Community Drug Early Warning System (CDEWS): Washington, D.C.

Center for Substance Abuse Research (CESAR)
University of Maryland, College Park
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Disclaimer

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Abstract

The Community Drug Early Warning System (CDEWS) provides timely information about emerging drug use in criminal justice and treatment populations in local communities by sampling and re-testing urine specimens already obtained and tested by the local program for a limited panel of drugs. The CDEWS methodology samples specimens that are ready to be discarded and sends the de-identified specimens to a collaborating laboratory for testing for an expanded panel of drugs. By using already collected urine specimens, CDEWS provides a relatively quick and inexpensive snapshot of the types of drugs recently used by participating populations and can help the local program to identify important drugs that their testing program may be missing. A major innovation of the current study is the expansion of the CDEWS testing panel from 169 to more than 240 licit and illicit substances, including opioids, benzodiazepines, antidepressants, and new psychoactive substances (NPS). The CDEWS methodology has been implemented in fifteen unique sites and the results are contained in thirteen reports already released by the Office of National Drug Control Policy (CESAR, 2018).

This report presents findings from specimens collected from probationers and parolees supervised by the Court Services and Offender Supervision Agency for the District of Columbia (CSOSA), for which drug testing was performed by the Pretrial Services Agency for the District of Columbia's (PSA) onsite laboratory. This is the fourth CDEWS study for which specimens for probationers/parolees were analyzed and provides an opportunity to compare results spanning a six-year period.

Four sub-samples of urine specimens were collected from the adult parolees and probationers, based on PSA's test results and how they stored specimens: 1) positive for any drug in their panel, excluding synthetic cannabinoids (SCs) and amphetamines (N=101), 2) negative for all drugs (99), 3) positive for amphetamines (35), and 4) positive for SC (36).

When we found that the CDEWS collaborating laboratory only detected SC in 47% of the SC+ sample, we engaged another independent laboratory to conduct testing for SC using different methods. The results from both the CDEWS collaborating laboratory and the external independent laboratory we consulted with were able to find SC in 97% of the specimens in which the PSA testing had found SC. This experience highlighted the complexity in detecting the wide range of changing analytes comprising SC and how much the testing for SC depends on the testing methods used by a laboratory.

The PSA+ specimens were found to test positive largely for marijuana (58%), non-fentanyl opioids (33%), and to a lesser extent, PCP (27%), cocaine (26%), and fentanyl (21%). Few drugs, mainly marijuana (43%), which is not routinely tested for by PSA, were detected in the PSA- sample.

The results for fentanyl were of considerable interest to us in view of the declining trend in opiate positives over the past 5 years that PSA has reported in their results from arrestees tested by

their routine pretrial testing program. We wondered whether this decline in opiate positives among arrestees was masking their use of fentanyl or other opioids. Our first CDEWS study in Washington, DC, had shown that the patterns of drugs found in probationers and parolees were very similar to those found in arrestees. We therefore applied our estimates of the occurrence of fentanyl positives among PSA+ and PSA- probationers and parolees to the numbers of PSA+ and PSA- arrestees published in recent PSA reports. Doing so, we estimate that only about 9% of arrestees would have tested positive for fentanyl if the drug were included in PSA's test panel.

The only drug that changed since our prior CDEWS study conducted three years earlier was marijuana (37% to 58%, $p<.01$). This increase is not unexpected, in view of the recent legalization of recreational use of marijuana in Washington, DC.

With the cessation of funding by ONDCP for the CDEWS program, this report describes the final CDEWS study in Washington, DC. The four CDEWS reports from DC have tracked the changing levels of drug use in the tested probationer/parolee populations and have shown CDEWS's usefulness for gauging the adequacy of current testing practices.

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Introduction

The Community Drug Early Warning System (CDEWS) project[1] provides information about emerging drug use in criminal justice and treatment populations in local communities by sampling and re-testing urine specimens already obtained and tested for a limited panel of drugs by local testing programs. CESAR or local staff sample the specimens that are ready to be discarded and send them de-identified to a collaborating laboratory for testing for an expanded panel of drugs. By using already collected urine specimens, CDEWS can provide a relatively quick and inexpensive snapshot of the types of drugs recently used by participating populations. The CDEWS methodology is designed to achieve two objectives: 1) to identify and describe the use of emerging drugs in populations at high risk for recent drug use; and 2) to discover any drugs that the current local testing program may be missing. A major innovation of the CDEWS methodology in the current study is the expansion of the CDEWS testing panel to include testing for more than 240 licit and illicit substances, including opioids, benzodiazepines, antidepressants, and new psychoactive substances (NPS), using more sensitive testing technology than is typically available to local testing programs. The CDEWS methodology has now been piloted in fifteen unique sites and the results are provided in thirteen reports already released by the Office of National Drug Control Policy (CESAR, 2018). This report presents findings from the specimens collected from adult probationers and parolees under community supervision in the District of Columbia.

[1]The name of the project was changed from CDEWS to DEWS for administrative reasons in 2018.

Site Specific Methodology

A complete description of the standard CDEWS study methodology is contained in a separate report (Billing et al., 2019). This section provides a description of any deviations from the standard methodology that were necessary to conduct the study in this site.

Urine specimens collected by the Court Services and Offender Supervision Agency for the District of Columbia are tested by the Pretrial Services Agency for the District of Columbia's (PSA) onsite laboratory. Specimens are tested using a screening panel that can detect up to 10 drugs/analytes (Adatsi, 2020). A 6-drug screening panel to detect 6-MAM, amphetamines, cocaine, opiates, PCP, and synthetic cannabinoids (SCs) is routinely used to screen all specimens. All amphetamine positives are confirmed by PSA using GC/MS. Twenty-one SC analytes are tested for using a combination of Homogenous Enzyme Immunoassay (HEIA), an immunoassay technology to screen for suspected SC analytes in current use, and LC-MS/MS for a limited number of analytes. Any specimens that screen positive by HEIA for SC are sent to an outside laboratory for liquid chromatography tandem mass spectrometry (LC-MS/MS) confirmation. EtG (Ethyl glucuronide, a specific metabolite for ethanol or alcohol) may be tested for in cases where alcohol consumption is suspected or upon request. Upon the probation officer's request, some specimens may also be tested for marijuana and/or methadone.

A total of 271 positive and negative specimens obtained from probationers or parolees between July 2018 and February 2019 were submitted to CDEWS. Each specimen was labeled by PSA as having tested positive or negative. Positive specimens were those positive for any drug in their test panel, with the exception of ethanol only positives. Negative specimens were those negative for all substances, including ethanol. The PSA Laboratory holds and processes amphetamine positive and SC positive specimens separately. Therefore, additional samples of specimens positive for amphetamines and SCs were obtained.

Special Outside Confirmatory Testing of SC Conducted

In accordance with our standard CDEWS protocol, we sent all specimens to the CDEWS collaborating laboratory, Division of Forensic Toxicology at the Armed Forces Medical Examiner System (AFMES). AFMES tested the specimens for approximately 240 drugs, including 46 SCs using LC-MS/MS (liquid chromatography tandem-mass spectrometry) testing. When AFMES confirmed that only 17 of the 36 specimens that PSA indicated were positive for SC, CDEWS sent the 36 specimens to the Center for Forensic Science Research and Education (CFSRE) laboratory at the Frederic Rieders Family Foundation for additional testing for SC. CFSRE uses high-resolution mass spectrometry (HRMS), including real-time identification of emergent compounds with non-targeted SWATH acquisition. This method can identify compounds with a relatively high degree of confidence using comparison against reference standards. Through in-house library development, CFSRE was able to test for over 300 SC parent compounds and metabolites (Krotulski et al., 2020). The methodology

was validated in accordance with ASB Method Validation Guidelines (Academy Standards Board, 2019). The test results for SC from AFMES and CFSRE are presented in Table 1 below.

The AFMES laboratory detected SCs in 17 of the 36 (47%) specimens. The most frequently detected analyte was MMB-FUBINACA, found in 13 specimens. Common metabolites detected were 5F-PB-22 3-Carboxyindole, MDMB-FUBINACA 3,3-Dimethylbutanoic Acid and FUB-PB-22 3-Carboxyindole. A total of 9 different SC analytes were detected.

CFSRE's expanded testing detected SCs in 34 of the 36 (94%) specimens. A total of 11 different SC analytes were detected. The most frequently detected metabolite was MMB-FUBINACA 3-Methylbutanoic Acid, found in all 34 positive specimens. Its parent drug, MMB-FUBINACA, was also commonly detected. Other frequently detected metabolites were 5F-ADB 3,3-Dimethylbutanoic Acid, 5F-MDMB-PICA 3,3-Dimethylbutanoic Acid, MFUBINAC, and 5F-NPB-22 3-Carboxyindazole.

Taken together, 97% (35/36) of the specimens that PSA labeled SC positive were confirmed positive for SC by the AFMES or CFSRE laboratories. We were interested in examining the type of testing that PSA had used that detected so many of the SC positives.

PSA conducts HEIA screening which has cross-reactivity with, and is capable of detecting 21 SC analytes. PSA then sends all SC positive specimens to an outside laboratory for confirmation by LC-MS/MS. The SC analytes that would have been detected by PSA are bolded in Table 1. It is possible that specimens with other analytes cross-reacted with the PSA screen to produce a positive for SC (Adatsi, 2020) making them suitable candidates for SC follow up testing using LC-MS/MS

PSA had sent to CDEWS a collection of specimens that had tested positive for SC and without individual results for each specimen we could not determine the number of specimens that tested positive for specific analytes. To obtain an idea of the analytes likely detected by PSA, we looked at PSA's monthly reports of their test results for arrestees during our study period (July 2018-February 2019). PSA's routine testing of arrestees had most commonly detected: 5F-PB-22 3-CI, AB-FUBINACA, AB-PINACA pentanoic acid, BB-22 3-CI, MDMB-FUBINACA Metabolite M1 (aka MDMB-FUBINACA 3,3-Dimethylbutanoic Acid), and PB-22 N-pentanoic acid (Pretrial Services Agency for the District of Columbia, July 2018- February 2019). We were unable to definitively determine which of these SC analytes, if any, had caused the PSA screen to test positive for the drug in the SC positive sample they had sent us.

Differences in the methodologies employed and/or the levels of detection used by each independent laboratory used in this confirmation study likely accounted for their differing capabilities to detect SC in the specimens that PSA had labeled SC positive. It is also possible that some degradation of SC analytes may have affected the detection of some SC analytes by the outside laboratories, as the urine specimens were held by PSA in cold storage over a prolonged period of

time while they were being accumulated for the study (Castaneto et al., 2015). For the remainder of this report, the 35 specimens that tested positive for SC by either AFMES or CFSRE were considered to be positive for SC by the CDEWS collaborating laboratories' expanded confirmation re-testing.

Table 1: Number of Specimens That Tested Positive for SC by Confirmatory Testing by AFMES and CFSRE
(N=36[a] specimens labeled SC positive by PSA)

Analyte Name(s) (including any known synonyms)	# of Specimens Positive by AFMES *f*	# of Specimens Positive by CFSRE *f*	# of Specimens Positive by AFMES or CFSRE Combined *f*
4F-MDMB-BINACA 3,3-Dimethylbutanoic Acid/4F-MDMB-BUTINACA Butanoic Acid/4F-MDMB-BINACA Ester Hydrolysis Metabolite	Not tested	1	1
5F-ADB 3,3-Dimethylbutanoic Acid/5F-ADB (Metab 7)/5F-MDMB-PINACA (Metab 7)	4	20	21
5F-ADB/5F-MDMB-PINACA (Parent)	Not tested	1	1
5F-AMB (Metab 7)	3	Not tested	3
5F-MDMB-PICA 3,3-Dimethylbutanoic Acid/5F-MDMB-PICA (Metab 7)/MDMB-2201 Butanoic Acid (Metab 7)	Not tested	17	17
5F-NPB-22 3-Carboxyindazole	Not tested	4	4
5F-PB-22 3-Carboxyindole	8	1	9
AB-CHMINACA 3-Methylbutanoic Acid/AB-CHMINACA (Metab M2)	Not tested	1	1
AB-FUBINACA (Parent)	4	0	4
AB-PINACA-N-COOH	3	0	3
FUB-PB-22 3-Carboxyindole	5	0	5
MDMB-FUBINACA 3,3-Dimethylbutanoic Acid/MDMB-FUBINACA (Metab M1)	5	3	7
MFUBINAC/Methyl 1-(4-Fluorobenzyl)-1H-Indazole-3-Carboxylate	Not tested	10	10
MMB-FUBINACA/AMB-FUBINACA/FUB-AMB (Parent)	13	24	27
MMB-FUBINACA 3-Methylbutanoic Acid/AB-FUBINACA (Metab 3)/MMB-FUBINACA (Metab 1)	Not tested	34	34
PB-22 3-Carboxyindole	2	0	2
Any Synthetic Cannabinoid	17	34	35

[a]Four specimens that were found to be SC positive by AFMES and re-tested by CSFRE were omitted from this table due to small cell sizes.

Note: Analytes likely detected by PSA testing are bolded.

Results

The results are presented for the four sub-samples of specimens provided by PSA according to their test results (positive, negative, amphetamine positive, and SC positive). The *PSA test result* will refer to the result of their routine urinalysis screen. *CDEWS test result* will refer to the expanded testing from the CDEWS collaborating laboratory, AFMES. The only exception to this is for the *CDEWS test result* for SC which is derived from the combined test results from the AFMES and CFSRE laboratories (see SC Confirmatory Testing section above, for more details).

A. Demographic Characteristics of Persons Providing Specimens

Table 2 shows that the majority of urine specimens came from males (74-90%), Black/African-Americans (71-95%), and people who were 31-50 years of age (43-71%). No significant differences were found between the samples in gender, race, or mean age. The greatest percentage of specimens across all samples came from Wards 5 and 8 of the District of Columbia (14-30% and 13-35%, respectively).

Table 2: Demographic Characteristics of Adult DC Parolees & Probationers Providing Specimens, by PSA Drug Screen Result

(N=271 specimens)

	PSA Drug Screen Result			
	PSA Positive Sample (N=101) %	PSA Negative Sample (N=99) %	PSA Amphetamine Positive Sample (N=35) %	PSA Synthetic Cannabinoid Positive Sample (N=36) %
Gender				
Male	84%	90%	74%	86%
Race				
Black/African-American	95%	94%	71%	94%
White	4	5	29	6
Asian	1	1	0	0
Total	100%	100%	100%	100%
Age				
18 to 20	4%	6%	0%	0%
21 to 25	15 (35%)	9 (36%)	6 (20%)	3 (17%)
26 to 30	16	21	14	14
31 to 40	19 (43%)	26 (50%)	51 (71%)	39 (69%)
41 to 50	24	24	20	30
51 and older	22	14	9	14
Total	100%	100%	100%	100%
Mean Age	38.8	37.4	37.7	41.1
Ward[a]				
DC – Ward 1	4%	9%	0%	3%
DC – Ward 2	5	6	8	13
DC – Ward 4	5	4	4	6
DC – Ward 5	14	24	27	30
DC – Ward 6	4	3	0	6
DC – Ward 7	17	16	0	26
DC – Ward 8	35	29	27	13
Maryland	13	9	19	3
Virginia	3	0	15	0
Total	100%	100%	100%	100%

[a]Residence was determined by zip code. Zip codes overlapping multiple wards were placed in the ward that appeared to include 50% or more of the zip code. Ward 1: 20009, 20010; Ward 2: 20001, 20005, 20013, 20037, 20052; Ward 4: 20011, 20012; Ward 5: 20002, 20017, 20018; Ward 6: 20003, 20024; Ward 7: 20019; Ward 8: 20020, 20032. Ward 3 was eliminated from the table because there were no specimens from zip codes in this ward.

Note: Some percentages have been rounded.

B. Drugs Detected in the Four Samples by the CDEWS Expanded Testing (Table 3)

PSA Positive (for any drug except amphetamines or SC) Sample: The most frequently detected drug was marijuana (58%). Non-fentanyl opioids were found in 33% of specimens, mostly morphine (25%), codeine (14%), oxycodone (8%), and oxymorphone (8%). In addition, 15% of the specimens tested positive for methadone/EDDP. PCP was found in 27% of specimens, while cocaine was detected in 26% of specimens. Fentanyl and/or one of its analogs was found in 21% of specimens, mainly fentanyl/norfentanyl (21%). An antidepressant was found in 16% of specimens, mostly amitriptyline (9%). Diphenhydramine was found in 15% of specimens. An amphetamine, specifically methamphetamine, was found in 9% of specimens. If PSA had detected an amphetamine, these specimens would have been included in the separate amphetamine/methamphetamine positive sample. The reason that the CDEWS collaborating laboratory detected methamphetamine in these specimens may be because they use more sensitive tests (5 ng/mL versus a PSA screen for amphetamines at 500 ng/mL which may have detected some methamphetamine positives due to its cross-reactivity). Dextromethorphan was detected in 7% of specimens. Only 5% were found to have other psychoactive substances not already mentioned. SC was detected in 3%, with only 2 analytes detected, MMB-FUBINACA (2%) and 5F-ADB 3,3-Dimethylbutanoic Acid (1%).

PSA Negative Sample: The most common individual drugs detected were marijuana (43%), diphenhydramine (13%), methamphetamine (10%), and dextromethorphan (8%). Approximately one-tenth (11%) of the negative specimens tested positive for an antidepressant, mostly trazodone/mCPP (6%). Non-fentanyl opioids were found in 7% of specimens; these mainly consisted of oxymorphone (5%), oxycodone (2%), and morphine (2%). Fentanyl/norfentanyl was found in 5% of specimens (no analogs were detected). Other psychoactive substances were found in 4% of the specimens. Consistent with PSA's results, no SC analytes were detected in this sample. Some of the drugs found in this PSA negative sample may have been detected because of the more sensitive tests used by the CDEWS collaborating laboratory.

PSA Amphetamine Positive Sample: As expected, the most frequently detected drug in this sample was methamphetamine (34%). Specimens may have also screened into this sample due to the presence of β-Methylphenethylamine (β-MPEA), a psychoactive substance found in 26% of specimens (Cholbinski et al., 2014). β-MPEA is a doping agent found in nutritional supplements, with stimulant effects that may mimic the effects of amphetamine (a compound to which it is structurally similar). Marijuana was detected in 31% and an antidepressant in 26% of specimens. These included bupropion (9%), citalopram (6%), doxepin (6%), fluoxetine (6%), sertraline (6%), and trazodone/mCPP (6%). Diphenhydramine was detected in 20%. A non-fentanyl opioid was found in 20% of specimens, mostly morphine (20%) and codeine (9%). Fentanyl and/or one of its analogs was found in 17% of specimens, mostly fentanyl/norfentanyl (17%). SC was detected in 3% of specimens, with two analytes detected: 5F-ADB 3,3-Dimethylbutanoic Acid (3%) and AB-FUBINACA (Parent) (3%).

PSA Synthetic Cannabinoid Positive Sample: As expected, SCs were the drug most frequently detected in this sample (97%). Sixteen analytes were detected, mostly MMB-FUBINACA 3-Methylbutanoic Acid (94%, as well as its parent, MMB-FUBINACA found in 75% of specimens), 5F-ADB 3,3-Dimethylbutanoic Acid (58%), 5F-MDMB-PICA 3,3-Dimethylbutanoic Acid (47%), MFUBINAC (28%), and 5F-PB-22 3-carboxyindole (25%). PCP was detected in 33%, marijuana in 31%, and cocaine in 17%. An antidepressant was found in 11%, including citalopram (6%), trazodone/mCPP (6%), and fluoxetine (3%). A non-fentanyl opioid was detected in 8%, most commonly tramadol (6%). Fentanyl was detected in only 3% of the specimens. Few other psychoactive substances (not already mentioned) were detected (6%), with 3% testing positive for β-Methylphenethylamine (β-MPEA) and 3% testing positive for 3,4,5-trimethoxycocaine.

Table 3: CDEWS Expanded Test Results, by PSA Test Result

(N=271 specimens)

% Positive by CDEWS Lab (drugs likely detected by the local screen are bolded).	PSA Positive Sample (N=101) %	PSA Negative Sample (N=99) %	PSA Amphetamine Positive Sample (N=35) %	PSA Synthetic Cannabinoid Positive Sample (N=36) %
Buprenorphine/Norbuprenorphine	2	2	3	0
Cocaine	26	2	9	17
Marijuana	58	43	31	31
Methadone/EDDP	15	0	3	0
PCP	27	7	6	33
Any Antidepressant	16	11	26	11
Amitriptyline	9	0	0	0
Bupropion	0	1	9	0
Citalopram	2	0	6	6
Desvenlafaxine/Desmethylvenlafaxine	0	1	0	0
Doxepin	0	0	6	0
Fluoxetine	1	2	6	3
Nortriptyline	0	1	0	0
Sertraline	2	1	6	0
Trazodone/mCPP[a]	2	6	6	6
Venlafaxine	0	1	0	0
Any Benzodiazepine	0	1	3	0
Alprazolam/α-Hydroxyalprazolam	0	1	3	0
Any Non-Fentanyl Opioid	33	7	20	8
6-Monoacetylmorphine (6-MAM)[b]	2	0	3	3
Codeine	14	0	9	3
Hydrocodone	1	0	0	0
Hydromorphone	1	0	3	0
Morphine	25	2	20	3
Noscapine	4	0	6	0
Oxycodone	8	2	0	3
Oxymorphone	8	5	0	3
Tramadol	2	0	6	6
Any Fentanyl	21	5	17	3
4-ANPP (Despropionyl fentanyl)	2	0	6	3
Acetylfentanyl/Acetyl Norfentanyl	2	0	6	0
Fentanyl/Norfentanyl	21	5	17	3
FIBF (p-fluoroisobutyryl fentanyl)	5	0	0	0
Para-Fluorobutyryl Fentanyl	4	0	0	0
Tetrahydrofuran Fentanyl (THF-F)	1	0	0	0
Any Amphetamine	9	10	34	0

Methamphetamine	9	10	34	0
Any Synthetic Cannabinoid (SC)	3[c]	0	3[c]	97[c]
4F-MDMB-BINACA 3,3-Dimethylbutanoic Acid/4F-MDMB-BUTINACA Butanoic Acid/4F-MDMB-BINACA Ester Hydrolysis Metabolite	¥	Not tested	¥	3
5F-ADB 3,3-Dimethylbutanoic Acid/5F-ADB (Metab 7)/5F-MDMB-PINACA (Metab 7)	1	0	3	58
5F-ADB/5F-MDMB-PINACA (Parent)	¥	Not tested	¥	3
5F-AMB (Metab 7)	0	0	0	8
5F-MDMB-PICA 3,3-Dimethylbutanoic Acid/5F-MDMB-PICA (Metab 7)/MDMB-2201 Butanoic Acid (Metab 7)	¥	Not tested	¥	47
5F-NPB-22 3-Carboxyindazole	¥	Not tested	¥	11
5F-PB-22 3-Carboxyindole	0	0	0	25
AB-CHMINACA 3-Methylbutanoic Acid/AB-CHMINACA (Metab M2)	¥	Not tested	¥	3
AB-FUBINACA (Parent)	0	0	3	11
AB-PINACA-N-COOH	0	0	0	8
FUB-PB-22 3-Carboxyindole	0	0	0	14
MDMB-FUBINACA 3,3-Dimethylbutanoic Acid/ MDMB-FUBINACA (Metab M1)	0	0	0	19
MFUBINAC/Methyl 1-(4-Fluorobenzyl)-1H-Indazole-3-Carboxylate	¥	Not tested	¥	28
MMB-FUBINACA/AMB-FUBINACA/FUB-AMB (Parent)	2	0	0	75
MMB-FUBINACA 3-Methylbutanoic Acid/AB-FUBINACA (Metab 3)/MMB-FUBINACA (Metab 1)	¥	Not tested	¥	94
PB-22 3-Carboxyindole	0	0	0	6
Any Other Psychoactive Substance	5	4	34	6
β-Methylphenethylamine (β-MPEA)	1	1	26	3
3,4,5-Trimethoxycocaine	0	0	6	3
Butylone	0	1	0	0
Ethylone	0	1	0	0
Eutylone	0	2	3	0
Ketamine/Norketamine	2	0	6	0
Mephedrone	0	1	0	0
Methedrone	1	0	0	0
Phentermine	0	0	3	0
PV9	1	0	0	0
Other Drugs				
Cetirizine	3	1	0	0
Cyclobenzaprine	1	2	0	0

Dextromethorphan	7	8	6	6
Diphenhydramine	15	13	20	6
Gabapentin	2	0	3	0
Haloperidol	1	3	0	3
Hydroxyzine	1	1	0	0
Loperamide	0	1	0	0
Naloxone	0	2	3	0
Promethazine	2	1	3	0

[a]Trazodone is an antidepressant whose major active metabolites is mCPP. It is not possible to definitively determine whether the presence of mCPP was due to trazodone use or whether mCPP was taken on its own. All specimens that tested positive for mCPP also tested positive for trazodone.
[b]The opiate screen does not detect the presence of 6-MAM (heroin metabolite) directly, but can detect morphine, the metabolite of 6-MAM. All of the specimens positive for 6-MAM also tested positive for morphine in the sample.
[c]Results for this drug category represent combined testing by both the AFMES and CFSRE laboratories.
[¥]Not calculated due to low number of cases (n<10).

C. SC Analytes Detected across Four CDEWS Studies, 2012-2019

Table 4 includes the 27 analytes that were detected in at least one specimen from any of the four CDEWS studies conducted with the samples of specimens from parolees and probationers provided by PSA spanning the period from 2012 through 2019. As expected, the SC analytes identified varied over this period because of likely changes in the chemical structure of the drugs available on the street and changes in our laboratory's ability to detect the emerging analytes. Several of the older generation cannabinoids that were tested for in the earlier CDEWS studies, such as UR-144 and XLR-11, were not found in the most recent study. Four analytes were detected in Study 1, 5 in Study 2, 12 in Study 3, and 16 in Study 4. However, it should be noted that the CDEWS test panel was expanded over time so some drugs could have been missed in the earlier studies. In addition, the testing in the current study (Study 4) includes expanded testing by both AFMES and CSFRE, who used more sensitive tests. Two of the four metabolites tested in all 4 studies, UR-144 and XLR-11, showed significant declines over time. None of the SC+ specimens in our latest study contained UR-144, while 42-99% of specimens tested positive for this metabolite in the 3 previous studies. XLR-11 was also not detected in our latest study, despite its detection in the previous 3 studies. Even among analytes added more recently in Study 3, several were no longer detected in our most recent study, including AB-CHMINACA (metab 4), AB-CHMINACA (Parent), and ADB-FUBINACA (Parent). Significant changes were observed in a number of other analytes over time, all of which decreased, including 5F-PB-22 3-Carboxyindole, AB-PINACA-N-COOH, PB-22 3-Carboxyindole, JWH-018, 5F-AB-PINACA, and ADB-PINACA. The following analytes were introduced in the current study and among those most detected were: MMB-FUBINACA 3-Methylbutanoic Acid (97%, along with its parent MMB-FUBINACA found in 76%), 5F-ADB 3,3-Dimethylbutanoic Acid (58%), 5F-MDMB-PICA 3,3-Dimethylbutanoic Acid (45%), and MFUBINAC (29%). These analytes were added as recent national and international data sources indicated increased detection of these analytes (Billing et al., 2019).

Table 4: Comparison of Analytes Identified in Synthetic Cannabinoid (SC) Positive Specimens from PSA across four CDEWS Studies

	Study 1 Adult Parole & Probation Population (N=45) %	Study 2 Adult Parole & Probation Population (N=67)[a] %	Study 3 Adult Parole & Probation Population (N=31)[a] %	Study 4 Adult Parole & Probation Population (N=38)[ab] %
DATES OF COLLECTION	NOVEMBER 2012-JANUARY 2013	DECEMBER 2013-MARCH 2014	AUGUST 2015-OCTOBER 2015	JULY 2018-FEBRUARY 2019
Percentage Positive by CDEWS Lab For:				
MMB-FUBINACA 3-Methylbutanoic Acid/AB-FUBINACA (Metab 3)/MMB-FUBINACA (Metab 1)	Not Tested	Not Tested	Not Tested	97
MMB-FUBINACA/AMB-FUBINACA/FUB-AMB (Parent)	Not Tested	Not Tested	Not Tested	76
5F-ADB 3,3-Dimethylbutanoic Acid/5F-ADB (Metab 7)/5F-MDMB-PINACA (Metab 7)	Not Tested	Not Tested	Not Tested	58
5F-MDMB-PICA 3,3-Dimethylbutanoic Acid/5F-MDMB-PICA (Metab 7)/MDMB-2201 Butanoic Acid (Metab 7)	Not Tested	Not Tested	Not Tested	45
MFUBINAC/Methyl 1-(4-Fluorobenzyl)-1H-Indazole-3-Carboxylate	Not Tested	Not Tested	Not Tested	29
5F-PB-22 3-Carboxyindole	Not Tested	10***[c]	52***[c]	24***[c]
MDMB-FUBINACA 3,3-Dimethylbutanoic Acid/ MDMB-FUBINACA (Metab M1)	Not Tested	Not Tested	Not Tested	18
FUB-PB-22 3-Carboxyindole	Not Tested	Not Tested	Not Tested	13
AB-FUBINACA (Parent)	Not Tested	Not Tested	3	11
5F-NPB-22 3-Carboxyindazole	Not Tested	Not Tested	Not Tested	11
AB-PINACA-N-COOH	Not Tested	0***[c]	65***[c]	8***[c]
5F-AMB (Metab 7)	Not Tested	Not Tested	Not Tested	8
PB-22 3-Carboxyindole	Not Tested	40***[c]	10***[c]	5***[c]
4F-MDMB-BINACA 3,3-Dimethylbutanoic Acid/4F-MDMB-BUTINACA Butanoic Acid/4F-MDMB-BINACA Ester Hydrolysis Metabolite	Not Tested	Not Tested	Not Tested	3
5F-ADB/5F-MDMB-PINACA (Parent)	Not Tested	Not Tested	Not Tested	3
AB-CHMINACA 3-Methylbutanoic Acid/AB-CHMINACA (Metab M2)	Not Tested	Not Tested	Not Tested	3
UR-144	91***[d]	99***[d]	42***[d]	0***[d]

XLR-11	40***[d]	5***[d]	26***[d]	0***[d]
AB-CHMINACA (metab 4)	Not Tested	Not Tested	77***	0***
AB-CHMINACA (Parent)	Not Tested	Not Tested	32***	0***
ADB-FUBINACA (Parent)	Not Tested	Not Tested	29***	0***
JWH-018	7*[d]	0*[d]	0*[d]	0*[d]
5F-AB-PINACA	Not Tested	0**[c]	10**[c]	0**[c]
AB-CHMINACA (metab 6)	Not Tested	Not Tested	10	0
ADB-PINACA	Not Tested	0*[c]	7*[c]	0*[c]
AKB-48	Not Tested	2	0	0
JWH-073	2	0	0	0

[a]To make the SC positive samples from Studies 2-4 comparable to those from Study 1, the amphetamine positive specimens oversampled in Studies 2-4 were omitted from this table.

[b]Includes 35 specimens from the *PSA SC positive* sample and 3 specimens from the *PSA Positive for any drug* sample found to be positive for SC by either AFMES and/or CFSRE.

[c]2x3 chi-square.

[d]2x4 chi-square.

*p<.05 by chi-square.

**p<.01 by chi-square.

***p<.001 by chi-square or Fisher's exact test.

D. Comparison of Common Drugs Detected in the Current and Prior CDEWS Studies

We also compared data for the most commonly detected drugs and/or drug classes from the two most recent CDEWS studies, as shown in Table 5. The only drug that changed significantly over this period was marijuana, which increased from 37% to 58% ($p<.01$). This increase is not surprising given the recent legalization of recreational marijuana in the District of Columbia. It should be noted that amphetamines and SCs were not included in this analysis because these specimens were sampled separately from the remainder of the sample.

Table 5: Comparison of Drugs Detected by CDEWS in PSA Positive Specimens from the Last Two CDEWS Studies

	PSA Screen Positive (for any drug)	
	Study 3 Adult Parole & Probation Population (N=100)^	Study 4 Adult Parole & Probation Population (N=101)^
DATES OF COLLECTION	AUGUST 2015-OCTOBER 2015	JULY 2018-FEBRUARY 2019
Percentage Positive by CDEWS Lab for:		
Drug/Drug Class	%	%
Marijuana	37%**	58%**
Cocaine	38	26
PCP	21	27
Opiates‡	24	26

^Drug test results for amphetamines and synthetic cannabinoids were omitted from this analysis given that specimens positive for these drugs were sampled separately from the sample analyzed in the above table.

‡Opiates include results for codeine, hydrocodone, hydromorphone, and/or morphine.

**p<.01 by Chi-Square.

E. Using the CDEWS Current Study Results to Estimate Fentanyl Positives among Tested Arrestees in Washington, DC

PSA routinely collects urine specimens from arrestees held in Central Booking and tests them for 6 drugs, including opiates. The opiate screen does not detect fentanyl. The percentage of arrestees testing positive for opiates has been declining since 1986 when 20.8% tested positive (Pretrial Services Agency for the District of Columbia, 1984-2020). In 2019, 4.8% tested positive for opiates. The decline in opiates was unexpected in view of the rise in opioid related deaths in

Washington, DC. In a separate study, we found that emergency department overdose patients in four Baltimore area hospitals also showed a trend towards declining opiate positives, but that once testing for fentanyl began, the positives for fentanyl dwarfed all other drugs tested (Dezman et al., 2020). We wanted to determine whether our CDEWS test results for fentanyl could be used to estimate how many arrestees would likely test positive for fentanyl. The use of the fentanyl test results from parolees/probationers to estimate fentanyl positives in arrestees seemed reasonable to us because our first CDEWS study had found that the test results for opiates for probationers/parolees in our CDEWS sample were identical to the results for opiates we found in the CDEWS sample of specimens from arrestees (25%).

We applied our results from probationers/parolees from our current study to the PSA's published test results from arrestees they had tested during the same period (from July 2018 to February 2019). PSA reports describe the number of urine specimens that are tested and the number that test positive for any drug using their screening panel. According to PSA's reports, there were a total of 10,277 urine specimens from arrestees tested during the study time period, of which 2,773 were positive for at least one drug and 7,504 were negative for all drugs (Pretrial Services Agency for the District of Columbia, July 2018- February 2019). Our current CDEWS study found that 20.8% of the specimens from parolees and probationers that screened positive for any drug (excluding amphetamine and SCs) by PSA tested positive for fentanyl and/or its analogues; as did 5.1% of those that PSA found had screened negative for all drugs. We therefore estimated that 577 (20.8% of 2,773) positive specimens from arrestees would have tested positive for fentanyl and/or its analogues, as would have 383 of the negative specimens (5.1% of 7,504). This would have resulted in a combined estimate of 960 of the 10,277 specimens or 9.3% of the arrestees testing positive for fentanyl. The estimated rate of positives for fentanyl and/or its analogues was virtually identical when we applied the same methodology to the PSA test results for the most recent quarter with data available (January-March 2020). In contrast to what we had found to be true in the Baltimore hospitals, the declining trend in opiate positives was not masking an alternative high rate of fentanyl positives in the District. It should be noted that these estimates do not apply the rates of positives for fentanyl to the amphetamine positive (17%) or SC positive (3%) samples. The impact of this omission should be small, however, because few arrestees in Washington, DC, test positive for amphetamine or SC (Pretrial Services Agency for the District of Columbia, March 2020).

Study Limitations

The CDEWS model depends on re-testing a small number of specimens that have already been collected and tested by a local testing program. We do not know whether the small number of specimens in this study are representative of all tested persons under criminal supervision on probation and/or parole in the District of Columbia. However, the CDEWS results from criminal justice populations have been found to be internally consistent and often agree with other indicators of drug use in the populations studied. This CDEWS study was designed to learn more about the types of drugs recently used by persons under criminal supervision, and not to provide precise prevalence estimates.

Every effort was made to include in the CDEWS Laboratory test panel most of the currently available drugs likely to be misused. However, given the rapidly changing nature of new psychoactive substances, it is possible that some drugs may have been missed by the CDEWS testing panel. The continuously changing nature of the substances available make it difficult to develop urine tests for all of the new drugs as quickly as they are discovered. It is also possible that some drugs/metabolites may have degraded over time due to extended specimen holding times (as specimens were being accumulated for the study collection) which may have affected their detection.

While we found that some specimens contained multiple drugs/metabolites, this does not necessarily mean that the user sought all of these drugs or was aware of the composition of the substance(s) ingested. Multiple drugs in a specimen may also simply reflect the byproducts produced from formulating, transporting, or ingesting the drug.

The CDEWS test results can only provide an indication of the recent use of licit and illicit drugs by the persons who provided the specimens. A more complete understanding of the results would require additional study. Nor can our test results tell us why or how often persons used a drug or where they obtained it.

Summary and Conclusions

We found that marijuana was one of the most prevalent drugs detected in specimens from the adults that we had sampled, present in 31-58% of specimens across the four samples. PCP was also prominent in the PSA+ (27%) and SC+ (33%) samples. Cocaine, another drug in the PSA test panel, was most prominent in the PSA+ sample (26%) but was less common in the other three samples. Nonfentanyl opioids, mostly morphine (the metabolite of heroin), were also most prevalent in the PSA+ specimens (33%). These results were expected because it was these more prevalent drugs that resulted in PSA labeling the specimens they provided to CDEWS as having tested positive. In contrast, few drugs, except marijuana, were found in the PSA- sample, suggesting to us that the test panel in use at the time of this study was quite adequate for finding drugs recently used.

Fentanyl presents a special case because it is not included in PSA's test panel and not detected by their opiate screen. We found, however, that fentanyl/norfentanyl was most prevalent in the specimens that had tested positive for another drug that PSA already tests for (21%). It was also detected in the amphetamine positive sample (17%) but this result was based on only 35 specimens. Most important, fentanyl was rare among the PSA- specimens (5%), suggesting that unlike what we had found in emergency department patients in Baltimore, there was not a large amount of recent fentanyl use by arrestees in Washington, DC, that was masked by the declining trend in opiate positives (Dezman et al., 2020). Applying our fentanyl test results for PSA+ and PSA- probationers/parolees to the test results PSA makes available for arrestees in DC, we estimate that only about 9.3% of tested arrestees in DC would have tested positive for fentanyl. We conclude that the majority of these fentanyl positive specimens would have occurred among arrestees that had already tested positive for drugs in PSA's routine test panel.

Perhaps the most dramatic findings from the current study were those regarding SC. When our collaborating laboratory only confirmed SC in 17 of the 36 (47%) specimens that PSA indicated had tested positive for SC, we sent the 36 specimens to the Center for Forensic Science Research and Education (CFSRE) laboratory at the Frederic Rieders Family Foundation for additional testing for SC using more sensitive tests. CFSRE's expanded testing detected SC in 34 of the 36 (94%) specimens. Taken together, the two laboratories were able to confirm 97% of these specimens to be positive for SC. This experience has highlighted for us the difficulty in detecting SC by urinalysis and its reliance upon the specific testing methods employed. Furthermore, comparing the test results for SC in four CDEWS studies spanning 2012-2019, we found that the earlier metabolites UR-144 and XLR-11 were no longer detected and that many new analytes/metabolites have emerged. Our findings therefore underscore the importance of frequently updating any SC testing panel to ensure that the panel will be able to detect the latest analytes/metabolites in substances being used.

Finally, our comparisons of the test results for the more prevalent drugs in the current study and the one completed three years earlier showed no significant changes in the rate of positives for

opiates, PCP, or cocaine among the PSA+ specimens. The only exception was marijuana, which increased from 37% to 58% ($p<.01$).

With the cessation of federal funding for the CDEWS program, this report describes the final CDEWS study in Washington, DC. The four CDEWS studies have tracked the changing levels and types of recent drug use, especially of SC, in the tested probationer/parolee populations and have shown CDEWS's usefulness for gauging the adequacy of current testing practices.

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