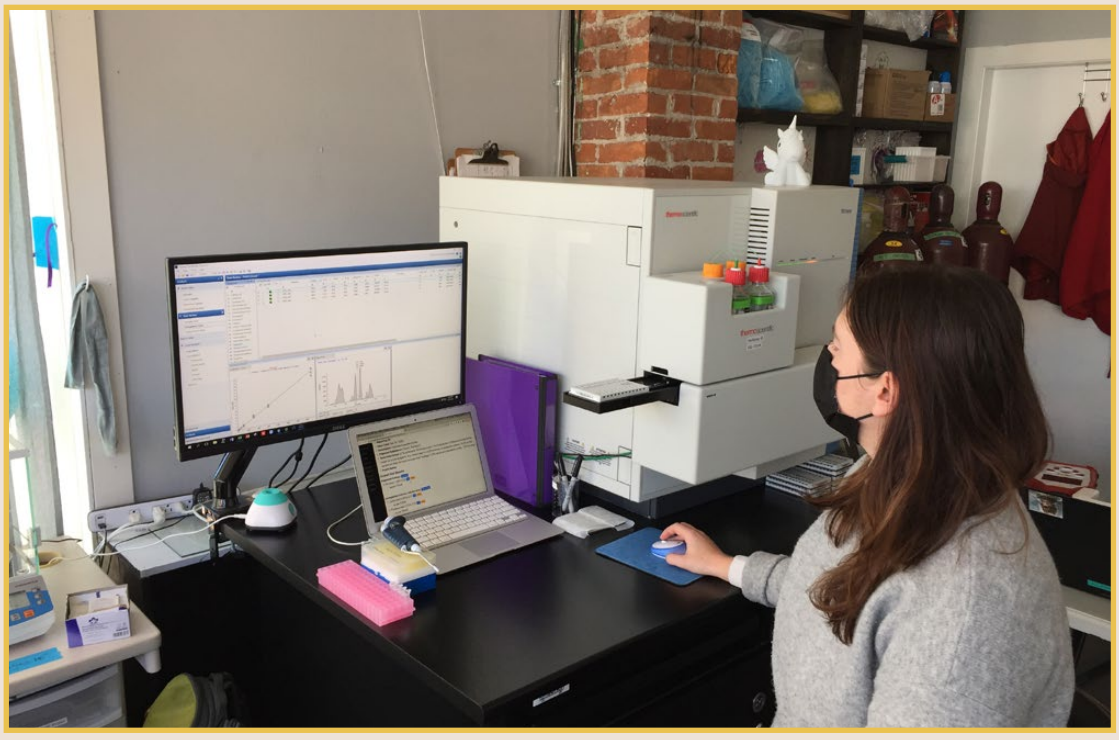
The strengths of the technologies used by Toronto's Drug Checking Service are their ability to: (1) detect rare drugs, "new" drugs, and drugs in very trace amounts, (2) break apart the most complex drug mixtures and differentiate between drugs that are chemically similar but may produce very different effects, and (3) determine exactly how much of a drug is present in a sample by applying a quantification method.

Beyond informing individual service users, the program combines results from samples checked and shares drug market trends and information in a timely and public way to inform care and advocate for services and safer alternatives for people who use drugs.

PORTRAIT

HarmCheck — Paper Spray-Mass Spectrometry (PS-MS)

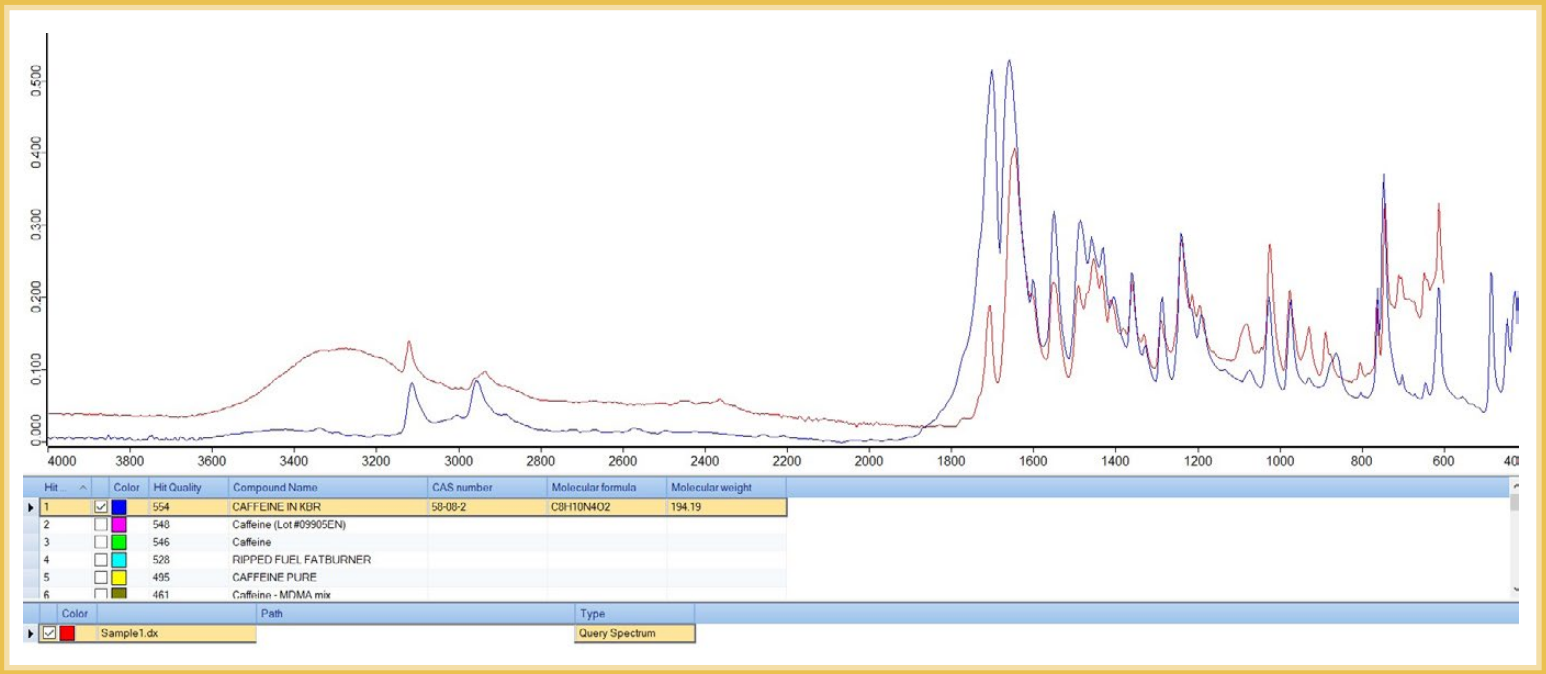
Mass spectrometry is one of the most sensitive and broadly utilized chemical measurement techniques available to scientists today. It is used in diverse applications ranging from environmental monitoring, space exploration, forensics testing, clinical diagnostics, and drug checking. In 2016, Dr. Chris Gill at Vancouver Island University began developing a rapid, high sensitivity, quantitative drug checking technique suitable for on-site use in drug checking. The technique, called 'HarmCheck', utilizes PS-MS, providing test results for tiny (1 mg) samples in minutes, including the quantitative analysis of up to 300 substances.



The PS-MS instrument named 'Matilda' in action at Substance — Image courtesy of Chris Gill

Dr. Gill has been a relentless advocate for PS-MS, since he first publicly shared its potential at the BCCSU organized Drug Checking Partner meeting in Richmond, BC (2018). In August 2019, the first real drug samples were collected and tested using PS-MS on-site at Powell Street Getaway in Vancouver's Downtown Eastside to further develop its methods. In late 2020, he and his team at VIU began checking samples at Lantern Services with the help of the Vancouver Island Drug Checking Project (Drs. Bruce Wallace and Dennis Hore). By the fall of 2021, over 2,000 samples had been checked at Lantern Services, which helped improve and refine the instrument's methods as well as provide detailed information regarding the composition and variability of the street drug supply.

Now, in strong collaboration with the Vancouver Island Drug Checking Project, a dedicated PS-MS HarmCheck system (nicknamed 'Matilda') is being operated on a full-time basis at Substance. It offers on-site, rapid drug checking in downtown Victoria, BC. PS-MS drug checking can clearly quantify the ingredients of drugs at high sensitivity (<0.01%) as well as confirm the identity of new toxics and diluents as they circulate in the drug supply. Currently, the methods are targeted towards opioids-down and can quantify fentanyl (and analogues including carfentanil), benzos (including etizolam) and various other ingredients (such as nitazenes and heroin). The quantitative nature of the technique has led to a higher fidelity of information relayed to both the individual service users and the greater community through the aggregated results. Read more about this instrument, and the ongoing research partnership between VIU and UVic here.



An FTIR spectra showing the sample spectra (red) matching with the library spectra (blue) — Image courtesy of Jarred Aasen

BINARY, QUALITATIVE, SEMI-QUANTITATIVE AND QUANTITATIVE RESULTS

There are various technologies that can be used to identify (qualitative) what substance(s) are in an unknown sample, and some can even give information on how much (quantitative) of a substance is present. The next section will look at the different types of results that can be produced with DC.

Binary results give a clear yes or no answer to the presence of a specific type of ingredient in the substance (e.g., fentanyl strip test), but do not give information on how much is present or to what exactly is that specific ingredient. Test strips only test for types of drugs and not unique individual substances.

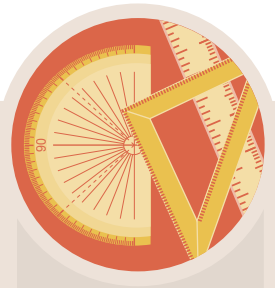
Qualitative results *identify* the contents of a substance using observable features. Qualitative means an observable quality of the substance (e.g., appearance of pharmaceutical tablets or smell of dimethyltryptamine (DMT) when burning). Reagent testing, also called colorimetric testing, gives qualitative information because it requires the technician to interpret the colour change of the reagent when mixed with the substance. It could be said that FTIR is also a qualitative method, as it simply compares a sample spectra to a library spectra.

Spectrum subtraction can be used to identify multiple single ingredients within a sample. Qualitative identification does not provide any information on the amount of various ingredients present in a sample.

Semi-quantitative results give rough approximations on how much of a substance is present in a sample using semi-quantitative models. Although currently implemented, semi-quantitative FTIR models are not accurate to the exact percentage point, they do give a good approximation of concentrations. Two examples of semi-quantitative models are Bruker's mixture analysis or Quant 2 model on their FTIR OPUS software. When reporting mixture analysis results, it is better to round to the nearest quarter, third, or half proportion. For example, if a cocaine sample tested 72% cocaine and 28% benzocaine (a topical anesthetic used as a diluent), then it should be reported as roughly three quarters cocaine and one quarter benzocaine. Semi-quantitative models with the FTIR can give approximate fentanyl concentrations within a range (e.g., 5-10%). Raman spectroscopy is also capable of providing semi-quantitative results.

Quantitative results give highly accurate information on how much of a substance is present in a sample. This includes technologies such as quantitative nuclear magnetic resonance (qNMR) used in Health Canada's DAS labs. Other quantitative technologies include liquid chromatography-mass spectrometry and paper spray-mass spectrometry. These technologies can quantify opioid-down to a decimal of a percentage (e.g., 0.1%). Quantitative results are usually reported as a relative percent of the overall substance by weight (w/w). For more information on quantifying fentanyl specifically, check out the Testing Fentanyl section.

Quantitative nuclear magnetic resonance instrument at Drug Analysis Service (Vancouver Laboratory) — Image courtesy of Jarred Aasen



TOOLS

- For a great introduction on how various drug checking technologies work, as well as other useful educational handouts and tools visit Community of Substance.

- Borden, S., Saatchi, A., Vandergrift, G.W., Palaty, J., Lysyshyn, M., & Gill, C.G. (2022). A new quantitative drug checking technology for harm reduction: Pilot study in Vancouver, Canada using paper spray mass spectrometry. *Drug and Alcohol Review, 41*(2):410-418.

- BCCSU (2021). Fentanyl Quantification and Messaging and Fentanyl Quantification Procedures.

- Gozdzialski, L., Ramsey, M., Larnder, A., Wallace, B., & Hore, D.K. (2021). Fentanyl detection and quantification using portable Raman spectroscopy in community drug checking. *Journal of Raman Spectroscopy*, *52(7)*.

- Ramsay, M., Gozdzialski, L., Larnder, A., Wallace, B., & Hore, D.K. (2021). Fentanyl quantification using portable infrared absorption spectroscopy. A framework for community drug checking. *Vibrational Spectroscopy, 114(103243)*.

- Tobias, S., Grant, CJ., Laing, R., Arredondo, J., Lysyshyn, M., Buxton, J., Tupper, K., Wood, E., & Ti, L. (2021). Time-series analysis of fentanyl concentration in the unregulated opioid drug supply in a Canadian setting. *American Journal of Epidemiology, 191(2)*.

Case Study

Testing Opioid-Down Samples Using Four Different Techniques

Someone brings in a sample of opioid-down into a DC service. This sample is tested using four different techniques:

A. Using strip tests to give a binary result

B. Using FTIR to give a qualitative result

C. Using FTIR to give a semi-quantitative result

D. Using PS-MS to give a quantitative result

Follow the diagram on the next page to see what information is gained from each technique. The text below gives further information of what a service provider CAN and CANNOT say about the opioid-down sample based on the technique used.

A) **Tier 1 — Strip Test Results (binary)** — when testing the opioid-down sample, both the fentanyl and benzo strip test come back positive.

- **A DC service provider CAN say** — this opioid-down sample contains both fentanyl AND a benzodiazepine
- **A DC service provider CANNOT say**— which fentanyl or benzo analogue is present, and cannot comment on their concentrations.

B) **Tier 2 — FTIR Results (qualitative)** — using spectrum subtraction, caffeine is found as the first ingredient, and fentanyl is found as the second ingredient.

- **A DC service provider CAN say** — this opioid-down sample contains caffeine as the diluent, and fentanyl appears to be present in a concentration greater than 5%. We know this because the **limit of detection** for FTIR is 5%, so if we can identify an ingredient on FTIR, it is at a concentration above 5%.
- **A DC service provider CANNOT say** — which exact fentanyl analogue is present, nor guess at the potency other than saying it is greater than 5%.

C) **Tier 2 — FTIR Results (semi-quantitative)** — after using spectrum subtraction (see above) the sample spectrum is analyzed with the semi-quantitative models such as mixture analysis or Quant-2. It is found that the concentration of fentanyl appears to be in the 8 and12% range.

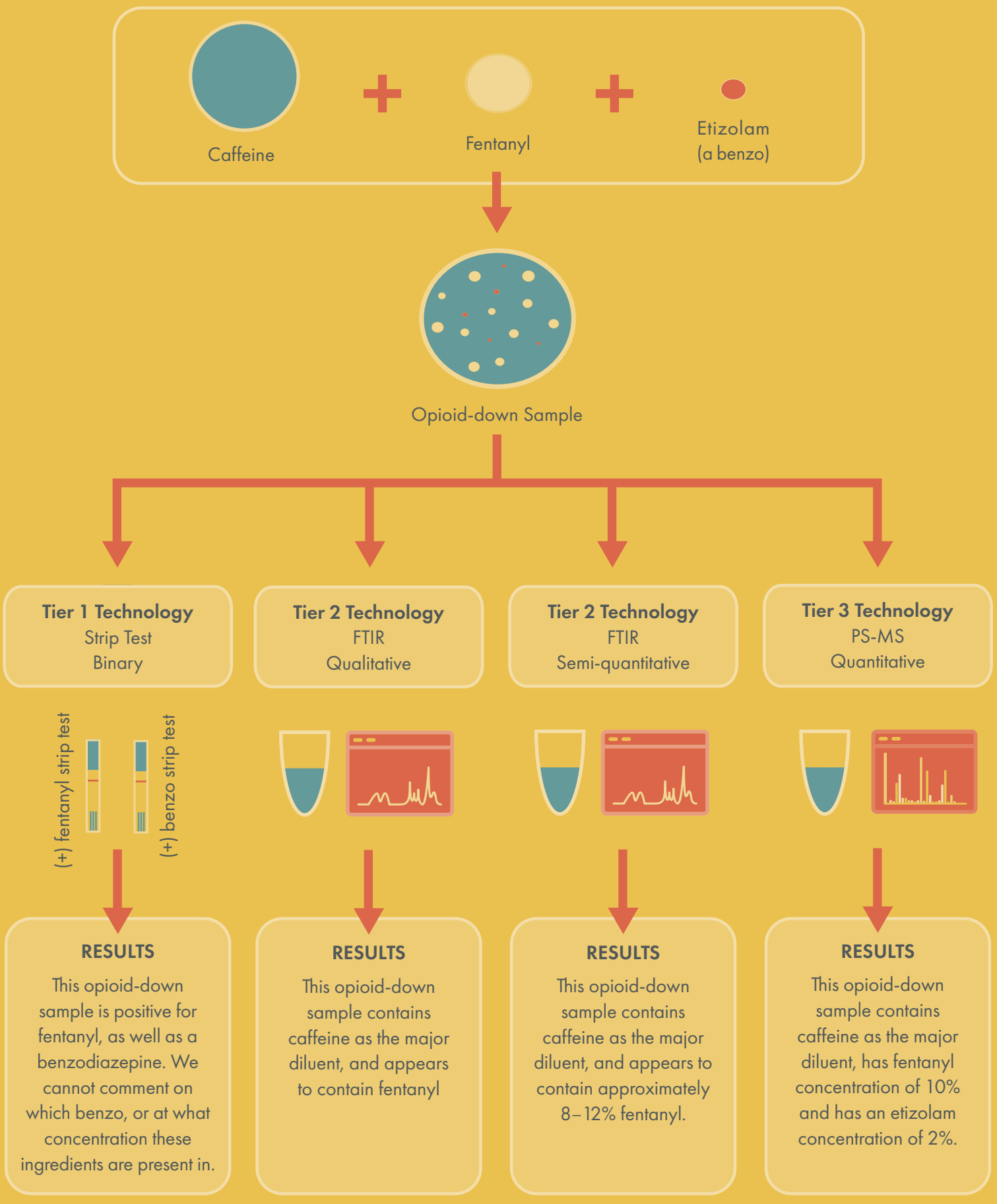
- **A DC service provider CAN say** — this opioid-down sample contains caffeine as the diluent, and according to the semi-quantitative models, fentanyl appears to be present in a concentration between 8 and12%.
- **A DC service provider CANNOT say** — that the exact concentration is known and give an exact number.

D) **Tier 3 — PS-MS Results (quantitative)** — caffeine is the diluent, fentanyl is present at a concentration of 10% and etizolam is present at a concentration of 2%.

- **A DC service provider CAN say** — this opioid-down sample contains caffeine as the diluent, fentanyl appears to be present in a concentration of 10% and etizolam was found at a concentration of 2%.
- **A DC service provider CANNOT say** — the results apply to the rest of the baggie beyond the specific portion of the substance that was tested. This applies to all tiers, unless the contents of the entire baggie are truly analyzed.

FIGURE 1: BINARY, QUALITATIVE, SEMI-QUANTITATIVE AND QUANTITATIVE RESULTS

Source: Jarred Aasen



Julie-Soleil is the harm reduction worker and Jarred is the technician in the ANKORS DC site at Shambhala Music Festival 2018 — Image courtesy of Tavi Parusel

TESTING FLOW

The previous section provided information and considerations on selecting an appropriate technology for a service. It also included a variety of portraits highlighting these technologies, as well as defining important terminology such as binary, qualitative, semi-qualitative and quantitative. This section will look at the flow of testing, which includes intake, testing, and results. Appropriate practices for handling samples — in-person samples for immediate results, drop-off samples and mail-in samples — and disposal of samples is also included.

Testing flow can be organized into three steps: first the sample is received by the DC service (intake), next the sample contents are analyzed (testing) and lastly the results are relayed back to the service user (results).

Note: some DC services will have one person perform the duties of both harm reduction worker and technician.

Please note: Ensure the DC service has the correct legal exemptions in place for handling, collection, storage, and transport of samples. These exemptions are critical to utilise further analysis. Please refer to the Legal Considerations Within Drug Checking section of *Chapter 2: Drug Checking: Implementation of Services*.

PRO TIP

When promoting the service for a fixed site, ask individuals to bring in only a very small sample to check; about the size of a match head and leave the rest at home if possible. Offer service users small baggies to put the sample.

03 STEPS OF TESTING FLOW

01.
INTAKE

The harm reduction worker will interact with the service user to receive the sample, review the disclaimer, obtain research consent (if applicable), and explain the technology and its limitations. Intake includes completing the data collection form (which can be entered into the electronic data capture software), correctly labeling the sample, and ensuring the service user can access their results.

02.
TESTING

The technician will perform the relevant tests on the sample, following accepted protocols and procedures to ensure accuracy and consistency of results. The results, including the overall interpretation, are entered into the electronic data capture software if available. The remaining sample is then given back to the service user or discarded.

03.
RESULTS

Once the analysis of the substance has been completed, these results are then disclosed to the service user, along with the appropriate harm reduction messaging and safer use supplies. Results could also be accessible remotely by the service user online or over the phone.

1. INTAKE

When somebody comes to service, they are greeted by DC staff. Once the person indicates they would like DC services, the intake process begins so the sample can be subsequently tested. In a DC service with both a HRW and technician, the HRW will handle most of these tasks:

- **Sample is given to DC staff** — this includes in-person, mail-in or drop-off.
- **Explain the overall process of testing** — this includes DC options (point of care, off-site, drop-off) and the time frame for results.
- **Review specific aspects of the DC service with the service user** — this includes reviewing the DC disclaimer (see *Chapter 2: Implementation of Services*: Appendix 1: Disclaimer) with the service user, explaining what technology is available and explaining their limitations, and getting consent for research (if applicable).
- **Complete data collection for sample** — ensure anonymous data collection sheet is completed and entered into online data capture software (see *Chapter 2: Drug Checking: Implementation of Services* Appendix 2A and 2B for example data collection sheets)
  - As substance use is currently criminalized, no personally identifying information will be recorded.
- **Ask the person checking the substance if they have tried the substance yet, and if so, what their experience with it was.** The service user can be asked if they found their substance stronger or weaker than usual, or if there were any unusual effects. **User experience can help the technician look for information on the results that may not have been otherwise noticed. Asking these questions can help piece together a picture of what components might be in there.**

  For example, if an expected fentanyl sample tests negative with the fentanyl test strip but the participant said it was really strong, this could mean a potent fentanyl analogue or an undetectable active ingredient is present and further analysis would be needed to confirm. Similarly, if the service user had hallucinations on a substance that was not a psychedelic, it could mean the presence of synthetic cannabinoids. If the service user felt extremely sleepy, it could mean that a sedative is present.
- **Correctly label samples and associate it with a unique sample code** — see Labeling Sample section for further information.
- **Ensure service users can access their results** — if the service user will return at a later time to get their results, or access their results remotely, HRW will give the service user a raffle ticket, or QR code.

Disclaimer and Limitations

A disclaimer is a key piece of a DC service (see *Chapter 2: Drug Checking: Implementation of Services* Appendix 1: Disclaimer). This disclaimer should acknowledge the limitations inherent to DC itself as well as the limitations of the specific technologies utilized. An inherent limitation of DC is that the results only apply to the specific portion of the substance that was tested. DC also acknowledges that substance use carries inherent risk and having a substance checked does not necessarily guarantee safety. **Have a clear description of what the service and the technology can and cannot provide, and clearly define its limitations.** It is a good idea to have the disclaimer printed and clearly posted. Go over the disclaimer with each person before DC, clarify the main points, and ask if they understand what it means. Keep in mind that some people may speak a different language, have trouble reading, or may not read at all. Have the disclaimer printed in more than one language. and clarify the main points.

Note: Chapter 1: Creating Safer Spaces with Harm Reduction in Drug Checking Settings gives information on how to structure a DC service and interact with service users in a way that makes them feel comfortable.

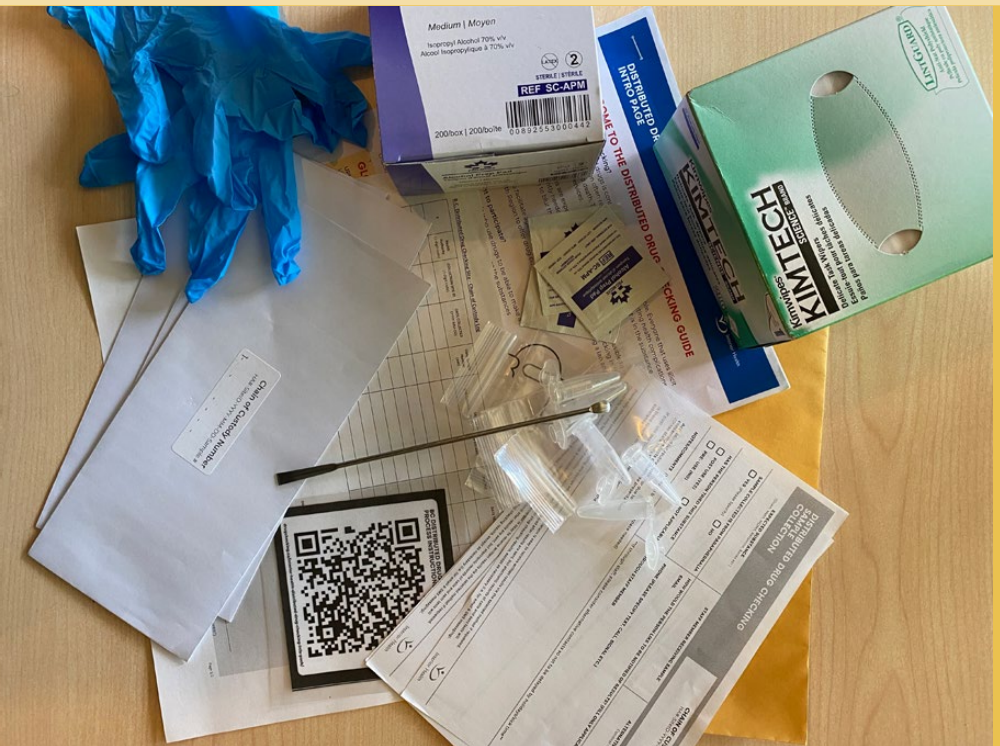
FIGURE 2: TEMPLATE FOR LABELING SAMPLES

Handling Samples

Having a standard way of intaking and handling samples is critical to reduce the chances of a sample mixup. For depositing the sample, the HRW can instruct the service user to deposit a small amount of sample needed for testing in a clean vessel that is labelled appropriately (see Labeling Samples section). Provide a clean metal spatula or disposable wooden stick for the service user to manipulate their sample. Discourage the use of handling the substance with their hands to avoid contamination of the sample. If a service user brings a large quantity of a substance, or the substance has different coloured or textured sections, it is a good idea to mix the contents of the bag thoroughly before sampling. Consider taking multiple samples throughout the baggie as there can be variation within the baggie itself. The technician will then move the sample onto the sensor.

Labeling Samples

It may be possible that the DC service will manage multiple samples and service users at one time, or collect a sample for later analysis. It is critical to have accurate and legible labeling so that the correct result can be given back to the correct individual. A common system is the two-digit sample code system, X–Y, where X is the service user number and Y is the sample number. For example, the first person on that day is 1. If they have three samples, then the sample codes will be 1–1, 1–2, and 1–3. If there was a sixth person testing 2 samples, the sample codes will be 6–1 and 6–2. **To keep people's anonymity, it is recommended not to take identifying information when labeling samples.** The diagram above adds the site and date information to the labeling. This can then be used as the sample's unique sample code.



Packaging and labeling samples for further analysis — Image courtesy of Antoine Marcheterre

PRO TIP

If testing in-person on FTIR with immediate results, have the service user place the sample on the instrument's sensor themselves. They may also retrieve the sample from the instrument when the testing is complete. This can reduce the handling of the sample by the technician.

Storage and Transport of Samples

Samples can be stored for analysis at a later time, **further analysis** or off-site testing. Common criteria for further analysis include: confirming a result, investigating adverse effects not explainable by current means of testing, quantification, uncertain result and no library match. To store samples, collect the minimum quantity needed, clearly label the sample and place it in a locked safe that is restricted to staff access.

When these samples need to be transported, clearly label them and secure them within two layers (e.g., a glass vial inside a tamper proof bag or a small baggie inside an envelope). If handing samples off to an organization for transport (e.g., bonded courier to transport for analysis), they require the samples to be clearly labelled and organized and must include a chain of custody log.

The chain of custody log for these samples should include information such as: dates, the individual releasing the samples (name, affiliation, and signature), the individual receiving the samples (name, affiliation, and signature), the number of samples being transferred, and ideally a log / printout of what samples are being transferred.

Canada Post does not condone sending controlled substances in the mail. That being said, there are DC services accepting samples in the mail. This means there are no guarantees that the sample will get to the DC service. It is recommended that people do not put a return address on the envelope. See the Mail-In section of *Chapter 2: Drug Checking: Implementation of Services* for a list of mail-in services.

2. TESTING

Once the sample has been properly received by the HR worker or technician and entered into the electronic data capture system, the technician will then perform the appropriate tests on the sample (see Testing Procedures sections for tips on testing specific substances). See the Technology section above for specifics on different technologies.

Sample Organization

If there are multiple samples to be tested, be diligent on not mixing up the samples. This includes keeping them in chronological order so that they are tested sequentially.

Manipulating a drug sample with clean equipment and gloves — Image courtesy of Kevin Light

Station Cleanliness

It is important to maintain a clean and organized working space to avoid cross contamination, which can lead to inaccurate results and confusion. Be sure to wipe down any surfaces with fresh alcohol wipes. **When cleaning the FTIR, wipe down the plate, anvil and sensor with an alcohol wipe. Then with a new alcohol wipe, clean the plate, anvil and sensor again. Dry with a fresh Kim Wipe.** Wipe down any tools used as well such as spatulas. Discard any contaminated disposable supplies, such as sample cups and vials. When working with samples, try to note which ones have touched what, and clean accordingly.

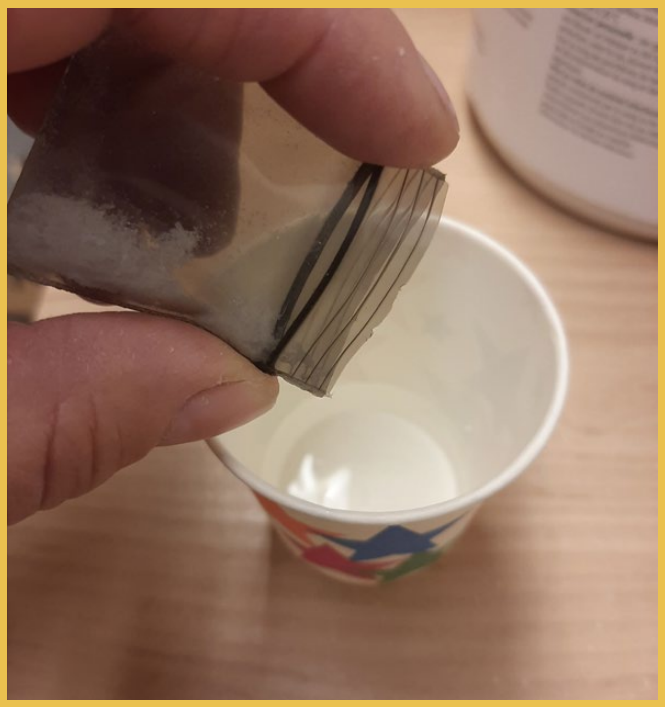
Disposal of Samples

Samples may be discarded as leftovers from testing, or service users may choose to dispose of the substance after it has been checked. It is important to have the appropriate protocols and supplies in place.

See Substance Disposal in the Legal Considerations section of *Chapter 2 Drug Checking: Implementation of Services* for more information on what Health Canada deems as appropriate sample disposal. Also see the following page for sample disposal protocols.

3. RESULTS

Once the analysis of the substance has been completed, these results are then disclosed to the service user, along with the appropriate harm reduction messaging. Remind the service user the limitations of the technologies used so a false sense of security is not conveyed. **Publicly displaying results that are of concern help to widen the reach to PWUD who could benefit from the results' information** (See *Chapter 4: Messaging Results in Drug Checking* for more information.)



Example of disposal process — Image courtesy of Chlöe Sage

PRO TIP

It is a good habit to always clean tools right after they are used. That way, if you get up and come back to your station, you know everything is clean and ready to be used.

SAMPLE DISPOSAL FOR DRUG CHECKING SITES

01.
DISSOLVE SAMPLE

All samples to be discarded are put into a disposable cup with water.

02.
SPOIL SAMPLE

Half fill a second disposable cup with clumping kitty litter.
Pour the water with the dissolved samples over the kitty litter.

03.
DISCARD SAMPLE

The discarded samples are now deemed "irretrievable" and are ready to be placed in the garbage.

These sample disposal protocols are in line with B.C's Standards for Distributed Drug Checking Sites and Health Canada

TOOLS

Distributed Drug Checking (DDC) or Urgent Public Health Needs Sites (UPHNS) designations

Antoine Marcheterre, Drug Checking Program Coordinator for Interior Health, has created an info pack of documents that gives detailed guidance to sites for registering and carrying out collection, storage, and transport of substances for the purpose of drug checking in the Interior Health region of British Columbia. These documents can be tweaked to work for other regions. The documents in this package include:

- What the distributed drug checking program (DDC) is and how a site can register.
- A summarized DDC process flow chart.
- A sampling process flow chart.
- A list of supplies a site needs to carry out collection, storage and transport of samples.
- A sample collection form.

See this webpage for the Interior Health documents made for UPHNS or DDC sample collection, storage and transport.

See the Legal Considerations Within Drug Checking section in *Chapter 2 Drug Checking: Implementation of Services* for a complete explanation of UPHNS and DDC designations.

Jarred Aasen testing a substance at Lantern Services in Victoria, BC — Image courtesy of Kevin Light

TESTING PROCEDURES

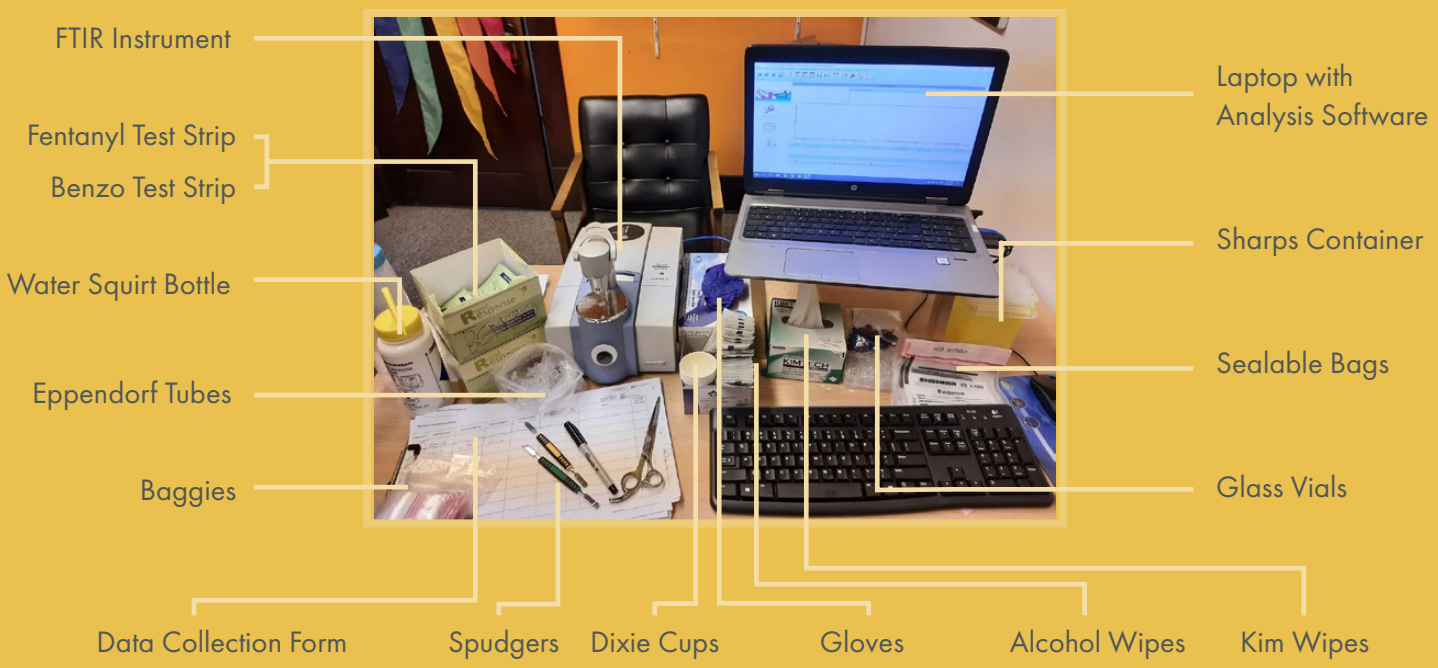
> **"With an FTIR and an open heart a lot can be done."**
>
> *Peter Moinichen*

The procedures section below is a compilation of some helpful hints from experienced technicians working in the field of DC. This section will focus on what supplies are needed to set up a workstation using an FTIR spectrometer with both fentanyl and benzo strip tests. It also gives some specific techniques for testing certain substances such as fentanyl, tablets, LSD, GHB, and detailed procedures for fentanyl and benzo test strips. Although this is not meant to be a technical guide to DC, by the end of this, the reader's technical knowledge should be expanded.

Chlöe Sage offers pop-up on-site drug checking with an FTIR at an Indigenous support organization in rural BC — Image courtesy of Chlöe Sage

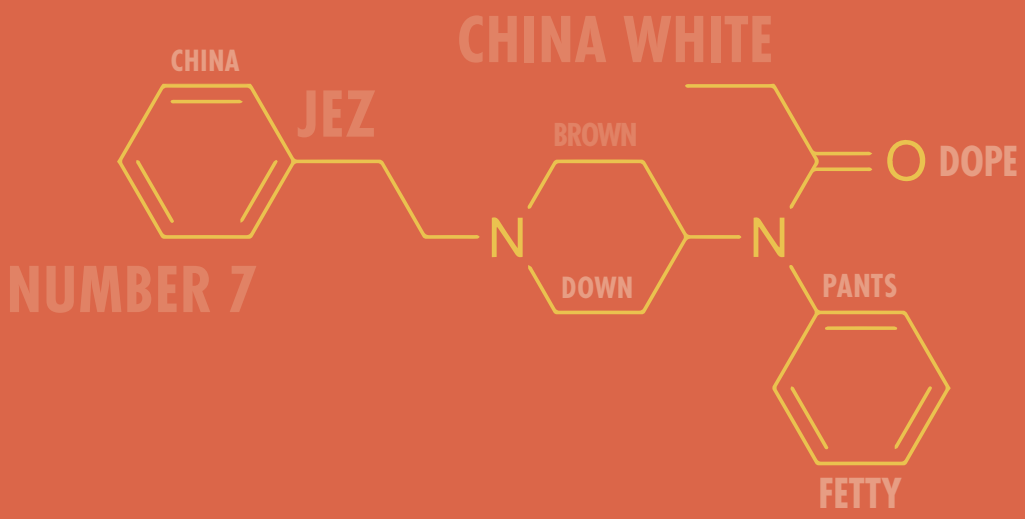
FIGURE 3: EXAMPLE WORK STATION

Source: Chlöe Sage



WORK STATION SUPPLIES

- ☐ Tech manuals and cheat sheets
- ☐ Data collection sheets
- ☐ Disclaimer
- ☐ Pens
- ☐ Nitrile or latex gloves
- ☐ 70% or higher alcohol wipes — to clean instrument and tools
- ☐ Kimtech™ wipes — a low lint non-abrasive wipe for drying cleaned surfaces
- ☐ Metal lab spatula or spudger — for manipulating samples
- ☐ Fentanyl / benzo / LSD test strips (ensure they are not expired)
- ☐ Dixie cups — small paper cups for testing for fentanyl
- ☐ 1.5mL to 2 mL microcentrifuge / eppendorf tubes — small snap top plastic tubes for benzo strip tests and sample storage
- ☐ Small 2" baggies — for people to put their drugs in, if needed
- ☐ Wash/squirt bottle or water bottle filled with tap water
- ☐ Sterile water ampoules — if not using tap water.
- ☐ Tweezers — for manipulating blotter paper
- ☐ Scissors with fine point — for cutting a corner of a blotter paper sample
- ☐ Micropipette or glass dropper — for extracting small amounts of liquid like methanol
- ☐ Methanol — for extractions (best kept in a tightly sealed container — see WHIMIS page for more information)
- ☐ Clumping kitty litter — for disposals (see Disposal section above)
- ☐ Container for clumping kitty litter — for disposals
- ☐ Vortexer — helps achieve proper dilution of sample in water using a microcentrifuge tube
- ☐ Mortar and pestle — double bag sample and crush it for fine powder
- ☐ Electric mug warmer — to keep wash/squirt bottle water warm for benzo strip testing



THE MANY NAMES OF FENTANYL

TESTING SUBSTANCES WITH AN FTIR

Sometimes, testing substances with an FTIR is as easy as putting the substance on the **sensor** and running the scan to confirm the identity of the single component (e.g., ketamine or cocaine). This section will look at several challenges:

- "The chocolate chip cookie effect" or **heterogeneous** or uneven mixtures.
- Testing samples with a low concentration of active ingredients within the **diluent** e.g., finding fentanyl in a caffeine dominated mixture.
- Finding the active ingredient in tablets (e.g., Xanax®) through extractions.
- Finding the active ingredient on blotter paper (e.g., LSD) through extractions.
- Testing liquids (e.g., GHB).

Testing Fentanyl

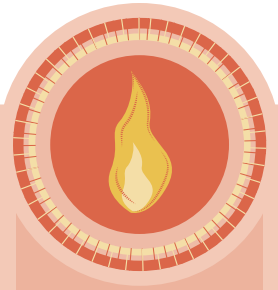
Fentanyl comes in many shapes (pebbles, powder, crumbs, pills or flakes) and colours (white, grey, brown, red, blue, yellow, and so on). Guessing the contents and potency of fentanyl is very inaccurate when done without any instrumentation (McCrae 2021).

See tools for BCCSU's Guidelines for Identifying Colours and Textures in tools.

Chocolate Chip Cookie Effect

Figure 4 gives a visual representation of how small concentrations of **active ingredients** can be distributed throughout the diluent. Let's take for example a sample of opioid-down which contains fentanyl and etizolam as the active ingredients and caffeine as the diluent.

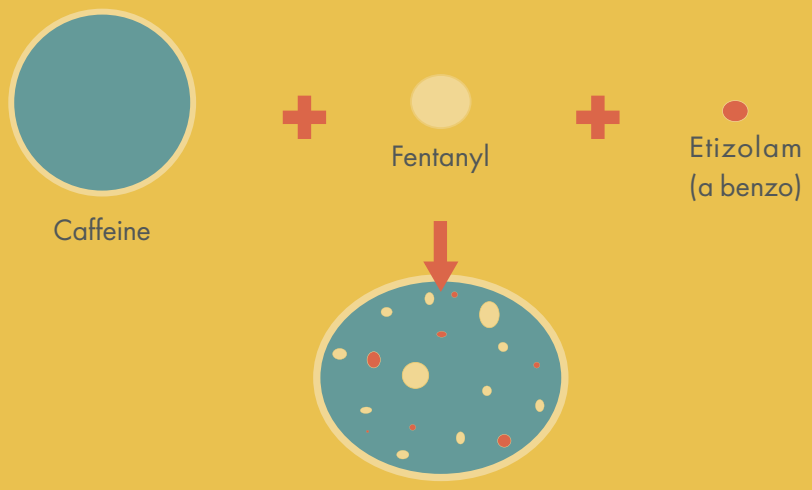
Fentanyl itself is a very potent opioid that as a single ingredient would lead to considerable dosing difficulties. Substances in quantities less than 10 mg are very difficult to manipulate, let alone accurately weigh.



PRO TIP

The same batch of fentanyl can be dyed many colours. In addition, there may be several batches of fentanyl with varying strength and contents dyed the same colour. **It is important not to infer the contents of fentanyl based on appearance alone.**

FIGURE 4: THE CHOCOLATE CHIP COOKIE EFFECT



A diluent, such as caffeine, can be used to evenly distribute a highly potent active ingredient (fentanyl). This allows for easier measurement of mixed substances. However, since fentanyl is being mixed in unregulated laboratories with improper techniques, it can lead to uneven distribution resulting in 'hot spots', or the '**chocolate chip cookie effect**'. This means, in some portions of the substance, there are parts with higher concentrations of active ingredients. The chocolate chip cookie effect has contributed to the high number of drug poisonings, as there can be considerable variation within a single sample. Although this heterogeneity has been reported by PWUD and observed by frontline drug checkers, this effect has only been reported anecdotally. With the current uptake in DC services and research groups, more formal research will be published in this area.

In order to get a representative sample from the substance being tested:

1. Crush the sample up to create a more **homogeneous** mixture before taking a sample to test.

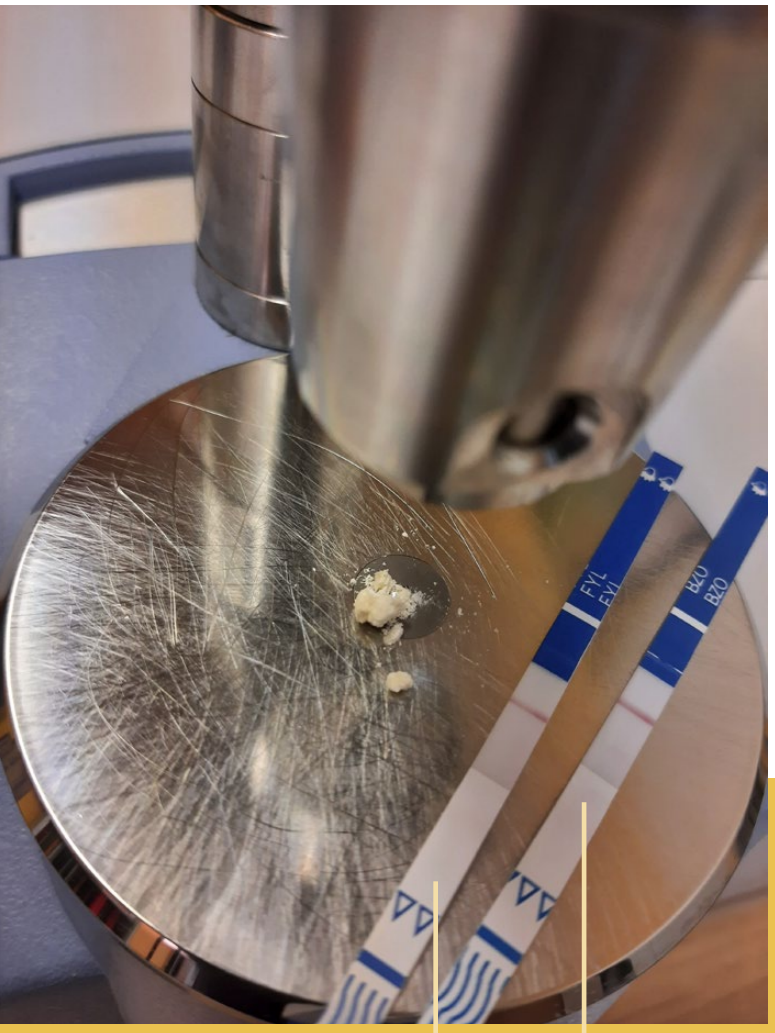
2. If visually **heterogeneous**, take samples from several different visually distinct areas in the baggie.

In Western Canada, caffeine is the most common diluent for fentanyl. Different regions have different diluents that are common. Sugar alcohols such as mannitol, inositol, xylitol, or erythritol can also be present. Fentanyl, the active component, is only a fraction of the overall composition. Fentanyl may not be detected by the FTIR at all if it has lower than approximately 5% concentration. As mentioned above, it is highly recommended to do a fentanyl test strip (see Fentanyl Test Strip Procedure section below) in conjunction with FTIR to detect the presence of fentanyl. Benzodiazepines, such as etizolam, are even harder to detect with the FTIR. It is recommended all opioid-down samples are paired with a benzo test strip. (See the Benzo Strip Test Procedure section below.) Benzos are commonly found in fentanyl samples in Canada (Scarfone 2022, CCENDU 2021).

When there are low concentrations of fentanyl, it is very difficult to obtain rough quantification with the FTIR. The mixture analysis function is NOT reliable with these mixtures as the percentage concentration is too low for an accurate estimation. Unfortunately, quantification is the answer most people seek when testing their fentanyl. Further method developments of quantitative analysis may lead us to be able to better

> **"The only thing 'purple' means is that your drug is coloured purple."**
>
> *Drug Checking Results September — December 2018, Sandy Hill Community Health Centre*

quantify with FTIR. The BCCSU has done a lot of work on FTIR quantification methods. If fentanyl is detectable by FTIR or if only the test strip is positive, that does not mean fentanyl is the only opioid present. It is important to always go over the disclaimer and limitations of the technologies with every DC service user and the risks and prevention measures as there could always be something harmful (e.g., carfentanil or another drug) present that is not detectable with the strip test.



Positive Fentanyl Test Strip

Positive Benzodiazapine Test Strip

Opioid-down sample tested on the FTIR in conjunction with both benzodiazepine and fentanyl test strips. The single band on both strips indicates positive results for both tests in this sample.
— Image courtesy of Chlöe Sage

Case Study

Testing opioid-down samples

A service user drops off a sample of opioid-down. It is grey and pebbled in appearance. The test strip results are positive for fentanyl and negative for benzos. According to the FTIR, the main ingredient is caffeine, with fentanyl as the top hit on subtraction. These results were reported to the service user. This sample was also sent off for further analysis via Health Canada's DAS labs. The results came back 10% fentanyl. Two weeks later, the service user came back for the detailed DAS labs results.

True or False: The service user can tell his friends that the rest of their opioid-down contains 10% fentanyl.

FALSE — There can be variation even within the same batch. The DC results only accurately apply to the small amount of substance tested.

True or False: A different service user comes in later that day with identical looking grey pebbled opioid-down and asks if it is "that 10% of stuff." You inform them that only testing the substance can tell what is in it.

TRUE — It is not accurate to identify a substance by appearance alone. There can be many different batches of the same colour.

Testing Xanax® and other tablets with low concentrations of active ingredients

When testing tablets with low concentrations of active ingredient on the FTIR, what is normally seen is simply the signal of the diluent (e.g., microcrystalline cellulose or starch) which will hide the active ingredient's signal. For example, a 2 mg Xanax® tablet has a total weight of approximately 250 mg. This means the amount of filler is 99% of the contents of the tablet. Some examples of tablets that contain low doses of active ingredients are Fake oxy's (oxycodone, fentanyl, or related), benzodiazepines, 2C–X (e.g., 2C–B, 2C–I, 2C–T–7), 4–HO–MET, 5–MeO–MiPT, or MeO–DiPT. To exclude the majority of this filler from the FTIR reading, a methanol extraction or alcohol wipe extraction can be performed.

Various illicitly made Xanax® bars — Image courtesy of Nic VCH

Methanol Extraction Procedure

This method is reliable, however it requires methanol, a pipette or micropipette and 1.5 mL centrifuge tubes for most accurate results. This procedure also requires considerable sample manipulation and time.

1. Crush a portion of the tablet into fine powder — as much as the service user is willing to spare, as it will not be retrievable. Deposit this finely crushed powder into a 1.5 mL centrifuge tube.

2. Using the pipette, withdraw a small amount of methanol (25–100 uL) and drop it into the 1.5 mL microcentrifuge tube. Shake the tube for 30 seconds to dissolve the sample in the methanol ideally using a vortexer to maximize agitation. Set the tube upright for a few minutes to allow the undissolved particles to settle to the bottom.

3. Ensure background measurement has been done on FTIR.

4. Using the pipette, withdraw from the top layer of liquid containing the methanol solution, and avoid the particles near the bottom of the tube. Drop one small drop of this solution onto the FTIR sensor. Too much liquid will spill over the edge of the sensor and take longer to dry. Allow the methanol to fully evaporate, a fan can help. *Do not place the FTIR anvil down.*

5. When methanol fully evaporates, it will leave behind a small film of the substance over the sensor, allowing for a low intensity reading that can then be interpreted. Another drop can be added to let dry again if the signal is too low.

Note: This technique is not guaranteed to work. Trying to use a minimal amount of methanol helps to concentrate the active ingredient in the upper liquid layer, thus increasing chances of having a usable signal. Not every drug is soluble in methanol, so there is a chance that this does not work at all.

PRO TIP

Never lower the FTIR anvil when testing liquids, as the FTIR can get a reading directly from liquids and lowering the anvil runs the risk of cracking the sensor.

LSD blotter paper — Image courtesy of /u/blotterart

Liquid GHB — Image courtesy of Chlöe Sage

Alcohol Wipe Extraction Procedure

1. Crush a portion of the tablet into fine powder — approximately a quarter of the tablet.

2. Using a 70% or higher alcohol concentration alcohol wipe, scoop up the crushed powder into the wipe. Moving the powder to the centre of the alcohol wipe, wrap the edges of the wipe around the powder and rub the swab until the powder is mostly dissolved.

3. Squeeze the alcohol wipe until a single drop falls on the FTIR sensor. Allow the alcohol to fully evaporate. As the alcohol fully evaporates, it will leave behind a small film of the substance over the sensor, allowing for low intensity reading that can then be interpreted.

Note: Although this method is more accessible than the methanol extraction technique, it can be hit and miss. Sometimes applying this method enables the identification of the active ingredient of a tablet (e.g., etizolam in a Xanax® bar), but other times it cannot see anything other than the diluent such as cellulose.

Testing LSD

LSD is generally sold in the form of blotter paper. If the blotter paper is directly tested with the FTIR, the cellulose (paper) would be detected but not LSD. One method for testing LSD blotter is with a methanol extraction.

LSD Methanol Extraction

1. Cut a small corner of the blotter and put it into a 1.5 mL centrifuge tube.

2. Using a micropipette, drop the minimum amount of methanol onto the piece of blotter (~20 uL) until the paper is fully wet. Let it sit for a few minutes.

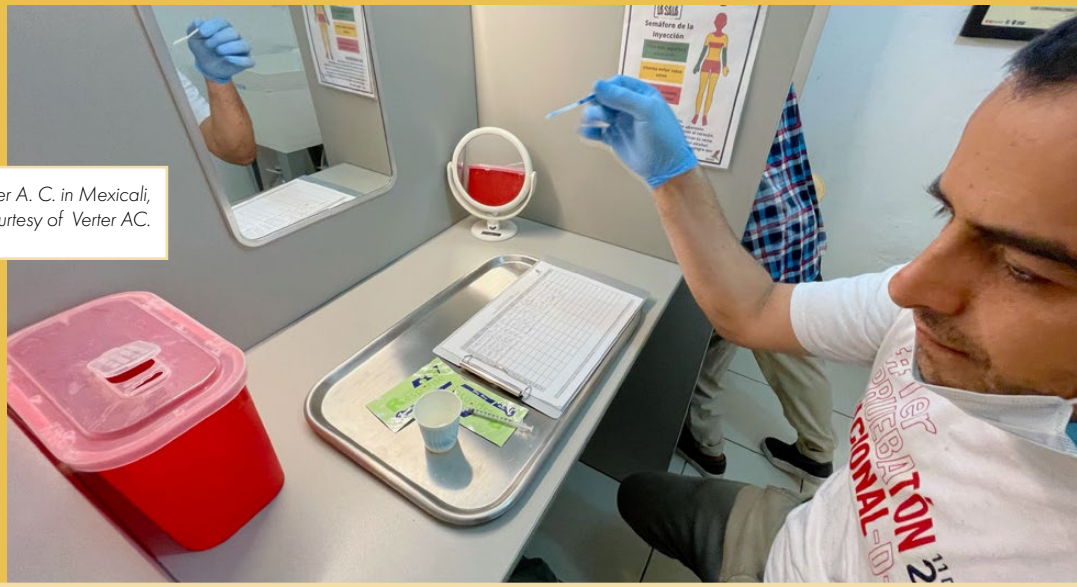
3. Using a pipette, withdraw this small volume and place it on the FTIR sensor. Once it dries, there MAY be a small reading to confirm the presence of LSD.

LSD in liquid form can be checked on the FTIR directly. Place one drop on the sensor and wait for it to dry. The sensor is that tiny square in the centre of the stainless steel circular plate.

Note on testing LSD on the FTIR. While it can be done sometimes, the rate of success of this technique is pretty low. Usually, LSD immunoassay strips or Erhlich's reagent would be the first choice among lower tiers of technology to detect LSD like compounds.

LSD Test Strips

LSD test strips can detect LSD and other closely related novel **lysergamides**. To test for their presence, cut off a small corner of the blotter paper and place in a cup or 1.5 mL centrifuge tube. Follow the benzo test strip procedures when testing those substances. (See Benzodiazepine Test Strip Procedure section)



Said, a harm reduction worker, at Integración Social Verter A. C. in Mexicali, Mexico testing heroin for the presence of fentanyl — Image courtesy of Verter AC.

Ehrlich Reagent Testing for LSD

Colorimetric reagent tests, specifically Ehrlich's reagent, will react with molecules containing an indole group. This includes all tryptamines (e.g., DMT, substituted tryptamines, psilocybin, psilocin), and lysergamides (e.g., LSD and analogs). While not 100% certain, it is an effective and cheap way to find potential lysergamides on the blotter since almost no other indoles have an effective dose low enough to fit on the blotter. Notable exceptions include the extremely rare 5–MeO–aMT. If the Ehrlich test does not turn purple, that *could* indicate that an NBOMe or other drug is present on the blotter instead of the expected LSD.

Testing Gamma Hydroxybutyrate (GHB)

GHB in liquid form is a solution of GHB salts in water. It can easily be tested on the FTIR as liquid concentrate. Use a pipette or dropper to place one drop on the sensor or dip a clean spatula into the GHB liquid then touch it to the sensor to release liquid enough to cover the sensor. It should make a clear, identifiable signal of water, GHB, GBL or a mixture of these.

TEST STRIP PROCEDURES

This section gives step by step procedures for testing with fentanyl and benzodiazepine test strips. **Remember that there can be 'hot spots' within a sample — e.g., one part of the sample contains fentanyl or benzos. Be sure to crush the sample into a homogeneous powder to get the best representative sample from the bulk mixture.**

When using FTIR and test strips together, while the FTIR is scanning the sample, scrape a bit of the sample off the plate that isn't under the anvil into a disposable cup and perform the strip test. This can save time.

PRO TIP

Service users can do their own fentanyl strip test while the drug checker coaches them. Bonus is they will leave having that knowledge on how to use them properly and can take some strips home with them.

Fentanyl Test Strip Procedure

1. Add approximately 5 mL of tap water to a paper cup. Next, add a few small grains (approximately 1 mg) of the sample (remember to crush sample for homogeneity) and swirl until dissolved. **Do not use larger amounts as this may cause false positive results, especially with MDMA, methamphetamine, or diphenhydramine (Lockwood 2021).**

Note: If testing non-amphetamines (e.g.,fentanyl, benzodiazepines, cocaine, ketamine), one can simply run the fentanyl strip test from the same 1.5 mL centrifuge tube that the benzo strip test is conducted in.

2. Remove the test strip from its pouch, and visually check for any obvious defects, such as bends or tears, and confirm it has not expired.

3. Holding the strip from the solid blue end, dip the white end of the strip into the water in the sample cup, taking care not to dip beyond the blue line- as this may interfere with the results. Hold the strip in the water while visually observing the water wicking up the strip. When the water reaches the top of the white portion of the strip (typically taking 10-15 seconds), remove the strip from the sample cup and place it on a clean surface (ideally the test strip pouch).

4. Visually examine the strip under bright, direct lighting (to avoid missing fainter bands). The result can normally be read off the strip immediately, but if colour is slow to develop, wait up to 1-2 minutes for well-defined bands to appear.

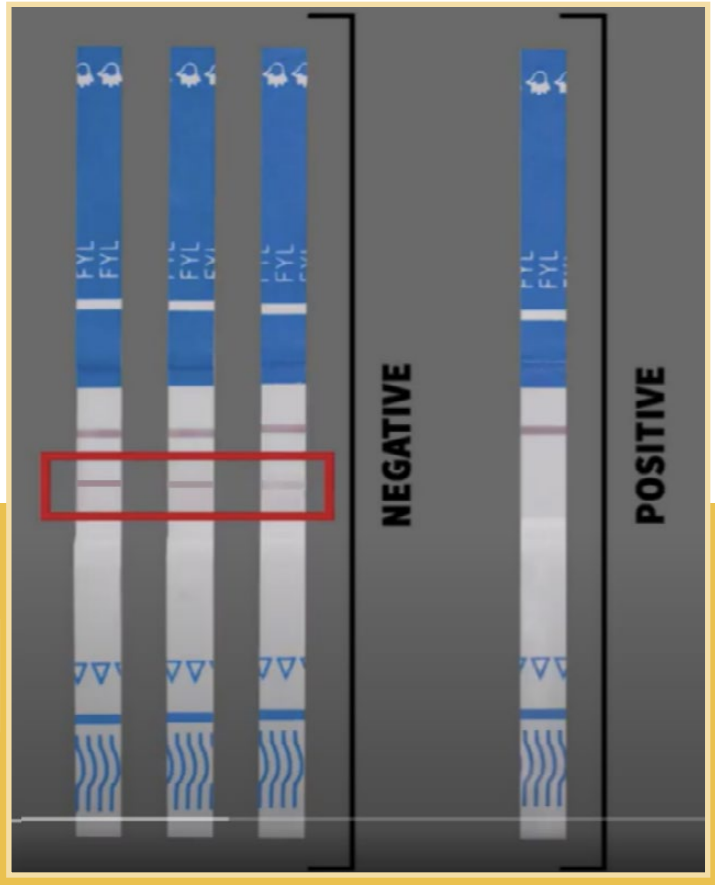
    - **One pink band (top only); positive for fentanyl**
    - **Two pink bands; negative for fentanyl**

5. If the result is positive and was NOT expected — such as a non-opioid sample (especially MDMA, amphetamines or diphenhydramine) — dilute mixture with 30 mL of water and run a new strip test. This is to rule out the possibility of a false positive. To rule out the possibility of **cross-contamination**, check to see if the baggie and/or sample is visually heterogeneous, and ensure a clean working station when repeating the strip test.

Note: The upper band (control line) must always appear, or else the test is invalid and must be repeated.

Note: If more than 5 minutes has passed since the strip was dipped in the sample, the result will no longer be valid. This may cause a second band to appear, even in a positive sample.

Note: The second (lower) band will often be lighter in colour than the upper (control) band. This does not indicate a positive test. Any second band, even if faint, means a negative test. If there is any doubt in interpretation, it is best to repeat the test with a second test strip.



Positive and negative fentanyl test strips — Image courtesy of Verter Mexico.
Uso de Pruebas Rápidas para Detección de Fentanilo- Falso positivo con metamfetamina - YouTube

Note: The fentanyl strip test cannot differentiate between fentanyl analogues such as carfentanil, acetyl fentanyl, and methyl fentanyl, and fluoro-substituted fentanyl.

6. The sample cup (at this point containing highly diluted substance) will be disposed of in accordance with existing site disposal procedures. (See Disposal section).

7. Regardless of test results, service users will be offered the opportunity to securely dispose of their substance before leaving the testing area. Record all substance disposals on the data collection sheet for that particular sample (See *Chapter 2 Implementation of Services* Appendices 2A and B). Discarded substances will be handled in accordance with existing site disposal procedures.

Fentanyl test strip procedure adapted from VCH/BCCSU Drug Checking Protocol for Drug Checking Sites.

Benzodiazepine Test Strip Procedure

1. Take a 1.5 mL or 2 mL centrifuge tube and place as much finely crushed substance as the person is willing to let go of. Add approx 0.25 mL to 0.5 mL of hot water.

Note: Most benzos, including etizolam, are practically insoluble in water. Using hot water may help to improve benzo solubility which will give a more representative result. Additionally, using only a small volume of solvent (water) along with a lot of drugs increases the chance that the concentration is above the threshold detection limit of the strips.

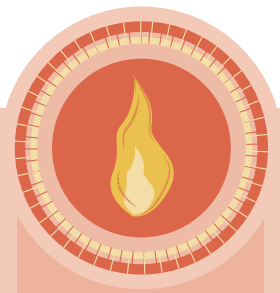
Note: A coffee mug warmer under a wash bottle to keep tap water warm works great. If neither of these options are available, pour hot water straight from the tap into the microcentrifuge tube. Alternatively, heating up plastic ampoules of sterile water for injections in a mug with hot water works. Once the sterile water ampoules are heated, snap off the top and squeeze the small amount of water into the centrifuge tube.

2. Close the lid and shake vigorously for at least 30 seconds. Inspect the contents of the tube and agitate more if needed.

Note: Using a vortexer to mix the sample will help benzos dissolve and give a more representative result. It will also give your arm a break.

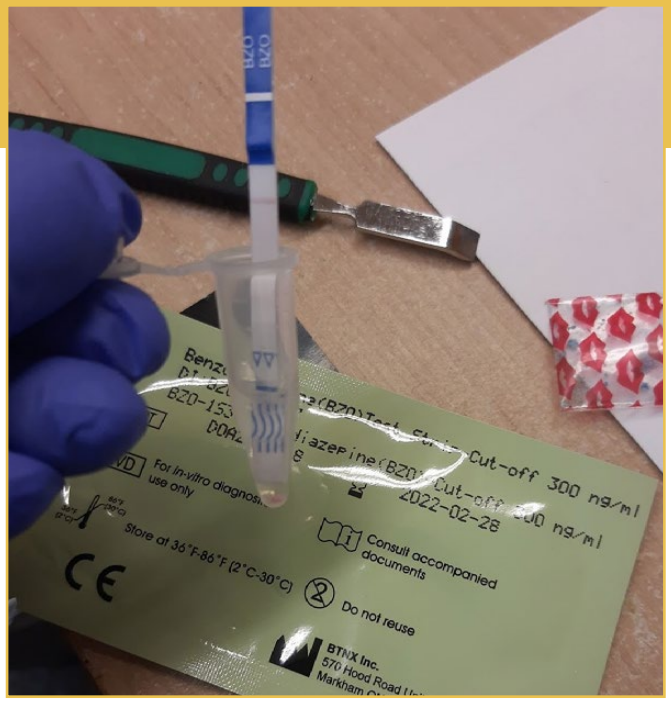
3. Remove the test strip from its pouch, and visually check for any obvious defects such as bends or tears in the strip, and confirm it has not expired.

4. Holding the strip from the solid blue end, dip the white end of the strip into the water in the sample cup, taking care not to dip beyond the blue line- as this may interfere with the results. Hold the strip in the water while visually observing the water wicking up the strip. When the water reaches the top of the white portion of the strip (typically taking 10–15 seconds), remove the strip from the sample cup and place it on a clean surface (ideally the test strip pouch).



PRO TIP

When testing opioid-down samples for benzos and fentanyl, the fentanyl strip test and benzo strip test can be done in the same centrifuge tube. The tube with the residual substance can be offered back to the service user if they want it.



Checking a sample of fentanyl for benzo contamination in a 1.5 mL centrifuge tube with a benzodiazepine strip — Image courtesy of Chlöe Sage

5. Give the test strip 1 to 2 minutes for well-defined bands to appear. Visually examine the strip under bright, direct lighting (to avoid missing fainter bands).

   - **One pink band (top only); positive for benzodiazepines**
   - **Two pink bands; negative for benzodiazepines**

Note: If the test was for opioids or benzos, the same solution and centrifuge from the benzo strip test can be used for the fentanyl strip test. If testing other drugs, refer to the fentanyl test trip procedure.

Note: The upper band (control line) must always appear, or else the test is invalid and must be repeated.

Note: If more than 5 minutes has passed since the strip was dipped in the sample, the result will no longer be valid. This may cause a second band to appear, even in a positive sample.

*Note: The second (lower) band will often be lighter in colour than the upper (control) band. This **does not indicate a positive test.** Any second band, even if faint, means a negative test. If there is any doubt in interpretation, it is best to repeat the test with a second strip test.*

6. The centrifuge tube, containing the highly diluted substance, will be disposed of in accordance with existing site disposal procedures.

7. Regardless of test results, service users will be offered the opportunity to securely dispose of their substance before leaving the testing area. Record all substance disposals on the data collection sheet for that particular sample. Discarded substances will be handled in accordance with existing site disposal procedures.

Note: The benzo strip test cannot differentiate between different benzodiazepines.

Note: New benzodiazepine-like substances appear on the illicit market, often present in opioid-down or sold as single ingredient benzodiazepines. The benzo strip tests have not been evaluated for all of these emerging substances.

PRO TIP

Some benzos are not reliably detected with the strips due to not being very soluble in water or in some cases having a different chemical structure. Understanding the limitations and conveying them to the service user is crucial.

TOOLS

- ANKORS (2021, April 9). How to Use Fentanyl Test Strips. [Video]. YouTube.
- Bergh, M.S.-S., Øiestad, A.M.L., Baumann, M.H., & Bogen, I.L. (2021). Selectivity and sensitivity of urine fentanyl test strips to detect fentanyl analogues in illicit drugs, *International Journal of Drug Policy, 90*(103065).
- British Columbia Centre on Substance Use. Confirmatory Testing (2022). Drug Checking Technician Manual Version 2 (2022). Sample Disposal (2022). Drug Checking: How to Use Benzodiazepine Test Strips (2020). Drug Checking guidelines for identifying colours and textures (2019).
- Interior Health's partner site has many resources for drug checking sites
- CCENDU Bulletin (2021). Risks and Harms Associated with the Nonmedical Use of Benzodiazepines in the Unregulated Drug Supply in Canada.
- Lockwood, TL.E., Vervoordt, A. & Lieberman, M. (2021). High concentrations of illicit stimulants and cutting agents cause false positives on fentanyl test strips. *Harm Reduction Journal 18*, 30.
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For more detailed technical instructions on how to use FTIR and strip tests, please see BCCSU's technical training at Community of Substance.

CONCLUSION

Choosing an appropriate technology - or combination of technologies - for a DC service is a critical consideration. There is a wide variety and each comes with considerable differences in ease of use, cost, and accuracy. Many technologies can be complementary when used in tandem. As drug checking is a newly emerging area of focus, there will undoubtedly be new technologies and instruments made for DC purposes in hopes of entering this new market. It is important to discuss and engage with DC communities to learn about what technologies and procedural techniques experienced technicians are using to analyze substances in the field.

The testing flow section discussed the three steps of testing flow: intake, testing, and results. The steps involved with intake included looking at how to handle, label, storage, and transport samples. The testing step was explored in the procedural section. The messaging section will be discussed in the next chapter.

The procedural section of this chapter should give the reader who uses FTIR and test strips some helpful hands-on testing knowledge to add to their training. The intention of this chapter was to leave the reader feeling more informed and confident on the technical jargon and in the field of testing substances. It should be noted that the glossary section provides a useful reference to those unfamiliar with the jargon of DC.

Next chapter, to be published on the DRED Project website, is *Chapter 4: Messaging Results in Drug Checking.* This chapter will be about relaying results with appropriate messaging to the service user. Stay tuned!

KEY POINTS

- Having technical expertise and the funding required for maintaining high upkeep technology is essential.
- When choosing a technology, the most comprehensive and up-to-date guide on technologies is the Trans-European Drug Information's 2022 (TEDI) TEDI Guidelines Drug Checking Methodology.
- A great free and accessible library for FTIR is SWG Drug.
- "Drug testing" refers specifically to chemically analyzing the component(s) of a substance, whereas "drug checking" refers to the service as a whole which includes intake and messaging the results.
- Each technology has its strengths and weaknesses, and often one technology enhances another's capability.
- Testing flow can be organized into three steps: first the sample is received by the DC service (intake), next the sample contents are analyzed (testing) and lastly the results are relayed back to the service user (results).
- User experience can help the technician look for information on the results that may not have been otherwise noticed. Asking these questions can help piece together a picture of what components might be in there.
- Have a clear description of what the service and the technology can and cannot provide, and clearly define its limitations.
- Having a standard way of intaking and handling samples is critical to reduce the chances of sample mixup.
- To keep people's anonymity, it is recommended not to take identifying information when labeling samples.
- When cleaning the FTIR, wipe down the plate, anvil and sensor with an alcohol wipe. Then with a new alcohol wipe, clean the plate, anvil and sensor again. Dry with a fresh Kim Wipe.
- It is important not to infer the contents of fentanyl based on appearance alone.
- Publicly displaying results that are of concern help to widen the reach to PWUD who could benefit from the results' information.
- When there are low concentrations of fentanyl, it is very difficult to obtain rough quantification with the FTIR.
- The mixture analysis function is NOT reliable with samples with low concentrations of active ingredients as the percentage concentration is too low for an accurate estimation.
- Remember that there can be 'hot spots' within a sample — e.g., one part of the sample contains fentanyl or benzos. Be sure to crush the sample into a homogeneous powder to get the best representative sample from the bulk mixture.
- Service users can do their own fentanyl strip test while the drug checker coaches them. Bonus is they will leave having that knowledge on how to use them properly and can take some strips home with them.

- Do not use larger amounts of substance than recommended for the fentanyl test strip. This may cause false positive results, especially with MDMA, methamphetamine, or diphenhydramine.

- For fentanyl strip tests, the second (lower) band will often be lighter in colour than the upper (control) band. This does not indicate a positive test. Any second band, even if faint, means a negative test. If there is any doubt in interpretation, it is best to repeat the test with a second test strip.

- The fentanyl strip test cannot differentiate between fentanyl analogues such as carfentanil, acetyl fentanyl, and methyl fentanyl, and fluoro-substituted fentanyl.

- The benzo strip test cannot differentiate between different benzodiazepines and has limitations that should be understood clearly. ■

GLOSSARY OF TERMS

Active ingredient
A specific ingredient in a mixture that is responsible for the substance's pharmacological activity (e.g., fentanyl is the active ingredient in a mixture of caffeine, mannitol and fentanyl.) Alprazolam is the active ingredient of pharmaceutical Xanax® tablets, whereas etizolam/flubromazolam are the active ingredients of street Xanax® tablets.

Analogue
A structurally similar molecule in the same family of drugs that can have varying levels of potencies and effects. I.e. carfentanil, fluorofentanyl, methylfentanyl and acetylfentanyl are all analogues of fentanyl.

Analysis
The act of using an instrument or technique to determine the contents of a drug sample.

Benzos
An abbreviation for benzodiazepines, which are a class of drugs which are commonly prescribed in Canada for anxiety, difficulty sleeping and seizure disorders. This class of drugs slow brain activity, which produces a calming or drowsing effect. Examples include Ativan® (lorazepam), Valium® (diazepam), Xanax® (alprazolam) and etizolam. There are also many different benzo analogues being manufactured in the illicit market (i.e. flubromazolam, flualprazolam, bromazolam). Benzos can lead to overdoses when mixed with other sedatives such as alcohol, GHB, or opioids.

Binary results
Only provides a yes or no answer (positive or negative) to the presence of a specific ingredient in a substance. An example is immunoassay strip tests (e.g., fentanyl strip tests).

Bulk mixture
Refers to the entire amount of the substance from which a portion is being tested.

Calibration
Many instruments require routine analysis of a known mixture to ensure that they are functioning properly.

Chocolate chip cookie effect
Referring to the sometimes uneven distribution of active ingredients in diluent, resulting in 'hot spots'. This means, in some portions of the substance, there are parts with higher concentrations of active ingredients. This is especially relevant to opioid-down, where the concentration of fentanyl can vary widely within a single sample.

Chromatography
A laboratory technique where mixtures are separated into their individual components. This can be achieved in a variety of ways, gas chromatography, liquid chromatography.

Colloidal gold solution
Contains extremely small gold particles that are suspended in a solution specifically used for SERS.

Cross-contamination
When the contents of a sample being tested is tainted by a different substance not originally intended to be included in the testing. Cross contamination can happen before the service user gets the drug, while they handle the drug and even when the technician handles the drug if proper technique is not adhered to.

Diluent
An ingredient added to a substance to both increase its volume and reduce the concentration of the active ingredient. A diluent is what the substance's active ingredient is diluted with, hence the name. In a tablet, the diluent is what gives tablets volume. Usually an inert white powder like microcrystalline cellulose, starch, or mannitol. In opioid-down, the diluent is often caffeine.

Distributed drug checking
A service model that allows samples to be collected, stored, and transported to another location for analysis. This means having many sites designated as 'collection sites' and a few sites designated as 'testing sites'.

Drug Checking
Refers to an integrated HR service that allows people involved with illicit substances (e.g., fentanyl, heroin, cocaine, MDMA, LSD, ketamine, DMT) to chemically analyze them. Results are received in a nuanced and non-judgmental way in order to increase the service user's knowledge and understanding of the substances they are considering taking.

Electronic data capture software
Software that allows electronic recording of samples, including intake and results. Ideally, it includes the ability to upload spectral files to be accessed remotely, or at a later date for further interpretation. This software can be as simple as a custom Excel Spreadsheet, or as complex as specifically made software for this purpose.

Fixed Site
A permanent drug checking site (e.g., in a harm reduction agency, clinic, or store front).

Further analysis
Refers to when samples are sent to a laboratory with access to Tier 3 technology, such as mass spectrometry or qNMR, that can detect new substances and quantify accurately, including trace amounts of active ingredients.

Harm Reduction
A holistic framework of practice that empowers people to decide what behaviors and services work best for them, based on their own unique life situations. Harm Reduction can include (but is not limited to) risk minimization drug use and sexual health education (ANKORS).

Heterogeneous
A non-uniform or non-homogeneous mixture.

Homogeneous
A uniform mixture in composition and concentration.

Immunoassay
A biochemical test that determines the presence of a specific molecule through the use of an antibody. Antibodies are also used by immune systems to neutralize foreign objects. These types of tests are extremely specific to the molecule that is being targeted by the test.

Indole
A specific chemical structure that is present in tryptamines (DMT, substituted tryptamines, psilocybin, psilocin etc) and lysergamides (LSD, 1P-LSD).

Instrument
A device a technician uses to determine the contents of a sample.

Internal standard
A mixture of known ingredients at known concentrations which is then used to help identify and quantify an unknown sample.

Ionize
To be made into a positively or negatively charged molecule. It allows for mass spectrometers to "see" the molecules.

Library
A database of spectra of known substances and ingredients that are used in analysis to compare with the substance being tested.

Limit of detection
The minimum amount of an ingredient that needs to be in a mixture for the technology to detect it. FTIR has a detection limit of 3–5%. Fentanyl test strips have a detection limit for fentanyl of 20 ng/mL. Tier 3 technologies have much lower limits of detection.

Lysergamides
A specific chemical structure that is present in LSD and other closely related chemicals.

Method
A specific process (set of parameters or settings) that is used by an instrument to analyze a substance.

Mixture analysis
Mixture analysis is a Bruker software feature for OPUS that allows for rough proportional estimates of how much of each of the main components are in a mixture.

On-Site
A temporary pop-up drug checking site that is set up for an event and taken down when the event is over (e.g., music festival, conference, hotel/motel, or street site).

Oppression
"The use of power to consciously or unconsciously disempower, marginalize, silence, and harm another social group that has been given less power in society, or has had power actively taken away from them to benefit the social group that is the oppressor." (taken from The Anti Oppression Network)

Pharmaceutical Standards
Pharmaceutically manufactured and laboratory-tested pure samples. These are usually used for calibrating instruments, creating quantification models and carrying out research studies.

Quant 2 Model
QUANT 2 is a software add-on to Bruker's analysis program (OPUS) and allows for the development of models to quantitatively analyze IR spectra to determine target component concentrations.

Qualitative results
Identify the contents of a substance using observable features but does not provide any information on the amounts of various ingredients present in a sample.

Quantitative results
Provides information on how much of an ingredient is present in a substance.

Reagent
A chemical solution that, when dropped on a sample, reacts with the ingredients present. Based upon the colour change they exhibit, the drug checker can infer if the presumed substance is or is not present in the sample. This technology is considered Tier 1 as it is not very reliable, and is not a definitive test to identify ingredients.

Sample preparation
Refers to the process of grinding, dissolving or manipulating a substance so that it is ready to be introduced to the sensor of the instrument. Some technologies require minimal sample preparation, whereas others require extensive sample preparation.

Semi-quantitative model
These models can roughly determine the concentration of certain active ingredients in a sample (e.g., proportion of benzocaine in a cocaine sample, or approximate amount of fentanyl in an opioid-down sample). Although semi-quantitative models used by Tier 2 technologies are not as accurate as quantitative models used by Tier 3 technologies, semi-quantitative models can give useful information about how much of an ingredient is present in a sample.

Sensor
The part of the instrument that takes the reading of the substance. They can be externally located where the substance goes directly on the sensor (e.g., FTIR), or they can be hidden away inside the instrument and the sample must be brought to it (e.g., GC-MS).

Service User
A person who uses a service that is being provided.

Signal
A reading received from an instrument's sensor to then be processed and interpreted by the software and technician.

Solvent
A substance that can dissolve other substances to create a solution. Within drug checking, the solvent is usually water or methanol.

Spectra
Adjective: spectral. The plural of spectrum.

Spectrum
A term used in spectroscopy (e.g., FTIR and Raman) that refers to the graphical representation of a reading that the instrument has made. This is displayed as a complex line that represents a chemical compound or mixture. When the reading is taken from the sample it is called the sample spectrum. It is then compared against library spectra to identify the sample spectrum.

Spectrum subtraction
The ability to remove one spectrum from another. It is the basis for identifying multiple components in a mixture when drug checking with FTIR.

Stigma
Stigma can occur when a person's worldview is not considered "socially acceptable", which can further lead to a sense of helplessness and disempowerment. Stigma can be used as a tool of oppression to take away people's power.

Urgent public health needs sites (UPHNS)
A fast-tracked federal exemption that is applied for and given out by regional health authorities within provinces that are implementing the UPHNS program. Designated by an MHO, the exemption will allow provinces and territories to establish new temporary urgent public health need sites that can be used as a collection, storage and transportation of drug checking samples for testing purposes. The decision to implement the exemption is up to the jurisdiction's discretion.

Vortexer
A device that is typically used to agitate a small container with liquid in it, the agitation helps the sample dissolve. A fancy alternative to shaking a container by hand.

WHIMIS
Stands for Workplace Hazardous Materials Information System. It is a standardized system for classifying hazardous substances, creating cautionary labels, and provides material safety data sheets (MSDS) and worker education and training programs. Read more about WHIMIS here.

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APPENDIX 1: FENTANYL TEST STRIP PROCEDURE

1. Add approximately 5 mL of tap water to a paper cup. Next, add a few small grains (approximately 1 mg) of the sample (remember to crush sample for homogeneity) and swirl until dissolved. **Do not use larger amounts as this may cause false positive results, especially with MDMA, methamphetamine, or diphenhydramine (Lockwood 2021).**

Note: If testing non-amphetamines (e.g.,fentanyl, benzodiazepines, cocaine, ketamine), one can simply run the fentanyl strip test from the same 1.5 mL centrifuge tube that the benzo strip test is conducted in.

2. Remove the test strip from its pouch, and visually check for any obvious defects, such as bends or tears, and confirm it has not expired.

3. Holding the strip from the solid blue end, dip the white end of the strip into the water in the sample cup, taking care not to dip beyond the blue line as this may interfere with the results. Hold the strip in the water while visually observing the water wicking up the strip. When the water reaches the top of the white portion of the strip (typically taking 10-15 seconds), remove the strip from the sample cup and place it on a clean surface (ideally the test strip pouch).

4. Visually examine the strip under bright, direct lighting (to avoid missing fainter bands). The result can normally be read off the strip immediately, but if colour is slow to develop, wait up to 1-2 minutes for well-defined bands to appear.

   - **One pink band (top only); positive for fentanyl**
   - **Two pink bands; negative for fentanyl**

5. If the result is positive and was NOT expected — such as a non-opioid sample (especially MDMA, amphetamines or diphenhydramine) — dilute mixture with 30 mL of water and run a new strip test. This is to rule out the possibility of a false positive. To rule out the possibility of cross-contamination, check to see if the baggie and/or sample is visually heterogeneous, and ensure a clean working station when repeating the strip test.

Note: The upper band (control line) must always appear, or else the test is invalid and must be repeated.

Note: If more than 5 minutes has passed since the strip was dipped in the sample, the result will no longer be valid. This may cause a second band to appear, even in a positive sample.

Note: The second (lower) band will often be lighter in colour than the upper (control) band. This does not indicate a positive test. Any second band, even if faint, means a negative test. If there is any doubt in interpretation, it is best to repeat the test with a second test strip.

Note: The fentanyl strip test cannot differentiate between fentanyl analogues such as carfentanil, acetyl fentanyl, and methyl fentanyl, and fluoro-substituted fentanyl.

6. The sample cup (at this point containing highly diluted substance) will be disposed of in accordance with existing site disposal procedures. (See Disposal section).

7. Regardless of test results, service users will be offered the opportunity to securely dispose of their substance before leaving the testing area. Record all substance disposals on the data collection sheet for that particular sample (See *Chapter 2 Implementation of Services* Appendices 2A and B). Discarded substances will be handled in accordance with existing site disposal procedures.

Fentanyl test strip procedure adapted from VCH/BCCSU Drug Checking Protocol for Drug Checking Sites.

APPENDIX 2: BENZODIAZEPINE TEST STRIP PROCEDURE

1. Take a 1.5 mL or 2 mL centrifuge tube and place as much finely crushed substance as the person is willing to let go of. Add approx 0.25 mL to 0.5 mL of hot water.

Note: Most benzos, including etizolam, are practically insoluble in water. Using hot water may help to improve benzo solubility which will give a more representative result. Additionally, using only a small volume of solvent (water) along with a lot of drugs increases the chance that the concentration is above the threshold detection limit of the strips.

Note: A coffee mug warmer under a wash bottle to keep tap water warm works great. If neither of these options are available, pour hot water straight from the tap into the microcentrifuge tube. Alternatively, heating up plastic ampoules of sterile water for injections in a mug with hot water works. Once the sterile water ampoules are heated, snap off the top and squeeze the small amount of water into the centrifuge tube.

2. Close the lid and shake vigorously for at least 30 seconds. Inspect the contents of the tube and agitate more if needed.

Note: Using a vortexer to mix the sample will help benzos dissolve and give a more representative result. It will also give your arm a break.

3. Remove the test strip from its pouch, and visually check for any obvious defects such as bends or tears in the strip, and confirm it has not expired.

4. Holding the strip from the solid blue end, dip the white end of the strip into the water in the sample cup, taking care not to dip beyond the blue line- as this may interfere with the results. Hold the strip in the water while visually observing the water wicking up the strip. When the water reaches the top of the white portion of the strip (typically taking 10–15 seconds), remove the strip from the sample cup and place it on a clean surface (ideally the test strip pouch).

5. Give the test strip 1 to 2 minutes for well-defined bands to appear. Visually examine the strip under bright, direct lighting (to avoid missing fainter bands).

   - **One pink band (top only); positive for benzodiazepines**
   - **Two pink bands; negative for benzodiazepines**

Note: If the test was for opioids or benzos, you can use the same solution and centrifuge from the benzo strip test can be used for the fentanyl strip test. If testing other drugs, refer to the fentanyl test trip procedure.

Note: The upper band (control line) must always appear, or else the test is invalid and must be repeated.

Note: If more than 5 minutes has passed since the strip was dipped in the sample, the result will no longer be valid. This may cause a second band to appear, even in a positive sample.

*Note: The second (lower) band will often be lighter in colour than the upper (control) band. This **does not indicate a positive test.** Any second band, even if faint, means a negative test. If there is any doubt in interpretation, it is best to repeat the test with a second strip test.*

6. The centrifuge tube, containing the highly diluted substance, will be disposed of in accordance with existing site disposal procedures.

7. Regardless of test results, service users will be offered the opportunity to securely dispose of their substance before leaving the testing area. Record all substance disposals on the data collection sheet for that particular sample. Discarded substances will be handled in accordance with existing site disposal procedures.

Note: The benzo strip test cannot differentiate between different benzodiazepines.

Note: New benzodiazepine-like substances appear on the illicit market, often present in opioid-down or sold as single ingredient benzodiazepines. The benzo strip tests have not been evaluated for all of these emerging substances.