EMERGING DRUG TRENDS

Adulterants and Novel Psychoactive Substances in Pennsylvania

PA State Epidemiological Outcomes Workgroup 2024

Significance & Scope

Illicit Drug Supply Adulteration

Adulteration of the illicit drug supply is a pressing public health issue. Street drugs are often cut with adulterants, sometimes unintentionally, which can lead to unanticipated adverse effects, poisonings, and fatalities [1,2]. Additionally, clandestine chemists are constantly manufacturing novel psychoactive substances (NPS) to mimic or substitute illegal, controlled drugs [3]. The U.S. illicit drug market introduces around 60 NPS each year [4], and the number of newly identified NPS increased from two in 2009 to over 158 in 2012 [5]. People who use illicit drugs have no way of knowing what substances they are consuming, therefore monitoring trends in adulterants and NPS and their associated risks is essential. [1,5-8].

Adulterants

- Adulterants are psychoactive or non-psychoactive substances combined with illicit drugs before they are sold to consumers [9]
- Intentional adulteration occurs to increase product weight & profits, and enhance effects of drugs they are combined with [1,10]
- Unintentional adulteration (also known as contamination) can occur due to poor production/manufacturing techniques [1]
- Examples: fentanyl, bromazolam, lidocaine, caffeine

Novel Psychoactive Substances

- Structural/functional analogs of controlled psychoactive substances designed to mimic their effects while avoiding legal regulations [11]
- Also known as “designer drugs” or “legal highs” [11]
- Often sold at head shops, on the Internet, or on the black market [12-14]
- Can be sold as NPS or used as adulterants in controlled substances to mimic/enhance their effects [2,15]
- Examples: bromazolam, Isonitazene

This report will cover emerging trends in adulterants, NPS, and drug checking services in PA, while also exploring public policies and the impacts of NPS scheduling. It will conclude with recommendations for public health and policy interventions aimed at reducing risk and saving lives.

PA Groundhogs: Adulteration Trends in Pennsylvania

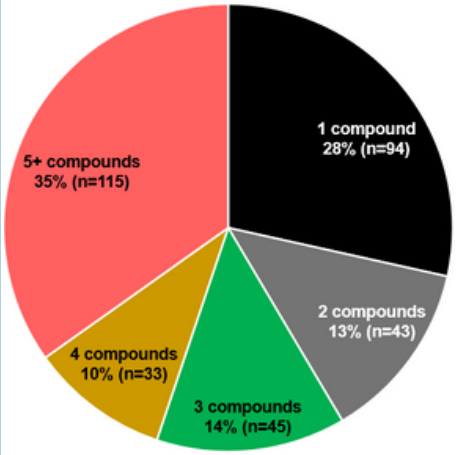


Figure 1: Number of compounds detected in 302 drug samples submitted to PA Groundhogs in 7/1/2022-9/30/2024

Source: PA Groundhogs [16]

Note: The detection threshold for samples is 0.01 milligrams (1µg/mL)

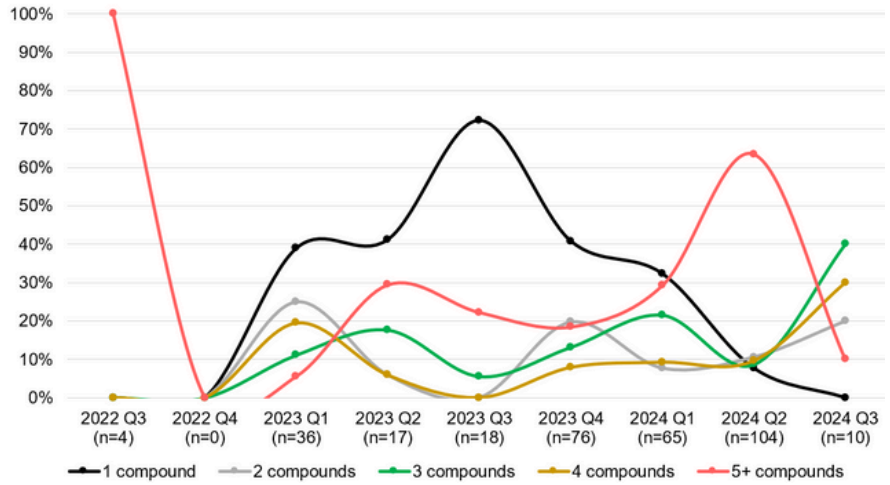


Figure 2: Trends in number of compounds detected in 302 drug samples submitted to PA Groundhogs in 7/1/2022-9/30/2024

Source: PA Groundhogs [16]

Note: The detection threshold for samples is 0.01 milligrams (1µg/mL)

From July 2022 to September 2024, PA Groundhogs analyzed 302 drug samples from Pennsylvania, and found that 115 samples (35%) contained five or more compounds (Figure 1). From 2023 Q3 (October-December) to 2024 Q2 (April-June), the percentage of drug samples with five or more compounds increased by 244.5%, while drug samples with only one compound decreased by 81.1% during that same period (Figure 2).

Drug Adulteration in PA: PA Groundhogs

PA Groundhogs: Specific Adulterants in Pennsylvania

Of the 302 PA Groundhogs drug samples, 233 samples (77.2%) contained adulterants or drugs other than what the samples were sold as [16]. Among adulterated samples, 45 distinct adulterants were detected, 13 (28.9%) of which were NPS. Nearly half of all PA Groundhogs samples (n=149, 49.3%) were adulterated with NPS.

Across all samples (including those not listed in Table 1), the most common adulterants were xylazine (n=149), 4-ANPP (n=135), Phenethyl-4-ANPP (n=61), dimethyl sulfone (n=55), and lidocaine (n=54). Table 1 describes the most commonly detected adulterants among specific drugs.

Heroin (n=13)	Fentanyl (n=149)	Marijuana (n=4)	Cocaine (n=33)	Crack (n=16)	Methamphetamine (n=43)	MDMA (n=6)	LSD (n=4)	Alprazolam (Xanax) (n=9)
Fentanyl (n=11)	Xylazine (n=137)	Methamphetamine (n=4)	Lidocaine (n=19)	Norcocaine (n=3)	Dimethyl sulfone (n=8)	Caffeine (n=3)	Methamphetamine (n=1)	Bromazolam (n=5)
4-ANPP (n=10)	4-ANPP (n=122)	Delta-8-tetrahydro cannabinol (n=2)	Dimethyl sulfone (n=10)	Levamisole (n=3)	Fentanyl (n=2)	Dimethyl sulfone (n=2)	Dimethyl sulfone (n=1)	Rilmazafone (n=1)
Xylazine (n=9)	Phenethyl-4-ANPP (n=56)	N/A	Methamphetamine (n=4)	Benzoylecgonine (n=3)	Dimethylamphetamine (n=2)	Methamphetamine (n=1)	Fentanyl (n=1)	N/A
6-monoacetyl morphine (n=8)	Ethyl-4-ANPP (n=47)	N/A	Norcocaine (n=4)	Lidocaine (n=2)	Xylazine (n=1)	Cocaine (n=1)	Glycerin (n=1)	N/A
Caffeine (n=7)	Caffeine (n=36)	N/A	Levamisole (n=3)	Dimethyl sulfone (n=2)	4-ANPP (n=1)	N/A	N/A	N/A

Opioids | Cannabinoids | Stimulants | Hallucinogens | Sedatives/Hypnotics | Inert substances

Table 1: The most commonly detected adulterants detected in 302 drug samples submitted to PA Groundhogs between 9/22/2022 and 7/23/2024

Source: PA Groundhogs [16]

Note: PA Groundhogs data represents a small portion of all drug samples in Pennsylvania, meaning results described here are limited. This dataset was analyzed because it is the most recent data on PA's drug supply contents. Specific to Table 1, some additional substances and adulterants are not included in Table 1, but are accounted for in the analysis of the entire (n=302) sample dataset. The detection threshold for these samples is 0.01 milligrams (1µg/mL).

Common Adulterants: Fentanyl & Xylazine

Fentanyl

Copyright: DEA, 2024

- A synthetic opioid; up to 50 times stronger than heroin [17]
- Pharmaceutical fentanyl was used to treat severe pain (i.e. for post-surgery or late-stage cancer) [17,18]
- Schedule II substance [19]
- Illicitly-manufactured fentanyl (IMF) is typically cut into heroin, cocaine, and methamphetamine or pressed into counterfeit opioid pills [17,18]
- Fentanyl has been replacing heroin in communities across the country [20,21]
- Fentanyl has become very prominent among people who use drugs (PWUD) [22-25]
- Fentanyl reports & overdoses started to increase around 2013 in the U.S. [26,27]
- In 2022, 74.6% of overdose deaths in the U.S. (30 jurisdictions) involved IMF [28]

Xylazine

Copyright: Jackson & Wallace, 2023

- A non-opiate sedative analgesic and muscle relaxant [29,30]
- Only authorized for veterinary use in the U.S. [29,30]
- Unscheduled in the U.S. [31]; a permanent Schedule III substance in PA [32]
- Typically cut into fentanyl, as well as heroin and cocaine [30,31]
- Used to prolong the effects of fentanyl and for its sedative effects [30,33]
- First identified in Puerto Rico in the early 2000s [30] and later in Philadelphia, PA in 2006 [34]
- Has been increasingly detected in overdoses since ~2018, especially in the Northeast U.S. [29,35]
- Can cause severe injection-related wounds [33,36]
- There was a 35-fold increase in xylazine-involved overdoses in the U.S. from 2018 (0.03 per 100K) to 2021 (1.06 per 100K) [35]

Adulterant-Involved Overdose Deaths

Fentanyl & Xylazine-Involved Overdose Deaths in PA in 2017-2023

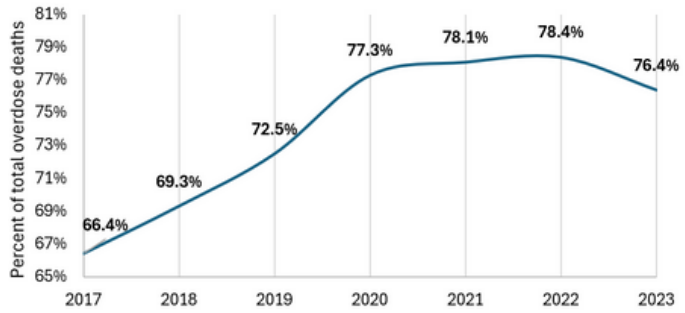


Figure 3: Percentage of fentanyl-involved overdose deaths of all unintentional and undetermined overdose deaths in PA 2017-2023

Source: ODSMP [37]

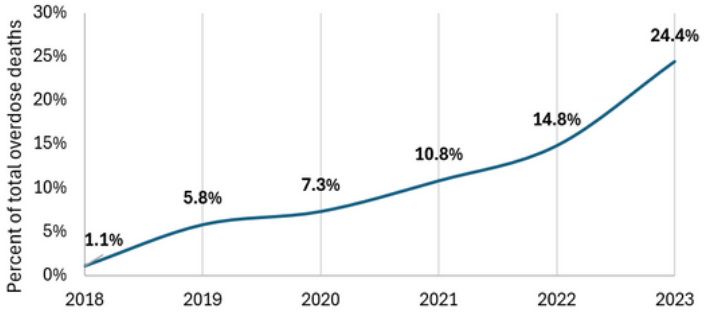


Figure 4: Percentage of xylazine-involved overdose deaths of all unintentional and undetermined overdose deaths in PA 2017-2023

Source: ODSMP [37]

Fentanyl, and increasingly xylazine, account for a significant proportion of overdose deaths. Fentanyl-involved overdose deaths peaked at 4,042 in 2022 (Figure 3). There was a more than 22-fold increase in xylazine-involved overdose deaths in PA from 2018-2023 (Figure 4). Additionally, overdoses involving fentanyl and xylazine are common in the U.S. and PA due to adulteration practices. Among 21 U.S. jurisdictions that reported data, the monthly percentage of overdose deaths involving both illicitly-manufactured-fentanyl (IMF) and xylazine increased by 276% from January 2019 (2.9%) to June 2022 (10.9%) [38]. In PA between January 2021 and June 2022, 23.3% (n=1,285) of IMF-involved deaths in PA also had xylazine detected, regardless of whether or not it contributed to death [38].

Fentanyl & Xylazine-Involved Overdose Deaths by PA Counties in 2023

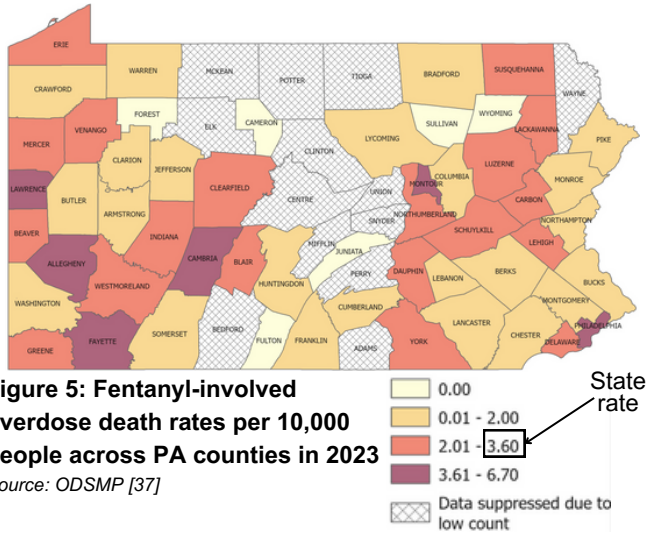


Figure 5: Fentanyl-involved overdose death rates per 10,000 people across PA counties in 2023

Source: ODSMP [37]

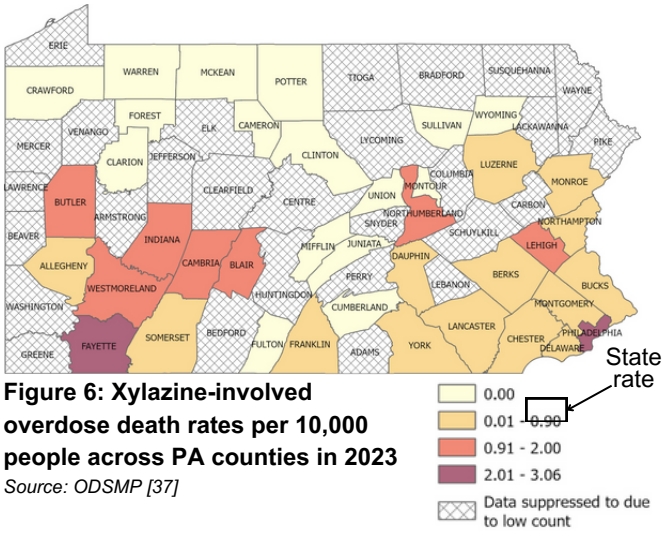


Figure 6: Xylazine-involved overdose death rates per 10,000 people across PA counties in 2023

Source: ODSMP [37]

Note on maps: Counts, and corresponding rates, between 1 and 5 are suppressed. 2023 overdose death data is preliminary, based on death record data as of September 2024. Death records for overdose deaths are often delayed by 3-6 months and counts may change. Counts do not include suicides or homicides where someone intended to harm another person by poisoning. Not all coroners test for xylazine, and some don't report toxicology results to the PA Department of Health (DOH). These data were supplied by the Office of Drug Surveillance and Misuse Prevention, PA DOH, Harrisburg, PA. The PA DOH specifically disclaims responsibility for any analyses, interpretations, or conclusions.

Of 54 non-suppressed counties, 6 had fentanyl overdose death rates above the state rate (3.6 per 10,000 people) (Figure 5). Western/southwestern and eastern PA had elevated overdose death rates compared to the state rate. Though not as widespread as fentanyl overdose deaths, out of the 39 non-suppressed counties, 9 counties had xylazine-involved overdose death rates above the state rate (0.9 per 10,000 people) (Figure 6). Overdose deaths were concentrated in southwestern and southeastern PA, especially in Philadelphia County (3.05 per 10,000 people).

Emerging Drug Adulteration Concerns

Fentanyl Adulteration of Methamphetamine Samples

Overdoses involving psychostimulants, particularly methamphetamine*, increased nearly eightfold from 2015 to 2023 in the U.S. [39]. Although stimulant overdose deaths involving stimulants other than cocaine nearly tripled from 2015 to 2019, methamphetamine use only rose by 43% [40]. This rise in methamphetamine-related overdoses may be linked to riskier drug use practices, polysubstance use, or unintentionally consuming adulterants. Since 2010, overdoses involving both stimulants and fentanyl have increased 50-fold, accounting for 32.3% of U.S. overdoses in 2021 [41]. One study of stimulant drug samples submitted by 77 harm reduction organizations across 25 states found fentanyl in 12.5% of methamphetamine samples and 14.8% of cocaine samples [42]. Increased methamphetamine use may also result from intentional use, as heroin users reporting past-month methamphetamine use rose from 9% in 2015 to 44% in 2019 [43]. Limitations in toxicology data make it difficult to distinguish between intentional, unintentional, or polysubstance use, and extensive monitoring of stimulant adulteration with fentanyl is needed.

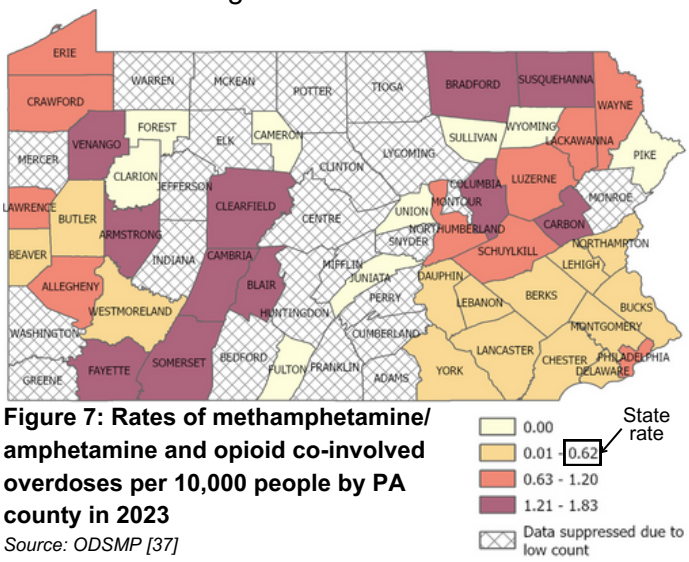


Figure 7: Rates of methamphetamine/ amphetamine and opioid co-involved overdoses per 10,000 people by PA county in 2023

Source: ODSMP [37]

In 2023, 17% of all overdose deaths in PA involved both methamphetamine and opioids (Figure 7). Among non-suppressed counties (n=44), 21 had rates of methamphetamine- and opioid-involved overdoses above the state rate (0.62 per 10,000 people).

*Note: All mentions of methamphetamine include both methamphetamine and amphetamine.

Counterfeit Benzodiazepines

There is growing concern and evidence about the increasing use of designer benzodiazepines (DBZs; e.g., bromazolam, rilmazafone) in counterfeit Xanax pills and "benzo-dope" (opioid drugs adulterated with benzodiazepines) across the U.S. and PA [44-47]. According to NFLIS, the number of DBZ seizures and undercover purchases more than doubled from 2018 (2,391) to 2019 (6,194) [48]. Many DBZs are used as adulterants; however, following the DEA's scheduling of several DBZs in 2023, bromazolam has become the most frequently detected DBZ in counterfeit Xanax pills [45]. Among PA drug samples submitted to PA Groundhogs from July 2022 to September 2024, six out of nine drug samples sold as Xanax (alprazolam) contained no alprazolam; five contained bromazolam and one rilmazafone. The unpredictable potency of DBZs increases risks of adverse effects when consumed alone or with other substances [44,45].

Real Xanax (left) and counterfeit Xanax (right)

Benzo-dope, first identified in Canada in 2020, has become increasingly common in the U.S. [45]. Many drug suppliers cut their fentanyl supplies with DBZs because they are cheap, widely available, and enhance the effects of fentanyl [45]. This combination significantly raises the risk of fatal respiratory failure, coma, and death, especially for those unaware they are consuming benzo-dope [45]. Some users, however, seek out these combinations for the extended or more intense highs they produce [49]. Since 2019, DBZs have been detected in 69% of fentanyl-positive cases in the U.S. [49]. Drug supply monitoring programs should continue focusing on DBZ adulteration, and PWUD should use benzodiazepine test strips to reduce risks.

Novel Psychoactive Substances (NPS)

NPS in the U.S.

The Internet's growth in the 1990s led to increased availability of NPS, which are now sold online, on the dark web, and in stores like head shops, gas stations, and convenience stores [12,50,51]. In stores, they may be labeled as legal products (e.g., herbal incense, potpourri, plant food) and "not for human consumption" to evade legal detection [52]. Once a certain NPS is scheduled, other analogs emerge with similar chemical structures to the original NPS, but different enough so that existent drug tests can not detect those new substances [53,54].

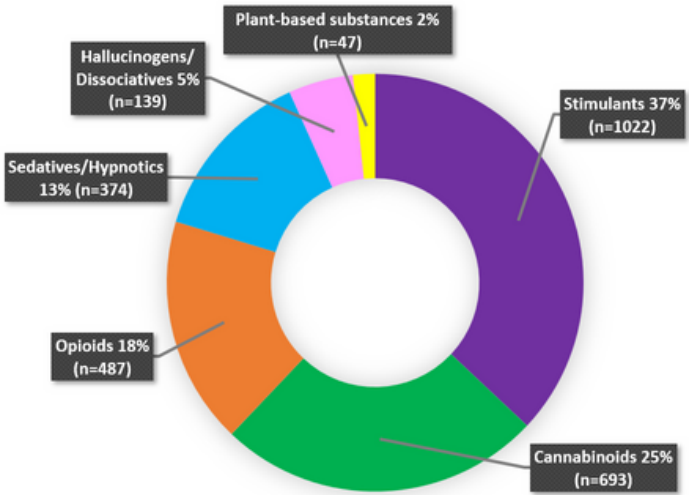


Figure 8: The distribution of NPS reported to the UNODC in the U.S. in 2013-2022, by effect group

Source: United Nations Office on Drugs and Crime (UNODC) [55]

As of 2022, in the U.S., the top three NPS categories reported are novel synthetic stimulants (37%), followed by synthetic cannabinoids (25%) and synthetic opioids (18%) (Figure 8).

NPS Trends in PA

Synthetic hallucinogens comprised nearly all NPS reports in PA from 2007 to 2009, when reports of synthetic cannabinoids and cathinones began to rise (Figure 9). From 2010 to 2012, hallucinogen reports decreased and synthetic cannabinoids emerged as the dominant category of NPS. Synthetic cathinones and other stimulants spiked in 2013 at 1,119 reports, and have remained a relatively constant presence ever since. Synthetic opioid reports were low until 2015, increasing from 206 reports to 4,075 reports in 2021. Synthetic benzodiazepines first emerged in PA in 2011, and increased significantly starting in 2018 (peaking in 2021 with 1,339 reports). Reports of all NPS categories declined from 2022 to 2023, and synthetic opioids remain the largest category overall. Table 2 shows the top five most reported NPS in PA from 2020 to 2023. The distribution across drug categories mirrors trends seen in Figure 9.

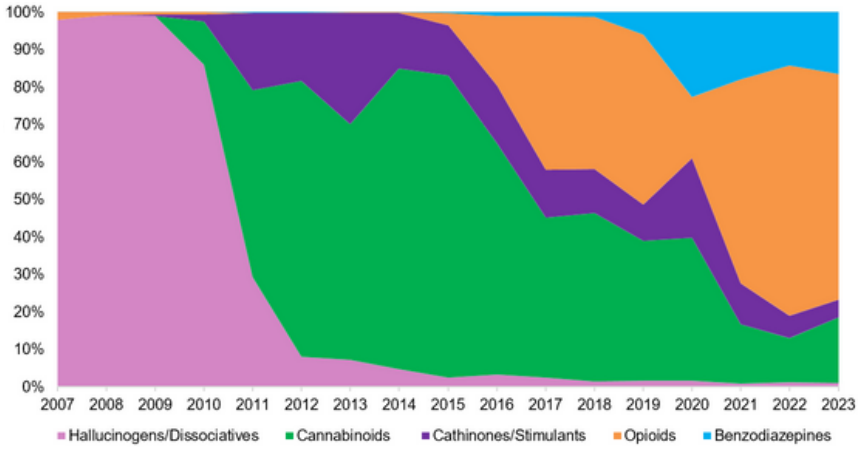


Figure 9: Percentage of NPS reports by category in PA in 2007-2023

Source: *U.S. Drug Enforcement Administration, Diversion Control Division [56]*

2020	2021	2022	2023
Eutylone (739)	Fluorofentanyl (2,060)	Fluorofentanyl (2,308)	Fluorofentanyl (1,103)
MDMB-4en-PINACA (634)	para-Fluorofentanyl (1,428)	para-Fluorofentanyl (755)	Bromazolam (388)
5F-MDMB-PICA (471)	Eutylone (678)	Clonazolam (261)	para-Fluorofentanyl (345)
Acetyl fentanyl (428)	Clonazolam (666)	MDMB-4en-PINACA (246)	MDMB-4en-PINACA (272)
Etizolam (384)	MDMB-4en-PINACA (470)	Acetyl fentanyl (228)	Acetyl fentanyl (269)

Cannabinoids
Opioids
Benzodiazepines
Stimulants

Table 2: Five most commonly detected novel psychoactive substances in PA in 2020-2023

Source: U.S. Drug Enforcement Administration, Diversion Control Division [56]

Note: Number in parenthesis indicates total number of drug samples for a specific drug in a given year.

Novel Psychoactive Substances (NPS)

SYNTHETIC STIMULANTS/CATHINONES

- Designed to mimic the effects of scheduled stimulants (e.g., cocaine, (meth)amphetamines, MDMA) [11,57]
- Desirable effects: euphoria, boosted energy/ alertness, enhanced sociability & self-confidence [11]
- Adverse effects: agitation, heart palpitations, hypertension/hyperthermia, & seizures [58]
- Most commonly available in a pressed pill/tablet and powder form to be swallowed, snorted, smoked, injected, or administered rectally [11,59]
- MDMA was first synthesized in 1912 [60], methcathinone synthesis was first described in 1929 [61]
- In the U.S., synthetic cathinone reports started to increase in 2010 [62]
- Examples in PA: MDPV, eutylone, dipentylone

SPOTLIGHT: EUTYLONE

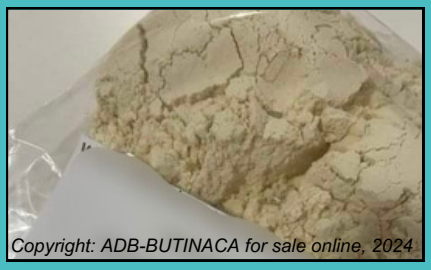
Copyright: Emma, 2019

- Street names: “Bath salt,” bk-EBDB [63]
- First synthesized in the 1960s [64]
- In the U.S., first identified in a seized drug casework in quarter 2 of 2019 [65]
- Found in 8,379 drug items from January to June 2021 [66]
- Was the predominant synthetic stimulant detected in forensic toxicology and seized drug cases in 2020 and 2021 [67]
- Listed as a Schedule I controlled substance as of October 2023 [63]

SYNTHETIC CANNABINOIDS

- Designed to mimic the effects of THC by binding to the CB1 and CB2 cannabinoid receptors [68]
- Desirable effects: relaxation, euphoria [69]
- Adverse effects: anxiety, fast/irregular heartbeat, vomiting, & seizures [69]
- Powdered chemicals mixed with solvents and sprayed onto herbs that can be smoked [69]
- Sold at gas stations/convenience stores & on the Internet as herbal incense or potpourri [69,70]
- Scientists began synthesizing in the 1960s [71-73]
- First emerged in Europe in 2005, in the U.S. in 2008 [74]
- In the first two months of 2024, 91 poison center calls for synthetic cannabinoid exposure were managed in the U.S. [75]
- Examples in PA: ADB-BUTINACA

SPOTLIGHT: ADB-BUTINACA



Copyright: ADB-BUTINACA for sale online, 2024

- Street name: “Spice” [76]
- First emerged in Sweden in July 2019, in the U.S. in July 2020 [76,77]
- 6 fatal and 8 non-fatal poisonings in the U.S. [76]
- People who used intentionally describe effects as mostly “sedating”, “warm”, and “fuzzy” [78]
- Adulteration with fentanyl and heroin; users describe as “extreme paranoia” and having “blacked out for 5 hours, didn’t remember anything” [79]
- Listed as a Schedule I substance as of 12/13/23 [80]

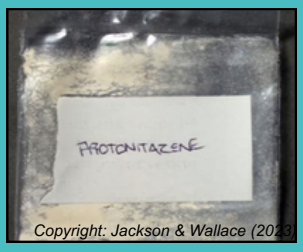
Novel Psychoactive Substances

SYNTHETIC OPIOIDS

- Central nervous system depressants [81]
- Desirable effects: relaxation, reduced anxiety, sedation, & hypnotic effects [11]
- Adverse effects: confusion, delirium, vomiting, respiratory depression [11]
- Sold as standalone products, counterfeit opioid pills, or adulterants in street-level supplies of heroin, cocaine, benzodiazepines, and other drugs [59]
- Can be swallowed, snorted, smoked, & injected
- Synthetic opioids first emerged in 1805 with the synthesis of morphine [82]
- Synthetic opioid use rapidly increased in the early 2000s in the U.S. [11]
- Mexican transnational criminal organizations obtain synthetic opioids from manufacturers in China and cut them into supplies sold to distributers [83]
- Examples in PA: fluorofentanyl

SPOTLIGHT: NITAZENES

- Also known as Benzimidazole-Opioids
- First synthesized in the 1950s [84]
- First detected in the U.S. in 2019, with over 4,300 toxicology reports from drug seizures [84] and 1,000-2,000 deaths since 2019 [85]



Copyright: Jackson & Wallace (2023)

- Up to 40 times more potent than fentanyl [86]
- Available in powders, counterfeit tablets, or liquids; often mixed with other substances like heroin, fentanyl, and benzodiazepines [87]
- Common analogs: metonitazene, isotonitazene, & n-pyrrolidino etonitazene [88]
- Nitazene presence in PA is traced back to October 2022 [89]
- PA temporarily listed nitazene compounds as Schedule I substances in June 2023 [90]

SYNTHETIC BENZODIAZEPINES

- Central nervous system depressants designed to mimic benzodiazepines like alprazolam (i.e., Xanax) [91]
- Desirable effects: relaxation, reduced anxiety, & sedation [11]
- Adverse effects: confusion, delirium, dizziness, auditory/visual hallucinations [11]
- Most commonly available as tablets, capsules, blotters of liquid form, obtained via the internet and online sellers [44] to be swallowed, snorted, or injected [92]
- Benzodiazepines were first synthesized in 1955 [93]
- Detection in the U.S. drug samples increased rapidly starting in 2018 [48]
- Examples in PA: clonazolam, bromazolam

SPOTLIGHT: CLONAZOLAM


Copyright: Lyon, 2022

- Street names: “Clam” and “C-lam” [94]
- First synthesized in 1971 [94]
- First emerged in the U.S. in 2015 [95]
- Identified in 408 toxicology cases since 2021 [96-104]
- Most notable adverse effects are loss of motor control, amnesia, & respiratory depression [44,105]
- Multiple users describe negative effects: “C-lam gave me 5 grand mal seizures lasting over 5 minutes” and “known to produce withdrawal seizures VERY quickly” [106]
- Temporarily listed as a Schedule I substance as of 7/26/23 [95]

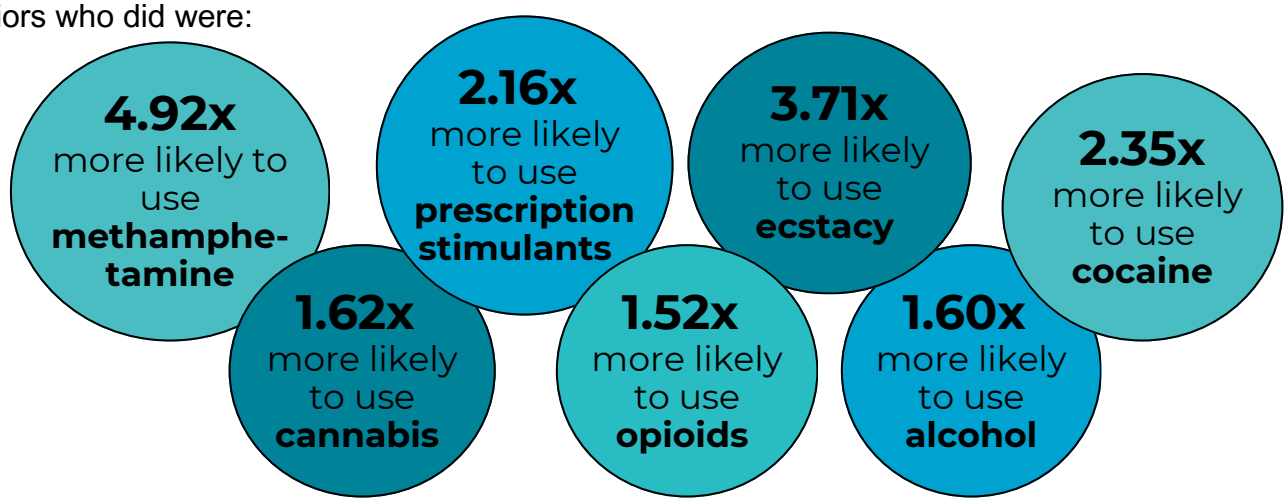
Spotlights on Special Populations

Adulteration and NPS in Party Drugs

Several studies indicate that drug use is prevalent (lifetime use ranges from 35.1-70%) among people who attend electronic dance music (EDM) events [107-110]. In 2017, MDMA was found to be among the top three substances used by people who attended EDM/hip-hop events in Philadelphia, following alcohol and marijuana. 70.6% of the participants used MDMA in their lifetime and 51% used MDMA in the past 6 months [111]. Another study found that over a third (31.5%) of NYC EDM event attendees surveyed reported lifetime use of NPS [108]. Examining NPS and other drug use among youth and adults who attend EDM events and festivals can be useful for understanding emerging and ongoing drug trends due to the prevalence of use and extent of adulteration. In a study of EDM event attendees in New York City, Palamar et al. (2017) hair tested past-year users of MDMA, and found that 51.1% tested positive for a drug they did not report taking [112]. One review of six studies found that 11-55% of drugs checked at dance festivals contained an adulterant that was unexpected by the user [113].

Drug Use Among Youth who Attend Raves

According to the Monitoring the Future Survey, in 2014-2019, 37% of the U.S. high school seniors reported attending raves in the past year [114]. Compared to those who did not attend raves, seniors who did were:



Trends in Synthetic Drug Use Among PA Youth

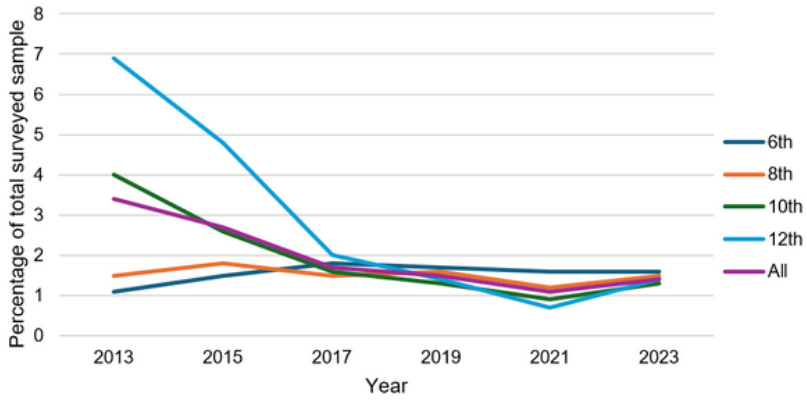


Figure 10: Trends in lifetime use of synthetic drugs among 6th, 8th, 10th, and 12th graders in PA in 2013-2023.

Source: Pennsylvania Youth Survey (PAYS) [115]

Note: Synthetic drugs - man-made drugs such as Bath Salts, K2, Spice, Mr. Smiley, Blaze.

The PA Youth Survey started asking youth about their lifetime synthetic drug use in 2013, and since then, lifetime use has decreased among 8th, 10th, and 12th graders and has increased among 6th graders (Figure 10). Since 2021, rates of use are increasing among 8th, 10th, and 12th graders. Overall, rates had likely decreased because of drug scheduling efforts, yet 6th graders reported the highest rates of lifetime synthetic drug use from 2019-2023. However, this may be due to overreporting of use among 6th graders due to misunderstanding the examples of synthetic drugs given.

U.S. and PA Policy Timelines

United States

1970

Passed the **Controlled Substances Act (CSA)** consolidated existing drug laws and organized substances into five schedules based on their medical value, potential for abuse, and other factors. [116,117].

1986

Created the **Controlled Substances Analogue Enforcement Act**, which made synthetic drugs with chemical and/or pharmacological similarity to Schedule I or II substances controlled drugs [118]. There is a lot of debate about what defines “similar” [116].

2012

Created the **Synthetic Drug Abuse Prevention Act** to control variations of designer drugs. It permanently placed 26 types of synthetic cannabinoids and cathinones as Schedule I substances. Defined “cannabimimetic agents.” Doubled the maximum time the DEA can emergency schedule substances from 18 months to 36 months [116,119,120].

2017

DEA temporarily categorized six synthetic cannabinoids as Schedule I substances under the **CSA** [121].

2018

DEA temporarily placed all fentanyl-related substances into Schedule I of the **CSA**. Emergency scheduling will expire 12/31/2024 [122].

2023

Congress passed the **Fentanyl Trafficking Prevention Act** (the HALT Fentanyl Act) in May 2023, which permanently categorized all fentanyl-related substances as Schedule I [123].

Pennsylvania

1972

Established the **PA Controlled Substance, Drug, Device, and Cosmetic Act** to regulate controlled substances, drugs, medical devices, and cosmetics within the state [124].

2011

PA amended the **Act** to include 8 synthetic cannabinoids (JWH-, HU-, and CP- analogs), 6 synthetic cathinones (including methylone, MDPV, and mephedrone), and 9 synthetic hallucinogens (in the 2C- family) [125].

2013

PA amended the **Act** to categorize additional substituted cathinone analogs and entire groups of synthetic cannabinoids [126].

2016

PA amended the **Act** to categorize 11 fentanyl derivatives (e.g., acetyl fentanyl), 3 synthetic hallucinogens, and additional synthetic cannabinoid subgroups as Schedule I substances, and added year-long temporary scheduling authority [127].

2018

PA temporarily categorized all fentanyl-related substances that weren’t already scheduled as Schedule I. This legislation was renewed for an additional year in 2019 [128].

2024

Xylazine was temporarily categorized as a Schedule III substance in PA in April 2023 [129]. In May 2024, Governor Josh Shapiro permanently scheduled xylazine as a Schedule III substance [130].

NPS Scheduling & Rates of Use

Impacts of NPS Scheduling in the U.S.

Drug scheduling and law enforcement are the dominant approaches to regulating NPS [131]. Data on NPS use rates and associations with scheduling efforts are varied, making it difficult to determine the efficacy of scheduling. Some studies suggest regulatory action may be ineffective or counterproductive, as it can lead to the creation of new, potentially more potent NPS [132-134]. For example, in April 2023, Governor Shapiro temporarily scheduled xylazine as a Schedule III substance, and right before it was permanently scheduled in May 2024, medetomidine--a much stronger veterinary tranquilizer--appeared in an overdose cluster in Philadelphia and Pittsburgh starting in late April of 2024 [135,136]. Other studies suggest that scheduling is associated with decreases in prescribing, dispensing, use, and use-related harms [131]. For example, among youth, rates of synthetic cannabis use decreased significantly following the passage of the Synthetic Drug Abuse Prevention Act in 2012, which scheduled certain synthetic cannabinoids and cathinones (Figure 11). However, this same policy didn't significantly impact youth use rates of synthetic cathinones, which may indicate differences in typical sources for acquiring these categories of NPS (Figure 12). NPS are constantly synthesized, modified, introduced, and removed from the drug market. In response, recent drug scheduling laws have targeted entire drug classes or all analogs of a substance, rather than individual drugs [137].

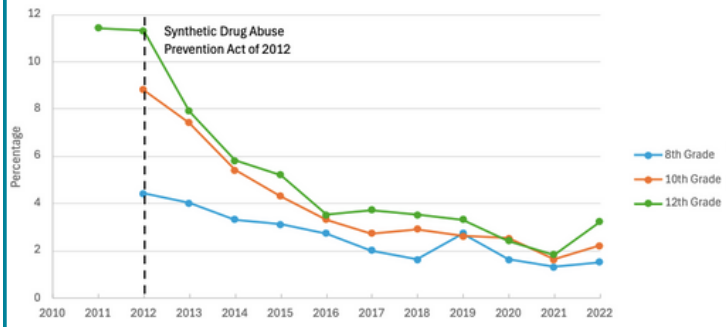


Figure 11: Youth rates of synthetic cannabis use in the U.S.
Source: Monitoring the Future Survey [138]

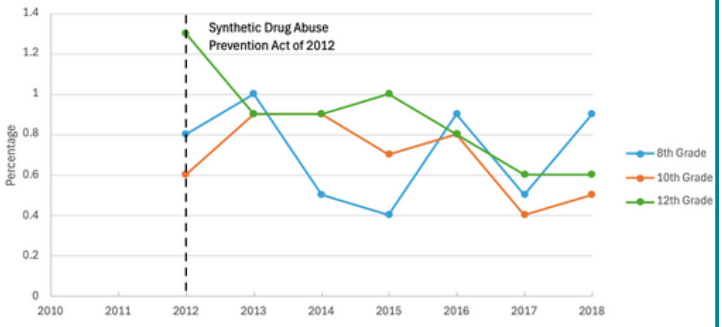


Figure 12: Youth rates of synthetic cathinone use in the U.S.
Source: Monitoring the Future Survey [138]

Impacts of NPS Scheduling in PA

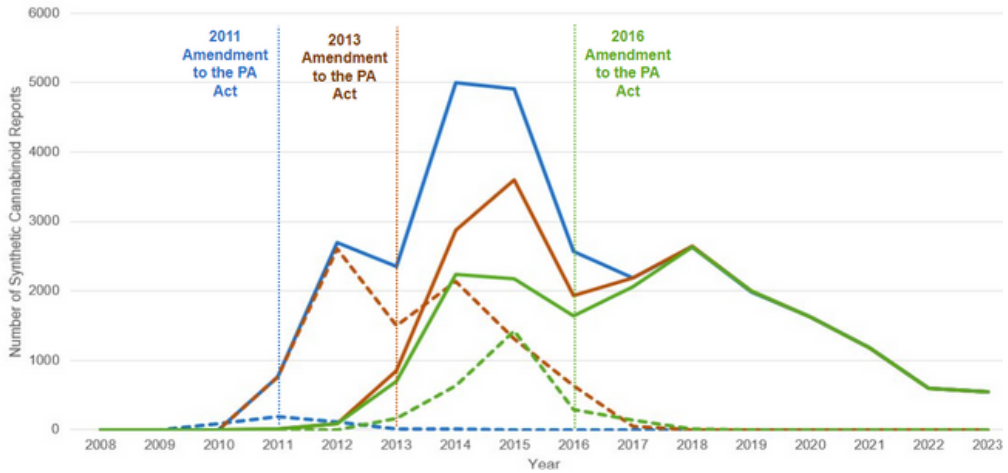


Figure 13: Trends in the number of synthetic cannabinoid (SC) reports in PA that were and were not scheduled by the PA Act.
Source: U.S. Drug Enforcement Administration, Diversion Control Division [56]
Notes: The "PA Act" refers to the PA Controlled Substance, Drug, Device, and Cosmetic Act of 1972. "Reports" refers to the number of detections of specific substances across all drug samples analyzed/received by the DEA and NFLIS in PA during this time frame.

- Total reports of SC scheduled in 2011
- Total reports of SC not scheduled in 2011
- Total reports of SC scheduled in 2013
- Total reports of SC not scheduled in 2013
- Total reports of SC scheduled in 2016
- Total reports of SC not scheduled in 2016

In PA, scheduling efforts appear to reduce numbers of reports for specific NPS named in the policies, but result in increased reports of unscheduled NPS in the same effect group. For example, the 2011 Amendment to the PA Act temporarily categorized eight SC as Schedule I and reports dropped from 187 in 2011 to 5 by 2014 (Figure 15). However, reports of SC other than those scheduled increased by 552% from 2011 to 2014.

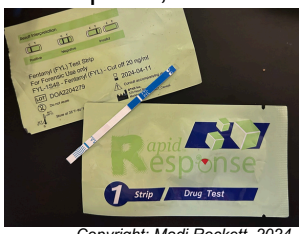
Drug Checking

Drug Checking Overview & Types

Drug checking is the risk reduction practice of testing drugs to characterize the individual components of the substance, which can be performed on the streets in real-time or in a laboratory. Many lab-based drug checking services analyze large sets of drug samples to monitor trends and emerging adulterants in the drug supply. Drug checking programs inform people who use drugs, medical professionals, risk reduction (a.k.a. harm reduction) programs, and public safety officers about what is in the local drug supply [139]. There are many types of drug checking equipment (DCE), including:

IMMUNOASSAY TEST STRIPS

Test strips are small strips of paper used to test a small sample of drugs dissolved in water. They can detect the presence of either fentanyl, xylazine, nitazenes, or benzodiazepines, but can't tell the user how much of the substance is present or identify which type of substance or analog is present [140,141].



Copyright: Madi Rockett, 2024

REAGENT KITS

Reagents are chemicals that turn different colors when they come into contact with certain drugs. With reagent kits, a drop of reagent is added to a small drug sample and it will change color if certain substances are present. Reagents can detect more substances than test strips, but cannot confirm the amount of those substances or those that weren't tested for [142].


Copyright: Dancesafe, 2024

FOURIER-TRANSFORM INFRARED (FTIR) SPECTROMETERS


Copyright: Bureau de la sécurité des transports du Canada, 2014

Analyzes infrared light absorption patterns to determine which substances and quantities are in a drug sample [143]. FTIR spectrometers are usually used in lab-based analysis, but some pilot programs are using portable devices [144,145]. FTIR machines don't destroy the drugs they test and produce results in seconds, but are expensive and require training to interpret results [143].

GAS/LIQUID CHROMATOGRAPHY MASS SPECTROMETRY (GC-/LC-MS)


Copyright: CFSRE

The most specific and accurate form of drug testing that works by measuring the molecular mass of ions that make up drug samples. Drawbacks to this method are that the sample is destroyed after testing, the equipment is expensive, and this service is only available in laboratories [146].

Efficacy of Drug Checking

Various studies show that people who use drugs who utilize DCE to detect undesired adulterants reported safer drug use practices [147-149]. For example, one study of a syringe services program (SSP) in North Carolina found that nearly half (43%) of the 125 participants reported changing their drug use behavior after detecting fentanyl, such as using less of their drug (32%) or snorting instead of injecting (10%) (Figure 16). Drug checking can also engage participants in harm reduction programs and serve as an entry point to connect them with other harm reduction services [150].

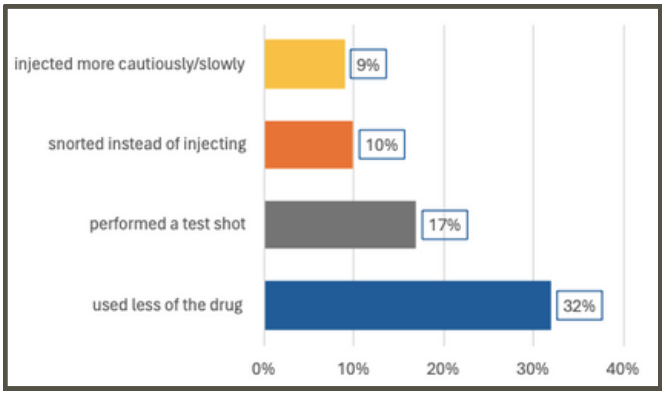


Figure 14: Changes in drug use behaviors after drugs tested positive for fentanyl
Source: Peiper et al., 2019 [148]

Drug Checking Policies & Challenges

Legal Status of Drug Checking in PA and the U.S.

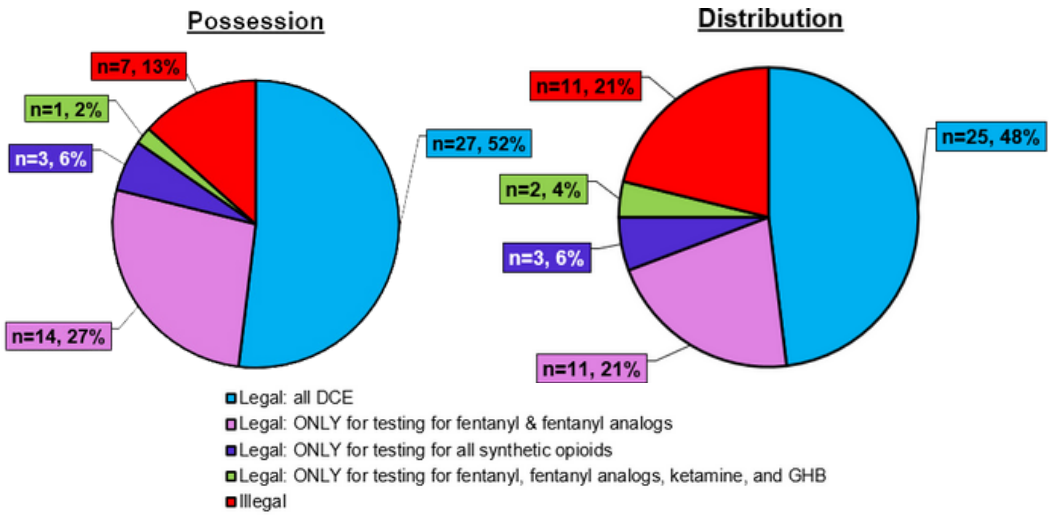


Figure 15: The legality of possession and distribution of drug checking equipment among the 50 United States, Washington D.C., and Puerto Rico as of 2023.

Source: The Network for Public Health Law [151]

Note: For the legal distribution of all DCE, two states have age limits: it is illegal to distribute DCE to persons under 18 years old in Arkansas and to persons under 15 years old in Oregon.

United States

As of 2023, it is legal to possess drug checking equipment (DCE) in 27 states and to distribute DCE in 25 states (Figure 15). It is illegal to possess DCE in 7 states and to distribute DCE in 11 states. The remaining states have a range of legal stipulations for possessing (18 states) and distributing (16 states) DCE.

Pennsylvania

In 2022, Pennsylvania Act 111 decriminalized the possession and distribution of drug-checking equipment, specifically naming FTS in the legislation [151]. The law went into effect in 2023.

Issues with & Barriers to Accessing Drug Checking

PWUD cannot access real-time AND comprehensive testing results for their drugs

- Test strips only detect drugs they're designed to identify, and cannot detect the presence of other substances [152]
- FTIR and mass spectrometers yield comprehensive results but are primarily located in labs; PWUD can send in samples but won't receive results for weeks

FTIR and mass spectrometer functioning issues & limitations

- If molecules aren't already in spectral libraries, they can't be identified [153]
  - NPS emerge and are sold faster than they can be uploaded to spectral libraries or scheduled [152]
- Portable FTIR spectrometers can be unreliable and require frequent repairs/cleaning [154]
- Advanced, comprehensive drug-checking machines are expensive and require specific training to interpret results [154]

Legal status of drug checking services varies

- Drug checking equipment possession is illegal in 7 states [151]
- Drug checking policies are ambiguous
- Federal, state, and local policies are all different
- Organizations providing real-time, on-the-ground drug checking risk arrest because the substances they are testing are illegal to possess

No method of drug checking is 100% accurate. Expanding access to comprehensive, real-time drug-checking services is one effective way to ensure safe supply and to reduce associated overdose deaths.

Drug Checking Programs

Notable Street-Based Drug Checking Pilots in the U.S.

In the U.S., a handful of pilots provide real-time on-site and mobile drug checking, allowing PWUD to bring the substances they intend on using to be analyzed for any unwanted and/or unexpected adulterants. These services also allow healthcare providers to be better informed about current trends in the drug supply and to reduce the potential risks of using adulterated drugs.

Dancesafe

- Founded in 1998, the oldest drug checking harm reduction nonprofit in the U.S.
- Sometimes offers free on-site drug checking at EDM festivals
- Uses reagent kits & FTIR spectrometers for drug checking
- Sells fentanyl and xylazine test strips (FTS; XTS), & reagent kits to the public. FTS/XTS are $1-2 per strip; reagent kits can range from $20-140 depending on the types of reagents ordered [155]

Chicago Recovery Alliance

- Pilot launched in 2019
- Operates 5 mobile outreach sites and 1 fixed-point site across Chicago
- Focuses on fentanyl adulteration utilizing FTIR, mass spectrometry, and FTS
- In just over a year, the CRA tested a total of 422 samples from 130 PWUD [156]
- 52% of participants used the service multiple times [156]

OnPoint NYC

- Pilot launched in 2021
- Runs two Harm Reduction Wellness Hubs located in NYC
- Offers on-site drug checking using FTIR and immunoassay test strips for a variety of substances
- Safer-use practices and drug checking services allowed them to prevent 10x more potentially fatal overdoses than NYC's estimates in their first year of operation [157]

Drug Supply Monitoring Programs in the U.S. and PA

The National Forensic Laboratory Information System (NFLIS-Drug)

- Established in 1997 as a DEA program
- Data from drugs seized in law enforcement operations, local, state, and federal forensic/toxicology laboratories, & mortality data
- Publishes annual and biannual drug trend summary reports and quarterly reports for select target areas [158]
- Uses mass spectrometry

The Center for Forensic Science Research & Education (CFSRE)

- A non-profit organization that started their drug checking program in 2018 and is partnered with labs across the U.S. [159]
- Data from toxicology reports, mortality data from medical examiners, drugs received from crime labs or public health agencies, or directly from the street from partnerships with local public health agencies
- Uses mass spectrometry

Erowid DrugsData

- Independent and anonymous drug checking service and database that started in 2001
- People can mail their lab a substance to be tested for $100-150 and get results in 2-5 weeks [160]
- Collects, reviews, manages, and publishes their own laboratory testing results and republishes data/reports collected from other programs around the world
- Uses mass spectrometry

PA Groundhogs: An Up-and-Coming Database

- PA Statewide drug-checking initiative that provides free analysis of drug samples for PWUD and compiles results in a statewide repository to track changes in the illicit drug supply [161]
- Educates medical providers to ensure appropriate treatment for PWUD and distributes test strips
- People can mail in substances and get results of what's in their drugs in as little as two weeks

Conclusions & Recommendations

Conclusion

- This report provided an overview of trends in adulterants, novel psychoactive substances, and drug use among youth and adults in PA. The number of adulterants in PA street drug samples increased in the last few years. Fentanyl is the most common cause of overdose deaths, and xylazine-related overdose deaths continue to increase. Stimulants, followed by cannabinoids and opioids, are the most frequently detected NPS in the U.S.. Notable NPS trends in PA include increases in nitazenes, synthetic benzodiazepine adulteration, and methamphetamine & fentanyl co-involved overdose deaths.
- Youth who attend raves use substances, especially stimulants, at significantly higher rates as compared to youth who don't attend these events. Moreover, drug use and adulteration are widespread among people of all ages who attend EDM events. Therefore, it is important to continue monitoring drug use within this subpopulation longitudinally at national and local levels.
- Scheduling of fentanyl and its analogs did not lead to a significant decrease in overdose deaths. On the other hand, nationally, the scheduling of synthetic cannabinoids coincided with the reduction in rates of use of these substances among U.S. youth. In PA, cannabinoid scheduling reduced reports of scheduled synthetic cannabinoids, but reports of unscheduled synthetic cannabinoids increased. Therefore, while limiting access through scheduling can potentially decrease use rates among novice users (e.g., adolescents), it may proliferate the emergence of other NPS and may not be an effective strategy for people who use frequently.
- Drug checking services allow people who use drugs (PWUD) to take precautions while using drugs that contain adulterants or other substances. Though these services reduce the risk of adverse reactions (i.e., overdose), on-the-ground, comprehensive drug checking services are lacking in the U.S.. While there are limitations to drug checking and supply monitoring programs, local, state, and national drug supply monitoring programs are vital to informing PWUD, policymakers, and healthcare professionals about current NPS and adulterant trends.
- Despite drug supply monitoring programs and drug checking services, with the current criminalization-based approach to drugs, there is no assurance for quality control, sterile production spaces, or dosage regulation—in other words, a safe drug supply. The overdose death crisis and the increasing toxicity of the illicit drug supply underscore the need for expanding harm reduction programs and reexamining how the U.S. and PA address drug use.

Recommendations

- Understanding and monitoring NPS trends is challenging because they are constantly being produced and taken off the market – having real-time and more than quarterly information about trends is vital
- Frequently update spectrometry substance libraries
- Expand drug checking services in PA and the U.S.
  - Authorize and fund on-the-ground, real-time drug checking
  - Prioritize testing drug samples obtained directly from the street
- Diversify data sources for drug checking analysis and NPS monitoring
  - Explore non-conventional drug analysis methods (i.e., wastewater surveillance)
  - Conduct extensive qualitative research on adulterants/NPS among PWUD
- Expand public access to drug supply testing data, including PWUD and service providers

References

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Pennsylvania SEOW

The State Epidemiological Outcomes Workgroup (SEOW) is supported by the Pennsylvania Department of Drug and Alcohol Programs. SEOW members represent both governmental and non-governmental agencies from across Pennsylvania. The goal of the SEOW is to inform state and community decisions on programs, practices and policies regarding substance use and related behavioral health concerns.

SEOW members involved in this report

Grace Kindt, Laura Suits Dolan, Jonathan Johnson, Mariko Rauch, Lauren Torso Orkis, Ralph Beishline, Rose Baker, Carrie Thomas Goetz, Tamar Wallace, Michaela Miller, Janna Ataiants, Ekaterina Fedorova, Samuel Pascal, Zachary Fusfeld, Madeline Rockett, Sophia Mastero, Linh Nguyen

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