Community Drug Early Warning System: The CDEWS-2 Replication Study

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Office of National Drug Control Policy
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Disclaimer

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Notice

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Abstract

The Community Drug Early Warning System (CDEWS) provides rapid information about emerging drug use in local communities by sampling anonymous urine specimens already collected and tested, and ready to be discarded by local criminal justice programs. CDEWS re-tests the specimens for an expanded panel of more than 75 drugs. The most dramatic finding from the first study, CDEWS-1, completed in September 2013, was the identification of specific synthetic cannabinoids (SC) used by adult arrestee and parole/probation populations in the Washington, DC and Richmond, VA Metropolitan Areas. SC metabolites were actually *equally or more likely* to be detected in specimens that had passed the local criminal justice system (CJS) drug tests than in those that failed, suggesting that people were using them to avoid detection by the routine CJS testing screens. This second report on CDEWS (CDEWS-2) replicates the CDEWS results for adult parolees/probationers in Washington, DC, and studies new adult and/or juvenile criminal justice populations from Washington, DC (juveniles), Denver, Colorado (drug court adults), and Tampa, Florida (juveniles). A total of 1,026 specimens from these populations were tested as part of the CDEWS-2 study.

The CDEWS-2 urinalyses showed dramatic changes from the SC metabolites detected the prior year in CDEWS-1, and shows substantial differences in SC found from site to site. For the CDEWS-2 study, we interviewed toxicologists and other experts to determine the most important drugs, including new psychoactive substances (NPS), to include on our testing panel. This shows the value of interviewing experts in order to update the CDEWS test panel to include newly discovered SC metabolites. A large number of specimens tested positive for the metabolites added during CDEWS-2. About 50% of the 21-30 year old male probationers from DC who had *passed* the local more limited CJS screen and about 1 in 5 of all tested juveniles in DC at all ages, from 13-17, tested positive for SC. The SC metabolites detected varied by population and site; for example, all SC positive specimens from Tampa juveniles contained only one metabolite, UR-144, but only 71% of the SC positive specimens from DC juveniles and 53% of SC positives from adults in the Denver drug court contained UR-144. In fact, among DC juveniles, 8 SC metabolites were found and among Denver adults 10 SC metabolites were found. Testing for designer stimulants was suspended after all subsamples for the 4 populations tested negative for these drugs.

The CDEWS-2 results attest to the value of expanded testing of specimens already collected by local CJS drug testing programs and the difficulties inherent in keeping up with the constantly evolving nature of NPS. The results suggest that many adults and juveniles in local CJS drug testing programs likely turn to SC to avoid detection. It is also likely that programs using similar protocols to test urine specimens in other contexts, such as schools, hospitals and treatment programs are missing SC use in their populations, leading to lost opportunities for diagnosis and intervention. These risks are especially dangerous for youths being exposed to new and constantly changing NPS at an early age. Future CDEWS studies of these populations might help to address these issues.

Executive Summary

The Office of National Drug Control Policy's (ONDCP) National Drug Control Strategy has emphasized the need for the United States to develop a rapid and low-cost system for identifying emerging drugs at the local community level (ONDCP, 2014). This need has become even more critical recently with the advent of a prescription drug epidemic and the rapid development of new psychoactive substances (NPS) such as synthetic cannabinoids (SCs) and designer stimulants (i.e., so-called bath salts). At a time of constrained Federal and local budgets and rapidly shifting drug trends, a useful drug use monitoring system needs to be capable of rapidly responding to newly available drugs and of producing results quickly at minimal cost. To that end, staff at the Center for Substance Abuse Research (CESAR) at the University of Maryland, College Park, worked with ONDCP to test the feasibility of the Community Drug Early Warning System (CDEWS). The first CDEWS study (CDEWS-1) was completed in September 2013 (Wish et al., 2013). The CDEWS-1 study showed that the model of expanded re-testing of urine specimens already collected by the criminal justice system was effective and timely.

In 2014, ONDCP sponsored CESAR to replicate CDEWS in additional sites. The present study, CDEWS-2, collected specimens from parolees/probationers in Washington, DC, and expanded CDEWS to two new sites and a new population of juveniles in the criminal justice system. A major innovation of CDEWS is that it relies on sampling urine specimens that have already been collected by criminal justice agencies, tested for a limited drug screen, and are ready to be discarded. CDEWS sends these anonymous specimens to a laboratory that retests them for an expanded panel of more than 75 drugs. After exploring a number of potential sites for this study, the following sites were selected: 1) the Pretrial Services Agency for the District of Columbia (PSA) (for juveniles) and the Court Services and Offender Supervision Agency for the District of Columbia (CSOSA) (for adult parolees/ probationers); 2) Denver District Drug Court (for adult participants); and 3) the Tampa Juvenile Assessment Center (JAC). These sites utilized different testing procedures, offered access to a variety of criminal justice populations, and were estimated to have access to an adequate number of specimens for analysis.

The CDEWS-2 project introduced for the first time the collection of urine specimens from juvenile criminal justice populations. It also tested all samples for SCs and a subset of specimens for designer stimulants. (When an initial subsample of specimens from each population tested negative for designer stimulants, testing for these drugs was dropped from the test panel in favor of testing additional populations for SCs.)

Methods. After obtaining the necessary site and University Institutional Review Board approvals, the selection and collection of specimens proceeded rapidly and smoothly, and was completed with one day or less of researchers' time onsite or in the laboratory. Staff collected a total of 1,026 anonymous specimens from four populations from the three sites. As was done in CDEWS-1, to increase the chances of finding emerging drugs, specimens that had tested positive for any drug in

the agency's routine drug screen were oversampled. This is because CESAR's prior research has indicated that the less prevalent drugs tend to be found in specimens testing positive for the more common drugs included in the standard criminal justice panels (Wish et al., 2012). However, an important exception was that CDEWS-1 found synthetic cannabinoids to be equally likely in specimens that had passed the limited CJS screen as in those that had failed. All specimens were sent to an independent laboratory for testing for the expanded CDEWS panel of more than 30 prescription and illicit drugs and then to a second independent laboratory for testing for 21 SC metabolites. A subset was also tested for a panel of 23 designer stimulants. The drugs and metabolites included in the CDEWS-2 panel were selected after interviewing 11 chemists at 9 labs, as well as 7 other experts from the Drug Enforcement Administration (DEA), National Institute on Drug Abuse (NIDA) Community Epidemiology Workgroup (CEWG) and High Intensity Drug Trafficking Area Program (HIDTA). As we identified NPS to add to our panel, we assessed the availability of tests for these drugs. We also used a variety of data sources, such as DEA's National Forensic Laboratory Information System (NFLIS), NIDA's CEWG reports, and other relevant presentations and publications to identify drugs for inclusion on the study testing panel.

Limitations. While a number of limitations are described in the full report, it is critical that readers understand that although the urinalyses identified a number of prescription drugs, the urine tests alone cannot determine whether a prescription drug was used under medical supervision. Rather, CDEWS can best be viewed as providing timely information about local drug use and availability that can be used to target populations where additional information may be collected. The results can also be used to identify drugs that local criminal justice and health-related testing programs might consider adding. The CDEWS urinalysis results should not be generalized to the general criminal justice population or the broader community. The findings apply more readily to those persons selected for testing by the participating agencies. However, drug trends in high risk criminal justice populations may foreshadow drug use trends that show up later in the general population (DuPont & Wish, 1992). Lastly, long holding times required for positive specimens by CJS monitoring agencies (prior to their release for inclusion in the study) may have resulted in the degradation of some drugs resulting in false negative results. This may be especially true of designer stimulants (Huestis, 2013), which were not detected in any of the CDEWS-2 specimens.

Summary of Selected Primary Findings

I. DC Adult Parolees and Probationers

- Adults who passed the CJS limited drug screen were twice as likely to test positive for synthetic cannabinoids as those who failed the CJS screen, 36% vs. 17%, p<.001, suggesting likely attempts to avoid detection (p. 15).

- About one half of the men ages 21-30 who had passed the limited CJS screen tested positive for SC (p. 19).

- The SC metabolite UR-144 was found in 99% of SC positive specimens, but the newly added metabolites (PB-22, 41% and 5F-PB-22, 13%) were also detected in a substantial minority of SC positive specimens (p. 16).

- SC positive specimens for juveniles contained a larger variety of SC metabolites than adults, including XLR-11 (26%) and AB-PINACA (13%) (p. 17).

- Across all ages, including the specimens from juveniles, those that had passed the limited CJS screen were more likely to contain SC than specimens that had failed the CJS screen, supporting the idea that people use SC to avoid detection by the criminal justice testing program (p. 19).

- In the one year since CDEWS-1 specimens were collected, considerable changes have occurred in the metabolites contained in SC used by these populations in DC (p. 24).

- CDEWS-1 and CDEWS-2 studies both showed that specimens containing marijuana, SC, and PCP tended to come from younger persons with average ages in their 20-30's, while opioids came from persons in their 40's and 50's (p. 26).

II. Denver Adults – Drug Court

- SC was identified in a small minority of tested specimens, 8% of CJS positive and 3% of CJS negative specimens (p. 32). Contrary to anecdotal reports, it does not appear that persons were abandoning expensive local marijuana for SC.

- The 19 SC positive specimens contained 10 different SC metabolites, and only 53% contained UR-144 (p. 34).

- Prescribed drugs not specifically tested for by the Denver criminal justice system but that showed up in 7% or more of CJS positive or negative specimens were oxymorphone, hydromorphone, oxycodone, hydrocodone, and methadone (p. 32).

III. DC Juveniles

- These first CDEWS findings from juveniles males aged 12-17 in DC show that SC use extends to youths, albeit at lower levels than found in adult males 18-50 (p. 19).

- Regardless of PSA screen result, about 1 in 5 youths tested positive for SC (p. 42).

- While UR-144 was the most detected metabolite, found in 71% of the SC positive specimens, many more metabolites were found in SC positive specimens from youths than adults (p. 40).

- Youths in diagnostic probation (see Appendix B) who passed the standard PSA screen were three times more likely to test positive for SC than youths who failed the PSA screen (25% vs. 8%, $p<.05$) (p. 41).

- SC was detected in all ages from 13-17 (p. 42).

IV. Tampa Juveniles

- An SC metabolite was found in a small minority (9%) of specimens, most of which had also tested positive for marijuana by the "likely" local CJS screen (p. 46).

- In contrast to other CDEWS sites, all SC positives contained only one metabolite (UR-144), suggesting a different variety/source of SC available in Tampa (p. 46).

- SC metabolites were found in both youths who were arrestees or violators of probation (p. 47).

V. Cross-Site Comparisons of SC Results

- The patterns of SC metabolites detected varies considerably across the 4 populations studied (p. 51).

- While SC positive specimens for Tampa juveniles contained only UR-144, those for adults and juveniles in DC and adults in Denver contained multiple metabolites (p. 51).

- Of the 12 SC metabolites found across all of the populations, 3 (MAM-2201, ADBICA, and 5F-AB-PINACA) have not yet been scheduled by the DEA as of January 2015 (p. 51).

- DEA's NFLIS reports for Florida and Denver identified most of the SC metabolites found by CDEWS-2; DC NFLIS reports identified none of the metabolites CDEWS detected in DC

juveniles or adults (p. 52; p. 53).

VI. Implications of CDEWS-2 Findings for the CDEWS Method

1. Refining the CDEWS method for classifying specimens according to the local CJS screen. The current CDEWS protocol asks each participating site to provide information on whether each specimen submitted to CDEWS tested positive or negative for any drug in their local screening panel. Based on our experiences in CDEWS-2 and to simplify the process, future CDEWS studies will no longer record the local CJS lab's overall screen results. We will still ask each site to collect the targeted number of positive and negative specimens, but will use the CDEWS laboratory's results to classify each specimen according to whether it would have passed or failed the local drug screen. This strategy will still enable CDEWS to analyze the drugs found in specimens that would have likely tested positive or negative by the local site's testing program.

2. Create ongoing dialogues with toxicologists. When we began CDEWS we had little understanding of the continuous development of drug tests required to keep up with evolving NPS. Differences in the SC metabolites identified in specimens collected about one year apart from participants in Washington, DC, and in the metabolites found in specimens from different areas of the country attest to the value of conducting interviews with toxicologists periodically to ensure the use of the most up-to-date testing protocols by CDEWS.

3. Expand CDEWS to additional geographic locations. The CDEWS-1 and CDEWS-2 studies attest to its value in the expanded testing of specimens already collected by local CJS drug testing programs and the difficulties inherent in keeping up with the constantly evolving nature of NPS. It is clear from the results that many adults subject to CJS drug testing programs likely seek to avoid detection by turning to SC. It is also likely that programs using similar panels to test urine specimens in other contexts, such as schools, hospitals and treatment programs are missing SC use in their populations, leading to lost opportunities for diagnosis and intervention. These risks are especially dangerous for youths being exposed to new and constantly changing NPS at an early age. Future CDEWS studies of these populations might help to address these issues.

4. Expand CDEWS juvenile focus to include additional CJS populations and beyond. CDEWS-2 has shown the value of testing specimens obtained from adults and youths in testing programs operated by the criminal justice system. Drug use by youths is often a risk factor for later substance use disorders, and it is critical to identify use of NPS so that early interventions can be planned. CDEWS should continue to include specimens from juvenile populations.

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Introduction

The Community Drug Early Warning System (CDEWS) provides timely information about emerging drug use in local communities at low cost by sampling and re-testing urine specimens already obtained and tested for a limited panel of drugs by local criminal justice testing programs. With input from CDEWS researchers, the criminal justice system (CJS) testing staff sample specimens that are ready to be discarded and sends them without identifying information to independent laboratories for testing for a larger panel of licit and illicit drugs. Through expanded testing of already collected urine specimens, CDEWS can provide a relatively quick and inexpensive (see Appendix A and C for details) snapshot of the types of drugs recently used by high risk criminal justice populations in a community. This information is important because prior illegal drug epidemics have often shown up in urine test results from criminal justice populations before they have become evident in the larger community (DuPont & Wish, 1992; Wish, 1997). The CDEWS methodology was first tested in the CDEWS-1 pilot study (Wish et al., 2013). The current report provides results from CDEWS-2, which replicates and extends the prior CDEWS-1 study. We briefly review the CDEWS-1 study and then provide results from the CDEWS-2 study.

The CDEWS-1 study. In 2013, ONDCP funded the Center for Substance Abuse Research (CESAR) to conduct a pilot test of the CDEWS methodology (the 2013 pilot study is referred to as CDEWS-1 in the rest of this report) in three jurisdictions: Washington, DC (adults on parole/probation, pretrial surveillance and in lockup), Prince George's County, MD (adult drug court participants), and Chesterfield, VA (adult probationers). A total of 1,064 samples were collected from 5 populations from these 3 jurisdictions and were tested for a panel of more than 30 drugs. Because of funding constraints, only a subsample of these specimens (N=591) were also tested for the presence of 12 synthetic cannabinoid (SC) metabolites. The CDEWS-1 results established that the CDEWS methodology could be successfully implemented in diverse adult criminal justice populations, including arrestees, probationers and parolees, and drug court participants. Most important, CDEWS proved its utility for uncovering emerging drugs. SCs were detected in the specimens from all participating sites. Furthermore, all of the SC positive specimens contained one or two of the metabolites (UR-144 and XLR-11) that had been recently identified and added to the federal schedule of prohibited SC metabolites after the CDEWS-1 study had begun. CDEWS-1 also yielded a dramatic unexpected finding: SCs were equally likely to be detected in specimens that had passed the limited CJS test screen, as in those that had failed it. Results suggested that persons subject to CJS drug monitoring might indeed be using SCs in order to pass the routine CJS drug screens that typically do not test for these metabolites as found in an earlier study (Presley et al., 2013). Additional illustrative analyses of the CDEWS-1 data identified specific areas of Washington, DC, where the SC positive specimens were more concentrated and where future studies of its use and availability could be focused (Wish et al., 2013).

The CDEWS-2 study. There were several reasons for undertaking the CDEWS-2 study. First, questions were raised about whether the SC metabolites detected and since made illegal, had changed since the original study in Washington, DC, and whether the other CDEWS-1 findings might have changed. Second, we also wanted to pilot CDEWS in new sites with additional CJS populations, to test all specimens for SC, and to include a panel of designer stimulants, which had not been included in the CDEWS-1 testing protocols. Therefore, in 2014, ONDCP supported CESAR to replicate the CDEWS-1 study in Washington, DC, to expand into two new sites, and to add a juvenile CJS population. After exploring a number of potential sites for this study, four criminal justice populations were selected: 1) adult parolees and probationers in Washington, DC; 2) adult participants in Denver District Drug Court; 3) juvenile detainees in Washington, DC; and 4) juvenile detainees in Tampa, FL. These sites utilized different testing procedures, offered access to different adult and juvenile criminal justice populations, and were believed to have access to an adequate number of specimens for analysis. The remainder of this report describes the methods and findings from the CDEWS-2 replication study.

Methodology

Site Selection Procedures

We selected DC Parole and Probation because we wanted to replicate the CDEWS-1 findings from that population. The DC parole/probation agency involved in the first study was also interested in participating again.

We next sought adult participants in the Denver District Drug Court because we had received anecdotal reports from drug court staff that SCs were being increasingly used by many persons in Denver because legal marijuana was becoming much more expensive to acquire. SC was reportedly sold openly in stores and was less expensive than legal marijuana. In addition, we had been able to previously study only a small number of drug court participants in Prince George's County, Maryland (N=60) as part of CDEWS-1. It seemed likely that drug court participants might turn to SC use to avoid detection by the existing drug testing program. We received an introduction to Kristin Wood, the Deputy Court Administrator of Denver District Court, from West Huddleston, Chief Executive Officer of the National Association of Drug Court Professionals (NADCP).

Having found in CDEWS-1 that adult men in the three populations tested in DC who were under age 30 were most likely to test positive for SC, we felt it important to examine if SC use extended to youths participating in the DC juvenile drug testing program. We therefore arranged to sample specimens submitted to the DC laboratory from criminal justice testing programs that obtained urine specimens from juveniles.

Through the assistance of Dr. Richard Dembo, a local criminologist, we were also able to recruit the Juvenile Assessment Center (JAC) site in Tampa, FL for inclusion in the study. We chose this site because they had a large enough sample of specimens from juveniles to serve as a comparison to the DC juvenile population described above. The Tampa site could provide specimens from juveniles that had recently been arrested and from those who had violated probation. Juveniles are asked to provide voluntary urine specimens during the JAC intake and assessment process.

The four selected sites completed the approval process in a timely manner, offered access to different adult and juvenile criminal justice populations in different geographic areas, and promised to provide an adequate number of specimens for analysis. These sites used onsite and offsite testing laboratories and different CJS drug screening protocols. A description of each of the four sites are included below in Table 1.

Table 1: Description of Participating Study Sites

Site	Populations Covered	Type of CJS Laboratory	Drugs in Standard CJS Screen
DC: Court Services and Offender Supervision Agency for the District of Columbia (CSOSA)	Adult parolees and probationers (est. 314,000 specimens per year)	Onsite laboratory	6-panel screen: marijuana, cocaine, opiates, amphetamines, 6-MAM and PCP. All amphetamine positives were confirmed by PSA using GC/MS.
DC: Pretrial Services Agency for the District of Columbia (PSA)	Juvenile Family Court (est. 13,000 specimens per year)	Onsite laboratory	3-panel screen: marijuana, cocaine, and PCP.
Denver, CO: Denver District Drug Court	Drug court participants (est. 17,000 specimens per year)	Offsite laboratory	7-panel screen: methamphetamine/amphetamine, barbiturates, benzodiazepines, cocaine, opiates, propoxyphene, and marijuana. 8-panel screen: methamphetamine/amphetamine, barbiturates, benzodiazepines, cocaine, opiates, propoxyphene, marijuana, and EtG (alcohol). Note: A 7-drug or 8-drug panel screen is administered depending on the drug court participant's history of alcohol and/or drug use/abuse or suspicion of use by their supervising officer.
Tampa, FL: Juvenile Assessment Center (JAC)	JAC program participants - juvenile arrestees and violators of probation (est. 6,000 specimens per year)	Offsite laboratory	4-panel screen: marijuana, cocaine, opiates and amphetamines.

Washington, DC is relatively close to CESAR's research offices. Prior to sampling adult and juvenile specimens from the DC site, we were able to meet with the local CJS and laboratory staff to explain the purpose of the study, recruit their participation, learn about their current testing procedures, and determine what sampling procedures would work best from a scientific, logistical, and efficiency standpoint. Logistics had to be discussed over the phone with the Denver District Drug Court and Tampa JAC programs and their off-site laboratories. Prior to data collection, CESAR submitted applications for the necessary approvals from each site and obtained approval for the CDEWS-2 study from University of Maryland's Institutional Review Board. The specific steps taken to recruit and work with each site are described in Appendix A, along with more details about each site in Appendix B.

Collection of Urine Specimens

Prior to collecting the specimens, CESAR met with staff from each site in-person and/or by phone to determine their policies regarding required specimen holding periods, testing protocols, detection limits and other relevant site details. Specimens were then accumulated by each site using specific guidelines provided by CESAR as to how specimens were to be handled and stored. As we had done in CDEWS-1, to increase the probability of detecting rare drugs, we oversampled specimens that had tested positive in their routine CJS drug screens. CESAR's prior research had indicated that the rarer drugs (except for SCs in CDEWS-1) tended to be found in persons testing positive for any of the more common drugs included in the standard criminal justice test panels (Wish et al, 2012).

If a person had contributed more than one specimen, only one specimen per donor (typically the most recent) was selected for CDEWS. Once the desired number of unique specimens was reached, CESAR staff arranged to prepare the specimens on-site for pick up or to have them shipped directly to our independent CDEWS research laboratory. All specimens were de-identified during preparation for transfer to the CDEWS laboratory. However, in most sites we were able to record the date the specimen was collected and the person's year of birth, gender, and zip code of residence. The Denver and Tampa sites also provided race/ethnicity for each specimen collected. The demographics collected for each site are summarized below in Table 2.

Table 2: Demographics Collected, by Site

	Demographics Collected				
Site	Specimen Collection Date	Year of Birth	Gender	Zip Code of Residence	Race/Ethnicity
DC Adult Parole and Probation	X	X	X	X	
Denver Adult Drug Court	X	X	X	X	X
DC Juveniles	X	X	X		
Tampa Juvenile Assessment Center (JAC)	X	X	X	X	X

The specimens from the DC sites were selected and prepared on-site by CESAR staff. For the Denver District Drug Court site, where specimens are sent to Norchem laboratory in Arizona for testing, drug court staff worked with Norchem laboratory staff to select specimens for the study, and Norchem laboratory staff then prepared them for shipment to the CDEWS laboratory in Maryland. Norchem was paid a processing fee of $5 for each specimen sent to the CDEWS laboratory for testing. Similarly, for the JAC program, CESAR worked with their contracted laboratory, ACTS, located in Florida, to select specimens for the study and ACTS laboratory staff then shipped them to the CDEWS laboratory. ACTS laboratory was paid a processing fee of $500 for the total sample of specimens sent to the CDEWS laboratory. Additional details of the specimen selection, storage, and processing in each site appear in Appendix B.

Interviews with Toxicologists to Develop the CDEWS-2 Testing Panel

In the CDEWS-1 study, we learned that both the chemical composition of synthetic drugs available and patterns of use can vary widely even within a brief period of time. It is a recognized challenge for both laboratories and law enforcement to keep up with the rapid changes in the composition of synthetic drugs. The chemists producing these drugs modify their chemical structures as existing formulations are scheduled by the DEA and then made illegal. To ensure that the test panel for CDEWS-2 was as current as possible and included the most relevant metabolites, CESAR staff contacted 11 chemists at 9 labs, as well as 7 other experts from the Drug Enforcement Administration (DEA), National Institute on Drug Abuse (NIDA) Community Epidemiology Workgroup (CEWG) and High Intensity Drug Trafficking Area Program (HIDTA) in DC and CO prior to finalizing the test panel for CDEWS-2. Contacts in Tampa, FL, were not interviewed, as this site was added to the study after the testing panel had been finalized and testing had already been started in other populations. The persons interviewed were selected using an online search for those having expertise in the area of NPS and/or urine testing. We also identified contacts through referrals from our existing network of toxicologists, researchers, and law enforcement representatives. A list of persons interviewed appears below in Table 3.

Table 3: Toxicologists Interviewed for CDEWS-2

NAME	TITLE/AFFILIATION
Dr. (CDR) Thomas Bosy; Justin Holler	Armed Forces Medical Examiner System (AFMES)
Thomas Carr; Ron Jones	Washington-Baltimore HIDTA
Dr. Gregory Endres	Cayman Chemical
Dr. Barry Logan	NMS Labs
Dr. Jeffery Moran	Arkansas Public Health Laboratory, Arkansas Department of Health
William Dietz; Esther Chege	U.S. Drug Enforcement Administration (DEA) Western Lab
Kristen Dixion	Addiction Research and Treatment Services, University of Colorado Denver
Thomas Gorman	Rocky Mountain HIDTA
Dr. Marilyn Huestis	National Institute on Drug Abuse, National Institutes of Health Biomedical Research Center
Bruce Mendelson	Denver Office of Drug Strategy & Denver CEWG
Barbara Roach	U.S. Drug Enforcement Administration (DEA), Denver Division
Jerome Robinson	Pretrial Services Agency for the District of Columbia
Wendi Roewer	U.S. Drug Enforcement Administration (DEA), Field Intelligence, Denver Division
Myron Shiplet	Friends Medical Laboratory
Donald Shriver	Denver Police Department Crime Laboratory

To plan our SC test panel, we also reviewed data for DC and Denver from the DEA National Forensic Laboratory Information System (NFLIS), which reports drugs items seized and tested by local law enforcement (DEA, 2013, 2013a, 2013b; Shriver, 2013, 2014). NIDA's CEWG reports, as well as other publications and presentations, provided valuable information about local drug trends (Comparin, 2014; Denver Office of Drug Strategy, 2013, 2013a; Endres, 2014; Gurney et al., 2014; Hobaica, 2013; Jones, 2014; Lozier et al., 2013; Presley et al., 2013; Seely et al., 2013).

Our interviews led us to add nine new SC metabolites to our previous (CDEWS-1) 12 metabolite screen (APINACA/AKB-48, 5F-AKB-48, BB-22, PB-22, 5F-PB-22, AB-PINACA, 5F-AB-PINACA, ADB-PINACA, and ADBICA were added, see Table 5 for the full list of metabolites), along with a new panel of 23 metabolites for designer stimulants. Given that some of the SC metabolites identified were recently discovered, we delayed testing of our collected specimens until the contracted CDEWS laboratory completed development of tests for these metabolites. Other SC metabolites were identified, but tests for many of them were not available at the time of CDEWS-2, and were therefore excluded from testing (see Appendix C).

Testing of Urine Specimens by CDEWS-2 Laboratories

All specimens were sent to Friends Medical Laboratory located in Maryland for an expanded drug testing panel of more than 30 drugs (Table 4). As Table 4 shows, positives for opiates, amphetamines, buprenorphine and PCP (along with oxycodone positives with a negative opiate screen) were confirmed by another test, to identify the specific drug involved. Friends Medical Laboratory does not conduct testing for synthetic cannabinoids (SC) or designer stimulants, so the study specimens were sent by Friends to Clinical Reference Laboratory (CRL) located in Kansas to test for those drugs.

CRL then tested all specimens for a panel of 21 synthetic cannabinoid metabolites (Table 5). A subset of the study specimens were also tested for a panel of 23 designer stimulants (Table 6). Designer stimulants were not included in the original CDEWS-1 study because of their higher testing costs. For CDEWS-2, we decided to first test approximately 15-20% of randomly selected specimens from each population for designer stimulants to determine if any were present. Each specimen was tested for a panel of 23 designer stimulants. We tested 170 of the 1,026 specimens collected for designer stimulants, 80 from DC Adult Parole and Probation, 20 of the DC juveniles, 50 adults from Denver District Drug Court and 20 juveniles (arrestees) from the JAC center in Tampa, FL (see Appendix B). When none of the test samples from any site came back positive, further testing for designer stimulants was suspended. We learned later that it was possible that the long holding times for the study specimens prior to testing may have resulted in some degradation of stimulant metabolites, thereby contributing to our inability to detect designer stimulants in any of our study specimens (personal communication, Marilyn Huestis, 2013). The cost savings from the reduced number of designer stimulant tests enabled us to add the juvenile populations in DC and Tampa, Florida as study sites.

Table 4: The CDEWS-2 Laboratory Expanded Drug Screening Panel

Drugs Tested, by Method	Detection Limit
Enzyme Immunoassay (EIA)	
Amphetamines	500 ng/mL
Barbiturates	200 ng/mL
Benzodiazepines	300 ng/mL
Buprenorphine	5 ng/mL
Cocaine	150 ng/mL
MDMA	500 ng/mL
Methadone	150 ng/mL
Methadone Metabolite	300 ng/mL
Opiates	300 ng/mL
Oxycodone	100 ng/mL
PCP	25 ng/mL
THC	50 ng/mL
6 Monoacetyl Morphine	150 ng/mL
Thin-layer Chromatography (TLC)	
Ami/Nortriptyline	Hydroxyzine
Amphetamines	Methadone
Ativan/Dalmane	Morphine
Benzodiazepines	Oxycodone
Clonazepam	Opiates
Cocaine	Phenmetrazine
Codeine	Phenothiazines
Demerol	Quinine
Dilaudid	Tramadol
Doxepin	Valium
Hydrocodone	
Confirmations	
Liquid Chromatography/Mass Spectrometry	
LC/MS was conducted on all EIA positives for opiates, amphetamines and buprenorphine. LC/MS confirmation for opiates was also conducted on all EIA oxycodone positives with a negative EIA opiate screen.	
Gas Chromatography/Mass Spectrometry	
GC/MS was conducted on all EIA positives for PCP.	

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 5: Synthetic Cannabinoid Metabolites Included in CDEWS-2 Drug Testing Panel, Metabolites Detected and their Detection Limits

Tested for in CDEWS-1

Synthetic Cannabinoid Metabolites		Metabolites Detected	Detection Limit
1.	JWH-018	5-(3-(1-naphthoyl)-1H-indol-1-yl)-pentanoic acid	0.2 ng/mL
2.	JWH-019	(1-(6-hydroxyhexyl)-1H-indol-3-yl)(naphthalen-1-yl)methanone	0.2 ng/mL
3.	JWH-073	4-(3-(1-naphthoyl)-1H-indol-1-yl)-butanoic acid	0.2 ng/mL
4.	JWH-081	(1-(5-hydroxypentyl)-1H-indol-3-yl)(4-methoxynaphthalen-1-yl)methanone	0.5 ng/mL
5.	JWH-122	(1-(5-hydroxypentyl)-1H-indol-3-yl)(4-methylnaphthalen-1-yl)-methanone	0.2 ng/mL
6.	JWH-210*	(4-ethylnaphthalen-1-yl)(1-(5-hydroxypentyl)-1H-indol-3-yl)methanone	0.5 ng/mL
7.	JWH-250	1-(1-(5-hydroxypentyl)-1H-indol-3-yl)-2-(2-methoxyphenyl)ethanone	0.5 ng/mL
8.	AM-2201	(1-(5-fluoro-4-hydroxypentyl)-1H-indol-3-yl)(naphthalen-1-yl)methanone	0.2 ng/mL
9.	MAM-2201*	5-(3-(4-methyl-1-naphthoyl)-1H-indol-1-yl)pentanoic acid	0.2 ng/mL
10.	RCS-4	5-(3-(4-methoxybenzoyl)-1H-indol-1-yl)pentanoic acid	0.5 ng/mL
11.	UR-144	5-(3-(2,2,3,3-tetramethylcyclopropanecarbonyl)-1H-indol-1-yl)pentanoic acid	0.5 ng/mL
12.	XLR-11	(1-(5-fluoro-4-hydroxypentyl)-1H-indol-3-yl)(2,2,3,3-tetramethylcyclopropyl)methanone	0.2 ng/mL
13.	APINACA (AKB-48)	1-pentyl-N-tricyclo[3.3.1.13,7]dec-1-yl-1H-indazole-3-carboxamide	2.5 ng/mL
14.	5F-AKB-48[+]	N-((3s,5s,7s)-adamantan-1-yl)-1-(5-fluoropentyl)-1H-indazole-3-carboxamide	2.5 ng/mL
15.	BB-22*	1-(cyclohexylmethyl)-8-quinolinyl ester-1H-indole-3-carboxylic acid	5 ng/mL
16.	PB-22	1-pentyl-8-quinolinyl ester-1H-indole-3-carboxylic acid	5 ng/mL
17.	5F-PB-22	1-(5-fluoropentyl)-8-quinolinyl ester-1H-indole-3-carboxylic acid	5 ng/mL
18.	AB-PINACA	5-(3-((1-amino-3-methyl-1-oxobutan-2-yl)carbamoyl)-1H-indazol-1-yl)pentanoic acid	5 ng/mL
19.	5F-AB-PINACA*	N-(1-amino-3-methyl-1-oxobutan-2-yl)-1-(5-fluoro-4-hydroxypentyl)-1H-indazole-3-carboxamide	5 ng/mL
20.	ADB-PINACA	5-(3-((1-amino-3,3-dimethyl-1-oxobutan-2-yl)carbamoyl)-1H-indazol-1-yl)pentanoic acid	5 ng/mL
21.	ADBICA*	5-(3-((1-amino-3,3-dimethyl-1-oxobutan-2-yl)carbamoyl)-1H-indol-1-yl)pentanoic acid	5 ng/mL

Note: The synthetic cannabinoids tests are performed using LC/MS/MS. The screening and confirmation tests are performed using different analytical phase columns to enhance accuracy in detection and reporting. The screening and confirmation methods were developed in accordance with the College of American Pathologist Guidelines for Forensic Drug Testing (FDT) and are subject to CAP and state agency inspections.

*These metabolites have not yet been scheduled by the DEA as of January 2015.

[+]Per DEA, this SC may be treated as a "controlled substance analogue" under the CSA pursuant to 21 U.S.C §§802(32)(A) and 813.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 6: Designer Stimulants Included in CDEWS-2 Drug Testing Panel

1. 25B-NBOMe	2-(4-bromo-2,5-dimethoxyphenyl)-*N*-[(2-methoxyphenyl)methyl]ethanamine
2. 25I-NBOMe	2-(4-iodo-2,5-dimethoxyphenyl)-*N*-[(2-methoxyphenyl)methyl]ethanamine
3. 2C-B	2-(4-bromo-2,5-dimethoxyphenyl)ethanamine
4. 2-Fluoroamphetamine*	1-(2-Fluorophenyl)propan-2-amine
5. 2-Fluoromethamphetamine*	1-(2-fluorophenyl)-N-methylpropan-2-amine
6. 3-Fluoromethcathinone	1-(3-Fluorophenyl)-2-methylaminopropan-1-one
7. 4-Methylethcathinone	2-ethylamino-1-(4-methylphenyl)propan-1-one
8. Buphedrone*	2-(methylamino)-1-phenylbutan-1-one
9. Butylone	1-(1,3-benzodioxol-5-yl)-2-(methylamino)butan-1-one
10. Benzylpiperazine	1-benzylpiperazine
11. Cathinone	2-amino-1-phenyl-1-propanone
12. Ephedrone/Methcathinone	2-(methylamino)-1-phenyl-propan-1-one
13. Ethylone*	1-(1,3-benzodioxol-5-yl)-2-(ethylamino)propan-1-one
14. Eutylone*	1-(1,3-benzodioxol-5-yl)-2-(ethylamino)butan-1-one
15. mCPP*+	1-(3-chlorophenyl)piperazine
16. MBDB*	1-(1,3-Benzodioxol-5-yl)-*N*-methylbutan-2-amine
17. MDPV	1-(Benzo[*d*][1,3]dioxol-5-yl)-2-(pyrrolidin-1-yl)pentan-1-one
18. Mephedrone	2-methylamino-1-(4-methylphenyl)propan-1-one
19. Methedrone	1-(4-methoxyphenyl)-2-(methylamino)propan-1-one
20. Methylone	2-Methylamino-1-(3,4-methylenedioxyphenyl)propan-1-one
21. Pentedrone	1-phenyl-2-(methylamino)pentan-1-one
22. Pentylone	1-(1,3-benzodioxol-5-yl)-2-(methylamino)pentan-1-one
23. TFMPP	1-[3-(trifluoromethyl)phenyl]piperazine

*Indicates synthetic compounds that have not yet been scheduled by the DEA as of January 2015.

+Testing for mCPP was not conducted on the juvenile population as this test was discontinued by the testing laboratory due to cross-reactivity issues with the immunoassay.

Note: MDMA, MDA and MDEA are detected as part of the amphetamine confirmation done by LC/MS. Detection limit for all of the above substances is 20 ng/mL.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Results

The results are presented for each of the 4 populations in separate sections of this report. For ease of discussion, the sites will be referred to as DC Adults (Parole and Probation), Denver Adults (Denver, CO, District Drug Court), DC Juveniles (PSA Juvenile Family Court) and Tampa Juveniles (Juvenile Assessment Center). CJS (or PSA for DC) test results refer to the limited screen routinely used by the local criminal justice agency. The CDEWS test results refer to the expanded drug tests used by the CDEWS laboratory, which also includes all of the drugs in the smaller CJS test panels. The CDEWS test results are separated into those drugs that had also been tested for in the routine CJS screen versus the additional specific substances tested for only in the expanded CDEWS screen. One should note that the specific drugs tested for only by CDEWS might have triggered a positive result in the more general screening tests used by the CJS protocols. For example, it is very likely that a screen which only tests for opiates as a class of drugs, is responding to the presence of codeine or morphine that was specifically identified only in the CDEWS expanded tests. This is because in the CDEWS testing panel, any specimen that tested positive for a class of drugs, such as opiates and/or amphetamines, was subjected to confirmatory testing to identify the exact substances being used (such as codeine or MDMA, respectively).

For each results section, we first describe the specimens collected and some basic demographic information about the persons who provided them. Next, we describe the CDEWS test results for specimens tested for in the expanded screen, including synthetic cannabinoids (SCs). Because we oversampled CJS positive specimens, we present the results for CJS positive and CJS negative specimens separately except for SCs, which we analyzed as a single group. We then examine correlates of an SC positive test result where possible and for DC, compare the results from our CDEWS-1 study with those from the CDEWS-2 study. Each results section ends with a summary of the primary findings for that population. After presenting results for each of the four populations in CDEWS-2, we present cross-site comparisons of SC results.

DC Adult Parolees and Probationers

A. Specimens Received

While we had targeted a total of 330 specimens - 200 CJS drug positive specimens, 100 CJS drug negative specimens and 30 amphetamine positive specimens - we actually received 218 CJS positive specimens and 101 CJS negative specimens, for a total of 319 specimens (see Appendix B). Thirty amphetamine positives were targeted and obtained as a separate sample because amphetamine positive specimens are confirmed by the DC (PSA) laboratory staff using GC/MS and held separately from the other specimens. The specimens were provided by probationers/parolees between December 5, 2013 and March 18, 2014.

B. Demographic Characteristics of Persons Providing Specimens

Table 7 presents the demographic characteristics associated with the 319 specimens, according to whether their PSA screen results were positive or negative. As one might expect in a CJS population, the overwhelming majority of specimens (87% to 98%) came from males. The age distribution was bi-modal, with about one third of specimens coming from persons age 18-30 and slightly more coming from persons over age 40. Washington, DC, is divided geographically into eight wards. Most of the specimens came from persons living in Wards 5, 7, and 8. A very small subset of specimens came from persons who reside in Maryland and Virginia.

C. CDEWS-2 Laboratory Test Results

Table 8 presents the CDEWS laboratory urinalysis results, according to the local PSA screen result. Drugs detected in 1% or fewer of both groups are excluded from the table. (Throughout this report, we have combined the PSA positive specimens with the separately sampled 30 amphetamine positive specimens and then weighted the amphetamine positive specimens to their expected proportion (2.2%) among all positive specimens, obtained from PSA.)

The results in Table 8 paint a very clear picture. With the exception of SC, the additional drugs included in the CDEWS expanded test protocol were rarely detected in either specimens that had tested positive or negative by the smaller PSA screen. Drugs found in the PSA positive specimens included methadone (7%), oxycodone (5%), oxymorphone (5%) and buprenorphine (4%). Both methadone and buprenorphine are legal drugs prescribed to treat opioid dependence and these results could reflect use by persons participating in supervised drug treatment. Morphine (20%) and codeine (17%) were more likely to be detected in the PSA positive specimens and could have triggered a positive by the PSA screen for opiates (23% in the CDEWS test results).

The only drug not tested for by the routine PSA screen that was found in a substantial number of specimens tested for by the expanded CDEWS protocol involved SC; SC metabolites were detected in 17% of the specimens that had tested positive by the PSA screen and 36% of those testing negative by the PSA screen (difference significant at $p<.001$). The most common SC metabolites detected were

UR-144 and PB-22. UR-144 was also the SC metabolite most likely to be detected in the CDEWS-1 study. PB-22, however, was one of the new metabolites added to the CDEWS-2 screen when the metabolite was newly available for testing. These results, and those discussed in later sections underscore the changing nature of the metabolites found in SCs being used.

D. SC Metabolites Detected

The following analyses combine SC positive specimens regardless of their PSA screen result. Figure 1 shows that the majority (56%) of the specimens testing positive for SC contained the metabolite UR-144 only, followed by those containing 2 metabolites, UR-144 with PB-22 (27%). A minority (13%) contained UR-144 and 2 or more other SC metabolites. The table below the pie chart on Figure 1 shows that virtually all (99%) SC positive specimens contained UR-144 and almost one half (41%) contained PB-22, a relatively new metabolite not tested for in CDEWS-1. Only 4% of SC positive specimens contained XLR-11, which has been implicated in acute kidney injury (CDC, 2013). These results indicate that we could have identified 99% of SC positives had we only tested the specimens for UR-144.

Table 9 compares the metabolites found in the 70 SC positive specimens from adults with the 38 SC positive specimens we obtained from the juvenile population described in a later section of this report. Important differences were found in the metabolites identified in the two populations. UR-144 was more likely to be detected in SC positive specimens for adults (99% of specimens from adults and 71% of those from juveniles, $p<.001$), as was PB-22 (41% vs. 5%, $p<.001$). Metabolites more prevalent in SC positive specimens from juveniles were XLR-11 (26% vs. 4%, $p<.001$) and AB-PINACA (13% vs. 0%, $p<.01$).

These differences in the SC metabolites identified in specimens from adults and juveniles from Washington, DC, raise important questions. Why do the SC positive specimens from youths contain a greater number of different metabolites? One possibility is that because the urine specimens from juveniles were collected 2-4 months after the adult specimens were collected, these differences might reflect changes in the composition of SC available locally rather than real differences in the substances used by the two populations. Or are these results caused by different preparations marketed to and used by youths? Do youths seek out different sources (perhaps online?) for their SC than adults? What will be the differential health impact on youths being exposed to these differing components of SC? The finding that youths are more likely to be exposed to XLR-11 is also disconcerting given the possibility that this metabolite may be associated with kidney injury. Full results for the study of the DC juvenile population from which these specimens were obtained are described later in this report (see DC Juveniles section).

Table 7: Demographic Characteristics of Adult DC Parolees & Probationers Providing Specimens, by PSA Drug Screen Result*

(N=319 specimens)

	Parole & Probation	
	PSA Screen Positive† *(N=218)*	*PSA Screen Negative (N=101)*
Gender		
Male	87%	98%
Age		
18-20	10%	3%
21 to 25	12 (38%)	15 (30%)
26 to 30	16	12
31 to 40	16	31
41 to 50	20	18
51 and older	26 (46%)	21 (39%)
Total	100%	100%
Ward‡		
DC – Ward 1	4%	3%
DC – Ward 2	10	10
DC – Ward 3	<1	0
DC – Ward 4	13	8
DC – Ward 5	16	25
DC – Ward 6	5	3
DC – Ward 7	18	11
DC – Ward 8	28	34
Maryland	4	4
Virginia	<1	0
Unknown	<1	2
Total	100%	100%

*Pretrial Services Agency for the District of Columbia (PSA) tested the Parole & Probation population for marijuana, cocaine, opiates, amphetamines, 6-MAM and PCP (some individuals were also tested for synthetic cannabinoids, methadone and/or ethanol). All amphetamine positives were confirmed by PSA using GC/MS. Synthetic cannabinoids are tested by PSA using LC/MS/MS. PSA positive specimens were oversampled. Therefore, separate estimates for the "PSA Screen Positive" and the "PSA Screen Negative" categories should not be averaged to create an overall estimate.

†Positive specimens from the DC parole and probation sample were weighted due to oversampling of amphetamine positive specimens. See the DC Adult Parolees and Probationers results section of the full report.

‡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; Ward 3: 20008; Ward 4: 20011, 20012; Ward 5: 20002, 20017, 20018; Ward 6: 20003, 20024; Ward 7: 20019; Ward 8: 20020, 20032; Unknown: no data on residence.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 8: CDEWS Laboratory Test Results for Adult DC Parole & Probation, by PSA Drug Screen Result*

(N=319 specimens)

	PSA Screen Positive† (for any drug) (N=218)	PSA Screen Negative (for any drug) (N=101)
Percent Positive by CDEWS Lab for:		
Drugs in the routine PSA testing panel		
Marijuana	24%	0%
Cocaine	24	0
Opiates	23	2
PCP	8	0
6-MAM	3	0
Drugs not specifically+ identified by the routine PSA testing panel		
Morphine‡	20	2
Codeine‡	17	0
Methadone	7	1
Oxycodone‡	5	3
Oxymorphone‡	5	2
Buprenorphine‖	4	5
Any SC	17***	36***
UR-144	16	36
PB-22	7	14
5F-PB-22	2	3

Drugs tested for but not detected in any specimen: AB-PINACA, 5F-AB-PINACA, ADBICA, ADB-PINACA, 5F-AKB-48, AM-2201, barbiturates, BB-22, clonazepam, Demerol, dextromethorphan, Dilaudid, Doxepin, ephedrine, hydroxyzine, JWH-018, JWH-019, JWH-073, JWH-081, JWH-122, JWH-210, JWH-250, ketamine, MAM-2201, MDA, MDEA, MDMA, naloxone, phenmetrazine, pseudoephedrine, RCS-4, and Valium. Drugs detected in 1% or less of specimens: AKB-48, amitriptyline/nortriptyline, amphetamines, Ativan/Dalmane, benzodiazepines, hydrocodone, hydromorphone, methamphetamine, phenothiazines (as a family), tramadol, and XLR-11. Only a subset of specimens were tested for designer stimulants and none were detected. See Table 6 for the designer stimulant panel.

*Pretrial Services Agency for the District of Columbia (PSA) tested the Parole & Probation population for marijuana, cocaine, opiates, amphetamines, 6-MAM and PCP (some individuals were also tested for synthetic cannabinoids, methadone and/or ethanol). All amphetamine positives were confirmed by PSA using GC/MS. Synthetic cannabinoids are tested by PSA using LC/MS/MS. PSA positive specimens were oversampled. Therefore, separate estimates for the "PSA Screen Positive" and the "PSA Screen Negative" categories should not be averaged to create an overall estimate.

†Positive specimens from the DC parole and probation sample were weighted due to oversampling of amphetamine positive specimens. See the results section of the full report.

+Some of the specific opiates (e.g., morphine, codeine, etc.) could have been detected by PSA as part of the opiate screen in the routine PSA testing panel.

‡These drugs screened positive for opiates and were identified by subsequent LC/MS confirmation.

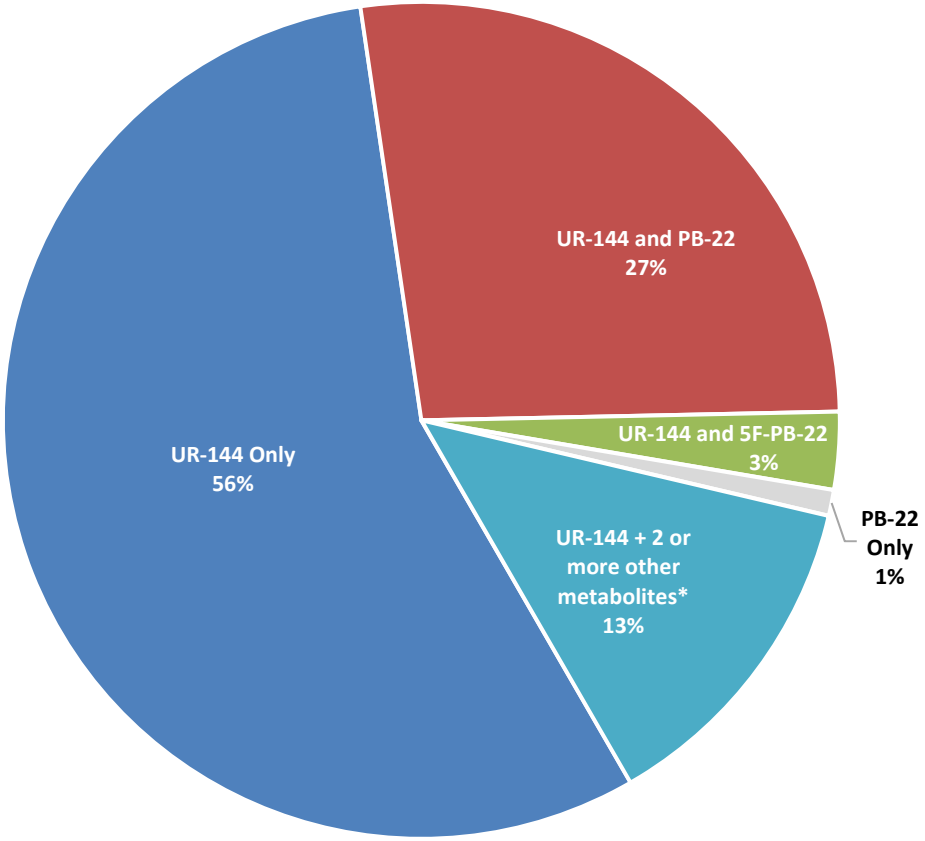
‖All buprenorphine positives were confirmed by LC/MS and tested positive for norbuprenorphine.

***p<.001 by Fisher's exact test.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Figure 1: Metabolites Found in All Synthetic Cannabinoid (SC) Positive Specimens from Adult Parolees and Probationers in Washington, DC

(N=70 specimens positive for SC collected between December 2013 and March 2014)



*Metabolites detected: UR-144+PB-22+XLR-11 (2), UR-144+PB-22+5F-PB-22 (6), and UR-144+PB-22+5F-PB-22+XLR-11+AKB-48 (1).

Percentage Positive for Each Metabolite (N=70)	
UR-144	99%
PB-22	41%
5F-PB-22	13%
XLR-11	4%
AKB-48	1%

Note: PSA positive specimens were oversampled, therefore these results may not be representative of the general adult parolee and probationer population.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 9: Metabolites Found in Synthetic Cannabinoid (SC) Positive Specimens by CDEWS-2 Laboratory in Washington, DC, by Population

	Adult Parole & Probation‖ (N=70)^	Juveniles (N=38)±
Metabolites Detected:		
UR-144	99%***	71%***
PB-22	41***	5***
5F-PB-22	13	21
XLR-11	4***	26***
AKB-48	1	0
AB-PINACA	0**	13**
5F-AB-PINACA	0	3
JWH-018	0	3
JWH-073	0	3

‖Positive specimens were oversampled, therefore CDEWS-2 results may not be representative of the general parole and probation population.

^70 positive for SC of 319 specimens collected between December 2013 and March 2014.

±38 positive for SC of 194 specimens collected between May and July 2014.

***p<.001 by Fisher's exact test.

**p<.01 by Fisher's exact test.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

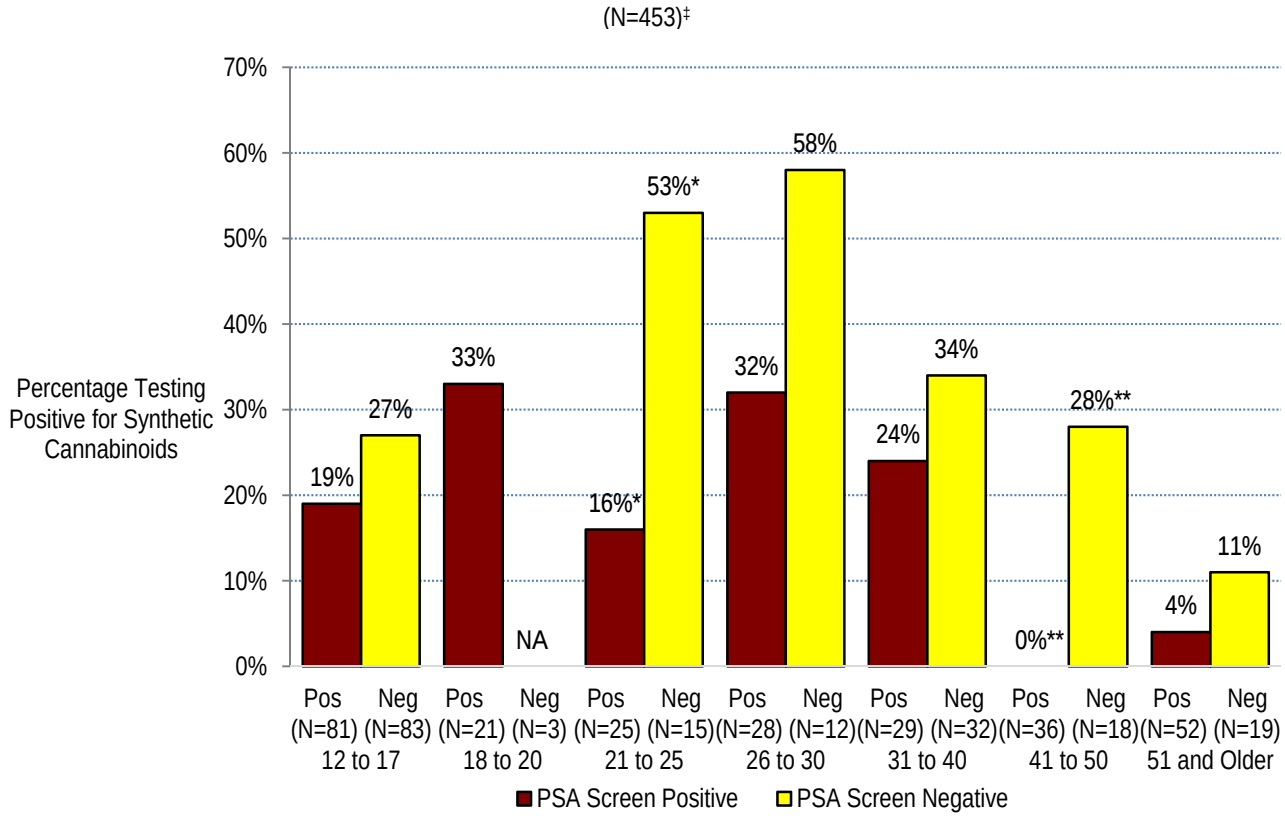
E. Correlates of Testing Positive for SC

CDEWS collected a few demographic characteristics that could be related to testing positive for each drug. In this section, we examine how age and ward of residence were related to the likelihood that the person tested positive for any SC metabolite. For the analysis by age, we again include test results from the DC juvenile study described in the DC Juveniles section of this report.

PSA test result and age. Figure 2 shows the likelihood that specimens from males tested positive for SC, according to PSA test result and age. Females are excluded from these analyses because of their small number. For every age group that had sufficient specimens to compute an estimate, the specimens that had passed the PSA drug screen (tested negative for all drugs in the limited PSA screen) were more likely to test positive for SC than the specimens that had failed the PSA screen. Because of the small number of specimens available in some age groups, not all of these apparent differences were statistically significant. PSA negative males ages 21-25 and 41-50 were significantly more likely to test positive for SC than males who were PSA positive. All three of the PSA negative specimens from 18-20 year olds tested positive for SC. The percentage testing positive for SC was greatest for males ages 21-30, with more than one half of their PSA negative specimens testing positive for SC. It is noteworthy that the juvenile males we studied (ages 12 to 17) were somewhat less likely to test positive for SC, 19%-27%. These results indicate peak use in persons ages 20-30 with less use among younger and older persons. It also appears that at all age levels, SC is being used by persons who are likely to test negative for other drugs and therefore, are presumed to be attempting to avoid detection by the criminal justice testing program.

Residence in Washington, DC. Washington, DC, is divided geographically into eight wards. We manually coded the zip code collected with each specimen from both males and females into the ward it came from. Zip codes overlapping multiple wards were placed in the ward that appeared to include 50% or more of the zip code. For more detail on the coding of these zip codes, see Table 10. We wanted to examine if SC metabolites were overly concentrated in specific wards. Table 10 compares the distribution of the SC test results to the distribution of all specimens obtained from each ward. We found that the likelihood of detecting SC and the two most prevalent metabolites largely followed the general distribution of all specimens collected. For example, 29% of the specimens came from residents of Ward 8, as did 36% of the specimens positive for any SC. Further, from Ward 8, a similar percentage of specimens (35%) were found to be positive for UR-144 and PB-22. One possible exception was Ward 7, which accounted for 16% of all specimens, but 24% of the specimens positive for PB-22. Ward 4 was slightly underrepresented with SC positive specimens; it accounted for 12% of all specimens but only 4% of SC positive specimens. We conclude that SC positives largely followed the general distribution of the residences of all specimens. These findings are illustrative of the value of CDEWS for providing researchers with an indication of the areas to be targeted for subsequent study to understand local emerging drugs.

Figure 2: Percentage of Specimens for Adult Male DC Parolees/Probationers and Juvenile Males Testing Positive+ for Synthetic Cannabinoids, by PSA Drug Screening Result and Age, 2014



+Positive specimens from the DC parole and probation sample were weighted due to oversampling of amphetamine positive specimens. See the DC Adult Parolees and Probationers results section of the full report.

‡The sum of all categories adds up to 454 because data are weighted resulting in some rounding effects.

*p<.05 by Fisher's exact test; **p<.01 by Fisher's exact test.

Note: PSA positive specimens were oversampled. Therefore, separate estimates for the "PSA Screen Positive" and "PSA Screen Negative" groups should not be averaged to create an overall estimate.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 10: Percentage of All Specimens from Washington, DC Adult Parolees and Probationers Testing Positive for Synthetic Cannabinoids, by Residence† (Unweighted)

(N=312 Specimens from Washington, DC Parolees & Probationers)

		Percent Positive by CDEWS Lab for:		
	All PSA Screened Specimens (for any drug) (N=312)	Any Synthetic Cannabinoids (of 5 metabolites)* (N=67)	UR-144 (N=66)	PB-22 (N=29)
Residents of Washington, DC:				
Ward 8	29%	36%	35%	35%
Ward 5	20	19	20	24
Ward 7	16	18	18	24
Ward 4	12	4	4	4
Ward 2	10	9	9	0
Ward 1	4	3	3	3
Ward 6	4	5	5	7
Ward 3	<1	0	0	0
Residents Outside of Washington, DC:				
Maryland	4%	6%	6%	3%
Virginia	<1	0	0	0
TOTAL	100%	100%	100%	100%

†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; Ward 3: 20008; Ward 4: 20011, 20012; Ward 5: 20002, 20017, 20018; Ward 6: 20003, 20024; Ward 7: 20019; Ward 8: 20020, 20032.

*Metabolites detected in less than 10 cases: 5F-PB-22, XLR-11, and AKB-48.

Note: Excluded from this table are 7 cases with missing zip codes.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

F. Comparison of DC Adult Test Results from CDEWS-1 and CDEWS-2

Changes in SC Metabolites in DC Adults from CDEWS-1 to CDEWS-2. The CDEWS-1 study tested for 12 SC metabolites thought to be common in DC at the time of the study (September 2012-September 2013). CDEWS-2 tested for the original 12 and 9 additional metabolites believed to be in use at the time of the CDEWS-2 testing (September 2013-March 2015). Since the CDEWS-1 study had only tested a limited number of specimens for SC, Table 11 combines SC positive specimens obtained from all three populations studied in DC in CDEWS-1 (pretrial surveillance, lockup and parole/probation). We felt comfortable doing so because the results from the Parole and Probation population from CDEWS-1 were similar to the results from the other two DC CJS populations studied in CDEWS-1. Table 11 shows that in both of these studies in DC, UR-144 was found in almost all specimens containing SC. PB-22, 5F-PB-22, and AKB-48 could not be detected in the tests used in CDEWS-1. Perhaps the major change was the virtual disappearance of XLR-11 at the time of CDEWS-2, from 38% to 4% ($p<.001$). XLR-11 had been implicated in possible cases of acute kidney injury (CDC, 2013) and perhaps this chemical was dropped from subsequent formulations of SC. JWH-18 and JWH-073 were detected in a few specimens in CDEWS-1 but were not detected in CDEWS-2. Clearly, the composition of preparations sold as SC have changed considerably in the approximate one year period between the times when the specimens from the two studies were collected. We do not know if some of the new metabolites added to the testing protocol in CDEWS-2 would have been found in CDEWS-1 had we been able to test for them.

The following sections compare the test results from DC adult parolees/probationers from CDEWS-1 and CDEWS-2. Because amphetamine positive specimens were segregated by PSA and not collected in CDEWS-1, we excluded the amphetamine positive specimens we collected in CDEWS-2 from these comparisons.

Drug Test Results, by PSA screen. Table 12 shows that the PSA positive specimens contained similar levels of positives for marijuana, opiates, cocaine, and PCP in both studies. None of these estimates were significantly different from each other. As would be expected, the PSA negative specimens from both studies rarely tested positive for any drugs. The only significant changes in test results from CDEWS-1 to CDEWS-2 involved buprenorphine. Buprenorphine positives declined in the PSA positive specimens (13% vs. 4%, $p<.01$) while they increased in PSA negative specimens (0% vs. 5%, $p<.05$). It is impossible to determine from urinalysis results whether the use of the legally prescribed drug, buprenorphine, was under medical supervision. Regardless, it is clear that the CDEWS-2 estimates of recent drug use remained highly stable in the parole/probation populations studied in the two time periods.

Mean age of positives for specific drugs. Table 13 shows the average age of persons who tested positive for each drug in the two studies. The test results were very similar. In both studies, persons positive for marijuana, SC, or PCP were likely to be in their 20's and 30's. Prescription opioids

were concentrated among persons in their 40's. Morphine, buprenorphine, and methadone positives were from the oldest persons. One possibility is that these persons come from the cohort that grew up during the time of the heroin epidemic of the 80's. These results show the value of CDEWS findings for describing characteristics of users of specific types of drugs.

SC use in adult men under age 30, by PSA screen, age and gender. In CDEWS-1 we had been able to test only a subsample of specimens for SC. We had unexpectedly found that young men who had passed the limited PSA screen were as likely to test positive for SC as were those who had failed the PSA screen. This led us to conclude that persons were trying to avoid detection by only using SC, which was not included in the routine PSA screen. Figure 3 shows that the findings for CDEWS-1 were replicated in CDEWS-2, but the differences were more extreme. In CDEWS-2 where we had tested all specimens for SC, we found that 60% of young men who had passed (tested negative for all drugs) the PSA screen tested positive for SC, compared with 27% of those who had failed the test ($p<.01$). (The 60% positive rate in Figure 3 is higher than the top rates shown in Figure 2 because Figure 3 includes three additional positives from persons aged 18-20). Among men over 30, not shown in Figure 3, we found the same relationship in CDEWS-2, with 26% of the PSA negative specimens testing positive for SC, compared with 8% of the PSA positive specimens ($p<.01$). In CDEWS-1, the number of specimens available for men over 30 were too few to statistically test any differences. There were too few specimens from females in either study to analyze.

The larger percentage of PSA negative specimens testing positive for SC may be due to the likelihood that these persons are using SC to avoid detection by the PSA screen, which is apparently known to not be included in the PSA screen for parolees and probationers.

SC test results, by DC residence. Table 14 shows from which DC ward SC positive specimens came from in CDEWS-1 and CDEWS-2. In each study, we found that the distribution of SC positive results was representative of the ward where the total sample of specimens came from. For example, in both studies the highest percentage of specimens came from persons living in Wards 8, 7, and 5, as did most of the SC positive specimens. In each study, there was no evidence of a disproportionate number of SC positive specimens coming from any ward.

G. Summary of Primary Findings

- Adults who passed the CJS limited drug screen (PSA negative) were twice as likely to test positive for SC as those who failed the CJS screen (PSA positive), 36% vs. 17%, $p<.001$.

- UR-144 was found in 99% of SC positive specimens, but the newly added metabolites (PB-22, 41% and 5F-PB-22, 13%) were also detected in a substantial minority of SC positive specimens.

- SC positive specimens for juveniles contained a larger variety of SC metabolites than adults, including XLR-11 (26%) and AB-PINACA (13%).

- Across all ages, specimens that had passed the limited CJS screen (PSA negative) were more likely to contain SC than specimens that had failed the CJS screen (PSA positive), supporting the idea that people use SC to avoid detection by the criminal justice testing program.

- About one half of the men ages 21-30 who had passed the limited CJS screen (PSA negative) tested positive for SC.

- The distribution of ward of residence for SC positive specimens largely followed the overall distribution of residence for all specimens collected.

- In the one year since CDEWS-1 specimens were collected, considerable changes have occurred in the metabolites contained in SC used by these populations in DC.

- CDEWS-1 and CDEWS-2 studies both showed that specimens containing marijuana, SC, and PCP tended to come from younger persons with average ages in their 20-30's, while opioids came from persons in their 40's and 50's.

- In CDEWS-1 and CDEWS-2, persons who had passed the limited CJS drug screen (PSA negative) were as or more likely to test positive for SC than persons who had failed the screen (PSA positive), indicating likely attempts to avoid detection.

- 60% of PSA negative males ages 18-30 tested positive for SC in CDEWS-2, compared to 39% of similar males in CDEWS-1.

Table 11: Metabolites Identified in SC Positive Specimens from Washington, DC, CDEWS-1 and CDEWS-2 Studies

	CDEWS-1 Three Adult CJS Populations (N=107)*	CDEWS-2 Adult Parole/Probation Population (N=70)
Percentage Positive For:		
UR-144	95%	99%
XLR-11	38***	4***
JWH-018	5	0
JWH-073	1	0
PB-22	Not Tested	41
5F-PB-22	Not Tested	13
AKB-48	Not Tested	1

*CDEWS-1 includes all SC positive specimens from three Washington, DC CJS populations (Parole & Probation, Pretrial Surveillance, and Lockup), while CDEWS-2 only includes specimens from the Parole & Probation population. We felt comfortable combining the three groups because the results from the Parole and Probation population from CDEWS-1 were similar to the results from the other two CJS populations studied in CDEWS-1.

***p<.001 by Fisher's exact test.

Note: PSA positive specimens were oversampled, therefore these results may not be representative of the criminal justice populations included.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 12: CDEWS Laboratory Test Results for Adult Parolees and Probationers from Washington, DC, by PSA Screen Result for CDEWS-1 and CDEWS-2

	CDEWS-1 PSA Screen Positive (for any drug) (N=197)	CDEWS-2 PSA Screen Positive (for any drug) (N=188)^	CDEWS-1 PSA Screen Negative (for any drug) (N=103)	CDEWS-2 PSA Screen Negative (for any drug) (N=101)
Percent Positive by CDEWS Lab for:				
Drugs in the routine PSA testing panel				
Marijuana	28%	25%	0%	0%
Opiates	25	23	1	2
Cocaine	18†	25	0	0
PCP	10	9	0	0
Drugs not specifically+ identified by the routine PSA testing panel				
Morphine‡	22	20	1	2
Codeine‡	21	17	1	0
Buprenorphine‖	13**	4**	0*	5*
Methadone	11	7	2	1
Oxymorphone‡	5	5	0	2
Oxycodone‡	5	5	0	3
Hydromorphone‡	3	1	0	0
Hydrocodone‡	2	1	0	0

Table includes any drug found in at least 2% of one or more of the four groups.

^To make the PSA positive specimens from CDEWS-2 comparable to those from CDEWS-1, the 30 amphetamine positive specimens oversampled in CDEWS-2 were omitted from this table.

†Cocaine positives from the PSA Screen Positive sample in CDEWS-1 is based on a subset of the sample (N=176). 21 PSA Screen Positive specimens from CDEWS-1 were excluded from this analysis as they were screened in error for cocaine with a detection limit of 300 ng/mL rather than 150 ng/mL which was the detection limit used for CDEWS-2.

+Some of the specific opiates (e.g., morphine, codeine, etc.) could have been detected by PSA as part of the opiate screen in the routine PSA testing panel.

‡These drugs screened positive for opiates and were identified by subsequent LC/MS confirmation.

‖All buprenorphine positives were confirmed by LC/MS and tested positive for norbuprenorphine.

*p<.05; **p<.01 by Fisher's exact test.

Note: PSA positive specimens were oversampled. Therefore, separate estimates for the "PSA Screen Positive" and the "PSA Screen Negative" categories should not be averaged to create an overall estimate.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 13: Mean Age of Persons Positive For Specific Drugs in Washington, DC Adult Parolees and Probationers for CDEWS-1 and CDEWS-2

	CDEWS-1 Average Age			CDEWS-2^ Average Age		
	(n)	$\bar{x}$	(SD)	(n)	$\bar{x}$	(SD)
Percent Positive by CDEWS Lab for:						
Marijuana	(55)	29.5	(8.7)	(47)	27.5	(9.1)
Synthetic Cannabinoids	(45)	28.1	(7.6)	(67)	30.8	(9.2)
PCP	(19)	32.8	(5.4)	(16)	31.6	(6.3)
Codeine	(43)	48.0	(10.2)	(32)	47.5	(13.3)
Cocaine	(31)	49.5	(8.8)	(46)	46.5	(10.7)
Oxymorphone	(9)	45.8	(12.6)	(11)	48.6	(10.9)
Opiates	(50)	47.8	(10.7)	(45)	48.0	(12.1)
Oxycodone	(9)	45.1	(12.6)	(13)	47.5	(12.6)
Morphine	(45)	48.5	(10.3)	(40)	50.4	(9.6)
Buprenorphine	(25)	46.2	(11.8)	(12)	52.0	(12.5)
Methadone	(24)	50.6	(8.6)	(15)	53.1	(6.8)

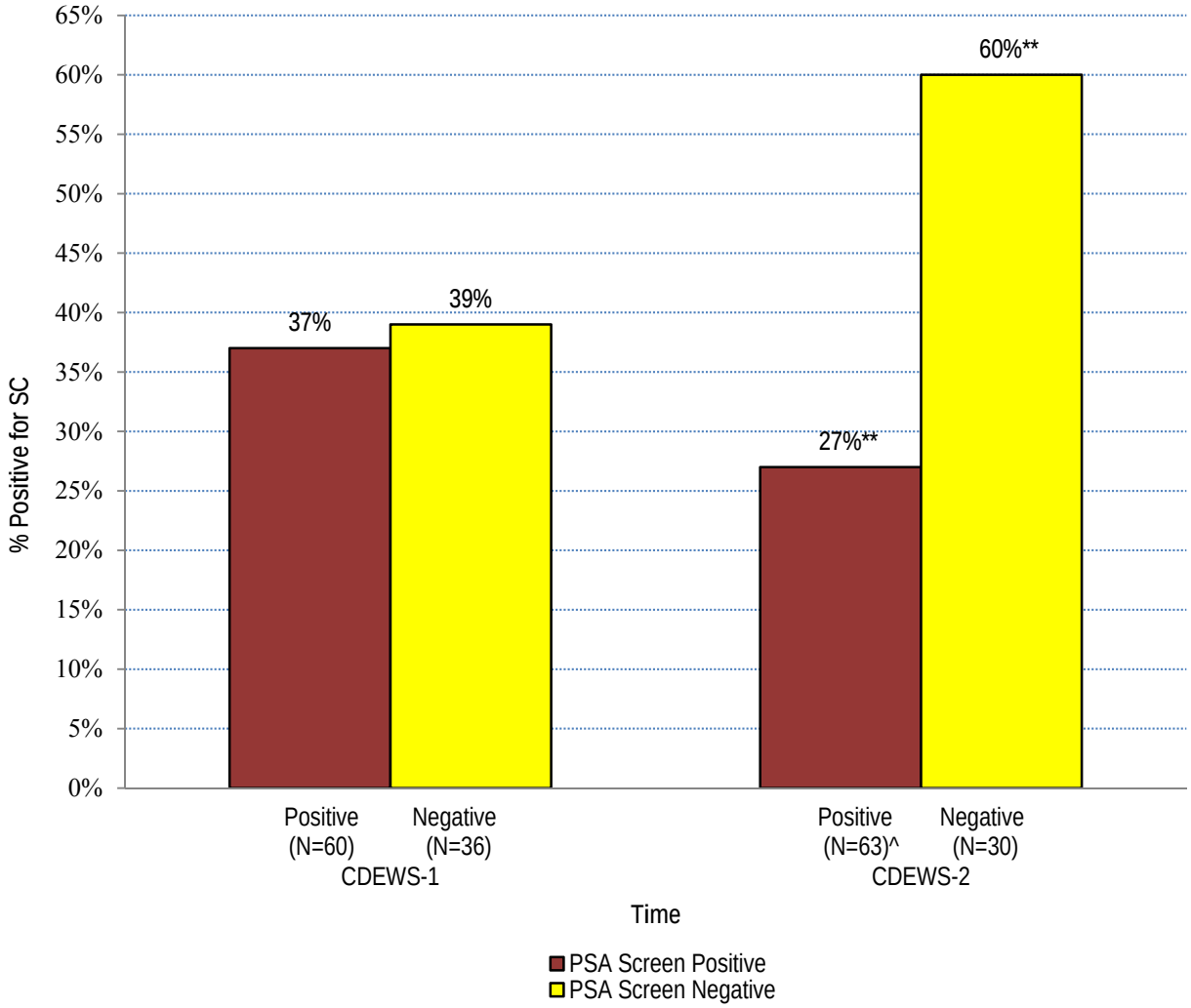
^To make the PSA positive specimens from CDEWS-2 comparable to those from CDEWS-1, the 30 amphetamine positive specimens oversampled in CDEWS-2 were omitted from this table.

Note: This table only includes drugs for which there were a minimum of 9 positive specimens.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Figure 3: Percentage of Young Adult Males Testing Positive for Synthetic Cannabinoids (SC), by PSA Screen Result and CDEWS Study

(N=189 Parolee/Probationer Specimens from Males Age 18-30)



^To make the PSA positive specimens from CDEWS-2 comparable to those from CDEWS-1, the 30 amphetamine positive specimens oversampled in CDEWS-2 were omitted from this table.

**p<.01 by Fisher's exact test.

Note: PSA positive specimens were oversampled. Therefore, separate estimates for the "PSA Screen Positive" and "PSA Screen Negative" groups should not be averaged to create an overall estimate.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 14: Residence† from which DC Adult Parolee and Probationer Synthetic Cannabinoid Positive Specimens Came, by PSA Drug Screen and CDEWS Study

	CDEWS-1		CDEWS-2	
	All PSA Screened Specimens (for any drug) (N=156)	Percent Positive by CDEWS Lab for Any Synthetic Cannabinoids (N=45)	All PSA Screened Specimens (for any drug) (N=286)^	Percent Positive by CDEWS Lab for Any Synthetic Cannabinoids (N=64)
Residents of Washington, DC:				
Ward 8	28%	27%	31%	36%
Ward 7	17	33	16	19
Ward 5	15	11	19	19
Ward 4	10	7	11	5
Ward 2	9	9	10	9
Ward 1	7	4	4	3
Ward 6	2	7	4	3
Ward 3	<1	0	<1	0
Residents Outside of Washington, DC:				
Maryland	11%	2%	4%	6%
Other States	<1	0	0	0
Virginia	0	0	<1	0
TOTAL	100%	100%	100%	100%

†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, 20036, 20037, 20052; Ward 3: 20008; Ward 4: 20011, 20012, 20015; Ward 5: 20002, 20017, 20018, 20022, 20074; Ward 6: 20003, 20024; Ward 7: 20019; Ward 8: 20020, 20032.

^To make the PSA positive specimens from CDEWS-2 comparable to those from CDEWS-1, the 30 amphetamine positive specimens oversampled in CDEWS-2 were omitted from this table.

Note: Excluded from this table are 3 cases from CDEWS-2 with missing zip codes.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Denver Adults - Drug Court

A. Specimens Received

We targeted 300 specimens from Denver Adults participating in the drug court program and received 295, 196 CJS positive and 99 CJS negative (see Appendix B). For Denver Adults, the CJS positive specimens were obtained over several months, August through November, 2013, because drug positive specimens had to be retained for a longer period of time before being released for use by our study. When we started the study, we were able to select specimens that had been collected and tested positive weeks/months earlier and were ready to be discarded. Drug negative specimens are generally discarded as soon as initial testing is complete and could be sampled during a shorter, more recent time period, spanning February 11, 2014 to February 19, 2014.

B. Demographic Characteristics of Persons Providing Specimens

Table 15 shows that about two-thirds of specimens came from males (69% of CJS positive specimens and 67% of CJS negative specimens). Again we found a bi-modal distribution of ages with approximately one-third coming from persons age 30 or younger and a similar percentage from persons above age 40. As we typically find, the CJS positive specimens came from slightly younger persons. The majority of specimens came from Caucasian/Non-Hispanic persons with sizable numbers also coming from African-Americans and persons of Hispanic/Latino descent.

C. CDEWS-2 Laboratory Test Results

Table 16 shows that few of the specimens that had tested negative for the limited routine CJS drug screen tested positive for any of the additional drugs in the CDEWS expanded screen, including SC. The CJS positive specimens contained more of the additional drugs. The most common drugs detected were oxymorphone (9%), hydromorphone (9%), oxycodone (8%), hydrocodone (8%), and methadone (7%). SCs were detected in 8% of the CJS positive specimens. The most frequently detected drugs in the CJS negative specimens were methadone (7%) and buprenorphine (4%). It is possible that these CJS negative persons were taking methadone or buprenorphine as part of supervised drug treatment and this is why no other drugs were found in their specimens. In our earlier study of drug court participants in Prince George's County, Maryland (CDEWS-1), we also found few drug positives among specimens that had passed the CJS screen (with the exception of methadone). It is likely that drug court participants are motivated to refrain from illicit drug use. The anecdotal reports that suggested there were large numbers of SC users among drug court participants were not supported by the CDEWS-2 data (found in only 3% of CJS screen negative specimens). (The rates of detection of SC in CJS screen positive and negative specimens were not statistically different from each other.) Contrary to other CDEWS-1 and CDEWS-2 study results, specimens that had passed (tested negative for all drugs) the CJS limited drug screen were *not* more

likely to test positive for SC.

D. SC Metabolites Detected

This section combines all 19 CDEWS-2 specimens that tested positive for SC regardless of whether they had passed or failed the routine CJS screens. The largest percentage (32%) tested positive for UR-144 alone, but only 53% of all of the SC positive specimens contained any UR-144 (see Figure 4). Nine other SC metabolites were identified with 5 metabolites showing up in 21% or more of the SC positive specimens: PB-22, 37%; MAM-2201, 32%; JWH-018, 32%; and 5F-PB-22 and JWH-122, each in 21%. More than one-fourth (26%) of the SC positive specimens contained three or more metabolites. The SCs used by the drug court participants in Denver contained metabolites that were quite different from those seen in DC (see Table 23).

E. Summary of Primary Findings

- SC was identified in a small minority of tested specimens, 8% of CJS positive and 3% of CJS negative specimens.

- Contrary to anecdotal reports, it does not appear that persons were abandoning expensive local marijuana for SC.

- The 19 SC positive specimens contained 10 different SC metabolites, and only 53% contained UR-144.

- Prescribed drugs not specifically tested for by the Denver criminal justice system but that showed up in 7% or more of CJS positive or negative specimens were oxymorphone, hydromorphone, oxycodone, hydrocodone, and methadone.

Table 15: Demographic Characteristics of Persons Providing Specimens from the Denver District Adult Drug Court Population, by CJS Drug Screen Result*

(N=295 specimens)

	CJS Screen Positive (N=196)	*CJS Screen Negative (N=99)*
Gender		
Male	69%	67%
Age		
20 and younger	1	3
21 to 25	17 (42%)	15 (33%)
26 to 30	24	15
31 to 40	26	29
41 to 50	15	18
51 and older	17 (32%)	20 (38%)
Total	100%	100%
Race/Ethnicity		
Caucasian/Non-Hispanic	57%	55%
African-American	26	22
Hispanic/Latino	16	22
Other	1	1
Total	100%	100%

*Specimens are routinely tested for a panel of seven or eight drugs (consisting of methamphetamine/amphetamine, barbiturates, benzodiazepines, cocaine, opiates, propoxyphene, marijuana and EtG (alcohol) added as the 8th potential drug). A 7-drug or 8-drug panel screen is administered depending on the drug court participant's history of alcohol and/or drug use/abuse or suspicion of use by their supervising officer. Positive specimens were oversampled. Therefore, separate estimates for the "CJS Screen Positive" and "CJS Screen Negative" categories should not be averaged to create an overall estimate.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 16: CDEWS Laboratory Test Results for Denver Adult Drug Court, by CJS Drug Screen Result

(N=285 specimens)

	Denver Drug Court+	
	CJS Screen Positive (for any drug) (N=186)	CJS Screen Negative (for any drug) (N=99)
Percent Positive by CDEWS Lab for:		
Drugs in the routine drug court testing panel		
Opiates	34%	0%
Marijuana	34	0
Cocaine	31	0
Amphetamines	26	0
Methamphetamine	24	0
Benzodiazepines	11	1
Drugs not specifically* identified by the routine drug court testing panel		
Morphine‡	24	0
Codeine‡	22	0
6-MAM	17	0
Oxymorphone‡	9	2
Hydromorphone‡	9	0
Oxycodone‡	8	2
Hydrocodone‡	8	0
Methadone	7	7
Tramadol	2	3
Valium	2	0
Buprenorphine‖	1	4
Any SC	(N=195)† 8%	3%
UR-144	4	2
PB-22	4	0
MAM-2201	3	0
JWH-018	3	1
5F-PB-22	2	0
JWH-122	2	0
XLR-11	1	0
JWH-073	1	0

AB-PINACA	<1	0
ADBICA	<1	0

Drugs tested for but not detected in any specimen: Demerol, dextromethorphan, dilaudid, doxepin, ephedrine, hydroxyzine, ketamine, MDA, MDEA, MDMA, naloxone, PCP, phenmetrazine, phenothiazines (as a family), and pseudoephedrine. Drugs detected in 1% or less of specimens: amitriptyline/nortriptyline, Ativan/Dalmane, barbiturates, and clonazepam. Only a subset of specimens were tested for designer stimulants and none were detected. See Table 6 for the designer stimulant panel.

[+]Specimens are routinely tested for a panel of seven or eight drugs (consisting of methamphetamine/amphetamine, barbiturates, benzodiazepines, cocaine, opiates, propoxyphene, marijuana and EtG (alcohol) added as the 8th potential drug). A 7-drug or 8-drug panel screen is administered depending on the drug court participant's history of alcohol and/or drug use/abuse or suspicion of use by their supervising officer. Positive specimens were oversampled. Therefore, separate estimates for the "CJS Screen Positive" and "CJS Screen Negative" categories should not be averaged to create an overall estimate.

*Some of the specific opiates (e.g., morphine, codeine, etc.) could have been detected by drug court as part of the opiate screen in the routine drug court testing panel.

[‡]These drugs screened positive for opiates and were identified by subsequent LC/MS confirmation.

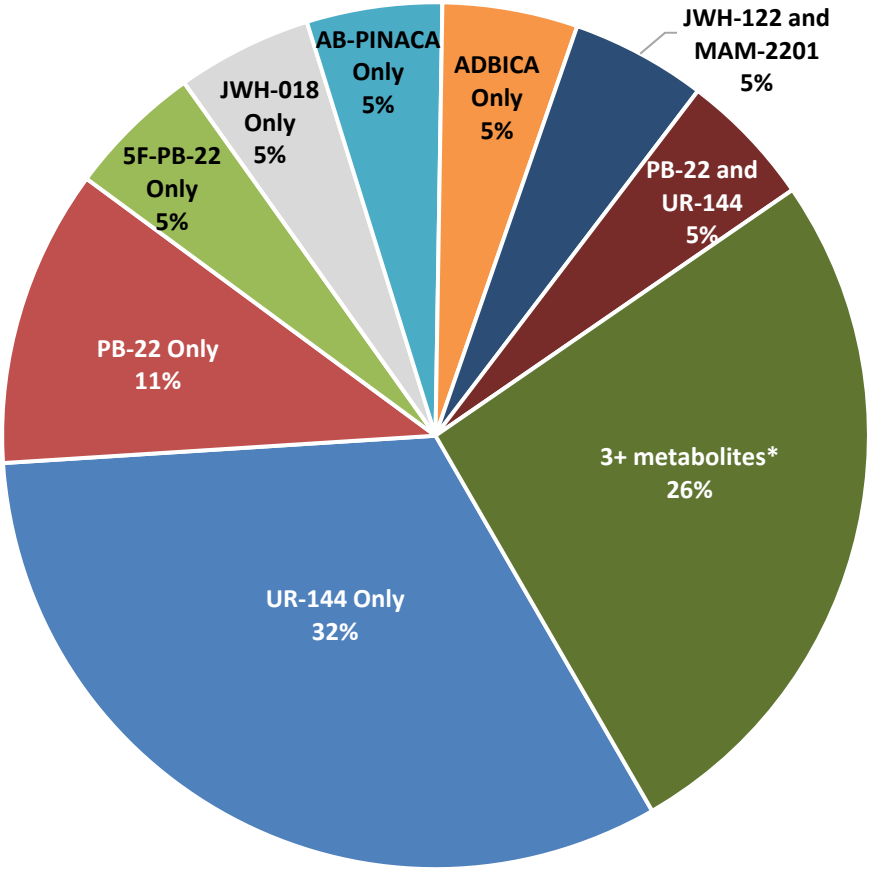
[||]All buprenorphine positives were confirmed by LC/MS and tested positive for norbuprenorphine.

[†]A greater number of specimens (N=195) were tested for synthetic cannabinoids than received the CDEWS basic panel given that specimens with low urine volume were tested for synthetic cannabinoids only and did not receive the basic screen.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Figure 4: Metabolites Found in All Synthetic Cannabinoid (SC) Positive Specimens from Adult Drug Court Participants in Denver, CO

(N=19 specimens positive for SC collected between August 2013 and February 2014)



*Metabolites detected: JWH-018+JWH-122+PB-22+5F-PB-22+MAM-2201 (1); JWH-018+JWH-073+JWH-122+PB-22+5F-PB-22+UR-144+MAM-2201 (1); JWH-018+5F-PB-22+MAM-2201 (1); JWH-018+JWH-122+PB-22+UR-144+XLR-11+MAM-2201 (1); JWH-018+JWH-073+PB-22+UR-144+XLR-11+MAM-2201 (1).

Percent Positive for Each Metabolite (N=19)	
UR-144	53%
PB-22	37%
MAM-2201	32%
JWH-018	32%
5F-PB-22	21%
JWH-122	21%
XLR-11	11%
JWH-073	11%
AB-PINACA	5%
ADBICA	5%

Note: Positive specimens were oversampled, therefore these results may not be representative of the general drug court population.

DC Juveniles

A. Specimens Received

We sought a total of 200 specimens from DC Juveniles, and obtained 194 specimens, of which 96 had tested positive by their CJS screen (see Appendix B). The DC Juvenile specimens were provided by youths in the Family Court Program under the jurisdiction of the Pretrial Services Agency (PSA) for the District of Columbia between May 21, 2014 and July 30, 2014. Specimens were selected from 7 referring programs. These included: 1) Juvenile-Diagnostic Probation, 2) Juvenile-Persons In Need, 3) Lockup; 4) Juvenile-Regular Probation, 5) Juvenile-Community, 6) Evaluation, and 7) Spot Test. Definitions of each group are provided in Appendix B.

B. Demographic Characteristics of Persons Providing Specimens

Table 17 shows that most of the specimens (84% of the PSA positive and 85% of the PSA negative specimens) came from males. Because of the small number of females available, most analyses include only results for males. Individuals in the referring programs ranged from ages 12-17, with almost 80% in each group being between the ages of 15-17. The largest percentage of specimens came from youths age 17 (46%/29%). Participants originated from a variety of Family Court Programs, with the majority coming from diagnostic probation (44%/63%), lockup (25%/24%), and persons in need (25%/4%) (see also Appendix B for more information on these referring programs).

C. CDEWS-2 Laboratory Test Results

Table 18 shows that with the exception of SC, few specimens tested positive for any of the drugs on the expanded screen, with only a small number of opiates (2%) and amphetamines (2%) detected. Most of the CJS positive specimens screened positive for marijuana (71%), a substance detected by the PSA screen. Probably because of the degradation of specimens (see also Study Limitations section), many of the PSA positive specimens that had contained marijuana were undetected by the CDEWS screen. SCs were detected in 17% of the CJS positive specimens and 22% of the CJS negative specimens. SC metabolites detected in 5% or more of either group were UR-144, XLR-11, 5F-PB-22 and AB-PINACA. Four other metabolites were also detected but in smaller quantities.

D. SC Metabolites Detected

This analysis combines all 38 CDEWS-2 specimens that tested positive for SC regardless of whether they had passed or failed the routine CJS screens. Figure 5 shows that the predominant metabolite was UR-144 (71% of all SC positive specimens contained this metabolite but only 45% contained UR-144 only). There was a wider range of SC metabolites found in this group as compared

to the DC Adult population. Metabolites detected in 13% or more of SC positives were UR-144, XLR-11, 5F-PB-22 and AB-PINACA. Several other metabolites including PB-22, 5F-AB-PINACA, JWH-018 and JWH-073 were also found in the juvenile population in smaller quantities. As noted above, the profile of SC metabolites detected in juveniles was more diverse than that which was found in the DC adult population. This may be due to changes in use patterns over time, given that these specimens were collected several months after the DC Adult specimens were collected. Alternatively, younger persons may seek out products which contain different SC metabolites than adults.

E. Correlates of Testing Positive for SC

SC positives, by juvenile program type. Table 19 compares the percentage of specimens positive for SC by juvenile program type for male juveniles only. There were too few specimens from females to include in this analysis. The highest percentage of SC positives were found in the lockup program, with 33% of PSA positive specimens and 17% of PSA negative specimens testing positive for SC. The numbers were small and this difference was not statistically significant. However, youths in lockup had presumably no knowledge that they would be arrested and subject to urine testing. For this reason, we might not expect higher rates of SC among PSA negative specimens because of attempts to avoid detection. Specimens from diagnostic probation showed much higher levels of SC positives in their PSA negative specimens than PSA positive specimens (25% vs. 8%, $p<.05$). This may be the result of youths on probation using SC to avoid drug use detection while under monitoring by the criminal justice system. Persons in need showed high levels of SC use in their PSA positive specimens (27%), however, we did not have a large enough sample size to analyze the PSA negative specimens from this group. For more information on the referring program categories, see Appendix B.

SC positives, by age. Figure 6 shows the percentage of juvenile male specimens testing positive for synthetic cannabinoids by age. The results show use of SC across all ages from ages 13-17. In an earlier section, we showed that SC positive rates for juveniles were somewhat lower than those for young adult male parolees and probations (Figure 2).

F. Summary of Primary Findings

- These first CDEWS findings from juveniles males aged 12-17 in DC show that SC use extends to youths, albeit at lower levels than found in adult males 18-50 (see Figure 2).
- Regardless of PSA screen result, about 1 in 5 youths tested positive for SC.
- While UR-144 was the most detected metabolite, found in 71% of the SC positive specimens, many more metabolites were found in SC positive specimens from youths than adults.

- Youths in diagnostic probation who passed the standard PSA screen were three times more likely to test positive for SC than youths who failed the PSA screen (25% vs. 8%, $p<.05$).

- SC was detected in all ages from 13-17.

Table 17: Demographic Characteristics of Persons Providing Specimens from DC Juvenile Family Court, by PSA Drug Screen Result*

(N=194 specimens)

	Juvenile Family Court	
	PSA Screen Positive (N=96)	*PSA Screen Negative (N=98)*
Gender		
Male	84%	85%
Age		
12	4%	1%
13	6 (16%)	9 (21%)
14	6	11
15	15	22
16	23	28
17	46	29
Total	100%	100%
Referring Program		
Juvenile – Diagnostic Probation	44%	63%
Juvenile – Persons In Need	25	4
Lockup	25	24
Juvenile – Regular Probation	4	5
Juvenile – Community	2	1
Evaluation	0	2
Spot Test	0	1
Total	100%	100%

*Pretrial Services Agency for the District of Columbia (PSA) tested the Juvenile population for marijuana, cocaine, and PCP (some individuals were also tested for synthetic cannabinoids). Synthetic cannabinoids are tested by PSA using LC/MS/MS.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 18: CDEWS Laboratory Test Results for DC Juveniles, by PSA Drug Screen Result*

(N= 188 specimens)

	PSA Screen Positive (for any drug) (N=91)	PSA Screen Negative (for any drug) (N=97)
Percent Positive by CDEWS Lab for:		
Drugs in the routine PSA testing panel		
Marijuana	71%	0%
Drugs not specifically identified by the routine PSA testing panel		
Opiates	2	0
Amphetamines	0	2
Any SC	(N=96)‖ 17%	(N=98)‖ 22%
UR-144	14	14
XLR-11	6	4
5F-PB-22	1	7
AB-PINACA	0	5
PB-22	2	0
JWH-073	0	1
JWH-018	0	1
5F-AB-PINACA	0	1

Drugs tested for but not detected in any specimen: 5F-AKB-48, ADBICA, ADB-PINACA, AKB-48, AM-2201, amitriptyline/nortriptyline, Ativan/Dalmane, BB-22, benzodiazepines, clonazepam, cocaine, codeine, Demerol, dextromethorphan, Dilaudid, Doxepin, ephedrine, hydrocodone, hydromorphone, hydroxyzine, JWH-019, JWH-081, JWH-122, JWH-210, JWH-250, ketamine, MAM-2201, MDA, MDEA, MDMA, methadone, methamphetamine, morphine, naloxone, oxycodone, oxymorphone, phenmetrazine, phenothiazines (as a family), pseudoephedrine, RCS-4, tramadol and Valium. Drugs detected in 1% or less of specimens: 6-MAM, barbiturates, buprenorphine, and PCP. Only a subset of specimens were tested for designer stimulants and none were detected. See Table 6 for the designer stimulant panel.

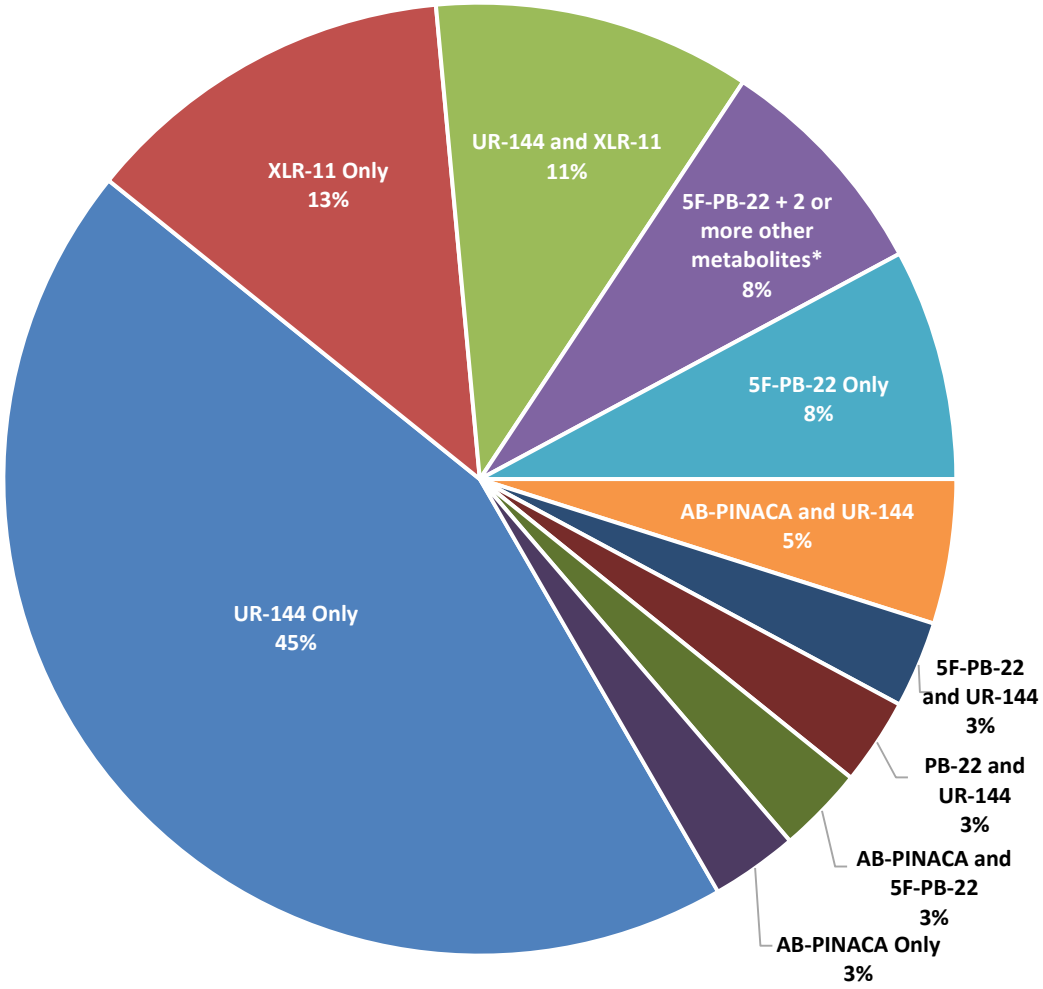
*Pretrial Services Agency for the District of Columbia (PSA) tested the Juvenile population for marijuana, cocaine, and PCP (some individuals were also tested for synthetic cannabinoids). Synthetic cannabinoids are tested by PSA using LC/MS/MS.

‖6 specimens were sent for synthetic cannabinoid testing only and did not receive the basic panel due to a low quantity of urine.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Figure 5: Metabolites Found in All Synthetic Cannabinoid (SC) Positive Specimens from Juveniles in Washington, DC

(N=38 specimens positive for SC collected between May and July 2014)



*Metabolites detected: 5F-PB-22+PB-22+UR-144 (1), 5F-PB-22+AB-PINACA+5F-AB-PINACA+XLR-11 (1), and 5F-PB-22+UR-144+JWH-018+JWH-073 (1).

Percentage Positive for Each Metabolite (N=38)	
UR-144	71%
XLR-11	26%
5F-PB-22	21%
AB-PINACA	13%
PB-22	5%
5F-AB-PINACA	3%
JWH-018	3%
JWH-073	3%

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 19: Percentage of Specimens Positive for Synthetic Cannabinoids (SC) in Washington, DC Male Juveniles, by PSA Screen Result and Program Type

(N=152 specimens)[+]

	Juvenile Program Type					
	Diagnostic Probation		Lockup		Persons in Need	
	PSA Screen Positive	*PSA Screen Negative*	*PSA Screen Positive*	*PSA Screen Negative*	*PSA Screen Positive*	*PSA Screen Negative*
Positive for:	(N) %	(N) %	(N) %	(N) %	(N) %	(N) %
Synthetic Cannabinoids	(39) 8[†]	(57) 25[†]	(21) 33	(18) 17	(15) 27	(2) *

[+]Specimens from the following juvenile programs were excluded from this table as there were too few cases to compute a valid estimate: Regular Probation (N=8), Community (N=3), and Evaluation (N=1).152 specimens remained after excluding these specimens from the table.

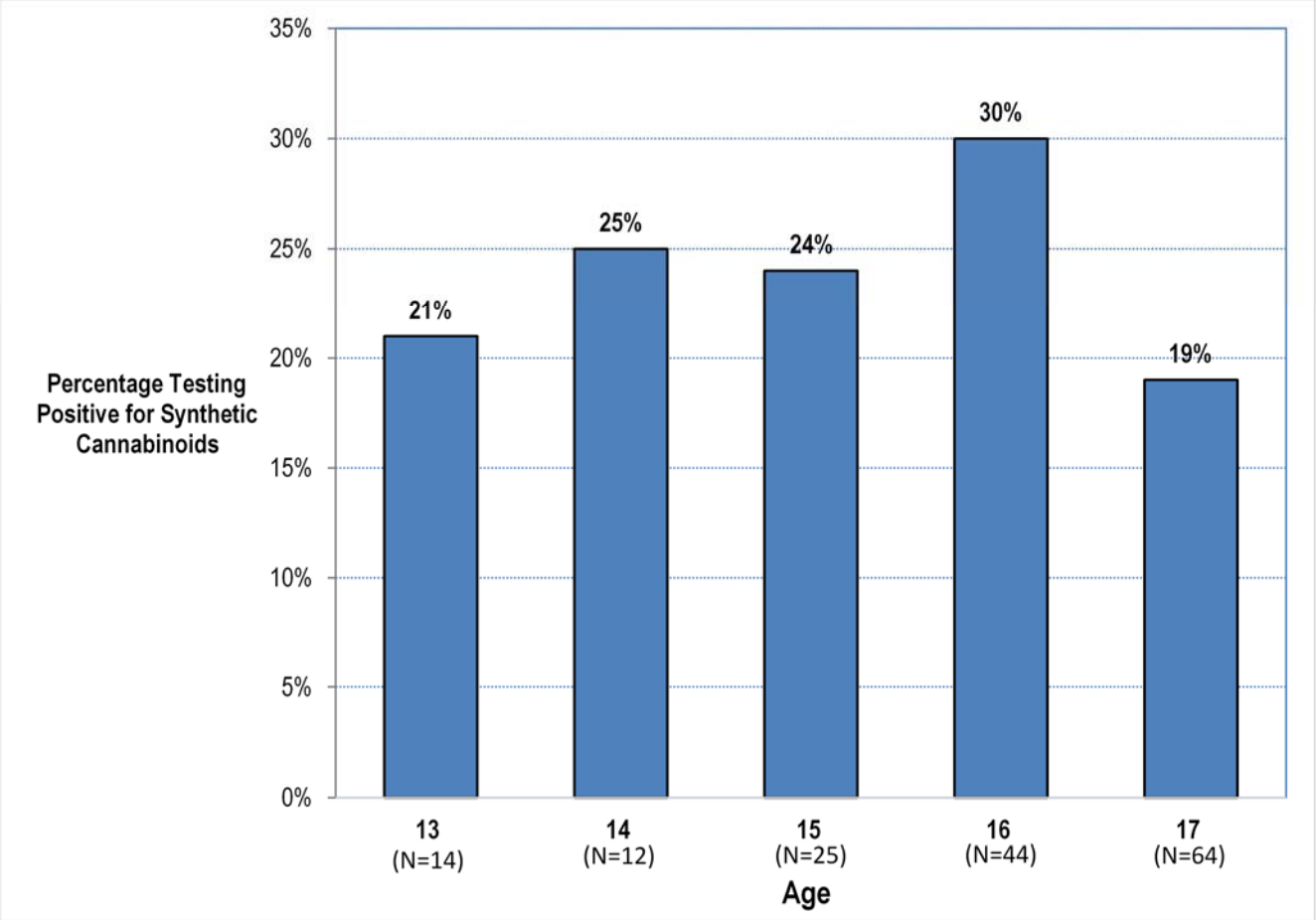
[†]p=.05 by Fisher's exact test.

*Too few cases to compute a valid estimate.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Figure 6: Percentage of Specimens from Washington, DC Juvenile Males Testing Positive for Synthetic Cannabinoids, by Age, 2014

(N= 159 specimens)*



*Five persons who were 12 years old were deleted from this analysis.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Tampa Juveniles

A. Specimens Received

We sought a total of 200 specimens from Tampa Juveniles, and obtained 218 specimens, of which 98 had tested positive by their CJS screen (see Appendix B). Perhaps because of degradation of samples or differing testing methods, the results from Tampa's JAC program test screen could not be exactly replicated by the CDEWS laboratory. We therefore reclassified all specimens as CJS positive or negative based on approximating the CJS limited screen result using the CDEWS lab results. Any specimens that tested positive for one of the drugs on the JAC testing panel, including marijuana, cocaine, opiates and/or amphetamines, are denoted in the following tables as "likely CJS screen positive." Specimens negative for all of those drugs are denoted as "likely CJS screen negative." The specimens came from two groups, arrestees and violators of probation. These specimens were provided by youths to the Tampa Juvenile Assessment Center (JAC) program between September 5, 2014 and November 2, 2014.

B. Demographic Characteristics of Persons Providing Specimens

Table 20 shows that most of the specimens (78-85%) came from males. Individuals in the program ranged in age from 10-17, with most being aged 15-17. The majority of specimens came from African-Americans, with a slightly smaller percentage from Caucasian/Non-Hispanics. Participants were comprised of two groups, 1) arrestees and 2) violators of probation. More than three-quarters of the sample came from the arrestees group.

C. CDEWS-2 Laboratory Test Results

Table 21 shows that most of CJS positive specimens screened positive for marijuana (95%), a substance screened for by the JAC screen. Seven percent of specimens in the CJS screen positive group also tested positive for benzodiazepines. SCs were detected in 9% of the CJS positive specimens and in less than 1% of the CJS negative specimens. The only SC metabolite detected was UR-144.

D. SC Metabolites Detected

In contrast to our other sites, the Tampa juvenile specimens contained only a single synthetic cannabinoid metabolite, UR-144 (Table 21). We were surprised to find only a single metabolite, as the other CDEWS-2 sites had much greater diversity in the SC metabolites found. This could either be due to varying products being used in different geographic regions, or a change in the composition of SC products to include new metabolites which were not detected on the panel (given that these specimens were collected last in the study).

E. Correlates of Testing Positive for SC

SC positives, by juvenile program type and race/ethnicity. Table 22 shows that SC positives were found in arrestees and violators of probation. All of the SC positives found in the arrestees group were found in the CJS positives (10% vs. 0%, $p<.01$). This was surprising given that prior studies have often found SC positives primarily in the CJS negative group, where persons are trying to avoid detection. SC was found in all three racial/ethnic groups in the study.

F. Summary of Primary Findings

- An SC metabolite was found in a small minority of specimens, most of which had also tested positive for marijuana by the likely local CJS screen.

- In contrast to other CDEWS sites, all SC positives contained only one metabolite (UR-144), suggesting a different variety/source of SC available in Tampa.

- SC metabolites were found in both youths who were arrestees or violators of probation.

Table 20: Demographic Characteristics of Persons Providing Specimens from Tampa Juvenile Assessment Center (JAC), by CJS Drug Screen Result*

(N=218 specimens)

	Tampa Juvenile Assessment Center	
	Likely CJS Screen Positive (N=98)	*Likely CJS Screen Negative* (N=120)
Gender		
Male	85%	78%
Age		
10-12	4%	11%
13	11	11
14	16	15
15	27	23
16	26 (69%)	27 (63%)
17	16	13
Total	100%	100%
Race/Ethnicity		
African-American	56%	63%
Caucasian/Non-Hispanic	43	37
Hispanic/Latino	1	0
Total	100%	100%
Referring Program		
Arrestees	79%	81%
Violators of Probation	21	19
Total	100%	100%

*Specimens are routinely tested for a panel of four drugs: marijuana, cocaine, opiates, and amphetamines. Positive specimens were oversampled. Therefore, separate estimates for the "CJS Screen Positive" and "CJS Screen Negative" categories should not be averaged to create an overall estimate.

Note: The classification of "Likely CJS Screen Positive" and "Likely CJS Screen Negative" was approximated using the CDEWS lab results for the same drugs typically screened for by the local Tampa JAC program. See the Tampa results section of the report for more information.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 21: CDEWS Laboratory Test Results for Tampa Juvenile Assessment Center (JAC), by CJS Drug Screen Result*

(N=218 specimens)

	Tampa Juvenile Assessment Center	
	Likely CJS Screen Positive (for any drug) (N=98)	Likely CJS Screen Negative (for any drug) (N=120)
Percent Positive by CDEWS Lab for:		
Drugs in the routine JAC testing panel		
Marijuana	95%	0%
Cocaine	5	0
Amphetamines	4	0
Opiates	1	0
Drugs not specifically identified by the routine JAC testing panel		
Benzodiazepines	7	0
Any SC	9	<1
UR-144	9	<1

Drugs tested for but not detected in any specimen: 5F-AB-PINACA, 5F-AKB-48, 5F-PB-22, 6-MAM, AB-PINACA, ADBICA, ADB-PINACA, AKB-48, AM-2201, amitriptyline/nortriptyline, Ativan/Dalmane, barbiturates, BB-22, buprenorphine, clonazepam, codeine, Demerol, dextromethorphan, doxepin, ephedrine, hydrocodone, hydromorphone, hydroxyzine, JWH-018, JWH-019, JWH-073, JWH-081, JWH-122, JWH-210, JWH-250, ketamine, MAM-2201, MDA, MDEA, MDMA, methadone, methamphetamine, naloxone, PB-22, PCP, phenmetrazine, phenothiazines (as a family), pseudoephedrine, RCS-4, tramadol and XLR-11. Drugs detected in 1% or less of specimens: morphine, oxycodone, oxymorphone, and Valium. Only a subset of specimens were tested for designer stimulants and none were detected. See Table 6 for the designer stimulant panel.

*Specimens are routinely tested for a panel of four drugs: marijuana, cocaine, opiates, and amphetamines. Positive specimens were oversampled. Therefore, separate estimates for the "CJS Screen Positive" and "CJS Screen Negative" categories should not be averaged to create an overall estimate.

Note: The classification of "Likely CJS Screen Positive" and "Likely CJS Screen Negative" was approximated using the CDEWS lab results for the same drugs typically screened for by the local Tampa JAC program. See the Tampa results section of the report for more information.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 22: Percentage of Specimens Positive for Synthetic Cannabinoids (SC) in Tampa Juvenile Assessment Center, by CJS Drug Screen Result and Program Type

(N=218 specimens)

Positive for:	Juvenile Program Type			
	Arrestees		Violators of Probation	
	Likely CJS Screen Positive	*Likely CJS Screen Negative*	*Likely CJS Screen Positive*	*Likely CJS Screen Negative*
	(N) %	(N) %	(N) %	(N) %
Synthetic Cannabinoids	(77) 10**	(97) 0**	(21) 5†	(23) 4†

**p<.01 by Fisher's exact test.

†Differences not statistically significant by Fisher's exact test.

Note: The classification of "Likely CJS Screen Positive" and "Likely CJS Screen Negative" was approximated using the CDEWS lab results for the same drugs typically screened for by the local Tampa JAC program. See the Tampa results section of the report for more information.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Cross-Site Comparisons of SC Results

This section compares test results for SC for all 4 populations studied in CDEWS-2.

SC Metabolites Detected in CDEWS-2 Populations.

Table 23 compares the SC metabolites found in the 4 populations studied in CDEWS-2. It is clear that across all 4 populations, UR-144 is the metabolite found in a least one-half of the specimen groups. It was the only metabolite found in the specimens obtained from the juveniles in Tampa. The SC positive specimens for adults and juveniles in DC were somewhat similar with 5 metabolites predominant (UR-144, PB-22, 5F-PB-22, XLR-11, AB-PINACA). Furthermore, in all populations but Tampa, specimens contained 2 or more metabolites. Of the 12 SC metabolites found across all of the populations, 3 (MAM-2201, ADBICA, and 5F-AB-PINACA) have not yet been scheduled by the DEA (as of January 2015).

CDEWS Detected SC Metabolites Compared with NFLIS SC Results.

CDEWS-2 offers a unique opportunity to see if the SC metabolites identified in each site were also reported in the local NFLIS reports. One might expect that the drugs being used by the CJS populations that we studied in DC and Denver would have been reported in the NFLIS tests of drugs seized around the same time periods. Tables 24 and 25 present these comparisons. We unexpectedly found that none of the metabolites detected in DC in either the adult or juvenile populations (Table 24) using the CDEWS-2 methodology were found in the data reported for DC by NFLIS in either 2012 or 2013. After talking with persons knowledgeable about NFLIS, we learned that these discrepancies were likely due to the fact that NFLIS data is collected from a variety of law enforcement agencies around the country who submit results based on the tests they have conducted. Given the cost of testing for SC metabolites, it is possible that the participating laboratories in DC may not have been testing for the SC metabolites that we included in the CDEWS-2 panel. It should also be noted that the NFLIS system for CY2013 reported that only 6 items from DC contained any SC and that the total number of NFLIS items reported for DC declined from 7,618 in 2009 to 2,619 in 2013. This sharp decrease in the number of reported items suggests that fewer laboratories may have been reporting to NFLIS or that local policies regarding testing for SCs may have changed. It is noteworthy that the NFLIS report for DC for CY2012 and CY2013 identified three metabolites that were not identified by the CDEWS-2 panel (JWH-019, AM-2201, and JWH-122).

The Denver NFLIS report for 2013 contained 643 reported items positive for SC. Eight of the 10 SC metabolites detected in Denver by CDEWS-2, were also reported in the Denver NFLIS reports (Table 25). The Denver NFLIS system also reported 7 SC metabolites not detected in the current CDEWS-2 study (AB-FUBINACA, AM-2201, ADB-PINACA, URB-754, STS-135, 5F-ADBICA, and AKB-48).

We also reviewed January-June 2013 data for NFLIS for the State of Florida. There were 940 SC reports for this period. UR-144 was the only SC metabolite detected in the CDEWS-2 sample. This

metabolite was also detected by NFLIS. However, the NFLIS system also detected a variety of other SC metabolites, including AKB-48, AM-2201, AM-2233, JWH-018, JWH-081, JWH-122, JWH-210, JWH-250, PB-22, STS-135, URB-754 and XLR-11. A wider spectrum of metabolites may have been detected by NFLIS given that the data represents the entire State of Florida rather than just the city of Tampa.

Summary of Primary Findings

- The patterns of SC metabolites detected varies considerably across the 4 populations studied.
- While SC positive specimens for Tampa juveniles contained only UR-144, those for adults and juveniles in DC and adults in Denver contained multiple metabolites.
- Of the 12 SC metabolites found across all of the populations, 3 (MAM-2201, ADBICA, and 5F-AB-PINACA) have not yet been scheduled by the DEA (as of January 2015).
- DEA's NFLIS reports for Florida and Denver identified most of the SC metabolites found by CDEWS-2; DC NFLIS reports identified none of the metabolites CDEWS detected in DC juveniles or adults.

Table 23: Metabolites Found In All Synthetic Cannabinoid Positive Specimens, By CDEWS-2 Population

	Adult Parole & Probation – Washington, DC (N=70)*†	Juvenile Family Court – Washington, DC (N=38)^	Adult Drug Court – Denver, CO (N=19)*‡	Juvenile Assessment Center – Tampa, FL (N=10)+
(Dates SC positives collected)	(12/5/13-3/18/14)	(5/21/14-7/30/14)	(8/25/13-2/12/14)	(9/20/14-10/31/14)
Metabolites Detected				
UR-144	99%	71%	53%	100%
PB-22	41	5	37	0
5F-PB-22	13	21	21	0
XLR-11	4	26	11	0
AKB-48	1	0	0	0
MAM-2201±	0	0	32	0
JWH-018	0	3	32	0
JWH-122	0	0	21	0
JWH-073	0	3	11	0
AB-PINACA	0	13	5	0
ADBICA±	0	0	5	0
5F-AB-PINACA±	0	3	0	0
Number of Above Metabolites (of 12) Detected				
1	57%	68%	63%	100%
2	30 } 43%	24 } 32%	11 } 37%	0
3+	13	8	26	0
Total	100%	100%	100%	100%

*Positive specimens were oversampled, therefore these results may not be representative of the general parolee/probationer or drug court populations.

†70 positive for SC of 319 specimens.

^38 positive for SC of 194 specimens.

‡19 positive for SC of 294 specimens.

+10 positive for SC of 218 specimens.

±These metabolites have not yet been scheduled by the DEA as of January 2015.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 24: Metabolites Found in Synthetic Cannabinoid (SC) Positive Specimens by CDEWS-2 Laboratory from Adult Parolees/Probationers and Juveniles in Washington, DC, and CY2012-2013 NFLIS* Results

	SC Metabolites Detected by CDEWS-2 from Adult Parole & Probation‖ (N=70)^	SC Metabolites Detected by CDEWS-2 from Juveniles (N=38)±	SC Metabolites Reported in CY2012 or CY2013 NFLIS+ for Washington, DC? (N=39)
Metabolites Detected by CDEWS-2:			
UR-144	99%	71%	No
PB-22	41	5	No
5F-PB-22	13	21	No
XLR-11	4	26	No
AKB-48	1	0	No
AB-PINACA	0	13	No
5F-AB-PINACA	0	3	No
JWH-018	0	3	No
JWH-073	0	3	No

*The National Forensic Laboratory Information System (NFLIS) is a Drug Enforcement Administration (DEA)-sponsored program that systematically collects drug chemistry analysis results, as well as other related information, from cases analyzed by state, local and federal forensic laboratories. These laboratories analyze substances secured in law enforcement operations across the country. NFLIS offers a valuable resource for monitoring illegal drug abuse and trafficking, including the diversion of legally manufactured drugs into illegal markets. NFLIS data are used to support drug scheduling efforts as well as to inform drug policy and drug enforcement initiatives both nationally and in local communities. Data in the NFLIS database consists of case and item/exhibit level information. https://www.nflis.deadiversion.usdoj.gov/FAQ.aspx.

‖Positive specimens were oversampled, therefore CDEWS results may not be representative of the general parole and probation population.

^70 positive for SC of 319 specimens collected between December 2013 and March 2014.

±38 positive for SC of 194 specimens collected between May and July 2014.

+Metabolites found in Washington, DC NFLIS (CY2012 or CY2013) but not in CDEWS-2: AM-2201, JWH-019, JWH-122, and JWH-203.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Table 25: Metabolites Found in Synthetic Cannabinoid (SC) Positive Specimens from Drug Court Participants in Denver, CO, by 2013 NFLIS* Results

	SC Metabolites Detected by CDEWS-2 from Denver Drug Court (N=19)‡	Reported in CY2013 NFLIS‖ for Denver? (N=643)
Metabolites Detected by CDEWS-2:		
UR-144	53%	Yes
PB-22	37	Yes
JWH-018	32	Yes
MAM-2201	32	Yes
5F-PB-22	21	Yes
JWH-122	21	Yes
JWH-073	11	No
XLR-11	11	Yes
AB-PINACA	5	Yes
ADBICA	5	No

Notes: Positive specimens were oversampled, therefore CDEWS results may not be representative of the general drug court population.

*The National Forensic Laboratory Information System (NFLIS) is a Drug Enforcement Administration (DEA)-sponsored program that systematically collects drug chemistry analysis results, as well as other related information, from cases analyzed by state, local and federal forensic laboratories. These laboratories analyze substances secured in law enforcement operations across the country. NFLIS offers a valuable resource for monitoring illegal drug abuse and trafficking, including the diversion of legally manufactured drugs into illegal markets. NFLIS data are used to support drug scheduling efforts as well as to inform drug policy and drug enforcement initiatives both nationally and in local communities. Data in the NFLIS database consists of case and item/exhibit level information. https://www.nflis.deadiversion.usdoj.gov/FAQ.aspx.

‡19 positive for SC of 294 specimens collected between August 2013 and February 2014.

‖Metabolites found in Denver, CO NFLIS (CY2013) but not in CDEWS-2: AB-FUBINACA, AM-2201, ADB-PINACA, URB-754, STS-135, 5F-ADBICA, AKB-48.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Study Limitations

This study has a number of important limitations that must be kept in mind in interpreting the results.

CDEWS obtains samples of urine specimens that have already been collected and tested by the criminal justice system as part of a drug testing program. The persons selected for testing are typically at high risk for drug use because of prior treatment history, suspected drug misuse and/or drug offense history. While a population at high risk for drug use is exactly what we seek in order to achieve the CDEWS mission of uncovering emerging drugs, it also means that the CDEWS findings do not represent all persons in the CJS populations we studied. Nevertheless, drug trends in high risk criminal justice populations often foreshadow trends that appear later in the general population (DuPont & Wish, 1992).

The CDEWS model depends on collecting a small number of specimens that have already tested positive or negative by the CJS agency's routine drug screen. Every attempt was made to randomly select from the specimens available that met our selection criteria. We do not know whether these small samples are representative of all persons tested in the participating CJS populations. However, CDEWS results have been found to be internally consistent and often agree with other indicators of drug use in the studied jurisdictions. CDEWS is designed to produce an indication of emerging drugs in a community rather than precise prevalence estimates.

A limitation in this study is that CJS positive specimens were subject to long holding times due to legal requirements that specimens be retained by CJS monitoring agencies for specified periods of time (in this study, up to 6 months) prior to their release for research purposes. This lengthy holding period may have resulted in the degradation of some specimens, making it less likely to detect certain drugs such as designer stimulants (Huestis, 2013). In addition, due to storage limitations at the CJS monitoring sites and laboratories, specimens were typically refrigerated rather than frozen, which may have also contributed to their degradation.

The CDEWS-2 results can only provide an indication of the prescription and illicit drugs used recently by the people who submitted the specimens. A more complete understanding of the results will require additional studies. For example, we cannot tell whether a person testing positive for a prescribed drug like methadone or buprenorphine is taking it under medical supervision, for self-medication, or to get high. Nor can our test results tell us why or how often they used the drug or where they obtained it.

Decisions regarding modifying CJS drug testing protocols should not be based solely on CDEWS results alone. Rather, local policymakers should review the CDEWS results as they weigh the complex law enforcement, public health, and budgetary considerations in their jurisdiction to determine what drugs to test for. CDEWS provides critical information with which to paint a picture

of the age and gender characteristics of likely CJS users and, most importantly, the local communities where one might wish to collect more detailed information about a particular emerging drug's availability and use.

Implications of CDEWS-2 Findings for the CDEWS Method

We present below significant implications of the current study for developing the CDEWS methodology.

1. **Refining the CDEWS method for classifying specimens according to the local CJS screen**

The current CDEWS protocol has each participating site provide information on whether each specimen submitted to CDEWS tested positive or negative for any drug in their local screening panel. Perhaps because of degradation of samples or differing testing methods, the results from Tampa's JAC program test screen could not be exactly replicated by the CDEWS laboratory. The discrepancies raised questions as staff tried to determine whether any testing or recording errors had occurred. This process was complicated by the fact that, to protect the anonymity of all specimens collected, there was no way to directly compare any individual specimen's results from the Tampa and CDEWS labs. We have concluded that it will be best in the future to have each submitting site collect the required number of specimens that had screened positive or negative, but to not provide CDEWS with the screen result for each specimen. Instead, as we did in this report for the Tampa results, the CDEWS lab will test each specimen for the drugs in the routine local screen to designate specimens that would have likely screened positive or negative at the local site. This strategy will still enable CDEWS to analyze the drugs found in specimens that would have likely tested positive or negative by the local site's testing program.

2. **Create ongoing dialogues with toxicologists**

When we began CDEWS we had little understanding of the continuous development of drug tests required to keep up with evolving NPS. Differences in the SC metabolites identified in specimens collected about one year apart from participants in Washington, DC, and in the metabolites found in specimens from different areas of the country attest to the value of conducting interviews with toxicologists periodically. The sharing of test availability and laboratory results by these experts can be used to design the most up-to-date testing protocols for use by CDEWS and other testing protocols.

3. **Expand CDEWS to additional geographic locations**

With the completion of the CDEWS-1 and CDEWS-2 studies, the value of CDEWS results for determining the drugs recently used by high risk offender populations has now been documented in sites in: 1) Washington, DC, 2) Denver, Colorado, 3) Tampa, Florida, 4) Chesterfield, Virginia and 5) Prince George's County, Maryland. The CDEWS methods appear feasible, rapid and cost-effective in a variety of locations using different testing methods. Future studies might look at expanding the

CDEWS methodology to other criminal justice populations, treatment populations and to even students undergoing drug testing. The findings might help these organization to refine their testing protocols and to respond to locally emerging drugs.

4. **Expand CDEWS juvenile focus to include additional CJS populations and beyond**

CDEWS-2 has shown the value of testing specimens obtained from adults and youths in testing programs operated by the criminal justice system. Evidence now exists regarding the use of various SC metabolites by juveniles in Tampa, Florida and Washington, DC. Drug use by youths is often a risk factor for later substance use disorders, and it is critical to identify use of NPS so that early interventions can be planned. CDEWS could be piloted in more juvenile criminal justice settings and could also be piloted in school drug testing programs and health organizations. CDEWS could provide these testing programs with critical information to ensure they are testing for the drugs being used locally.

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Appendices

Appendix A: Site Selection Procedures

This section describes negotiations with the sites included in the study.

1. ***District of Columbia: Pretrial Services Agency for the District of Columbia (PSA) and Court Services and Offender Supervision Agency for the District of Columbia (CSOSA)***

Data collection was repeated in this site given that a high proportion of synthetic cannabinoid positives were uncovered in DC in our first CDEWS study completed in 2013. In the current CDEWS study, we repeated collection in parolees/probationers given that most jurisdictions around the country conduct routine urine testing with this population. We also collected specimens from a new population, juveniles in family court, as part of this follow-up study.

PSA uses an agency-run laboratory to test their specimens and maintains an advanced electronic record-keeping system to track results. This system was utilized during the sampling process to ensure that only one specimen per person was sampled for the study and also to collect demographic data. The demographic data obtained for specimens from this site were specimen collection date, year of birth, gender, and zip code of residence (adult population only).

Adult Parolee/Probationer Study

In order to obtain approval for this research study, we submitted a brief proposal for review by the agency research committee. Given that this was a repeat collection at PSA and followed a very similar protocol to that used in the previous study, the approval process for the parolee/probationer study was brief, approximately one month (see Table 26). The University of Maryland Institutional Review Board (UM IRB) application was then processed and approved. The first data collection for parolee/probationer specimens occurred approximately four months after approval was received from the PSA research committee (after specimens were accumulated and prepared for CESAR to collect). Researchers spent one day on-site to sample the already collected specimens.

Juvenile Family Court Study

At the conclusion of the parolee/probationer collection, we determined that there were sufficient funds to complete some additional urine testing. Given this, we met with PSA to explore the possibility of collecting specimens from juveniles. Upon learning that this study was feasible, we submitted a brief proposal for review and approval. This was reviewed by PSA and Juvenile Family Court and approved within approximately 2 weeks (see Table 26). The UM IRB application was then processed and approved. The first data collection for juvenile family court specimens took place approximately 2.5 months following approval from the PSA research committee (after specimens were accumulated and prepared for CESAR to collect). Researchers spent one day on-site to sample the already collected specimens.

2. Denver, CO: Denver District Drug Court

This site was of interest to the study as it allowed us to repeat collection in a drug court population. This site tests its specimens using an offsite testing laboratory (Norchem). We collaborated with both the drug court administrators and the offsite testing laboratory in order to collect the specimens. In order to obtain approval for this site, we began by meeting with both drug court administrators and laboratory staff to share information on the study and learn about the procedures being used by their site. An overview of the proposed methods was then sent to the administrators and laboratory staff for review. Using this document, approvals from drug court administrators were then obtained for the study. Negotiations and approval took approximately 3.5 months (see Table 26). The UM IRB application was then submitted and approved. Using a specified protocol, specimens were prepared by the drug court contracted laboratory staff and sent to the CDEWS laboratory. CESAR staff then prepared the specimens for the study by de-identifying them which was completed in two days, approximately 2 months (negatives) and 3.5 months (positives) following approval by the Denver District Drug Court. The interim period was used to accumulate specimens for collection by CESAR. A longer period was needed to accumulate positive specimens due to an extended holding period required by the drug court (6 months for uncontested positives; 7 days for negatives).

3. Tampa, FL: Juvenile Assessment Center (JAC)

This site was of interest to the study as it allowed us to collect specimens from a new juvenile population in a different geographic location. This site tests its specimens using an offsite testing laboratory (ACTS). We collaborated with both the Juvenile Assessment Center (JAC) program and the offsite testing laboratory, ACTS, in order to collect the specimens. In order to obtain approval for this site, we began by meeting via phone with both the JAC administrators and ACTS laboratory staff to share information on the study and learn about the procedures being used by their site. An overview of the proposed methods was then sent to the JAC administrators and laboratory staff for review. Using this document, approvals from JAC and ACTS staff were then obtained for the study. Negotiations and approval took approximately 1 month (see Table 26). The University of Maryland (UM) Institutional Review Board (IRB) application was then submitted and approved. Using a specified protocol, specimens were prepared by ACTS laboratory staff and sent to the CDEWS laboratory. CESAR staff then prepared the specimens for the study by de-identifying them which was completed in one day. The interim period was used to accumulate specimens for collection.

Table 26: Time to Obtain Approval and Collect Specimens On-Site

Site	Time to Obtain Approval	Researcher Time On-Site Collecting Specimens
District of Columbia: Adult Parole and Probation - Pretrial Services Agency for the District of Columbia (PSA) and Court Services and Offender Supervision Agency for the District of Columbia (CSOSA)	1 month	1 day
District of Columbia: Juvenile Family Court - Pretrial Services Agency (PSA) for the District of Columbia	2 weeks	1 day
Denver, CO: Denver District Drug Court	3.5 months	No on-site collection – 2 days at CDEWS lab for specimen preparation
Tampa, FL: Juvenile Assessment Center	1 month	No on-site collection – 1 day at CDEWS lab for specimen preparation

Appendix B: Collection of Urine Specimens

DC – Pretrial Services Agency for the District of Columbia (PSA) and Court Services and Offender Supervision Agency for the District of Columbia (CSOSA)

The Pretrial Services Agency for the District of Columbia (PSA) processes more than 800,000 urine specimens per year. Of these, approximately 314,000 are comprised of parolees and probationers and 13,000 are from juveniles within family court.

Parolee/Probationer Study

Over the period of approximately 4 months (November 2013 to March 2014), staff at the PSA laboratory accumulated specimens for parolees and probationers for inclusion in the study. PSA laboratory staff randomly selected negatives and positives from boxes of specimens for which the 48 hour holding period for negatives and the 40 day holding period for positives had passed until an adequate number of specimens had been obtained. These specimens at PSA are routinely tested for marijuana, cocaine, opiates, amphetamines, 6-AM (a metabolite of heroin used to definitively assess heroin use), and PCP (some individuals are also tested for synthetic cannabinoids, methadone and/or ethanol). All amphetamine positives are confirmed by PSA using GC/MS. Synthetic cannabinoids are tested by PSA using LC/MS/MS. Specimens are also tested to assess creatinine levels.

330 specimens (230 positives and 100 negatives) that were ready to be discarded were selected for the parolee and probationer population. 30 of the positive specimens were selected from a known group of amphetamine positives. These were sampled separately as they are held separately by PSA from the other specimens. We selected a number that approximated their typical percentage of amphetamine positive specimens as a proportion of our sample. Approximately 25 extra positive and 25 extra negative specimens were also selected in the event that specimens were found to contain an insufficient volume of urine at the time of sampling. All specimens were refrigerated prior to sampling by CESAR.

Our target sample was approximately 330 specimens. 319 specimens were collected – although 330 specimens had been prepared by PSA for the study, a small number were not selected for the sample as they had been inadvertently collected by PSA lab staff from the pretrial population rather than from parolees/probationers (see Table 27). One round of sampling was conducted to collect the required number of specimens. Two CESAR research staff participated in this sampling, which took approximately seven to eight hours.

All specimens were tested for synthetic cannabinoids, however, only a subsample of 25 (of 200) positives and 25 (of 100) negatives were selected for designer stimulant testing. Specimens were selected randomly (every 4-6th specimen) for designer stimulant testing – however, specimens with low volume were not selected for testing given that a significant volume was required to run this panel in conjunction with the basic panel and synthetic cannabinoid screens. Further, all of the 30 specimens in the known amphetamine positive group were sent for designer stimulant testing, given the suspicion that some of these amphetamine positives had been triggered by designer stimulant use.

Juvenile Family Court Study

Over the period of approximately 2.5 months (May 2014-July 2014), staff at the PSA laboratory accumulated specimens for juveniles in the family court system for inclusion in the study. PSA laboratory staff randomly selected negatives and positives from boxes of specimens for which the 48 hour holding period for negatives and the 40 day holding period for positives had passed until an adequate number of specimens had been obtained. These specimens at PSA are routinely tested for marijuana, cocaine, and PCP (some individuals are also tested for synthetic cannabinoids). Synthetic cannabinoids are tested by PSA using LC/MS/MS. Specimens are also tested to assess creatinine levels.

Specimens were selected from 7 referring programs. These are defined as follows: 1) *Juvenile-Diagnostic Probation*: The program into which all respondents with delinquency cases that have not yet been adjudicated are placed. These individuals are tested at the discretion of their Probation Officer, so they may or may not be notified of testing in advance; 2) *Juvenile-Persons In Need*: The program into which respondents are placed when they have non-criminal issues which are being monitored by the court. These individuals may or may not be notified of testing in advance; 3) *Lockup*: A test given to a respondent in lockup following an arrest; 4) *Juvenile-Regular Probation*: This program is similar to Juvenile-Diagnostic Probation and is for delinquency cases after adjudication has occurred. Respondents who test positive after their arrest are typically placed in this category for testing; 5) *Juvenile-Community*: This is used by the court when it has ordered the respondent to undergo drug testing. However, the respondent would not have been arraigned in court yet and there is no assigned docket; 6) *Evaluation*: A one-time drug test which is ordered by the court. If the respondent is negative, no further testing is needed unless further ordered by their probation officer or judge. If the respondent is positive, they will be placed into a weekly testing program; and 7) *Spot Test*: One time drug test issued by the court or probation officer when the subject makes an appearance. The subject being tested has no prior knowledge of the administration of the test.

200 specimens (100 positives and 100 negatives) that were ready to be discarded were selected for the juvenile family court population. Approximately 25 extra positive and 25 extra negative specimens were also selected in the event that specimens were found to contain an insufficient volume of urine at the time of sampling. All specimens were refrigerated prior to sampling by CESAR.

Our target sample was approximately 200 specimens. 194 specimens were collected (see Table 27). One round of sampling was conducted to collect the required number of specimens. Two CESAR research staff participated in this sampling, which took approximately six hours.

All specimens were tested for synthetic cannabinoids, however, only a subsample of 10 (of 100) positives and 10 (of 100) negatives were selected for designer stimulant testing. Specimens were selected randomly (every 6^{th}-8^{th} specimen) for designer stimulant testing – however, specimens with low volume were not selected for testing given that a significant volume was required to run this panel in conjunction with the basic panel and synthetic cannabinoid screens.

Method for all PSA samples

Each available specimen was scanned by PSA laboratory staff using a barcode on its label and entered electronically into a database. Once all specimens were obtained, the database for was sent to the IT department at PSA to ensure that only one specimen per person was selected and so that demographic data for each individual specimen could be added to the file. In instances when more than one specimen from a single individual was present in the database, PSA used the Police Department Identification Number (PDID) to select the most recent specimen collected from that individual which also contained an adequate quantity of urine for expanded testing (30mL). Specimen collection date, year of birth, gender, zip code of residence, and whether the specimen tested positive or negative for any drug on the PSA screen were added to the database. PSA staff also assigned a temporary ID to each record. Any specimens with creatinine levels of less than 20 ng/mL[1] were eliminated from the sample by PSA staff. The selected specimens were then aliquoted into new specimen cups and labeled with a temporary PSA ID using labels provided by CESAR. The temporary PSA IDs were also added to the corresponding records in the database. All negative and positive specimens were held separately in distinct groups to make sampling easier.

Once all specimens were labeled with the temporary IDs, the database was emailed to CESAR staff. All personal identifiers, including PDID's, were removed from the database before it was shared with CESAR staff. CESAR staff then scheduled a day to conduct sampling at the PSA laboratory. The process for sampling was as follows. For each specimen selected, a CESAR staff member blacked out the temporary PSA ID on the specimen label and re-labeled the specimen cup with a non-identifiable CESAR-assigned study ID. The study label utilized by CESAR included the CESAR-assigned study ID and other administrative codes required by the CDEWS laboratory (Friends), such as sampling date, testing panel type, and agency number. The CESAR-assigned study ID was not shared with PSA staff. CESAR staff then replaced the temporary PSA assigned ID in the database with the CESAR-assigned study ID. The urine specimen cup was then placed in a sealed plastic bag and prepared for pick up by Friends. The final database retained by CESAR did not contain any identifying information from PSA. Therefore, it is not possible to link the specimen or the records in the database back to the person by CESAR or by PSA.

[1] These specimens were eliminated because the urine was considered to be diluted and not valid.

Denver, CO - Denver District Drug Court

The Denver District Drug Court processes approximately 17,000 urine specimens per year from drug court participants. Over the period of approximately 3.5 months (February 2014 to May 2014), staff at the Denver District Drug Court identified specimens for possible inclusion in the study. Given that a longer period was needed to accumulate positive specimens due to an extended holding period required by the drug court (6 months for uncontested positives; 7 days for negatives), the negative and positive specimens were sampled at different times to allow for more timely testing. Contested positives were not sampled, due to an even longer holding period (12 months). Once the specimens for inclusion in the study were identified by drug court staff, the list of specimens for selection was transferred to their offsite testing laboratory, Norchem. These specimens were then packaged and shipped to the CDEWS laboratory (Friends). CESAR then went to Friends to prepare the specimens for additional testing.

Specimens are routinely tested by their offsite testing laboratory, Norchem, for a panel of seven or eight drugs (consisting of methamphetamine/amphetamine, barbiturates, benzodiazepines, cocaine, opiates, propoxyphene, marijuana and EtG (alcohol) added as the 8th potential drug). A 7-drug or 8-drug panel screen is administered depending on the drug court participant's history of alcohol and/or drug use/abuse or suspicion of use by their supervising officer.

Denver District Drug Court staff began by identifying all negative and uncontested positive specimens that were approaching their holding period expiration dates and could be released for the study. Positive specimens were defined as specimens positive for any drug other than EtG (alcohol). Two spreadsheets were created – one for the positive specimens and one for the negative specimens. Each eligible specimen was entered into its respective spreadsheet by drug court staff until the desired number was reached. Demographic and other elements were also added for each specimen, including a non-identifiable temporary study ID, specimen collection date, year of birth, gender, zip code of residence, ethnicity, test panel conducted (7 or 8 drug panel) and whether the specimen screened positive or negative for anything. Client names and specimen ID's were also included for Norchem staff to reference but deleted by Norchem prior to transfer to CESAR. All duplicate persons were removed from the spreadsheet as it was generated so that only one specimen per person was selected. Furthermore, individuals were selected only once for the study and were removed if they were in both the negative and positive sample. Specimens that had tested with creatinine levels of less than 20 mg/dL during their standard screen were eliminated from the sample. Extra specimens were included in the spreadsheets in the event that a specimen selected contained low volume or if it could not be located by Norchem staff. These spreadsheets were shared with Norchem staff on an ongoing basis to ensure that specimens were not disposed of once their holding dates had approached. The large number of negative specimens obtained from the drug court population, along with their shorter holding periods, allowed this group of specimens to be collected more quickly (approximately 2 months in advance of the positives).

Once the spreadsheet contained the desired number of specimens (150 negatives; 250 positives including extra specimens), it was sent to Norchem staff so that they could pull the specimens from storage. All specimens were kept frozen during the holding period. Any specimen

with low volume (<20mL) were eliminated from the sample. For each specimen on the spreadsheets, Norchem recorded the status of the specimen (i.e., selected, low volume, missing, not selected-extra). Each selected specimen was de-identified by Norchem staff and labeled with the corresponding temporary study ID in the spreadsheet. The negative and positive specimens were sent in two separate batches due to the difference in their holding period requirements. Once the required number of specimens from either group (negatives or positives) was collected, these were packaged and shipped to the CDEWS laboratory (Friends). 100 negatives and 200 positives were collected for the study. Client names and specimen ID's were deleted from the database by Norchem staff and then it was transferred to CESAR staff.

Upon arrival to the CDEWS laboratory, CESAR staff conducted a site visit to Friends prior to the start of testing. CESAR staff removed the temporary study ID assigned by Denver Drug Court staff and re-labeled the cup with a non-identifiable study ID, collection site code, collection date and other administrative testing codes required by the outside testing laboratory. The CESAR-assigned study ID was not shared with the drug court or Norchem staff. The final database retained by CESAR did not contain any identifying information from the drug court or Norchem. Therefore, it is not possible to link the specimen or the records in the database back to the person by CESAR, drug court staff or Norchem.

Two site visits to Friends lab were conducted– one for the negatives (March 2014) and one for the positives (May 2014). We collected 196 positive and 99 negative specimens from this site (see Table 27). A small number of specimens spilled out during shipment and were removed from the sample. Two research staff participated in each sampling, which took approximately 2-3 hours per visit to complete.

All specimens were tested for synthetic cannabinoids, however, only a subsample of 25 positives and 25 negatives were selected for designer stimulant testing. Specimens sent for testing were selected randomly (every 4-6th specimen) – however, specimens with low volume were not selected for testing given that a significant volume was required to run this panel in conjunction with the basic panel and synthetic cannabinoid screens.

Tampa, FL: Juvenile Assessment Center (JAC)

The JAC program processes approximately 6,000 urine specimens per year from juveniles that are either arrestees or violators of probation. Over the period of approximately 2 months (October 2014 to November 2014), staff at the ACTS laboratory, the contracted testing laboratory for the JAC program, identified specimens for possible inclusion in the study. Once the specimens for inclusion in the study were identified by ACTS staff, the list of specimens for selection was prepared and demographic information was added to the database. All specimens were frozen during the time while specimens were being accumulated for the study. These specimens were then packaged and shipped to the CDEWS laboratory (Friends). CESAR then went to Friends to prepare the specimens for additional testing.

Specimens are routinely tested by their offsite testing laboratory, ACTS, for a panel of four drugs (consisting of marijuana, opiates, cocaine, and amphetamines). This panel is administered on a voluntary basis to every juvenile that agrees at the time of booking. During the period of the study, specimens were also tested for creatinine.

ACTS laboratory staff attempted to identify 200 specimens (100 positives and 100 negatives) that were ready to be discarded for the juvenile population. ACTS laboratory staff began by identifying all specimens that were ready to be discarded from 2 groups: 1) **arrestees** (50 positives and 50 negatives) and 2) **violators of probation (VOP)** (50 positives and 50 negatives). There is no holding period for these specimens, as both negatives and positives are discarded after the completion of testing. Each eligible specimen was entered into a spreadsheet by ACTS laboratory staff until the desired number was reached. Unfortunately, given the number of participants in the JAC program, it was not possible for ACTS laboratory staff to accumulate 200 specimens from these populations during the study period – as such they provided as many specimens as possible. ACTS laboratory staff was given access to a JAC database with demographic elements for this population. Demographic and other elements were then added to the spreadsheet for each specimen, including the study ID assigned by ACTS, the specimen collection date, program type (new arrestee or VOP), year of birth, gender, ethnicity, zip code of residence, and whether the specimen tested positive or negative for any drug in the JAC panel. Client names, specimen ID's and month/day of birth were also included for ACTS staff to reference but deleted by ACTS prior to transferring the data to CESAR. All duplicate persons were removed from the spreadsheet as it was generated so that only one specimen per person was selected. Furthermore, individuals were selected only once for the study so they would not appear in both the negatives AND positives or in both of the program groups (arrestees and violators of probation). Specimens that had tested with creatinine levels of less than 20 mg/dL during their standard screen were eliminated from the sample.

Each selected specimen was de-identified by ACTS staff and labeled with the corresponding temporary study ID in the spreadsheet. The specimens were sent by mail in one batch. They were packaged and shipped to the CDEWS laboratory (Friends). Client names, specimen ID's and month/day of birth were deleted from the database by ACTS staff and then it was transferred to CESAR staff.

In November 2014, upon arrival of the specimens at Friends laboratory, CESAR staff visited Friends laboratory prior to their initiating testing. CESAR staff removed the temporary study ID assigned by ACTS staff and re-labeled the cup with a non-identifiable study ID, collection site code, collection date and other administrative testing codes required by the outside testing laboratory. The CESAR-assigned study ID was not shared with the JAC program or ACTS staff. The final database retained by CESAR did not contain any identifying information from the JAC program or ACTS. Therefore, it is not possible to link the specimen or the records in the database back to the person by CESAR, JAC staff or ACTS laboratory. Three research staff participated in the sampling, which took approximately 4 hours to complete. The final sample consisted of 218 specimens from the JAC site (see Table 27).

All specimens were tested for synthetic cannabinoids, however, only a subsample of 10 positives (all from arrestees) and 10 negatives (all from arrestees) were selected for designer stimulant testing. Specimens from the violators of probation group were not selected for designer stimulant testing due to the small sample size. Specimens sent for designer stimulant testing were selected randomly (every 4-6th specimen) – however, specimens with low volume were not selected for testing given that a significant volume was required to run this panel in conjunction with the basic panel and synthetic cannabinoid screens.

Table 27: Number of CJS Positive and Negative Specimens Sampled from Each Population and Subsample Tested for Designer Stimulants

Site and Population	CJS Test Result			Subset Tested for Designer Stimulant Panel
	Positive	*Negative*	*Total*	
Washington, DC - Pretrial Services Agency for the District of Columbia (PSA)				
CSOSA Parole & Probation	218*	101	319	80
Juvenile Family Court	96	98	194	20
Denver, CO – Denver District Drug Court				
Drug Court	196[+]	99	295[‡]	50
Tampa, FL – Juvenile Assessment Center (JAC)[†]				
Juvenile Arrestees	77	97	174	20
Juvenile Violators of Probation (VOP)	21	23	44	0
Total	608	418	1026	170

*This includes a sample of 30 PSA screen positive specimens that were found by PSA to be positive for amphetamines.

[+]One case was removed from this sample due to an insufficient volume of urine for testing.

[‡]Not all specimens were tested for the complete panel of drugs due to insufficient volume in some specimens. 285 specimens were tested for the expanded drug screening panel and 294 were tested for the synthetic cannabinoid panel. Specimens with low volume that could not be tested for both panels were sent for synthetic cannabinoid testing (except for one case, in error).

[†]The CJS test result for the Tampa JAC site was approximated using the CDEWS lab results for the same drugs typically screened for by the local Tampa JAC program. See the Tampa results section of the report for more information.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS-2), March 2015.

Appendix C: Testing of Urine Specimens by CDEWS Laboratories

Friends Medical Laboratory

CESAR contracted with Friends Medical Laboratory to conduct the expanded testing because their staff had been especially helpful in testing specimens from our previous CDEWS-1 study, as well as our earlier Adult Offender Population Urine Screening (OPUS) and Substance Abuse and Need for Treatment among Arrestees (SANTA) studies. The drugs and metabolites included in the CDEWS-2 panel were selected after interviewing 11 chemists at 9 labs, as well as 7 other DEA, NIDA CEWG and HIDTA contacts in DC and CO, to identify new psychoactive substances (NPS) to consider adding to our panel and to assess the availability of tests for these drugs. Also, prior to testing, a toxicologist at Friends briefed CESAR staff on current standards and detection limits for drug testing and worked with CESAR staff to develop a plan to obtain the most accurate testing results for the study. The laboratory repeated the panel of immunoassay tests done routinely by the participating sites as part of our expanded panel of drug tests for more than 75 substances. Initial screens used EIA and/or Thin-layer Chromatography (TLC). GC/MS (gas chromatography/mass spectrometry) and LC/MS (liquid chromatography/mass spectrometry) confirmation were conducted on selected EIA positives if needed to determine the specific drug that triggered the initial screen (see Table 4). Confirmation tests were conducted for opiates, amphetamines, PCP, buprenorphine and for any oxycodone positives with a negative opiate screen. All specimens were sent by Friends to CRL Laboratory for synthetic cannabinoid testing. In addition, for CDEWS-2, CRL screened a subset of 170 specimens for designer stimulants. LSD screening was not conducted due to its excessive cost and screening for phentermine was discontinued during the study period due to changes in test availability at Friends. The test results, labeled by study ID, were sent electronically to CESAR. It took approximately 48 hours for Friends Medical Laboratory to run initial screens. Specimens requiring confirmations took a slightly longer period to process (approximately one week). These specimens were then sent to CRL for synthetic cannabinoid and designer stimulant testing. Once all testing was complete, the results were reported to CESAR using an electronic reporting system available through Friends.

Total testing costs depended on the number of confirmation tests required, and averaged $20-30 (per specimen) across all tested specimens for the expanded panel not including SC testing. SC testing cost an additional $32.50 per specimen and the designer stimulant panel cost an additional $30.00 per specimen.

Selecting Substances for Inclusion in the Testing Panel

Selecting substances to include in the study test panel was critical to the ability of the study to detect emerging drugs, particularly as it relates to synthetic cannabinoid (SC) use since the SC metabolites in use are constantly altered, presumably to avoid detection and legal sanction. NPS are also an area of fast-paced change in terms of availability and use. Prior to testing, we did an assessment of existing data in DC and CO, including the DEA's *National Forensic Laboratory Information System* (*NFLIS*), which tracks law enforcement results for drug items seized by law enforcement and tested by state and local forensic laboratories (DEA, 2013, 2013a, 2013b; Shriver,

2013, 2014). Other large national laboratories, such as NMS Labs, routinely release information on SC metabolites being used which can assist in identifying currently available SC metabolites. We also reviewed data from NIDA's Community Epidemiology Work Group (CEWG) reports and other available presentations and publications to inform this topic (Comparin, 2014; Denver Office of Drug Strategy, 2013, 2013a; Endres, 2014; Gurney et al., 2014; Hobaica, 2013; Jones, 2014; Lozier et al., 2013; Presley et al., 2013; Seely et al., 2013). Data for Tampa, Florida was not reviewed as this site was added after the testing panel had already been finalized for the study.

In addition, we interviewed 11 chemists at 9 labs (PSA, Friends, AFMES, Arkansas Public Health Laboratory, Cayman Chemical, NIDA, NMS, Denver Police Department, DEA) as well as 7 other DEA, NIDA CEWG and HIDTA experts in DC and CO to identify NPS to consider adding to our panel and to assess the availability of tests for these drugs. Contacts in Tampa, Florida were not interviewed, as this site was added to the study after the testing panel had been finalized and testing had already been started for the study sample. A standard set of questions was asked including:

- What specific substances do think are most important for us to include in our testing panel?
- Are there any new or emerging synthetic drugs that we should include?
- What synthetic drugs do you test for at your agency?
- What synthetic cannabinoid metabolites have you been finding in your most recent specimens? cathinones? other synthetic drugs?
- To your knowledge, are there tests available for each of these drugs? What would be the recommended test (EIA, LC/MS, etc.)?

After working with these agencies, we expanded our SC panel to include 9 new metabolites for which tests had only just been developed. These include: APINACA (AKB-48), 5F-AKB-48, BB-22, PB-22, 5F-PB-22, AB-PINACA, 5F-AB-PINACA, ADB-PINACA, and ADBICA. We also tested specimens for the synthetic cannabinoid metabolites that were part of our first CDEWS-1 study, including: JWH-018, JWH-019, JWH-073, JWH-081, JWH-122, JWH-210, JWH-250, AM-2201, MAM-2201, RCS-4, UR-144, and XLR-11. Many additional SC metabolites were identified as relevant to the study, however, CRL did not have urine tests available for these metabolites at the time the study began. These included: 5-fluoro-ADBICA, RCS-8, STS-135, THJ-2201, THJ-018, AM2201 benzimidazole analog/FUBIMINA, AB-FUBINACA, ADB-FUBINACA, URB-754, FUB-PB-22, and MN-24 (NNE1).

Further, for CDEWS-2, we added a designer stimulant panel containing 23 compounds, all of which were new to the testing panel. Several additional designer stimulant compounds were identified as relevant to the study but were not included due to test availability and cost. These included: α-PVP, 4-MEC, 2C-I-NBOMe, 25C-NBOMe, 3,4-DMMC, 4-FMC, MDPPP, MPPP, 5-APB, 6-APB, and DMAA and Mitragyna (Kratom).

Synthetic Cannabinoid and Designer Stimulant Testing by Clinical Reference Laboratory (CRL)

Given that Friends Medical Laboratory does not test for synthetic cannabinoids or designer stimulants in their own laboratory, CESAR contracted with CRL to conduct the synthetic cannabinoid (SC) and designer stimulant testing for the study.

CRL was selected because at the time of the study, CRL was offering the widest known panel available for the testing of SC metabolites. The SC assay conducted by CRL contained 21 different synthetic cannabinoid metabolites: JWH-018, JWH-019, JWH-073, JWH-081, JWH-122, JWH-210, JWH-250, AM-2201, MAM-2201, RCS-4, UR-144, XLR-11, APINACA (AKB-48), 5F-AKB-48, BB-22, PB-22, 5F-PB-22, AB-PINACA, 5F-AB-PINACA, ADB-PINACA, and ADBICA (see Table 5). Detection limits varied between 0.2 and 5.0 ng/mL using 0.1 mL of urine. Nine new metabolites were added to this screen since the CDEWS-1 study. CRL is a SAMHSA certified laboratory for federal workplace drug testing.

The synthetic cannabinoid tests were performed using liquid chromatography-tandem mass spectrometry (LC/MS/MS). If a specimen was negative following the first LC/MS/MS screening, the result was reported on the basis of the first test. If they screened positive with the first test, they were subsequently confirmed by a second LC/MS/MS procedure (not simply a retesting by the same method). The screening and confirmation methods were developed in accordance with the College of American Pathologist (CAP) guidelines for forensic drug testing and are subject to CAP and state agency inspections. SC test results were typically obtained within approximately 1-2 weeks of testing and reported electronically to CESAR by Friends Medical Laboratory. To date, CRL has tested more than 30,000 samples with the SC assay used for CDEWS and have had positive samples retested at other labs upon request of the donor. All samples have reconfirmed, which indicates a 0% false positive rate. However, specimens testing negative for SC have not been retested. So, a rate for false negatives cannot be calculated.

Designer stimulants were added as a new panel for the CDEWS-2 study. The designer stimulant assay contained 23 different compounds, including 25B-NBOMe, 25I-NBOMe, 2C-B, 2-Fluoroamphetamine, 2-Fluoromethamphetamine, 3-Fluoromethcathinone, 4-Methylethcathinone, Buphedrone, Butylone, Benzylpiperazine, Cathinone, Ephedrone/Methcathinone, Ethylone, Eutylone, mCPP, MBDB, MDPV, Mephedrone, Methedrone, Methylone, Pentedrone, Pentylone, and TFMPP (see Table 6). All of these substances were tested at a detection limit of 20 ng/mL. mCPP testing was discontinued during the study by the testing laboratory due to cross-reactivity issues with the immunoassay – as such no juvenile populations in the study were tested for this drug.

The designer stimulant tests were performed using liquid chromatography-tandem mass spectrometry (LC/MS/MS). The sample aliquot volume was 25 uL for the screening test and 10 uL for the confirmation test. If a specimen was negative following the first LC/MS/MS screening, the result was reported on the basis of the first test. If they screened positive with the first test, they were subsequently confirmed by a second LC/MS/MS procedure (not simply a retesting by the same method). The screening and confirmation methods were developed in accordance with the College of American Pathologist (CAP) guidelines for forensic drug testing and are subject to CAP and state agency inspections. Designer stimulant test results were typically obtained within approximately 1-2

weeks of testing and reported electronically to CESAR by Friends Medical Laboratory. To date, CRL has tested more than 16,500 samples with the designer stimulant assay used for CDEWS and have had positive samples retested at other labs upon request of the donor. All samples have reconfirmed, which indicates a 0% false positive rate. However, specimens testing negative for designer stimulants have not been retested. So, a rate for false negatives cannot be calculated.

Appendix D: Glossary of Abbreviated Terms

6-MAM: 6-Acetyl Morphine, a unique metabolite of heroin used to definitively determine heroin use

ADAM: Arrestee Drug Abuse Monitoring program, a redesign of the DUF program that operated in more than 35 sites from 1998 to 2003, under the auspices of NIJ.

ADAM II: Arrestee Drug Abuse Monitoring II program. The ADAM II program is a continuation of the ADAM program under the auspices of ONDCP.

CAP: College of American Pathologists

CDEWS: Community Drug Early Warning System

CESAR: Center for Substance Abuse Research

CJS: Criminal Justice System

CRL: Clinical Reference Laboratory, a contracted laboratory for the CDEWS study that conducted testing for synthetic cannabinoids

CSOSA: Court Services and Offender Supervision Agency for the District of Columbia

DEA: Drug Enforcement Administration

DPP: Maryland Division of Parole and Probation (which is now part of Community Supervision at the Maryland Department of Public Safety and Correctional Services)

DUF: Drug Use Forecasting program, an NIJ program that collected self-reported drug use information and urine specimens from juvenile and adult arrestees quarterly in 23 sites from 1987 to 1997.

EIA: Enzyme Immunoassay, a method of urine drug testing

GC/MS: Gas Chromatography/Mass Spectrometry, a method for confirming drug positives in urine

IRB: Institutional Review Board at the University of Maryland, a committee that must approve all human subjects research at the University of Maryland

IT: Information Technology

LC/MS: Liquid Chromatography/Mass Spectrometry, a method for confirming drug positives in urine

LC/MS/MS: Liquid Chromatography-Tandem Mass Spectrometry, a method for confirming drug positives in urine

LSD: Lysergic Acid Diethylamide, a hallucinogen

MDMA: 3,4-methylenedioxy-N-methylamphetamine, also known as ecstasy or Molly

NFLIS: National Forensic Laboratory Information System

NIDA: National Institute on Drug Abuse

NIJ: National Institute of Justice

ONDCP: Office of National Drug Control Policy

OPUS: Offender Population Urine Screening, an earlier set of studies completed by CESAR in advance of CDEWS

PSA: Pretrial Services Agency for the District of Columbia

PSA ID: The temporary ID PSA staff assigned to each urine specimen

PCP: Phencyclidine, a dissociative anesthetic and hallucinogen
PDID: Police Department Identification Number
SAMHSA: Substance Abuse and Mental Health Services Administration
SANTA: Substance Abuse and Need for Treatment among Arrestees
SC: Synthetic Cannabinoid, also known as synthetic marijuana, K2, or spice
TLC: Thin Layer Chromatography, a method of urine drug testing
THC: Tetrahydrocannabinol, the primary active ingredient in marijuana
UM: University of Maryland