v3 | June 2025

Service and technology limitations

It is important to remember that drug checking as a response to North America's toxic drug supply crisis is in its infancy. Incredibly sophisticated and sensitive technologies continue to be required to effectively check highly contaminated unregulated opioids that are most likely to contribute to overdose. **At this time, there is no perfect drug checking technology – all have limitations. What is most important is that service providers understand that all technologies have limitations, understand what the limitations of the technologies they use are, and can clearly communicate those limitations to service users**.

About the technologies we use

- All drug checking results we share with service users and all data we include in our community-led unregulated drug market monitoring efforts come from technologies validated for overdose prevention drug checking. A validated drug checking technology is one that has demonstrated consistent and reliable performance and has undergone rigorous testing and evaluation to determine its limitations – and this information is publicly available.
- The validated drug checking technologies we currently use include gas chromatography-mass spectrometry (GC-MS), high-resolution liquid chromatography-mass spectrometry (HR-LC-MS), and Fourier transform infrared spectroscopy (FTIR) with test strips.
- We are committed to ensuring service providers and service users understand the unique limitations of each technology we use.

General drug checking limitations

1. Checking your drugs **cannot guarantee that a drug is safe to use**.
2. At this time, **there is no perfect drug checking technology**. All have limitations, as well as trade-offs in terms of ease of use, quality of results, turnaround times for results, and cost.
3. Results for the sample you are having checked **may not represent the rest of the drugs you took the sample from** (this is known as the Chocolate Chip Cookie Effect). Imagine your drugs as a chocolate chip cookie. If you check a piece of the cookie that is only dough, chocolate may not be found. Mixing a powder or crushing crystals, rocks, and pills during sample collection can improve the representativeness of your sample.

4. Due to technological limitations and/or samples not fully dissolving during preparation for analysis, some **substances may be missed or inaccurately quantified**.
5. **Some human interpretation is required** by skilled technical staff, meaning there could be some variation in results.
6. Drugs most likely to contribute to overdose and other harms (i.e., those bought or got as unregulated opioids) are increasingly more contaminated and less predictable. **Incredibly sophisticated and sensitive technologies that are validated for overdose prevention drug checking are required to accurately determine the composition of unregulated opioids**.

Gas and liquid chromatography-mass spectrometry limitations

Considered the gold standard for chemical analysis and routinely used in clinical settings to analyze biological specimens, like blood and urine, gas and liquid chromatography-mass spectrometers separate the substances in a sample and determine what they are based on their unique weight and retention time (i.e., the amount of time they take to pass through the instrument's chromatography column). We use GC-MS and HR-LC-MS.

1. Sample type: Drug and used equipment samples can be checked using GC-MS and HR-LC-MS. However, **checking drugs instead of used equipment is preferred** because:
    - Drug equipment, like cookers, are often re-used. GC-MS and HR-LC-MS are so sensitive that very trace amounts of substances may be found. This means that **when equipment is re-used, substances from past use may present in the results for the sample that is being checked**. This can interfere with current drug market monitoring, which is why we rely only on drug samples when reporting trends.
    - Fatty acids are more commonly found in samples that are taken from used equipment, most likely from oils on skin. These **fatty acids can interfere with the mass spectrometry analysis**. It may be difficult to see past them to determine which substances are present.
2. Drug detection: The GC-MS and HR-LC-MS libraries we use contain thousands of drugs, including those that are "new" or rare. These libraries are constantly updated, limiting the likelihood we will miss drugs. To date, these instruments have detected nearly 600 unique drugs in the samples we have checked.
3. Non-drug filler detection: Our current GC-MS and HR-LC-MS techniques **do not detect or report non-drug fillers**. This could include non-drug fillers that may be dangerous, such as bacteria, metals, pesticides, or inorganic salts. Other non-drug fillers may not be dangerous, such as sugar or laxatives.
4. Limit of detection (i.e., the smallest amount of a substance that can be detected with confidence): 0.05%. We use HR-LC-MS to report the precise amount of some substances found in some samples. We have found substances, like fentanyl, fluorofentanyl, caffeine, and medetomidine, accounting for as little as 0.05% of the sample checked. This implies the limit of detection for our HR-LC-MS is 0.05%, meaning **substances that account for less than 0.05% of the sample are likely to be missed by HR-LC-MS**. This limit of detection was determined based on the information we have from checking thousands of

samples. That said, the limit of detection may differ between substances found and from sample to sample.

5. Results type: Semi-quantified or quantified.
    - Semi-quantified results (aka relative % for a substance found) report whether there is more or less of a substance than other substances in a sample. They answer the question: is there more of substance X than substance Y in this sample? Semi-quantified substances found are listed from most to least present.
    - Quantified results (aka amount or concentration of a substance found) report the precise amount of a substance in a sample. They answer the question: how much of the total sample checked is substance X? Quantified results are reported for select substances in drug samples that are powder, crystals, rocks, or a crushed bit of a pill. Quantified substances found are listed as a % of the total sample checked and in mg of a standard 10 mg sample.

FTIR limitations

We use a Bruker Alpha II FTIR. Considered the benchmark for onsite drug checking for overdose prevention, FTIR shines light at a substance – some of the light is absorbed and indicates a substance's chemical fingerprint.

1. Sample type: Drug samples can be checked using FTIR.
2. Drug detection: The FTIR libraries we use contain thousands of drugs. Many of these libraries are updated regularly to include drugs that are "new" or rare.
3. Non-drug filler detection: The FTIR libraires we use contain hundreds of non-drug fillers. Many of these libraries are updated regularly to include non-drug fillers that are "new" or rare.
4. Limit of detection (i.e., the smallest amount of a substance that can be detected with confidence): 5%. This means **substances that account for less than 5% of the sample are likely to be missed by FTIR**. For this reason, FTIR is paired with test strips, which are more likely to detect certain drugs in trace amounts.
5. Results type: Semi-quantified. Semi-quantified results (aka relative % for a substance found) report whether there is more or less of a substance than other substances in a sample. They answer the question: is there more of substance X than substance Y in this sample? Semi-quantified substances found are listed from most to least present.

Fentanyl test strip limitations

We use BTNX Rapid Response strips with an advertised sensitivity of 200 ng/mL.

1. Sample type: Drug and used equipment samples can be checked using fentanyl test strips.
2. Drug detection: Fentanyl and certain fentanyl-related drugs.
3. Limit of detection (i.e., the smallest amount of a substance that can be detected with confidence): Well below 0.1%, as advertised by BTNX. This means **fentanyl and certain fentanyl-related drugs are unlikely to be missed by the fentanyl test strips we use**.

4. Results type: Binary. Binary results (aka + or -) report whether a specific substance is found in a sample with a simple Yes or No.

LSD test strip limitations

We use BTNX Rapid Response strips with an advertised sensitivity of 50 ng/mL.

1. Sample type: Drug samples can be checked using LSD test strips.
2. Drug detection: LSD.
3. Limit of detection (i.e., the smallest amount of a substance that can be detected with confidence): Well below 0.1%, as advertised by BTNX. This means **LSD is unlikely to be missed by the LSD test strips we use**.
4. Results type: Binary. Binary results (aka + or -) report whether a specific substance is found in a sample with a simple Yes or No.

Drug market monitoring limitations

1. The **unregulated drug market monitoring we share** is based on samples checked by Ontario's Drug Checking Community only. This means **our data may not be completely representative of drugs circulating in the region the sample was collected, Ontario, or elsewhere**. Our data should therefore be used with caution when determining trends or drawing conclusions about the unregulated drug supply.
2. We sometimes share the colour and texture of a sample when describing it, particularly when **communicating to the public about a new drug trend**. **The way a sample looks should not be used to determine its composition**. Colour and texture do imply similar drug checking results.

About this resource: These are the limitations associated with the technologies used by Ontario's Drug Checking Community.

About Ontario's Drug Checking Community: Ontario's Drug Checking Community is a national leader in drug checking service delivery and community-led unregulated drug market monitoring and education. It involves implementing the offsite drug checking model designed and in use by Toronto's Drug Checking Service since 2019 in other jurisdictions across the province. The primary reason for doing so is to inform evidence-based responses to the worsening toxic drug supply crisis by educating people who use drugs, community health workers, public health units, clinicians, first responders, policy makers, coroners and toxicology laboratories, and others about what's circulating in the unregulated drug supply and anticipated harms.

Our program is comprised of a group of members, including collection sites, analysis sites, and a small central team that operates from within St. Michael's Hospital in Toronto.

Our work would not be possible if people who use drugs did not donate their drugs to our program in an effort to reduce the harms associated with using unregulated substances and facilitate community-led drug market monitoring and education.

(website) www.drugchecking.community | (email) hello@drugchecking.community | (IG) @drugchecking