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Substances injected at the Sydney supervised injecting facility: A chemical analysis of used injecting equipment and comparison with self-reported drug type

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ABSTRACT

Providing information about substances injected can reduce the negative impact of illicit drug consumption and support people who inject drugs to make informed decisions. In Australia, information about drugs injected relies largely on periodic self-report surveys. For the first time, the analysis of the residual content of used injecting equipment was conducted in a supervised injecting facility (SIF) located in Sydney, Australia.

The aim was to gain a better understanding of the substances injected by clients through: (1) chemical analyses of the content of used syringes; (2) comparison of these results with clients' self-reported drug use; and (3) assessing the usefulness of analysing other injecting equipment to detect substances used.

During one week in February 2019, syringes and other injecting equipment were collected at the Sydney SIF. Their residual content was analysed by gas-chromatography/mass-spectrometry. Heroin was the most commonly detected substance (present in 51% of syringes), followed by methamphetamine (22%) and oxycodone (10%). In addition to the main psychoactive substance, cutting agents reported in the literature were also detected in used syringes. The main psychoactive substance identified by laboratory analysis reliably corresponded with users' self-reported drug type.

Analytical confirmation of substances injected allows for the provision of better targeted harm reduction messaging based on timely and objective data. The approach used is amenable to clients and feasible in the Australian SIF context. Upscaling and wider implementation could be done through Needle and Syringe Programs, and would support the early detection of harmful substances entering drug markets and better inform harm reduction strategies.

1. Introduction

Drug injection is associated with considerable mortality and morbidity due to overdose and infectious disease (Des Jarlais et al., 2005; Mathers et al., 2013). Australia's National Drug Strategy encompasses three pillars – demand reduction, supply reduction and harm reduction (Dolan et al., 2005). Harm reduction aims to reduce the negative impact of drug consumption by providing clean injecting equipment and specific risk advice, supportive environments (e.g. supervised injecting centres) and reducing risks.

Providing information about substances injected by people who inject drugs (PWID) in Australia currently relies on periodic self-report surveys (Iversen et al., 2017; Peacock et al., 2018). While results from these surveys are most informative, the methodology does not allow results to be confirmed analytically. Furthermore, the surveys rely on users' perceptions of the drug injected and their willingness to report

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the information (Evrard et al., 2010). Even if the main psychoactive substance is known to PWID, the presence of cutting agents are generally unknown or not reported (Broséus et al., 2015).

Chemical analysis of the residual content of used syringes provides important objective and complementary information about the substances injected. This knowledge allows better targeted harm reduction information and supports PWID to make informed decisions. However, to our knowledge, no such studies have been undertaken in Australian settings.

Since 2016, several European studies have already implemented this approach (Lefrançois et al., 2017, 2016; Néfau et al., 2015; Péterfi et al., 2016, 2014). The European Monitoring Centre for Drugs and Drugs addiction (EMCDDA) published a study entitled drugs in syringes from six European cities (Amsterdam, Budapest, Glasgow, Helsinki, Lausanne, Paris) (EMCDDA, 2019). Results show that consumption trends are different in neighboring European cities and at that time no fentanyl or analogues were detected. Meanwhile in North America, Blachman-Forshay et al. (2018) conducted a similar study and reported the presence of fentanyl and analogues in 17% of syringes collected. The success of these studies in Europe and North America inspired the actual study conducted at the Uniting Medically Supervised Injecting Centre in Sydney (Sydney SIF).

The Sydney SIF was established in Sydney in 2001 in response to the high rates of overdose and ambulance call outs in the vicinity. At the Sydney SIF, trained staff (nurses and health education officers), provide a low threshold and non-judgmental space, clean injecting equipment, supervision of injection episodes, overdose management and referral to a range of health and social services (Latimer et al., 2016). The Sydney SIF has approximately 16,500 registered clients, has supervised more than one million injections and successfully managed almost 8500 opioid overdoses (Uniting Medically Supervised Injecting Centre MSIC, 2019).

In this study we aimed to develop a better understanding of all substances injected by clients of the Sydney SIF by: (1) conducting chemical analyses of the content of used syringes and other injecting equipment; (2) comparing the results with self-reported drug type; and (3) assessing the usefulness of analysing other injecting equipment to detect substances used.

2. Materials and method

2.1. Design

During a seven-day period in February 2019, all used injecting equipment was retrieved from randomly selected disposal bins. The Sydney SIF has eight injecting booths where each booth can seats up to two people and contains one syringe disposal ('fit') bin. For each clients' visit, specific information is routinely recorded, including the substance the client intends to inject, the number of the booth they use for injection and other events that occur during the visit, including the nature and management of onsite overdoses. As the service routinely collects self-reported data on drugs injected, it is a unique source of real-time self-report drug trend information that can be compared to the chemical analysis of used syringes.

Once collected, the residual drug content of the used equipment was analysed by gas-chromatography/mass-spectrometry. The results were then compared to the substance self-reported by clients during the same time period.

All participants were informed of the voluntary and anonymous nature of the study and consented to the inclusion of their data. They were also informed that it was not possible to link the analytical results to an individual. An opt-out approach to consent was utilised whereby participants' used injecting equipment was included in the research unless they requested otherwise. If a client wished to be excluded, they informed staff and were directed to one of the remaining seven booths which were not being used for the study. The study had overwhelming support from clients and was informed and supported by the Sydney SIF Consumer Action Group. Ethics approval was obtained (ETH18-2295, University of Technology Sydney, Human Research Ethics Committee).

2.2. Sampling procedure

Syringes and other injecting equipment disposed of in syringe disposal bins were collected every day for a period of seven days from a randomly selected booth. The booth where the collection of used equipment occurred was randomly selected each day and was only known to staff (so client choice of booth was not influenced by the study). At the end of each day or when the syringe disposal bin was full, the bin was labelled with the date, time of collection, and booth number and put aside by clinical staff. The bins were then transported second-daily to the University of Technology Sydney (UTS) for analysis.

2.3. Chemical analysis

2.3.1. Chemicals and standards

Certified reference materials of the most common target compounds (psychoactive substances and cutting agents) were purchased from Novachem (Collingwood, VIC, Australia). Mephedrone, Methamphetamine, Cocaine, Fentanyl, Oxycodone, Buprenorphine, Phenobarbital, Paracetamol, Caffeine, Levamisole, Phenacetin, Morphine, Codeine, Diacetylmorphine and Methamphetamine-D5 were obtained as 1000 ppm methanolic solutions. Carfentanil, Ocfentanyl, Furanylfentanyl were obtained as 100 ppm methanolic solution. A mixture of phenazine (50 ppm) and methamphetamine-D5 (20 ppm) was used as the Internal Standard (IS). Liquid chromatography-mass spectrometry (LC–MS) grade methanol (MeOH) and ethyl acetate (EtAC) were purchased from ChemSupply (Gillman, SA, Australia). MEOH was used for extraction and a mixture of MEOH and EtAC was used as Gas-Chromatography/Mass Spectrometry (GC–MS) washes.

2.3.2. Sample preparation and instrumental analysis

The sample preparation and analysis occurred at UTS and followed the procedure published by Lefrançois et al., 2016 based on toxicology literature (Maurer, 2005; Pfleger et al., 1992). In short, syringe disposal bins were emptied and injecting equipment were separated according to their type (i.e. syringes, spoons, concealment bags and filters). The residual content of used injecting equipment was extracted with one milliliter of methanol (the syringes were filled and emptied five times, spoons and concealment bags were filled up with methanol, and filters were soaked in 1 ml of MeOH for one minute). Once the extraction was done, 250 µl methanolic extract was filtered into a GC–MS vial. 50 µl of IS was added and one microliter was analysed by GC–MS. Separation was obtained with a HP-5 ms capillary column (30 m length, 0.25 mm in diameter and 0.25 um film thickness). Splitless mode was used, with an inlet temperature of 270 °C, and an oven temperature program increasing from 70 °C to 320 °C for a total run time of 31 min. This analytical method was previously validated (Lefrançois et al., 2016) and followed a general unknown screening approach that includes a large variety of substances registered in commercial libraries. The list of compounds screened for can be found in (EMCDDA, 2019).

2.3.3. Data treatment and statistical analysis

After analysis, total ion chromatogram visualisation and peak area integration were performed on the MSD Enhanced ChemStation software. Library search was performed with several commercial libraries (Maurer, Pfleger, Weber library, PMW_3 acronym; National Institute of Standards and Technology, NIST17 and Wiley Mass Spectra of Designer Drugs 2019 DDdrugs). When a peak was characterised by the commercial libraries and if a standard was available, a standard stock solution was injected to confirm the compound presence based on the retention time and mass spectra comparison. For all compounds characterised, peak areas were integrated. Limit of quantification (LOQ) for

a standard stock solution was determined to be 5 ppm. When a peak integration (normalized by IS) was lower than the LOQ, the result was not considered.

Based on a combination of legal (UNODC, 2019a) and chemical status, identified compounds were grouped into two categories, namely the main psychoactive substances (group A) and adulterants detected in addition to the main psychoactive substance, usually used to either enhance its effects or increase profits (group B). Due to different legislation status, subcategories were created. In particular, the main psychoactive substances (group A) were categorized as (group A.1.) illicit drugs (e.g. amphetamine, cathinone, cocaine, heroin, methamphetamine and MDMA) and (group A.2.) prescription drugs and medicines (e.g. buprenorphine, methadone, fentanyl, other pharmaceutical opioids, benzodiazepines). Adulterants (group B) included other non-controlled psychoactive substances (e.g. caffeine, dimethylsulfone) and non-psychoactive medicines (e.g. paracetamol and methenamine). Other non-psychoactive substances (e.g. sugars, usually referred as diluents) were also detected but are not reported in this paper. Only syringes that contained at least one substance were included in the data analysis. The numerical data obtained were compiled and further analysed using Microsoft Excel (version Microsoft Office Professional Plus 2016) and Tableau software (version 10.4.19).

2.4. Comparison with self-reported drug use

Once laboratory analysis was completed, a comparison between the main psychoactive substance detected and the self-reported record in the selected booths was conducted using the Kendall rank correlation test. Kendall rank correlation is a non-parametric hypothesis test used to test statistical dependence based on the tau coefficient. Tau coefficient values range from 0 to 1, with higher values indicating a higher level of agreement between self-reported and chemical results (McLeod, 2005). Comparison between the self-reported record in the selected booth and the previous year was also performed using this statistical test. Statistical tests were performed using R (ISBN: 3-900051-07-0. R foundation for statistical computing, Vienne, 2015).

3. Results

3.1. Participation

During the seven days of the study in February 2019, there were a total of 966 visits to the Sydney SIF, made by 142 individual clients to eight different booths. Of those total visits, 118 visits were to selected booths (chosen at random each day) where the syringe disposal bins were being sent for analysis. All clients who attended the selected booths in that week provided anonymised data for the study (i.e. nobody opted out of the study). The average number of clients visiting the Sydney SIF per day during the study period was typical of the visit pattern generally (average number of clients visiting per day in the previous month was n = 153 and in the previous year was n = 144).

3.2. Main psychoactive substances

In total, 147 syringes were retrieved from disposal bins and analysed. A main psychoactive substance (referred as group A) was detected in 116 syringes (see Fig. 1). In particular, 81% of syringes (n = 95) contained at least one illicit drug (group A.1). The most commonly detected substance in syringes was heroin (51%; n = 59), followed by methamphetamine (22%; n = 26) and its derivative. The methamphetamine derivative detected in five syringes (4%) was characterised as being N-hydroxyamphetamine 2AC (according to the PMW_3 library) and N-methoxycarbonylamphetamine (according to the NIST17 library, spectrum available as supplementary material; *m/z*: 102: 100; 45: 70; 162: 18, 56: 13).

Prescription drugs and medicines (group A.2) were detected in 19% of used syringes (22) (Oxycodone: 10%, n = 12; Buprenorphine: 4%, n = 5; Methadone: 2%, n = 2; Morphine: 2%, n = 2; Hydromorphone: 1%, n = 1). Only four syringes contained a mixture of two substances (a mixture of methamphetamine-heroin: 2%, n = 2; a mixture of methamphetamine-buprenorphine: 1%, n = 1; a mixture of heroin-oxycodone: 1%, n = 1).

3.3. Adulterants

Only three different adulterants (group B) were detected. All adulterants detected were in syringes containing heroin or methamphetamine. Caffeine was detected in 10% of syringes containing heroin (6/59 syringes) and 4% of syringes containing methamphetamine (1/26 syringes). Dimethylsulfone or methylsulfonylmethane was detected in 50% of syringes containing methamphetamine (13/26 syringes) and in 20% of syringes containing heroin (11/59 syringes). Methenamine was detected in 3% of syringes containing heroin (2/59 syringes).

3.4. Comparison with self-reported drug use

Fig. 2 compares the proportion of the main psychoactive substances detected in used syringes (n = 116) and the substances self-reported by Sydney SIF clients at the entry to the service of the collected booths only (n = 118). Heroin was the most reported drug (by 56% of clients; n = 66), followed by methamphetamine (28%; n = 33), oxycodone (7%; n = 8), buprenorphine (reported as subutex and suboxone, 6%; n = 7), methadone (syrup form, 2%; n = 2) and morphine (MS Cotin, 2%; n = 2).

Kendall's test showed that there was no statistically significant difference between the results of the chemical analyses and the self-reported drug type (Kendall's test, p-value = 0.00067317 < 0.05, Tau = 1, methamphetamine and its derivative were grouped). In addition, self-reported drug type during the study week on the study booth are consistent with the yearly drug type use record (Kendall's test, p-value = 0.000616 < 0.05, Tau = 0.94). A summary of self-reported drug type is available as supplementary material.

3.5. Other injecting equipment

Injecting paraphernalia retrieved from the bins other than syringes are represented in Fig. 3. In total, 155 other pieces of injecting paraphenalia were analysed, including 76 spoons (68 plastic spoons, 4 metal spoons and 4 stericups), 51 concealment bags that were in direct contact with the substance/s in question (29 zip bags, 20 plastic-wrapped drug containers and 2 aluminum foils) and 17 filters. A main psychoactive substance (group A) and adulterants (group B) were detected in 94% of concealment bags, 75% of spoons and 64% of filters. For concealment bags, heroin was detected in 30 bags, methamphetamine in 18, a mixture of both in 2 and MDMA in one. In one of them, amphetamine was detected in addition to methamphetamine for the first time during this study.

4. Discussion

Chemical analysis of used syringes was successfully conducted at the Sydney SIF and showed that (1) adulterants not reported in the literature and occasional high potency substances were detected (2) self-report drug types were consistent with results confirmed by chemical analysis; and (3) other injecting equipment analysis brings additional information but are not representative of Sydney SIF consumption trends. These major findings are developed below.

4.1. Main psychoactive substances detected

4.1.1. Sydney SIF analysis

Based on this study, illicit drugs (group A.1.) remained the most

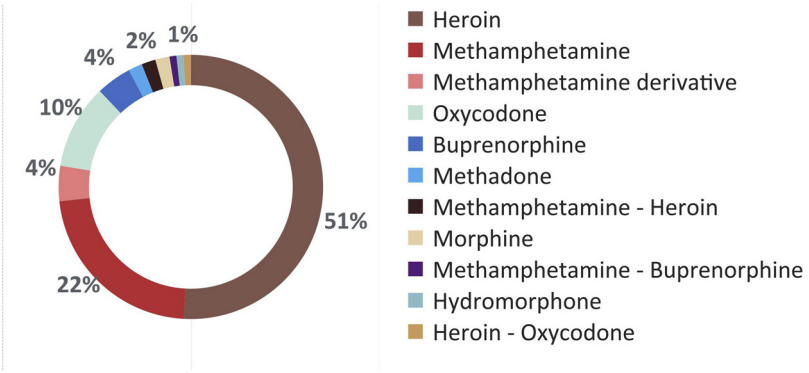

Fig. 1. Main psychoactive substances detected in the used syringes (percentages less or equal to 1% are not reported).

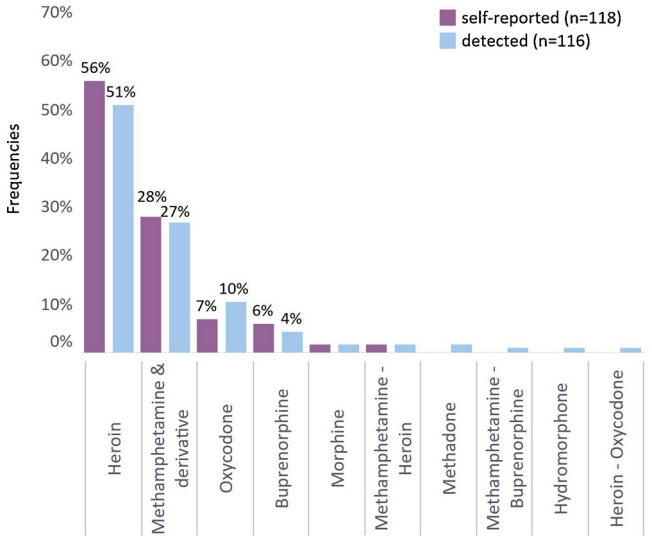

Fig. 2. Proportion of psychoactive substances reported by clients during the SIF visit and detected in syringes.

detected substances. Among them, heroin (51%) and methamphetamine (22%) were the two main substances detected in syringes. While heroin injection has been common in Australia, the injection of methamphetamine is a more recent trend reported in Australia and confirmed by other monitoring tools (Karlsson and Burns, 2018). According to the Illicit Drug Reporting System (IDRS), the use of methamphetamine as a drug of choice among PWID increased from 16% to 32% from 2010 to 2017.

In addition to methamphetamine, its derivative was also detected. This compound was also characterised above the highest point of the calibration curve for the methamphetamine standard (100 ppm). In the analytical literature, it appears that the structure of methamphetamine is re-arranged due to the high temperature reached in the inlet (i.e. 270 °C) during GC–MS analysis (Li et al., 2006; Sugie et al., 2018). To our knowledge, N-hydroxyamphetamine 2AC or N-methoxycarbonylamphetamine has not been reported in the literature. However, previous studies mentioned that this phenomenon is common during methamphetamine analysis (Andersson et al., 2007; Dujourdy et al., 2008; Lock et al., 2007). The detection of this compound seems to indicate that this re-arrangement only occurs when the concentration of methamphetamine is high. This suggests that some Sydney SIF clients might be accessing potent methamphetamine. Reportedly, the annual median purity of analysed methamphetamine specimens has increased from 4.4%–84% in Australia since 2007 (Australian Institute of Criminology's Crime Statistics, 2017). The increase of methamphetamine potency has its own set of risks, prevention and harm reduction messages can include the risks associated with this higher potency.

Another finding concerns the non-medical use and injection of prescription drugs and medicines, particularly pharmaceutical opioids. Around 10% of syringes contained one of these substances which is consistent with previous results from Sydney SIF clinical records reported in literature (Latimer et al., 2016). In addition to the chemical analysis, blister packs (i.e. oxycodone) were found in bins which suggests that tablets were crushed and dissolved for injection purpose. It needs to be highlighted that injecting medications intended for oral administration puts users at higher risk of vascular complications and infections (Roux et al., 2011), however some filtration process could limit these effects (Steele et al., 2018).

4.1.2. International comparison

This section aimed to highlight similarities and differences between Sydney SIF results and studies conducted in six European cities (EMCDDA, 2019) (see Fig. 4). In addition to providing local information on the drug market, analysis of used syringes could also be used to compare consumption, adulterants and potency of substances across different countries. With an expanding and diversifying global drug market as never before (e.g. diversifying supply of stimulants, drug trafficking on the internet), equally dynamic surveillance responses must be available and, therefore, this is an area of growing significance (UNODC, 2019b). In the EMCDDA study, a total of 1521 syringes were chemically analysed and 1278 of them (84%) contained at least one psychoactive substance. The results show a high proportion of opioids in western European countries (heroin: Amsterdam, 95%; Glasgow, 49% and Lausanne, 36%) and stimulants in all cities ((meth)amphetamine: Helsinki, 53%; cathinones: Budapest, 80% and Paris: 44%; cocaine: Amsterdam: 43%; Glasgow: 80% and; Lausanne: 72%).

The comparison revealed that strong local variations exist. However, some general trends can be identified: (1) heroin remains one of the main psychoactive substances injected in western Europe and in Sydney (2) stimulants (methamphetamine, cocaine and cathinone) detected in used syringes are largely reported in all cities studied (3) prescription drugs and medicines, particularly pharmaceutical opioids (i.e. methadone, buprenorphine and other opioids) are detected in all cities (except Glasgow). They represent, however, a low percentage in all cities (less than 10%), with the exception of Helsinki (53%).

The main difference between European cities and Sydney is related to stimulant consumption. Methamphetamine was mainly detected in Sydney, whereas cocaine was detected in Western European cities and cathinones in Budapest. A similar difference was reported in previous studies (Bannwarth et al., 2019; Farrell et al., 2019).

Another main difference concerns polydrug use (i.e. presence of multiple drugs indicating the co-use of several substances). Only four syringes (3%) collected at Sydney SIF contained a mixture of two main psychoactive substances while 54% of the European syringes collected contained at least two main psychoactive substances (EMCDDA, 2019). This result is supported by self-reported survey, where only 1% of PWID

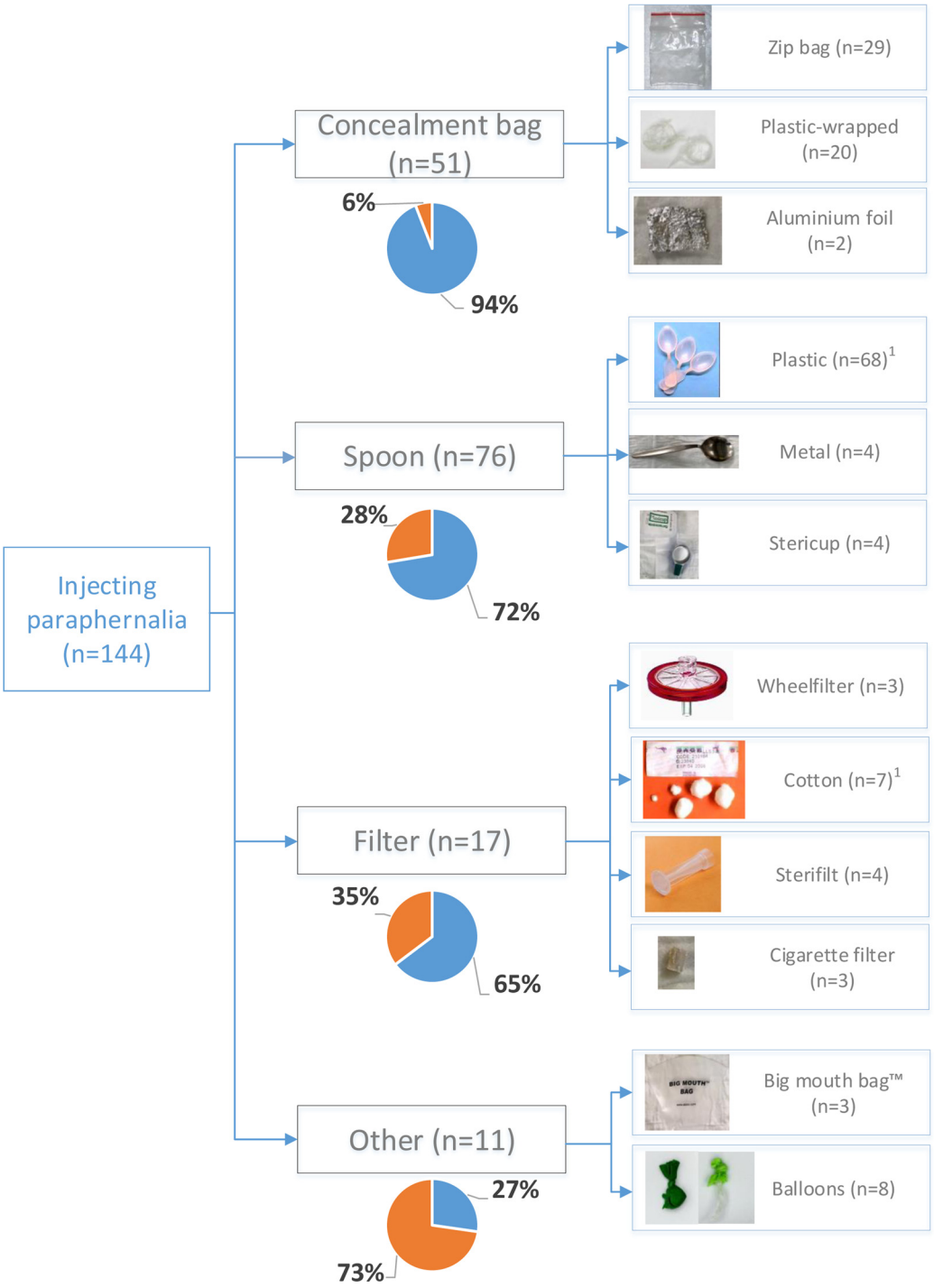

Fig. 3. Injecting equipment collected. The pie charts represent the proportion of psychoactive substances detected (at least one main psychoactive substances (group A)) in black vs no substance detected in grey. Photographs from "Injecting equipment available at the needle and syringe programs, Northern Sydney central coast brochure, NSW Health."

reported injecting a mixture of drugs at the Sydney SIF in the previous year (see supplementary material - table 1), while in Europe polydrug use is becoming more prevalent than before (Pirona et al., 2018).

Overall, one of the main general trends concerns the high prevalence of injecting stimulants which was recently reported as a new challenge due to the potential of dependence (Farrell et al., 2019). In addition to highlighting this new phenomenon, international comparison is useful to obtain an objective snapshot of the geo-spatial consumption of injected drugs.

4.2. Adulterants

Based on the literature, adulterants are pharmacologically active substances detected by forensic laboratories in illicit drugs (Broséus et al., 2016). These types of cutting agents may be added at different steps in the history of the illicit drug. During this study, three types of substance that could be considered as adulterants were detected: caffeine, methenamine and dimethylsulfone. Adulterants were only detected in syringes containing illicit drugs (group A.1).

Caffeine, as an adulterant, is generally used in heroin to lower its

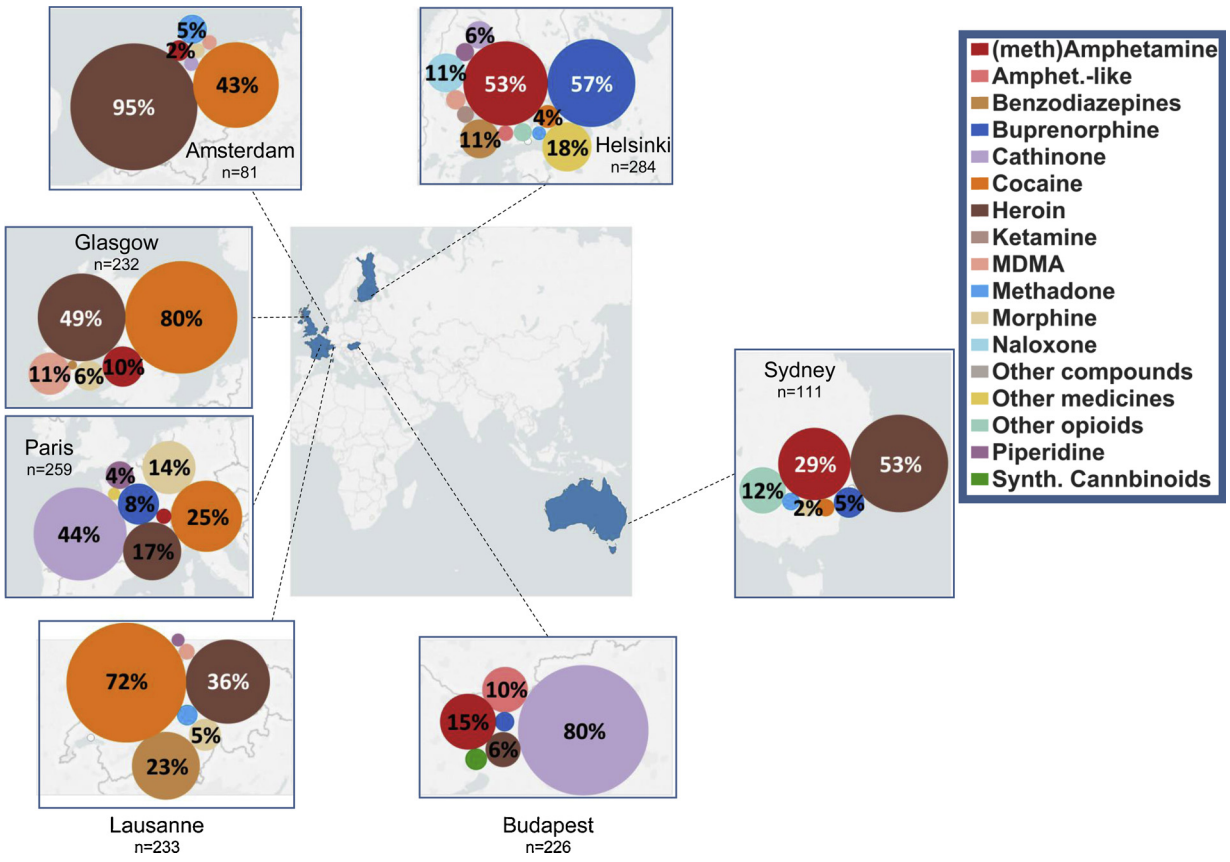

Fig. 4. European and Australian comparison – frequency of the main psychoactive substances detected on n syringes collected by city. Syringe could contain more than one substance, therefore the total per cities exceeds 100%. The data collection for European countries was performed in 2017 while it was conducted in 2019 in Sydney.

vaporisation temperature. It is also used in cocaine, amphetamine, methamphetamine, MDMA, as a stimulant to mimic the effects of the main psychoactive substance (Broséus et al., 2016; Cole et al., 2010). Although only a few serious health repercussions are reported when caffeine is consumed in small quantities, large doses can cause considerable harms (mood disturbances, induce anxiety, addictive, sleep disturbance, increases risk of a range of health problems as cardiomyopathies) (Cole et al., 2010).

Dimethylsulfone is a commonly reported cutting agent in methamphetamine seizures (Collins, 2017; Morelato, 2015). In the literature, it has not been previously reported as being a heroin cutting agent in New South Wales (Michelot, 2018). However, heroin containing dimethylsulfone was recently seized by the Australian Federal Police. Interestingly, all these seizures were of small quantity (personal communication). When a cutting agent is only detected in smaller seizures, this could indicate the addition of the cutting agent at the end of the distribution chain, i.e. when it reaches consumers (Broséus et al., 2016, 2015; Morelato et al., 2019).

Methenamine is a medicine used for the treatment of cystitis, but to our knowledge this substance has not been reported as an adulterant.

It is important to note that the analysed syringes contained some blood, and that the method used for compound detection is sensitive enough to detect traces from anterior consumption (a compound that may have been consumed by another route rather than injection). For example, both caffeine and methenamine can be consumed orally and could have therefore been swallowed prior to the injection.

Finally, as adulterants are pharmacologically active substances, their interaction with the main psychoactive substance is not predictable (Cole et al., 2011; Kudlacek et al., 2017) and the risks related to their presence should not be underestimated. For example, the combined use of a stimulant (i.e. caffeine) and opioid (i.e. heroin) can influence the cardiovascular system and is associated with poorer health outcomes (Connor et al., 2014). Moreover, adulterants used are not intended for intravenous consumption and can be hazardous. The potential harms linked to the consumption of dimethylsulfone are not known.

4.3. Comparison with self-reported drugs

In total, 147 syringes were collected during the week for only 118 visits registered on the selected booth. No psychoactive substances were detected in 21% of syringes (31), meaning that a psychoactive substance was detected in 116 syringes. At the Sydney SIF, clients may use more than one syringe for a variety of reasons. One syringe may be used to have a small 'taste' of the substance before full injection with another syringe (consistent with overdose prevention advice); syringes may be changed after unsuccessful attempts at venipuncture and drugs transferred from one to another, syringes may be used in the preparation of a specialty wheel filter without containing active drugs, and even if unused, an opened syringe package must be disposed. All of these may account for the difference between the number of syringes collected and the number of visits.

Based on the results, there was a remarkable consistency between the main psychoactive substances detected in syringes and reported by clients. Indeed, based on Kendall rank correlation result, the main psychoactive substance injected by clients at the Sydney SIF corresponded to the substance reported being consumed. Consequently, results is a good indicator to test the reliability of self-reported surveys and vice versa (Darke, 1998),

Considering the reliability and relative ease of impementation of self-report surveys, the added-value of chemical analysis of used syringes which requires laboratory expertise and strict safety measures

may be questioned. The benefit of chemical analysis lies in the potential detection of more potent substances or adulterants. For example, the presence of a more potent methamphetamine was highlighted thanks to this analysis. This information could be used to inform PWID to use smaller amounts and test the product before injecting an entire dose to reduce negative effects.

Of note is the prominence of fentanyl-related overdoses in North America and this is forecast in Australia (Latimer et al., 2016). A contributing factor is the consumption of illicit drugs (i.e. heroin) cut with potent fentanyl and its analogues (Ciccarone, 2017; Warner et al. (2018); Tupper et al., 2018). Even though during this study fentanyl was neither self-reported nor detected in used syringes, applying such a method could help detect abnormal phenomena such as the situation that North America is facing. Based on the literature, only 55% of users were aware of the presence of fentanyl in heroin in North America (Daniulaityte et al., 2019; Griswold et al., 2018). The presence of fentanyl in heroin could therefore not appear in self-reported surveys as the users were usually not aware of it. Fentanyl presence can, however, be detected by chemical analysis which was highlighted by Blachman-Forshay and colleagues (2018) through the analysis of used syringes in the United Stated. Had this type of analysis been implemented earlier, it may have provided early warning of fenatnyl adulturation of illict drug supplies. Finally, if such an approach was to be periodically implemented, it could provide information about potential changes in the composition of illicit drugs available on market (e.g. more potent methamphetamine).

4.4. Other injecting equipment

For the first time, we also investigated the usefulness of analysing other injecting equipment (i.e. not just syringes). The collection and analysis of the concealment bags for example, circumvent having to transport sharp material. During this study, we only collected 51 concealment bags compared to 116 syringes (43%). Sydney SIF clients usually dispose of concealment bags into general waste near the staff counter where they have access to scissors to open the bags. In addition, a number of other reasons can explain this discrepancy, such as the use of a single bag when people attend the service together and share a booth, the use of tablets (i.e. prescription drugs and medicines contained in blister-packs), or the use of paper to conceal the drug. Out of the 51 bags, a main psychoactive substance was detected in 48 of them (94%). These results show that concealment bags contained enough material to perform the analysis and give helpful results if collected. MDMA and amphetamine were also detected in two bags containing methamphetamine, but were neither self-reported nor detected in used syringes.

When syringe collection cannot be performed and concealment bags are not available, spoons could be analysed as an alternative. However, spoons have more chance of being contaminated due to their direct contact with other injecting equipment within the bin. Filters were the least effective way to detect substances in our analysis.

For long-term monitoring, collection of used injecting equipment in a SIF when an overdose is reported could provide additional information about the substances injected . It could highlight an unusual illicit drug or a harmful adulterant. If the analysis is conducted systematically, it could provide a better understanding of any additional or unexpected reasons why overdoses occur. Preventive and harm reduction messages could thus be adapted accordingly.

4.5. Limitations

The limitations of the analysis of the content of used syringes have already been published elsewhere (EMCDDA, 2019; Néfau et al., 2015; Péterfi et al., 2017) and are summarised here. In this study, it was not possible to match the drug type self-reported by an individual to the syringe that individual actually used. In some syringes, blood traces were observed and the method is sensitive enough to detect very small amounts of substances. Consequently, we cannot exclude that some substances detected are the results of a previous consumption through another route. This problem can be accounted for by setting an arbitrary threshold (e.g. anything below 10% of the mass is not reported). During our study, in two syringes containing heroin there was a low amount of cocaine detected. The amount of cocaine detected was estimated to be lower than the limit of quantification of the cocaine calibration curve (5 ppm). This low amount of cocaine was not considered as an actual consumption during injection, but rather a contamination. Conversely, no psychoactive substances were detected in 21% of syringes. The sensitivity and nature of the analytical method applied might not enable the detection of traces of extremely potent drugs never detected before and not referenced in commercial libraries. Finally, this study analysed only seven consecutive days-worth of used syringes from one randomly selected injecting booth each day. This study results were generally consistent with the trend of self-reported drug type injected at the Sydney SIF in the past month and the past year.

5. Conclusion

For the first time in Australia, substances contained in used injecting equipment collected in a supervised injecting facility (SIF) at Sydney were analytically confirmed. The study found that that there was remarkable consistency between self-report of illicit drugs procured and main psychoactive substance detected with laboratory analysis. It also found that alternatives to syringes may be tested and provide useful analytical results. In addition to confirming self-reported drug type, analysis of used syringes highlighted detection of a methamphetamine derivative that suggests there is access to a potent methamphetamine supply.

Other used injecting equipment (i.e. other than syringes) was also analysed. Findings suggest however, that used syringes analysis gives the most accurate overview of all psychoactive substances injected.

Finally, this study demonstrates that the approach used is amenable to clients and feasible in the Australian SIF context. It may also be applicable to other settings such as Needle and Syringe Programs (programs which provide injecting equipment). Upscaling and wider implementation would support the early detection of harmful substances entering drug markets and better inform harm reduction strategies.

Contributors

Elodie Lefrançois: methodology, original draft of the manuscript, manuscript review & editing, data analysis, visualization. Vendula Belackova: project administration, contribution to project design, and manuscript review. Edmund Silins: project supervision, contribution to project design, collection of samples, and manuscript review. Julie Latimer: project coordination, collection of samples, and manuscript review. Marianne Jauncey: contribution to project design and manuscript review. Ronald Shimmon and Dayanne Mozaner Bordin: laboratories induction and analytical support. Marc Augsburger: methodology, resources, and manuscript review. Pierre Esseiva: conceptualization, methodology, resources, manuscript review. Claude Roux: resources, supervision, project administration. Marie Morelato: conceptualization, methodology, validation, manuscript review & editing, project administration, supervision.

Authors disclosures

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Declaration of Competing Interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.drugalcdep.2020.107909.

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