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Is fentanyl in everything? Examining the unexpected occurrence of illicit opioids in British Columbia's drug supply

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Abstract

Background Illicit opioids, including fentanyl, are linked to unprecedented levels of overdose in Canada and elsewhere. The risks associated with illicit opioids can include high potency, unpredictable concentration and the unexpected presence in other drugs. Within this context, we examine drug checking data to better understand the presence of illicit opioids such as fentanyl in other drugs and possible ways to interpret these results.

Methods Three years (2021–2023) of data (18,474 samples) from Substance Drug Checking in British Columbia, Canada were examined to investigate the risks associated with the detection of opioids in other drugs such as cocaine and methamphetamine, as well as in other drug categories. Samples were tested by paper spray mass spectrometry (PS-MS), fentanyl test strips and Fourier-Transform infrared spectroscopy (FTIR). We examine the 8889 samples not expected to include fentanyl to confirm; if the expected drug was detected, if unexpected opioids were detected, and when the unexpected opioids are in trace concentration.

Results Unexpected opioids were rarely detected (2%) in other drugs (189 of 8889 samples) with most (61.4%) detected at trace concentration levels. Unexpected opioids are far more likely to be found in samples that did not contain the expected drug than in samples that were confirmed to contain the expected drug. The least common scenario (below 1%) were substances that included the expected drug plus unexpected opioid above trace concentration. These findings raise questions on how to interpret and communicate the detection of fentanyl and related opioids in other drugs. We present three potential interpretations: (1) mistaken and misrepresented samples where the expected drug was never detected, (2) cross contamination when opioids were at trace concentration levels, or (3) adulteration as the least frequent scenario where opioids were detected above trace concentrations in combination with the expected drug.

Conclusions In a region where fentanyl is associated with extreme rates of overdose, it remains rare to find such opioids in other drugs. However, the risk of fentanyl in other drugs remains an ongoing threat that warrants responses by individuals and public health. We provide possible interpretations to inform such responses. Our data raises questions on how to interpret and communicate the detection of fentanyl and other opioids in other drugs.

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Keywords Fentanyl, Overdose, Drug checking, Harm reduction

Background

The illicit drug overdose crisis continues in North America. Canada and the United States are experiencing unprecedented rates of overdose with fentanyl, fentanyl analogs, and co-occurring drugs such as xylazine and benzodiazepines associated with the vast majority of overdoses [1, 2]. British Columbia is frequently referred to as the epicenter of the overdose crisis in Canada where the overdose death rate is approximately 45 in 100,000, with fentanyl linked to more than 85% of drug related deaths in this region [3].

Risks associated with fentanyl in the unregulated drug supply includes its high potency, the unpredictability of the potency, and the unknown presence of fentanyl in illicit drugs. The risks of fentanyl in stimulants, including cocaine and methamphetamine, is a particular threat with potentially tragic consequences [4–8]. In this context, there can be a perception of fentanyl being present in the entire illicit drug supply [9, 10].

The strengthening of surveillance data is recommended to better understand and respond to the persistent epidemic [11]. Specifically, there is a need for real-time surveillance programs including drug market data [12]. In the absence of a universal drug supply monitoring system, current monitoring strategies rely on multiple data sources [7, 13]. Drug checking is being increasingly implemented as a data source for public health monitoring, as well as for individuals testing substances [14–17].

Our drug checking project sought to interrogate a large body of drug data to gain understanding of illicit substance trends to inform and better serve our community. Given the scarcity of literature on these concepts, and in light of both the importance and controversy that surrounds this data, we investigate drug checking results where fentanyl-related opioids were detected in other drugs and propose potential interpretations of these results to better understand and report on the risks of fentanyl in other drugs. By examining these data, we seek ways to interpret these results in a more informed and nuanced way for people accessing drug checking as well as public health and society overall. Can this data hold potential explanations for why fentanyl/analogs may be in other drugs, and how can these results be used to inform public health and individuals testing their drugs?

Methods

To examine the nature of unexpected opioid contamination in the illicit drug supply, we pose five key questions of our data and methodology.

1. What proportion of drug checking samples contained an unexpected opioid?
2. What is the prevalence and distribution of unexpected opioids in other drug categories?
3. What proportion of samples contained the expected drug as well as unexpected opioid?
4. What was the prevalence of trace level and above trace level opioid among samples that contained the expected drug as well as an unexpected opioid?

Inclusion criteria

We processed drug checking data collected between January 1, 2021 and December 31, 2023 at Substance Drug Checking (https://substance.uvic.ca) located in British Columbia, Canada (Fig. 1). For this enquiry we reviewed all samples that were submitted, analyzed and reported to service users. The project received ethical approval from the Health Research Ethics Board at Island Health Authority (REB Number: H20-03384).

The study omitted all samples expected to contain an "illicit" opioid, i.e., samples expected to include fentanyl and/or analogs, heroin and/or synthesis byproducts, and/or nitazene opioids. We also excluded any samples that were unknown to the person submitting them. We focus exclusively on samples that were not expected to include "illicit" opioids. During this time, the service tested 18,474 samples of which 8,122 expected "illicit" opioid samples and 1,445 samples unknown to the service user were excluded. Eighteen samples were further excluded because; the presence/absence of the expected compound could not be confirmed by the drug checking service (i.e. the expected active compound was beyond detection capacity by PS-MS and was either not available among FTIR libraries or was otherwise below the FTIR-detectable threshold). This paper focuses on the remaining 8,889 samples which represent instances of samples not expected to contain "illicit" opioids by the people submitting drugs to be tested.

We define "trace" as samples found to contain an opioid at a concentration of less than 0.50% wt/wt. While any amount of an unexpected opioid may be considered significant, we designate any percentage less than or equal to 0.50% wt/wt as the trace concentration because it corresponds to the limit of detection among our least sensitive quantitative methods (30 ng/ml). Since detection cutoffs for the fentanyl strip tests used in this study range from 200 to 500 ng/ml, 0.5% also represents a component concentration that may lie below the theoretical limit of detection of strip tests depending on sample volume. Data were filtered such that the proportion of trace and non-trace opioid containing samples were reflected.

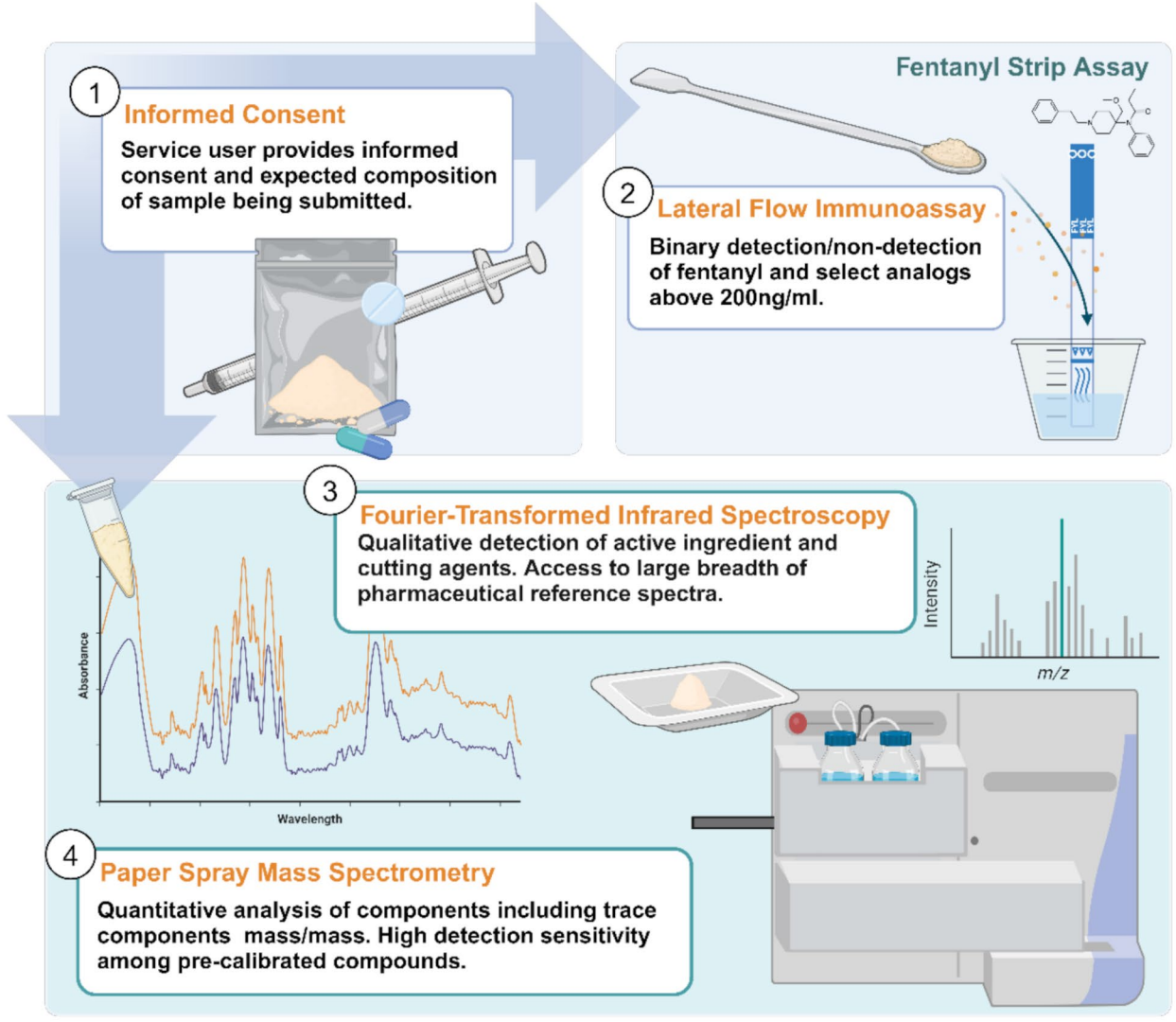

Fig. 1 Schematic representation of analysis pipeline for submitted substances. Samples were tested via fentanyl strip immunoassay, Fourier-transformed infrared spectroscopy, and paper spray mass spectrometry to identify and quantify sample components. Created in https://BioRender.com

Sample analysis

Substance Drug Checking provides a multi-instrumental response which includes mass spectrometry, infrared spectrometry and strip tests which we describe here (Fig. 2). Fentanyl immunoassay strip tests (FYL-18S7, BTNX, 20 ng/ml) were used to test all samples. Samples were subsequently evaluated with Fourier-transform infrared (FTIR) spectroscopy using an Agilent 4500a portable FTIR spectrometer operated by a trained technician in a point-of-care setting. Technicians conducted spectral interpretation on 5–10 mg of sample with the assistance of spectral matching algorithms with drug databases [18].

A majority of the samples were additionally evaluated with paper spray ionization mass spectrometry (PS-MS) using PS-MS methodology similar to previously described work on a TSQ Fortis triple quadrupole mass spectrometer with a VeriSpray paper spray ion source (Thermo Fisher Scientific, San Jose, CA, USA) [19]. Samples were weighed at 1 mg/ml ± 0.2 mg into methanol and subsequently diluted to a final concentration of 6 µg/mL in a methanolic working solution containing isotopically labeled internal standard analogs of target compounds for quantitation (the full target list can be found at https://substance.uvic.ca/paperspray). 10 µl of this working solution was spotted onto strips in PS-MS paper cassettes, allowed to air dry for approximately 2–5 min, and analyzed immediately.

This study utilizes this drug checking data where some samples underwent all three analysis methods while some received both strip testing and one of FTIR or PS-MS due to availability of technologies at the time of sampling. While multiple technologies working in

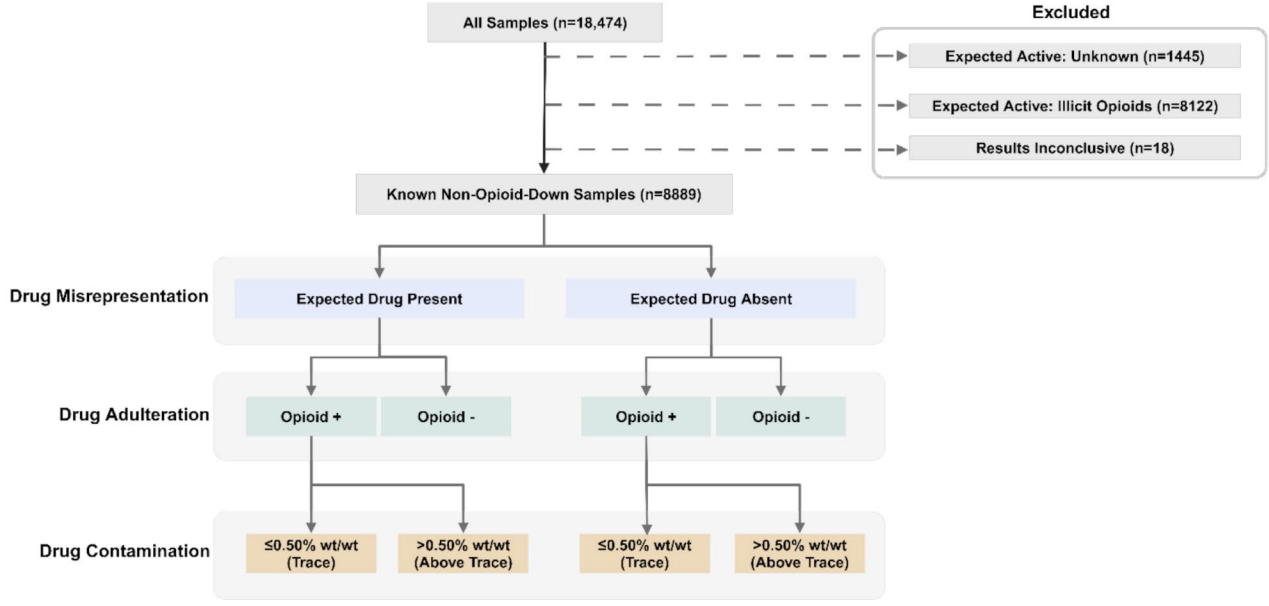

Fig. 2 Data framework for parsing of nested variables from all samples included in the study. Each filter pass denotes a sub aim of study. Created in https://BioRender.com

Table 1 Proportion of samples containing opioids overall and at trace levels

Category	(*n*)	Opioid +		Opioid + - Trace Level	
		n	%	*n*	% of Opioid + Samples
Cocaine	2756	52	1.9%	34	65.4%
MDMA	2079	9	0.4%	4	44.4%
Dissociatives	997	2	0.2%	2	100.0%
Methamphetamine	972	34	3.5%	25	73.5%
Psychedelics	660	3	0.5%	2	66.7%
Other	591	7	1.2%	4	57.1%
Benzodiazepines	557	39	7.0%	23	59.0%
Expected Opioids	277	43	15.5%	22	51.2%
Total	8889	189	2.1%	116	61.4%

tandem enhances compound detection capabilities [20], some compounds may have been missed if they were below the FTIR detection limit and/or undetectable by strip test or PS-MS. FTIR and PS-MS minimum detection thresholds are ~3% wt/wt and 0.01% wt/wt (dilution dependent) respectively.

The expected identity of each sample was defined by the service user who disclosed the expected contents at intake. For this analysis, samples were grouped into 8 categories based on the most frequently occurring compounds or family of compounds (Additional File 1). Data was filtered to reflect two variables; expected active drug (whether samples contained or did not contain the expected active compound) and opioid positivity (whether an opioid was detected in each sample). Where quantitative information was available, these data were used.

Results

Our primary aim was to determine the prevalence of unexpected opioids in other drugs (Table 1). Unexpected opioids were found in 2.1% of samples tested (189 of 8907 samples). We further report on when unexpected opioids were below or above trace level detection. We found 61.4% of samples with unexpected opioids (116 of 189) to be below trace level detection. The unexpected opioids were almost always fentanyl and related analogues (86.6%, $n = 164$) while nitazene opioids represented 11.1% ($n = 21$) of the detected unexpected opioids, and heroin and related byproducts made up 4.8% ($n = 9$) of unexpected opioid detections. Four samples had both fentanyl-related compounds and heroin-related compounds detected; one sample had both fentanyl-related compounds and nitazene opioids detected.

Unexpected opioids were detected in all drug categories, in most cases the rate of unexpected opioid positivity was below or at 1%. For example, in over 2,000 MDMA samples, we found nine to include an unexpected opioid (0.4%). Similarly, less than 0.5% of psychedelics and dissociatives were found to include an opioid. Less than 2% of cocaine samples (52 of 2756) were found to contain an opioid, while 3.5% of methamphetamine samples included an opioid. Opioids from the illicit supply were more prevalent in substances expected to contain other

Table 2 Proportions of samples containing opioids as a function of presence of expected drug

Category	Expected Drug Present		Expected Drug Present & Opioid +			Expected Drug Absent		Expected Drug Absent & Opioid +		
	n	% of total	*n*	% of all Opioid + Samples	% of all Expected Drug Present Samples	*n*	% of Total	*n*	% of all Opioid + Samples	% of all Expected Drug Absent Samples
Cocaine	2656	96.4%	29	55.8%	1.1%	100	3.6%	23	44.2%	23.0%
MDMA	1845	88.7%	3	33.3%	0.2%	234	11.3%	6	66.7%	2.6%
Dissociatives	943	94.6%	1	50.0%	0.1%	54	5.4%	1	50.0%	1.9%
Methamphetamine	903	92.9%	26	76.5%	2.9%	69	7.1%	8	23.5%	11.6%
Psychedelics	509	77.1%	0	0.0%	0.0%	151	22.9%	3	100.0%	2.0%
Other	358	60.6%	1	14.3%	0.3%	233	39.4%	6	85.7%	2.6%
Benzodiazepines	162	29.1%	3	7.7%	1.9%	395	70.9%	36	92.3%	9.1%
Expected Opioids	188	67.9%	5	11.6%	2.7%	89	32.1%	38	88.4%	42.7%
Total	7564	85.1%	68	36.0%	0.9%	1325	14.9%	121	64.0%	9.1%

opioids (15.5%) and benzodiazepines (7.0%). This is a useful but unsurprising finding as benzodiazepines are a well-known co-intoxicant among illicit opioids ("benzodope") in the regional market [21].

Next, we investigated the relationship between the detection of unexpected opioids and the presence or absence of the expected drug. Overall, 85.1% of all samples (7564/8889) were confirmed to contain the expected drug, while 14.9% of samples (1325/8889) did not contain the expected drug (Table 2). Averaged across all drug categories, unexpected opioids were more likely to be found in samples where the expected drug was not present (Table 2). Of the 189 cases where an unexpected opioid was detected in another drug, the expected drug was absent in 121 (64.0%) of cases and present in 68 (36.0%) of cases. If the expected drug was detected, then the likelihood of also finding an unexpected opioid drops to 0.9% across all categories. If the expected drug was not detected, then the likelihood of also finding an unexpected opioid increases ten-fold to 9.1% across all categories. Given that unexpected opioids are far more likely to be found in samples that did not contain the expected drug than in samples that were confirmed to contain the expected drug, we propose that sample misrepresentation plays a greater role than adulteration or contamination as we explore more in the discussion.

Discussion

In this study, we have examined drug checking results from the epicenter of the overdose crisis in Canada where fentanyl and other potent opioids are linked to extreme rates of toxicity and overdose [3]. Understandably, the unexpected adulteration of drugs with fentanyl is a prevalent fear in the community and among people who use drugs. In this context of unprecedented drug related deaths, we examine the nature of opioid-down adulteration focusing upon the co-occurrence of opioid-down with expected active compounds, using concentration levels to categorize potential drug adulteration, misrepresentation, and cross contamination.

Our findings confirm that while the unexpected and unwanted presence of opioids in other drugs poses legitimate risk, such occurrences are rare [5]. Using our analysis, we sought to theorize potential interpretations for these rare, but notable, cases. To deepen our understanding of unexpected opioids co-occurrence with other drugs, we determined whether the expected substance was also present and whether the unexpected opioid was at trace levels.

Misrepresented identity: Unexpected opioid without the expected drug

The most common scenario among samples with an unexpected opioid were samples that did not contain the expected drug at all (64% of all opioid-positive samples did not contain the expected drug). This was detected largely among expected benzodiazepines and expected opioids where 92.3% and 88.4% of unexpected opioid-positive samples did not contain the expected drug, respectively. We suggest that these instances can be considered cases of misrepresentation or mistakes. That is, the expected drugs cannot be considered adulterated given the absence of the expected drug itself. There are many potential scenarios where a drug may be misrepresented or mistaken and actually be fentanyl or a related opioid. In the context of criminalization where people seek to conceal their drugs and forgo labeling prohibited substances, the risks of mistaken or mixed-up samples are understandably increased. Cases of mistaken samples can also occur when a third-party is accessing drug checking on behalf of others, which is a common practice [22]. Such scenarios also include fentanyl being misrepresented and sold or provided as a non-opioid. In the case of illicitly purchased prescription opioids, cases of misrepresentation are likely given that an illicit opioid is

meant to replace the psychoactive primary components of such samples.

Cross contamination: Unexpected opioids in trace concentration

In nearly two thirds (61.4%) of the cases where unexpected opioid were detected – among samples with and without their expected drug – the unexpected opioid was found at trace concentration levels. When the opioid did co-occur with the expected drug, it was most often (72.6%) detected at trace levels. Speculation on the nature of such occurrences is challenging given poly-substance use (such as speedballs and goofballs) as well as the covert nature of illicit drug manufacturing, sales, transport and possession. The measurement and handling of different substances with contaminated instruments, negligence towards best practices in illicit laboratories, storage of different drugs in the same location, and the re-use of packaging materials all. increase the likelihood of cross-contamination events.

Trace fentanyl contamination does not imply a degree of safety – individual tolerance, expected drug dosage, and use patterns are all contributors to overall relative risk. Trace contamination, more so, implies unintentionality in drug co-occurrence when there is neither a pharmacological nor financial incentive for compounds to be sold or consumed together.

Adulteration: Co-occurrence of expected drug and unexpected opioid above trace concentration

The least common scenario observed overall (0.9%) were substances that included the expected compound and an unexpected opioid above trace level. Such cases lend themselves to existing narratives of intentional fentanyl adulteration. On closer look, such scenarios were primarily detected in other opioids, benzodiazepines, and methamphetamine. Opioids and benzodiazepines represent two examples of central nervous system depressants with unique pharmacology but convergent intoxication experiences and use motivations [21]. Both categories of substances have potential to produce euphoria, sedation, and disinhibition. As such, they represent a key opportunity for adulteration with opioids and with each other. Conversely, methamphetamine differs significantly from opioids and benzodiazepines in pharmacology and effects but shares a demographic and social proximity to illicit opioids [23]. While opioids can be consumed through multiple routes, preference within British Columbia leans towards smoked rather than injected [24]. This shared mode of administration among methamphetamine and opioids is a likely contributor to overlap in polysubstance usage demographics as well as common inhalation paraphernalia.

The data for this study has limitations. Most importantly, these results reflect those drugs presented at the drug checking service for testing and cannot be assumed to be representative of the illicit market. Related, the findings from this drug checking project in British Columbia, Canada cannot be assumed to capture the diversity of illicit drug markets globally. All drug checking technologies and methods have limitations and this data is not exempt from those limitations while it does reflect what is being tested and what is being reported by a typical drug check in our service. Results presented here cannot be assumed to capture the diversity of illicit drug markets globally and care should be taken when contextualizing these findings. Despite limitations which are inherent to the technologies used and a lack of sampling control, these data provide a unique vantage point from which to observe the local supply and apply our discussion framework.

Insight and implications

These findings contest the misconception that "fentanyl is in everything" – even in a region where fentanyl and other opioids are associated with extreme rates of overdose. The risks of unexpected opioids to people using non-opioids are much less than for those who are knowingly accessing the illicit opioid supply which includes unknown fentanyl analogues, unpredictable concentrations and frequently multiple drugs such as benzodiazepines, xylazine, and nitazenes. However, the risk of any unexpected opioids in other drugs is irrefutable and remains of concern for public health, warranting responses by both individuals and public health [5].

Our data raises questions on how to interpret and communicate the detection of unexpected opioids in other drugs. Currently, issuing drug alerts is an accepted response to such unexpected risks. The effectiveness of drug alerts have been questioned, with calls for greater attention to the design and messaging of potential risks [25–29]. Concerns have also been raised on public health alerts and messaging of a "bad batch" and "fentanyl panic" as the problem and how such messaging, while genuine, can contribute to both moral panic and detract from the systemic risks faced by people who use drugs [27, 30, 31].

These findings suggest utility in taking efforts to interpret such unexpected results to inform potential responses. If drug alerts are the primary response, what are we alerting people of – the risks of cross contamination, of mistaken samples or of drugs being misrepresented? Drug checking services hold potential in pursuing such interpretations with those using the services and the data from the services. Specifically, when providing unexpected drug checking results there are opportunities for nuanced discussion about the potential

reasons for unexpected opioids in their drugs and strategies to navigate these risks.

Discourse continues around how and when drug checking data should be used to issue public alerts in the face of existing moral panics and drug scares. Care and consideration must be taken when conveying drug-associated risk to the public to comprehensively but concisely convey risk level without alarm [25, 29, 32, 33]. Beyond this, drug checking holds great potential to be used as an interpretation and information tool; the impacts of which could reach further than drug alerts alone. When drug checking can provide qualitative, quantitative results, including trace level detection, the reporting of unexpected results can be provided within context and with potential interpretation of the results to best inform those accessing results on the potential risks in the substances and markets.

These findings point to the value of enhancing knowledge of drugs and drug markets [34, 35] when faced by the current risks associated with illicit fentanyl and other drugs linked to extreme rates of overdose. The threat of fentanyl in other drugs is likely increased by both prohibition and stigma, both of which demand a clandestine market, thus, limiting proper handling [36] and increasing risks of cross contamination. Harm reduction that engages people who sell drugs can enact upstream actions [37–39] in this context to inform less risky drug market activities such as measures to reduce cross-contamination and mistaken supplies. Engaging people who use drugs and people who may sell drugs can provide a more informed response to fentanyl in other drugs and avoid simplistic alerts that risk misinformation on the actual risks and ways to minimize them [34].

Conclusion

Illicit opioids, including fentanyl and its analogs, were rarely detected in other drugs. There is a scarcity of data available on the extent of drug adulteration – particularly concerning illicit opioids like fentanyl in other drugs like cocaine, MDMA, etc. Three years of drug checking data from the epicenter of Canada's overdose crisis are analyzed to better understand why fentanyl may be in other drugs and possible explanations inform public health and individuals testing their drugs. When such occurrences were recorded, three potential interpretations are presented. The least likely interpretation is that illicit opioids are intentionally being added to other drugs. Based on our data, cross contamination and cases of mistaken or misrepresented drug identity appear to be the most likely scenario in the majority of cases. Our data challenges the assumption that illicit opioids present in all drugs equally and seeks to elucidate risks of illicit opioid adulteration. We conceptualize a framework for understanding drug adulteration and emphasize how harm reduction can inform measures to reduce cross-contamination and mistaken supply. The drug toxicity crisis remains heavily stigmatized and misunderstood.

Abbreviations

PS-MS Paper spray mass spectrometry
FTIR Fourier-transformed infrared spectroscopy

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12954-025-01189-w.

Additional file 1: Active Compounds Description of Data: Listed table of all compounds and compound combinations screened for specifically by PS-MS. Compounds are sub-categorized by compound type reflected in text

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Author contributions

B.W. contributed manuscript writing and preparation as well as historic and philosophical guidance in the harm reduction field. I.S. conducted a major proportion of data analysis, contributed to historic data generation and presentation as well as manuscript preparation. C.K. and D.R. contributed significantly to data generation, data analysis and historic database maintenance. L.G., J.J., A.M., and P.G.N. contributed significantly to historic data generation and provided substantial editorial revisions. A.S. conducted extensive early work on method development and data interpretation. L.A. and T.Z. provided major historic oversight on method optimization and manuscript revisions for technical fluency. C.G. and D.H. contributed historic, philosophical, and technical guidance in the fields of analytical and computational chemistry as well editorial revisions of manuscript.

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Data availability

No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate

This project received ethical approval from the Health Research Ethics Board at Island Health Authority (REB Number: H20-03384).

Competing interests

The authors declare no competing interests.

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