Harm Reduction Journal

RESEARCH

Open Access

Characteristics of take-home fentanyl test strip use and support for drug checking services among people who use heroin in Australia: learnings for an increasingly complex drug market

Rachel Sutherland[1*], Maureen Steele[2], Craig Rodgers[3], Edmund Silins[4,1], Rosie Gilliver[4], Amy Peacock[1,5], Monica Barratt[6,1], Nadine Ezard[1,3,7], Krista J. Siefried[1,3,7], Robert Page[8,9], Raimondo Bruno[5,1] and Phillip Read[4,10]

Abstract

Background This paper examines: (i) the acceptability of, and behavioural outcomes associated with, take-home fentanyl test strips (FTS), and (ii) support for, and preferences regarding, drug checking services among people who use heroin.

Methods Data were obtained from 78 people who had used heroin in the past 6 months, recruited from treatment and harm reduction services in Sydney, Australia in 2020–21. Participants were provided with 10 BTNX Rapid Response™ single-use immunoassay FTS and surveyed 4 weeks later.

Results Among those who completed the follow-up survey (n = 72), 81% (n = 58) had used at least one FTS by the time of follow-up (median 6 strips). Participants reported high confidence in their ability to use FTS at both baseline (immediately post training) and follow-up. Of those who self-reported a positive FTS result (n = 25), 48% (n = 12) reported using less than they otherwise would have or starting with a smaller amount, and 60% (n = 15) shared this information with peers and/or health professionals. Of those who used FTS and responded, 95% (n = 54/57) reported that they would continue using FTS if they were free to access, and 97% (n = 56/58) would recommend them to their peers. Among those who completed the follow-up survey, the majority (93%; n = 67) reported that they would like to be able to access a drug checking service, preferably via a supervised injecting facility or Needle and Syringe Program.

Conclusions Acceptability of FTS and support for drug checking were high among our sample. Multi-instrument approaches to drug checking may form one component of an effective response to the emerging threat of illicitly manufactured synthetic opioids.

Keywords Opioids, Fentanyl, Drug checking

*Correspondence:
Rachel Sutherland
rachels@unsw.edu.au
Full list of author information is available at the end of the article

Background

Illicitly manufactured synthetic opioids comprise an array of synthetic analogs, including novel synthetic opioids (NSO; e.g., nitazenes) and illicitly manufactured fentanyl, and are typically of greater potency than opioids like heroin, with corresponding elevated toxicity risk [1, 2]. These substances have contributed to hundreds of thousands of deaths worldwide [3–6], particularly in North America [7]. In the United States, 38,382 deaths involving 'illegally-made fentanyls' were recorded in 2022 [8], while in Canada, 82% of opioid related overdoses in 2023 involved fentanyl and/or fentanyl analogues, increasing by 44% since 2016 when national surveillance began [9]. In response to this public health crisis, community-based organisations in both countries began distributing fentanyl test strips (FTS) so that people who use drugs could test their substances for the presence of fentanyl and/or fentanyl analogues. These commercially available test strips have been designed to detect fentanyl, related analogues and their metabolites in urine (post-consumption), however can be used off-label to test drug samples and residue (pre-consumption) [10]. The results of studies examining distribution of FTS in this context show high consumer acceptability of such a strategy, as well as the potential to result in changes to drug use behaviour [11–15]. To-date, there are no studies which have explicltly examined the distribution of take-home nitazene test strips, likely due to the fact that nitazenes are a more recent and emerging public health concern, with the strips first made commercially available in 2024.

It cannot be assumed that findings regarding the acceptability of take-home FTS are transferrable to countries where fentanyl, or other NSO, adulteration and harms have not been widely documented, and where there may subsequently be less of a perceived 'need' for such initiatives among people who use drugs [16]. Australia has not yet witnessed the same magnitude of overdoses related to illicitly manufactured synthetic opioids: between 2000 and 2021, 31 NSO-related deaths were identified [17], while 5% of all fentanyl-related deaths were attributable to fentanyl analogues and/or illicitly manufactured fentanyl [18]. There is, however, evidence of an emerging risk to public health in Australia, with an increasing number of public health alerts regarding NSO-adulterated products [19], and large documented seizures of illicitly manufactured fentanyl and nitazenes [e.g., 20, 21]. Further, there is widespread concern that the reduction in opium production in Afghanistan may result in an increase of synthetic opioids in international markets [22], including Australia. Thus, it is of critical importance that Australia is prepared to respond if harms escalate.

Despite studies from North America demonstrating that take-home immunoassay strips are are a potentially scalable and low-cost response to the public health threat of undetected opioids, there is no routine provision of fentanyl or other immunoassay strips in Australia. Some harm reduction services do provide fentanyl test strips free of charge, but this is done on an ad-hoc basis, with 'transaction' limits applied by some services (e.g., can order FTS online free of charge, but can only order one 'test kit' which includes two FTS and a postage charge applies). Further, there are few Australian studies that have explicitly examined take-home ummonassay strips as an option. Three studies used FTS to test the urine of clients entering supervised injecting facilities [16, 23, 24], one of which documented concerns about low consumer interest and testing fatigue among staff and clients of supervised injecting facilities [16]. However, to-date, there remain no studies which have assessed the use of FTS to test drug samples/residue, or the distribution of take-home FTS. Providing the option for people to test their substances prior to consumption carries clear harm reduction benefits compared to testing their urine post consumption. Further, distributing take-home FTS or other immunoassay strips via drug treatment or needle syringe program settings, as has been done in North America, has the potential to increase the accessibility of this harm reduction initiative.

The provision of drug checking services, whereby drug samples are received and tested, with results disseminated back to the client alongside tailored education [25], is another potential response option to the public health threat of illicitly manufactured synthetic opioids. These services are particularly important given the increasing fluidity and complexity of drug markets, with much of the concern about illicitly manufactured synthetic opioids in Australia shifting from fentanyl to nitazenes. Currently, more sophisticated technology (e.g., gas chromatography–mass spectrometry) is needed for reliable detection of a range of illicitly manufactured synthetic opioids, which is only available via (some) drug checking services. In Australia, drug checking services are available at certain events (e.g., festivals) and there are currently four fixed site drug checking services operating in Canberra, Sydney, Brisbane, and the Gold Coast. Some Australian studies have examined design features of a drug-checking service that would be feasible, attractive and likely to be used by Australian festival and nightlife attendees [26], yet there remains limited research on the acceptability of such services among those most likely to be exposed to illicitly manufactured synthetic opioids. One Australian study found that, among a sentinel sample of people who inject drugs, 75% would be willing to use a fixed site drug checking service [27], while a survey

of clients entering supervised injecting facilities (n = 34) found that 26% would be 'highly likely' to get their drugs checked without a research payment, if the test was conducted before using, and 42% would be 'highly likely' if the test was after using. However, more specific details about preferred service design features among such populations remain limited.

This study will address these knowledge gaps by examining the following among a sample of people who use heroin in Sydney, Australia:

(1) The acceptability of, and behavioural outcomes associated with, take-home FTS.
(2) Support for, and preferences regarding, drug checking services.

While aim 1 relates specifically to FTS, we believe the findings will generate important learnings that can be applied to the emerging threat of other illicitly manufactured synthetic opioids (e.g., nitazenes), and the potential take-home distribution of other immunoassay strips.

Methods

Study design and participants

Participants were recruited from Rankin Court Treatment Centre, a public opioid treatment program, and Kirketon Road Centre, a harm reduction based primary health care service for people who use drugs. Both services are located in Sydney, Australia, within close proximity (i.e., < 1 km) to the Sydney Medically Supervised Injecting Centre. Eligibility criteria comprised: (i) being 18 years or older; (ii) any heroin use in the past 6 months, (iii) consent to participate in a naloxone training program (or engagement in naloxone training in the previous 2 years); and (iv) consent to provide contact details (to allow follow-up). Eligibility criterion (iii) was included to mitigate the risks associated with a false negative result, with participants also informed that fentanyl or fentanyl analogues may still be present in a sample despite a negative test strip result.

Eligible participants attended a short training session, delivered by health care workers at each of the services (authors MS, RG and ES), on how to use FTS to test their drug solution/residue, and how to interpret the results (see Appendix A for further details). Upon completion of the training, participants received 10 BTNX Rapid Response™ single-use immunoassay FTS, as well as written and visual materials on how to use and interpret the test strips. All participants also received take-home naloxone, as well as general overdose information (see Appendix A) and were reimbursed 10AUD for this initial training and provision of contact and demographic information.

Four weeks after receiving the FTS, participants were contacted via their preferred method of contact (text, call, email) to schedule a follow-up survey. The follow-up, face-to-face survey was conducted by a Research Assistant and took approximately 20–30 min to complete, with participants reimbursed 50AUD.

All information disclosed was anonymous and confidential. Ethical approval was granted by South East Sydney Local Health District Human Research Ethics Committee (2019/ETH13776), with the project registered as a clinical trial with the Australian New Zealand Clinical Trials Registry and the Therapeutic Goods Administration (ACTRN12620000872932 and FYLAUS001, respectively). Findings are reported according to the STROBE checklist (see Appendix B).

Measures

The full baseline and follow-up surveys are provided in Appendix C, with the surveys conducted between July 2020 and July 2021.

Baseline survey

Participants were asked basic demographic information (i.e., age, gender identity), drug use information (i.e., frequency of injection/use in past month, which drugs used), as well as whether they suspect previous drugs they've consumed had been adulterated with fentanyl and whether they were concerned about fentanyl adulteration. After completion of the short training session, participants were also asked whether they felt confident using and interpreting the results of the test strips.

Follow-up survey

At the follow-up survey, participants were asked whether they had used any of the 10 FTS they had been given. Participants who had not used all, or any, of the FTS were asked why not. Those who reported yes were then asked a series of questions about how many strips they used, what drugs they tested, where they were, and what the reported results were.

Participants who reported receiving a positive result for fentanyl were asked whether this changed the way they used the tested substance, while participants who had not received a positive result (or had not used the test strips) were asked what they think they would have done had they received a positive detection.

Participants were also asked about their willingness to use other drug checking services, including whether they would be willing to provide a sample of their drugs for testing, as well as how long they would be willing to wait for the results, where they would like these services to be located, and if/how they would like to receive drug alerts.

Participants were also asked what concern/s, if any, they may have about drug checking.

Analysis

Data were analysed using SPSS (Version 27) and are reported descriptively, presented as a valid percent.

Results

A total of 80 participants completed the baseline survey: two participants were later found to be ineligible (i.e., had not used heroin in past 6 months), resulting in total sample of 78. Of these, 92% (n = 72) completed the follow-up survey (5 unable to be contacted, 1 deceased).

Sample characteristics

Of the baseline sample (n = 78), the median age was 43 (IQR: 39–49; range: 21–63) and 64% (n = 50) identified as male, 33% (n = 26) as female and 3% (n = 2) as non-binary or gender fluid. Approximately one-third (35%; n = 26) reported using heroin once a day or more in the past month, 58% (n = 45) had ever intentionally used fentanyl, 71% (n = 53) had ever experienced an opioid overdose (16% [n = 12] in past year) and 12% (n = 9) reported previous engagement with drug checking (7% [n = 5] in past year), either using a drug testing kit or drug checking service.

Among those who answered, 68% (n = 43/63) suspected that they had previously consumed drugs adulterated with fentanyl, and 76% (n = 56/74) reported being concerned about their drugs being contaminated with fentanyl.

Aim 1: consumer acceptability

Uptake and details of use

Among those who completed the follow-up survey (n = 72), most (81%, n = 58) had used at least one test strip by the time of follow-up, using a median of 6 strips (range 1–10) (Table 1).

Among those who had used a test strip (n = 58), almost all (95%, n = 55) reported using the strips to test heroin samples, and 29% (n = 17) to test methamphetamine. The majority reported using the strips in their own home (83%, n = 48), with smaller numbers using them at someone else's home (17%, n = 10) or at the Medically Supervised Injecting Centre (MSIC; 14%, n = 8). Four-fifths (81%, n = 47) reported that they were with other people from their social network at the time of using the strips, and 14% (n = 8) reported that a health professional was present (i.e., those who injected at MSIC). Approximately one-third (35%; n = 20) reported being alone on at least one of the occasions they used the strips.

A total of 342 strips were used, representing 48% of the FTS given to participants who completed the follow-up survey (n = 720), with an additional 72 (10%) reported as being given away to other people. Of the 342 strips used, 269 (79%) returned a self-reported negative result, 56 (16%) a positive result and 15 an invalid result. These results were self-reported by participants and were not analytically verified.

The main reason/s that participants gave for not using all, or any, of their strips (n = 60) was that they did not have them on them at the time of use (e.g., consuming the drug at someone else's place, but strips were at home) (22%; n = 17) or they forgot they had them (20%; n = 12). One-third (33%; n = 20) reported that they had injected substances < 10 times since their baseline survey (i.e., had strips left over despite using a test every time they injected).

Table 1 Uptake of fentanyl test strips, self-reported results, and context of use

	N = 72
Used at least one FTS by time of follow-up survey % (n)	81 (58)
Among those who reported use of FTS (n = 58)	
Self-reported result/s % (n)	N = 57[#]
At least one positive result	44 (25)
At least one negative result	97 (55)
At least one invalid result	12 (7)
Median number of FTS used (IQR)	6 (4–8)
Total number of FTS used	342
Negative	*269*
Positive	*56*
Invalid	*15*
Don't know	*2*
Total number of FTS given away	72
Substances tested^ % (n)	N = 58
Heroin	95 (55)
Methamphetamine	29 (17)
Location of testing^ % (n)	N = 58
Own home	83 (48)
Someone else's home	17 (10)
Medically Supervised Injecting Centre	14 (8)
Who with when used FTS^ % (n)	N = 58
Friend/partner/peer/relative/acquaintance	81 (47)
Alone	35 (20)
Health professional	14 (8)
Why did not use any/all FTS^ % (n)	N = 60
Number of strips exceeded number of times injected	33 (20)
Didn't have them on me when using	22 (17)
Forgot I had them	20 (12)
Gave the rest away	10 (6)

One participant could not remember all of their results, so were excluded from analysis. ^Responses options endorsed by ≤ 5 participants are not presented; multiple responses could be selected

Perception of strips

Of those who had used the strips and responded, most viewed the strips favourably, reporting that would continue using the strips (95%; n = 54/57) if they were free to access, and that they would recommend them to their peers (97%; n = 56/58).

At both baseline and follow-up survey, the vast majority of participants were confident in their ability to both use the strips, and to interpret the results (see Fig. 1).

Behavioural outcomes

Of those who reported a positive fentanyl detection using the test strips (n = 25), 48% (n = 12) reported that they used less than they otherwise would have or started with a smaller amount. An additional 60% (n = 15) reported sharing this information with peers and/or health professionals, and 40% (n = 10) told their dealer/supplier. Notably, one-fifth (20%; n = 5) reported using the test after they had already consumed the substance (this accounts for some of those who reported 'using as originally intended').

Notably, these self-reported behaviours cover multiple occasions of use, and may have changed over time. For example, one participant reported that after their first positive detection they consumed the substance anyway and overdosed. For each of the subsequent positive detections they self-reported that they disposed of the drugs.

Participants who had not received a positive result (or had not used the test strips) were asked what they *think they would have done* had they received a positive detection. Among these participants (n = 45), 53% (n = 24) reported that they thought they would use less or start with a smaller amount, while 27% (n = 12) reported they would use as originally intended. Approximately one-quarter (29%; n = 13) reported that they would tell their

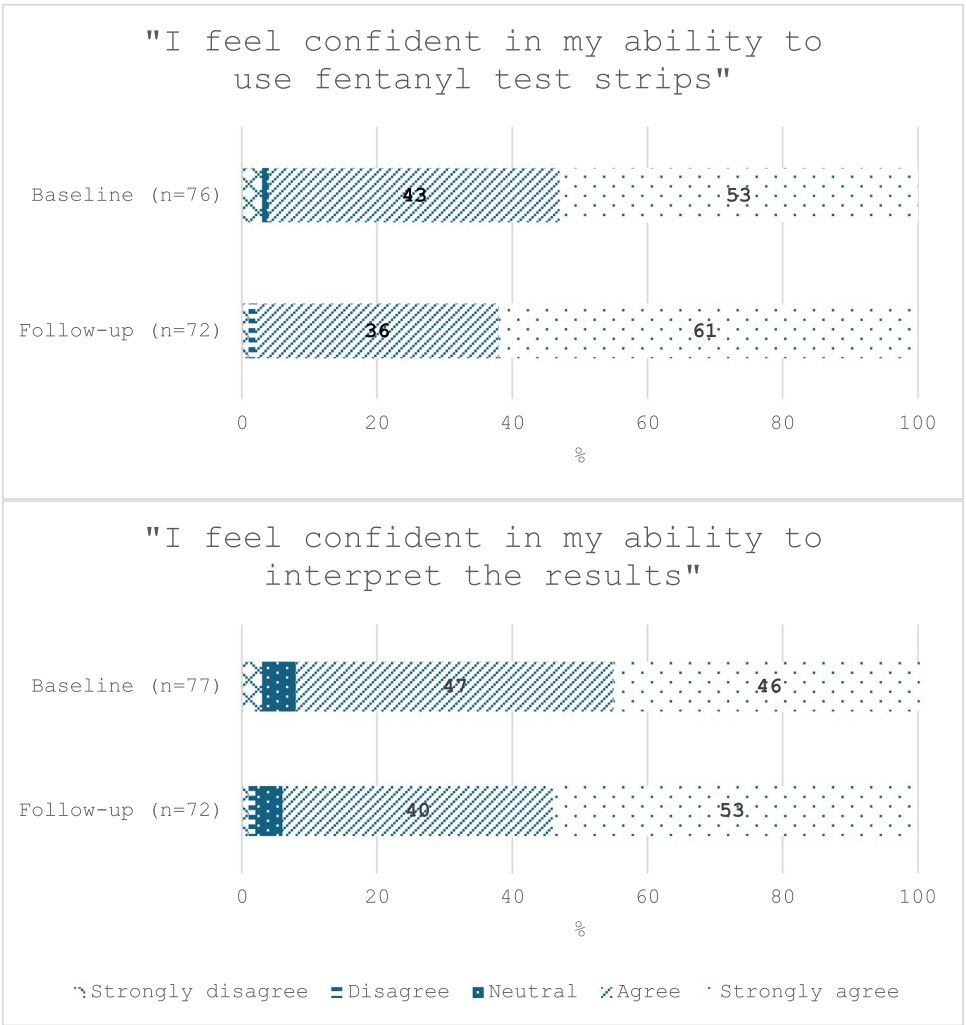


Fig. 1 Confidence in ability to use, and interpret the results of, fentanyl test strips. Note: Data labels suppressed for infrequently endorsed (n ≤ 5) response options

dealer/supplier and 24% (n = 11) reported they would tell others (Fig. 2).

As noted above, one person reported overdosing after consuming a substance that had tested positive for fentanyl. No participants reported overdosing after consuming a substance that had tested negative or invalid.

Aim 2: support for drug checking services

Among those who completed the follow-up survey, the majority (93%, n = 67) reported that they would like to be able to access a drug checking service to have the contents and/or purity of their substances tested. Of these participants, 99% (n = 66) reported that they would like to be able to check purity of their substances and 93% (n = 62) reported that would like to test the entirety of the contents: the majority (97%, n = 65) reported that it would be acceptable to give up a pinhead's amount of drug for the test to be undertaken (Table 2).

How long people would be willing to wait for results varied considerably. If the testing were conducted in-person (n = 67), people most commonly reported being willing to wait between 5 and 15 (27%; n = 18) and 16–29 (24%; n = 16) minutes. The majority of participants reported that they would not post in a substance for testing, although one-in-five (18%; n = 12) reported that they would be willing to wait 1–2 days for the results (Table 2).

Among those who would like to be able to access a drug checking service (n = 67), the majority reported that they would feel most comfortable getting their drugs tested at a supervised injecting facility (73%; n = 48), followed by a Needle and Syringe Program (53%; n = 35). Almost all (99%; n = 66) participants reported that they would like to receive a drug alert from a drug checking service if a public health threat was detected, mostly via SMS (76%; n = 51).

Among those who reported a desire to be able to access drug checking services (n = 67), most reported that they had no concerns about accessing such services (60%; n = 40), although approximately two-fifths (37%; n = 25) reported concerns about the potential to be targeted by police. Few (n < 5) participants nominated any of the remaining pre-defined concerns (i.e., giving up some of the drug for testing; time spent waiting for results; lack of access; incorrect results; drug dealers using it as a quality control measure), although 12% (n = 8) identified some other concerns—these were predominantly concerns about confidentiality.

Discussion

This is the first study to examine acceptability of *take-home* fentanyl test strips in the Australian context. Consistent with international studies [11–15], we found

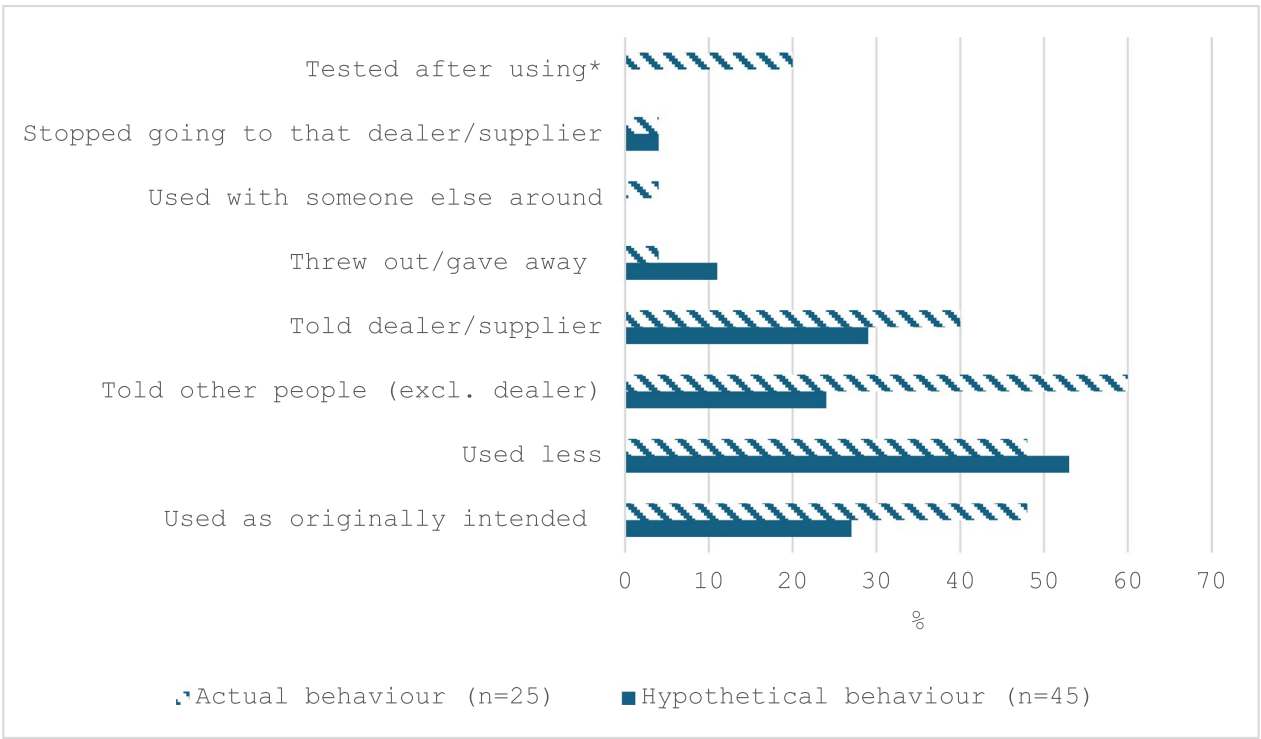


Fig. 2 Behavioral changes after receiving a self-reported, or hypothetical, positive detection for fentanyl *Was derived from the 'other' response option. Note: people could endorse multiple responses. 'Used less' incorporates 'used less than originally intended', 'went slower' and 'consumed a tester (i.e. started with a smaller amount to see what it was like)'

Table 2 Support and preferences for drug checking services

	N = 72 % (n)
Would like to able to access a drug checking service	93 (67)
Among those who would like to be able to access a drug checking service (n = 67):	
Willingness of give up a pinhead's worth of drug for testing	97 (65)
Type of testing^	N = 67
All contents (psychoactive and non-psychoactive)	93 (62)
Purity	99 (66)
Preferred location of drug checking service^	N = 66
Supervised injecting centre	73 (48)
Needle & Syringe Program	53 (35)
Drug treatment service	23 (15)
Pharmacy	14 (9)
Length of time willing to wait for results	
In-person	N = 67
< 5 min	15 (10)
5–15 min	27 (18)
16–29 min	24 (16)
30–59 min	9 (6)
1 h or more	8 (5)
1–2 days (e.g., confirmation testing)	9 (6)
3–7 days (e.g., confirmation testing)	9 (6)
Via post	N = 67
< 24 h	2 (1)
1–2 days	18 (12)
3–7 days	6 (4)
> 7 days	8 (5)
Would not post in my substances	67 (45)
Preferred way to receive drug alerts from drug checking service^# % (n)	N = 67
SMS/text message	76 (51)
Nurses/workers at health services/clinics/Medically Supervised *Injecting Centre*	34 (23)
Email	22 (15)
Phone call	22 (15)
Peer workers	18 (12)
Social media	13 (9)
Traditional media (e.g., newspaper, television)	12 (8)

^Responses options endorsed by ≤ 5 participants are not presented (note: this not applied where response options are cumulative). #Note: Only one participant reported they would not like to receive drug alerts

high uptake of FTS, as well as high willingness to continue using the test strips, if they were free to access, and to recommend to their peers. Further, of those who reported a positive fentanyl detection, approximately half reported using less than they otherwise would have or starting with a smaller amount. This is consistent with studies of both take-home fentanyl test strips [28] and festival-based drug checking services [29, 30], which demonstrate changes in behaviour in response to drug checking results across a broad spectrum of people who use drugs. Although a small sample, these findings lend support to the growing evidence base that people who use drugs want objective information about the contents and/or purity of their drugs, and will change their behaviour accordingly, challenging the persistent narrative that people who inject drugs are 'irresponsible' with their health [31].

However, despite high acceptability of FTS, the high proportion of self-reported positive results led to concerns among the research team about potential misinterpretation of the results (see Appendix A for further

information). That is, while participants self-reported high confidence in being able to interpret the results of FTS, two-fifths self-reported receiving at least one positive detection for fentanyl (56 total detections in total; 16% of samples tested). This was considerably higher than expected, with other studies showing rare identification of fentanyl adulterated substances in the Australian market [16, 23]. Upon investigation, it was found that the second line on the test strip (which indicates that fentanyl has *not* been detected) can be very faint, an issue that has since been identified in a number of studies [16, 24]. There were also anecdotal reports from participants that they found it counterintuitive that one line indicated a positive detection, with the inverse being the case for many other test strips (e.g., pregnancy test strips, rapid antigen tests). Given the self-reported results in the current study were not analytically verified, we cannot conclusively state whether test results were being misinterpreted, however we suspect that this may have been the case, in at least some situations.

A number of limitations associated with BTNX Rapid Response™ FTS have emerged since this study was undertaken, which may further explain the high proportion of positive results reported in the current study. Specifically, studies have found that when non-fentanyl drugs and adulterants are present in high concentrations, BTNX Rapid Response™ FTS can give a false positive result, and additionally the presence of certain drugs (e.g., MDMA, methamphetamine) can generate false positive readings [32]. The latter of these findings is particularly concerning given the increasingly complex fentanyl market in North America, with most of the fentanyl detections in the United States including stimulants [33]. Another study of four different brands of commercially available FTS (including BTNX Rapid Response™) found that results were highly concentration dependent, such that the authors categorised a faint second line as 'slightly' positive (rather than negative) [34]. It has subsequently been recommended that positive detections from fentanyl test strips are analytically verified [16, 24], however this may not feasible in the context of self-testing (i.e., confirmatory analyses, conducted via gas chromatography–mass spectrometry, is not routinely available across Australia).

Combined, these findings indicate further work is required to enhance test interpretation if BTNX Rapid Response™ FTS are to be more broadly distributed in a take-home capacity, particularly in countries where there is not widespread fentanyl adulteration. That is, in countries where there is widespread fentanyl adulteration, the current limitations of FTS are arguably outweighed by the public health threat posed by adulterated substances. However, in countries where adulteration is low, the possibility that high rates of false positives will result in broader distrust of drug checking technologies arguably outweighs the benefit of providing FTS. While some of above limitations have been documented in other brands of FTS [e.g., 34, 35], it is unknown if these limitations apply to all brands, or to immunoassay strips which test for other types of illicitly manufactured synthetic opioids. However, given that some of the test strips (e.g., nitazene test strips) are produced by the same manufacturer (i.e., BTNX), we would suggest that similar studies need to be undertaken to test for reliability and cross-reactivity with a range of substances and concentrations, and to ensure that those using these strips are provided with the appropriate information to allow for accurate interpretation of results. Further, we would urge efforts to improve the sensitivity of these immunoassay strips, and where possible to improve processes to overcome these potential limitations. Indeed, if it were not for limitations with the strips themselves, we believe that our findings provide support for the widespread roll-out of a range of take-home immunoassay strips.

These limitations could partially be overcome via formal drug checking services, provided by appropriately trained staff, and with more sophisticated technologies. Indeed, we found that the majority of participants expressed a desire to be able to access drug checking services to test their drugs for both content and purity and were willing to provide a small amount of their drugs for such testing to occur. This is consistent with broader surveys of people who inject drugs, which found that 75% of participants reported they would use drug checking services, if available [27], although it remains unclear how often such populations would be willing to use these services given their generally high frequency of injecting drug use [16]. Notably, being targeted by police was a common concern reported by participants. This is a consistent theme across many studies [36], highlighting the importance of services being able to operate without fear of disruption from the police. Indeed, it has been argued that a policy environment consisting of transparent support for drug checking services, including from high-level police 'champions', is necessary to facilitate the mechanisms of wider public support and increase perceived legitimacy of drug checking services [36].

As noted previously, Australia now has four fixed site drug checking services, all of which are operating either at Needle and Syringe Programs (NSP), or in collaboration with organisations running NSPs, and at supervised injecting facilities: this aligns with the preferred locations identified by participants in the current study. However, these services remain limited in scope (e.g., the service in Sydney is a pilot, which will test samples for up to 100 participants) and are only available in three out of eight jurisdictions. Further, many NSO can only be detected by more complex testing approaches (e.g., gas chromatography–mass

spectrometry), which is expensive and can take days to return a result [37]. This may not be acceptable to certain people who use drugs, with only one-in-five participants in the current study reporting that they would be willing to wait a few days for confirmatory testing.

Indeed, no single instrument can achieve all of the objectives of drug checking [37], and multi-instrument approaches will likely be required to effectively respond to the potential threat of illicitly manufactured synthetic opioids. This must occur alongside other established (e.g., naloxone, opioid agonist therapy) responses to opioid overdose [38], although it has been argued that such interventions are being compromised by the increasing complexity and polysubstance profile of drug markets [39]. Indeed, drug-checking services are constantly playing 'catch-up' with the emergence of novel psychoactive substances. Thus, new policy options, such as the provision of pharmaceutical grade substances [i.e., 'safer supply'; 40], also need to be considered when assessing our preparedness to respond to the public health threat of illicitly manufactured synthetic opioids.

Limitations

This pilot study comprised a small sample of people who use heroin in Sydney, and our findings cannot be considered representative of all people who use/inject heroin. Further, findings could be influenced by selection bias, with most participants reporting that they suspected that they had previously consumed fentanyl-adulterated substances and/or that they were concerned about fentanyl adulteration at the time of the survey. This could have resulted in higher consumer acceptability of both FTS, and drug checking more broadly, than would be otherwise be the case. We used a brand of FTS currently available and easily accessible in Australia. However, we do not know if the issues of test interpretation would apply should a different product be used. Further, the study was conducted during COVID, but before the widespread use of Rapid Antigen Tests (RATs): it is possible that the subsequent roll-out, and widespread use, of RATs has increased familiarly with, and confidence using, other immunoassay strips such as FTS. Finally, the results of the fentanyl test strips were self-reported and were not analytically verified, and we were unable to assess results by substance type. However, it was not the purpose of this study to assess the accuracy of these strips, but rather to examine uptake and willingness to utilise them in a take-home context.

Conclusion

Exposure to illicitly manufactured synthetic opioids present a serious public health concern, with take-home test strips and drug checking services potential responses to this emerging threat. We found that there was high acceptability of take-home FTS among people who use heroin, as well as a desire to be able to access drug checking services. Further, of those who reported a positive fentanyl detection, approximately half reported using less than they otherwise would have or starting with a smaller amount. There are, however, concerns about the potential for BTNX Rapid Response™ FTS to generate 'false positives', and further work is needed to validate reliability of other immunoassay strips and, where possible, to provide immunoassay strips that overcome these limitations. Indeed, if it were not for potential limitations of the strips themselves, we believe that our findings provide support for the widespread roll-out of a range of take-home immunoassay strips.

Appendix

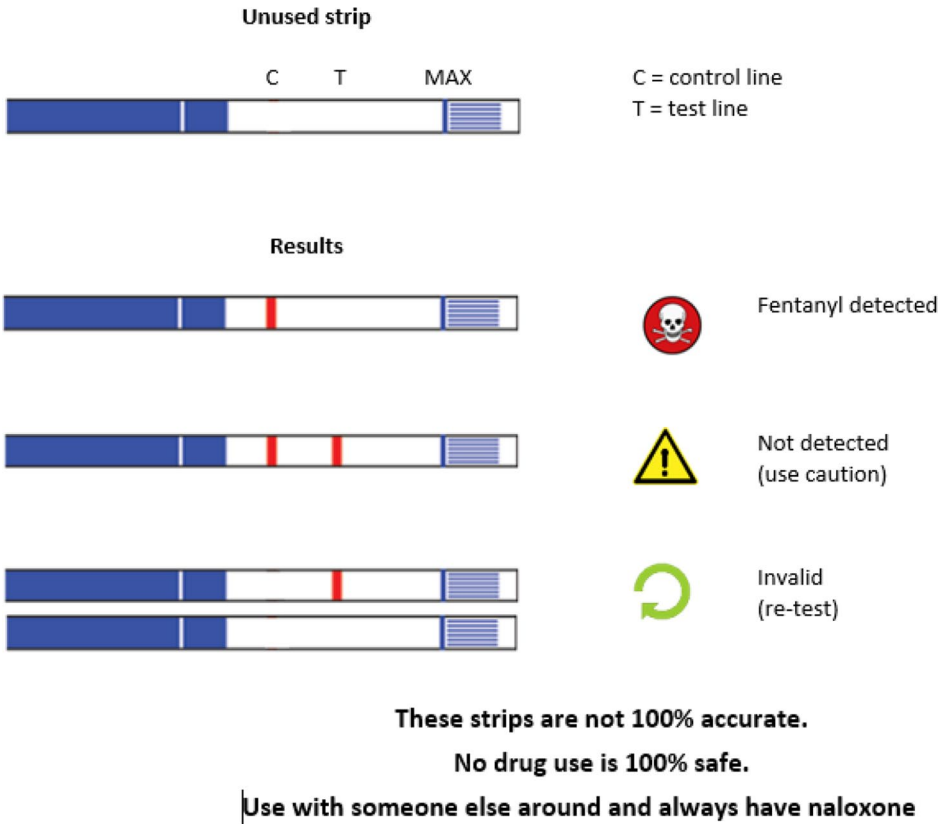
A. Training, and materials provided

Participants were required to watch two short videos, with authors MS, ES, or RG available to answer any questions that emerged throughout. Participants were able to ask for a demonstration of FTS if they were still uncertain how to use them (i.e., using water), however this was done on an ad hoc basis. The first of the videos is available here: https://www.youtube.com/watch?v=gIovAAV-Amg (note: this was edited to start from ~ 1.13 m and finish at ~ 3.45 m, and was overlayed with text explaining US-centric language—i.e., 'cooker = spoon'). The second video has since been removed from YouTube, however, can be provided upon request. Briefly, the first video showed how to test residue, whereas the second showed how to test drug solutions (i.e., a small sample of the drug mixed with water).

These videos were shown to ~ 6 members of the KRC consumer reference group prior to the study commencing, to ensure that they were fit for purpose and/or to determine whether a new video should be developed (individuals reimbursed 40AUD). It was originally intended that only one video would be used for the current study, however there was consensus from the group that it would be useful to show both videos, particularly given that they were fairly short (~ 2 to 3 min each) and covered slightly different methods of testing. It was determined that there was no need to develop a new video explaining how FTS are used and interpreted.

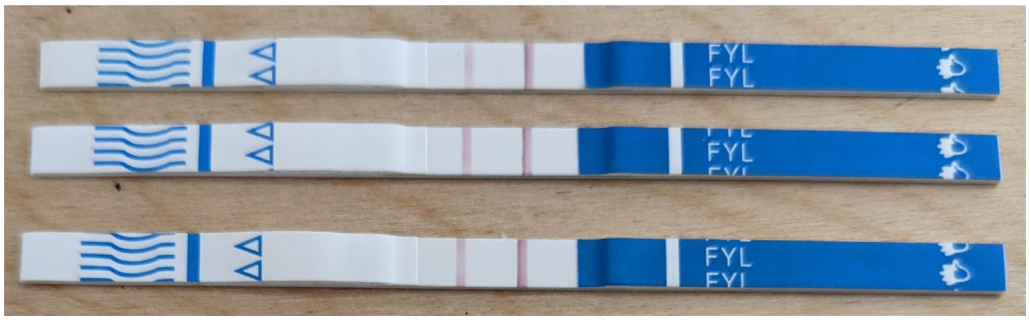
The FTS came with their own brochure and product inserts, however, to facilitate ease of interpretation the following materials were also provided (these align with those provided in https://doi.org/https://doi.org/10.1016/j.drugpo.2018.09.009, however were adapted

slightly to ensure that they were appropriate for the Australian context e.g., '999' changed to '000'):



Once concerns emerged about results being potentially misinterpreted*, participants were also shown the

following photos to illustrate variation in the faintness of the second line:



*Note: These concerns emerged after the first three follow-up surveys were completed, with all three participants reporting positive detections (in roughly half of the samples they tested). RS emailed the research team on 24 August 2020 to notify them of these results, and to determine if anyone was aware of similar reports (e.g., from clients attending the two recruitment sites, or from emergency departments (NE is the Clinical Director of the Alcohol and Drug Service at St Vincent's Hospital Sydney)). RS also contacted colleagues at Sydney's Medically Supervised Injecting Centre. No indications of fentanyl adulterated products (e.g., overdose) were noted. After examining the FTS that some participants had brought back, it was observed that very faint second lines were present (although results were no longer valid due to being weeks old). Combined, this led to suspicions that some results were being misinterpreted, and the training provided to participants was subsequently updated in late August/early September 2020.

B. STROBE Checklist

	Item No	Recommendation	Checked
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	✓
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	✓
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	✓
Objectives	3	State specific objectives, including any prespecified hypotheses	✓
Methods			
Study design	4	Present key elements of study design early in the paper	✓

	Item No	Recommendation	Checked
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	✓
Participants	6	(*a*) *Cohort study*—Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up	✓
		Case–control study—Give the eligibility criteria, and the sources and methods of case ascertainment and control selection. Give the rationale for the choice of cases and controls	
		Cross-sectional study—Give the eligibility criteria, and the sources and methods of selection of participants	
		(*b*) *Cohort study*—For matched studies, give matching criteria and number of exposed and unexposed	N/A
		Case–control study—For matched studies, give matching criteria and the number of controls per case	
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	✓
Data sources/measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	✓
Bias	9	Describe any efforts to address potential sources of bias	✓
Study size	10	Explain how the study size was arrived at	N/A
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	✓
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	✓
		(*b*) Describe any methods used to examine subgroups and interactions	✓
		(*c*) Explain how missing data were addressed	✓
		(*d*) *Cohort study*—If applicable, explain how loss to follow-up was addressed	✓
		Case–control study—If applicable, explain how matching of cases and controls was addressed	
		Cross-sectional study—If applicable, describe analytical methods taking account of sampling strategy	
		(*e*) Describe any sensitivity analyses	N/A
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	✓
		(b) Give reasons for non-participation at each stage	✓
		(c) Consider use of a flow diagram	N/A
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	✓
		(b) Indicate number of participants with missing data for each variable of interest	✓
		(c) *Cohort study*—Summarise follow-up time (eg, average and total amount)	N/A

	Item No	Recommendation	Checked
Outcome data	15*	*Cohort study*—Report numbers of outcome events or summary measures over time	N/A
		Case–control study—Report numbers in each exposure category, or summary measures of exposure	N/A
		Cross-sectional study—Report numbers of outcome events or summary measures	✓
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	N/A
		(*b*) Report category boundaries when continuous variables were categorized	✓
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	N/A
Discussion			
Key results	18	Summarise key results with reference to study objectives	✓
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	✓
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	✓
Generalisability	21	Discuss the generalisability (external validity) of the study results	✓
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	✓

*Give information separately for cases and controls in case–control studies and, if applicable, for exposed and unexposed groups in cohort and cross-sectional studies.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

C. Surveys

Baseline survey.

1. How old are you? _____ years.

2. Which of the following best describes your gender identity?

0	Female
1	Male
2	Non-binary/gender fluid
3	Different identity. **Specify**: _____
97	Don't know
98	Refuse to answer

3. During the last month approximately how often did you inject drugs?

0	Not in the last month
1	Monthly
2	Fortnightly
3	Weekly
4	More than once a week
5	Once a day
6	More than once a day
97	Don't know
98	Refuse to answer

4. During the last month approximately how often did you use heroin?

0	Not in the last month

1	Monthly
2	Fortnightly
3	Weekly
4	More than once a week
5	Once a day
6	More than once a day
97	Don't know
98	Refuse to answer

5. What other illicit substances have you used in the past month? (Do NOT include substances that have been prescribed to you)

[Mark all that apply]

1	Oxycodone (e.g. Endone, Oxycontin)
2	Morphine (e.g. MS Contin)
3	Methadone
4	Other opiates. **Specify:** _____
5	Methamphetamine
8	Cocaine
9	Pharmaceutical stimulants
10	Benzodiazepines
12	Cannabis
13	Other (specify)

6. Have you heard of fentanyl?

0	No (skip to Q11)
1	Yes
97	Don't know

7. Have you ever (intentionally) used fentanyl?

0	No (skip to Q10)
1	Yes, but not in the past month
2	Yes, in the past month
97	Don't know

8. Have you ever (intentionally) injected fentanyl?

0	No
1	Yes, but not in the past month
2	Yes, in the past month
97	Don't know

If yes, to past month use:

9. Thinking about your fentanyl use in the past month, was this prescribed to you, not prescribed, or both?

0	Prescribed
1	Not prescribed
2	Both
97	Don't know
98	Refuse to answer

If yes to Q6: Now we are going to ask you some questions about fentanyl. Please answer True, False or Don't know for the next five questions

10.1. Fentanyl is an opioid

0	False
1	True
97	Don't know

10.2. Fentanyl is not as strong as heroin

0	False
1	True
97	Don't know

10.3. Fentanyl comes on more quickly than heroin

0	False
1	True
97	Don't know

10.4. A drug checking test can detect if fentanyl has been mixed with other drugs like heroin

0	False
1	True
97	Don't know

10.5. Someone is more likely to overdose when using fentanyl-laced drugs than when using drugs that aren't laced with fentanyl

0	False
1	True
97	Don't know

Now I am going to read out a series of statements. Please answer strongly disagree, disagree, neutral, agree or strongly agree for the next four questions.

11. I enjoy using fentanyl

Strongly disagree	Disagree	Neutral	Agree	Strongly agree	DK/R

11a. I am concerned about my drugs being contaminated with fentanyl

Strongly disagree	Disagree	Neutral	Agree	Strongly agree	DK/R

12. I suspect that drugs I've previously consumed have been contaminated with fentanyl

Strongly disagree	Disagree	Neutral	Agree	Strongly agree	DK/R

13. I don't care whether there are adulterants in my drugs

Strongly disagree	Disagree	Neutral	Agree	Strongly agree	DK/R

13a. Getting value for money is more important than whether or not my drugs contain adulterants

Strongly disagree	Disagree	Neutral	Agree	Strongly agree	DK/R

14. I would like to be able to detect if there is any fentanyl in my drugs before I take them

Strongly disagree	Disagree	Neutral	Agree	Strongly agree	DK/R

15. I would like to be able to detect other adulterants (not just fentanyl) in my drugs before I take them

Strongly disagree	Disagree	Neutral	Agree	Strongly agree	DK/R

Drug checking allows you to have your drugs tested to find out what is in your drugs and how strong they are. The next few questions are about your previous experiences with drug checking.

15. Have you or someone else ever tested the content and/or purity of your illicit drugs, using a drug-testing kit or drug-checking service?

0	No (skip to Q20)
1	Yes, but not in the last year
2	Yes, in the last year
97	Don't know
98	Refuse to answer

16. The last time your illicit drugs were tested, using a drug-testing kit or drug-checking service, who did the testing?

1	I did
2	Someone else did
97	Don't know
98	Refuse to answer

17. Last time your illicit drugs were tested, what technology/service was used?

1	Personal testing kit (e.g. colourmetric or reagent test). **Specify:** _____
2	Face-to-face testing service (e.g., festival pill-testing service). **Specify:** _____
3	Postal/online testing service (e.g., Energy Control, Ecstasy Data). **Specify:** _____
4	Testing strips (e.g. BTNX fentanyl strips or other immunoassay testing strips). **Specify:** _____
5	Other. **Specify:** _____
97	Don't know
98	Refuse to answer

17a. Where were you the last time your drugs were tested using a testing strip?

1	Medically Supervised Injecting Centre (MSIC)
2	Private Home
3	Somewhere else

18. Still thinking about the last time your illicit drugs were tested, using a drug-testing kit or drug-checking service, what was the substance originally sold/given to you as?

1	Heroin
2	Methamphetamine
3	Cocaine
4	Ketamine
5	LSD
6	MDMA
7	Unknown substance (i.e. purchased/obtained as an unknown substance)
8	'Ground find' (i.e. substance was found on the ground)
9	Other. **Specify:** _____
97	Don't know
98	Refuse to answer

19. The last time your illicit drug composition was tested, what did the test suggest it contained?

1	Heroin
2	Fentanyl
3	Methamphetamine
4	Cocaine
5	Ketamine
6	LSD
7	MDMA
8	Unknown substance
9	NBOMe
10	PMA
11	N-ethyl-pentylone

12	Other. **Specify:** _____
97	Don't know
98	Refuse to answer

Thinking about harm reduction more broadly…

20. When you used heroin in the past month, did you do any of the following in an attempt to minimise potential harms?

[READ OUT ALL RESPONSES; MARK ALL THAT APPLY]

0	None
1	Consumed a test dose (i.e. started with a smaller amount to see what it was like)
2	Smoked instead of injected
3	Used with someone else around
4	Used the drug somewhere safe (like where someone could find me)
5	Obtained/carried naloxone/Narcan
6	Avoided combining substances
7	Attended the Medically Supervised Injecting Centre (MSIC)
8	Asked dealer about strength/new batch
9	Other: ***Specify*** _____

21. Have you ever experienced an opioid overdose?

0	No
1	Yes, in the past year
2	Yes, but not in the past year
97	Don't know

Note: these questions are to be asked following the FTS training.

Now I am going to read out a series of statements. Please answer strongly disagree, disagree, neutral, agree or strongly agree for the next four questions.

22. I am confident in my ability to use fentanyl test strips to find out if fentanyl is in my drugs

Strongly disagree	Disagree	Neutral	Agree	Strongly agree	DK/R

23. I feel confident in my ability to read the results of the fentanyl test strips

Strongly disagree	Disagree	Neutral	Agree	Strongly agree	DK/R

24. Which of the two videos that you just watched did you prefer?

0	Video 1 (lady talking)
1	Video 2 (video with the hand/drawing)
2	Liked them both equally
97	Don't know
98	Skip question

Follow-up survey

Participant ID

1. During the last month approximately how often did you inject drugs?

0	Not in the last month
1	Monthly
2	Fortnightly
3	Weekly
4	More than once a week
5	Once a day
6	More than once a day
97	Don't know
98	Refuse to answer

2. During the last month approximately how often did you use heroin?

0	Not in the last month
1	Monthly
2	Fortnightly
3	Weekly
4	More than once a week
5	Once a day
6	More than once a day
97	Don't know
98	Refuse to answer

3. What other illicit substances have you used in the past month? (do not include substances that have been prescribed to you)

[Mark all that apply]

0	Fentanyl
1	Oxycodone (e.g. Endone, Oxycontin)
2	Morphine (e.g. MS Contin)
3	Methadone
4	Other opiates. **Specify:** _____
5	Methamphetamine
8	Cocaine
9	Pharmaceutical stimulants
10	Benzodiazepines
12	Cannabis
13	Other. **Specify:** _____

4. Have you experienced an opioid overdose in the past month, since we last spoke to you?

0	No (skip to Q4b)
1	Yes
97	Don't know (skip to Q4b)

4a. Did any of these overdoses occur after consuming a substance that you had tested using the fentanyl test strips?

0	No (skip to 4b)
1	Yes
97	Don't know (skip to 4b)

4ab. How many of these overdoses occurred after consuming a substance that tested positive for fentanyl, meaning you only saw one line on the test strip? __

4ac. How many of these overdoses occurred after consuming a substance that tested negative for fentanyl, meaning you saw two lines on the test strip? __

4ad. How many of these overdoses occurred after consuming a substance that produced an invalid result, meaning you saw no lines (or no control line) on the test strip? __

If Q4ac ≥ 0

4ae. The following question relates to the most recent overdose that occurred after consuming a substance that tested negative for fentanyl.

In your opinion, did the substance that you overdosed on contain fentanyl?

0	No (skip to Q4b)
1	Yes
97	Don't know (skip to Q4b)

4af. What makes you think that the substance that you overdosed on contained fentanyl? _____

4b. Have you overdosed on any other drug in the past month, since we last spoke to you?

0	No (skip to Q4c)
1	Yes
97	Don't know (skip to Q4c)

4ba. Did any of these overdoses occur after consuming a substance that you had tested using the fentanyl test strips?

0	No (skip to 4c)
1	Yes
97	Don't know (skip to 4c)

4bb. How many of these overdoses occurred after consuming a substance that tested positive for fentanyl, meaning you only saw one line on the test strip? __

4bc. How many of these overdoses occurred after consuming a substance that tested negative for fentanyl, meaning you saw two lines on the test strip? __

4bd. How many of these overdoses occurred after consuming a substance that produced an invalid result, meaning you saw no lines (or no control line) on the test strip? __

4be. The following question relates to the most recent overdose that occurred after consuming a substance that tested negative for fentanyl.

In your opinion, did the substance that you overdosed on contain fentanyl?

0	No (skip to Q4c)
1	Yes
97	Don't know (skip to Q4c)

4bf. What makes you think that the substance that you overdosed on contained fentanyl? _____

4c. Did you use any of the fentanyl test strips we gave you?

0	No (skip to Q11)
1	Yes

5. What substances did you test using the fentanyl test strips?

0	Heroin
1	Methamphetamine
2	Cocaine
3	MDMA
4	LSD
5	Other. **Specify: _____**

6. Where were you when you used the tests? [Mark all that apply]

0	Own home
1	Someone else's home
2	Car
3	Public place (e.g. park, carpark)
4	Private venue (e.g. pub)
5	Other: **Specify _____**
97	Don't know
98	Refuse to answer

7. Were you alone or with someone when you used the tests?

[Mark all that apply]

0	Alone
1	With friends/partner/peers/relatives/acquaintances
2	With dealer
3	With health professional
4	Other: **Specify** _____
5	Don't know

8. Would you use the tests again, if they were free to access?

0	No
1	Yes
97	Don't know

9. Would you recommend the tests to peers?

0	No
1	Yes
97	Don't know

10. Of the 10 tests we gave you, how many tests did you use? ____

11. Of the 10 tests we gave you, how many did you give away to others? ____

12. How many tests were positive for fentanyl, meaning you only saw one line on the test strip? ___

13. How many tests were negative for fentanyl, meaning you saw two lines on the test strip? ___

14. How many tests produced an invalid result, meaning you saw no lines (or no control line) on the test strip? ___

If Q12 ≥ 1:

15. What did you do after you found out that your substance contained fentanyl?

[Mark all that apply]

1	Used as originally intended (nothing different)
2	Used less than originally intended
3	Went slower
4	Consumed a tester (i.e. started with a smaller amount to see what it was like)
5	Smoked instead of injected
6	Used with someone else around
7	Used the drug somewhere safe (like where someone could find me)
8	Threw them out
9	Gave them away
10	Sold them
11	Got naloxone/Narcan
12	Told the dealer/supplier
13	Got money back from dealer/supplier
14	Beat up dealer/supplier
15	Told other people who use the same dealer/supplier
16	Stopped going to that dealer/supplier
17	Other: **Specify** _____

If Q12 = 0:

16. If the test *had* detected fentanyl, what do you think you would have done?

[Mark all that apply]

1	Used as originally intended (nothing different)
2	Used less than originally intended
3	Went slower
4	Consumed a tester (i.e. started with a smaller amount to see what it was like)
5	Smoked instead of injected
6	Used with someone else around
7	Used the drug somewhere safe (like where someone could find me)
8	Threw them out
9	Gave them away
10	Sold them
11	Got naloxone/Narcan
12	Told the dealer/supplier
13	Got money back from dealer/supplier
14	Beat up dealer/supplier
15	Told other people who use the same dealer/supplier
16	Stopped going to that dealer/supplier
17	Other: **Specify** _____

If Q13 ≥ 1:

17. What did you do after receiving a negative test result?

1	Used as originally intended (nothing different)
2	Used more than originally intended
3	Used less than originally intended
4	Used alone
5	Went slower
6	Consumed a tester (i.e. started with a smaller amount to see what it was like)
7	Smoked instead of injected
8	Used with someone else around
9	Used the drug somewhere safe (like where someone could find me)
10	Got naloxone/Narcan
11	Told the dealer/supplier
12	Told other people who use the same dealer/supplier
13	Other: **Specify** _____

If Q14 ≥ 1:

18. What did you do after receiving an invalid test result?

1	Re-tested the substance using a new test strip
2	Used as originally intended (nothing different)
3	Used more than originally intended
4	Used less than originally intended
5	Used alone
6	Went slower
7	Consumed a tester (i.e. started with a smaller amount to see what it was like)
8	Smoked instead of injected
9	Used with someone else around
10	Used the drug somewhere safe (like where someone could find me)
11	Got naloxone/Narcan
12	Told the dealer/supplier
13	Told other people who use the same dealer/supplier
14	Other: **Specify** _____

Only ask of those who answered < 10 to Q10.

19. Why did you not use any/all of the strips? (mark all that apply)

0	Not concerned about the presence of fentanyl and/or fentanyl analogues
1	Lost the strips
2	Forgot I had them
3	Didn't want to give up any of my drugs
4	Didn't want to wait for the results
5	Other: **Specify** _
97	Don't know

I am going to read out a series of statements. Please answer strongly disagree, disagree, neutral, agree or strongly agree for the next three questions.

20. I am confident in my ability to use fentanyl test strips to detect if fentanyl is in my drugs

Strongly disagree	Disagree	Neutral	Agree	Strongly agree	DK/R

21. I feel confident in my ability to read the results of the fentanyl test strips

Strongly disagree	Disagree	Neutral	Agree	Strongly agree	DK/R

We are interested in getting some more feedback on the use of the strips (note: these are open-ended, qualitative questions).

23. Did you have any problems or issues using the strips?

0	No (skip to Q25)
1	Yes
97	Don't know

24. If yes, what were they? What got in the way of using the tests?

25. Is there anything that would make it easier to use the tests?

26. How was the training we gave you?

27. Is there anything about the tests or this process that we are missing? What else should we know about?

(In addition, is there any way to improve the training session that you received?)

These next few questions are about drug checking more broadly.

Drug checking technologies can be used to test for the presence of a range of psychoactive and non-psychoactive substances, as well as the potency of a substance. In many countries, there are dedicated drug checking services, which consumers can visit in-person to have their substance tested by a health professional, or to which they can send their substances via post. Results are received anywhere from a couple of minutes post-testing (if visiting in-person) up to several days post-testing (if the substance is posted in or sent off for confirmatory testing).

28. Would you like to be able to access a service to have your drugs tested for contents and/or purity?

0	No (skip to Q38)
1	Yes
97	Don't know

29. What would you like to test your drugs for? (Contents, purity, both)

[Mark all that apply]

0	Absence or presence of a particular substance/s
1	All psychoactive contents
2	All contents (psychoactive and non-psychoactive)
3	Purity (i.e. how strong it is/what the dose is)
4	Other. **Specify:** _____

30. Where would you prefer to get your drugs checked? (Feel most comfortable)

[Mark all that apply]

Supervised injecting centre (i.e. MSIC/the gallery)
Hospital-based drug health service (e.g. Rankin Court, Langton Centre)
NSP Needle & Syringe Program
Pharmacy
Medical clinic (GP Practice)
Other community location (e.g. an anonymous shopfront; a church). **Specify:** _____
Would prefer to do it myself (i.e. personal testing kits)
Via post
Other. **Specify:** _____
Choose not to answer

31. If you had to give up a pinhead's worth of your drugs in order to run a drug checking test, would this be acceptable?

0	No
1	Yes
97	Don't know

32. If you were to attend a drug checking service in person, how long would you be willing to wait for the results?

0	< 5 min
1	5–15 min
2	16–29 min
3	30–59 min
4	1 h or more
5	1–2 days (e.g. confirmation testing)
6	3–7 days (e.g. confirmation testing)

33. If you were to post in your substances for testing, how long would you be willing to wait for the results?

1	< 24 h
2	1–2 days
3	days
4	> 7 days
5	Would not post in my substance

34. What concerns, if any, do you have about drug checking? (mark all that apply)

0	None
1	Giving up some of the drug sample for testing
2	Time spent waiting for test result
3	Lack of access
4	Being targeted by police
5	Incorrect results
6	Drug dealers using it as a "quality control" measure
7	Other: **Specify** _____
8	Chose not to answer

35. If you (or someone else) detected adulterants in your drugs, who would you tell? (mark all that apply)

0	No-one (skip to Q26)
1	Health professional
2	Peers/partner/friends
3	Dealer/supplier
4	The public (e.g. post on an online forum)
5	Other: **Specify**_____

36. How would you disseminate this message? (mark all that apply)

0	In-person
1	Voice/video call
2	Text message/Email/Private message
3	Social media post to friends
4	Social media post to private groups
5	Social media post to public
6	Web forums or website (e.g. pill reports)
7	Other: **Specify**_____

37. Most drug checking services will issue alerts if a public health threat is detected (e.g. high purity heroin, detection of dangerous adulterants). Ideally, how would you want to receive such alerts? [Mark all that apply].

0	Would not want to receive such alerts
1	Posters in health services/clinics/MSIC
2	Nurses/workers at health services/clinics/MSIC telling me
3	NUAA/peer workers telling me
4	SMS/text message
5	Email
6	Phone call
7	From friends
8	Traditional media (e.g. newspaper, TV)
9	Social media (e.g. Twitter, Facebook)
10	Phone app
11	Website
12	Other: **Specify** _____

Only ask of those who answered no to Q28.

38. If no to question 28: Why not?

[Mark all that apply]

0	I don't feel it's necessary (e.g. have a reputable dealer, would use substance regardless of result)
1	I don't think that it would be accurate
2	I'm worried that the police would get involved
4	I don't want to have to give up any drugs to have them tested
5	I don't want to wait for test result
6	Other: **Specify** _____
98	Chose not to answer

39. When you used heroin in the past month, did you do any of the following in an attempt to minimise potential harms?

[READ OUT ALL RESPONSES; MARK ALL THAT APPLY]

0	None
1	Consumed a tester (i.e. started with a smaller amount to see what it was like)
2	Smoked instead of injected
3	Used with someone else around
4	Used the drug somewhere safe (like where someone could find me)
5	Obtained/carried naloxone/Narcan
6	Avoided combining substances
7	Attended the Medically Supervised Injecting Centre
8	Asked dealer about strength/new batch
9	Other: **Specify** _____

Author contributions

All authors were involved in conceptualizing the manuscript and developing the methodology. MS, CR, ES, RG and PR delivered and/or oversaw the distribution of fentanyl test strips, and associated training. MS, ES, and RG undertook the baseline surveys, and RS (along with a Reserarch Assistant) conducted the follow-up surveys. RS wrote the original draft and conducted the formal analysis. MS, CR, ES, RG, AP, MB, NE, KS, RP, RB and PR contributed to the review and editing process. All authors read and approved the final manuscript.

Funding

Seed funding for this pilot study was provided by the National Centre for Clinical Research on Emerging Drugs (NCCRED) and the National Drug and Alcohol Research Centre (NDARC) funded by the Australian Government Department of Health and Aged Care under the Drug and Alcohol Program. RS and AP are supported by NHMRC fellowships (#1197241 and #1174630).

Data availability

No datasets were generated or analysed during the current study.

Declarations

Competing interests

RS has received untied educational funds from Seqirus. AP has received untied educational grants from Seqirus and Mundipharma for study of opioid medications. RB has received untied educational grants from Indivior and Mundipharma for study of opioid medications. Funding from these organisations has now ceased for all three authors, funding was for work unrelated to this project, and the funding bodies had no role in study design, analysis and reporting. RB has received speaker fees from Boehringer Ingelheim. RP and MB are members of The Loop Australia, a not-for-profit organisation established to deliver drug checking services. All other authors have no conflicts of interest to declare.

Author details

[1]National Drug and Alcohol Research Centre, UNSW Sydney, Sydney, NSW 2052, Australia. [2]NSW Ministry of Health, Sydney, Australia. [3]St Vincent's Hospital Sydney, Sydney, Australia. [4]Kirketon Road Centre, Kings Cross, Sydney, Australia. [5]School of Psychological Sciences, University of Tasmania, Hobart, Australia. [6]Social Equity Research Centre and Digital Ethnography Research Centre, RMIT University, Melbourne, Australia. [7]The National Centre for Clinical Research on Emerging Drugs (NCCRED), Sydney, Australia. [8]The Langton Centre, Sydney, Australia. [9]School of Medicine, UNSW Sydney, Sydney, Australia. [10]Kirby Institute, UNSW Sydney, Sydney, Australia.

Received: 4 December 2024 Accepted: 1 April 2025
Published online: 13 May 2025

References

1. Prekupec MP, Mansky PA, Baumann MH. Misuse of novel synthetic opioids: a deadly new trend. J Addict Med. 2017;11(4):256–65.
2. Salle S, et al. Novel synthetic opioids: a review of the literature. Toxicol Anal Clin. 2019;31(4):298–316.
3. Dai Z, et al. Fentanyl and fentanyl-analog involvement in drug-related deaths. Drug Alcohol Depend. 2019;196:1–8.
4. Daniulaityte R, et al. Trends in fentanyl and fentanyl analogue-related overdose deaths – Montgomery County, Ohio, 2015–2017. Drug Alcohol Depend. 2019;198:116–20.
5. Jones CM, Einstein EB, Compton WM. Changes in synthetic opioid involvement in drug overdose deaths in the United States, 2010–2016 Letters. JAMA. 2018;319(17):1819–21.
6. McGowan CR, et al. Fentanyl self-testing outside supervised injection settings to prevent opioid overdose: do we know enough to promote it? Int J Drug Policy. 2018;58:31–6.
7. Ciccarone D. The triple wave epidemic: supply and demand drivers of the US opioid overdose crisis. Int J Drug Policy. 2019;71:183–8.
8. Centers for Disease Control and Prevention, State Unintentional Drug Overdose Reporting System (SUDORS). Preliminary Data. 2024, US Department of Health and Human Services, CDC; [19/05/2024]: Atlanta, GA.
9. Federal provincial and territorial Special Advisory Committee on the Epidemic of Opioid Overdoses, Opioid- and Stimulant-related Harms in Canada. 2024, Public Health Agency of Canada; https://health-infobase.canada.ca/substance-related-harms/opioids-stimulants/: Ottawa.
10. Green TC, et al. An assessment of the limits of detection, sensitivity and specificity of three devices for public health-based drug checking of fentanyl in street-acquired samples. Int J Drug Policy. 2020;77:102661.
11. Krieger MS, et al. Use of rapid fentanyl test strips among young adults who use drugs. Int J Drug Policy. 2018;61:52–8.
12. Krieger MS, et al. High willingness to use rapid fentanyl test strips among young adults who use drugs. Harm Reduct J. 2018;15(1):7.
13. Peiper NC, et al. Fentanyl test strips as an opioid overdose prevention strategy: findings from a syringe services program in the Southeastern United States. Int J Drug Policy. 2019;63:122–8.
14. Tupper KW, et al. Initial results of a drug checking pilot program to detect fentanyl adulteration in a Canadian setting. Drug Alcohol Depend. 2018;190:242–5.
15. Mema SC, et al. Expanding harm reduction to include fentanyl urine testing: results from a pilot in rural British Columbia. Harm Reduct J. 2018;15(1):19.
16. Nielsen S, et al. Monitoring for fentanyl within Australian supervised injecting facilities: findings from feasibility testing of novel methods and collaborative workshops. Int J Drug Policy. 2023;115:104015.
17. Darke S, et al. Characteristics of fatal 'novel' synthetic opioid toxicity in Australia. Drug Alcohol Depend. 2022;232:109292.
18. Roxburgh A, Nielsen S. Twenty-year trends in pharmaceutical fentanyl and illicit fentanyl deaths, Australia 2001–2021. Int J Drug Policy. 2022;109:103854.
19. National Centre for Clinical Research on Emerging Drugs (NCCRED), Emerging drug briefing. Increasing Reports of Nitazene Toxicity in

Australia. 2024, NCCRED. Available at: https://nccred.org.au/wp-content/uploads/2024/04/Nitazenes-Emerging-Drug-Briefing.pdf: Sydney.
20. Australian Federal Police (AFP), Fentanyl warning following Australia's largest detection of deadly opioid. 2022, AFP; https://www.afp.gov.au/news-centre/media-release/fentanyl-warning-following-australias-largest-detection-deadly-opioid: Canberra.
21. Australian Federal Police (AFP), Rising imports of potent drug nitazene raises concern 2024, AFP; https://www.afp.gov.au/news-centre/media-release/rising-imports-potent-drug-nitazene-raises-concern: Canberra.
22. European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), EU Drug Market: Heroin and other opioids - Production of opioids. 2024, EMCDDA; https://www.emcdda.europa.eu/publications/eu-drug-markets/heroin-and-other-opioids/production_en: Lisbon.
23. Barratt MJ, et al. Urine drug screening for early detection of unwitting use of fentanyl and its analogues among people who inject heroin in Sydney Australia. Drug Alcohol Rev. 2018;37(7):847–50.
24. Lam T, et al. Infrequent detection of unintentional fentanyl use via urinalysis among people who regularly inject opioids in Sydney and Melbourne Australia. Addiction. 2022;117(8):2331–7.
25. Barratt MJ, Measham F. What is drug checking, anyway? Drugs, Habits Soc Policy. 2022;23(3):176–87.
26. Barratt MJ, et al. Pill testing or drug checking in Australia: acceptability of service design features. Drug Alcohol Rev. 2018;37(2):226–36.
27. Uporova J, Sutherland R, Peacock A. Level of support and willingness to use drug checking services among people in Australia who regularly consume illicit substances, 2022–2023, In: Drug Trends Bulletin Series. National Drug and Alcohol Research Centre, UNSW Sydney: Sydney; 2024.
28. Klaire S, et al. Take-home drug checking as a novel harm reduction strategy in British Columbia Canada. Int J Drug Policy. 2022;106:103741.
29. Measham F, Turnbull G. Intentions, actions and outcomes: a follow up survey on harm reduction practices after using an English festival drug checking service. Int J Drug Policy. 2021;95:103270.
30. Valente H, et al. A longitudinal study of behavioural outcomes following a visit to the Boom Festival 2018 drug checking service: individual and group level results. Drugs: Educ Prev Policy. 2023;30(4):373–82.
31. Lancaster K, Seear K, Treloar C. Laws prohibiting peer distribution of injecting equipment in Australia: a critical analysis of their effects. Int J Drug Policy. 2015;26(12):1198–206.
32. Halifax JC, et al. Testing the test strips: laboratory performance of fentanyl test strips. Harm Reduct J. 2024;21(1):14.
33. Friedman J, Shover CL. Charting the fourth wave: Geographic, temporal, race/ethnicity and demographic trends in polysubstance fentanyl overdose deaths in the United States, 2010–2021. Addiction. 2023;118(12):2477–85.
34. Bergh MS, et al. Selectivity and sensitivity of urine fentanyl test strips to detect fentanyl analogues in illicit drugs. Int J Drug Policy. 2021;90:103065.
35. Abbott DL, et al. ELISA screens for fentanyl in urine are susceptible to false-positives in high concentration methamphetamine samples. J Anal Toxicol. 2021;46(4):457–9.
36. Masterton W, et al. A realist review of how community-based drug checking services could be designed and implemented to promote engagement of people who use drugs. Int J Environ Res Public Health. 2022;19(19):11960.
37. Gozdzialski L, Wallace B, Hore D. Point-of-care community drug checking technologies: an insider look at the scientific principles and practical considerations. Harm Reduct J. 2023;20(1):39.
38. European Monitoring Centre for Drugs and Drug Addiction (EMCDDA), Opioid-related deaths: health and social responses. 2023. EMCDDA; https://www.emcdda.europa.eu/sites/default/files/pdf/14244_en.pdf?534557: Lisbon.
39. Fischer B. The continuous opioid death crisis in Canada: changing characteristics and implications for path options forward. Lancet Reg Health Am. 2023;19:100437.
40. Holland A, et al. "Safer supply" alternatives to toxic unregulated drug markets. BMJ. 2024;384:q6.

Publisher's Note