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Research paper

Diverted medications and new psychoactive substances—A chemical network analysis of discarded injecting paraphernalia in Hungary

Valéria Anna Gyarmathy[a,b,*], Anna Péterfi[c,f], Tamás Figeczki[d], József Kiss[d], Katalin Medgyesi-Frank[d], János Posta[e], József Csorba[d]

[a] Johns Hopkins Bloomberg School of Public Health, United States
[b] Semmelweis University, Hungary
[c] Hungarian National Focal Point (REITOX), Hungary
[d] Hungarian Interchurch Aid, Hungary
[e] University of Debrecen, Hungary
[f] Eötvös Loránd University, Doctoral School of Psychology, Hungary

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ABSTRACT

Background: Until about 2010, people who inject drugs (PWIDs) injected almost exclusively heroin and amphetamines in Hungary. After 2010, self-reported studies have indicated a dominance of new psychoactive substances on the drug market for injectable drugs.
Methods: Between March 2015 and February 2016, we collected used and discarded injecting paraphernalia. We utilized chemical analysis to assess and UCINet to visualize the connections between the most prevalent main substances and their respective co-occurring additional components at 7 locations in Hungary.
Results: The samples (n = 2977) contained a mean of 4.5 components (SD = 3.1, range: 1–18); 422 contained only one component. We found that the most common main components were the diverted substitution medication methadone (32%) and cathinones: pentedrone (18%), mephedrone (13%), alpha-PHP (8%), and alpha-PEP (5%). While these main substances also occurred among the top co-occurring additional components, caffeine and benzoic acid (a preservative) also frequently co-occurred.
Conclusion: A large number of co-occurring additional components indicate either common reuse of injecting paraphernalia or the common addition of additives or both. While caffeine may indeed be an adulterant, the high prevalence of benzoic acid may be difficult to explain. The preference of methadone despite the availability of a wide array of drugs may indicate a preference for opioids during the current heroin drought and/or a true demand for opioid substitution therapy.
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Introduction

Until about 2010, people who inject drugs (PWIDs) almost exclusively injected heroin and amphetamines in Hungary (Péterfi, Tarján, Horváth, Csesztregi, & Nyírády, 2014; Rácz, Csák et al., 2016). After that time and coinciding with a heroin drought in Europe (Griffiths, Mounteney, & Laniel, 2012), there has been a rapid expansion in the country in the number of legal or semi-legal new psychoactive substances (NPS), especially cannabinoids – which are mainly smoked – and cathinones – which are often injected (European Monitoring Centre for Drugs and Drug Addiction, 2015a; United Nations Office on Drugs and Crime, 2013a, 2013b). In 2014, 101 NPS were registered in the European Early Warning System: 31 cathinones, 30 cannabinoids, 9 phenethylamines, 5 opioids, 5 tryptamines, 4 benzodiazepines, 4 arylalkylamines, and 13 other substances not belonging to the previous groups (European Monitoring Centre for Drugs and Drug Addiction, 2015a). These chemical developments were matched by a ten-fold increase of NPS drug seizures in Europe, by now almost mimicking the number and weight of seizures of heroin (European Monitoring Centre for Drugs and Drug Addiction, 2015a).

NPS are an increasing problem in a number of European countries, including Ireland, Poland, the United Kingdom, Romania and Hungary (United Nations Office on Drugs and Crime, 2013b). While most often NPS are used non-injected (Karila, Megarbane, Cottencin, & Lejoyeux, 2015), the percutaneous use has been associated with very high injecting risk behaviors (Rácz, Gyarmathy, & Csák, 2016; Tarján et al., 2015) and a challenge for drug

* Corresponding author.
E-mail address: agyarma1@jhu.edu (V.A. Gyarmathy).

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treatment and emergency services (Rácz, Csák et al., 2016). A recent study in Hungary showed that while until 2010 almost all clients at the country's largest needle exchange program (NEP) injected almost exclusively heroin and amphetamine, after 2010, NPS under five different street names appeared and disappeared one after the other depending on their legal status (Rácz, Csák et al., 2016). While participants in that study did not report the injecting of prescription drugs, especially prescription opioids to compensate for the disappearance of heroin from the drug market, prescription medication diversion and abuse (including injection) have been an increasingly acute phenomenon in many countries (Degenhardt et al., 2008).

Self-report of drug street names, however, shows only the tip of the iceberg and does not accurately reflect the situation of the actual substances that are being injected by PWIDs. Drug analysis of residual content of used syringes is a new approach for improving knowledge of injected drugs (Nefau et al., 2015), but so far only few studies have utilized this novel method to have a better understanding of chemical patterns of drug injecting (Nefau et al., 2015; Lefrancois et al., 2016). Given the promising nature of this method, we undertook a project that utilized chemical analysis of used and discarded injecting paraphernalia to identify the actual substances that are injected by PWIDs in Hungary.

Methods

Used drug paraphernalia composite samples (e.g. a needle and a spoon) were collected by needle and syringe programs ran by the Hungarian Interchurch Aid and from the streets by partner organizations between March 2015 and February 2016 at 7 locations in Hungary: Budapest 7th and 23th districts, Debrecen, Miskolc, Szeged, Békéscsaba and Pécs (Péterfi et al., 2017). Composite samples were tagged based on the location of collection and month of submission, and the tag included a description of sample visuals. Samples were photographed for record keeping purposes.

Objects in the samples underwent a preparation process, where, for example, needles were removed from the syringes by a high frequency oscillating knife. Paraphernalia was then rinsed with 100–150 μL high purity 37 °C water 5–10 times. After the evaporation of the water, 20–40 μL of chloroform–ethanol solution was added to the extracted material. Active agents of the substance residues were identified by a validated gas chromatography method with mass spectrometry detection (Agilent 7980B-5977A) at the Toxicology Laboratory of the Institute of Forensic Medicine of the University of Debrecen. The analysis had the following parameters. Capillary column: HP-35MS UI, 30 m × 0,25 mm × 0,25 μm; injection volume: 1 μL; injector temperature: 250 °C; sampling: split; split ratio: 20:1; oven temperature program: 80 °C (1 min), heating: 15 °C/min, 300 °C, 21 min hold times; interface: 280 °C, MS source: 230 °C; ionization: EI; detection mode: SCAN. Compounds were identified based on analytical standards or international mass spectral libraries (Cayman Spectral Library v.05202016, SWGDRUG MS Library v.2.4, PMW Tox3. Library, NIST08 Mass Spectral Library v2.0, SUDMED 2288 Library, EMCDDA EDND database). We grouped compounds into one of ten categories, based on a combination of legal and chemical status, as driven by our data: A. Controlled substances: 1. Cathinones, 2. Amines, 3. Cannabinoids, 4. Opioids, 5. Cocaine; B. Diverted medications: 6. Substitution medications, 7. Other psychoactive medications (e.g. benzodiazepines), 8. Non-psychoactive medications (e.g. acetaminophen, ibuprofen); and C. Other: 9. Other non-controlled psychoactive substances (e.g. caffeine, nicotine), 10. Other non-psychoactive compounds (e.g. vanillin, mannitol). Each of the identified compounds was registered as a compound case within a sample.

One composite sample may have contained none to several compounds. The compound that was the most dominant among the other active agents detected in the sample is referred to as the main component. Other compounds, if any, within the same sample are referred to as additional components.

Data management and analysis

All data management and analysis were performed in SAS V9.2. Frequency tables were created in SAS. Data on co-occurrence of main components and their respective additional components were imported for visualization into the social network analysis software UCINET (Borgatti, Everett, & Freeman, 2002) as edgelist 1 text. NetDraw was used to visualize the connections between the top five main components and their respective top five additional components, and other main components and other additional components.

Since this analysis focused on assessing the substances that were being injected, only data related to samples that held following types of objects were used: (1) needle, (2) syringe, (3) bottom of tin can, (4) metal cap, (5) heating tin, (6) metal container, (7) metal spoon. If there were several objects in a sample (e.g. a needle and a spoon) and the objects contained the same compound (e.g. both the needle and the spoon contained methadone) then the compound was entered as one compound case in the database for the particular sample (i.e., only one dataline was added within the sample for methadone even though it was identified in two objects in that sample).

During the 12 months of the study, 3261 composite samples were collected (Fig. 1). One composite sample consisted of between one and 25 objects, yielding a total of 22,005 objects. Altogether 3132 samples contained active compounds, and

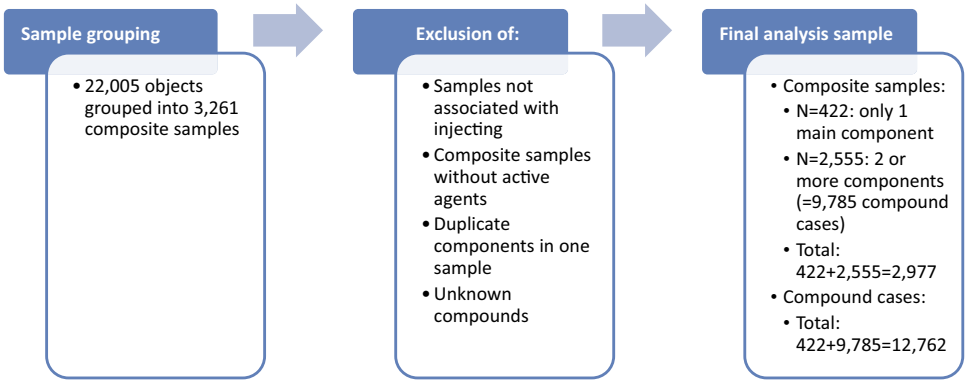

Fig. 1. Study sampling process.

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