Community Drug Early Warning System: The CDEWS Pilot Project

September 2013

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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

This report describes a pilot test of the Community Drug Early Warning System (CDEWS) in three jurisdictions in the Washington, DC and Richmond, VA, Metropolitan Areas. CDEWS was designed to provide rapid information about emerging drug use in local communities by sampling urine specimens already obtained and tested for a limited panel of drugs by local criminal justice agencies and retesting them for a larger panel of drugs. The anonymous specimens were sent to an independent laboratory for testing for a panel of more than 30 licit and illicit drugs including 12 synthetic cannabinoid (SC) metabolites. The results demonstrated that CDEWS could be successfully implemented in diverse 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 in the District of Columbia, Maryland, and Virginia. Furthermore, all of the SC positive specimens contained one or two of the metabolites (UR-144 and XLR-11) recently identified and added to the federal schedule of prohibited SC metabolites after this study began. Additional analyses of the CDEWS results identified areas of Washington, DC, where the SC positive specimens were more concentrated and where future studies of its use and availability could be focused. The report concludes with research implications of the findings and next steps for implementing CDEWS in other sites.

Executive Summary

The Office of National Drug Control Policy's (ONDCP) National Drug Control Strategy has often emphasized the need for the United States to develop a rapid and low-cost system for identifying emerging drugs at the local community level. This need has become even more critical recently with the advent of a prescription drug epidemic and the rapid development of "designer drugs" such as synthetic cannabinoids. At a time of constrained federal and local budgets and rapidly shifting drug trends, any useful drug use monitoring system needs to be capable of rapidly responding to newly available drugs and of producing results quickly with minimal cost. Staff at the Center for Substance Abuse Research (CESAR) at the University of Maryland worked with ONDCP to test such a system.

In the past, the national Drug Use Forecasting (DUF) and the Arrestee Drug Use Monitoring (ADAM) programs were both based on evidence that trends in arrestee urinalysis results could provide advance warning of emerging drugs in the larger community (Wish 1997; DuPont and Wish 1992). While the information collected by these federally sponsored programs over the past 25 years has been valuable, the DUF and ADAM programs have relied on periodically stationing research staff in booking facilities to collect urine specimens and conducting brief interviews with arrestees (ONDCP 2013a). These programs have had three important limitations: they became very expensive and time consuming to operate; they were limited to functioning in large urban facilities where the required number of urine specimens could be collected in a few weeks; and they typically tested for a standard limited number of drugs. The new model described in this report was designed to address these limitations.

In 2013, ONDCP asked CESAR to test the Community Drug Early Warning System (CDEWS) in three venues in the Washington, DC and Richmond, VA Metropolitan Areas. 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 30 drugs. After exploring a number of potential sites for this study, the following sites were selected: 1) Prince George's County Drug Court; 2) Community Corrections Services in Chesterfield, Virginia; and 3) the Pretrial Services Agency for the District of Columbia and the Court Services and Offender Supervision Agency for the District of Columbia. These sites utilized different testing procedures, offered access to a variety of criminal justice populations, and were believed to have access to an adequate number of specimens for analysis.

This project introduced three important innovations to the CDEWS model. First, it focused on a diverse group of criminal justice populations: pretrial surveillance, lockup, parole and probation, and drug court. Second, CDEWS was implemented in two types of urine testing programs—those that conducted on-site urine testing with dipsticks and those that sent specimens to a laboratory for

screening. Third, and perhaps most important, tests for synthetic cannabinoids (SC) were included in the expanded CDEWS urinalysis screen for the first time.

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 three days or less of researchers' presence in each site. We collected a total of 1,064 anonymous specimens, including 900 specimens from the agencies in DC, 104 from the agency in Chesterfield, Virginia, and 60 specimens from the drug court in Prince George's County. To increase the chances of finding emerging drugs, we oversampled specimens that had tested positive for any drug in the agency's routine drug screen. CESAR's prior research using similar methodology has indicated that the rarer 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). All specimens were sent to an independent laboratory for testing for the expanded CDEWS panel of more than 30 prescription and illicit drugs. In addition, approximately half (56%) of these specimens were sent to a second independent laboratory for testing for 12 SC metabolites. The drugs and metabolites included in the CDEWS panel were selected after discussions with local criminal justice system (CJS) staff, ONDCP staff, staff at several national labs, and a review of the most recent Drug Enforcement Administration (DEA) National Forensic Laboratory Information System (NFLIS) data available.

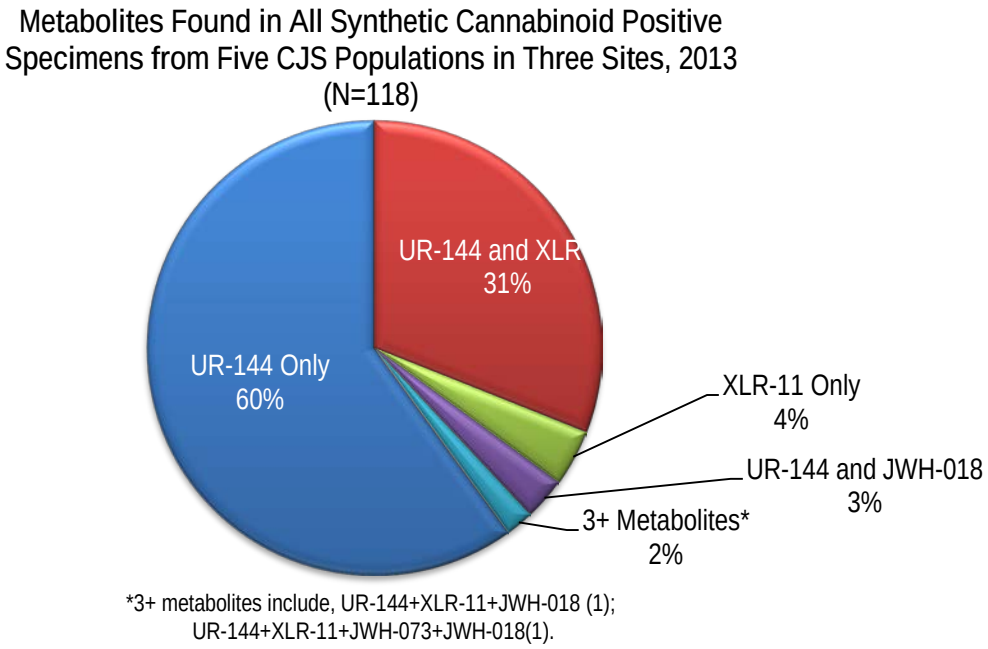
Limitations. While a number of limitations are described in the full report, it is critical that readers understand that although the urinalyses identified a number of prescription drugs, the urine tests alone cannot determine whether or not a prescription drug was used under medical supervision. Rather, CDEWS can best be viewed as providing timely information about local drug use and availability that can be used to target communities where additional information may be collected. In addition, the CDEWS urinalysis results should not be generalized to the general criminal justice population or broader community. However, drug trends in high risk criminal justice populations may foreshadow drug use trends that show up later in the general population (DuPont and Wish 1992).

Results and Conclusions. The full report highlights six key findings:

1. CDEWS was successfully tested in sites in Washington, DC; Chesterfield, Virginia; and Prince George's County, Maryland, with a variety of criminal justice programs. In addition, for the first time specimens were successfully collected from a site that used on-site dipstick tests, expanding the types of programs that could participate in CDEWS. In general, sites needed two months or less to accumulate sufficient specimens and CESAR staff spent three days or less at each site collecting and processing the specimens.
2. In a diverse set of criminal justice populations we have found that the additional drugs included in the expanded CDEWS screen were found mainly in persons who had tested positive for one of the drugs in the routine, more limited, screens used by the CJS testing programs. These additional drugs were rarely found in persons who had tested negative for

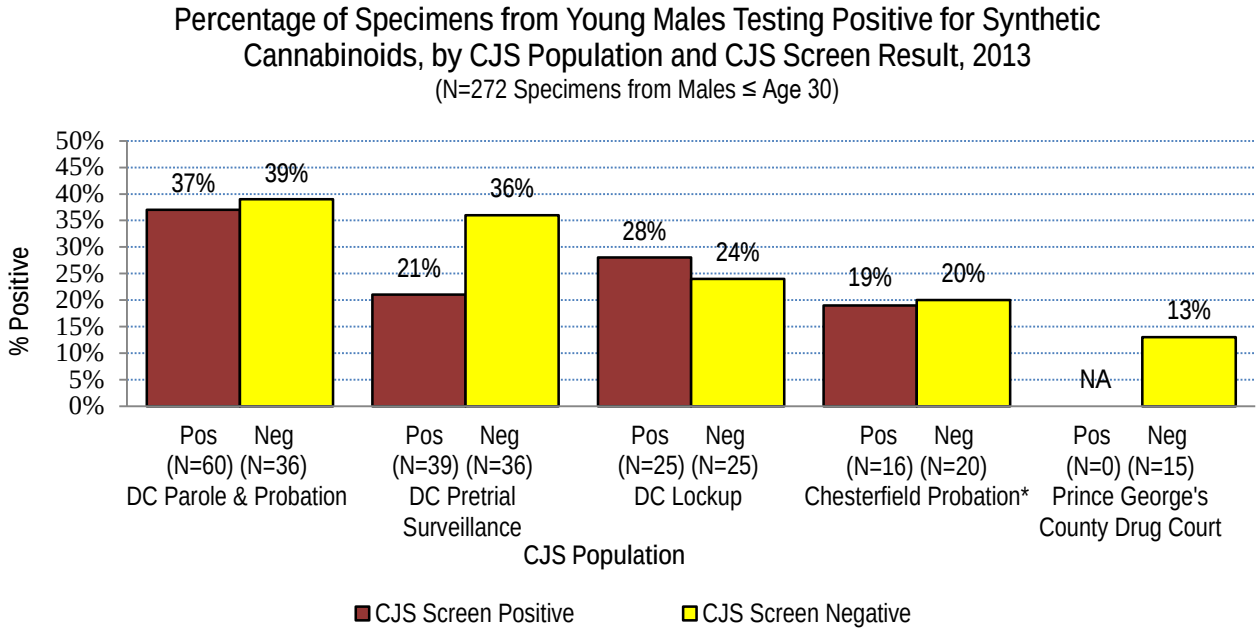
all of the drugs in the more limited CJS screen. Therefore, the CDEWS approach of oversampling CJS positive specimens appears to be justified for its primary mission of detecting newer or less common drugs that may be increasing in use.

3. However, we did find an important exception to the above with regard to synthetic cannabinoids (SC). **For the first time, we found a drug that was as likely to be found in persons who had failed the limited CJS screen as in persons who had passed. In other words, current drug testing screens which do not test for SC are likely to be missing significant drug use (and users) in the populations they monitor.** One possibility is that persons who know they will be tested use SC because they know that the drug is not included in most test panels (Perrone et al. 2013).
4. The CDEWS model demonstrated one of its unique strengths—to adapt quickly to emerging drugs of abuse. On the advice of the CDEWS laboratory staff, we added two new SC metabolites, XLR-11 and UR-144, to our planned ten metabolite screen just before we shipped the specimens. Our results show that all specimens positive for SC from all sites contained XLR-11 and/or UR-144. **Had we not tested for these two metabolites, only 5 specimens, rather than 118, would have tested positive for SC.** A recent MMWR report from the Centers for Disease Control and Prevention addresses the possible involvement of XLR-11 in acute kidney injury in emergency department admissions in six states (CDC 2013).



5. As expected, SC was most likely to be detected in younger men. What was not expected was the level of use that we found. **Regardless of whether they had failed or passed the routine CJS limited drug screen, between one-quarter and one-third of young men in the populations we studied in DC tested positive for SC.** For example, as the figure below

shows, 37% of the young men in Court Services and Offender Supervision Agency for the District of Columbia (CSOSA) Parole and Probation who had tested positive for the CJS screen also tested positive for SC, as did 39% of the persons who had tested negative for the CJS screen. While the numbers were based on smaller sample sizes, we also found evidence of SC use in specimens from probationers in Chesterfield, Virginia, and drug court participants in Prince George's County. Thus, SC was detected in all of the criminal justice populations studied.



*Virginia Probation sample only includes persons < age 30.
NA = No specimens available for testing.
Note: CJS positive specimens were oversampled and results were stratified by gender, age, and PSA test result. Therefore, separate estimates for the "CJS Screen Positive" and "CJS Screen Negative" groups should not be averaged to create an overall estimate.

6. Additional illustrative analyses of the data from the three DC criminal justice populations provided clues for understanding who is using the detected drugs. For example, we found that PCP, marijuana, and SC were likely to be found in the same specimens and in younger persons. In fact, 34% of the specimens from the DC populations that contained PCP also contained marijuana. Our analyses of drug test results and the DC residence of persons providing the specimens identified areas of the city where certain drugs appeared more prominent and where additional information about specific drugs might be collected.

Implications of CDEWS Findings

- CJS drug testing programs should weigh the value of adding SC metabolites to their testing protocols. 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.

- All of the specimens that were tested for SC metabolites were positive for UR-144 and/or XLR-11. XLR-11 is the metabolite that may be implicated in acute kidney injury (CDC 2013). The CDEWS model is based on evidence that trends in arrestee urinalysis results can provide advance warning of emerging drugs in the larger community (Wish 1997; DuPont and Wish 1992). Given the amount of SC found in the CJS populations we studied, it is imperative that local public health systems conduct prevention campaigns to educate the public, and especially youth and young adults, about the lack of understanding of the chemicals included in products sold as "synthetic marijuana" and the potential harm that can result from its use.
- CJS drug testing programs should consider adopting an annual CDEWS type of process for reviewing and updating the drugs included in their testing protocols. This could include contacting local and national testing experts or conducting expanded testing on a sample of specimens to check for drugs that may be being missed by current screens.
- While we sampled only criminal justice populations here, the CDEWS results may also have implications for expanded testing of urine specimens collected in hospital, physician, military, and workplace environments to accurately identify drugs recently used.

Additional Lessons Learned for Implementing CDEWS

- It is important at the beginning of a CDEWS study to work with toxicologists, chemists, and all participating sites to develop the initial testing panel. Moreover, to ensure the detection of emerging drugs such as SCs, it is essential to communicate regularly throughout the study to update testing panels as necessary. Given that the test panels may be refined or expanded during the study, it is important to retain all specimens even after testing is complete to allow for any additional testing for unanticipated drugs.
- Drug test panels used in future CDEWS specimen collections might include additional synthetic drugs such as synthetic cathinones (bath salts), acetyl fentanyl, and others for which use may be increasing across the country.

Next Steps for Implementing CDEWS

- The CDEWS specimen collection should be repeated in one or more of the DC criminal justice populations we studied to assess if the same SC metabolites identified are still being used and to determine if new metabolites are emerging.
- New sites should also be considered for inclusion in future CDEWS studies. Indicators such as the DEA's NFLIS should be reviewed to identify future CDEWS sites in which to test for emerging drugs. For example, in 2010, the states with the highest number of NFLIS reports positive for SC were North Dakota, Louisiana, and Kansas. The states with the highest number

of reports positive for synthetic cathinones were Texas and Arkansas (DEA 2011a). These might be excellent sites in which to implement CDEWS.

- The results from the current study can be used to target interviews with persons under criminal justice supervision who live in areas of the District of Columbia from where many of the SC positive specimens came. These interviews can collect critically needed information about the use and availability of SC.
- The CDEWS model could also be expanded to study emerging drugs outside of criminal justice populations For example, hospitals, pain clinics, drug treatment programs, and military departments that routinely collect urine specimens could serve as good venues for implementing the CDEWS methodology.

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Introduction

The Office of National Drug Control Policy's (ONDCP) National Drug Control Strategy has often 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 2010; ONDCP 2013b). This need has become even more critical recently with the advent of a prescription drug epidemic and the rapid development of "designer drugs" such as synthetic cannabinoids. At a time of constrained federal and local budgets and rapidly shifting drug trends, any useful drug monitoring system needs to be capable of rapidly responding to newly available drugs and of producing results quickly with minimal cost. Staff at the Center for Substance Abuse Research (CESAR) at the University of Maryland worked with ONDCP staff to test just such a system.

Both the national Drug Use Forecasting (DUF) and the Arrestee Drug Use Monitoring (ADAM) programs were based on evidence that trends in arrestee urinalysis results could provide advance warning of emerging drug use in the larger community (Wish 1997; DuPont and Wish 1992). While the information collected by these federally sponsored programs over the past 25 years has been valuable, the DUF and ADAM programs have relied on periodically stationing research staff in booking facilities to collect urine specimens and conduct brief interviews with arrestees (ONDCP 2013a). These programs have had three important limitations: they became very expensive and time consuming to operate; they were limited to functioning in large urban facilities where the required number of urine specimens could be collected in a few weeks; and they typically tested for a standard limited number of drugs. The new model described in this report was designed to address these limitations.

In 2006 and 2012, CESAR conducted two pilot studies of the new model that relied on obtaining specimens already collected by the Maryland Division of Parole and Probation (DPP) and were ready to be discarded (Wish et al. 2006; Wish et al. 2012). These studies showed that it was feasible to sample urine specimens that had been routinely collected and tested by the criminal justice system (CJS) for a few drugs, and send them to an independent laboratory for testing for an expanded panel of more than 30 drugs. Not only did this new methodology prove itself to be rapid and practical, but the pilot study's findings actually identified the emergence of prescription drug misuse in specific geographic locations in Maryland. Statewide drug test information had been collected quickly and at a much reduced cost (Wish et al. 2012).

In 2013, the ONDCP staff asked CESAR to conduct the Community Drug Early Warning System (CDEWS) in CJS programs in Maryland, Virginia, and Washington, DC. This project introduced three important innovations to the CDEWS model. First, the project would focus on a diverse group of urban and suburban criminal justice populations (pretrial surveillance, lockup, parole and probation, and drug court), including a population that did not know that they would be tested. Second, CDEWS

was to be implemented in two types of urine testing programs—those that conducted on-site urine testing with dipsticks and those that sent specimens to a laboratory for screening. Third, and perhaps most important, for the first time staff from ONDCP and the participating sites asked CESAR to include in the expanded urinalysis screen tests for synthetic cannabinoids (SC).

This report documents the steps taken to test the CDEWS model in each site and the lessons learned. We will also present the urinalysis findings from each participating population and the implications for the future development of the CDEWS methodology and for using the results to understand emerging drugs at the local level. We begin by placing the CDEWS model in its historical research context.

The National Drug Use Forecasting (DUF) and Arrestee Drug Abuse Monitoring (ADAM) Programs

From 1987 to 1990, Dr. Eric Wish, Principal Investigator of the CDEWS project, helped the National Institute of Justice (NIJ) launch the DUF Program. DUF provided a new drug monitoring system that could enable the country to obtain advance warning of future drug epidemics. The program was based on research that analyzed urinalysis results from arrestees who provided a specimen as part of the DC pretrial drug testing program (DuPont and Wish 1992). Since 1970, most persons arrested in DC and charged with a criminal offense have been asked to provide a urine specimen for use by the court in making decisions regarding treatment and subsequent drug monitoring.

The data from the DC testing program detected three major drug epidemics and formed the basis of the DUF program (Wish et al. 1981). The heroin epidemic in DC in the 1970s was found to have shown up in arrestees' urine test results one year or more before it was detected in other community indicators of drug use (Wish 1997). Arrestee test results from adults also foreshadowed the crack cocaine epidemic in the District in the 1980s (Wish 1990) and the juvenile arrestee test results identified the resurgence of marijuana use by youth in the District and the nation in the 1990s (Wish 1997). Arrestee drug use patterns can serve as a leading indicator of community drug use, because as an illicit drug becomes available in a community, the people who are likely to be committing other illegal behaviors are among the first persons in a community to use newly available illicit drugs.

The DUF program involved sending teams of researchers into a city's busy booking facility for several weeks to obtain about 200 voluntary and anonymous urine specimens, along with interview data, from randomly selected samples of arrestees each calendar quarter. It often took many months for local researchers to work out the approvals and the logistics required to enter a booking facility and to collect the necessary data. The DUF program was eventually established in 35 sites across the United States. The findings from the program documented the urban crack cocaine epidemic in the 1980s. Many DUF sites registered drug positive rates for cocaine exceeding 60% (Wish 1990). These

dramatic statistics were used by jurisdictions to provide convincing evidence for the need for additional resources to fund drug courts and other treatment programs for offenders.

NIJ redesigned the DUF program as the ADAM program in 2000. The ADAM program introduced systematic probability sampling and an expanded arrestee interview protocol (ONDCP 2013a). However, after a few years NIJ ceased funding the ADAM program, as it had become too expensive for that agency to sponsor (NIJ 2004). In 2007, ONDCP brought back the ADAM program as ADAM II. The new program continued the methodology of the original ADAM program in nine counties and in Washington, DC (ONDCP 2013a), but ONDCP's funding for the program is now ending (Zobeck 2013). The ADAM and ADAM II programs expanded the length and duration of the arrestee interviews so that multiple research topics could be studied and implemented a complex probability sampling methodology.

The Maryland Offender Population Urine Screening (OPUS) Studies

While many persons under the supervision of the CJS are required to participate in drug testing programs, these programs typically test specimens for a very limited number of drugs, usually those that achieved notoriety in a prior drug epidemic. It might be possible to sample these already collected specimens and greatly reduce the time and labor required to implement a drug monitoring system. Such a system could provide a cost-effective way of determining the types of drugs recently used by high-risk persons. It could not provide precise prevalence estimates of recent drug use in the studied population because the persons who are subject to testing are often at higher risk for drug use. However, such a system might provide a snapshot of the types of drugs being used recently by these persons and enable the study of drug use in rural or suburban areas where the relatively small number of offenders processed made ADAM-type data collection impractical. The locally-specific test results could then enable researchers to target areas of emerging drug use where focused interviews could be conducted with offenders to understand local drug use and availability.

In 2005, researchers at CESAR at the University of Maryland pilot tested the Adult Offender Population Urine Screening (OPUS) program, a system for expanded testing of specimens that had already been collected from probationers and parolees in Maryland. Each year, the Maryland Department of Public Safety and Correctional Services routinely collects about 500,000 specimens from probationers and parolees. Each probationer or parolee may be tested multiple times. Until a reconfiguration of the Agency in 2012, the specimens were collected through the Division of Parole and Probation (DPP) and sent to one of three local laboratories for analysis. After the DPP laboratories completed testing each specimen for the standard panel of four to five drugs (i.e., opiates, cocaine, benzodiazepines, marijuana, PCP), the specimen was eventually discarded (positive specimens were held for 60 days). CESAR's first pilot study collected specimens sent to the Guilford laboratory in Baltimore, Maryland. Laboratory staff allowed CESAR researchers to draw stratified random samples (positive or negative for the DPP screen result) from each submitting office for additional testing. In just a few hours, the researchers sampled 299 anonymous, de-identified

specimens and sent them to an independent laboratory, Friends Medical Laboratory, to be screened for more than 30 legal and illegal drugs using a combination of enzyme immunoassay (EIA) and thin layer chromatography (TLC) screens, with gas chromatography/mass spectrometry (GC/MS) confirmation of selected drugs (Wish et al. 2006).

The findings from the 2005 pilot study demonstrated the feasibility and value of the OPUS protocols. Urine specimens were easily obtained from all of the DPP collection sites that had submitted specimens to the Guilford laboratory. The expanded testing identified a number of prescription drugs not tested for by DPP, including buprenorphine, methadone, and oxycodone. Moreover, approximately one-half of the specimens that contained buprenorphine or oxycodone also contained two or more other drugs, raising the possibility that these prescription drugs were being misused. Also, not a single specimen tested positive for methamphetamine, providing evidence that the widely predicted epidemic of methamphetamine use had not arrived in this population in Maryland (Wish et al. 2006).

The findings showed considerable geographic face validity, in that specimens containing drugs like PCP and opiates tended to come from DPP collection sites in counties which typically have a larger number of substance mentions for these drugs at admission to treatment. Finally, the fact that the more limited DPP five-drug screen identified almost all of the *users* detected by the expanded screen gave the agency some assurance of the ability of their routine screens to identify most recent drug users, even while not detecting certain drugs. However, it was still important to determine the OPUS program's ability to obtain a larger, statewide sample of specimens that included rural counties that typically submit a small number of specimens to DPP for testing. A larger study would allow CESAR to determine if the methodology could be replicated with additional laboratories and to assess the stability of the local estimates obtained in the 2005 pilot study from the sites serviced by the Guilford laboratory. To this end, CESAR initiated the replication and statewide expansion of the Adult OPUS program in 2008.

The 2008 pilot study answered a number of questions raised by the earlier study. First, it was possible to rapidly sample 1,061 specimens that had been submitted to one of three state laboratories from probation offices across Maryland. Second, the test results from around Baltimore (the only site in the smaller 2005 study) were almost identical in the two studies, showing remarkable stability in the estimates three years later. The only significant difference was an increase in specimens testing positive for buprenorphine (Wish et al. 2012). This increase in buprenorphine positives was expected because it occurred during the period when the state was expanding treatment for opioid dependence using buprenorphine. CESAR researchers were able to use the urinalysis results to identify a site at which parolees and probationers could be interviewed about the potential diversion of buprenorphine (Wish et al. 2012).

Birth of the Community Drug Early Warning System (CDEWS)

The 2005 and 2008 OPUS studies demonstrated the feasibility of conducting a local and statewide study of drug use in Maryland by analyzing urine specimens already collected as part of a probationer and parolee drug testing program. Not only was the OPUS methodology useful, but it helped uncover the emergence of a newly available prescription drug (buprenorphine) that was potentially being diverted and sold on the streets of Baltimore. The expanded laboratory testing of specimens opened up the possibility of monitoring for potential prescription and synthetic drug misuse. However, urinalysis alone cannot determine if a person is using a prescription drug under medical supervision.

The Centers for Disease Control and Prevention (CDC) has proclaimed prescription drug misuse as a drug epidemic across the United States (CDC 2011). More persons die from prescription opioid overdoses than from cocaine and heroin overdoses combined (CDC 2011). The importance of this epidemic, along with ONDCP's stated recommendation to "develop a community early warning and monitoring system that tracks substance use and problem indicators at the local level" (ONDCP 2010, p. 96; ONDCP 2013b, p. 65) led ONDCP to fund CESAR to further develop the OPUS methodology as CDEWS in the DC and Richmond, VA, Metropolitan Areas in 2013.

In response to ONDCP's requirement that measures of drug use be useful at state and community levels (ONDCP 2013b, p. 65), three major innovations were planned for CDEWS and are described below.

1. Testing for synthetic cannabinoids (SC). Synthetic cannabinoids are psychoactive substances that bind to and stimulate the same cannabinoids receptors in the brain as THC, the psychoactive ingredient in marijuana (Logan et al. 2012). In 2012, there were an estimated 54 SC metabolites identified in law enforcement drug seizures (an increase from only 2 in 2009) (DEA 2013). However, these metabolites are constantly changing and new varieties are developed as quickly as the government adds the popular metabolites to the schedule of controlled dangerous substances. As we planned the CDEWS project, participating sites expressed interest in our including synthetic cannabinoids in our expanded test panel.

DEA's National Forensic Laboratory Information System (NFLIS) program analyzes drug items seized during law enforcement operations and tested by local law enforcement laboratories (DEA 2011). NFLIS results, national forensic laboratory results, and those from testing programs in other countries are the best indicators of what metabolites are being sold as synthetic marijuana. However, keeping up with the exact composition of synthetic marijuana is difficult because as governments make each metabolite illegal, the manufacturers design new SCs with slightly different chemical structures not banned by current law. Until a specific metabolite is made illegal, it can be sold in stores such as head shops, variety stores, or gas stations, as spice, K2, or incense, "not for human consumption," with exotic or pop culture names that attract youth and drug users (Johnson et al. 2011; Bhatty and Wu 2013). When CESAR designed the 2013 CDEWS project, we intended to test

specimens for 30+ licit and illicit drugs plus the 10 synthetic cannabinoid metabolites believed to be prevalent nationally and in the CDEWS sites. During the study, we increased the SC metabolites included in our testing protocol to 12 to include two "new" metabolites. As we discuss later, one of the dramatic findings of the CDEWS study is that we were more likely to find these "new" metabolites than the older ones in our original list.

2. Studying CDEWS feasibility in urban and suburban criminal justice populations. The first two OPUS pilot studies involved obtaining urine specimens that had been collected from probationers and parolees in Maryland. The current study aimed to implement the CDEWS methodology in criminal justice populations in Maryland and nearby jurisdictions, including the District of Columbia and Virginia. We also hoped to study persons being monitored at varying stages of the criminal justice system, including near arrest, on pretrial release, and in a drug court program. One of the purposes of the study was to determine how difficult it would be to recruit sites and implement the data collection in different venues.

3. Laboratory vs. on-site testing. Some CJS drug testing programs collect specimens and send them to a laboratory for testing and/or confirmation, while others collect specimens and test them immediately using an approved dipstick or test cup. Specimens may be discarded after initial testing or saved for further testing or confirmation. This project aimed to determine how easily the CDEWS methodology could be implemented in a site that used somewhat different testing procedures than those followed in the original pilot studies conducted with the Maryland DPP, where all specimens were sent to laboratories.

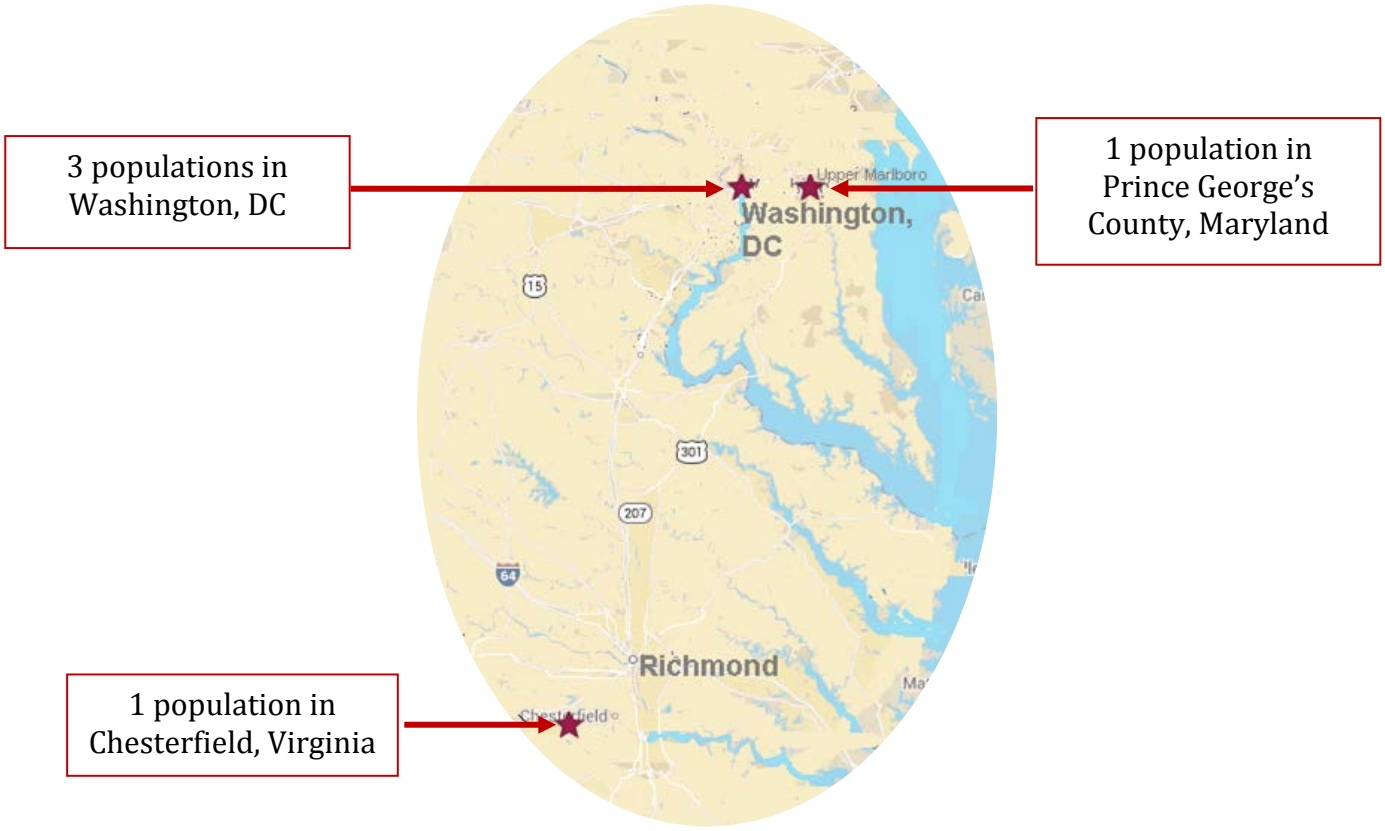
The CDEWS methodology and results are detailed in the following sections. All tables and figures and a glossary of terms used in this report follow the text.

Methodology

Site Selection Procedures

We attempted to recruit sites with different testing methodologies and a variety of criminal justice populations. We sought to recruit one site each from the District of Columbia, Maryland, and Virginia. We ultimately assessed the potential of six sites in these locations and selected three for inclusion in the study. A map of the participating study sites is shown in Figure 1 below.

Figure 1: Location of Participating Study Sites



The selected sites utilized different testing procedures, completed the approval process in a timely manner, offered access to specific criminal justice populations in clearly defined geographic areas, and could provide an adequate number of specimens for analysis.

The three selected sites and the populations they covered are listed below:

Site	Populations Covered	Type of CJS Laboratory	Drugs in CJS Screen
DC: Pretrial Services Agency for the District of Columbia (PSA) and Court Services and Offender Supervision Agency for the District of Columbia (CSOSA)	Arrestees in lockup, persons in pretrial surveillance (drug testing), parolees and probationers (est. 800,000 specimens per year)	Onsite laboratory	PSA, Lockup and Pretrial Surveillance: cocaine, opiates, amphetamines, PCP, 6-acetylmorphine (6-AM, a metabolite of heroin used to definitively assess heroin use) (some individuals are also tested for marijuana, methadone, and/or ethanol) CSOSA, Parole & Probation: marijuana, cocaine, opiates, amphetamines, PCP (some individuals are also tested for methadone and/or ethanol) Note: DC PSA added 6-acetylmorphine (6-AM) to their testing panel after the CDEWS study had already begun.
Prince George's: Prince George's County Drug Court	Drug court participants (est. 14,000 specimens per year)	Onsite laboratory	4-panel screen Any four of the following five drugs: marijuana, cocaine, PCP, opiates, ethanol
VA: Chesterfield Community Corrections Services (CCCS)	Probationers (est. 25,000 specimens per year)	Onsite dipstick	6-panel screen: marijuana, opiates, cocaine, benzodiazepines, oxycodone, methamphetamine 12-panel screen: marijuana, opiates, cocaine, benzodiazepines, oxycodone, methamphetamine, amphetamines, methadone, PCP, MDMA, barbiturates, propoxyphene Note: A 6-drug or 12-drug panel screen is administered by CCCS depending on the charge of the individual.

Prior to sampling specimens from each site, we met with 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 from a scientific, logistical, and efficiency standpoint. A plan was then developed with each site to obtain the necessary samples in the most efficient and scientifically accurate method possible. Prior to data collection, we submitted applications for the necessary approvals from each site and also obtained approval for the 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.

Collection of Urine Specimens

Prior to collecting the specimens, CESAR met with staff from each site 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. To increase the probability of detecting rare drugs, we oversampled specimens that tested positive in their routine CJS drug screens. CESAR's prior research in this area has indicated that the rarer drugs tend to be found in persons testing positive for the more common drugs included in the standard criminal justice panels

(Wish et al. 2012). Only one specimen per donor (generally the most recent) was selected for CDEWS. Once the desired number of unique specimens was reached, CESAR arranged to either prepare the specimens on-site for pick up or have them shipped directly to the outside testing laboratory. All specimens were de-identified during preparation for transfer to the CDEWS laboratory. However, in most sites we were able to record the person's year of birth, zip code of residence, and gender. In Washington, DC, and Prince George's County Drug Court, specimens were selected and prepared on-site by CESAR staff. In Chesterfield, Virginia, where specimens are tested on site with a dipstick, the probationer was instructed to cap his or her own specimen and give it to CCCS staff who then labeled and prepared it for shipment to the CDEWS laboratory. Details of the specimen selection, storage, and processing in each site appear in Appendix B.

Testing of Urine Specimens by CDEWS Contracted Laboratories

All specimens were sent to Friends Medical Laboratory for the expanded drug testing panel of more than 30 drugs (Table 1, p. 24). As Table 1 shows, positives for certain drugs were confirmed to identify specific drugs. Given that our primary CDEWS laboratory, Friends Medical Laboratory, does not conduct testing for synthetic cannabinoids (SC), the specimens were sent to the Clinical Reference Laboratory (CRL) after the completion of testing for the expanded panel. Prior to testing specimens, we were advised by Friends Medical Laboratory staff to expand our SC testing panel to include 12 (rather than 10) metabolites due to recent changes in metabolites being used and found in local specimens (Table 2, p. 25). Funding was sufficient only for testing of approximately one-half (56%) of specimens in the sample (Table 3, p. 26). We decided to select a subsample of specimens for SC testing on the basis of age, gender, and CJS test result. Past studies (SAMHSA 2012) had indicated that SC users are typically young males. We therefore attempted to select as many specimens as possible from males 30 or younger. We also wanted to ensure that we selected enough specimens that had tested positive or negative by the CJS screen. Additional information about the selection of these labs is provided in Appendix F.

Results

The results are organized around three topics. First, we describe the specimens collected and some basic demographic information about the persons who provided them. Next, we describe the laboratory test results for specimens tested for the expanded screen and the subsample tested for SC. Because we oversampled CJS positive specimens, we present the results for CJS positive and negative specimens separately rather than combing them. We conclude with an overview of illustrative analyses possible with the large number of specimens obtained from DC. These additional analyses demonstrate how the CDEWS test data can be used to understand the drug use detected and to identify subgroups that could be studied to further understand these patterns. For ease of discussion, the sites will be referred to in this section as DC (PSA Lockup, PSA Pretrial Surveillance, CSOSA Parole and Probation), Prince George's Drug Court, and Chesterfield Probation (Chesterfield Community Corrections Services in Virginia). All of the tables and figures cited in this section appear collectively at the end of the report.

Specimens Received from Each Site and Dates of Collection

A total of 1,064 specimens were collected across all sites. Table 3 (p. 26) shows the number of CJS drug positive and drug negative specimens received from each site. For each of the populations in DC, we received the desired 300 specimens. While we targeted 200 CJS drug positive specimens and 100 CJS drug negative specimens from each population, we inadvertently received 197 positive specimens and 103 negative specimens from CSOSA Parole and Probation. We targeted 100 specimens from Chesterfield and received 104, 37 of which had tested positive by their drug screen. We collected a total of 60 specimens from Prince George's, 16 of which had tested positive by their screen. Approximately half (591, 56%) of the specimens were tested for synthetic cannabinoids (SC).

Table 4 (p. 27) shows the time period spanned by each CJS agency's specimen collection. The CJS positive specimens covered a longer period of time because drug positive specimens had to be retained for a specified period in each site before they could be discarded. When we started the study, we were able to select specimens that had been collected and tested positive weeks 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.

Demographic Characteristics of Persons Providing Specimens

DC. Gender, age, and zip code of residence had been collected for each specimen. Table 5 (p. 28) presents these results for each population. As one would expect in a CJS population, the overwhelming majority of specimens came from males. The age distributions were similar, with a few exceptions. Almost one-half (49%) of the PSA negative specimens from arrestees in Lockup came from persons below age 26 and more than one-half (52%) of the PSA positive specimens from persons in Pretrial Surveillance came from persons older than 40. We do not know how much these

age patterns reflect true differences in the tested populations. Washington, DC, is geographically divided into eight wards. Most of the specimens came from persons living in Wards 5, 7, and 8. A subset of persons processed in DC (15%) resided in Maryland.

Chesterfield Probation. Table 6 (p. 29) shows that most participants were males (64% of positive specimens and 74% of negative specimens). Almost three-quarters were under age 30 (72% of positive specimens and 73% of negative specimens). Zip code of residence was not obtained from this site.

Prince George's Drug Court. As seen in Table 7 (p. 30), the majority of specimens came from males (100% of positive specimens and 86% of negative) over age 30 (82% of positive specimens and 62% of negative) and all resided in Maryland.

CDEWS Laboratory Test Results—Excluding Synthetic Cannabinoids (SC)

DC. Table 8 (p. 31) presents the urinalysis results, by site and PSA drug test result. Tested drugs showing up in 1% or less of all groups are excluded from the table. It is immediately clear that few of the specimens testing negative for all drugs in the PSA limited drug screen tested positive for any of the *additional* drugs included in the CDEWS screen. Buprenorphine[1] was the drug not in the PSA screen that was most likely to be detected in specimens from Pretrial Surveillance (14%) and Parole and Probation (13%) that had tested positive for any drug in the PSA screen. Other drugs detected in persons who had tested positive for the PSA screen were methadone (3-11%), oxymorphone (5-6%), oxycodone (5%) and benzodiazepines (1-4%). Oxymorphone is a metabolite of oxycodone, but a positive test could also result from a person taking only that drug. Urinalysis results cannot determine whether use of any prescribed drug was taken illicitly or under a physician's supervision.

Chesterfield Probation. Table 9 (p. 32) shows that, like the DC results above, few specimens that had tested negative for the CJS drug screen tested positive for the additional drugs in the CDEWS expanded screen. Our expanded CDEWS panel was less likely to identify drugs missed by their screen than in the other two sites. However, 24% of the CJS positive specimens tested positive for the prescription drug oxymorphone (which is also a metabolite of oxycodone) and 8% for buprenorphine. In addition, 19% tested positive for oxycodone, 14% for benzodiazepines, and 8% for amphetamines that were included in the CJS panels. Methadone was detected in 5% of the specimens from persons who tested positive or negative by the Chesterfield Probation screen. It is not possible to determine whether the prescription drugs detected were being used under medical supervision.

Prince George's Drug Court. Drug court specimens that tested negative for the CJS screen were also unlikely to test positive for any of the drugs in the expanded CDEWS screen (Table 10, p.

[1] Buprenorphine is an opioid prescribed for office-based treatment of opioid dependence and many of these persons could have been receiving it by prescription. However, buprenorphine can also be diverted and misused on the street (Wish et al. 2012).

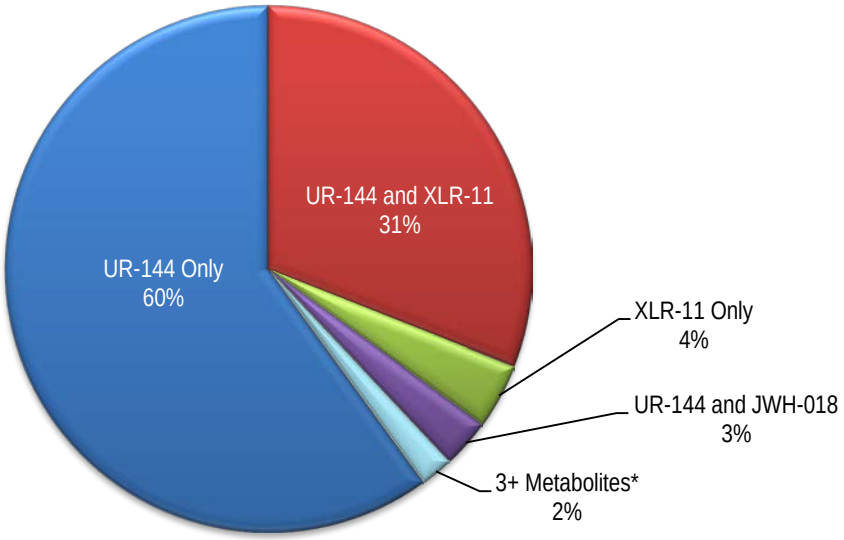
33). One exception was methadone, found in only 5% of the specimens. Specimens testing positive for the CJS screen also tested positive for a variety of prescription drugs. Six percent of the specimens were positive for buprenorphine, hydrocodone, hydromorphone, naloxone (probably as part of Suboxone®, a combined buprenorphine/naloxone preparation), amitriptyline/nortriptyline, or amphetamines. The prevalence of prescription drugs in drug court participants requires further examination.

CDEWS Laboratory Test Results for Synthetic Cannabinoids (SC) for All Sites

Metabolites detected. We noted above that we had proposed to test specimens for ten metabolites believed to be most commonly available but added two new metabolites to the panel (UR-144 and XLR-11) at the urging of our local laboratory. We therefore wanted to examine how often these two metabolites were detected in the specimens obtained from each site. The results across sites, however, were so consistent that we presented the specific SC metabolites identified in all sites combined in Figure 2 (see below). Separate results for each site appear in Appendix D. A total of 118 specimens tested positive for SC, but all contained either XLR-11 or UR-144. In fact, had we tested our specimens only for the initial list of ten metabolites, only five specimens would have tested positive for SC.

Figure 2: Metabolites Found in All Synthetic Cannabinoid Positive Specimens from Five CJS Populations in Three Sites, 2013

(N=118)



*3+ metabolites include UR-144+XLR-11+JWH-018 (1) and UR-144+XLR-11+JWH-073+JWH-018 (1).

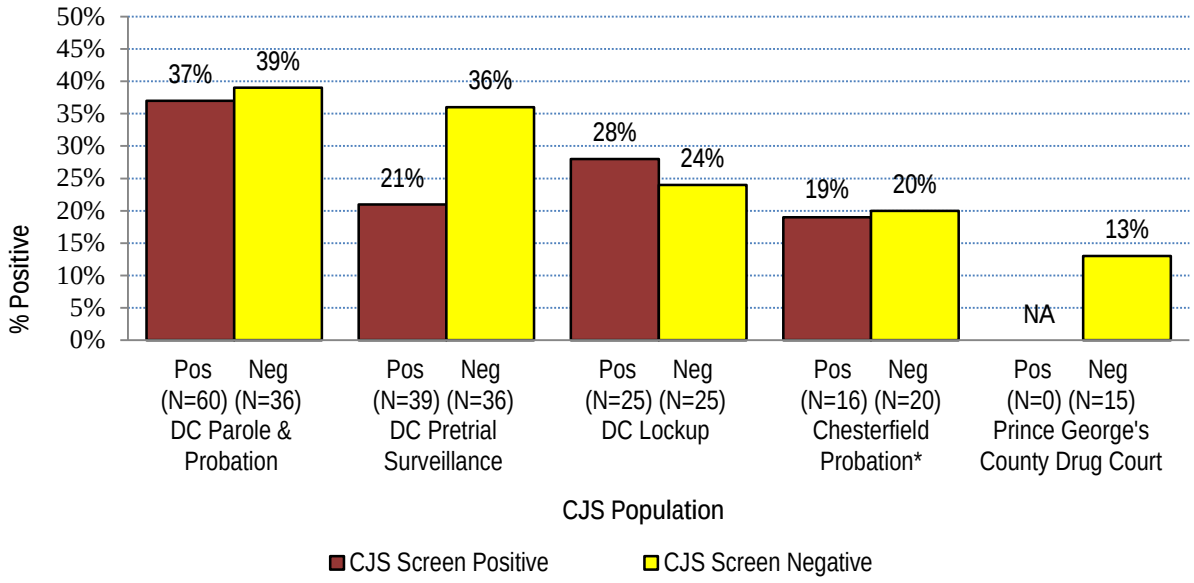
SC results. Because of the complex way that we selected the subset of specimens to be tested for SC (see Appendix C), Table 11 (p. 34) presents the results for each site, grouped by CJS screen, age, and gender. The SC test results were dramatic and unexpected. First of all, SC was detected in all sites and

populations studied. In the DC sites, approximately one-quarter to one-third of young men tested positive for SC. In Virginia, about one-fifth of young men in the Chesterfield probation program tested positive for SC. SC was least likely to be found in the Prince George's Drug Court population, where our tested sample sizes were quite small. Nevertheless, we did find SC primarily among younger men with a negative CJS screen (13%).

In our past research, we usually found that the less common drugs picked up in the expanded screen were detected primarily among persons who had failed the CJS screen. That is, persons who test positive for the less common drugs typically are using the more common drugs. As Figure 3 (see below) clearly shows, this pattern was not found for SC. For example, 37% of the young men in CSOSA Parole and Probation who had tested positive for the CJS screen also tested positive for SC, and 39% of the persons who had tested negative for the CJS screen tested positive for SC. The most logical explanation for this result is that persons who know they are being tested by the CJS and know that SC is not being screened for are likely to use SC to avoid detection. However, this situation would not apply to persons in the PSA Lockup population, who presumably did not know they would be arrested and tested. In spite of this, 24% of the males 30 or under in PSA Lockup who had tested negative for the CJS screen were still found to test positive for SC.

Figure 3: Percentage of Specimens from Young Males Testing Positive for Synthetic Cannabinoids, by CJS Population and CJS Screen Result, 2013

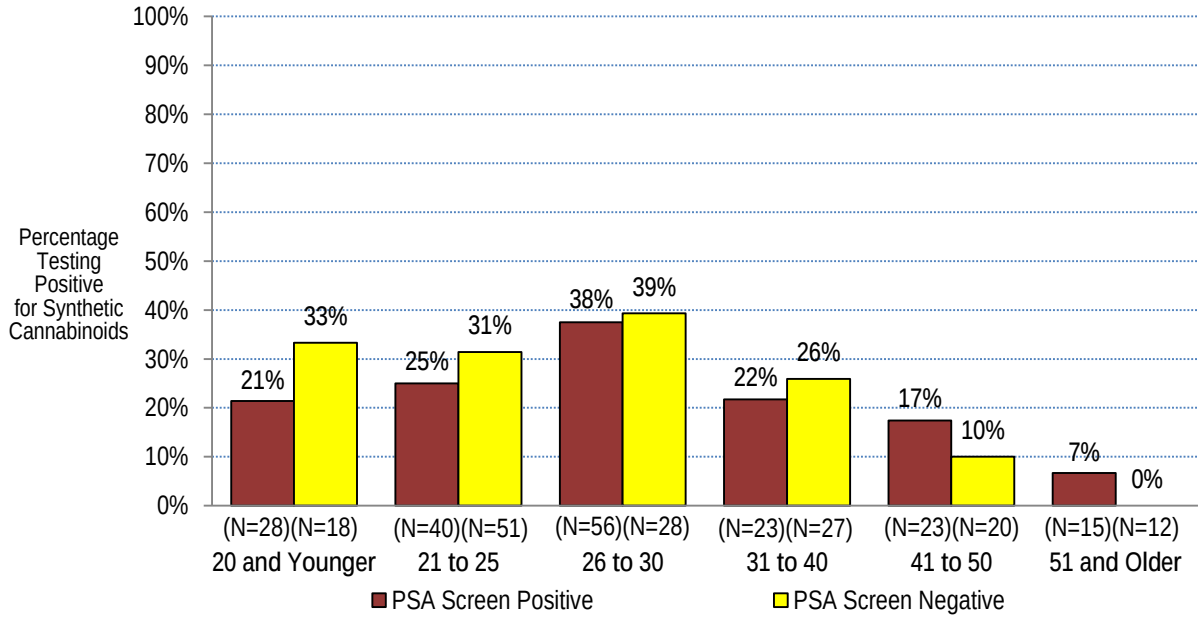
(N=272 Specimens from Males ≤ Age 30)



*Virginia Probation sample only includes persons < age 30.
NA = No specimens available for testing.
Note: CJS positive specimens were oversampled and results were stratified by gender, age, and PSA test result. Therefore, separate estimates for the "CJS Screen Positive" and "CJS Screen Negative" groups should not be averaged to create an overall estimate.

SC use, by age and site. In order to have sufficient cases, we combined the specimens from all three DC sites and looked at the association between age and testing positive for SC. As Figure 4 (see below) shows, SC was more likely to be found in persons under age 40. We had oversampled persons age 30 or under for testing for SC, but it might have been more effective had we oversampled persons aged 40 or under. Nevertheless it is clear that in this population around DC, SC is primarily found among younger adults.

Figure 4: Percentage of Specimens from Three DC CJS Male Populations Combined Testing Positive for Synthetic Cannabinoids, by PSA Drug Screen Result and Age, 2013
(N=341 specimens from Washington, DC Parole & Probation, Pretrial Surveillance and Lockup)



Notes:

Pretrial Services Agency for the District of Columbia (PSA) tested the Pretrial Surveillance and Lockup populations for cocaine, opiates, amphetamines, PCP and 6-acetylmorphine (6-AM) (some individuals were also tested for marijuana, methadone, and/or ethanol) and tested the Parole & Probation population for marijuana, cocaine, opiates, amphetamines, and PCP (some individuals were also tested for methadone and/or ethanol). The "PSA Screen Positive" category includes some samples that were positive for ethanol only (Lockup: 1 sample; Pretrial Surveillance: 3 samples; Parole & Probation: 18 samples). Amphetamine-positive specimens were inadvertently excluded from the sample selected from PSA.

PSA positive specimens were oversampled and results were stratified by gender, age, and PSA test result. Therefore, separate estimates for the "PSA Screen Positive" and the "PSA Screen Negative" categories should not be averaged to create an overall estimate. A subsample of these collected specimens was tested for synthetic cannabinoids. The synthetic cannabinoid metabolites included in the separate screen were 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.

Additional Illustrative Analyses of DC Test Results

With one exception (Table 17, p. 40), the following analyses pool all urine specimens obtained from the three DC populations. They are illustrative of the types of analyses possible with CDEWS data to understand drug use patterns and to identify subpopulations that might be studied further to understand local drug use patterns.

Drug use and age. Table 12 (p. 35) shows the average age of persons who provided specimens that tested positive for specific drugs. It is clear that SC, marijuana and PCP are likely to be found

among younger persons. Prescription opioids and benzodiazepines were concentrated among persons in their 40s. In contrast, methadone and cocaine were found among the oldest persons. One possibility is that these persons come from the cohort that grew up during the time of the crack and heroin epidemics of the 80s.

Other drugs detected in specimens positive for prescription opioids. Table 13 (p. 36) compares specimens containing buprenorphine, methadone, or oxycodone. The specimens containing oxycodone appear somewhat different from those containing buprenorphine or methadone. Oxycodone positive specimens are less likely to contain morphine or codeine, but are more likely to contain marijuana, PCP, and other prescription drugs, especially benzodiazepines and hydromorphone. Almost all (93%) of the oxycodone positive specimens tested positive for oxymorphone, which can be a metabolite of oxycodone; this may explain the high levels detected. More research is needed to understand if people who use oxycodone tend to have different drug use patterns than persons using methadone or buprenorphine.

Other drugs detected in specimens positive for PCP. PCP use has been found in the DC testing program for many years. We noted above that PCP positive specimens came from some of the youngest persons in our sample, as did marijuana and SC. It should not be surprising, therefore, that PCP positive specimens were also likely to contain marijuana (34%) or SC (29%) (Table 14, p. 37). Marijuana has been reported in the past to sometimes be laced with PCP (CESAR 2004). Young users of any one of these drugs appear more likely to use the other drugs.

Other drugs detected in specimens positive for marijuana or SC. We classified all specimens from the three DC populations that had been tested for SC according to whether they tested positive for marijuana, SC, or both drugs. Table 15 (p. 38) shows that the three groups of specimens contained similar patterns of other drugs. About one-fourth of each group also tested positive for PCP. The only other potential difference was that cocaine was somewhat more likely to be detected in specimens that contained both marijuana and SC (14%), but the number of cases was quite small.

Prescription drugs detected in PSA positive or negative specimens. Table 16 shows (p. 39) that prescription drugs were rarely found among persons who passed the PSA drug screen. The percentage of PSA negative specimens that tested positive for any prescription drug ranged from 1% to 9%. The situation was much different for persons who tested positive for any drug in the PSA screen, where the percentages ranged from 17% to 23%. Buprenorphine was the prescription drug most likely to be detected in the PSA Pretrial Surveillance (14%) and CSOSA Parole and Probation (13%) specimens that had tested positive by the PSA screen. It is not possible to tell from a urine test how many of these persons were taking buprenorphine under medical supervision. However, the results in Table 13 (p. 36) indicate that more than half of the specimens that contained buprenorphine also contained morphine or codeine and one-fifth contained cocaine.

Drug test results, by DC residence. By combining the data from the three DC populations, it was possible to examine whether use of certain drugs was concentrated in certain geographic areas.

If so, such findings could provide researchers with an indication of the areas to be targeted to collect additional information to understand local emerging drugs. Maps showing these relationships appear in Appendix E (E-1 to E-8). Washington, DC, is divided into four quadrants and eight wards. The CDEWS results in Appendix E-9 indicate that to learn more about PCP, researchers might conduct interviews in Wards 6, 7, and 8. Prince George's County in Maryland, bordering Wards 7 and 8, is another area to target for information about PCP. However, to learn more about cocaine, researchers might conduct interviews in Wards 2, 4, 5, and 6. Specimens testing positive for prescription opiates are more widely distributed across the District. The results by ward for SC are displayed separately in Appendix E-10 because only a subset of specimens was tested for SC. Appendix E-10 shows that SC positives predominate in the same wards as positives for marijuana and PCP—Wards 6, 7, and 8**.** These results are reasonable given the earlier suggestion that use of these three drugs seem to occur together.

Weighted Combined Estimates for DC PSA Lockup. The results in Table 8 (p. 31) were presented separately for persons who tested positive or negative by the PSA screen because we had purposefully oversampled specimens that had tested positive. We used the published PSA monthly statistics indicating the percentage of persons in PSA Lockup that had tested positive by their routine screen near the time from which the CDEWS specimens were collected. We used this percentage to compute an estimate of the CDEWS drug test results had we not oversampled drug positive specimens. Thus, while 67% of the specimens we collected from PSA Lockup had tested positive by the PSA screen, the true naturally-occurring percentage would be approximately 29%. After weighting our sample so that drug positive specimens represented 29% of our sample, we estimate that about 20% of all persons tested positive for marijuana, 13% for cocaine, and 10% for PCP. The full table of weighted estimates appears in Table 17 (p. 40).

Study Limitations

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

CDEWS obtains samples of urine specimens that have already been collected 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. (Perhaps the only exception to this characterization in the current study is the sample of arrestees in the DC PSA Lockup, who presumably did not expect to be arrested and tested.) 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. Never the less, drug trends in high risk criminal justice populations often foreshadow trends that appear later in the general population (DuPont and Wish, 1992).

The CDEWS model depends on rapidly and inexpensively collecting a small number of specimens that had tested positive or negative by the CJS agency's routine drug screen. We do not know whether these small samples are representative of all persons tested in the participating CJS populations. Every attempt was made to randomly select from the specimens available that met our selection criteria. 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.

Another limitation to this study was that due to the cost of the SC panel, we were able to test only a subset of the collected specimens for SC. If we had tested all of our specimens for SC, our estimates would have been based on a preferably larger number of specimens. We also would have liked to test the specimens for cathinones, or "bath salts," another likely emerging drug of abuse.

Our study's 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 is doing so under medical supervision, for self-medication, or to get high. Nor can we tell 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 users and, most importantly, the local communities where one might wish to pursue greater information about a particular emerging drug's availability and use.

Conclusions and Discussion

Six Key Conclusions

1. The CDEWS model can be implemented in both small and large sites and a variety of populations. CDEWS was successfully tested in new sites in Washington, DC; Chesterfield, Virginia; and Prince George's County, Maryland, with a variety of criminal justice populations, including arrestees, probationers, persons under pretrial supervision, and drug court participants. After obtaining the necessary approvals, the selection and collection of specimens proceeded rapidly and smoothly. In general, sites needed two months or less to accumulate sufficient specimens and CESAR staff spent three days or less at each site collecting and processing the specimens. In addition, for the first time specimens were successfully collected from a site that used on-site dipstick tests, expanding the types of programs that could participate in CDEWS.

2. In a diverse set of criminal justice populations we have found that the additional drugs included in the expanded CDEWS screen were found mainly in persons who had tested positive for one of the drugs in the routine, more limited, screens used by the CJS testing programs. The additional drugs were rarely found in persons who had tested negative for all of the drugs in the CJS screen. The CDEWS approach of oversampling CJS positive specimens appears to be justified for the mission of detecting newer or less common drugs that may be increasing in use.

3. However, we did find an important exception to the above with synthetic cannabinoids (SC). **For the first time, we found a drug that was as likely to be found in persons who failed the limited CJS screen as in persons who had passed. In other words, current drug testing screens which do not test for SC are likely to be missing significant drug use (and users) in the populations they monitor.** One possibility is that persons who know they will be tested use SC because they know that the drug is not included in most test panels (Perrone et al. 2013).

4. CJS drug testing programs need a process that enables them to frequently update their test panels to detect emerging drugs. The CDEWS model demonstrated the unique ability to adapt rapidly to emerging drugs of abuse. With very little notice after the CDEWS study was already underway, we were able to request that the CDEWS laboratory expand their test panel for SC. On the advice of the CDEWS laboratory staff, we added two new SC metabolites (XLR-11 and UR-144) to our planned ten metabolite screen just before we shipped the specimens. These were two new metabolites that the federal government added to the federal list of controlled dangerous substances during this study (DEA 2013a). **Had we not tested for these 2 metabolites, only 5 specimens, rather than 118, would have tested positive for SC**. The makers of SC developed new metabolites as the usual ones were made illegal. One of them, XLR-11, was the metabolite recently reported by the CDC as having possible involvement in acute kidney injury in emergency department admissions in six states (CDC 2013).

5. As expected, SC was most likely to be detected in younger men. What was not expected was the level of use that we found. **Regardless of whether they had failed or passed the routine CJS limited drug screen, between one-quarter and one-third of young men in the populations we studied in DC tested positive for SC.** While the numbers were based on small sample sizes, we also found evidence of SC use in specimens from probationers in Chesterfield, Virginia, and drug court participants in Prince George's County. Thus, SC was detected in all of the criminal justice populations studied.

6. Additional illustrative analyses of the data from the three DC criminal justice populations provided clues for understanding who is using the detected drugs. For example, we found that PCP, marijuana, and SC were likely to be found in the same specimens and in younger persons. In fact, 34% of the specimens from the DC populations that contained PCP also contained marijuana. Our analyses of drug test results and the DC residence of persons providing the specimens identified areas of the city where certain drugs appeared more prominent and where additional information about specific drugs might be collected.

Implications and Next Steps for CDEWS

Our experience planning and implementing CDEWS in these three sites leads us to suggest the following implications, lessons learned, and next steps for the future development of CDEWS.

Implications of CDEWS Findings

- CJS drug testing programs should weigh the value of adding SC metabolites to their testing protocols. 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.
- All of the specimens that were tested for SC metabolites were positive for UR-144 and/or XLR-11. XLR-11 is the metabolite that may be implicated in acute kidney injury (CDC 2013). The CDEWS model is based on evidence that trends in arrestee urinalysis results can provide advance warning of emerging drugs in the larger community (Wish 1997; DuPont and Wish 1992). Given the amount of SC found in the CJS populations we studied, it is imperative that local public health systems conduct prevention campaigns to educate the public, and especially youth and young adults, about the lack of understanding of the chemicals included in products sold as "synthetic marijuana" and the potential harm that can result from its use.
- CJS drug testing programs should consider adopting an annual CDEWS type of process for reviewing and updating the drugs included in their testing protocols. This could include contacting local and national testing experts or conducting expanded testing on a sample of specimens to check for drugs that may be being missed by current screens.

- While we sampled only criminal justice populations here, the CDEWS results may also have implications for expanded testing of urine specimens collected in hospital, physician, military, and workplace environments to accurately identify drugs recently used.

Additional Lessons Learned for Implementing CDEWS **(see also Appendix G)**

- It is important at the beginning of a CDEWS study to work with toxicologists, chemists, and all participating sites to develop the initial testing panel. Moreover, to ensure the detection of emerging drugs such as SCs, it is essential to communicate regularly throughout the study to update testing panels as necessary. Given that the test panels may be refined or expanded during the study, it is important to retain all specimens even after testing is complete to allow for any additional testing for unanticipated drugs.
- Drug test panels used in future CDEWS specimen collections might include additional synthetic drugs such as synthetic cathinones (bath salts), acetyl fentanyl, and others for which use may be increasing across the country.

Next Steps for Implementing CDEWS

- The CDEWS specimen collection should be repeated in one or more of the DC criminal justice populations we studied to assess if the same SC metabolites identified are still being used and to determine if new metabolites are emerging.
- New sites should also be considered for inclusion in future CDEWS studies. Indicators such as the DEA's NFLIS should be reviewed to identify future CDEWS sites in which to test for emerging drugs. For example, in 2010, the states with the highest number of NFLIS reports positive for SC were North Dakota, Louisiana, and Kansas. The states with the highest number of reports positive for synthetic cathinones were Texas and Arkansas (DEA 2011a). These might be excellent sites in which to implement CDEWS.
- The results from the current study can be used to target interviews with persons under criminal justice supervision who live in areas of the District of Columbia from where many of the SC positive specimens came. These interviews can collect critically needed information about the use and availability of SC.
- The CDEWS model could also be expanded to study emerging drugs outside of criminal justice populations For example, hospitals, pain clinics, drug treatment programs, and military departments that routinely collect urine specimens could serve as good venues for implementing the CDEWS methodology.

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Tables

Table 1: The Friends 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	300 ng/mL
Methadone Metabolite	300 ng/mL
Opiates	300 ng/mL
Oxycodone	100 ng/mL
PCP	25 ng/mL
THC	50 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), September 2013.

Table 2: Synthetic Cannabinoid Metabolites Included in CDEWS 2013 Drug Testing Panel

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*

Notes*:* 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. Detection limits vary between 0.2 and 0.5ng/ml using 0.1ml of urine.

*Three new synthetic cannabinoids were recently put on temporary scheduling by DEA. Two of the three (UR-144 and XLR-11) were included in the CDEWS testing panel. One (AKB-48) was not included in the CDEWS testing panel because it was not available for testing at the time of the study.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 3: Number of CJS Positive and Negative Specimens Sampled from Each Population and Subsample Tested for Synthetic Cannabinoids (SC)

Site and Population	CJS Test Result			Subset Tested for SC
	Positive	*Negative*	*Total*	
Washington, DC - Pretrial Services Agency for the District of Columbia				
Parole & Probation	197	103	300	156
Pretrial Surveillance	200	100	300	164
Lockup	200	100	300	162
Virginia - Chesterfield Community Corrections Services				
Probation	37	67	104	58
Maryland - Prince George's County Drug Court				
Drug Court	16	44	60	51
Total	650	414	1064	591

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 4: Urine Specimen Collection Date Range, by Site and CJS Drug Screen Result

Site	Specimen Collection Date Range	
	Positive	*Negative*
Washington, DC - Pretrial Services Agency for the District of Columbia		
Parole & Probation	11/21/2012-11/29/2012	1/14/2013-1/15/2013†
Pretrial Surveillance	12/17/2012-1/3/2013	2/5/2013-2/7/2013
Lockup	12/28/2012-2/16/2013	2/23/2013-3/11/2013
Virginia - Chesterfield Community Corrections Services		
Probation	3/5/2013-3/11/2013	3/5/2013-3/11/2013
Maryland - Prince George's County Drug Court		
Drug Court	12/10/2012-3/28/2013	3/5/2013-4/1/2013*

†Two parole and probation specimens were collected on 11/23/12.

*One drug court specimen was collected on 12/27/12.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 5: Demographic Characteristics of CDEWS Specimens for Three DC CJS Populations, by PSA Drug Screen Result
(N=900 specimens from Washington, DC Parole & Probation, Pretrial Surveillance and Lockup)

	Parole & Probation		Pretrial Surveillance		Lockup	
	PSA Screen Positive (N=197)	*PSA Screen Negative (N=103)*	*PSA Screen Positive (N=200)*	*PSA Screen Negative (N=100)*	*PSA Screen Positive (N=200)*	*PSA Screen Negative (N=100)*
Gender						
Male	85%	90%	70%	83%	81%	78%
Age						
20 and younger	6%	2%	5%	10%	5%	16%
21 to 25	14	20	6	22	14	33
26 to 30	17	17	14	8	16	11
31 to 40	20	25	24	23	25	17
41 to 50	20	20	22	18	23	17
51 and older	23	16	30	19	18	6
Residence*						
DC – Ward 1	7%	7%	3%	3%	3%	4%
DC – Ward 2	9	4	8	3	7	9
DC – Ward 3	0	1	0	0	<1	0
DC – Ward 4	8	14	9	7	6	1
DC – Ward 5	14	22	21	18	16	19
DC – Ward 6	5	2	4	3	3	1
DC – Ward 7	18	10	15	11	16	11
DC – Ward 8	31	31	23	25	17	21
Maryland	8	9	18	26	19	13
Virginia	<1	0	1	3	4	4
Other States	<1	0	0	1	2	0
Unknown	0	1	<1	0	9	17

Notes: Pretrial Services Agency for the District of Columbia (PSA) tested the Pretrial Surveillance and Lockup populations for cocaine, opiates, amphetamines, PCP and 6-acetylmorphine (6-AM) (some individuals were also tested for marijuana, methadone, and/or ethanol) and tested the Parole & Probation population for marijuana, cocaine, opiates, amphetamines, and PCP (some individuals were also tested for methadone and/or ethanol). PSA positive specimens were oversampled and results were stratified by gender, age, and PSA test result. Therefore, separate estimates for the "PSA Screen Positive" and the "PSA Screen Negative" categories should not be averaged to create an overall estimate. The "PSA Screen Positive" category includes some samples that were positive for ethanol only (Lockup: 1 sample; Pretrial Surveillance: 3 samples; Parole & Probation: 18 samples). Amphetamine-positive specimens were inadvertently excluded from the sample selected from PSA.

Percentages may not sum to 100% in each demographic category due to rounding.

*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; Unknown: no data on residence.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 6: Demographic Characteristics of CDEWS Specimens for Chesterfield Community Corrections Services, by CJS Drug Screen Result
(N=102 specimens*)

	CJS Screen Positive (N=36)	*CJS Screen Negative (N=66)*
Gender		
Male	64%	74%
Age		
Under 30	72%	73%
30 to 39	17	21
40+	11	6

Notes: Chesterfield Community Corrections Services tests the probation population using either a 6-panel (marijuana, opiates, cocaine, benzodiazepines, oxycodone and methamphetamine) or a 12-panel screen (marijuana, opiates, cocaine, benzodiazepines, oxycodone, methamphetamine, amphetamines, methadone, PCP, MDMA, barbiturates and propoxyphene) depending on the charge of the individual. Positive specimens were oversampled and results were stratified by gender, age, and CJS screen result. Therefore, separate estimates for the "CJS Screen Positive" and "CJS Screen Negative" categories should not be averaged to create an overall estimate.

*A total of 104 specimens were collected but only 102 had demographic information.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 7: Demographic Characteristics of CDEWS Specimens for Prince George's County Drug Court Population, by CJS Drug Screen Result
(N=60 specimens)

	CJS Screen Positive (N=16)	*CJS Screen Negative (N=44)*
Gender		
Male	100%	86%
Age		
20	0%	2%
21 to 25	0	16
26 to 30	19	21
31 to 40	38	25
41 to 50	19	23
51 and older	25	14
Residence		
Prince George's County	100%	

Notes: Prince George's County Drug Court tests the drug court population using a 4-panel drug screen on all specimens. Specimens are tested for any combination of four of the following substances: marijuana, cocaine, PCP, opiates, and ethanol. Positive specimens were oversampled and results were stratified by gender, age, and CJS screen result. Therefore, separate estimates for the "CJS Screen Positive" and "CJS Screen Negative" categories should not be averaged to create an overall estimate.

Percentages may not sum to 100% in each demographic category due to rounding.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 8: CDEWS Laboratory Test Results for Three DC CJS Populations, by PSA Drug Screen Result

(N=900 specimens collected from Washington, DC Lockup, Pretrial Surveillance, and Parole & Probation)

	Lockup		Pretrial Surveillance		Parole & Probation	
Percent Positive by CDEWS Lab for:	PSA Screen Positive (for any drug) (N=200)	PSA Screen Negative (for any drug) (N=100)	PSA Screen Positive (for any drug) (N=200)	PSA Screen Negative (for any drug) (N=100)	PSA Screen Positive (for any drug) (N=197)	PSA Screen Negative (for any drug) (N=103)
Marijuana	36%	14%	20%	21%	28%	0%
Cocaine	44	0	26	0	16*	0
PCP	35	0	35	0	10	0
Opiates	25	1	26	0	25	1
Morphine^	24	1	24	0	22	1
Codeine^	21	1	21	0	21	1
Buprenorphine‡	6	3	14	5	13	0
Methadone	3	1	7	2	11	2
Oxymorphone	6	0	5	2	5	0
Oxycodone	5	0	5	2	5	0
Benzodiazepines	4	5	3	1	1	1
Hydromorphone	3	0	4	0	3	0
Hydrocodone	2	0	2	0	2	0
Tramadol	2	0	2	0	1	0
Ativan/Dalmane	1	2	0	0	0	0
Barbiturates	2	0	0	0	0	0
Dextromethorphan	2	0	0	0	0	0

Notes: Drugs tested for but not detected in any specimen in any DC criminal justice population: Demerol, Dilaudid, Doxepin, ephedrine, hydroxyzine, ketamine, MDA, MDEA, MDMA, methamphetamine, naloxone, phenmetrazine, phenothiazines (as a family), phentermine, or pseudoephedrine. Drugs detected in 1% or less of specimens in at least one DC criminal justice population: clonazepam, Valium, and amitriptyline/nortriptyline. Amphetamines were not detected in any specimen because amphetamine-positive specimens were inadvertently excluded from the sample selected from PSA.

Pretrial Services Agency for the District of Columbia (PSA) tested the Pretrial Surveillance and Lockup populations for cocaine, opiates, amphetamines, PCP and 6-acetylmorphine (6-AM) (some individuals were also tested for marijuana, methadone, and/or ethanol) and tested the Parole & Probation population for marijuana, cocaine, opiates, amphetamines, and PCP (some individuals were also tested for methadone and/or ethanol). PSA positive specimens were oversampled and results were stratified by gender, age, and PSA test result. Therefore, separate estimates for the "PSA Screen Positive" and the "PSA Screen Negative" categories should not be averaged to create an overall estimate. The "PSA Screen Positive" category includes some samples that were positive for ethanol only (Lockup: 1 sample; Pretrial Surveillance: 3 samples; Parole & Probation: 18 samples). Amphetamine-positive specimens were inadvertently excluded from the sample selected from PSA.

*124 specimens from Parole & Probation were screened for cocaine with a detection limit of 300 ng/ml instead of 150 ng/ml.

^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

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS) Project, September 2013.

Table 9: CDEWS Laboratory Test Results for the Chesterfield Probation Population, by VA 6- or 12-Drug Screen Result

(N=104 specimens collected from Chesterfield Community Corrections Services)

Percent Positive by CDEWS Lab for:	VA 6 or 12-Drug Screen	
	CJS Screen Positive (for any drug) (N=37)	CJS Screen Negative (for any drug) (N=67)
Marijuana	38%	2%
Opiates	30	2
Morphine*	24	0
Oxymorphone	24	0
Oxycodone	19	0
Hydromorphone	14	2
Benzodiazepines	14	0
Codeine*	14	0
Amphetamines	8	3
Buprenorphine‡	8	2
Hydrocodone	8	2
Methadone	5	5
Tramadol	3	2
Cocaine	3	0
Ativan/Dalmane	3	0
Amitriptyline/Nortriptyline	3	0
Barbiturates	0	3

Notes: Drugs tested for but not detected in any specimen: clonazepam, Demerol, dextromethorphan, Dilaudid, Doxepin, ephedrine, hydroxyzine, ketamine, MDA, MDEA, MDMA, methamphetamine, naloxone, PCP, phenmetrazine, phenothiazines (as a family), phentermine, pseudoephedrine and Valium. Propoxyphene was not tested for by the CDEWS laboratory.

Chesterfield Community Corrections Services tests the probation population using either a 6-panel (marijuana, opiates, cocaine, benzodiazepines, oxycodone and methamphetamine) or a 12-panel screen (marijuana, opiates, cocaine, benzodiazepines, oxycodone, methamphetamine, amphetamines, methadone, PCP, MDMA, barbiturates and propoxyphene) depending on the charge of the individual. Positive specimens were oversampled and results were stratified by gender, age, and CJS test result. Therefore, separate estimates for the "CJS Screen Positive" and "CJS Screen Negative" categories should not be averaged to create an overall estimate.

*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.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 10: CDEWS Laboratory Test Results for the Prince George's County Drug Court, by Drug Court 4-Drug Screen Result

(N=60 specimens collected from Prince George's County Drug Court)

Percent Positive by CDEWS Lab for:	Drug Court 4-Drug Screen	
	CJS Screen Positive (for any drug) (N=16)	CJS Screen Negative (for any drug) (N=44)
Oxymorphone	19%	0%
Oxycodone	19	0
Opiates	13	2
Codeine*	13	0
Morphine*	13	0
Buprenorphine‡	6	2
Hydrocodone	6	2
Hydromorphone	6	2
Naloxone	6	2
Amitriptyline/Nortriptyline	6	0
Amphetamines	6	0
Marijuana	6	0
Methadone	0	5
Barbiturates	0	2
Tramadol	0	2

Notes: Drugs tested for but not detected in any specimen: Ativan/Dalmane, benzodiazepines, cocaine, clonazepam, Demerol, dextromethorphan, Dilaudid, Doxepin, ephedrine, hydroxyzine, ketamine, MDA, MDEA, MDMA, methamphetamine, PCP, phenmetrazine, phenothiazines (as a family), phentermine, pseudoephedrine and Valium.

Prince George's County Drug Court tests the drug court population using a 4-panel drug screen on all specimens. Specimens are tested for any combination of four of the following substances: marijuana, cocaine, PCP, opiates, and ethanol. Positive specimens were oversampled and results were stratified by gender, age, and test result. Therefore, separate estimates for the "Screen Positive" and "Screen Negative" categories should not be averaged to create an overall estimate.

*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. Two specimens (one CJS screen positive and one CJS screen negative) tested positive for naloxone.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 11: Percentage of Specimens Positive for Synthetic Cannabinoids (SC) in Each CJS Population, by CJS Screen Result, Age, and Gender

(N=591 Specimens Screened for SC)

CJS Population	**Age ≤30**				Age >30			
	Male		Female		Male		Female	
	CJS Screen Positive	*CJS Screen Negative*	*CJS Screen Positive*	*CJS Screen Negative*	*CJS Screen Positive*	*CJS Screen Negative*	*CJS Screen Positive*	*CJS Screen Negative*
	(N) %	(N) %	(N) %	(N) %	(N) %	(N) %	(N) %	(N) %
Washington, DC - Pretrial Services Agency for the District of Columbia								
Parole & Probation	(60) 37	(36) 39	(12) 8	(4) *	(13) 31	(14) 7	(11) 27	(6) *
Pretrial Surveillance	(39) 21	(36) 36	(10) 30	(4) *	(22) 0	(20) 25	(20) 10	(13) 8
Lockup	(25) 28	(25) 24	(16) 13	(12) 17	(26) 23	(25) 12	(23) 13	(10) 0
Virginia - Chesterfield Community Corrections Services								
Probation	(16)† 19	(20)† 20	(10)† 10	(12)† 0	NSS	NSS	NSS	NSS
Maryland - Prince George's County Drug Court								
Drug Court	NSS	(15) 13	NSS	NSS	(13) 0	(23) 4	NSS	NSS

*Too few cases to compute a valid estimate. DC Pretrial Surveillance Population: 1 positive was found for females age ≤30 with a negative CJS screen result. DC Parole & Probation Population: No positives were found for females with a negative CJS screen in either age category.

†Virginia Probation sample only includes persons < age 30.

Notes: CJS positive specimens were oversampled and results were stratified by gender, age and PSA test result. Therefore, separate estimates for the "CJS Screen Positive" and "CJS Screen Negative" groups should not be averaged to create an overall estimate.

NSS = No specimens selected or sent for testing.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 12: Mean Age of Persons Positive for Specific Drugs
(N=900 specimens collected from DC Lockup, Pretrial Surveillance, and Parole & Probation)

Percent Positive by CDEWS Lab for:	Average Age $\bar{x}$ (SD)
Synthetic Cannabinoids (n=107)	28.5 (8.5)
Marijuana (200)	31.0 (11.0)
PCP (158)	34.5 (10.4)
Oxymorphone (32)	39.9 (13.6)
Hydrocodone (11)	40.0 (13.1)
Hydromorphone (18)	40.2 (15.0)
Oxycodone (30)	41.3 (13.5)
Buprenorphine (72)	43.2 (13.5)
Benzodiazepines (23)	43.3 (11.5)
Opiates (152)	43.4 (12.7)
Morphine (141)	44.1 (12.5)
Codeine (127)	44.4 (12.3)
Cocaine (170)	46.4 (10.2)
Methadone (46)	50.2 (7.9)

Notes: Drugs tested for but not detected in any specimen in any DC criminal justice population: Demerol, Dilaudid, Doxepin, ephedrine, hydroxyzine, ketamine, MDA, MDEA, MDMA, methamphetamine, naloxone, phenmetrazine, phenothiazines (as a family), phentermine, or pseudoephedrine. Drugs detected in less than 10 cases: Ativan, amitriptyline/nortriptyline, barbiturates, clonazepam, dextromethorphan, Valium, and tramadol. Amphetamines were not detected in any specimen because amphetamine-positive specimens were inadvertently excluded from the sample selected from PSA.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 13: Other Drugs Found in Specimens Testing Positive by CDEWS Laboratory for Buprenorphine, Methadone or Oxycodone

(of All Specimens from Washington, DC Parole & Probation, Pretrial Surveillance and Lockup Populations)

Percent also Positive by CDEWS Lab for:	Buprenorphine Positive by CDEWS Lab (N=72)	Methadone Positive by CDEWS Lab (N=46)	Oxycodone Positive by CDEWS Lab (N=30)
Morphine	60%	54%	37%
Codeine	56	52	23
Cocaine	22	15	17
Marijuana	15	9	33
Buprenorphine	NA	13	13
PCP	8	2	17
Methadone	8	NA	3
Benzodiazepines	7	9	17
Oxycodone	6	2	NA
Oxymorphone	4	2	93*
Hydromorphone	4	4	17
Hydrocodone	3	2	13
Barbiturates	1	0	3
Tramadol	0	0	10
Ativan/Dalmane	0	0	7
Synthetic Cannabinoids	(N=28) 21‡	(N=11) 18‡	(N=13) 8‡

Note: Amphetamine-positive specimens were inadvertently excluded from the sample selected from PSA, which is why the table does not include a CDEWS estimate for this drug.

*Oxymorphone is a metabolite of oxycodone.

‡A subset of specimens were tested for synthetic cannabinoids. These included: 28 buprenorphine positives, 11 methadone positives and 13 oxycodone positives. The synthetic cannabinoid metabolites included in the separate screen were 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.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 14: Other Drugs Found in Specimens Testing Positive by CDEWS Laboratory for PCP
(of All Specimens from Washington, DC Parole & Probation, Pretrial Surveillance and Lockup Populations)

Percent also Positive by CDEWS Lab for:	PCP Positive by CDEWS Lab (N=158)
Marijuana	34%
Cocaine	6
Morphine	6
Buprenorphine	4
Codeine	4
Dextromethorphan	3
Oxycodone	3
Oxymorphone	3
Tramadol	2
Benzodiazepines	<1
Hydrocodone	<1
Hydromorphone	<1
Methadone	<1
Synthetic Cannabinoids	(N=86) 29*

Note: Amphetamine-positive specimens were inadvertently excluded from the sample selected from PSA, which is why the table does not include a CDEWS estimate for this drug.

*A subset of specimens were tested for synthetic cannabinoids. These included 86 PCP positives.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 15: Other Drugs Found in Specimens Testing Positive by CDEWS Laboratory for Marijuana, Synthetic Cannabinoids (SC) or Both

(N=210 specimens from Washington, DC Parole & Probation, Pretrial Surveillance and Lockup Populations Tested for Synthetic Cannabinoids)

Percent also Positive by CDEWS Lab for:	SC Only Positive by CDEWS Lab (N=85)	Marijuana Only Positive by CDEWS Lab (N=103)	Marijuana and SC Positive by CDEWS Lab (N=22)
PCP	22%	23%	27%
Marijuana	0	NA	NA
Cocaine	4	7	14
Codeine	8	7	5
Morphine	8	7	9
Buprenorphine	7	6	0
Oxymorphone	0	6	5
Oxycodone	0	5	5
Hydromorphone	1	1	5
Methadone	2	1	0
Benzodiazepines	0	1	0
Hydrocodone	1	1	5
Dextromethorphan	0	0	5
Tramadol	1	2	0
Synthetic Cannabinoids	NA	0	NA

Notes: Amphetamine-positive specimens were inadvertently excluded from the sample selected from PSA, which is why the table does not include a CDEWS estimate for this drug.

A subsample of these collected specimens was tested for synthetic cannabinoids. The synthetic cannabinoid metabolites included in the separate screen were 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.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Table 16: CDEWS Laboratory Test Results for Prescription Drugs for Three DC CJS Populations, by PSA Drug Screen Result

(N=900 specimens collected from Washington, DC Lockup, Pretrial Surveillance, and Parole & Probation)

	Lockup		Pretrial Surveillance		Parole & Probation	
Percent Positive by CDEWS Lab for:	PSA Screen Positive (for any drug) (N=200)	PSA Screen Negative (for any drug) (N=100)	PSA Screen Positive (for any drug) (N=200)	PSA Screen Negative (for any drug) (N=100)	PSA Screen Positive (for any drug) (N=197)	PSA Screen Negative (for any drug) (N=103)
Buprenorphine*	6	3	14	5	13	0
Oxymorphone	6	0	5	2	5	0
Oxycodone	5	0	5	2	5	0
Benzodiazepines	4	5	3	1	1	1
Hydromorphone	3	0	4	0	3	0
Hydrocodone	2	0	2	0	2	0
Tramadol	2	0	2	0	1	0
Ativan/Dalmane	1	2	0	0	0	0
Barbiturates	2	0	0	0	0	0
Dextromethorphan	2	0	0	0	0	0
Clonazepam	0	1	0	0	0	0
Valium	0	1	0	0	0	0
Amitriptyline/Nortriptyline	0	0	0	1	0	0
Any of the above	17	7	23	9	19	1

Notes: Drugs tested for but not detected in any specimen in any DC criminal justice population: Demerol, Dilaudid, Doxepin, ephedrine, hydroxyzine, ketamine, MDA, MDEA, MDMA, methamphetamine, naloxone, phenmetrazine, phenothiazines (as a family), phentermine, or pseudoephedrine. Amphetamines were not detected in any specimen because amphetamine-positive specimens were inadvertently excluded from the sample selected from PSA.

Pretrial Services Agency for the District of Columbia (PSA) tested the Pretrial Surveillance and Lockup populations for cocaine, opiates, amphetamines, PCP and 6-acetylmorphine (6-AM) (some individuals were also tested for marijuana, methadone, and/or ethanol) and tested the Parole & Probation population for marijuana, cocaine, opiates, amphetamines, and PCP (some individuals were also tested for methadone and/or ethanol). PSA positive specimens were oversampled and results were stratified by gender, age, and PSA test result. Therefore, separate estimates for the "PSA Screen Positive" and the "PSA Screen Negative" categories should not be averaged to create an overall estimate. The "PSA Screen Positive" category includes some samples that were positive for ethanol only (Lockup: 1 sample; Pretrial Surveillance: 3 samples; Parole & Probation: 18 samples). Amphetamine-positive specimens were inadvertently excluded from the sample selected from PSA.

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

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS) Project, September 2013.

Table 17: Weighted and Unweighted CDEWS Drug Test Results for DC Lockup Population
(N=300 specimens collected from Washington, DC Lockup Population)

Percent Positive by CDEWS Lab for:	Unweighted		Weighted Combined Sample Estimate (for all specimens) (N=300)
	PSA Screen Positive (for any drug) (N=200)	PSA Screen Negative (for any drug) (N=100)	
Marijuana	36%	14%	20%
Cocaine	44	0	13
PCP	35	0	10
Opiates	25	1	8
Morphine*	24	1	8
Codeine*	21	1	7
Buprenorphine‡	6	3	4
Methadone	3	1	1
Oxymorphone	6	0	2
Oxycodone	5	0	2
Benzodiazepines	4	5	5
Hydromorphone	3	0	<1
Hydrocodone	2	0	<1
Tramadol	2	0	<1
Ativan/Dalmane	1	2	2
Barbiturates	2	0	<1
Dextromethorphan	2	0	<1

Notes: Drugs tested for but not detected in any specimen in any DC lock-up sample: Demerol, Dilaudid, Doxepin, ephedrine, hydroxyzine, ketamine, MDA, MDEA, MDMA, methamphetamine, naloxone, phenmetrazine, phenothiazines (as a family), phentermine, or pseudoephedrine. Drugs detected in 1% or less of PSA positive or negative specimens were deleted from table: amitriptyline/nortriptyline, clonazepam, and Valium.

*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.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS) Project, September 2013.

Appendices

Appendix A: Site Selection Procedures

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

1. *Prince George's County Drug Court*

This site was of interest to the study as it was the first opportunity to test the CDEWS methodology using a drug court population. This site was using both on-site testing and laboratory testing. However, since all specimens were being routinely tested by the county laboratory, we collected all samples from their laboratory. 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. Approval took approximately 6 months. The University of Maryland (UM) Institutional Review Board (IRB) application was then submitted and approved. Data collection was completed on one day approximately one month following approval by the Prince George's County Drug Court. This one-month period was used to accumulate specimens for collection by CESAR.

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

This site was identified because PSA had access to a high volume of specimens from three CJS populations (parole/probation, pretrial surveillance, lockup) in the District of Columbia. 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 no duplicate specimens were sampled and also to collect demographic data. The demographic data obtained for specimens from this site were year of birth, gender, and zip code of residence. In order to obtain approval for the research study, we had to follow a formal approval process similar to the process followed in Maryland in earlier studies. We met with both PSA laboratory staff and administrators to discuss the testing protocol being used by PSA, to further understand the research study approval process, and to address questions raised by PSA staff. Follow-up calls with laboratory staff were necessary to clarify their testing procedures and prepare and submit the research application to the PSA/CSOSA research committee. A conference call was then held with PSA staff to address questions on the research application. PSA staff also provided us with written comments that were used to revise the application, which was then resubmitted and approved. The total process for approval took approximately four and one-half months. The UM IRB application was then submitted and approved and a MOU was executed. The first data collection took place approximately one month following approval from the PSA research committee (after specimens were accumulated and prepared for CESAR to collect). Data collection was completed in three days over the course of approximately two months.

3. Chesterfield Community Corrections Services (CCCS): Chesterfield Probation

This site was of particular interest for the study given that it was a community probation office supervising offenders from six court programs and the only site recruited that was conducting on-site testing. Specimens being collected at this site are tested using a dipstick for a 6- or 12-drug panel. The CDEWS methodology had not yet been tested on a site conducting on-site testing. Further, it was the first time that the CDEWS methodology had been tested in Virginia. This site had multiple programs reporting for urine specimen collection. We selected two of the highest volume programs, the General District Court/Circuit Court and Domestic Court. Each of these programs collects specimens from probationers assigned to Chesterfield Community Corrections Services. The approval process for this site was relatively rapid. It involved multiple phone and email communications to understand the testing procedures being used by this site and a review of recent test results. Following this, an overview of the proposed methods was sent for review. Approvals for data collection were received quickly. The approval process for this site took approximately 3 months. An UM IRB application was then submitted and approved. Upon initiation, data collection was completed over two testing days within less than a month.

Time to Obtain Approval and Collect Specimens On-Site

Site	Time to Obtain Approval	Researcher Time On-Site Collecting Specimens
District of Columbia: Pretrial Services Agency (PSA) for the District of Columbia	4.5 months	3 days
Chesterfield Probation: Chesterfield Community Corrections Services	3 months	2 days
Prince George's County Drug Court	6 months	1 day

Appendix B: Collection of Urine Specimens

Maryland - Prince George's County Drug Court

The Prince George's County Drug Court processes approximately 25,000 urine specimens per year from drug court participants. Over the period of approximately two months (March 2013 to April 2013), staff at the Prince George's County Department of Corrections Drug Monitoring Laboratory (Butler lab) retained leftover urine specimens while administering their normal testing protocol. A small number of older specimens dating back to December 2012 were also included in the sample since they were available. Specimens are routinely tested by Butler lab for a panel of four drugs (consisting of some combination of marijuana, cocaine, PCP, opiates and ethanol). Specimens that had tested with creatinine levels of less than 20 mg/dL during their standard screen were eliminated from the sample. Butler lab staff set aside specimens from the Drug Court program and separated them by test result (drug positive or negative). All specimens were refrigerated prior to sampling by CESAR (with the exception of a small number of specimens sampled from December 2012 to January 2013 which were not refrigerated prior to the study period). After the required specimen holding period expired (30 days for positives; no holding period for negatives), CESAR staff visited the laboratory to conduct sampling.

At the time of sampling, Drug Court staff provided CESAR staff with a paper list of all drug court participants, including names, year of birth, gender and zip code of residence for each individual. Urine specimens were labeled with the name of the individual who provided the specimen, which was matched against this list to ensure that only one (the most recent) specimen was obtained for each individual. As each individual was checked off the list, their respective demographics from the paper document were entered into a database and a non-identifiable study ID was assigned for each specimen. The specimen collection date that was present on the label was also recorded. Names were not recorded in the database. Given that the specimens had already been divided into positives and negatives by the Butler lab staff, CESAR staff selected as many unduplicated positives as possible and took the remainder of specimens from the negatives. Using data on the label, CESAR staff confirmed that each specimen was from the Adult Drug Court program. After each sample was selected, all existing identifiers were marked out from the specimen cup label in black ink and CESAR staff 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. Specimens were then packaged and refrigerated for pickup by Friends Medical Laboratory laboratory.

We initially anticipated collecting approximately 100 unique specimens from the Prince George's County Adult Drug Court program. However, given that some program participants were not submitting urine specimens during the study period for reasons such as enrollment in inpatient drug treatment, jail, etc., we were only able to collect 60 unique specimens. Drug Court staff indicated that this included most current participants. One round of sampling was sufficient for sampling, with 100% of the sample (n=60) obtained in the first round. Two research staff participated in the sampling, which took approximately three hours to complete.

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

The Pretrial Services Agency (PSA) for the District of Columbia processes more than 800,000 urine specimens per year. Over the period of approximately four months (November 2012 to March 2013), staff at the PSA laboratory accumulated specimens for three populations (parole/probation, pretrial surveillance and lockup) for inclusion in the study. Specimens were accumulated for one group at a time, starting with parole/probation and completing the study with the lockup group. 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. Specimens at PSA are routinely tested for cocaine, opiates, amphetamines, PCP, 6-AM (a metabolite of heroin used to definitively assess heroin use, collection of which was started after the CDEWS study began) and creatinine. Some of their specimens are also tested for marijuana, methadone and ethanol. Amphetamines were not detected in any specimen selected for CDEWS because amphetamine positive specimens were inadvertently excluded from the specimens provided by PSA.

A minimum of 300 specimens (200 positives and 100 negatives) that were ready to be discarded were selected for each group by PSA staff. Approximately 25 extra positive and 25 extra negative specimens were also selected in the event of duplicate specimens or specimens found to contain an insufficient volume of urine at the time of sampling. All specimens were refrigerated prior to sampling by CESAR.

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 for a group, the database for that group was sent to the IT department at PSA for duplicate checking and so that demographic data for each individual specimen could be added to the file. Using the Police Department Identification Number (PDID) for each individual, the IT department eliminated any duplicates from the sample. When duplicate PDID's were identified, PSA staff selected the most recent specimen collected from that individual which also contained an adequate quantity of urine for expanded testing (30 ml). Specimen collection date, population group (parole/probation, pretrial, etc.), 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 (1-900). Any specimens with creatinine levels of less than 20 ng/mL[2] 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

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

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 Friends Medical Laboratory, such as 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 Medical Laboratory. 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.

Our target sample was approximately 900 specimens; 300 for each population group. This number was obtained as expected. Three rounds of sampling were conducted with 300 specimens (1 population) collected during each site visit. Two CESAR research staff participated in each round of sampling, which took approximately seven to eight hours per round.

Chesterfield Community Corrections Services (CCCS) – Chesterfield Probation

Chesterfield Community Corrections Services (CCCS) processes more than 14,000 urine specimens per year. CCCS was a unique site, as this site was the only participating site in the study that was conducting on-site testing. Their routine testing includes screening with either a 6- or 12-panel dip device. The 6-panel dip included screening for cocaine, marijuana, opiates, methamphetamines, benzodiazepines and oxycodone. The 12-panel dip included cocaine, marijuana, opiates, amphetamines, methamphetamines, PCP, benzodiazepines, barbiturates, methadone, MDMA, oxycodone and propoxyphene (not screened for by Friends Medical Laboratory). The 6-panel test is conducted on most individuals, with felony deferred cases receiving the 12-panel tests. Two high volume testing dates were selected (3/5/13 and 3/11/13) for sampling as CCCS staff indicated that most probationers currently being monitored would be called in for testing on one of these two dates. We collected specimens from two of their programs: General District Court/Circuit Court and Domestic Court.

On each testing date, a single tester conducted the dip tests on all screened individuals. The results were then recorded by the tester on a form. Using these forms, CCCS staff participating in the study identified specimens for inclusion in the study. CCCS retains only specimens for individuals disputing their drug test results, thus all other specimens were included in the study. CCCS selected as many positive specimens as possible, supplying the remainder of specimens for the study from the negatives. Only one specimen was selected from any individual for inclusion in the study. All specimens were capped and a label supplied by CESAR staff was adhered to each cup. No identifying information or ID number was included on the label. The label contained check boxes to identify the gender, age range, program the offender is enrolled in, test panel conducted, and whether the results were positive for any drug on their 6- or 12-panel screens or negative for all drugs. For this population, we included only three age ranges to reduce the likelihood of later identification of participants using age data. The label also contained administrative testing codes required by Friends Medical Laboratory, our outside testing laboratory. After the completed label was affixed to the bottle, the offender was asked to place the specimen in a sealed plastic bag for shipping. All

specimens were packaged in large FedEx specimen mailers and sent the next day to Friends Medical Laboratory for testing.

Upon receipt of the specimens by Friends Medical Laboratory, each cup was assigned a study ID by Friends staff. These study IDs were then used to report results on each specimen to CESAR. After testing by Friends Medical Laboratory was complete, two CESAR research staff visited Friends laboratory to record the study IDs and demographic data from each specimen cup label into a database. The process took approximately two hours. Drug test results were then linked to this data using the study IDs.

We anticipated collecting approximately 100 unique specimens from the CCCS program. We were able to collect 104 specimens from their two participating programs. However, only a limited number of positives were available for sampling. Two rounds of sampling were sufficient, with 63% of specimens collected on the first testing date and 37% of specimens collected on the second. Of all specimens collected (n=104), 27% were from the Domestic Court Program and 73% were from the General District Court Program.

Table 3 (p. 23) provides a full breakdown of the specimens selected from each of these sites.

Appendix C: Selection of Specimens Tested for SC

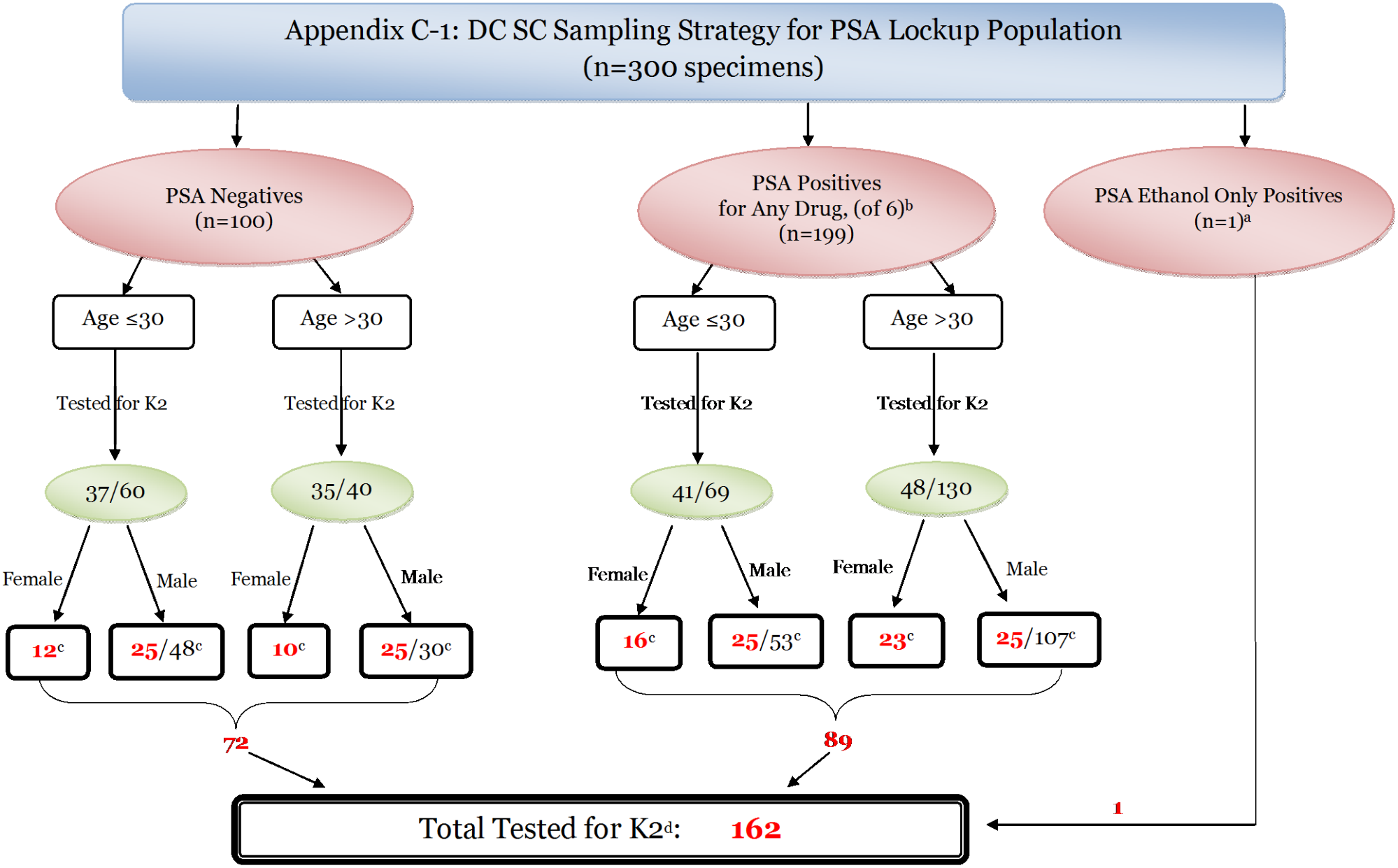
C-1: DC K2 Sampling Strategy for PSA Lockup Population

C-2: DC K2 Sampling Strategy for PSA Pretrial Population

C-3: DC K2 Sampling Strategy for CSOSA Parole and Probation Population

C-4: K2 Sampling Strategy for Virginia Community Probation Population

C-5: K2 Sampling Strategy for Prince George's County Drug Court Population

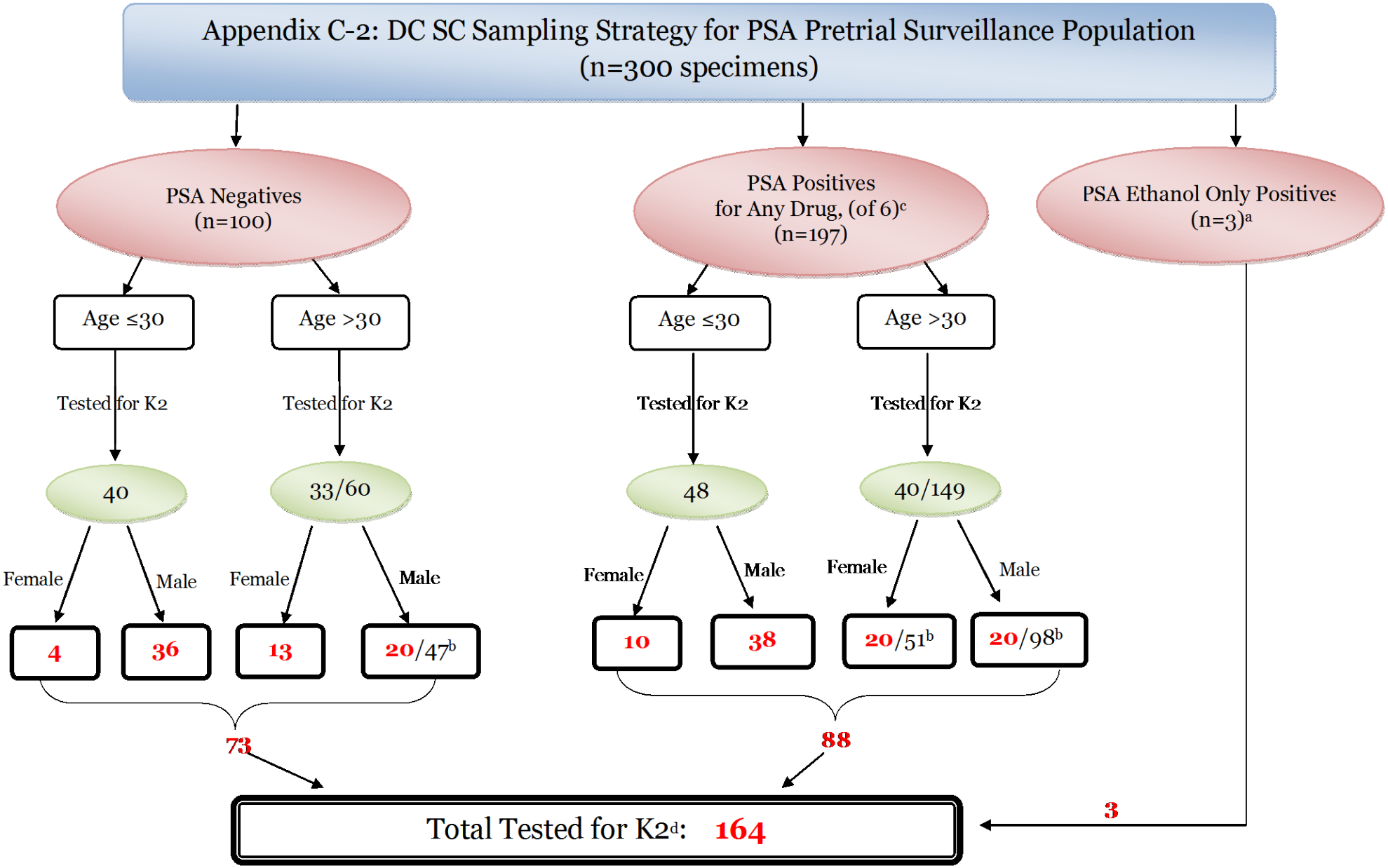


a: Ethanol only positives: males age >30=1.

b: Substances tested for by PSA include cocaine, opiates, amphetamines, PCP and 6-acetylmorphine (6-AM). Some, but not all, individuals in the sample were tested by PSA for marijuana, methadone, and ethanol.

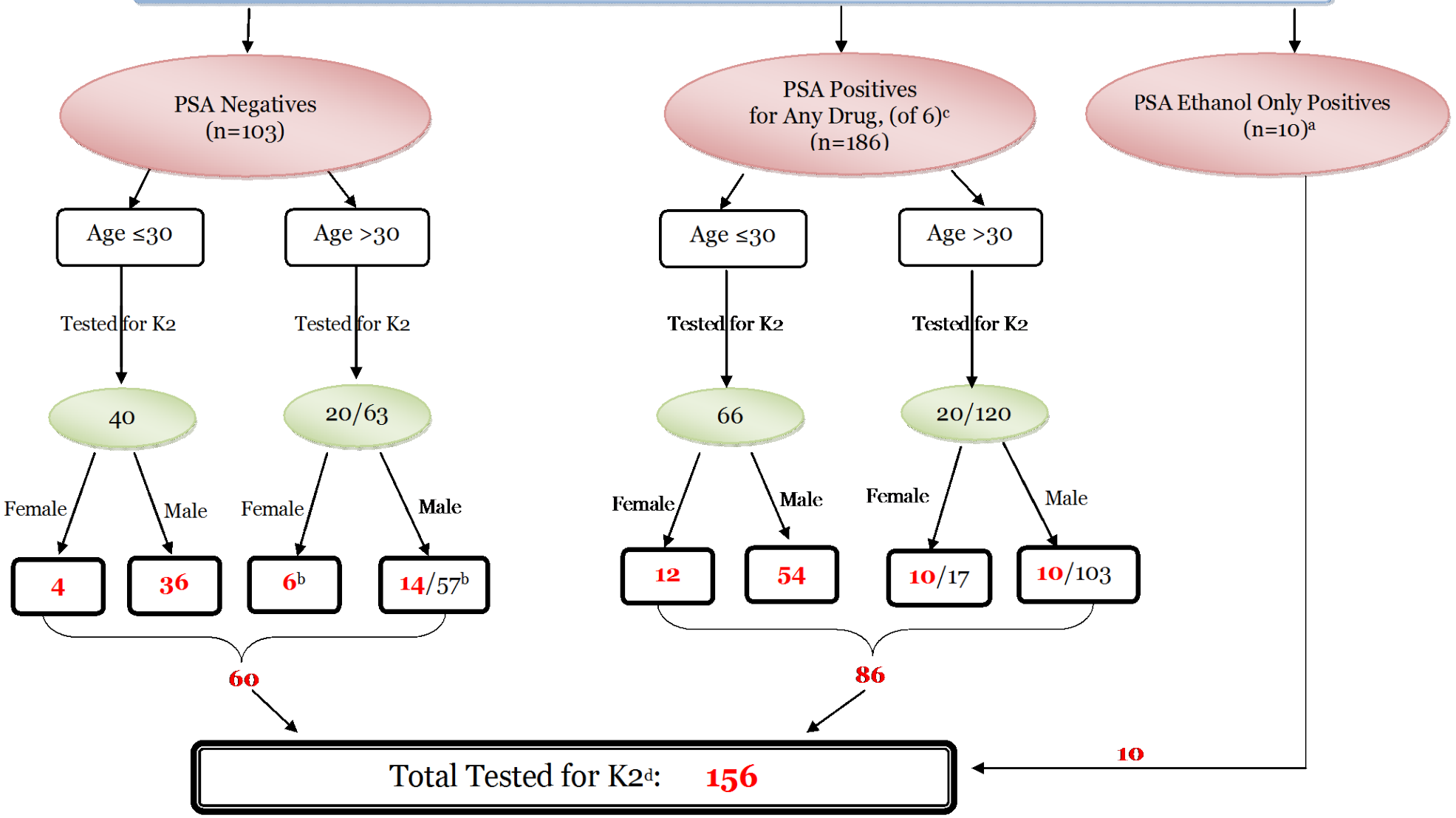
c: Selected all specimens from female subgroups. 25 specimens were randomly selected from all male subgroups.

d: K2 testing detected the following 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



a: Ethanol only positives: males age ≤30=1; males age >30=2.
b: Selected all specimens from persons age ≤30. For persons age >30, selected up to 20 specimens for each male and female subgroup, if available. 20 specimens were randomly selected from subgroups containing more than 20 specimens.
c: Substances tested for by PSA include cocaine, opiates, amphetamines , PCP and 6-acetylmorphine (6-AM). Some, but not all, individuals in the sample were tested by PSA for marijuana, methadone, and ethanol.
d: K2 testing detected the following 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.

Appendix C-3: DC SC Sampling Strategy for CSOSA Parole & Probation Population (n=300 specimens)

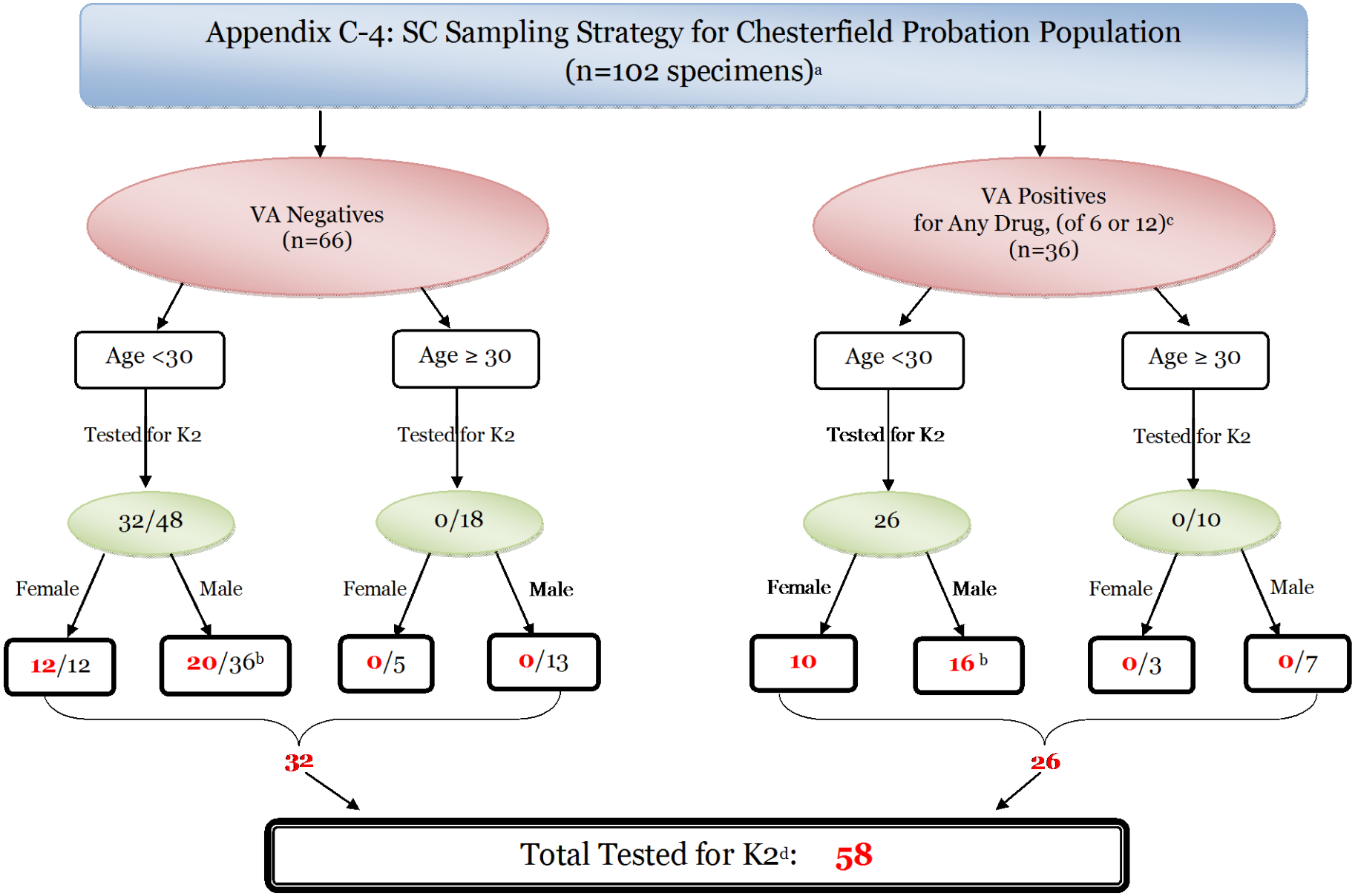


a: Ethanol only positives: males age ≤30=6; females age >30=1; males age >30=3. One additional specimen that was part of the original sample of males age > 30 ethanol only positive group was missing and could not be tested.

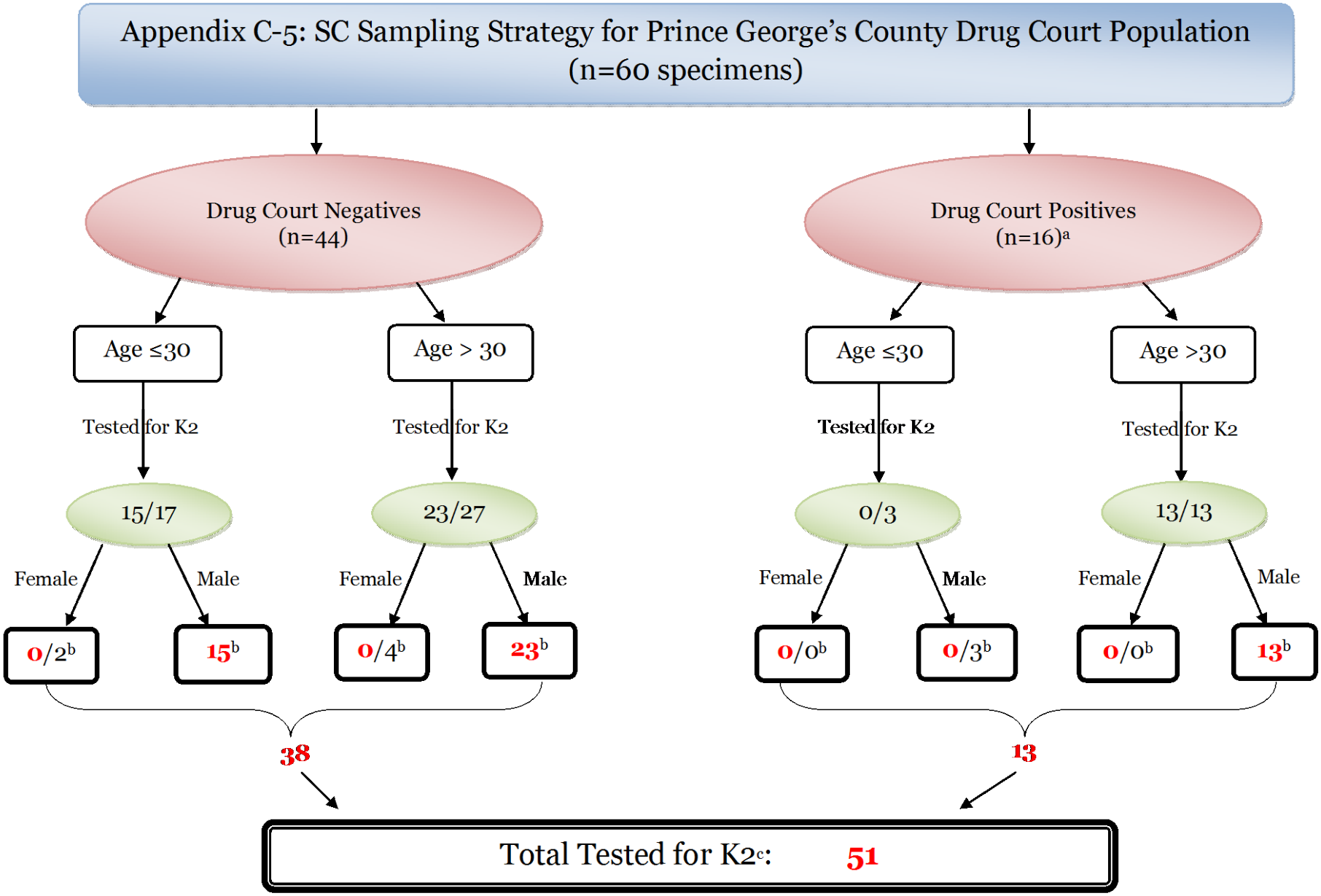
b: Selected all specimens available from persons age ≤30; for persons age >30, selected 20 PSA positive and 20 PSA negative specimens. Since 10 specimens were unavailable for female PSA negatives, 14 male PSA negative specimens were randomly sampled to obtain the 20 specimens total.

c: Substances tested for by PSA include: marijuana, cocaine, opiates, amphetamines, and PCP. Some, but not all individuals in the sample were tested by PSA for methadone and ethanol.

d: K2 testing detected the following 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.



a: Total of 104 specimens collected – only 102 contained demographic information.
b: Selected all specimens up to 20 from subjects age <30. Randomly selected 20 specimens from the 1 subgroup containing more than 20 specimens.
c: VA screening was done using a 6 panel (marijuana, opiates, cocaine, benzodiazepines, oxycodone and methamphetamines) or 12 panel screen (marijuana, opiates, cocaine, benzodiazepines, oxycodone, methamphetamines, amphetamines, methadone, PCP, MDMA, barbiturates and propoxyphene).
d: K2 testing detected the following 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.



a: A 4-panel drug screen is run on all specimens. Substances tested for may include: marijuana, cocaine, PCP, opiates, and/or ethanol.

b: Selected all specimens from male subgroups with at least 10 specimens. No specimens were selected from the female subgroups due to very small sample sizes.

c: K2 testing detected the following 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.

Appendix D: Metabolites Found in Specimens Positive for Synthetic Cannabinoids, by CJS Population

D-1: DC Parole and Probation

D-2: DC Pretrial Surveillance

D-3: DC Lockup

D-4: Chesterfield Probation

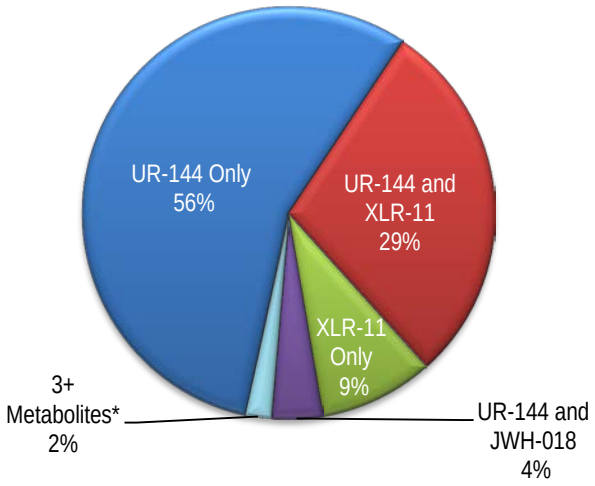
D-5: Prince George's County Drug Court

D-6: All SC Positive Specimens

Appendix D: Metabolites Found in Specimens Positive for Synthetic Cannabinoids, by CJS Population

D-1

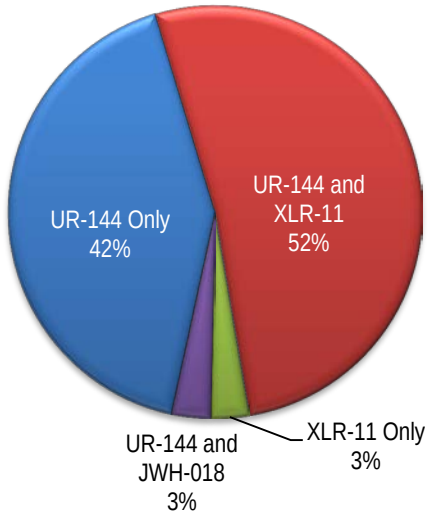
DC Parole & Probation (n=45)



*3+ metabolites include, UR-144+XLR-11+JWH-073+JWH-018 (1).

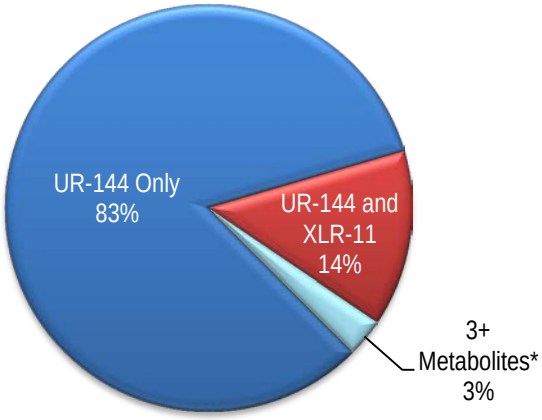
D-2

DC Pretrial Surveillance (n=33)



D-3

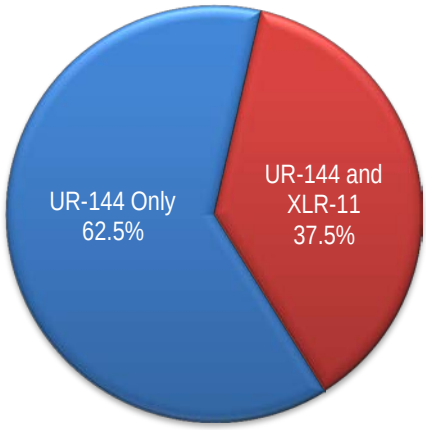
DC Lockup (n=29)



*3+ metabolites include, UR-144+XLR-11+JWH-018 (1).

D-4

Chesterfield Probation (n=8)

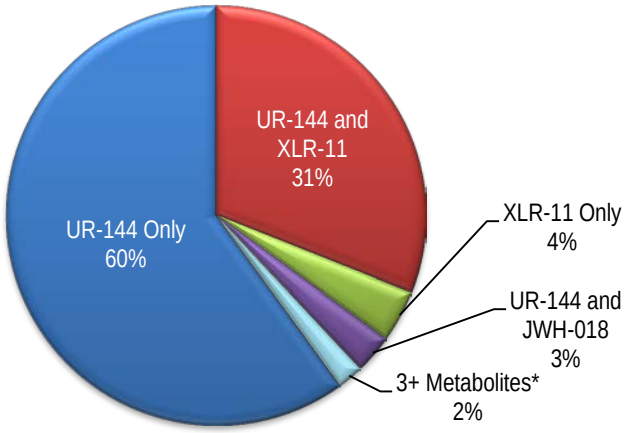


D-5

Prince George's County Drug Court (n=3)

D-6

All SC Positive Specimens (n=118)



*3+ metabolites include, UR-144+XLR-11+JWH-018 (1);
UR-144+XLR-11+JWH-073+JWH-018 (1).

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS) preliminary findings, September, 2013.

Appendix E: Percentage of Specimens from Three DC CJS Populations Combined Testing Positive, by Drug and Residence

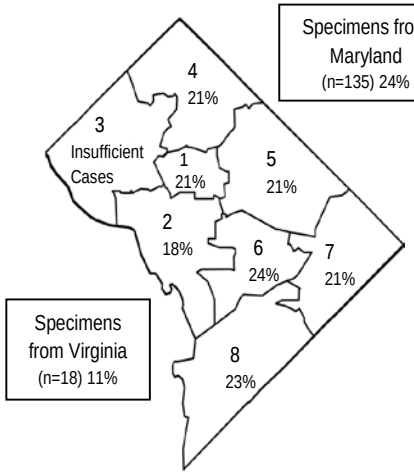
Maps:

Tables:

Appendix E: Percentage of Specimens from Three DC CJS Populations Combined Testing Positive, by Drug and Residence (DC Ward or State)*

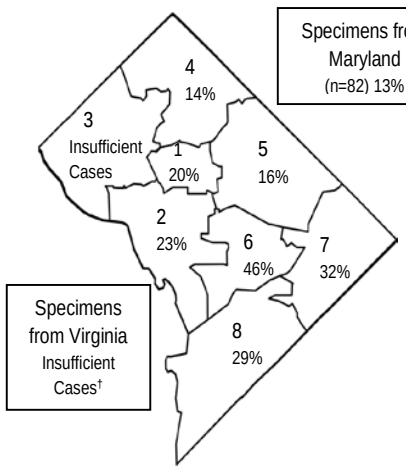
(All Specimens from Washington, DC Parole & Probation, Pretrial Surveillance, and Lockup)

E-1 Marijuana



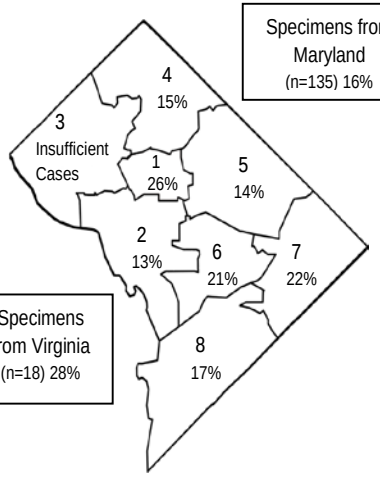
Average for 856** specimens: 22%

E-2 Synthetic Cannabinoids



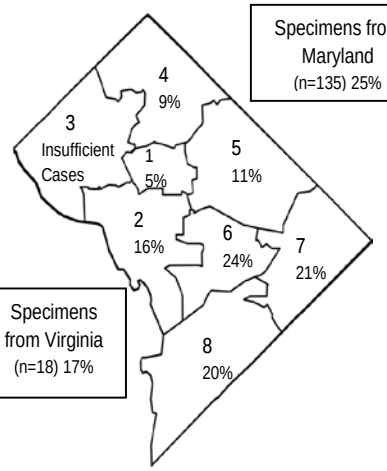
Average for 446‡ specimens: 23%

E-3 Opiates



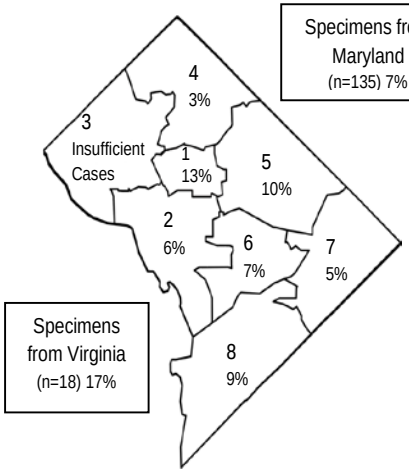
Average for 856 specimens: 17%

E-4 PCP



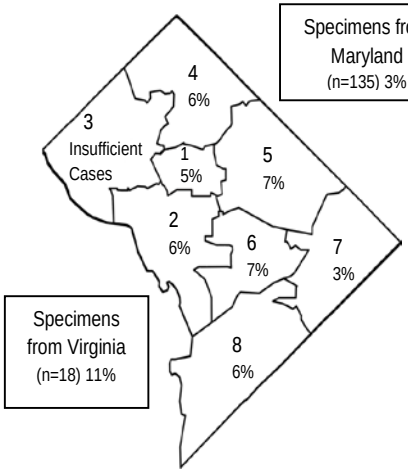
Average for 856 specimens: 18%

E-5 Buprenorphine



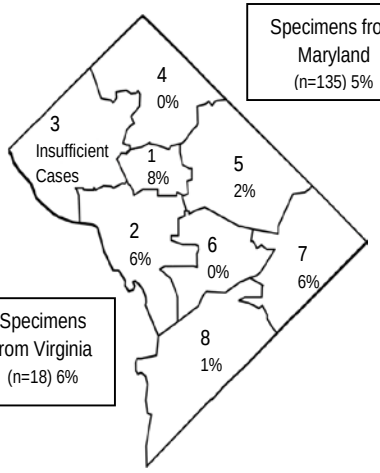
Average for 856 specimens: 8%

E-6 Methadone



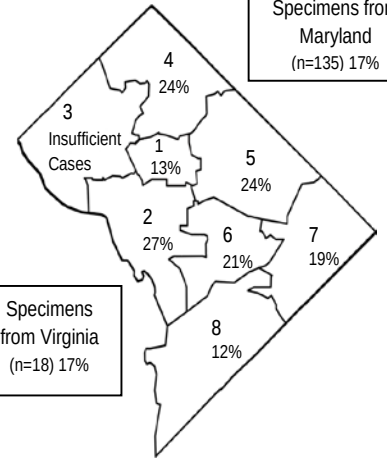
Average for 856 specimens: 5%

E-7 Oxycodone



Average for 856 specimens: 4%

E-8 Cocaine



Average for 856 specimens: 19%

Zip Codes in DC Each Ward:

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

*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 3 was not included in any of the averages because of an insufficient number of cases.
**Excluded from the total sample (n=900) are 6 cases from a zip code outside of Maryland, Virginia and DC; 2 cases from Ward 3; and 36 cases with missing zip codes.
†Virginia was not included in the synthetic cannabinoid average because of an insufficient number of cases.
‡Excluded from the total sample tested for synthetic cannabinoids (n=482) are 4 cases from a zip code outside of Maryland, Virginia and DC; 1 case from Ward 3; 9 cases from Virginia; and 22 cases with missing zip codes.
Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Appendix E-9: Percentage of Specimens from Three DC CJS Populations Combined Testing Positive, by Drug and Residence

Percentage of Specimens from Three DC CJS Populations Combined Testing Positive, by Drug and Residence[†] (DC Ward or State)

(N=856 Specimens from Washington, DC Parole & Probation, Pretrial Surveillance, and Lockup)

Percent Positive by CDEWS Lab for:	DC Ward							Virginia residents tested by DC (18)	Maryland residents tested by DC (135)	All Specimens (856)*
	1 (n=38)	2 (63)	4 (67)	5 (161)	6 (29)	7 (129)	8 (216)			
Marijuana	21%	18%	21%	21%	24%	21%	23%	11%	24%	22%
Cocaine	13	27	24	24	21	19	12	17	17	19
Opiates	26	13	15	14	21	22	17	28	16	17
PCP	5	16	9	11	24	21	20	17	25	18
Buprenorphine	13	6	3	10	7	5	9	17	7	8
Methadone	5	6	6	7	7	3	6	11	3	5
Oxycodone	8	6	0	2	0	6	1	6	5	4

[†]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. Ward 3 was not included in the table because zip code 20008 only had 2 cases.

*Excluded from this table are 2 cases from Ward 3, 6 cases from a zip code outside of Maryland, Virginia and DC, and 36 cases with missing zip codes.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Appendix E-10: Percentage of Specimens from Three DC CJS Populations Combined Testing Positive for Synthetic Cannabinoids, by Residence

Percentage of Specimens from Three DC CJS Populations Combined Testing Positive for Synthetic Cannabinoids, by Residence† (DC Ward or Maryland)

(N=446 Specimens from Washington, DC Parole & Probation, Pretrial Surveillance and Lockup)

	DC Ward							Maryland (82)	All Specimens (446)*
	1 (N=20)	2 (30)	4 (36)	5 (76)	6 (13)	7 (71)	8 (118)		
Positive for Synthetic Cannabinoids	20%	23%	14%	16%	46%	32%	29%	13%	23%

†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. Ward 3 was not included in the table because zip code 20008 only had 1 case.

*Excluded from the total sample tested for synthetic cannabinoids (n=482) are 4 cases from a zip code outside of Maryland, Virginia and DC; 1 case from Ward 3; 9 cases from Virginia; and 22 cases with missing zip codes.

Source: Center for Substance Abuse Research (CESAR), Community Drug Early Warning System (CDEWS), September 2013.

Appendix F: 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 earlier Adult Offender Population Urine Screening (OPUS) and Substance Abuse and Need for Treatment among Arrestees (SANTA) studies. The testing protocol was determined in consultation with the Friends Medical Laboratory toxicologist. Prior to testing, he 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 30 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 1). Confirmation tests were conducted for opiates, amphetamines, PCP, buprenorphine and for any oxycodone positives with a negative opiate screen. Screens for mephedrone (and other cathinones/bath salts) and LSD were not conducted due to their excessive cost. 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 and to report results on most specimens from a batch. Specimens requiring confirmations took a slightly longer period to process (approximately one week).

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. Prior to testing, we did an assessment of existing data, 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. 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. In addition, we consulted with urine toxicologists and other laboratory contacts to determine the latest SC metabolites in use at the time of the study. They indicated that reference standard producers, such as Cayman Chemical, can be used to identify SC metabolites for testing. After working with these agencies, we expanded our SC panel to include two newer metabolites for which tests had only just been developed. As seen in this study, the primary metabolites that were in use six months prior to the study (JWH-018 and JWH-073) revealed few positives during the study period and instead, manufacturers of the drug transitioned to two new metabolites (UR-144 and XLR-11) which were detected with high frequency during the 2013 CDEWS study period. Thus, this indicates the need to do a thorough assessment of current metabolites in use prior to testing in order to ensure that the most prevalent metabolites will be detected by the testing protocol. The CDEWS testing method is flexible and can adapt quickly to changing use patterns, as was done in our 2013 CDEWS study.

Synthetic Cannabinoid Testing by Clinical Reference Laboratory (CRL)

Given that Friends Medical Laboratory does not test for synthetic cannabinoids in their own laboratory, CESAR contracted with CRL to conduct the synthetic cannabinoid (SC) 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 12 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 and XLR-11. Detection limits varied between 0.2 and 0.5 ng/mL using 0.1 mL of urine.

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. CRL is a SAMHSA certified laboratory for federal workplace drug testing. 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.

Appendix G: Future Enhancements to the CDEWS Methodology

1. *Determine the drug testing panels and detection limits being used by all participating sites prior to beginning testing*

In conducting this study, it was determined that each testing site not only had their own unique panel of drugs for which they were testing, but also used varying drug detection limits. It is recommended that any similar project start by assessing all testing panels and detection limits in advance of beginning any testing. These can then be used to determine the most appropriate testing panel and detection limits for the study. For future studies, we would recommend considering the addition of 6-Acetyl Morphine (6-AM) to the CDEWS panel in order to be able to definitively identify heroin use.

2. *Specimen storage*

It is not uncommon that drug positive specimens must be held for a period of 30 days or more before they can be released for testing. During this study, some degradation of specimens was detected for marijuana. This occurred in specimens that were refrigerated and held for 40 or more days. To minimize any potential for degradation we recommend freezing specimens and collecting them as quickly as possible.

3. *Holding specimens for later testing*

During this study, it was necessary to retest some urine specimens at lower drug detection limits to compare them against our participating sites and assess potential issues related to degradation. Furthermore, during the first round of testing we refined our testing panel and ordered additional confirmations after the preliminary testing. Given this, we feel it is important to retain all specimens after initial testing in the event of additional unanticipated testing that might be necessary during the course of the study.

4. *On-site testing*

The on-site testing protocol differed only slightly from our routine protocols in that the sampling was conducted by probation staff rather than by the research staff at CESAR. Demographic data was entered on the specimen labels by probation staff prior to shipping. These specimens were then shipped to the CDEWS testing laboratory using large FedEx Clinical Paks. Specimen IDs were assigned by the CDEWS laboratory upon receipt. After testing by the CDEWS laboratory was complete, CESAR staff transcribed this demographic data into a database and linked it to the expanded drug testing results.

5. *Site approvals*

Each participating site in the study had its own unique approval process. Some required review of the project by program administrators, while others (in this case, the DC site) required review of the project by a research committee. The review process for the study by these committees was lengthy

and required several months of time to complete. All protocols required review by the University of Maryland's Institutional Review Board.

6. Seeking input from a toxicologist

Over the course of the study, after consulting with the CDEWS contracted laboratory toxicologist we decided to add several new confirmation tests to our panel. This included LC/MS confirmations for buprenorphine and LC/MS confirmations for opiates in instances where we had an oxycodone positive by EIA but the opiate EIA screen was negative. A review of current research indicated that high dose morphine, as well as tramadol use, can result in a false positive for buprenorphine. Thus, confirmation of this drug is indicated. Further, we were advised by the toxicologist at the CDEWS laboratory that all oxycodone EIA positives should be confirmed. At the conclusion of the study, LC/MS confirmation results were compared with EIA positive results. All buprenorphine EIA positives confirmed as positives using LC/MS. However, a small number of oxycodone EIA positives (4 out of 42) did not confirm using LC/MS.

DC. Special situations were detected with marijuana and cocaine which required further testing by the CDEWS laboratory. Some degradation of marijuana was detected in the initial CSOSA parole/probation sample, as the CDEWS screening detected a lower number of positives than PSA (as per the PSA drug positive/negative screen). To investigate this, a sub-study of 31 specimens was conducted screening marijuana at a lower level (20ng/mL) and 22 additional marijuana positives were detected. Given that we were able to account for most of the differences in positives, we did not continue rescreening at this lower threshold and decided to continue screening samples for marijuana at a detection limit of 50 ng/mL since that was the standard detection limit being used by most of the participating sites.

Testing costs

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 $35.00 per specimen.

Appendix H: Glossary of Abbreviated Terms

6-AM: 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

CCCS: Chesterfield Community Corrections Services

CDC: Centers for Disease Control and Prevention

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

MMWR: Morbidity and Mortality Weekly Report, a journal published by the CDC

MOU: Memorandum of Understanding

NFLIS: National Forensic Laboratory Information System

NCIPC: National Center for Injury Prevention and Control

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