

A distributed model to expand the reach of drug checking

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Abstract

Purpose – While there is increasing interest in implementing drug checking within overdose prevention, we must also consider how to scale-up these responses so that they have significant reach and impact for people navigating the unpredictable and increasingly complex drug supplies linked to overdose. The purpose of this paper is to present a distributed model of community drug checking that addresses multiple barriers to increasing the reach of drug checking as a response to the illicit drug overdose crisis.

Design/methodology/approach – A detailed description of the key components of a distributed model of community drug checking is provided. This includes an integrated software platform that links a multi-instrument, multi-site service design with online service options, a foundational database that provides storage and reporting functions and a community of practice to facilitate engagement and capacity building.

Findings – The distributed model diminishes the need for technicians at multiple sites while still providing point-of-care results with local harm reduction engagement and access to confirmatory testing online and in localized reporting. It also reduces the need for training in the technical components of drug checking (e.g. interpreting spectra) for harm reduction workers. Moreover, its real-time reporting capability keeps communities informed about the crisis. Sites are additionally supported by a community of practice.

Originality/value – This paper presents innovations in drug checking technologies and service design that attempt to overcome current financial and technical barriers towards scaling-up services to a more equitable and impactful level and effectively linking multiple urban and rural communities to report concentration levels for substances most linked to overdose.

Keywords Drug checking, Substance use, Harm reduction, Overdose, Spectroscopy, Mass spectrometry

Paper type Case study

1. Introduction

Community drug checking has been recognized as an important intervention in response to the illicit drug overdose crisis, in which rates of overdose deaths continue to escalate to unprecedented levels (Bardwell and Kerr, 2018; Barratt *et al.*, 2018; Dasgupta *et al.*, 2018; Laing *et al.*, 2018; Measham, 2020). The enduring crisis is linked to the increasingly complex and unpredictable drugs in the illicit market which include synthetic opioids, predominantly fentanyl (Gozdziński *et al.*, 2021b; Green *et al.*, 2020; McCrae *et al.*, 2020; Ramsay *et al.*, 2021; Ti *et al.*, 2020; Tupper *et al.*, 2018), as well as benzodiazepines (Bowles *et al.*, 2021; McAuley *et al.*, 2022) and the combinations of these active ingredients in the same supply (Gozdziński *et al.*, 2021a; Laing *et al.*, 2021). Despite heightened demands for decriminalization and widespread access to safer, regulated drug options, there continues to be limited supply options beyond the existing unregulated market (Ivins *et al.*, 2020; Pardo *et al.*, 2021; Tyndall, 2018).

Drug checking is a harm reduction service that provides people with a chemical analysis of drug samples as well as reports of aggregate drug checking data to monitor the unregulated market (Maghsoudi *et al.*, 2021). We define community drug checking as a model of drug checking that is implemented within communities to provide an ongoing service to the whole population which may be unique from event or festival site models. Fentanyl test strips are often integrated within harm reduction services at supervised consumption sites and overdose prevention services and are used off-label to provide a simple positive/negative result of the presence of fentanyl in a sample (Bergh *et al.*, 2021; Park *et al.*, 2021; Peiper *et al.*, 2019; Weicker *et al.*, 2020; Zibbell *et al.*, 2021). At the same time, more sophisticated methods, typically optical-based technologies such as spectrometers, are being pursued for their potential to detect and report on the full composition of a sample including the active (psychoactive) ingredients and cuts and, whenever possible, to determine and report on the concentration of ingredients (Borden *et al.*, 2021; Green *et al.*, 2020; Maghsoudi *et al.*, 2020; Scarfone *et al.*, 2022). In other words, these technologies seek to provide both a qualitative analysis (all of the ingredients detected in a sample) as well as a quantitative analysis (the concentration of main ingredients, notably the actives).

The emergence of community drug checking is not a coordinated response and has rarely been spearheaded by public health as a publicly funded, comprehensive overdose prevention service (Carroll, 2021; Palamar *et al.*, 2019; Peacock *et al.*, 2021). Rather, what exists is a scattering of pilot projects, research initiatives, grassroots and sometimes unsanctioned services. These efforts are often championed by harm reductionists responding to overdose and are informed by the evidence and practices of drug checking within party/dance settings. Further, forums for information sharing between drug checking projects enable knowledge exchange and capacity-building.

The growing literature on community drug checking as a response to the current overdose crisis illustrates the varied technologies and methods being pursued and underscores implementation barriers and limitations (Barratt *et al.*, 2018; Brunt, 2017; TEDI, 2022). While portable Fourier transform infrared (FT-IR) spectroscopy is popular and has been demonstrated to be of significant value in identifying components such as fentanyl in drug mixtures, its limited sensitivity often requires other methods for the detection of potent fentanyl analogues such as carfentanil, as well as benzodiazepines (McCrae *et al.*, 2020; Ti *et al.*, 2020, 2021; Tobias *et al.*, 2020). Raman and the associated surface enhanced Raman (SERS) show potential with benzodiazepines, specifically etizolam; however, these technologies appear to remain in the pilot stage with new advances still under development (Gozdzialski *et al.*, 2021a, 2021b). Drug checking projects are also using traditional lab-based instruments such as liquid chromatography- and gas chromatography-mass spectrometry and nuclear magnetic resonance spectroscopy, which can report on trace level ingredients and concentrations (TEDI, 2022).

The associated costs and operational challenges of these technologies at point-of-care, however, may be an additional limitation to wide-scale implementation (Gozdzialski *et al.*, 2021a; Maghsoudi *et al.*, 2020; Valdez, 2021). Paper spray mass spectrometry (PS-MS) provides increased specificity and sensitivity (Borden *et al.*, 2021) but inherits similar challenges for scale-up. Colorimetric reagents are another example of technologies of interest that are used in drug checking (Lockwood *et al.*, 2020). Based on all of the technologies that have been evaluated over the past decade, it appears that the ideal instrument for drug checking has yet to be determined, and this is in part because of the compromise between cost, ease of use, sensitivity and utility of the results. In the near future, community drug checking will likely continue to engage multiple instruments when seeking to report on the synthetic opioids often associated with overdose and the frequent combinations of active ingredients such as “so-called benzo-dope” (Wallace *et al.*, 2021a, 2021b, 2021c).

Overall, there is a need to address the implementation barriers that are hindering its scale and reach (Wallace *et al.*, 2021a). Notably, drug checking is showing benefits for those who access these services (Maghsoudi *et al.*, 2021). But drug checking is not accessible for most people, particularly those beyond the reach of urban health services and those less likely to access current harm reduction services. While examples of mail-in and online drug checking services exist (Barratt *et al.*, 2018; Brunt, 2017; TEDI, 2022), these options remain limited and typically remain in a legal grey area that impedes integration within public health's overdose responses. Barriers include costs of instruments and their operations; shortage of skilled technicians capable of operating the instruments for harm reduction purposes; limited engagement of people with lived experience and those with drug/pharmaceutical knowledge to interpret results for service users; and the necessity of multiple sites and service delivery models to truly "meet people where they are at" (Wallace *et al.*, 2020). External barriers include criminalization and the need for public health sanctioning to be able to operate drug checking services within prohibition; substance use stigma at all levels; risk avoidance on the part of public health; fiscal austerity for substance use and harm reduction interventions and innovations; and intersecting forms of structural violence that sustain inequities and intensify harms for certain people and populations who use drugs.

This paper describes a distributed model of community drug checking that addresses the multiple implementation barriers the authors experienced in establishing and delivering drug checking as a response to the overdose crisis (location anonymized). The distributed drug checking model implements technologies, protocols and practices that facilitate increased scale and reach of drug checking to multiple urban and rural communities. It does so by reducing financial and technical barriers to drug checking, while providing trace-level detection and reporting of concentration levels for substances such as fentanyl and benzodiazepines, which are most linked to overdose while also building and growing a community of practice.

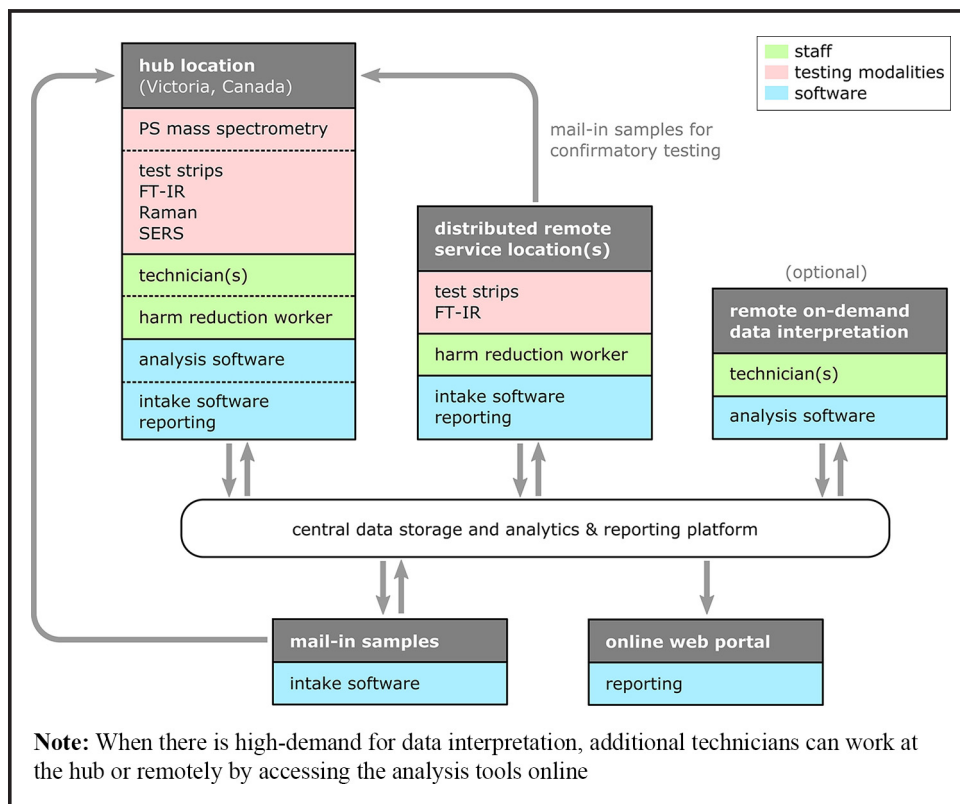
2. Distributed model of drug checking

A key feature of the design of our distributed service is that there are multiple ways in which a sample can be delivered to a drug checking site and multiple ways in which the results and associated harm reduction messaging can be relayed to the individual. Here, we describe the key hardware and software components in the infrastructure that enable this flexibility (Figure 1).

The model seeks to be responsive to the following objectives:

- to operate a central site that hosts harm reduction workers, technicians and a suite of drug checking technologies including test strips, IR absorption (FT-IR), Raman and mass spectrometry;
- to link a central site to distributed sites in both rural and urban areas, providing point-of-care drug checking without the need for skilled technicians at each location;
- to enable online and mail access for people less likely to access harm reduction services and for regions with limited access to harm reduction sites;
- to combine immediate point-of-care drug checking and harm reduction services with delayed access to comprehensive mass spectrometry results online;
- to produce site-specific drug monitoring reports for each distributed site/community to inform harm reduction responses; and
- to support capacity-building and services at distributed sites through training, resources and an online community of practice.

Figure 1 A schematic illustrating the relationship between the options available for sample intake (walk-in to hub, walk-in to remote service location or mail-in) and the delivery of drug checking results (in-person at the hub, in-person at remote service locations and online through the Web portal)



2.1 Description of the distributed service model

The hub is housed at a single inner city location. This central site has a full set of chemical analytical capabilities including fentanyl and benzodiazepine test strips, FT-IR, Raman spectrometers operating on powders directly and in SERS mode and a PS-MS. Currently, the site is staffed with three people, typically one harm reduction worker and two technicians (one dedicated to the PS-MS and one to the other spectrometers) working 7-h shifts, six days per week. As a result of its prominent storefront location on a street corner in a busy part of the city (and efforts to create an inviting atmosphere), the location welcomes and encourages samples to be delivered in person. Typically, all of the results are available within 15 min. If somebody wishes to wait for the results or comes back to the site, then they receive an interpreted explanation through a collaborative discussion with the harm reduction worker and technicians.

To provide remote locations with the ability to access drug checking services in a timely and cost-effective way, the availability of low-cost hardware that is easy to use and maintain is necessary, but it is only a small part of the full solution. Some of the most critical, and often overlooked, components are the challenges and expenses associated with recruiting, training, remunerating and retaining suitably trained technicians. While some communities and public health authorities can afford the one-time expenses associated with instrument costs, the ongoing expense of a technician poses a serious impediment to the sustainability of community drug checking initiatives.

Our service model is centered around a custom drug checking platform that diminishes the need for trained technicians at multiple sites (e.g. overdose prevention/safe consumption

sites, etc.), while still enabling point-of-care services and immediate, on-site harm reduction messaging. The drug checking hardware platform consists of a touch screen laptop, a printer and an FT-IR spectrometer. Our pilot project includes five distributed sites located in unique communities throughout a large geographical area – all linked electronically to the hub site. In the event that the demand on the technicians is high within a single day, either because of many remote sites or a few busy ones, additional technicians can interpret the FT-IR spectra remotely, as indicated by the top right box in [Figure 1](#). This adds capacity without increasing the staffing requirements of the hub and also makes use of expertise outside of the geographic area of the hub. This also addresses the challenge of using a technician’s time and skill set effectively if they are in a location that receives only a small number of samples on a daily or weekly basis or when the demand for drug checking varies.

The drug checking process at the remote service locations is initiated by a description of the service limitations and an informed consent request. On-screen instructions provide step-by-step prompts for completing the FT-IR measurement and then notifies the technician at the main site that there is FT-IR data ready for interpretation. Meanwhile, the screen at the remote site provides guidance on the next steps, including a fentanyl (and possibly benzo) strip test using a small amount of sample retrieved from the FT-IR. Those strip test results are input into the database, so they are available to aid in the remote data analysis. Instructions for securely packaging and sending a small sample to the main site for further analysis on the paper spray mass spectrometer follow. We, therefore, seek to maximize the capacity of trace level detection and quantification from a single mass spectrometer at the hub location. A mailing label and unique QR code are generated and printed to facilitate mailing the samples and to provide a database tag to link the results back to the service user. When the technician in the hub site has completed the FT-IR data analysis, they input the results and interpretations (“technician notes”) into the database and the remote site receives a “results ready” notification.

After the test is complete, there are on-screen options to access resources such as the most recent monthly drug checking results from a particular community, interesting drug facts and service updates, as well as a prompt for retrieving any remaining sample, cleaning the FT-IR and instruments and sample destruction guidance if required.

An additional route to chemical analysis is through a mail-in service. From the project website ([insert web link](#)), people can access a form to print out or submit electronically, which accompanies samples sent to the hub location. When these samples are received, the same analysis used for walk-in samples is performed. After all of the tests are completed, the staff enter a combination of prepared responses (e.g. standard information for a particular drug type) and custom messages (anything unique that was encountered, potential uncertainties and drug alerts) into a communication section for the corresponding database entry. The results are then available for reporting to the service user, in person or through the online Web portal. As a harm reduction response, drug checking needs to be able to meet people where they are at, which requires service options beyond fixed sites. Online access to services and to drug checking results allows for people to better access services from where they live. The option to mail a sample into a site offers additional drug checking opportunities for individuals who may experience barriers to accessing harm reduction sites. When governments provide sanctioning to service sites and staff, these sanctions generally do not encompass an integral component of drug checking: sample transport. Drug checking necessitates someone transporting a controlled substance, either by foot or mail or courier. Such options are vital and continue to be prohibited or function in a legal gray area.

Regardless of whether samples (a) initially arrived in-person at the hub (b) were mailed directly to the hub or (c) were initially brought to a remote testing location for partial analysis and then completed after arriving by mail at the hub, there are several options available for clients to receive the results of their drug check. Service users can (1) get results face-to-face

at the Victoria hub location, (2) access their results online, (3) visit any of the remote sites and use the “retrieve” results screen of the computer to view their results themselves or (4) communicate directly with a local harm reduction worker in their community who can access and explain the results.

As an example, the preliminary results for an expected opioid sample would include the fentanyl and possibly benzo test strip results (available during the testing process), and the interpreted FT-IR result (confirmation of drug class, most actives and cutting agents and concentration estimates – available at the time of testing, subject to a short wait). The final test results will include a more comprehensive list of ingredients including low concentration actives and precise concentration information, available online within the days following the test.

2.2 Data fusion, analytics and reporting

An objective of the distributed model is not only point-of-care drug testing but also localized drug monitoring reports for each community, as well as overall data fusion and aggregate reporting. A primary objective of having samples tested by the FT-IR and also sent to the hub for confirmatory testing by mass spectrometry is to produce more detailed reports for each community and for the overall project, primarily based on the detailed quantitative information the PS-MS is able to provide. The reports produced from the data fusion and analytics have both independent as well as integrated functions. Autonomous from the service, the reports can be accessed by anyone to gain current drug market monitoring information in their community and greater knowledge and resources – without actually having a sample to test or accessing the testing sites/services. The reports are also integrated within the testing services as a resource for staff to contextualize the individual drug checking results within the overall market trends when reporting back to the service users. For example, at each site, the staff are able to provide immediate FT-IR results while contextualizing these immediate results with the more detailed PS-MS results from the recent month within each region that features trace level detection and relevant quantification of notable drugs and trends. Each month the reports are distributed through a subscribed email list, promoted on social media and released with a blog post (insert web link) that seeks to provide much more context and discussion rather than a basic data report.

2.3 Training and community of practice

The distributed model is supported by a training program, housed within a community of practice site for the project (insert web link). The training program is designed to build drug checking capacity across distributed model sites and to ensure knowledge of and adherence to the program’s standard operating practices, as well as its values and objectives as a harm reduction intervention. Training modules encompass the technical skills for completing remote tests, harm reduction messaging for working with service users and resources for working within contexts of criminalization and the ongoing overdose crisis. The training is designed to complement the automated job aids and resources provided by the project platform, supporting harm reduction workers in distributed sites to engage service users in drug checking in a similar manner to the hub site. Successful completion of the training is required for those conducting drug checking at the sites.

In addition to housing the training program, the online community of practice is designed as a virtual hub for all workers who are part of the distributed model to share and access resources and support. It provides an online space to post and store drug checking-related content and supports mutual learning and knowledge exchange beyond the training program, across disparate locations. The site provides links to an email list and hosts harm reduction and technician discussion forums, as well as ongoing opportunities for education

and engagement with other stakeholders through the project. Our goal is to build capacity and expertise among the community of people providing drug checking through the distributed model and to facilitate greater inclusion and incorporation of drug checking as a critical component of harm reduction practice.

3. Tools that enable and support remote sites

The choice to use FT-IR at the remote locations was based on a compromise between ease of use, cost, immediate utility of the results, suitability for a broad range of samples, transportability and manageable maintenance requirements. There are two aspects to the custom software that enable service at remote drug checking sites: the frontend (user interface) and the backend. The frontend consists of a program that runs on the service computer itself. It is designed so that the test is performed either by the person who brings in the sample, the local harm reduction worker or both collaboratively. When a new drug test is performed, the frontend touch screen interface:

- provides a greeting and description of the service;
- informs of the risks and collects the consent;
- asks the intake survey questions;
- provides guidance on how to load the drug sample;
- informs if adjustments need to be made to the sample to improve the quality of the data analysis;
- performs the initial automated analysis to determine the drug class;
- displays results about that drug class; and
- informs on what is trending based on drug checks in that community recently and, if necessary, provides drug alerts.

Alternatively, a service user can look up the results of a previous drug test and the screen would display the results. It would indicate the status as either:

- results pending – if no technician has been able to provide an interpretation of the FT-IR data yet;
- FT-IR results available, confirmatory testing pending – when remote interpretation is complete to provide preliminary results, but the sample has not yet been analyzed using Raman/SERS and PS-MS; the sample could be in transit or received and in the hub queue; and
- complete results available – holistic interpretation and harm reduction messaging once all of the tests have been completed.

The frontend software that performs both sets of tasks has been written with the ultimate goal of simplicity in the presentation of the interface. Everything happens in a single full-screen kiosk-style application, including control of the FT-IR. That way, people who are performing the tests do not have to manage the communication between different pieces of software.

A separate software package is designed for a trained technician to use at the hub location (or working remotely) and facilitates data analysis, manipulation and comparison of raw data with that from previous drug samples to aid in the interpretation. This technician application can display any record but has the primary function of writing to the backend database. In contrast, when staff or service users request results online, the application providing the Web interface only reads from that database. The software at the remote service locations saves the consent, survey, test strip and FT-IR results to this database.

This synchronization enables up-to-date information, including relevant drug alerts, to be available to all persons using the service from any location, including data obtained from other samples at any location. The backend software, the collection of tools that support the database, is not visible to the users. However, it coordinates the data input, stores all records, provides an analysis platform for technicians and enables all results to be accessed from all sites.

4. Outlook

For drug checking to have a meaningful impact, a public health response to overdose (Saloner *et al.*, 2018) is required, including public health resources and enabling policies and legislations. Pardo *et al.* (2021) make the dire claim that implementing current best practices will not be sufficient to reduce the unprecedented rates of overdose deaths. Consequently, innovations in technologies and policy are both needed. This paper presents one approach at implementing innovations in drug checking technologies to overcome barriers to scaling-up services to a more equitable and impactful level. Importantly, policy innovations must be accompanied by public health funding; otherwise, drug checking innovations will remain impracticable and limited to the margins of the public health emergency. Our pilot project benefits from being initiated in a provincial jurisdiction in which enabling legislations and policies have supported sanctioning not available to others. Equity-oriented approaches (Wallace, *et al.*, 2021c) to drug checking are needed, as they engage communities in more comprehensive approaches that move beyond individual-level responses (Wallace *et al.*, 2021a) and adopt proportionate universalism in service designs to ensure equitable reach and impacts. In responding to the urgency of the ongoing overdose crisis, we must support and implement evidence-making interventions (Rhodes *et al.*, 2016; Rhodes and Lancaster, 2019) instead of settling for an evidence-based approach.

Our model seeks to minimize financial and technical barriers to the operation of multiple sites and provides both targeted and whole population responses. Our service design model diminishes the need for trained technicians at multiple point-of-care drug checking services by linking these instruments to a technician offsite or at a central hub. By providing analysis and interpretations in real time back to the remote sites, locally based harm reduction workers can engage service users with the results, be responsive to questions and provide additional information and support. We suggest that a combination of service design features may be relevant for community drug checking to continue to expand its capacity and integration within public health responses to illicit substances. These include the combined use of different instruments and their data fusion, reporting on multiple levels, the efficient use of a well-equipped centralized drug checking facility linked to community sites, the availability of online and mailing options and peer engagement through a community of practice. The distributed model seeks innovative ways to engage local peers and integrate peer knowledge and information sharing with drug checking results and reporting. Rather than attempting to replace experiential knowledge through the use of technology, the model draws on localized knowledge and experience of the drug supply and provides relational reporting. Tailoring services to best fit local needs and a diversity of service users is a related objective to ensure services and reporting are as relevant and effective as possible.

5. Conclusions

There are known implementation barriers to initiating and integrating drug checking within substance use and harm reduction services. There are further barriers to scaling-up these responses to achieve significant reach and impacts for people navigating the unpredictable and increasingly complex drug supplies that are linked to overdose. This paper seeks to extend the knowledge base for scaling-up drug checking services to a more equitable and

impactful level. We have presented a distributed model for community drug checking, developed as a harm reduction response within the context of the ongoing overdose public health emergency. The model seeks to implement technologies and practices that reduce current financial, technical and operational barriers while providing trace-level detection and reporting of concentration levels for substances most linked to overdose. The model aims to meet these objectives through a foundational database and an integrated software platform that links a multi-instrumental, multi-site service design that does not require a technician on-site, with online service options, reporting functions, training and a community of practice to facilitate engagement and capacity-building.

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