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ESTIMATE OF THE INCIDENCE OF DRUG-FACILITATED SEXUAL ASSAULT IN THE U.S.

FINAL REPORT

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ABSTRACT

The term drug-facilitated sexual assault (DFSA) has been recently coined to describe victims who were given a drug by an assailant and subsequently sexually assaulted. Previous studies that have attempted to determine the prevalence of drugs in sexual assault complainants have had serious biases. This research was designed to better estimate the rate of DFSA and to examine the social aspects surrounding it.

Four clinics were provided with sexual assault kits and asked to enroll sexual assault complainants. Subjects provided two urine specimens, a hair specimen and completed a questionnaire describing the assault, as well as any drugs they were using. The three specimens were then analyzed to evaluate the self-reporting of illegal drugs and the number of drugs found in the subjects. Following this analysis, the results were combined with the subject's account of the assault and evaluated as to whether DFSA was a possibility.

A total of 144 subjects were enrolled and the drugs analyzed for were found in 61.8% of the subjects with 4.9% positive for the classic "date-rape" drugs. For the evaluation of the validity of self-reporting of drug use, three drugs were employed; marijuana, cocaine, and amphetamines. We hypothesized that sexual assault complainants would be more truthful in their reporting than other populations studied. However, in this study, subjects' positive for these drugs reported their usage approximately 40% of the time.

DFSA was evaluated for each subject based on criteria developed for this work. In this study, 4.2% of the subjects were evaluated as to have been victims of DFSA through surreptitious drugging. When voluntary drug use by the subject is included, 35.4% of our subjects were estimated to have been victims of DFSA. The true value of DFSA for our subjects

is most likely to be between these two estimates. This work is the first to include toxicological analyses with the subject's statements to determine DFSA.

LIST OF ABBREVIATIONS

AMPS	-	Amphetamines
BZ	-	Benzodiazepines
BSTFA	-	Bis(trimethylsilyl)trifluoroacetamide
CNS	-	Central Nervous System
DEA	-	Drug Enforcement Agency
DFSA	-	Drug Facilitated Sexual Assault
DOA	-	Drug of Abuse
FBI	-	Federal Bureau of Investigation
GABA	-	Gamma Aminobutyric Acid
GC/MS	-	Gas Chromatography / Mass Spectrometry
GHB	-	Gamma-hydroxybutyrate
IRB	-	Institutional Review Board
LOD	-	Limit of Detection
MBHFBA	-	N-Methyl-bis(heptafluorobutyramide)
MDMA	-	Methylenedioxy-n-methylamphetamine
MG	-	Milligram
ML	-	Milliliter
MTBSTFA	-	N-(tert-butyldimethylsilyl)-N-methyltrifluoroacetamide
MTF	-	Monitoring the Future
NAD	-	Nicotinamide Adenine Dinucleotide
NCVS	-	National Crime Victimization Survey
NFLIS	-	National Forensic Laboratory Information System

NG - Nanogram

NIDA - National Institute of Drug Abuse

NIJ - National Institute of Justice

OTC - Over the Counter

PCP - Phencyclidine

RAINN - Rape, Abuse, & Incest National Network (www.rainn.org)

SAMHSA- Substance Abuse and Mental Health Services Administration

SIM - Selected Ion Monitoring

SOFT - Society of Forensic Toxicologists

SOP - Standard Operating Procedure

SSRI - Selective Serotonin Reuptake Inhibitor

TCA - Tricyclic Antidepressant

THC - Tetrahydrocannabinol (marijuana)

TMCS - Trimethylchlorosilane

UCR - Uniform Crime Reports

UCT - United Chemical Technologies

USDTL- United States Drug Testing Laboratories

SUMMARY

Sexual assault is a serious problem that is estimated to affect 64 per 100,000 females each year. The use of drugs in sexual assault has recently been reported in journals and through the media. Individuals who use drugs, with or without alcohol, are thought to be at a significantly higher risk for sexual assault. In some cases, the substances are taken voluntarily by the victims, impairing their ability to make decisions. In other cases the substances are given to the victims surreptitiously which may decrease their ability to identify a dangerous situation or to resist the perpetrator. The term drug-facilitated sexual assault (DFSA) has been coined to describe this subset of sexual assault. However, it is not precisely known how often drugs are used to facilitate sexual assault. Some of the drugs that could be used in DFSA cause unconsciousness, impair the victim's memory, or limit their decision-making ability.

There has been one previous study that attempted to determine the prevalence of drugs in sexual assault complainants. However, the study only accepted subjects with a drug history or those who believed that they were given a drug surreptitiously. Analytically, the study did not include many prescription and over-the-counter drugs that could be used in DFSA. The study also did not attempt to determine if the subjects were victims of DFSA, only to describe the drugs in their system when they presented to the clinic.

This study was developed to correct the problems in the previous study by accepting subjects without any bias. Urine and hair specimens were then analyzed for approximately 45 drugs that have either been detected in sexual assault victims, or whose pharmacology could be exploited for DFSA. Each case was then analyzed based on the subject's description of the assault, the drugs they admitted to using, and the toxicology analysis. For this work, two definitions of DFSA were used; one only included presumed surreptitious drugging, while the

second included subject's whose intended drug use may have led to the assault. The estimated prevalence of DFSA was then assessed.

An IRB-approved, multi-jurisdictional study was conducted that included four regionally diverse clinics. The clinics were located in Texas, California, Minnesota, and Washington State. Each clinic was provided with sexual assault kits and asked to enroll willing sexual assault complainants. When a subject was enrolled, a urine specimen was initially provided. One week later, the subject was asked to provide an additional urine specimen as well as a hair specimen. The subject then completed a questionnaire describing the details about the alleged assault, as well as any illegal, prescription or OTC drugs they were using. The three specimens were then analyzed to evaluate the validity of self-reporting of sexual assault complainants, the number of drugs found in the subjects, and whether drugs that could be used in DFSA were found. Following this analysis, the results were combined with the subject's account of the assault and evaluated as to whether DFSA was a possibility.

A total of 144 subjects were enrolled from all four participating clinics with only two clinics supplying the desired amount of 35 subjects. The racial profile of the enrolled subjects correlates well with the census data for the U.S. The ages of the subjects ranged from 18 to 56 years of age, with a mean of 26.6 years, which corresponded well with previous studies on sexual assault complainants. Only 41% of the enrolled subjects returned for the second visit, which was considerably lower than desired.

The analyzed drugs were found in 61.8% of the subjects with 4.9% positive for the classic "date-rape" drugs. For the evaluation of the validity of self-reporting of drug use, three drugs were employed; marijuana, cocaine, and amphetamines. These were chosen as they would

not normally be given surreptitiously, thus the subject had to willingly take the drug. Also, these drugs are illegal and may affect the subject's truthfulness. Previous studies on self-reporting of illegal drug usage have shown that different subsets of the population are more truthful than others. However, no studies have been done on sexual assault complainants. We hypothesized that sexual assault complainants would be more truthful in their reporting than other populations studied. However, in this study, subjects reported their usage of the above three drugs approximately 40% of the time.

The number of drugs found in the subjects was compared to previous work on drug use among the general population as well as the drugs found in the previously mentioned DFSA study. This study had nearly 62% of the patients' positive for one of the drugs being analyzed, which correlates extremely well with the previous DFSA study. When compared to a national survey on drug use, MTF, our subject's reported drug use compared well with the reported drug use by the general population. However, as seen above, our subjects underreported their drug usage and when the actual number of positives is compared to MTF; our subjects had a much higher rate of drug use.

DFSA was evaluated for each subject based on specific criteria we developed. DFSA1 is the conservative estimate of DFSA which only accepts surreptitious drug use as the indicator for DFSA. In this study, 4.2% of the subjects were evaluated as to have been victims of DFSA by this method. DFSA2 includes the criteria for DFSA1; however, it also includes voluntary drug use by the subject which may have facilitated the sexual assault (i.e., the assault might not have happened if the subject had not used the drug). By this method, 35.4% of our subjects were estimated to have been victims of DFSA. The true value of DFSA for our subjects is most likely to be between these two estimates.

This study demonstrated the need for toxicological analyses in sexual assault cases. This is due to the high number of subjects positive for drugs and the subsequent need for a complete drug profile of the complainant. It was also demonstrated that sexual assault complainants severely underreport their illegal drug usage. This could be corrected if the administering nursing staff was better educated on taking a truthful drug history. This study also confirmed that DFSA is more of a problem due to the subject's own drug use, rather than surreptitious drugging by the perpetrator.

I. INTRODUCTION

A. Sexual Assault

Sexual assault is a problem significantly studied in the scientific literature (1-21). According to a 1998 survey, one in five women will be sexual assaulted in their lifetime (22). RAINN (www.rainn.org) estimates that an American is sexually assaulted every two minutes. In recent years, researchers have noticed a decline in the number of reported violent crimes in the United States, including rape and sexual assault (Table I). However, estimates of sexual assault incidence and prevalence are widely divergent for several reasons, but mainly in part because of underreporting of the crime.

The Department of Justice uses two different programs to estimate the number of sexual assaults that happen each year in the U.S. and the numbers presented can vary widely between the programs. When using data provided by each of these programs, it is best first to examine how the two methods differ. While the methods for gathering data on specific crimes are internally consistent within each program, for the purposes of this work, only data on sexual assault is noted. The programs are the Uniform Crime Reports (UCR) conducted by the Federal Bureau of Investigation (FBI) and the National Crime Victimization Survey (NCVS) conducted by the Bureau of Justice Statistics (BJS).

UCR began in 1929 and collects information about crimes based on their being reported to law enforcement. Each month, law enforcement agencies submit a report to the FBI that details how many sexual assaults have been reported in the previous month. In 2001, law enforcement agencies submitting to UCR represented 89.6% of the total population in the U.S. It should be noted that states which do not follow precise FBI guidelines in reporting are not represented in the final tallies (23). UCR's main goal is to

present the number of crimes that were reported to all submitting law enforcement agencies. Thus, if the crime is not reported, UCR does not measure it. To adjust for changes in the size of the population, the UCR also calculates rates of reported offenses, e.g., the number of sexual assaults per 100,000 inhabitants. The absolute numbers and the rates can diverge. In Table I, for example, the lowest absolute number of reported sexual assaults occurred in 1999, but the lowest rate of sexual assault in the years shown occurred in 2001.

Table I. TWELVE YEAR UCR SURVEY OF NUMBER AND RATE OF SEXUAL ASSAULTS IN THE U.S.

Year	Number of Sexual Assaults	Rate / 100,000
1990	102,560	41.1
1991	106,590	42.3
1992	109,060 - Highest	42.8 - Highest
1993	106,010	41.1
1994	102,220	39.3
1995	97,470	37.1
1996	96,252	36.3
1997	96,153	35.9
1998	96,144	34.5
1999	89,411 - Lowest	32.8
2000	90,178	32.0
2001	90,491	31.8 - Lowest
2002	95,136	33.0

NCVS began in 1973 and was initiated to complement the information presented by UCR. The sampling method for the NCVS involves polling of households across the U.S. rather than law enforcement agencies. Each year, about 160,000 interviews are conducted with a carefully devised statistical sample of the general public. These interviews collect information regarding, if any, crimes the interviewee has been a victim

of in the past year. If the interviewee has been the victim of a crime, it is further determined if the crime was reported and if not, the reason why it wasn't reported. The NCVS works in conjunction with UCR by attempting to measure crimes that weren't reported to law enforcement agencies.

There are several major differences between UCR and NCVS that need to be addressed before analyzing data from either program. First, sexual assaults perpetrated on males are not included by UCR's reporting, but are included by NCVS. It is commonly assumed that most sexual assaults are committed against females, however sexual assaults involving males is a reality (24). Therefore, the NCVS results could be more accurate in estimating total sexual assaults. Second, UCR's data are based on reporting from a large percent of law enforcement agencies across the U.S. and any estimates for nonparticipating agencies represent a small percent of the total. NCVS estimates are based on a much smaller sample (160,000 interviews out of about 300,000,000 people) and thus any sampling error could bias the results.

Despite NCVS's small sample, it may provide better estimates for sexual assault due to the underreporting of sexual assault. There are several reasons why victims of a sexual assault may be unwilling to report the crime to a law enforcement agency. The main reason is that sexual assaults violate someone both physically and psychologically. Not only do victims suffer these effects during the assault, many have significant problems for years after the assault took place. Holmes *et al.* found in her study that 71.3% of sexual assault complainants expressed one or more fears following the alleged assault (5). The most common fear, retaliation, is expressed when the complainant knows the perpetrator and worries that by filing a police report, the perpetrator will

further cause harm to them. RAINN estimates that two-thirds of sexual assault victims knew the assailant. Holmes *et al.* found a comparable rate of 71% in her study (5). Many complainants also may not want friends and family to find out about the assault, so they do not report it. Some complainants also believe that the assault is their fault or that they will not be believed.

Another factor in the underreporting of sexual assault could be if the complainant was using alcohol or drugs at the time of the alleged assault. Fear of prosecution may dissuade them from reporting the assault. Ledray *et al.* reported that complainants who were using alcohol or drugs were more likely to either delay reporting the assault or not report it at all (25). Another study found that 41.7% of the alleged victims studied had been using alcohol when victimized (2). Ledray notes that when sexual assault complainants do report to the hospital, only 68% are certain that they want to file a police report (25). When all of these factors are combined, it becomes clear that underreporting of sexual assaults is a reality. What is not known is to what degree sexual assaults are underreported.

Another common characteristic of sexual assaults is reluctance among the complainants to follow-up their initial visit to the hospital. It is strongly suggested that sexual assault victims should be reassessed within 6 weeks of the assault (9). This follow-up will evaluate the mental health of the victim (i.e. presence of post-traumatic stress) and to confirm that HIV or other sexually transmitted diseases were not contracted during the assault. One retrospective study of 389 sexual assault complainants found that only 31% of the complainants returned for the recommended follow-up visit (5). This study also found that if the complainant had admitted to using drugs or alcohol, this

negatively influenced whether they returned for the follow-up visit. They also found that 42.6% of the alleged victims expressed a fear of retaliation from the alleged assailant. This fear, along with the fear of having to see the alleged assailant or deal with the trauma again, could explain the low follow-up visits. The rate continues to be low even when the follow-up is unobtrusive and convenient, for example by telephone.

The issue of underreporting is one reason known to affect national data on sexual assaults. Another major factor is that even after a complainant seeks treatment from a clinic, there is no guarantee that a criminal case will develop as many complainants refuse to press charges. One study found that only 62% of the complainants reporting a sexual assault to the clinic were willing to also report to the police (25). Another study found that of 888 sexual assault complainants, 132 or 15% had charges eventually filed by the prosecution (12). Of these 132 cases, 15% of the alleged perpetrators were released. The remaining 85% of the perpetrators were either found guilty or entered a plea before the trial. An 85% conviction rate does sound promising; however, the sexual assault cases that progress to trial are a small percent of all sexual assaults. For example, in Hennepin County, Minnesota, 2% of sexual assault cases reported to the clinic in 1997 eventually went to trial; for the rest of the cases, the prosecution either did not want to pursue charges, or the offender entered a plea (26).

One addition to the clinical setting that may help decrease underreporting is sexual assault nurse examiners (SANEs). SANE's are specially trained to conduct sexual assault examinations with an attention to complainant's well-being and to find and document important forensic evidence. A SANE may also be qualified as an expert at the trial, further strengthening any testimony they provide. The original SANEs began

working in the late 1970's, but their achievements were not officially recognized until 1995, when the American Nurses Association made SANEs a nursing specialty. Ledray's study found that of the 38% of alleged victims that did not report the crime before presenting to the hospital, 12% did report after talking to a SANE. Only 3% were certain that they would never report, with the remaining 23% still undecided (25). This demonstrates that specialized nurses may be able to increase the amount of sexual assaults reported to law enforcement agencies.

B. Drug-Facilitated Sexual Assault (DFSA)

The idea of using a drug to incapacitate someone in order to victimize him or her is not novel. Chloral hydrate, historically referred to as a "Mickey Finn", is one of the best-known examples of a drug that can be added into someone's drink to induce unconsciousness. Alcohol is the best-known incapacitating drug found in sexual assaults, and the most studied (1, 27-30). It is commonly accepted that there is a high degree of correlation between alcohol intoxication and the risk of being sexually assaulted. However, in recent years there has been increased attention in the literature of people using other drugs to render their victims unconscious or lower their level of resistance with the intent to sexually assault them (7, 31-43).

A common scenario might involve a young woman out at a bar. She meets a man who buys her a drink and she then proceeds to consume the beverage. The drink is normally alcoholic and she may have already had several drinks before meeting this man. But this drink is different; it has been spiked with a drug that will disorient and confuse her, facilitating the man's attempts at getting the woman out of the bar and into a secluded location. Because the woman is in a bar and has been seen drinking alcohol,

other patrons would not find it odd that she is now having a hard time standing and must rely on the man to walk. He then leaves the bar with her and takes her some place where he can sexually assault her. During the assault, the woman may be completely unconscious or going in and out of consciousness. The next day when she wakes up, she may be in unfamiliar surroundings or at home confused as to how she got there. She may also feel sore in her vaginal or anal regions and wonder what happened to produce these pains. She may be wondering if she was sexually assaulted, but has no recollection of the event happening. Many people in this situation may not immediately go to the police or hospital to report a sexual assault. If they do not remember the sexual assault, they might believe that it did not take place or that they have no case against the perpetrator.

This differs from sexual assaults that do not involve drugs because the complainant remembers the entire event and can describe exactly what took place to the proper authorities. Reporting of sexual assaults has been shown to be limited. If data from 1995 is examined when only 36% of sexual assaults were reported, how will this number change if DFSA is increasing? This question has not currently been answered. There is no known estimate of the number of DFSA's that take place every year. There have been many anecdotal and news reports (44-47) on DFSA, but no scientific study has been conducted to examine this problem.

Two studies have examined which drugs were present in sexual assault complainants. Slaughter's work showed that two-thirds of the specimens collected (N=2003) were positive for alcohol and/or drugs (48). ElSohly's research involved 1,179 specimens and 60.3% of their specimens tested positive for at least one drug (49). The two best-known so-called "date-rape" drugs, GHB and flunitrazepam, were found in less

than 4% of the specimens in both studies. Slaughter's study is in conjunction with ElSohly's laboratory, and it is unclear if Slaughter's 2,003 specimens contain the 1,179 specimens analyzed in ElSohly's study. However, both studies had a major bias in the samples included. The specimens were submitted from forensic laboratories or SANE units across the U.S. in conjunction with Hoffman-La Roche Laboratories, the makers of flunitrazepam. Any center that treated suspected sexual assault victims was encouraged to send urine specimens to ElSohly's laboratory for a toxicological analysis. However, both studies only accepted specimens from complainants who either had a history of drug use, or where drugs were suspected following a physical examination. Thus, their results are only important in a subset of sexual assault complainants and the prevalence of DFSA among all sexual assaults cannot be calculated. The work for this thesis is an attempt to provide a better estimate of the prevalence of DFSA among all sexual assault complainants.

The GHB analysis in the previous study also raises questions. In ElSohly's paper, a LOD for GHB is never given and the GC/MS method being used is an in-house SOP. In Slaughter's paper, a GHB LOD is given as 1 μg/mL, but each paper fails to specify a cut-off limit. As discussed below, GHB is found endogenously in urine and reporting all values as positive does not take this into account. Thus, ElSohly's and Slaughter's reporting of positive GHB specimens of 16 and 25, respectively, does not clearly show whether these specimens were positive because of the alleged victim taking GHB or endogenous levels of GHB. The disregard for endogenous levels of GHB is not the only flaw in either study. In addition, there was a perceived conflict of interest with Hoffman-La Roche funding the studies.

DFSA also presents challenges for successful prosecution in court. In order to analyze a sexual assault complainant's urine for drugs, the complainant must first give their consent for the analysis to happen. If they were using illegal drugs on their own accord, they may be worried about being prosecuted. The complainant may also believe that the presence of cocaine or marijuana in their system will weaken their story and cause the authorities to not believe that an assault happened. However, to conduct a thorough investigation of the alleged assault it is very important that investigators know exactly what was in the complainant's system. Finding drugs in a sexual assault complainant does not always hurt their case.

Wiley's study of 132 sexual assault trials found that amnesia about the alleged assault negatively influenced the legal outcome, while alcohol or drug use had no effect (12). This is due to the fact that finding drugs with the ability to produce amnesia in the alleged victim may strengthen their case and provide a reason why they are unable to remember the assault. Another study found that cases involving alcohol were three times more likely to result in conviction, but as the alleged victim's age increased, the likelihood of a conviction decreased (2). This was thought to be due to a generalized perception that older women are more sexually experienced.

C. Date-Rape Drugs

Any drug that is given to a sexual crime complainant before they are assaulted could be classified as a "date-rape" drug. However, we are only interested in drugs that could be given to the complainant in order to render them unable to consent to sexual activities. There are two well-known drugs that have been implicated in DFSA. Flunitrazepam, or Rohypnol®, is probably the best-known example of a "date-rape" drug

and has received the most attention in the literature (38, 39, 50-71). Flunitrazepam is a member of the benzodiazepine family, and is ten times more potent than diazepam (Valium®). Flunitrazepam binds to the GABA receptor in the CNS. GABA is an inhibitory neurotransmitter and when it binds to its receptor, chloride conductance increases leading to neuronal hyperpolarization resulting in less synaptic transmission. Flunitrazepam binds non-selectively to the omega receptors on the GABA receptor complex, enhancing the ability of GABA to bind to its receptor. There are several subtypes of the the omega receptor with omega-1 responsible for the sedative effects and omega-2 responsible for the amnestic effects. Flunitrazepam binds to both subtypes; however, it binds preferentially to the omega-2 receptor and thus exhibits more amnestic properties than other benzodiazepines (70).

Flunitrazepam produces anterograde amnesia, which affects the ability to remember anything after taking the drug. This leaves the complainant with no recollection of the assault ever taking place. It has been shown that flunitrazepam interferes with the formation of new memories by disrupting the encoding of memories (33). Secondly, flunitrazepam begins to produce an effect very quickly (i.e. 20 to 30 minutes) and does not require a large dose to produce a state of unconsciousness (e.g. a 1 to 2 milligram tablet is given). There are several anecdotal stories of people on benzodiazepines, like flunitrazepam, who are able to function normally but have no memory of anything they did. Friends and co-workers do not realize anything is wrong until the medicated individual begins to replicate their actions (e.g. reports to work after already having been there for four hours) or asks questions that have already been answered (72). When combined with alcohol's sedative effects, flunitrazepam becomes

an ideal drug for quickly incapacitating the complainant and leaving no memory of the event.

Flunitrazepam is illegal in the U.S. (because of its use as a "date-rape" drug), but is legal in Europe and Mexico where it is used as a sleep aid for severe cases of insomnia. The trafficking of flunitrazepam through Florida and Texas via Mexico or Colombia has been shown to be very easy. Hoffman-La Roche, the manufacturer of flunitrazepam, has received so many complaints about its use in DFSA, that they have changed the formulation of the drug to include a dye that will cloud a drink if it is surreptitiously added. They have also offered free urine testing for any sexual assault complainant who believes they were drugged with flunitrazepam. The DEA made flunitrazepam a Schedule IV drug to comply with the United Nations Psychotropic Convention; however, it is currently investigating if flunitrazepam should be Schedule I, further establishing the dangerousness of the drug. The finding of this drug in the complainants urine does not necessarily mean that it was given surreptitiously as flunitrazepam has been shown to be used recreationally and for the purposes of self-medication among the depressed (73-75). Thus, it is difficult for toxicologists to determine if a drug was given surreptitiously or taken recreationally by the user and this issue is discussed below.

Flunitrazepam is so powerful, that its illicit use could be life threatening. This most often occurs when it is combined with other CNS-depressants, such as alcohol (50). An Australian study found that while flunitrazepam only accounts for 2.4% of all benzodiazepines prescriptions, it had the highest prevalence of death associated with its use (54). The mechanism by which it causes death is difficult to discern, and could be

either a result of respiratory depression, or respiratory obstruction due to unconsciousness (53).

GHB is the second well-known date-rape drug and has recently gained attention from the media and the forensic toxicology community (76-88). GHB is naturally occurring and is structurally very similar to the neurotransmitter GABA (Figure 1). GHB is a CNS depressant and its interaction is thought to involve a GABA receptor (89). In the 1980's, GHB use among bodybuilders increased due to its purported ability to increase muscle mass and its presence in herbal supplements increased its use as a sedative (86). However, GHB eventually moved to recreational users for its intoxicating effects and then to criminals who find its sedation and the potential for amnesia desirable (84). GHB is easily synthesized from precursors and is also available in Europe where it is prescribed for ethanol withdrawal (88).

Samantha Reid is probably the best known victim of GHB misuse. Samantha, a fifteen-year-old Detroit resident, was given the drug surreptitiously at a party. Soon after finishing her drink she became unresponsive and was rushed to a hospital. There, she fell into a coma and later died. The four young men, who gave the drug to her, were convicted of involuntary manslaughter, representing the first case of a GHB related death being successfully prosecuted (90). In February of 2000, the "Hillory J. Farias and Samantha Reid Date-Rape Drug Prohibition Act of 2000" was enacted which made GHB a Schedule I drug. This made the drug illegal and increased the penalties for anyone found with GHB. In 2002, the FDA approved GHB to be prescribed for extreme cases of narcolepsy. The brand name is Xyrem®, and it has been made a Schedule III compound.

However, illicit use of Xyrem® will result in Schedule I penalties and the prescribing physician monitors its use closely.

Due to GHB's suspected use in DFSA, its inclusion in this study is of the utmost importance as it is unknown if GHB is widely used as a "date-rape" drug. There is one caveat for the analysis of GHB. Because it is an endogenous compound in humans, any interpretation of GHB levels in urine or hair will have to be compared to previously reported levels of endogenous quantities (91).

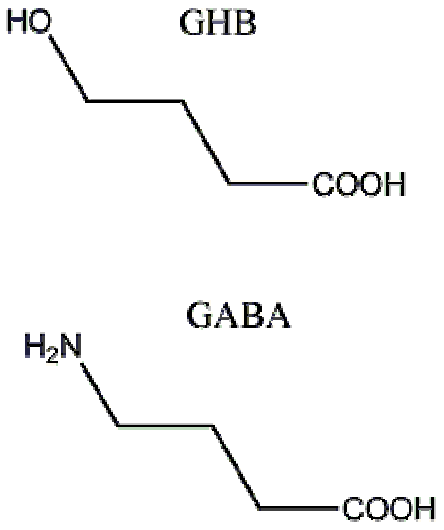

Figure 1. Structural similarities of GHB and GABA.

D. <u>Legal Aspects of Drug-Facilitated Sexual Assault</u>

Successful convictions of DFSA's are difficult due to several reasons. First, if we assume that 50% of sexual assault complainants report the crime, half of all sexual assailants are free from prosecution. Second, sexual assault complainants who do report the crime may wait too long, and thus eliminate any chance of detecting a "date-rape"

drug in their urine. If a perpetrator is discovered, there are still many difficulties for a successful conviction. One common defense the perpetrator could use during a criminal or civil trial is that the complainant consented to engage in the sexual activity. However, most states have laws stating that someone is unable to give their consent if they are unconscious, of diminished mental capacity (i.e. intoxicated), or mentally handicapped, and that any sexual activities with them are correspondingly illegal. One could also argue that if both parties are drunk, then neither is capable of giving their consent. Many courts uphold that whoever initiates the sexual acts is responsible for insuring that their partner is capable of giving consent. In DFSA, the prosecution needs to prove that the complainant had been unknowingly given a drug or had been recreationally using a drug that diminished their mental capacity to an extent where they were unable to give their consent to sexual activities. If illegal drugs that are not commonly suspected in DFSA are found, the counsel for the defendant could use this evidence against her to diminish the validity of any testimony she provided.

E. Hypotheses

In this report, we present the results of a study whose principal hypothesis is: The prevalence of "date rape" drugs, such as flunitrazepam, ketamine and GHB, is low in a sample of sexual assault complainants recruited at several different U.S. locations. The subhypotheses that were tested include:

(1) Sexual assault complainants will exhibit approximately the same prevalence of OTC, prescription, and other drugs of abuse, as a comparable group of the same gender and age cohort.

(2) Sexual assault complainants are more honest in admitting to the use of illegal substances, such as marijuana, cocaine, amphetamine, etc., than other populations that have been studied.

The results obtained in the present study are compared with prior studies in which:

(1) Sexual assault complainants have actually submitted urine or hair for testing for drugs of abuse.

(2) The prevalence of illegal substance use is estimated by self-reporting survey techniques.

(3) The incidence of seizures of drugs by law enforcement.

(4) Prior studies on specific populations designed to measure the accuracy of self-reporting the ingestion of drugs of abuse.

We are further able to estimate the prevalence of DFSA by two different methods. Not only is this study the first epidemiologically appropriate estimate of prevalence, it is also the first time a clear distinction has been made for DFSA between the surreptitious drugging of a victim and the recreational use/misuse of drugs by the victim.

F. Explanation of Selected Drugs and Their Pharmacology

As previously noted, it is difficult to describe DFSA in terms of only several drugs. Any drug that diminishes the mental or physical capacity of a potential victim could be identified as a drug used in DFSA. To handle the intricacies of this problem, SOFT developed a special committee charged with producing a list of all drugs that have been used or could be used in DFSA (Table II). Drugs that were included in this study are marked with a star in Table II. The reason the drugs were selected is described below.

TABLE II. DRUG-FACILITATED SEXUAL ASSAULT COMMITTEE'S LIST OF DRUGS THAT HAVE BEEN, OR COULD BE USED, IN DFSA

1,4-Butanediol	Dextromethorphan *	Methamphetamine *
Alprazolam *	Diazepam *	Morphine *
Amitriptyline *	Diphenhydramine *	Oxazepam *
Amobarbital *	Doxepin *	Oxycodone *
Amphetamine *	Doxylamine *	Paroxetine *
Butalbital *	Ethanol *	PCP *
Carisoprodol *	Flunitrazepam *	Pentobarbital *
Chloral Hydrate	Fluoxetine *	Phenobarbital *
Chlordiazepoxide *	GHB *	Propoxyphene
Chlorpheniramine *	Hydrocodone *	Scopolamine *
Citalopram *	Hydromorphone *	Secobarbital *
Clonazepam *	Imipramine *	Sertraline *
Clonidine *	Ketamine *	THC *
Cocaine *	MDMA *	Triazolam *
Codeine *	Meprobamate *	Valproic Acid *
Cyclobenzaprine *	Methadone *	Zolpidem *

a. <u>Drugs of Abuse</u>

This section contains the drugs that comprise the SAMHSA drugs of abuse. This list includes: amphetamines, marijuana, cocaine, PCP, and opiates. Each drug will be described pharmacologically as well as whether it could be used effectively as a "date-rape" drug. While some of these drugs do not have pharmacological properties that would be desirable for incapacitating someone with the purpose of sexually assaulting them, their inclusion in this study is very important. Having the knowledge of all drugs that are in a complainants system can provide a better background into the circumstances of the assault. It is important to know if sexual assault complainants are more or less likely to have illegal drugs of abuse in their system for several reasons. One reason is that in a criminal investigation, a crime laboratory will routinely analyze for all drugs, and our research should reflect the normal protocol for sexual assault complainants.

Secondly, it helps to provide information as to whether or not the complainant was involved in risky behavior that could have placed them in a dangerous position which could have led to sexual assault. Lastly, because each complainant completes a questionnaire detailing their drug history, it is important to determine how truthful the complainants are in their self-reporting. Self-reporting is notoriously known to be different from what is actually found in someone's system. However, it is unknown how truthful sexual assault complainants are in their self-reporting. Our hypothesis is that sexual assault complainants will be more truthful than the general public in self-reporting illegal drug use. Analyzing for illegal drugs and comparing the results to the drug-use questionnaires will evaluate the validity of self-reporting among sexual assault complainants.

i. <u>Amphetamines</u>

The amphetamines being analyzed in this study include: *d*-amphetamine, *d*-methamphetamine, MDMA, and MDA. Amphetamines belong to the class of drugs known as sympathomimetic amines. Amphetamines act both peripherally and centrally with the largest effect from their action in the CNS (92). Peripherally, amphetamines raise blood pressure, increase the breathing rate, and cause tachycardia. At higher doses, this can lead to cardiac arrhythmias (93). Another smooth muscle markedly affected by amphetamines is the bladder (94). By increasing the contraction of the bladder sphincter, amphetamines can stop urine from being released. This pharmacological effect has been used for the treatment of subjects with the inability to control their urine release, such as in enuresis and incontinence.

Centrally, amphetamines are some of the most potent stimulators available. This makes their actions desirable to someone looking for an increase in their mental alertness. Truck drivers and pilots that work long hours have been known to abuse amphetamines due to the increased wakefulness and lessened sense of fatigue that they receive after taking an amphetamine (95, 96). Elation and euphoria have also been known to occur while abusing amphetamines, and this is partially responsible for amphetamine's addictive qualities (92). Amphetamines are also used as appetite suppressants, and thus may be abused by dieters as a way to control how much they eat.

These pharmacological effects are mainly due to amphetamine releasing norepinephrine and dopamine presynaptically. Amphetamines also block re-uptake of dopamine and norepinephrine and inhibit monoamine oxidase, the enzyme responsible for the metabolism of amphetamines (92, 97). All three mechanisms serve to drastically increase the amount of norepinephrine and dopamine available to bind to receptors. Very high doses of amphetamines are believed to release 5-HT in the mesolimbic system, and this is believed to cause the psychotic disturbances seen in amphetamine overdoses (98).

Methamphetamine is very similar structurally with the exception of the addition of a methyl group to the amino moiety. This addition of the methyl group increases methamphetamine's lipid solubility and allows it to cross the blood-brain-barrier much more easily. Thus, methamphetamine's actions are mainly central rather than peripheral. However, at higher doses the peripheral effects are still seen.

MDMA and MDA are analogs of methamphetamine and amphetamine, respectively. They are commonly known by their street name Ectasy, and their use among attendants of raves and parties has been well documented (99-103). MDMA and

MDA are structurally similar to the above-mentioned amphetamines; however most of their pharmacological effect is a result of an increase in serotonin (92). Both are classified as empathogens and are responsible for an increase in mood and heightened perceptions. They may also cause bruxism, hyperthermia, cardiac arrhythmias, and at high doses, death.

Clinically, amphetamines are used in the treatment of narcolepsy, anorexia, and attention deficit/hyperactivity disorder (104). MDMA and MDA are both Schedule I drugs, and thus have no clinical applications. Amphetamines mainly have stimulant properties and thus their use as a "date-rape" drug is most likely minimal. However, the psychotropic properties of MDMA and MDA may distort a victim's reality to a degree where sexually assaulting them would be easier than a sober person. Their inclusion in this study is mainly to determine a complainant's background drug use and to determine how truthful they were in describing their amphetamine use.

ii. <u>Marijuana</u>

Marijuana is still the most commonly abused illegal drug in the U.S. (105). THC, the active moiety in marijuana, is a member of the family of cannabinoids obtained from the flowers of the herb *Cannabis*. *Cannabis sativa* has several different agronomic varieties depending on growing conditions. *Cannabis* contains psychoactive compounds called cannabinoids that are found in the highest concentration in the flowering tops of the plant. There are over 60 different cannabinoids in marijuana, but Δ^9-THC is the most psychoactive, and thus the cannabinoid most often analyzed for the identification of marijuana. Marijuana is known to produce sedation, loss of aggressive behavior, and a decrease in motor skills; however it may also cause stimulation (106,

107). The exact mechanism of action of Δ^9-THC is unknown, but there are several theories as to how it exerts its effect. One theory suggests that Δ^9-THC increases the fluidity of cell membranes through its interaction with lipids (108). Another theory suggests that Δ^9-THC may affect prostaglandin synthesis, but whether it is through up-regulation or down-regulation is unknown (109).

Marijuana exerts its main effect in the CNS causing changes in mood, motor skills, self-perception and euphoria by binding to its receptor (CB1) in the brain (110). CB1 is coupled to a G protein, and when activated, modulates neurotransmitter release. "Temporal disintegration" is a term developed for marijuana's ability to alter one's sense of time along with a change in the ability to recognize one's own self (111). High doses of marijuana may produce hallucinations and paranoid feelings (112, 113).

In 1938, a propaganda film was released titled *Reefer Madness* which suggested that the abuse of marijuana leads to wanton sexual activity and murder. Recently there have been television ads produced by the Partnership for a Drug Free America® proclaiming that smoking marijuana may lead to being sexually assaulted. While this has not been explicitly proven, marijuana may cause sedation and when combined with alcohol, the sedative effects could be additive. The lost sense of time may also diminish the user's ability to identify a possible predator, and thus put them in a risky situation that they might have avoided if they were not using marijuana. Marijuana is included in this study due to its high degree of abuse, the possibility of sedation and to validate self-reporting of its use.

iii. Cocaine

Cocaine is used clinically as an anesthetic agent, but it is used illicitly for its psychotropic effects (114). Cocaine is a strong CNS stimulant that works by inhibiting the re-uptake of neurotransmitters, most notably, dopamine (115). Dopamine is very important in the reward center of the brain, and use of cocaine activates the reward center and makes the use of cocaine addictive (116). Cocaine also increases norepinephrine which raises blood pressure and increases the heart rate (117). Cocaine's effects on serotonin cause an increase in body temperature and a decrease in one's appetite (118). Cocaine is most commonly used by insufflation or by smoking the free base form known as "crack". Cocaine users report effects very similar to those described for amphetamines, and in laboratory tests, cocaine users are unable to distinguish between cocaine and amphetamine (119).

Like the amphetamines, cocaine would probably not be a suitable choice for use as a "date-rape" drug due to its stimulant properties. However, cocaine use may be correlative to the abuse of other drugs that could be used as "date-rape" drugs and may also suggest risky behavior of the complainant. Its analysis is also important to validate self-reporting among sexual assault complainants, thus its inclusion in this study.

iv. PCP

PCP is a member of the group of compounds known as arylcyclohexylamines. It was originally used clinically as an anesthetic when it was classified as a "dissociative anesthetic" (120, 121). It received this name due to PCP's ability to cause anesthesia without loss of consciousness in the subject. The subject could feel no pain due to their dissociation from the environment around them.

PCP's mechanism of action is not completely known. The currently accepted theory is that PCP blocks the cation channel for the NMDA receptor, inhibiting the activity of glutamate (122). PCP has also been shown to affect serotonin, GABA, dopamine, norepinephrine and acetylcholine (123).

PCP causes a feeling of intoxication similar to alcohol in small doses. The "fight or flight" mechanism is also activated which causes the user to become unmanageable (120). As the dose increases, there is marked anesthesia and amnesia may occur. The dissociative effects when combined with amnesia make PCP a good candidate for use as a "date-rape" drug. However, the psychosis that can develop with large doses of PCP may make a potential victim too unpredictable for a sexual assault to take place.

v. <u>Opiates</u>

There are several opiates that have been included in the analysis for "date-rape" drugs. These include: heroin, morphine, codeine, hydrocodone, hydromorphone, and oxycodone. Heroin is the only opiate that currently is a Schedule I drug, indicating that it has a high potential for abuse and *no* accepted medical use in the U.S. Morphine, the prototypical opiate, comes from the poppy plant, *Papaver somniferum.* Codeine is methoxymorphine and heroin is morphine with two acetyl groups attached to the hydroxy moieties on morphine. Hydrocodone, hydromorphone, and oxycodone are all synthesized by modifying the structure of morphine. Each of these drugs has different physiochemical properties (heroin is more lipid soluble than morphine) but all have relatively the same pharmacological properties as morphine. Thus, only morphine will be described in detail.

Morphine exerts its main effect by binding to the μ opioid receptor in the CNS causing analgesia and constipation (124). It also has some affinity for the κ and δ opioids receptors, which are responsible for the neuroendocrine effects and both supraspinal and spinal analgesia (125). The main response of morphine, analgesia, occurs through the inhibition of nociceptive neurons (126). By blocking the signal relayed by nociceptive neurons, the subject does not feel pain. The pain is still present, but the signal to perceive pain is blocked. Euphoria is also reported following morphine administration. This euphoria is not always present, as vomiting and nausea may also occur following administration of morphine. Opioids could be used as "date-rape" drugs due to the sedation and analgesia that they cause. However, prescriptions for opioids are strictly regulated and their availability may be lower than other potential "date-rape" drugs.

b. Prescription and OTC Drugs

The prescription and OTC drugs being screened have been carefully selected due to certain properties that would make them attractive in DFSA. They all share similar characteristics that make them desirable to someone that wants to incapacitate another person for the purpose of committing a sexual assault. The drugs are normally depressants or have depressive qualities that help to incapacitate the complainant from fighting back during the assault. Some of the drugs are also used due to their amnestic properties. When taken, these drugs can cause anterograde amnesia in the complainant that prevents them from remembering what happened during the assault or what events led them to being in a compromising situation. The drugs with the anterograde amnestic properties are the most insidious because the complainant usually does not remember anything and a successful conviction of the perpetrator becomes challenging. Another

quality of these drugs that makes them desirable is that they have additive sedative effects when taken with ethanol. In a nightclub, the dark, noisy conditions make it an ideal environment for a potential sexual offender to add a drug to someone's drink and have them consume it without their knowledge or consent. The alcoholic beverage can mask the taste of the drug, and then the depressant properties of alcohol combine with the drug's to incapacitate the complainant faster.

i. <u>Tricyclic Antidepressants (TCA)</u>

We have analyzed for five drugs that belong to the class of compounds called tricyclic antidepressants (TCA). They are amitriptyline, desipramine, doxepin, imipramine, and nortriptyline. Tricyclic antidepressants are used to treat depression and panic disorders (127). They work by blocking the reuptake of norepinephrine and serotonin into the presynaptic neurons, which causes an increase in the levels of these neurotransmitters able to act on the postsynaptic neuron (128, 129). This neurotransmitter increase is believed to be partly responsible for the antidepressant effects; however other mechanism may be present. It has been well established that TCAs can cause sedation in naïve users by blocking histamine (H1) receptors in the brain (130-132). Only after several weeks of treatment do the sedative effects diminish (133). TCAs are also contraindicated with the use of alcohol (134, 135). Although alcohol and TCAs work by different mechanisms, their combined sedative qualities could be dangerous. In DFSA, the drug could be added to the complainant's drink or given to the complainant under false pretenses. If the complainant is not taking TCAs regularly and/or has been drinking, they could become unresponsive and unable to stop a sexual attack.

Imipramine and its active metabolite, desipramine, are dibenzazepines which were first discovered in the 1940's as effective sedative and hypnotic agents. Studies of imipramine demonstrated that it was effective in treating depressed subjects and it became the first TCA to be used. These drugs decrease the number of times a subject wakes up and thus have been used as hypnotics for subjects exhibiting depression with the inability to fall asleep. Each TCA affects 5-HT and norepinephrine reuptake to a different degree. Desipramine is more selective for norepinephrine reuptake than 5-HT (136). It is theorized that desipramine is the active compound when imipramine is given, but this has still not been completely proven.

Amitriptyline and its active metabolite, nortriptyline, belong to the group of compounds known as dibenzocycloheptadienes. They were developed after searching for compounds that were chemically related to imipramine. Amitriptyline has been shown to have equal efficacy in blocking both norepinephrine and 5-HT, however, its activity is about 20 times less potent than desipramine. TCAs also block muscarinic cholinergic receptors, which may explain why side effects such as confusion are seen (137). Amitriptyline blocks these receptors about 100 times more effectively than desipramine, and thus sedation is more pronounced with amitriptyline.

Doxepin is a dibenzoxepin compound that closely resembles amitriptyline in blocking both norepinephrine and 5-HT equally (138). However, doxepin demonstrates the highest degree of sedation due to its blocking H1 receptors more than the other TCAs (138). Thus, doxepin's ability to effectively block both cholinergic and histaminic receptors gives it the highest level of sedative qualities of all of the TCAs (132).

ii. Selective Serotonin Reuptake Inhibitors (SSRI)

SSRI's are a relatively new class of drugs that have been indicated for the treatment of depression, anxiety, obsessive-compulsive disorder, bulimia nervosa, and sometimes premenstrual dysphoric disorder (139-143). SSRI's work in a similar manner to TCAs, but are targeted to serotonin with little to no effects on norepinephrine (144). By selectively targeting serotonin, many of the side effects seen with TCAs are not seen with SSRI's. While it is commonly accepted that SSRIs produce more activation than sedation as compared to TCAs, a recent meta-analysis of 36 clinical trials for TCAs and SSRIs determined that **both** TCAs and SSRIs produced more sedation than activation (145). SSRIs are contraindicated with the use of alcohol, especially in naïve users. Before the subject knows how SSRIs affect them, they are cautioned against the use of alcohol or other depressants. In DFSA, complainants that are not on SSRIs are more likely to feel the sedative effects, especially if they have been using alcohol or other sedatives. Our analysis looked for citalopram, fluoxetine, paroxetine, and sertraline. Due to the large number of prescriptions that are written for these drugs (some estimates place worldwide usage at over 40 million people), we have been cautious in the interpretation of our results since some of the complainants may have valid prescriptions.

Citalopram is the most selective of the SSRIs, mainly inhibiting serotonin uptake. All SSRIs have little activity blocking histaminic receptors and this probably represents why sedation is not seen as often in SSRIs as in TCAs. A literature search revealed that fluoxetine and sertraline have more activation properties where as paroxetine and citalopram have more sedative properties (146). Their inclusion as possible "date-rape"

drugs is important since they have demonstrated sedative properties, especially in naïve users. When combined with alcohol, prominent sedation may be demonstrated.

iii. Muscle Relaxants

Muscle relaxants are powerful drugs that are used to help subjects deal with pain from muscular injuries and post-operative pain. These drugs work by blocking the signals that are sent from nociceptive neurons to the brain (147). By blocking these pathways, the pain signal is unable to reach the brain to be processed and thus, the subject is unaware of the pain. Carisoprodol, cyclobenzaprine, and meprobamate are the muscle relaxants screened for in this study. These drugs are contraindicated with antihistamines, sedative-hypnotics, and alcohol and are not normally prescribed to someone with a history of addiction. Prescriptions of these drugs may not be completely used, leaving the subject with extra pills in case of further pain. This creates the problem of family and friends having access to a potential "date-rape" drug. A potential complainant could be given a muscle relaxant surreptitiously or take it voluntarily with the hopes of further intoxication. However, if they are mixing these drugs with alcohol, they will most likely become extremely tired and may even pass out. This puts the complainant in a dangerous situation where they could be sexually assaulted while they are unconscious.

Carisoprodol is currently an unscheduled drug, but its active metabolite, meprobamate is schedule IV. Meprobamate has been shown to be addictive and some experts have suggested that using carisprodol may lead to addiction (148). One study showed that subjects using carisoprodol, especially those with addictive tendencies, may abuse it if the drug is administered for more than three months (149). Cyclobenzaprine is not as addictive as carisoprodol and is structurally related to TCAs such as imipramine

and amitriptyline, therefore, all side-effects mentioned above for the TCAs may be applied to cyclobenzaprine (150).

iv. Benzodiazepines and Barbiturates

Benzodiazepines and barbiturates are classes of drugs that are used in the treatment of anxiety and for the induction of sleep (151). Benzodiazepines are prescribed over barbiturates because benzodiazepines are safer and more efficacious (151). According to the NFLIS, barbiturates currently represent about 0.15% of all drugs seized by law enforcement agencies. However, there is still access to barbiturates and their inclusion in the analysis is important.

Both drug classes work by different mechanisms to enhance the action of GABA neurons (152, 153). GABA is a very important inhibitory neurotransmitter and the enhancement that these drugs provide allows better inhibition of neuron firing and the resulting decrease in neuronal activity. All of these drugs have sedative properties and their combination with alcohol is very drastic and sometimes lethal. Table III shows the relative duration of action for the benzodiazepines and barbiturates. The screening process employed by USDTL is capable of detecting most benzodiazepines and barbiturates; however there are several that may be missed in their screening. The immunoassay detects oxazepam and any benzodiazepine that is not metabolized to oxazepam has very low cross-reactivity. Therefore, the analysis conducted at UIC selectively looked for any drugs that may be missed in the USDTL screening.

Amobarbital and butalbital comprise the two barbiturates that were screened for selectively. Alprazolam, chlordiazepoxide, clonazepam, flunitrazepam, and triazolam are the benzodiazepines that were selectively screened. While all benzodiazepines have

some amnestic properties, flunitrazepam is widely known to have severe amnestic qualities (154). Anecdotal accounts of flunitrazepam use in DFSA have indicated that the complainant had no knowledge of the assault even though they may have been awake during the assault (31). There are also accounts of the complainant only learning of the assault after seeing it on a videotape confiscated from the suspect (155). These two classes of drugs have all of the properties that a DFSA assailant would want. With the incapacitation that they provide, their synergy with alcohol, and their amnestic properties, they can easily be used to sexually assault someone without fear of being caught. LeBeau *et al.* (36) have also noted that routine drug analyses will often miss many benzodiazepines due to their low cross-reactivity with immunoassay techniques and low concentrations following a single dose.

TABLE III. DURATION OF ACTION OF SOME COMMON BENZODIAZEPINES AND BARBITURATES.

	Short Duration	**Medium Duration**	**Long Duration**
Benzodiazepines	Alprazolam Lorazepam Oxazepam Triazolam	Estazolam Temazepam	Clorazepate Chlordiazepoxide Clonazepam Diazepam Flunitrazepam Flurazepam Quazepam
Barbiturates	Thiopental	Amobarbital Pentobarbital Secobarbital	Butalbital Phenobarbital

v. Zolpidem

Zolpidem is a member of the imidazopyridine class of compounds and is a sedative-hypnotic similar to benzodiazepines. While structurally different from benzodiazepines, zolpidem interacts with the same receptor with one main difference. Benzodiazepines interact with three distinct receptors, omega-1, omega-2, and omega-3, while zolpidem selectively interacts only with omega-1 (156). Omega-1 is responsible for the sedative effects and omega-2 is responsible for impairments in memory and cognitive function (157). By selectively activating only the omega-1 receptor, zolpidem only causes sedation without the deleterious side effects and is more desirable than benzodiazepines. However, because it does cause sedation, it is included as a possible "date-rape" drug.

vi. Antihistamines

Antihistamines are a class of drugs that most people would not associate with DFSA. These drugs are used in the treatment of allergies by blocking histamine in our bodies, the substance responsible for allergic reactions. One of the main side effects with the use of antihistamines is sedation (158, 159). When combined with alcohol or other sedatives, the effects will be additive and may put the complainant at risk for a sexual assault. We have screened for chlorpheniramine, diphenhydramine, and doxylamine, all first generation antihistamines. The first generation histamines have more undesirable side effects than second generation antihistamines (most notably sedation), but the first generation are still used because they are inexpensive and effective (160-162). Diphenhydramine has also been shown to be a potent cholinergic inhibitor which increases its sedative qualities (163). All of these drugs are contraindicated with

alcohol and are available over-the-counter. This increases the chance of their use in DFSA due to their wide availability. Typical toxicological screens are not set-up for the detection of antihistamines and their inclusion in this study was important. However, those with allergies commonly use these drugs and any interpretation of the results has taken this into account.

vii. Clonidine

Clonidine is a direct-acting agonist of α_2-adrenergic receptors. The α_2 receptor is located pre-synaptically and its activation leads to feedback inhibition and a decrease in the amount of norepinephrine released. Clonidine is used mainly for the treatment of hypertension, but has also been shown to be effective in the treatment of withdrawal from several drugs (164, 165). Clonidine can produce sedation and one study demonstrated its effectiveness as a sedative for subjects who require mechanical ventilation (166). Clonidine has also been shown to cause amnesia through activation of a G-protein (167). It is possible for clonidine to act synergistically with other sedatives and thus its inclusion in this study.

viii. Scopolamine

Scopolamine is an anti-muscarinic agent of the belladonna alkaloid family, of which atropine is a member. However, scopolamine differs from atropine in that scopolamine blocks the formation of short-term memories due to its higher affinity in the CNS (168). Scopolamine also produces a higher degree of sedation than atropine, again due to the higher degree of penetration into the CNS. Therapeutically, scopolamine is used to prevent motion sickness, but its amnestic qualities have made it desirable for criminals wishing to “erase” the memories of their victims. In South America, where it is

known as burundanga, criminals have been using it to rob and kidnap victims for decades. A literature search did not reveal any extensive illegal use of scopolamine in the U.S., however, its use for DFSA could become popular and thus its inclusion.

ix. Valproic Acid

Valproic acid is an anticonvulsant used to control most types of seizures (169). Its exact mechanism is not completely understood, but it is assumed that valproic acid works with GABA to decrease neuronal activity (170). Thus it has the sedative qualities seen in barbiturates, benzodiazepines, and GHB which all act on the GABA receptor. It is molecularly very similar to GHB and a dual analysis with GHB was conducted. Valproic acid is known to cause sedation and will enhance the effects of alcohol and other sedatives.

II. MATERIALS AND METHODS

A. Materials

Doxylamine succinate (1 mg/mL), Carisoprodol (1 mg/mL), and Cyclobenzaprine HCl (1 mg/mL) were purchased from Alltech (State College, PA). Norketamine HCl (1 mg/mL), 7-Aminoflunitrazepam (1 mg/mL), 7-Aminoflunitrazepam-D7 (100 μg/mL), 7-Aminoclonazepam (1 mg/mL), Alprazolam (1 mg/mL), Norfluoxetine-D6 (100 μg/mL), Paroxetine-D6 (100 μg/mL), Hydromorphone (1 mg/mL), Meprobamate (1 mg/mL), Chlorpheniramine maleate (1 mg/mL), Diphenhydramine HCl (1 mg/mL), Doxepin (1 mg/mL), Amitriptyline (1 mg/mL), Desipramine HCl (1 mg/mL), Desipramine-D3 HCl (100 μg/mL), α-Hydroxyalprazolam (100 μg/mL), α-Hydroxytriazolam (100 μg/mL), Desmethyldoxepin (100 μg/mL), GHB-D6 (100 μg/mL), Butalbital (1 mg/mL), Butalbital-D5 (100 μg/mL), Oxycodone (1 mg/mL), Triazolam (1 mg/mL), Hydrocodone (1 mg/mL), Paroxetine maleate (1 mg/mL), Chlordiazepoxide (1 mg/mL), Nortriptyline (1 mg/mL), Norfluoxetine Oxalate (1 mg/mL), Dextromethorphan (1 mg/mL), Clonidine (1 mg/mL), Imipramine (1 mg/mL), Imipramine-D3 (100 μg/mL), Nortriptyline-D3 HCl (100 μg/mL), Hydrocodone-D6 (100 μg/mL), Hydromorphone-D6 (100 μg/mL), Oxycodone-D6 (100 μg/mL), Oxazepam (1 mg/mL), Cocaine (1 mg/mL), Methamphetamine (1 mg/mL), Amphetamine (1 mg/mL), MDMA (1 mg/mL), PCP (1 mg/mL), 11-nor-9-Carboxy-Δ^9-THC (100 μg/mL), Morphine (1 mg/mL), 6-Acetylmorphine (1 mg/mL), Codeine (1 mg/mL), and Amobarbital (1 mg/mL) were purchased from Cerilliant Corporation (Round Rock, TX). Citalopram (1 mg/mL), Scopolamine (1 mg/mL), Valproic Acid (1 mg/mL), Zolpidem (1 mg/mL), and Sertraline (1 mg/mL) were purchased from Utak Laboratories (Valencia, CA). Methanol (HPLC

grade), glacial acetic acid (HPLC grade), methylene chloride (HPLC grade), isopropanol (HPLC grade), ethyl acetate (HPLC grade), acetonitrile (HPLC grade), sodium phosphate (dibasic), and concentrated ammonium hydroxide (certified A.C.S. Plus) were purchased from Fisher Scientific (Hanover Park, IL). The derivatizing agent, Bis(trimethylsilyl)trifluoroacetamide + 1% Trimethylchlorosilane (BSTFA + 1% TMCS), was purchased from Campbell Supply Company (Rockton, IL). The enzyme β-glucuronidase (Type H-2 crude solution, 100,350 units/mL from Helix pomatia) was acquired from Sigma (St. Louis, MO). The Clean Screen® Column extraction columns were purchased from United Chemical Technologies, Inc. (Bristol, PA). The high purity nitrogen gas was purchased from AGA (Hammond, IN).

B. Recruitment of Subjects and Collection of Specimens

The UIC IRB approved the protocol being used for this project. Since subject recruitment and specimen collection took place at remote clinical sites, local IRB approval was also required. In one exceptional case that did not have a recognized IRB, a Single Project Assurance was obtained from the National Institute of Justice, the project sponsor.

This study was being conducted in four clinical facilities across the country (Figure 2). Many hospitals and clinics were approached to determine if they would be interested in participating in this sexual-assault study. The protocol required that the facility agree to serve as a recruiting and specimen collection site, and that it cooperate in obtaining appropriate, multiple IRB approvals. The protocol further called for the collection of two specimens for each volunteer, first at presentation, and second about a week later. Clinical settings with no provision for follow-up were not considered.

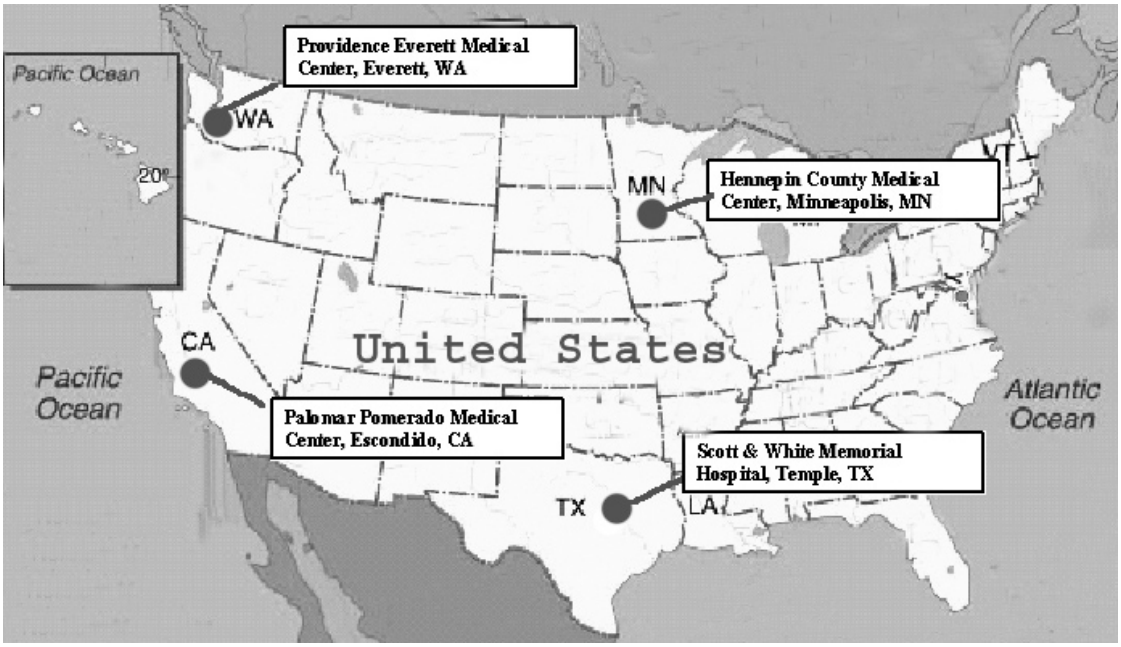

Figure 2. Map of the U.S. showing where the four submitting sites are located.

If a hospital or clinic agreed to participate, urine and hair collection kits were prepared and sent. The kit consisted of two packages, one for the initial visit and one for the follow-up visit.

Initial Visit Kit

1. IRB approved consent form (2)
2. Script for nurse to follow to introduce study to potential subject
3. Urine collection container
4. Pre-addressed and pre-paid UPS package

Follow-up Visit Kit

1. Questionnaire regarding drugs used by subject and description of assault
2. Urine collection container
3. Hair collection envelope
4. Pre-addressed and pre-paid UPS package

When someone reported to the clinic for a sexual assault examination, the nurse who treated the subject asked him or her if they were interested in participating in this study. If the subject agreed, the initial visit package was then opened. The nurse used the script so that they could explain any research risks to the subject and what protections had been implemented. The script also helped explain that the subject's name would never be used and that there was no chance that the researchers conducting the drug screen would be able to match their urine back to them. The urine container provided held up to 30 mL of urine and the subject was asked to furnish as much as possible. The more urine that was collected meant the more tests that could be performed. The signed consent form was retained by the clinic, but an unsigned copy was returned, signifying that the subject had the script read to them and that they understood and agreed with the research protocol. The only identifying characteristic on the consent form is the subject's date of birth (DOB). After the script had been read and the subject had agreed to participate, they signed the consent and provided the urine specimen. The urine container was then securely sealed and placed into a sealable polypropylene bag. This was then placed into two more containers before finally being ready to be shipped. The subject was then asked by the nurse to return to the hospital in one week for a follow-up visit,

however, there was no guarantee that the subject would return. They were also informed that if they did return, they would be compensated to cover any expenses (babysitter, transit costs, loss of work) that they may incur as a result of the second visit. If the subject returned the second time, the second visit package was then opened. The nurse asked again for the subject to fill the urine container as much as possible. The nurse then completed the questionnaire to provide a background as to what happened during the sexual assault, what drugs they were using the day of the assault, and whether they believe that they were given a drug without their consent before the sexual assault. The nurse then cut a specimen of the complainant's hair and placed the specimen in the provided hair package. Representative hair specimens were provided to each hospital so that the amount of hair needed was known. The urine, the hair, and the questionnaire were then packaged and shipped in the same manner as the first visit. The subject was financially compensated and concluded their participation in this study.

When a specimen arrived in our laboratory, it was either immediately processed or placed in a refrigerator until it could be properly handled. All of the packaging was removed and destroyed, if there was a biohazard concern. The specimen was then given a unique identifying code based on where the specimen came from, the subject's DOB, and the visit this specimen represented. An example of this code is **SW111477-1**. This represents the initial visit of a subject from the Texas clinic, born on November 14, 1977. This code was placed on the consent form, the questionnaire, the urine specimens, and the hair specimen. We then insured that the consent form had been properly filled out and included, and it was then filed in our records. The urine specimen was then processed by first placing the specimen code in at least two places on the urine container.

Ten milliliters of the subject's urine was transferred to a separate tube that had also been labeled twice. The separate tube was analyzed at our partner laboratory and the original urine container was retained at our laboratory for analysis. The second visit specimen was treated the same way as the first, but instead of a consent form, a questionnaire was received and properly filed. We also received a hair specimen that was properly labeled and securely stored in our laboratory for eventual analysis.

Screening of the specimens for common drugs of abuse was done at the USDTL. Their screening and confirmation methods were subject to approval by our laboratory. All testing for OTC, prescription and "date-rape" drugs was done in our laboratory.

C. USDTL Methods

a. Screening for Drugs of Abuse in Urine Using Enzyme Multiplied Immunoassay Technique (EMIT)

This method was done on an Olympus AU640 at USDTL for the detection of amphetamines, marijuana, opiates, PCP, cocaine, methadone, barbiturates, benzodiazepines, and ethanol. Of the original urine specimen sent from the hospital, half of the volume (up to 10 mL) was used for this analysis. EMIT is a homogenous enzyme immunoassay technique which is based on the competition to bind to antibodies specific for a certain drug between drug in the urine and enzyme-labeled drug which is added to the specimen. The enzyme's activity decreases when it binds to the antibody, thus the more drug present in the urine, the more the enzyme can catalyze the conversion of NAD to NADH. The instrument measures this conversion of NAD to NADH spectrophotometrically and reports a value.

The urine specimens were initially assigned a unique USDTL number, which was used to track the specimen throughout its analysis. A printed barcode of this number was

then printed and affixed to a clean 13 x 100 mm polypropylene tube. To the tube, approximately 0.5 mL of the corresponding specimen urine was added. This was done for all specimens that were analyzed that day. Once this step was completed, the specimens were ready to be analyzed on the Olympus AU640.

There are two reagents (Reagent 1 and Reagent 2) for each class of drug that was to be analyzed. Reagent 1 is the Antibody/Substrate which contains either mouse monoclonal or sheep polyclonal antibodies that are reactive to the drug of interest. For example, the amphetamines Reagent 1 contains mouse monoclonal antibodies reactive to *d*-methamphetamine and *d*-amphetamine. Reagent 1 also contains bovine serum albumin, glucose-6-phosphate, NAD, stabilizers, and preservatives. Reagent 2 contains the enzyme-labeled drug, Tris/HEPES buffer, bovine serum albumin, stabilizers and preservatives. For example, the amphetamine Reagent 2 contains amphetamines labeled with glucose-6-phosphate dehydrogenase.

At the beginning of the analysis, certified calibration standards were run and verified to determine that the instrument was working properly. If the calibration standards passed, the specimens were analyzed. Of the total number of specimens analyzed, ten percent were controls to further validate that the instrument was working properly. These controls were made up of certified negative controls, below threshold positive controls and above threshold positive controls. The threshold was an established cut-off value, above which the specimen was positive and below which the specimen was negative. In order for the analysis to be acceptable, the negative control and the below threshold control must be negative and the above threshold control must be positive throughout the entire run. Once all specimens and controls were analyzed, a report was

printed documenting the results of the analysis. Positive specimens were flagged as to which drugs they were positive for and were ready to be prepared for the confirmation analyses. If alcohol was found, it was quantitated against known standards. Any specimen that was negative for all drugs completed its analysis for the above-mentioned drugs.

b. <u>Confirmation of Amphetamine and Methamphetamine</u>

Sample Preparation

The internal standards (d_5-Amphetamine and d_8-Methamphetamine) were first added to 1.0 mL of urine to give a final concentration of 500 ng/mL. This was followed by the addition of 2.0 mL of 0.1M-phosphate buffer (pH 6) and 0.1 mL of 0.8 N periodic acid and the subsequent heating of the samples at 60^{o}C for 10 minutes. Once the samples cooled, they were ready for extraction on mixed mode (cation and hydrophobic) solid-phase extraction columns (200 mg bed) UCT.

Column Conditioning

1. 3.0 mL of methanol was added
2. 3.0 mL of water was added
3. 3.0 mL of 0.1 M phosphate buffer (pH 6) was added

Add Sample

Column Clean-up

1. 2.0 mL of water was added and dried for 1 minute under vacuum
2. 1.0 mL of 1.0 M acetic acid was added and dried for 1 minute under vacuum
3. 3.0 mL of methanol was added and dried for 5 minutes under vacuum

Elute Sample

1. 3.0 mL of methylene chloride:isopropanol:ammonia (80:20:2) was added

2. Eluate dried at 17 psi and 55^{o}C using a Turbo Vap evaporator

3. One drop of 0.2% succinic acid in acetone was added after 5 minutes
4. A second drop of 0.2% succinic acid in acetone was added after another 5 minutes.

Sample Derivatization

1. 100 μL of butyronitrile was added and then transfered to autosampler vials

2. 30 μL of MBHFBA was added and heated at 80^{o}C for 20 minutes

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.20 mm ID, 0.33 μm film thickness, 12 m length.	
GC Conditions:	Injector Temp:	250 ^{o}C
	Transfer Line Temp:	270 ^{o}C
	Start Temp:	100^{0}C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	100^{0}C; Hold for 1 min; Ramp at 15 ^{o}C/min to 190^{o}C; Hold for 0.0 min. Total Run Time = 7.0 min.
MS in SIM mode:		
	Group 1 Ions:	244*, 123 (d_5 Amphetamine), 240*, 118, 91 (Amphetamine)
	Group 2 Ions:	261*, 213 (d_8 Methamphetamine), 254*, 210, 118 (Methamphetamine)

*Quantifying Ion
Dwell Time for all ions was 50 msec

Quantitation

The standard curve ranged from 500 ng/mL to 2000 ng/mL. Samples with values below 500 ng/mL were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve.

c. <u>Confirmation of Benzoylecgonine (Metabolite of Cocaine)</u>

Sample Preparation

The internal standard (d_3-Benzoylecgonine) was first added to 1.0 mL of urine to give a final concentration of 200 ng/mL. The sample was then centrifuged for 5 minutes at 2000 rpm and following centrifugation, 2.0 mL of 0.1M phosphate buffer (pH 6) was added. The samples were now ready for extraction on mixed mode (cation and hydrophobic) solid-phase extraction columns (200 mg bed) UCT.

Column Conditioning

1. 3.0 mL of methanol was added
2. 1.0 mL of water was added
3. 1.0 mL of 0.1 M phosphate buffer (pH 3) was added

Add Sample

Column Clean-up

1. 2.0 mL of water was added and dried for 1 minute under vacuum
2. 1.0 mL of 0.1 N hydrochloric acid was added and dried for 1 minute under vacuum
3. 3.0 mL of methanol was added and dried for 5 minutes under vacuum

Elute Sample

1. 3.0 mL of methylene chloride:isopropanol:ammonia (80:20:2) was added

2. Eluate dried at 17 psi and 55^{o}C using a Turbo Vap evaporator

Sample Derivatization

1. 30 μL of butyronitrile was added and then transfered to autosampler vials

2. 40 μL of MTBSTFA was added and heated at 80^{o}C for 20 minutes

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.20 mm ID, 0.33 μm film thickness, 12 m length.	
GC Conditions:	Injector Temp:	270 ^{o}C
	Transfer Line Temp:	310 ^{o}C
	Start Temp:	150^{0}C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	150^{0}C; Hold for 1 min; Ramp at 55 ^{o}C/min to 230^{o}C; Hold for 0.0 min, then ramp 4^{o}C/min to 250^{o}C; Hold for 0.0 min. Total Run Time = 7.45 min.
MS in SIM mode:		
	Group 1 Ions:	406*, 285 (d_3 Benzoylecgonine), 403*, 346, 282 (Benzoylecgonine)

*Quantifying Ion
Dwell Time for all ions was 50 msec

Quantitation

The standard curve ranged from 150 ng/mL to 1000 ng/mL. Samples with values below 150 ng/mL were reported as negative, samples within the standard curve were

reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve.

d. <u>Confirmation of Morphine and Codeine</u>

Sample Preparation

The internal standards (d_3-Morphine and d_3-Codeine) were first added to 1.0 mL of urine to give a final concentration of 200 ng/mL. Morphine glucuronide was cleaved by the addition of 100 μL of β-glucuronidase and 2.0 mL of 2.0 M Acetate Buffer (pH 4.8). The samples were then capped, vortexed, and heated at 55^{o}C for two hours. Once the samples cooled, they were ready for extraction on Clean Screen Extraction Columns (200 mg bed) UCT.

Column Conditioning

1. 3.0 mL of methanol was added
2. 3.0 mL of water was added
3. 1.0 mL of 0.1 M phosphate buffer (pH 6) was added

Add Sample

Column Clean-up

1. 2.0 mL of water was added and dried for 1 minute under vacuum
2. 2.0 mL of 2.0 M acetate buffer (pH 4.8) was added and dried for 1 minute under vacuum
3. 3.0 mL of methanol was added and dried for 5 minutes under vacuum

Elute Sample

1. 3.0 mL of methylene chloride:isopropanol:ammonia (80:20:2) was added
2. Eluate dried at 17 psi and 60^{o}C using a Turbo Vap evaporator

Sample Derivatization

1. 50 μL of ethanol was added and then transfered to autosampler vials
2. 50 μL of BSTFA was added and heated at 80^{o}C for 20 minutes

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.20 mm ID, 0.33 μm film thickness, 12 m length.	
GC Conditions:	Injector Temp:	250 ^{o}C
	Transfer Line Temp:	250 ^{o}C
	Start Temp:	100^{0}C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	100^{0}C; Hold for 1 min; Ramp at 25 ^{o}C/min to 230^{o}C; Hold for 0.0 min. Ramp at 3^{o}C/min to 250^{o}C; Hold for 0.0 min. Total Run Time = 12.87 min.
MS in SIM mode:		
	Group 1 Ions:	374*, 346 (d_3 Codeine), 371*, 343, 243 (Codeine)
	Group 2 Ions:	432*, 417 (d_3 Morphine), 429*, 430, 401 (Morphine)

*Quantifying Ion
Dwell Time for all ions was 100 msec

Quantitation

The standard curve ranged from 300 ng/mL to 1000 ng/mL. Samples with values below 300 ng/mL were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve.

e. <u>Confirmation of Oxazepam</u>

Sample Preparation

The internal standard (d_5-Oxazepam) was first added to 1.0 mL of urine to give a final concentration of 300 ng/mL. Oxazepam glucuronide was first cleaved by the addition of 100 μL of β-glucuronidase and 2.0 mL of 2.0 M Acetate Buffer (pH 4.8) followed by capping, vortexing, and heating the sample at 65^{o}C for two hours. The sample was then centrifuged for 10 minutes at 2000 rpm and the resulting pellet was discarded. The samples were now ready for extraction on mixed mode (cation and hydrophobic) solid-phase extraction columns (200 mg bed) UCT.

Column Conditioning

1. 3.0 mL of methanol was added
2. 1.0 mL of water was added
3. 1.0 mL of 0.1 M phosphate buffer (pH 6) was added

Add Sample

Column Clean-up

1. 2.0 mL of water was added and dried for 1 minute under vacuum
2. 2.0 mL of 20% acetonitrile in 0.1 M phosphate buffer (pH 6) was added and dried for 5 minute under vacuum
3. 2.0 mL of hexane was added and dried for 5 minutes under vacuum

Elute Sample

1. 3.0 mL of ethyl acetate was added
2. Eluate dried at 40^{o}C

Sample Derivatization

1. 50 μL of ethyl acetate was added and then transfered to autosampler vials

2. 50 μL of BSTFA + 1% TMCS was added and heated at 80^{o}C for 20 minutes

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.20 mm ID, 0.33 μm film thickness, 12 m length.	
GC Conditions:	Injector Temp:	250 ^{o}C
	Transfer Line Temp:	230 ^{o}C
	Start Temp:	100^{0}C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	100^{0}C; Hold for 1 min; Ramp at 30 ^{o}C/min to 250^{o}C; Hold for 0.5 min, then ramp 10^{o}C/min to 280^{o}C; Hold for 0.0 min. Total Run Time = 9.5 min.
MS in SIM mode:		
	Group 1 Ions:	434*, 435 (d_5 oxazepam), 429*, 430, 313 (oxazepam)

*Quantifying Ion
Dwell Time for all ions was 50 msec

Quantitation

The standard curve ranged from 300 ng/mL to 1000 ng/mL. Samples with values below 300 ng/mL were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve.

f. <u>Confirmation of PCP</u>

Sample Preparation

The internal standard (d_5-PCP) was first added to 1.0 mL of urine to give a final concentration of 100 ng/mL. To this, 2.0 mL of 0.1M phosphate buffer (pH 6) was added and the samples were ready for extraction on mixed mode (cation and hydrophobic) solid-phase extraction columns (200 mg bed) UCT.

Column Conditioning

1. 3.0 mL of methanol was added
2. 3.0 mL of water was added
3. 1.0 mL of 0.1 M phosphate buffer (pH 6) was added

Add Sample

Column Clean-up

1. 2.0 mL of water was added and dried for 1 minute under vacuum
2. 2.0 mL of 1.0 M acetic acid was added and dried for 5 minutes under vacuum
3. 3.0 mL of methanol was added and dried for 10 minutes under vacuum

Elute Sample

1. 3.0 mL of methylene chloride:isopropanol:ammonia (80:20:2) was added
2. Eluate dried at 17 psi and 37^{o}C using a Turbo Vap evaporator

Preparation of Sample for GC/MS

1. 30 μL of butyronitrile was added and then transfered to autosampler vials
2. 20 μL of BSTFA + 1% TMCS was added and heated at 80^{o}C for 10 minutes (Only increased stability)

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.20 mm ID, 0.33 μm film thickness, 12 m length.	
GC Conditions:	Injector Temp:	220 ^{o}C
	Transfer Line Temp:	300 ^{o}C
	Start Temp:	120^{0}C
	Injection Mode:	Splitless
	Purge Time On:	0.5 min
	Program:	120^{0}C; Ramp at 25 ^{o}C/min to 280^{o}C; Hold for 0.4 min. Total Run Time = 9.4 min.
MS in SIM mode:		
	Group 1 Ions:	205*, 248 (d_5 PCP), 200*, 243, 242 (PCP)

*Quantifying Ion
Dwell Time for all ions was 50 msec

Quantitation

The standard curve ranged from 25 ng/mL to 100 ng/mL. Samples with values below 25 ng/mL were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve.

g. <u>Confirmation of Carboxy-THC</u>

Sample Preparation

The internal standard (d_3-Carboxy-THC) was first added to 1.0 mL of urine to give a final concentration of 50 ng/mL. Conjugated Carboxy-THC was cleaved by the addition of 200 μL of 12N NaOH, followed by vortexing and heating for 20 minutes at 60^{o}C. Once the samples cooled, they were neutralized with the addition of 2.0 mL of

glacial acetic acid. The samples were now ready for extraction on Clean Screen solid-phase extraction columns (200 mg bed) UCT.

Column Conditioning

1. 3.0 mL of hexane/ethyl acetate (75:25) was added
2. 3.0 mL of methanol was added
3. 3.0 mL of water was added
4. 1.0 mL of 0.1 M hydrochloric acid was added

Add Sample

Column Clean-up

1. 2.0 mL of water was added and dried for 1 minute under vacuum
2. 2.0 mL of 0.1 M hydrochloric acid/acetonitrile (70:30) was added and dried for 5 minutes under vacuum
3. 0.2 mL of hexane was added and dried for 1 minute under vacuum

Elute Sample

1. 3.0 mL of hexane/ethyl acetate (75:25) was added
2. Eluate dried at 17 psi and 55^{o}C using a Turbo Vap evaporator

Sample Derivatization

1. 50 μL of ethanol was added and then transfered to autosampler vials
2. 50 μL of MTBSTFA was added and heated at 80^{o}C for 20 minutes

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.20 mm ID, 0.33 μm film thickness, 12 m length.	
GC Conditions:	Injector Temp:	270 ^{o}C
	Transfer Line Temp:	310 ^{o}C
	Start Temp:	150^{0}C

	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	150^0C; Hold for 1 min; Ramp at 35 ^{o}C/min to 280^{o}C; Hold for 0.0 min. Ramp at 5^{o}C/min to 305^{o}C; hold for 0 min. Total Run Time = 9.71 min.
MS in SIM mode:		
	Group 1 Ions:	518*, 575, 416 (d_3 Carboxy-THC), 515*, 572, 413 (Carboxy-THC)

*Quantifying Ion
Dwell Time for all ions was 100 msec

Quantitation

The standard curve ranged from 15 ng/mL to 75 ng/mL. Samples with values below 15 ng/mL were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve.

D. <u>UIC Laboratory Methods</u>

a. <u>Screening for OTC and Prescription Drugs</u>

Recently, the Society of Forensic Toxicologists (SOFT) created a Sexual Assault Committee designed to tackle the issue of DFSA in the Toxicology field. Two of the members of this laboratory are members of the committee and aided in preparing a list of drugs that could be, or have been, used in DFSA. The list comprises about 50 compounds, including illicit, prescription, and over-the-counter drugs. Our partner laboratory, USDTL, is able to screen and confirm all major DOA's, such as cocaine, amphetamines, benzodiazepines, barbiturates, opiates, methadone, alcohol, and PCP. A screening and confirmation method was needed to analyze for the other drugs, mostly

OTC and prescription drugs, but also the specific “date-rape” drugs flunitrazepam, GHB, and ketamine.

A catalog search of UCT’s list of available solid-phase extraction columns aided us in finding a column that best suited our needs. UCT provided a recommended method for the analysis of acidic, basic, and neutral compounds using only two milliliters of urine and one Clean Screen® Column. First, each drug was separately derivatized with BSTFA + 1% TMCS and analyzed on the GC/MS using a standard ramping program. Although derivatization does not occur with each drug, consistency was maintained with the method of analysis. The corresponding mass spectrum for each drug was then either compared to literature spectra, or if no known spectrum was available, the fragmentation pattern was compared to the structure of the compound and evaluated as to whether it was similar to what would be expected. Then, either three or four ions were chosen for each compound, preferably ions above m/z 100. A selected ion monitoring (SIM) program was then established that would scan for the chosen three or four ions around the retention time of the compound. The final SIM program was quite complex, however, the sensitivity was increased because every compound was not being scanned at each moment in time, but rather only those compounds that would elute at a certain window of time. Each compound’s representative mass spectrum was then added to a spectral library, which would allow for each subject’s sample to be scanned quickly and have a list of possible drug matches printed out.

After each of the 30 compounds was analyzed, they were divided into two groups of 15. These two groups were then spiked into blank urine creating spiked control urines that would be run with each analysis to insure that each drug was still being detected.

The extraction method was then tested to determine if the method that UCT provided would work for all of our compounds. The two spiked urines were analyzed along with two blank urines. The extraction process began with cleavage of any glucuronide conjugates with the addition of 50 μL of β-glucuronidase and 1.0 mL of ammonium acetate, pH 4.5. The cleavage was done in capped test tubes at 37 ^{o}C for 60 minutes. The UCT method did not detail β-glucuronidase cleavage, and thus we had already modified their method. This, however, produced a new problem. Following UCT's method, the pH of the column is crucial for efficient extraction. Because 1.0 mL of an acidic solution had been added to the urine, this resulted in the pH being too acidic. It was then determined that to correct for this pH difference, 3.0 mL of 0.1 M sodium phosphate, dibasic, pH 9 should be added to the urine following the enzyme cleavage.

Following cleavage, the extraction columns were then prepared prior to addition of the sample. First, 3.0 mL of methanol was added to each column and allowed to flow through the column. Next, 3.0 mL of water was added, followed by 1.0 mL of 0.1 M sodium phosphate, dibasic, pH 6.0. Care was taken in these preparatory steps to not allow the columns to dry, as this will negatively affect the resulting chromatography. The samples were then added to the columns and allowed to flow through at about 1-2 mL/min. This allowed sufficient time for all of the compounds to bind to the column. The columns were then washed with 3.0 mL of water and dried under vacuum which was followed by the addition of 1.0 mL of 1.93M acetic acid and vacuum drying for 5.0 minutes. Finally, 2.0 mL of hexane was added and each column was thoroughly dried. The elution vials were then placed under each column to allow for collection of the eluent. The first elution solvent was 3.0 mL of hexane:ethyl acetate (50:50). Once all of

the elution solvent had traveled through the column, the elution vials were recovered and dried under N_2. These vials contained the acidic and neutral drugs present in the sample. While Fraction 1 was drying, 3.0 mL of methanol was added to each column and vacuum-dried for 5.0 minutes. Once each elution vial was thoroughly dried, they were again placed underneath the columns, and Fraction 2 was eluted. The second elution solvent was methylene chloride:isopropanol:ammonia (78:20:2) and this eluted the basic drugs. The elution solvent was again dried under N_2 and the vials now contained all compounds from both fractions. 30 μL of acetonitrile was added to each dried residue and each vial was vortexed. Each vial was then transferred to a pre-labeled autosampler vial and 50 μL of BSTFA + 1% TMCS was added to create silylated derivatives, if possible. The autosampler vials were heated at 60^{o}C for 30 minutes to allow for complete derivatization. After the derivatization was complete, the vials were then ready for analysis on GC/MS. The limits of detection (LOD) for each compound are shown in Table IV. Representative chromatograms of the two spiked urines are shown in Figures 3 and 4. This method was recently published with the entire results (171).

TABLE IV. LIMITS OF DETECTION FOR GC/MS SCREENING METHOD

Drug (Metabolite monitored)	**LOD (ng/mL)**	**Drug (Metabolite monitored)**	**LOD (ng/mL)**
Alprazolam (α-hydroxyalprazolam)	25	Doxylamine	25
Amitriptyline	2.5	Flunitrazepam (7-Amino Flunitrazepam)	25
Amobarbital	12.5	Fluoxetine (Norfluoxetine)	12.5
Butalbital	12.5	Hydrocodone	12.5
Carisoprodol	125	Hydromorphone	1
Chlordiazepoxide	12.5	Imipramine	12.5
Chlorpheniramine	12.5	Ketamine (Norketamine)	12.5
Citalopram	12.5	Meprobamate	12.5
Clonazepam (7-Amino Clonazepam)	1	Nortriptyline	12.5
Clonidine	2.5	Oxycodone	250
Cyclobenzaprine	5	Paroxetine	125
Desipramine	12.5	Scopolamine	2.5
Dextromethorphan	25	Sertraline	12.5
Diphenhydramine	5	Triazolam (α-hydroxytriazolam)	25
Doxepin (Desmethyldoxepin)	5	Zolpidem	12.5

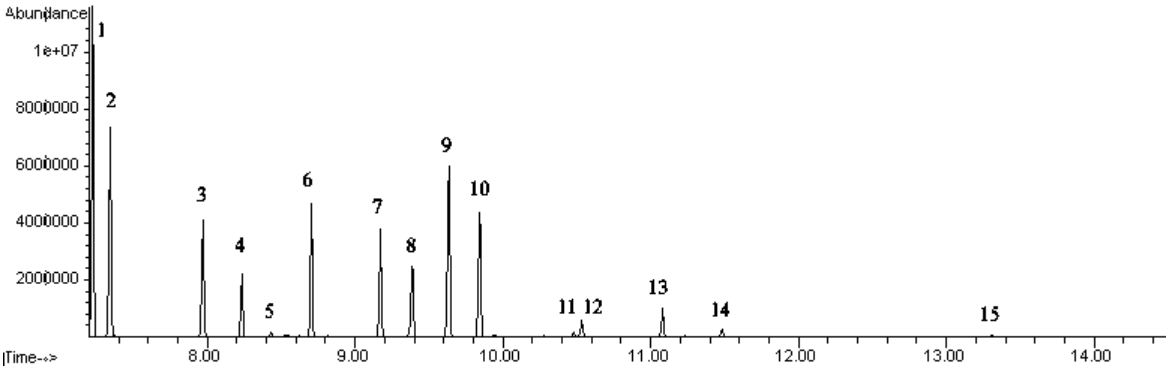

Figure 3. Representative chromatogram for control A. 1, butalbital; 2, amobarbital; 3, diphenhydramine; 4, doxylamine; 5, carisoprodol; 6, chlorpheniramine; 7, clonidine; 8, dextromethorphan; 9, amitriptyline; 10, cyclobenzaprine; 11, desmethyldoxepin; 12, citalopram; 13, chlordiazepoxide; 14, 7-aminoclonazepam; and 15, α-hydroxyalprazolam.

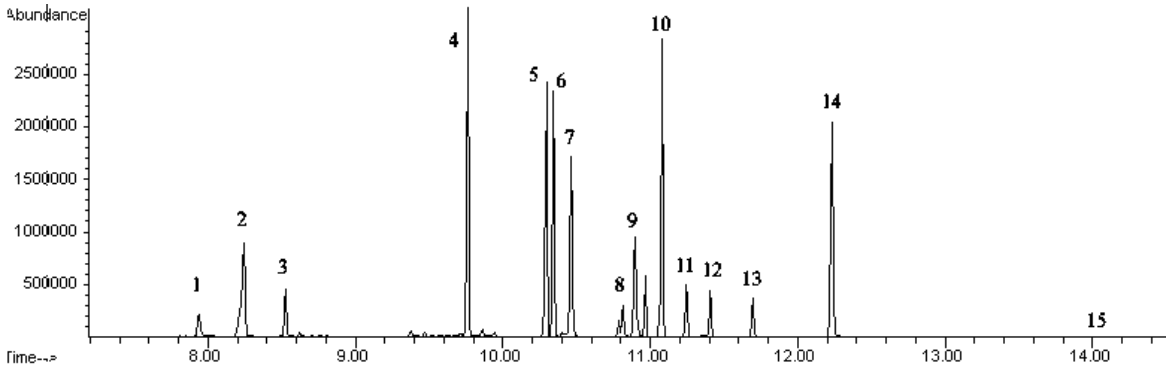

Figure 4. Representative chromatogram for control B. 1, norfluoxetine; 2, norketamine; 3, meprobamate; 4, imipramine; 5, scopolamine; 6, nortriptyline; 7, desipramine; 8, hydrocodone; 9, hydromorphone; 10, sertraline; 11, oxycodone; 12, paroxetine; 13, 7-aminoflunitrazepam; 14, zolpidem; and 15, α-hydroxytriazolam.

b. <u>Confirmation of Hydrocodone, Hydromorphone and Oxycodone</u>

Sample Preparation

The internal standards (d_6-hydrocodone, d_6-hydromorphone, and d6-oxycodone) were first added to 1.0 mL of urine to give a final concentration of 200 ng/mL. Samples were first enzymatically cleaved as described above, and allowed to cool. To each sample, 2.0 mL of 0.1 M of acetate buffer (pH 4) and 0.5 mL of a 10% hydroxylamine solution were added. These samples were then capped, vortexed, and heated for an additional one hour at 60^{o}C. This step was done to convert all of the opiates to the oxime derivatives, to prevent keto-enol tautomerization (172). SPE was the same as in the screening method described above with Fraction 2 collected.

Sample Derivatization

1. 30 μL of acetonitrile was added and then transfered to autosampler vials
2. 30 μL of BSTFA + 1% TMCS was added and heated at 60^{o}C for 30 minutes

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.25 mm ID, 0.25 μm film thickness, 30 m length.	
GC Conditions:	Injector Temp:	250 ^{o}C
	Transfer Line Temp:	280 ^{o}C
	Start Temp:	165^{0}C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
Program:	165^{0}C; Hold for 0 min; Ramp at 35 ^{o}C/min to 195^{o}C; Hold for 0.0 min, then ramp 5^{o}C/min to 240^{o}C; Hold for 0.0 min; then ramp at 30 ^{o}C/min to 300^{o}C; Hold for 2.0 min. Total Run Time = 13.86 min.	

MS in SIM mode:

Group 1 Ions: 386*, 371, 297 (hydrocodone) 392*, 377, 303 (d_6 hydrocodone), 450*, 435, 361 (d_6 hydromorphone) 444*, 429, 355 (hydromorphone) 459*, 474, 401 (oxycodone) 465*, 480, 407 (d_6 oxycodone)

*Quantifying Ion
Dwell Time for all hydrocodone and hydromorphone ions was 15 msec, and for oxycodone ions was 20 msec.

Quantitation

The standard curves for hydrocodone and hydromorphone ranged from 25 ng/mL to 1000 ng/mL and the standard curve for oxycodone ranged from 50 ng/mL to 2000 ng/mL. Samples with values below 25 ng/mL or 50 ng/mL, respectively, were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve.

c. <u>Confirmation of Citalopram and Sertraline</u>

Sample Preparation

Sample preparation and SPE was the same as in the screening method described above with only Fraction 2 collected.

Sample Derivatization

1. 50 µL of ethyl acetate was added and then transferred to autosampler vials
2. Samples were then dried at 60°C for 15 minutes under vacuum
3. 50 µL of HFBA was added and the vials were capped and heated at 60°C for 30 minutes
4. Vials were then uncapped and dried at 60°C for 60 min under vacuum

5. Reconstitution was done with 25 μL ethyl acetate

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.25 mm ID, 0.25 μm film thickness, 30 m length.	
GC Conditions:	Injector Temp:	240 ^{o}C
	Transfer Line Temp:	280 ^{o}C
	Start Temp:	160^{0}C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	160^{0}C; Hold for 0.5 min; Ramp at 30 ^{o}C/min to 260^{o}C; Hold for 3.4 min. Total Run Time = 7.23 min.
MS in SIM mode:		
	Group 1 Ions:	274*, 262, 304 (Citalopram), 324*, 238 (Sertraline)

*Quantifying Ion
Dwell Time for all ions was 50 msec

Quantitation

The standard curve ranged from 10 ng/mL to 10,000 ng/mL. Samples with values below 10 ng/mL were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve. Shown in Figure 5 is a representative gas chromatogram for this confirmation analysis.

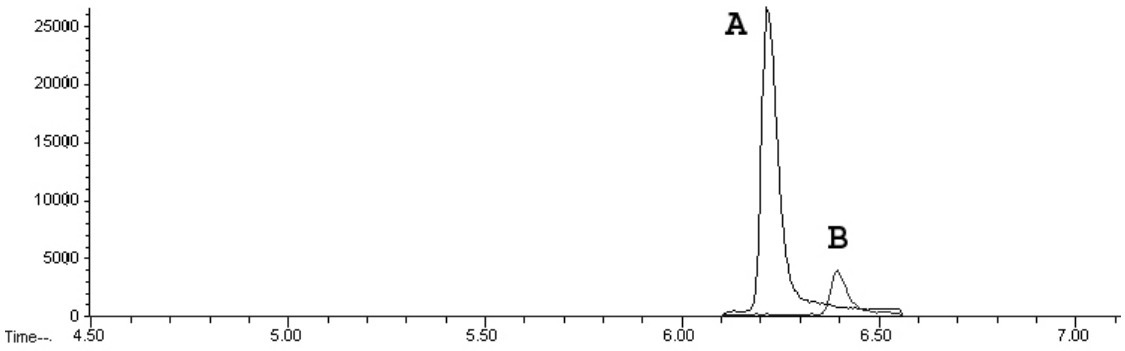

Figure 5. Gas chromatogram for confirmation of citalopram (A) and sertraline (B).

d. <u>Confirmation of Amobarbital, Butalbital, and Meprobamate</u>

Sample Preparation

The internal standard (d_5-Butalbital) was first added to 1.0 mL of urine to give a final concentration of 50 ng/mL. Sample preparation and SPE was the same as in the screening method described above with only Fraction 1 collected.

Sample Derivatization

1. 30 µL of acetonitrile was added and then transfered to autosampler vials

2. 30 µL of BSTFA + 1% TMCS was added and heated at 60^{o}C for 30 minutes

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.25 mm ID, 0.25 µm film thickness, 30 m length.	
GC Conditions:	Injector Temp:	250 ^{o}C
	Transfer Line Temp:	280 ^{o}C
	Start Temp:	100^{0}C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	100^{0}C; Hold for 1.0 min; Ramp at 20 ^{o}C/min to 310^{o}C;

Hold for 3.0 min. Total Run Time = 14.5 min.

MS in SIM mode:

Group 1 Ions:	358* (d_5 butalbital), 353*, 325, 312 (butalbital), 355*, 300, 283 (amobarbital)
Group 2 Ions:	190*, 230, 304 (meprobamate)

*Quantifying Ion

Dwell Time for Group 1 ions was 20 msec and for Group 2 ions was 50 msec

Quantitation

The standard curve for amobarbital and meprobamate ranged from 5 ng/mL to 100 ng/mL and the standard curve for butalbital ranged from 25 ng/mL to 100 ng/mL. Samples with values below 5 ng/mL or 25 ng/mL, respectively, were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve. Shown in Figure 6 is a representative gas chromatogram for this confirmation analysis.

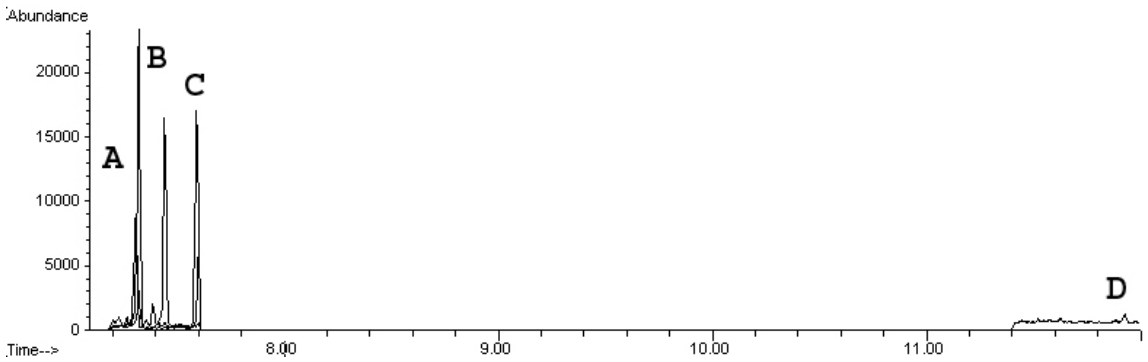

Figure 6. Gas chromatogram for confirmation of butalbital (B), amobarbital (C), and meprobamate (D) with internal standard (A).

e. <u>Confirmation of α-Hydroxy Alprazolam, α-Hydroxy Triazolam, 7-Amino Clonazepam, 7-Amino Flunitrazepam, and Zolpidem</u>

Sample Preparation

The internal standard (d_7-7-amino flunitrazepam) was first added to 1.0 mL of urine to give a final concentration of 100 ng/mL. Sample preparation and SPE was the same as in the screening method described above with both fractions collected.

Sample Derivatization

1. 30 μL of acetonitrile was added and then transfered to autosampler vials

2. 30 μL of BSTFA + 1% TMCS was added and heated at 60^{o}C for 30 minutes

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.25 mm ID, 0.25 μm film thickness, 30 m length.	
GC Conditions:	Injector Temp:	250 ^{o}C
	Transfer Line Temp:	280 ^{o}C
	Start Temp:	160^{0}C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	160^{0}C; Hold for 2.0 min; Ramp at 20 ^{o}C/min to 310^{o}C;

Hold for 3.0 min. Total Run Time = 12.5 min.

MS in SIM mode:

Group 1 Ions:	429*, 414, 394 (7-amino clonazepam)
Group 2 Ions:	362*, 334 (d_7 7-amino flunitrazepam), 355*, 327, 312 (7-amino flunitrazepam)
Group 3 Ions:	235*, 219, 307 (zolpidem)
Group 4 Ions:	381*, 383, 396, 398 (α-hydroxy alprazolam)
Group 5 Ions:	415*, 417, 430, 432 (α-hydroxy triazolam)

*Quantifying Ion
Dwell Time for all ions was 50 msec

Quantitation

The standard curve for 7-amino clonazepam, 7-amino flunitrazepam, and zolpidem ranged from 1 ng/mL to 200 ng/mL, the standard curve for α-hydroxy alprazolam ranged from 1 ng/mL to 100 ng/mL, and the standard curve for α-hydroxy triazolam ranged from 10 ng/mL to 200 ng/mL. Samples with values below 1 ng/mL or 10 ng/mL, respectively, were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve. Shown in Figure 7 is a representative gas chromatogram for this confirmation analysis.

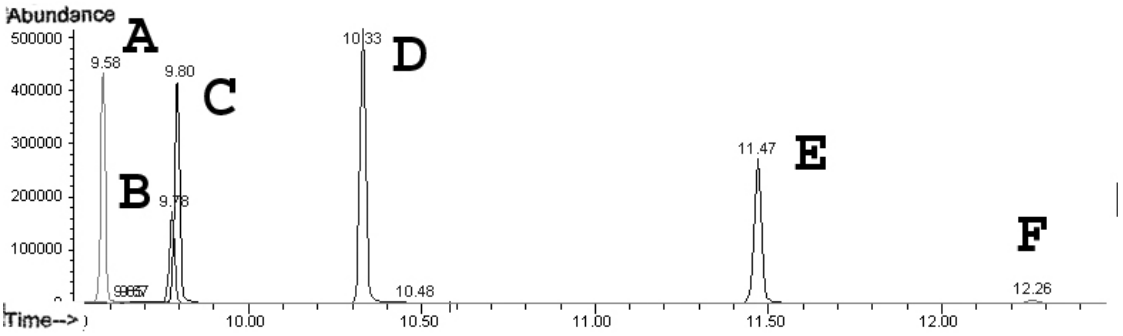

Figure 7. Gas chromatogram for confirmation of α-hydroxyalprazolam (E), α-hydroxytriazolam (F), 7-aminoclonazepam (A), 7-aminoflunitrazepam (C), and zolpidem (D) with internal standard (B).

f. <u>Confirmation of Desipramine, Imipramine, Amitriptyline, and Nortriptyline</u>

Sample Preparation

The internal standards (d_3-desipramine and d_3-imipramine) were first added to 1.0 mL of urine to give final concentrations of 100 ng/mL. Sample preparation and SPE was the same as screening method described above with only Fraction 2 collected.

Sample Derivatization

1. 30 µL of acetonitrile was added and then transferred to autosampler vials

2. 30 µL of BSTFA + 1% TMCS was added and heated at 60^{o}C for 30 minutes

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.25 mm ID, 0.25 µm film thickness, 30 m length.	
GC Conditions:	Injector Temp:	250 ^{o}C
	Transfer Line Temp:	280 ^{o}C
	Start Temp:	100^{0}C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min

	Program:	100^0C; Hold for 2.0 min; Ramp at 20 ^{o}C/min to 310^{o}C; Hold for 3.0 min. Total Run Time = 15.5 min.
MS in SIM mode:		
	Group 1 Ions:	283* (d_3 imipramine), 280*, 234, 193 (imipramine), 202*, 215, 217 (amitriptyline)
	Group 2 Ions:	341* (d_3 desipramine), 338*, 193, 234, 208 (desipramine), 116*, 202, 320 (nortriptyline)

*Quantifying Ion
Dwell Time for all ions is 100 msec

Quantitation

The standard curves for imipramine and desipramine ranged from 5 ng/mL to 200 ng/mL, the standard curve for amitriptyline ranged from 50 ng/mL to 500 ng/mL, and the standard curve for nortriptyline ranged from 5 ng/mL to 500 ng/mL. Samples with values below 5 ng/mL or 50 ng/mL, respectively, were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve. Shown in Figure 8 is a representative gas chromatogram for this confirmation analysis.

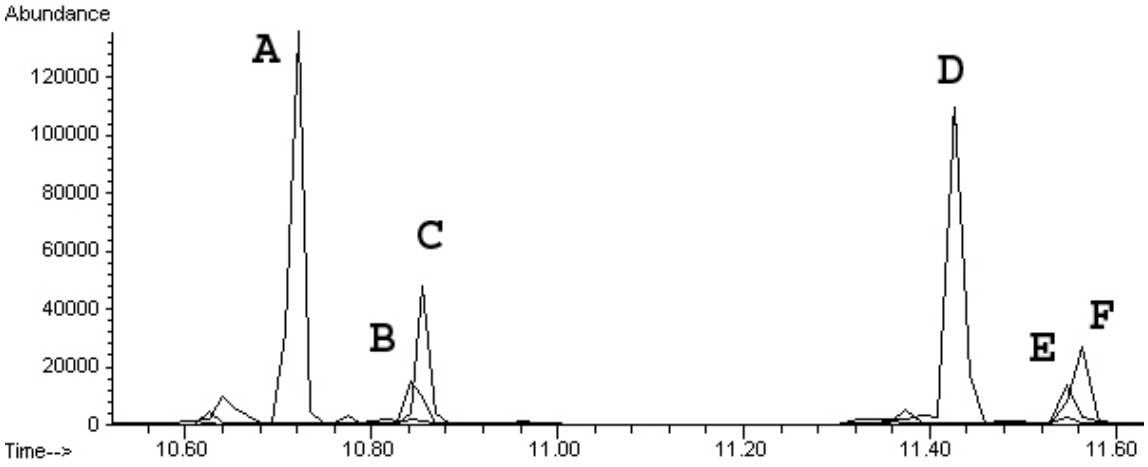

Figure 8. Gas chromatogram for confirmation of amitriptyline (A), imipramine (C), nortriptyline (D), and desipramine (F) with internal standards (B and E).

g. <u>Confirmation of Norfluoxetine, Norketamine, and Desmethyldoxepin</u>

Sample Preparation

The internal standard (d_6-norfluoxetine) was first added to 1.0 mL of urine to give a final concentration of 100 ng/mL. Sample preparation and SPE was the same as screening method described above with only Fraction 2 collected.

Preparation of Sample for GC/MS

1. 30 μL of acetonitrile was added and then transferred to autosampler vials

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.25 mm ID, 0.25 μm film thickness, 30 m length.	
GC Conditions:	Injector Temp:	250 ^{o}C
	Transfer Line Temp:	280 ^{o}C
	Start Temp:	100^{0}C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	100^{0}C; Hold for 2.0 min; Ramp at 30 ^{o}C/min to 310^{o}C;

Hold for 3.0 min. Total Run Time = 12.0 min.

MS in SIM mode:

Group 1 Ions:	140* (d_6 norfluoxetine), 134*, 162, 191 (norfluoxetine), 166*, 195 (norketamine)
Group 2 Ions:	44*, 178, 202, 165 (desmethyldoxepin)

*Quantifying Ion
Dwell Time for all ions was 50 msec

Quantitation

The standard curve for norfluoxetine ranged from 5 ng/mL to 500 ng/mL, the standard curve for norketamine ranged from 1 ng/mL to 100 ng/mL, and the standard curve for desmethyldoxepin ranged from 50 ng/mL to 500 ng/mL. Samples with values below 1 ng/mL, 5 ng/mL or 50 ng/mL, respectively, were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve. Shown in Figure 9 is a representative gas chromatogram for this confirmation analysis.

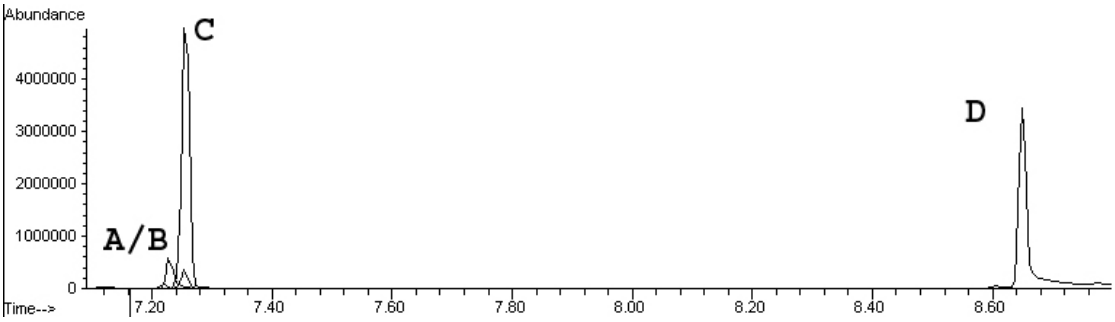

Figure 9. Gas chromatogram for confirmation of norfluoxetine (B), norketamine (C), desmethyldoxepin (D) with internal standard (A).

h. <u>Confirmation of Chlorpheniramine, Cyclobenzaprine, Dextromethorphan, Diphenhydramine, and Doxylamine</u>

Sample Preparation

Sample preparation and SPE was the same as screening method described above with only Fraction 2 collected.

Preparation of Sample for GC/MS

1. 30 μL of acetonitrile was added and then transferred to autosampler vials

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.25 mm ID, 0.25 μm film thickness, 30 m length.	
GC Conditions:	Injector Temp:	250 ^{o}C
	Transfer Line Temp:	280 ^{o}C
	Start Temp:	60^{0}C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	60^{0}C; Hold for 2.0 min; Ramp at 20 ^{o}C/min to 310^{o}C; Hold for 3.0 min. Total Run Time = 17.5 min.
MS in SIM mode:		
	Group 1 Ions:	152*, 58, 165 (diphenhydramine)

Group 2 Ions:	167*, 180, 182, 71 (doxylamine)
Group 3 Ions:	203*, 205, 167, 58 (chlorpheniramine)
Group 4 Ions:	271*, 269, 214, 171 (dextromethorphan)
Group 5 Ions:	58*, 189, 202, 215 (cyclobenzaprine)

*Quantifying Ion
Dwell Time for all ions was 100 msec

Quantitation

The standard curve for all five drugs ranged from 5 ng/mL to 100 ng/mL. Samples with values below 5 ng/mL were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve. Shown in Figure 10 is a representative gas chromatogram for this confirmation analysis.

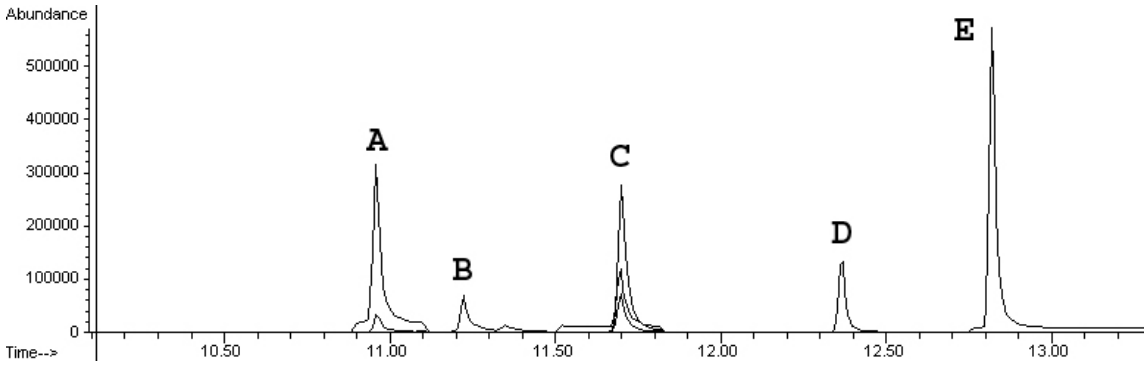

Figure 10. Gas chromatogram for confirmation of diphenhydramine (A), doxylamine (B), chlorpheniramine (C), dextromethorphan (D), and cyclobenzaprine (E).

i. <u>Confirmation of Paroxetine</u>

Sample Preparation

The internal standard (d_6-paroxetine) was first added to 1.0 mL of urine to give a final concentration of 200 ng/mL. Sample preparation and SPE was the same as screening method described above with only Fraction 2 collected.

Preparation of Sample for GC/MS

1. 30 μL of acetonitrile was added and then transferred to autosampler vials

2. 30 μL of BSTFA + 1% TMCS was added and heated at 60°C for 30 minutes

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.25 mm ID, 0.25 μm film thickness, 30 m length.	
GC Conditions:	Injector Temp:	250 °C
	Transfer Line Temp:	280 °C
	Start Temp:	160°C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	160°C; Hold for 2.0 min; Ramp at 20 °C/min to 310°C; Hold for 3.0 min. Total Run Time = 12.5 min.

MS in SIM mode:

Group 1 Ions:	407*, 252 (d_6 paroxetine), 401*, 249 (paroxetine)

*Quantifying Ion
Dwell Time for all ions was 50 msec

Quantitation

The standard curve ranged from 10 ng/mL to 200 ng/mL. Samples with values below 10 ng/mL were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve. Shown in Figure 11 is a representative gas chromatogram for this confirmation analysis.

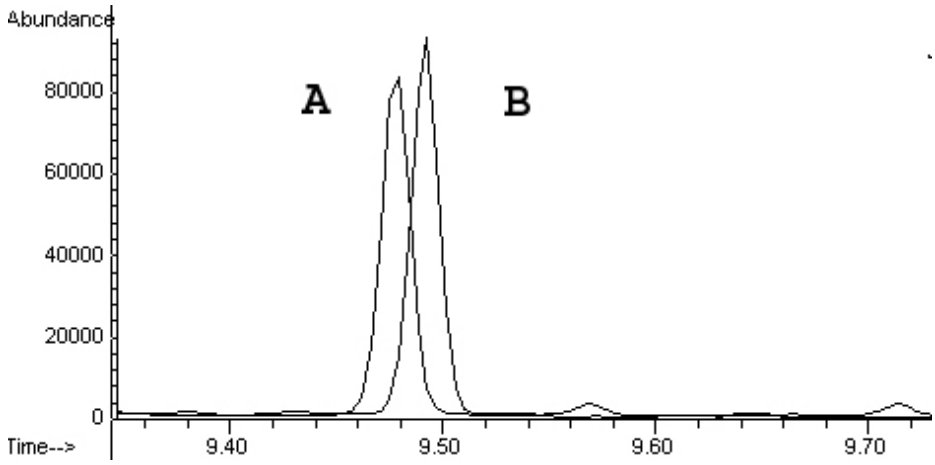

Figure 11. Gas chromatogram for confirmation of paroxetine (B) with internal standard (B).

j. Screening and Confirmation of GHB and Screening of Valproic Acid

Sample Preparation

The internal standard (d_6-GHB) was first added to 0.5 mL of urine to give a final concentration of 500 ng/mL. To this, 0.5 mL of an acetate buffer (pH 4) solution and 2.0 mL of ethyl acetate were added. The samples were then shaken on a vertical shaker for 10 minutes and centrifuged at 3000 rpm for 10 minutes. The top layer (ethyl acetate) was then transferred to a separate vial and evaporated under N_2 at 37^{o}C. To the original sample, another 2.0 mL of ethyl acetate was added and the extraction procedure was repeated. Following centrifugation, the ethyl acetate layer was again removed and added to the original extract. The samples were then completely dried under N_2.

Sample Derivatization

1. 30 μL of acetonitrile was added and then transferred to autosampler vials

2. 30 μL of BSTFA + 1% TMCS was added and samples were let stand for 10 minutes.

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.25 mm ID, 0.25 μm film thickness, 30 m length.	
GC Conditions:	Injector Temp:	250 ^{o}C
	Transfer Line Temp:	280 ^{o}C
	Start Temp:	60^{0}C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	60^{0}C; Hold for 2.0 min; Ramp at 20 ^{o}C/min to 200^{o}C; Hold for 2.0 min. Total Run Time = 11.0 min.

MS in SIM mode:

Group 1 Ions:	129, 201, 145 (valproic acid), 233*, 234, 235 (GHB), 239*, 240, 241 (d_6 GHB)

*Quantifying Ion
Dwell Time for all ions was 25 msec

Quantitation

The standard curve for GHB ranged from 1 μg/mL to 200 μg/mL. Samples with values below 10 μg/mL were reported as having endogenous levels, samples above 10 μg/mL but within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve. Shown in Figure 12 is a representative gas chromatogram for this analysis.

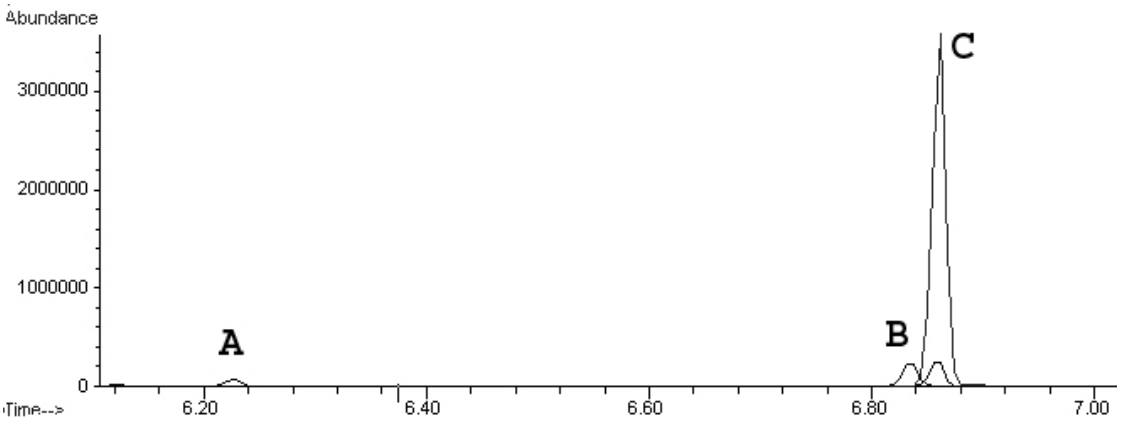

Figure 12. Gas chromatogram for screening/confirmation of GHB (C) and screening of valproic acid (A) with internal standard (B).

k. <u>Confirmation of Valproic Acid</u>

The sample preparation, derivatization, and GC/MS parameters were the same as in the screening method for valproic acid. The quantifying ion for valproic acid was 129.

Quantitation

The standard curve ranged from 500 ng/mL to 2000 ng/mL. Samples with values below 500 ng/mL were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve. Shown in Figure 13 is a representative gas chromatogram for this confirmation analysis.

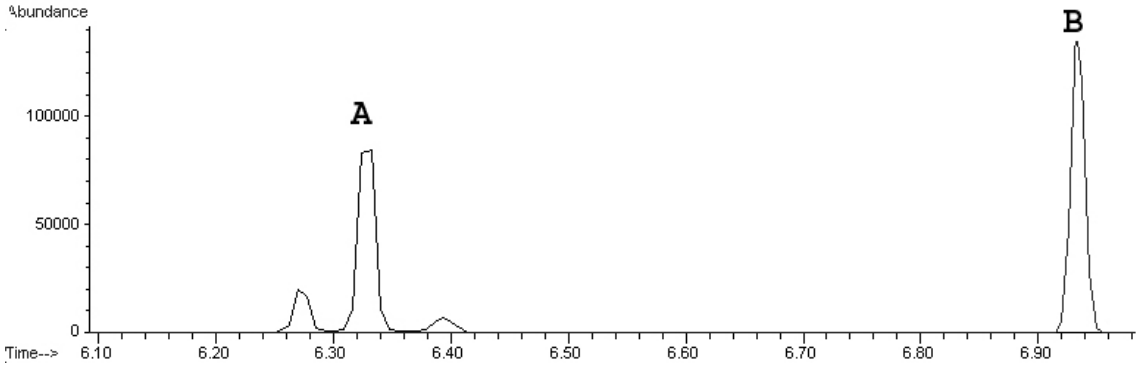

Figure 13. Gas chromatogram for confirmation of valproic acid (A) with internal standard (B).

l. <u>Screening for all Drugs in Hair</u>

For each sample, 50 mg of the pulverized hair was weighed out and placed into a test tube. If the sample weighed less than 50 mg it was completely used for the screening method. To each test tube, 1 mL of methanol was added and the tubes were capped and sonicated for one hour. The samples were then centrifuged and the supernatant was transferred to a clean test tube and refrigerated. To the remaining hair pellet, 3 mL of

0.1M hydrochloric acid was added, and the samples were heated at 60°C for approximately 24 hours. The samples were then centrifuged, and the supernatant was pooled with the previous supernatant. To the pooled supernatants, 3 mL of 0.1 M sodium phosphate, dibasic, pH 9 was added. The solid-phase extraction, derivatization and analysis by GC/MS described in the screening method for urine were then followed.

m. <u>Confirmation in Hair of Chlordiazepoxide, Codeine, Cocaine, and Sertraline</u>

Sample Preparation

The internal standard (d_6-paroxetine) was first added to 50 mg of pulverized hair to give a final concentration of 4 ng/mg. Sample preparation and SPE was the same as screening method for hair described above with only Fraction 2 collected.

Sample Derivatization

1. 30 µL of acetonitrile was added and then transferred to autosampler vials

2. 30 µL of BSTFA + 1% TMCS was added and heated at 60°C for 30 minutes

GC/MS Parameters

Column:	5% Phenyl-95% Methyl Silicone, 0.25 mm ID, 0.25 µm film thickness, 30 m length.	
GC Conditions:	Injector Temp:	250 °C
	Transfer Line Temp:	280 °C
	Start Temp:	160°C
	Injection Mode:	Splitless
	Purge Time On:	1.0 min
	Program:	160°C; Hold for 2.0 min; Ramp at 20 °C/min to 310°C; Hold for 3.0 min. Total Run Time = 12.5 min.
MS in SIM mode:		
	Group 1 Ions:	182*, 303, 82 (cocaine)

Group 2 Ions:	371*, 234, 196 (codeine)
Group 3 Ions:	274*, 334, 348 (sertraline), 340*, 354, 282 (chlordiazepoxide)
Group 4 Ions:	407*, 252 (d_6 paroxetine)

*Quantifying Ion
Dwell Time for Group 1, 2, and 3 ions was 50 msec and for Group 4 ions was 100 msec

Quantitation

The standard curves for sertraline and chlordiazepoxide ranged from 0.1 ng/mg to 2 ng/mg, the standard curve for codeine ranged from 0.02 ng/mg to 0.5 ng/mg, and the standard curve for cocaine ranged from 0.02 ng/mg to 2 ng/mg. Samples with values below 0.1 ng/mg or 0.02 ng/mg, respectively, were reported as negative, samples within the standard curve were reported as positive and the value was given, and samples above the standard curve were analyzed following dilution to include them within the range of the standard curve. Shown in Figure 14 is a representative gas chromatogram for this confirmation analysis.

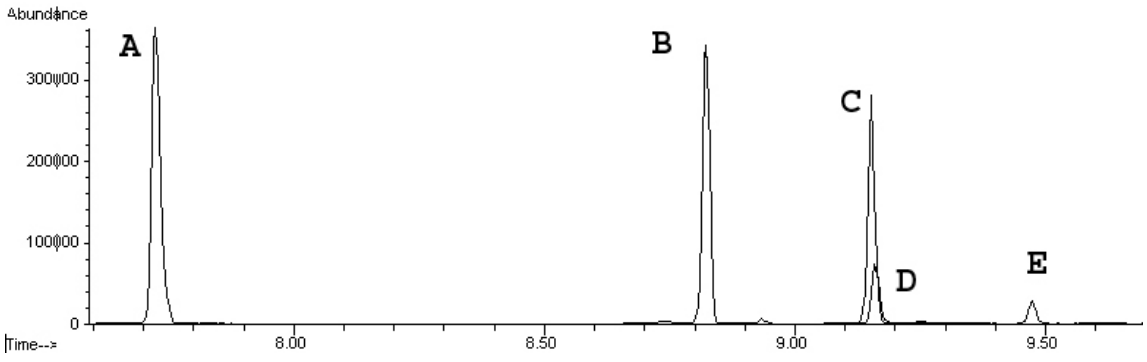

Figure 14. Gas chromatogram for confirmation of cocaine (A), codeine (B), sertraline (C), and chlordiazepoxide (D) with internal standard (E).

E. Criteria for Determination of DFSA in Individual Cases

The present study was designed to estimate the prevalence of drug-facilitated sexual assault. We took an epidemiological approach to the question – recruiting into the study subjects who had reported they had been sexually assaulted, and testing their urine and hair for the presence of 45 drugs, including drugs of abuse, and some therapeutic drugs. We make the assumption that all the complainants were victims of sexual assault. "Sexual assault" is a legal concept – defined by the statutes of each state. It is fair to say that a completed sexual assault (as against an "attempted" one) includes sexual penetration by one person (usually a man) of another (usually a woman) against her will, i.e., she did not consent to the sexual activity. Below the "age of consent," which varies among the different states, a person is legally incompetent to consent. All of our subjects were over the age of consent. DFSA has to do with the victim's ability to give consent. Some drugs or combinations of drugs can affect a person's competence to give consent. However, the quantity of drug(s) confirmed in urine or hair after the fact does not permit a toxicologist to determine either the dose of the drug(s) or the time of administration. Further, it does not permit a toxicologist to know with certainty whether the drugs found were clandestinely administered to a victim, or taken recreationally or therapeutically. Accordingly, DFSA could be defined in different ways, and it is essential that we make the definitions as precise as possible before estimating a prevalence.

The literature has not clearly defined DFSA. One school of thought believes that a sexual assault is only drug-facilitated if the perpetrator gave the drug surreptitiously to the victim to render them unconscious or impair their memory to such a degree that would facilitate sexual assault (42, 173, 174). The second school of thought believes that

if the victim was rendered unable to consent to sexual acts by surreptitious drugging **or** by their own recreational drug use, the sexual assault is drug-facilitated (36, 40, 175). Definitions of DFSA are important for legislatures when enacting or modifying criminal law in this area. Federal and some state laws (e.g. Illinois) make clandestine drugging a separate crime or an aggravating factor to the crime, potentially increasing penalties for those convicted.

For this work, we constructed two definitions of DFSA which takes into account both schools of thought on DFSA. Explicit criteria for each definition have been developed which rely on toxicological findings and case history. We call these DFSA1 and DFSA2. If a subject is positive under DFSA1, it is probable that they were given one or more drugs surreptitiously, thereby causing unconsciousness or leading to a reduced mental competence to consent to sexual acts. As noted above, the laws tend to be directed towards the DFSA1 definition. DFSA2 is broader, and means that in addition to DFSA1 criteria, cases of a victim's own recreational drug use led to incapacitation or reduced mental competence to consent to sexual acts. The criteria for classifying a subject's case as DFSA1 or DFSA2 are presented below. The criteria take into consideration the pharmacological actions of the drug(s), the subject's report of the assault and what drugs they were using on their own accord, and the time delay between the assault and reporting to the site. It must also be noted that subjects are placed into one of the categories based on likelihood judgments considering these factors. We cannot be certain that a given subject falls into DFSA1 or DFSA2; additionally, any case that falls under DFSA2 will also fall under DFSA1, by definition. Some of the cases do not have enough

information to classify the case as more likely DFSA1 or DFSA2. These cases are classified as “Unknown.”

Thus for each subject case, three classifications are possible: Yes, there is a high probability that the subject was a victim of DFSA1 or DFSA2; No, the possibility that the patient was a victim of DFSA is low; and Unknown, there is insufficient information to make a reasonable probability estimate as to whether or not the case is DFSA.

DFSA1 Criteria:

1. Drugs analyzed for were found.
2. More than cocaine, amphetamines, or marijuana were found.
3. The patient reported to the clinic within 72 hours.
4. If “date-rape”, OTC, or prescription drugs were found, and the subject gave no history of having used them.
5. If the subject stated on the questionnaire that she was given drugs before the assault.
6. If the subject states (or thinks) a drug was surreptitiously given to her, and states that she did not take the drug voluntarily, and a drug capable of producing sedation was found.

Exclusion criteria:

7a. If the subject admitted to using the drug and it was found on both visits, we assume that she is recreationally using the drug.

Unknown:

If the subject did not provide a questionnaire and drugs are found.

DFSA2 Criteria:

1. If no drugs analyzed for were found = No
2. If the patient reported to the clinic greater than 72 hours after the alleged assault = No

3. If any drugs being analyzed for were found that, either alone or in combination, could have reduced the mental competence of the subject to consent to sexual acts = Yes

These criteria were developed to help in aiding a toxicologist in determining what they are willing to testify to regarding their analysis. First, if no drugs were found in the first visit urine specimen, regardless of what the subject may have said, DFSA will have to be excluded as a possible scientific finding. Second, if a subject only has stimulants (amphetamines or cocaine) and/or marijuana, DFSA is ruled out under DFSA1 since these compounds would not normally be given by a perpetrator to render a potential victim submissive. However, under DFSA2, these drugs are considered capable of producing mental incapacitation to such a degree that the subject would have been unable to consent to sexual acts and thus the drugs facilitated the sexual assault. Third, if the subject did not believe that they were given any drugs, DFSA1 does not accept that a DFSA could have occurred, regardless of the drugs that are found. By DFSA2, the subject could have been the victim of a DFSA but been unaware that their own recreational drug use was the reason. Fourth, a cut-off of 72 hours post-assault is used because most toxicology laboratories would not be able to detect drugs used greater than 72 hours ago, and any results may suggest post-assault drug use by the subject. For DFSA1, the only criterion that admits that a DFSA most likely happened is when the subject believes they were given something and a drug is found that they did not admit to taking. There is a caveat to this criterion; if the drug is found in the second visit also, we assume that the subject is a recreational user who did not admit to using the drug. Cases for DFSA2 are evaluated carefully by the criteria as to whether the drugs found **could**

have produced a degree of mental incapacitation making the subject unable to give her consent to sexual acts. Thus, if fluoxetine (which was admitted to) is the only drug found in a subject's urine and they did not believe they were given anything nor impaired, the case is most likely not a DFSA. For any case, it is impossible for one to determine that a DFSA absolutely happened. But if after considering the drug profile with the subject's statements a DFSA is possible, a tentative ruling of "Yes" will be denoted. These rules will be followed for each of the four sites in determining an estimate of DFSA. There are three possibilities for each subject; it is highly likely that a DFSA occurred (Yes), it is unable to be determined if a DFSA occurred (Unknown), or it is highly unlikely that a DFSA occurred (No).

F. Statistical Analysis

All statistical analyses were done using Microsoft® Office Excel 2003. Correlations between time interval and age were calculated by using a one-tailed, two-sample unequal variance, Student t-Test. Confidence intervals for the drug prevalence's were handled by first setting a positive finding of a drug to 100, and a negative finding to zero. The standard deviation was then calculated by Excel for all subjects. Excel's Confidence Interval function was then employed using the calculated standard deviation, the total sample size (N=144) and an alpha equal to 0.05 to calculate the 95% Confidence Intervals.

III. RESULTS and DISCUSSION

A. All Subjects Enrolled

a. Demographics

A total of 144 subjects were enrolled in this study. All submitting subjects were female and their ages ranged from 18 to 56 with a mean age of 26.6 ± 9.0 years (median age 23). One prior study of 1,076 sexual assault complainants had subjects with a mean age of 25 years, which is similar to the subject population in this study (10). Another study of 1421 sexual assault complainants who suspected DFSA had participants with a mean age of 25.8 years, which again corresponds well with this study (38). The study population was divided into six age cohorts (Figure 15). Nearly 70% of the subjects were below the age of 30 years. The first group, 18-20 years, only contains three years, but is important when considering the drug profiles of subjects below the legal drinking age. One hypothesis is that subjects above the drinking age are more likely to frequent bars and clubs where drugs can be easier to give surreptitiously. This hypothesis will be supported if the subjects that are 18 to 20 years old are found to have less cases of suspected DFSA.

The racial distribution of the subjects is shown in Figure 16. The three races studied were White, Black, and Hispanic. If a subject identified with a race different from these three, or the race was not identified, they fall into the fourth category (Other/Unknown). When compared to the U.S. Census data from 2000 (Table V), the racial distribution of the subjects in this study corresponds well with the racial distribution of the U.S. (176). When this study was first initiated, efforts were made to

insure that the racial make-up of the subjects in this study would generally reflect the racial make-up of the entire U.S. and this goal was achieved.

The further distribution of the races into the six age cohorts is shown in Figure 17. The racial distribution among the age cohorts was unremarkable with White always outnumbering any of the other categories. It is difficult to draw any conclusions about the Other/Unknown category as the race of the subjects in this population was not always identified; thus, most analyses are done on the three identifiable races. However, for total sample analyses that do not involve race breakdown, the Other/Unknown group subjects were included.

The time interval between when the alleged assault occurred and when the subject reported to the clinic ranged from 1.5 hours to 456 hours with a mean and standard deviation of 32.4 ± 69.1 hours (median 13 hours). This time interval was extremely important when determining if the drugs that were confirmed in a sexual assault complainant's urine were representative of the drugs that were in their system at the time of the assault. For example, if the subject reported to the clinic six hours after an assault, the drugs that were found will most likely represent the drugs that were exerting their pharmacologic effect at the time of the assault. However, if a subject reported after three days and drugs were found, it was difficult to determine if the drugs that were found were pharmacologically active at the time of the assault.

The time intervals for subjects who returned for the second visit and subjects who believed they were given something are not statistically different from all of the subjects. Therefore, the length of time between the alleged assault and the subject reporting to the clinic did not appear to affect whether a subject returned for a second visit or if they

believed that they were given a drug. If someone was given a drug that rendered her unconscious, it would be expected that she would report to the clinic much later than someone who was completely cognizant at the time of the assault. However, nearly 25% of the subjects who believed they were given a drug reported to the clinic within eight hours of the assault.

The age cohorts were examined to determine if the subject's age had any apparent influence on how quickly they reported to the clinic after the assault. For all subjects above the age of 21, there was no statistical difference ($p > 0.05$) in this variable between the age cohort and subjects of all ages. However, for the 18 to 20 age cohort, there was a statistically significant difference ($p = 0.004$). Subjects in this age cohort had a mean time interval for reporting more than 50% shorter than for all of the subjects. Subjects in this study under the age of 21, were more likely to report to the clinic in a shorter time period after the sexual assault incident than subjects above the age of 20.

The reporting time interval was also examined for variation within racial groups. For White, Hispanic, and the Other/Unknown subjects, there was no statistical difference ($p > 0.05$) when compared to data for all races. However, Black subjects did show a statistically significant difference ($p = 0.008$). As in the 18 to 20-age cohort, Black subjects had a shorter reporting time interval to the clinics of more than 50%. Thus, at least in this study population, Black complainants reported sexual assault much faster than those who identified themselves as another race. There were no statistically significant differences for the time interval and whether drugs were found or not.

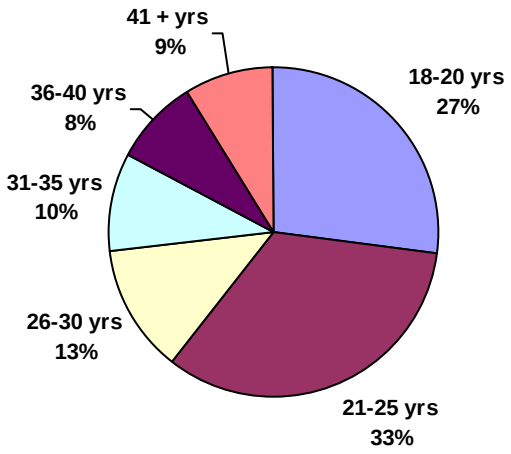

Figure 15. Age distribution of all subjects into six age cohorts.

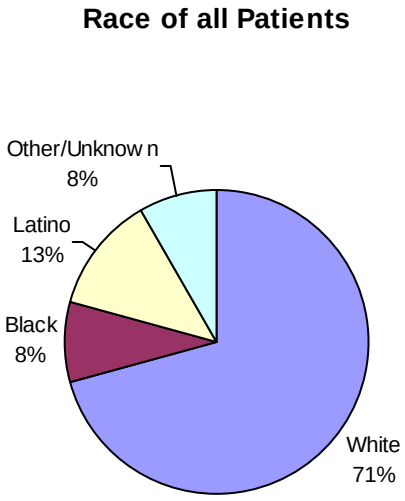

Figure 16. Race distribution of all subjects into four race categories.

TABLE V. RACIAL GROUP IN THIS STUDY COMPARED TO THE 2000 U.S. CENSUS DATA.

Race	% in U.S.	% in this Study
White	69.1	71.0
Black	12.3	8.0
Hispanic	12.5	13.0

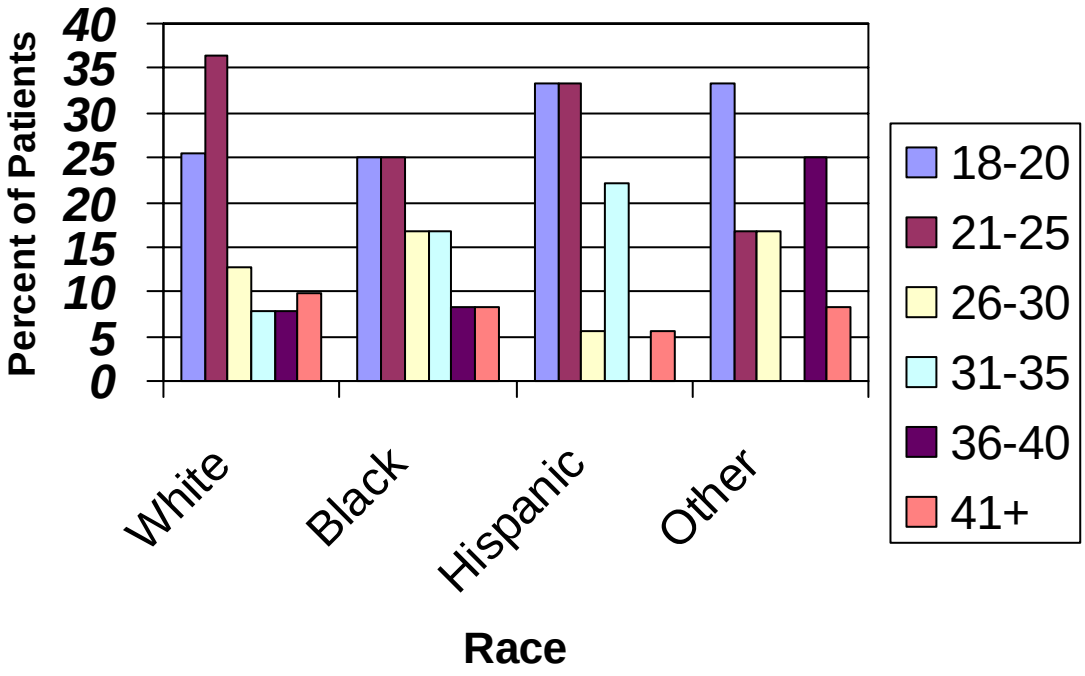

Figure 17. Racial distribution of all subjects into the six age cohorts.

This study was limited by the number of subjects enrolled, and specimens received. The initial proposal for this study included more locations across the U.S.; however, due to difficulties in finding clinics willing to participate, only six clinics were included. Of these six, two clinics in Chicago, IL never enrolled any subjects into the study. There were problems getting the other sites up and running as well. Washington took the longest time to start enrolling subjects, and they did so towards the end of the study. Texas, although running the entire length of the study, had to stop enrolling subjects for a time in the middle of the study due to problems involving nurse training at the clinic. Two sites were able to enroll the minimum number of subjects we desired (35): California and Minnesota.

b. Second Visit Analysis

Fifty-nine subjects (41%) returned to the clinic for the second visit, which was considerably lower than would have been desirable. However, a study conducted by Putz, *et al.* found that only 50% of the sexual assault complainants in their study returned for the recommended follow-up visit (9). The reasons cited in that study as to why the subject did not return for a follow-up visit included a lack of time and the inability to find a babysitter. These reasons probably existed for this study also. Loss of sexual assault complainants to follow-up after an initial clinic visit is a chronic problem, even when the follow-up is by phone. Shown in Figures 18 and 19 are the race for the returning subjects and the distribution of those subjects into the six age cohorts, respectively. There were no observed trends indicating any racial group or age cohort bias in the returning group.

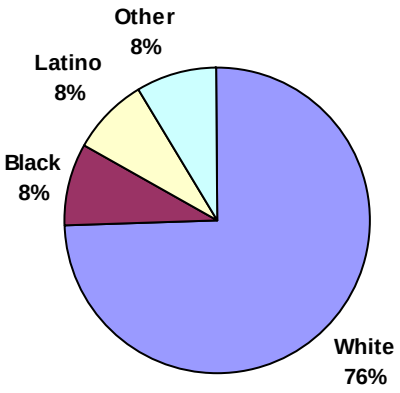

Figure 18. Race distribution of all subjects returning for the second visit.

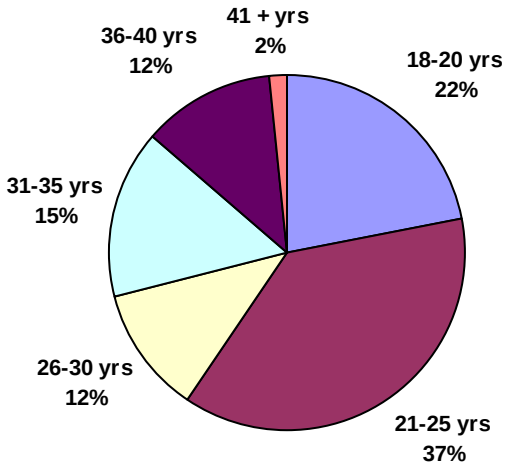

Figure 19. Distribution into the six age cohorts of all subjects returning for the second visit.

c. Questionnaire Analysis

Of the 144 subjects in this study, 119 (82.6%) returned a completed questionnaire. Originally, the protocol called for completion of the questionnaire during the second visit. This step was changed, however, in accordance with the practices of the particular site. The questionnaire could best be completed in connection with the taking of the history. In those cases where the questionnaire information was to be gathered on the second visit, and the subjects did not return, a self-reported drug history and the circumstances of the alleged assault were never provided. In some subjects, the racial group was not recorded either, even though there was a checkbox on the urine collection container itself in addition to the questionnaire. Thus, a few of the races listed as Other/Unknown were due to the race of the subject never being noted. With experience, it was decided to have the questionnaires completed at the first visit to insure that as much information as possible was gathered for patients who did not return for the second visit. Had this change not been implemented, only 59 questionnaires would have been completed, instead of the 119 that were ultimately returned.

Self-reporting of drug use is discussed later, but subject belief about surreptitious drug administration is discussed here. As to whether the subject believed that she was given a drug surreptitiously, 28 (23.5%) answered yes, 14 (11.8%) answered maybe or could not remember, and 77 (64.7%) said no. The age distribution of these answers as well as the racial distribution is shown in Tables VI and VII, respectively. Subjects below the age of 30 comprised more than 80% of those who believed they were given a drug. If these subjects were correct in their assumption, this would suggest that DFSA is a problem that mainly affects women in their twenties or younger. No Hispanic subject

believed that she was given a drug and only two thought that it was a possibility. This suggests that women complainants in the Hispanic community are less likely to think they were drugged.

TABLE VI. DISTRIBUTION OF SUBJECTS WHO ANSWERED WHETHER THEY DO OR DO NOT BELIEVE THEY WERE GIVEN A DRUG SURREPTITIOUSLY INTO THE SIX AGE COHORTS.

Age Cohort (yrs)	**Do you think you were given a drug surreptitiously?**		
	Yes	**No**	**Maybe/Don't Remember**
18-20	8	19	4
21-25	9	25	6
26-30	6	6	1
31-35	2	9	3
36-40	2	10	0
41 +	1	8	0

TABLE VII. DISTRIBUTION OF SUBJECTS WHO ANSWERED WHETHER THEY DO OR DO NOT BELIEVE THEY WERE GIVEN A DRUG SURREPTITIOUSLY INTO THE FOUR RACE CATEGORIES.

Race	**Number**	**Do you think you were given a drug surreptitiously?**		
		Yes	**No**	**Maybe/Don't Remember**
White	88	24 (27.3%)	52 (59.1%)	12 (13.6%)
Black	5	2 (40.0%)	3 (60.0%)	0 (0.0%)
Hispanic	18	0 (0.0%)	16 (88.9%)	2 (11.1%)
Other	8	2 (25.0%)	6 (75.0%)	0 (0.0%)

d. Drugs of Abuse

USDTL analyzed 143 of the 144 first visit urine specimens and all 59 second visit urine specimens provided for certain drugs of abuse. The initial visit specimens, if received soon after the alleged assault, provide an assessment of the drugs that were in the subject's system at the time of the assault. The second visit urine specimen helps in determining if the subject is a regular user of the drug that was found or if they changed their drug usage after the assault. The first visit specimens are described here. Of the 143 specimens, 81 (56.6%) were presumptively positive for at least one of the following drugs or drug classes: ethanol, cocaine, amphetamines, opiates, benzodiazepines, marijuana, or PCP. No specimens were presumptively positive for barbiturates or methadone, and confirmations were not done for these compounds. Of the 81 subjects with presumptive positives, 15 were positive for ethanol, 27 for cocaine, 48 for marijuana, 18 for opiates, 7 for benzodiazepines, 14 for amphetamines, and 1 for PCP. Confirmations were then done on all of the presumptive positives, and 66 of the 81 (81.5%) subjects were confirmed positive. Of the 66 subjects with confirmed positives, 14 were positive for ethanol, 26 for cocaine, 38 for marijuana, 14 for opiates, 5 for benzodiazepines, 10 for amphetamines, and 0 for PCP. These results include patients that were positive for more than one drug/drug class and thus the number of positive samples do not add up to the number of positive subjects. The ranges of concentrations for the confirmed samples are shown in Figures 20-29.

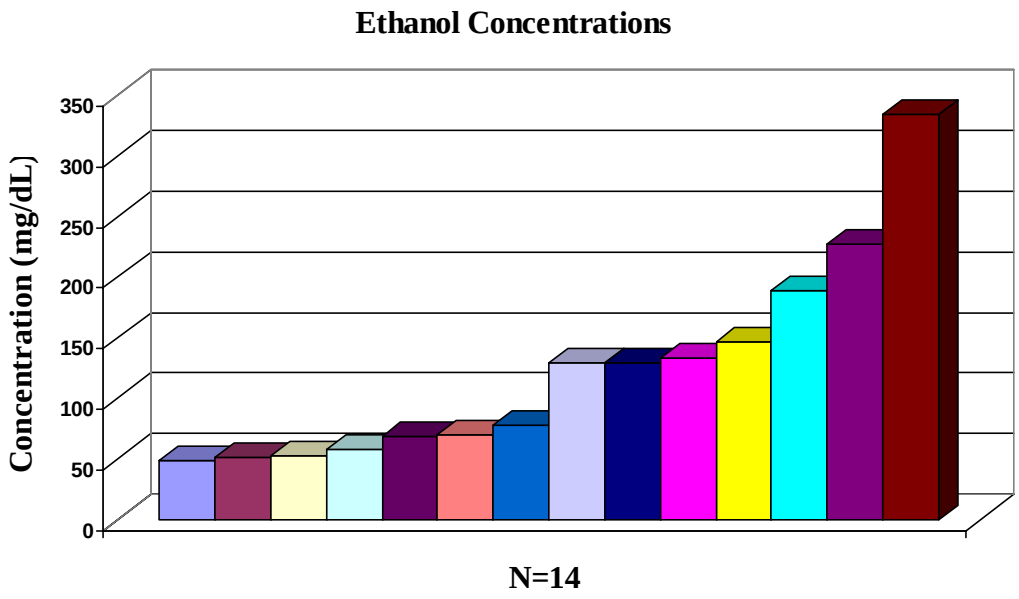

Figure 20. Concentration range for all samples (N=14) that were positive for ethanol.

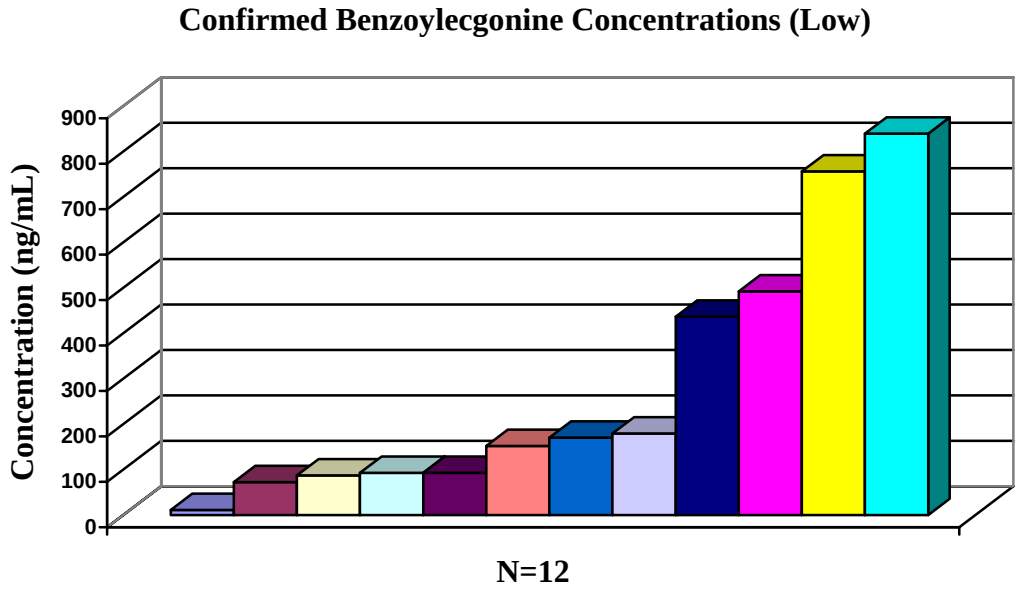

Figure 21. Low concentrations for samples (N=12) that were positive for the metabolite of cocaine (benzoylecgonine).

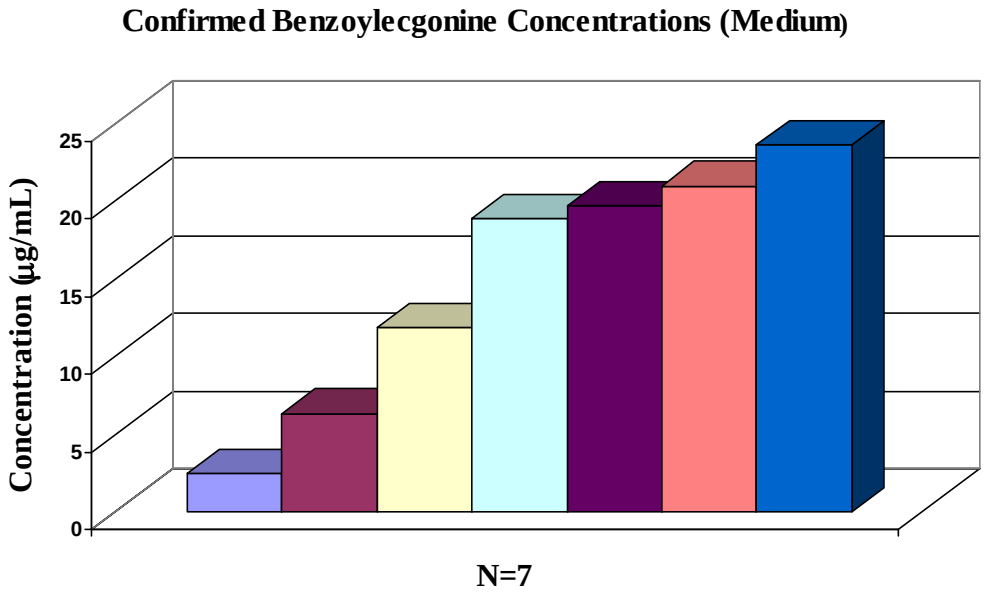

Figure 22. Middle concentrations for samples (N=7) that were positive for the metabolite of cocaine (benzoylecgonine).

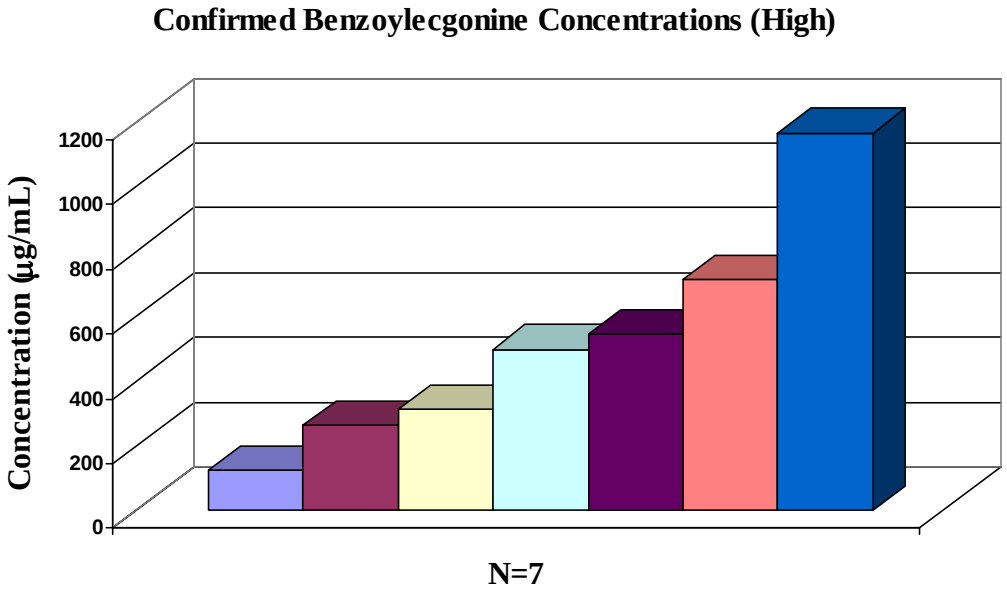

Figure 23. High concentrations for samples (N=7) that were positive for the metabolite of cocaine (benzoylecgonine).

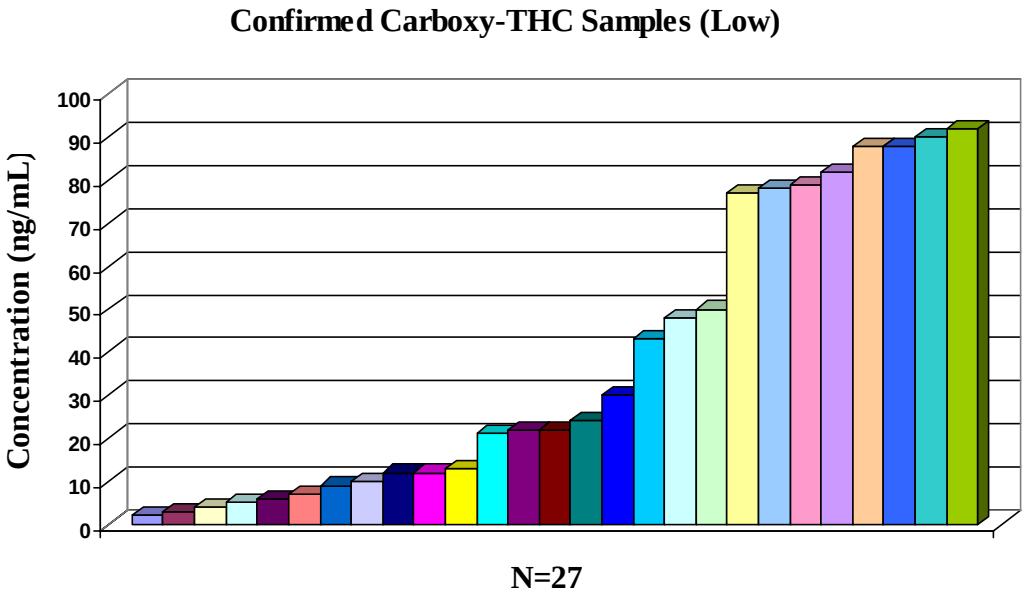

Figure 24. Low concentrations for samples (N=27) that were positive for the metabolite of THC (carboxy-THC).

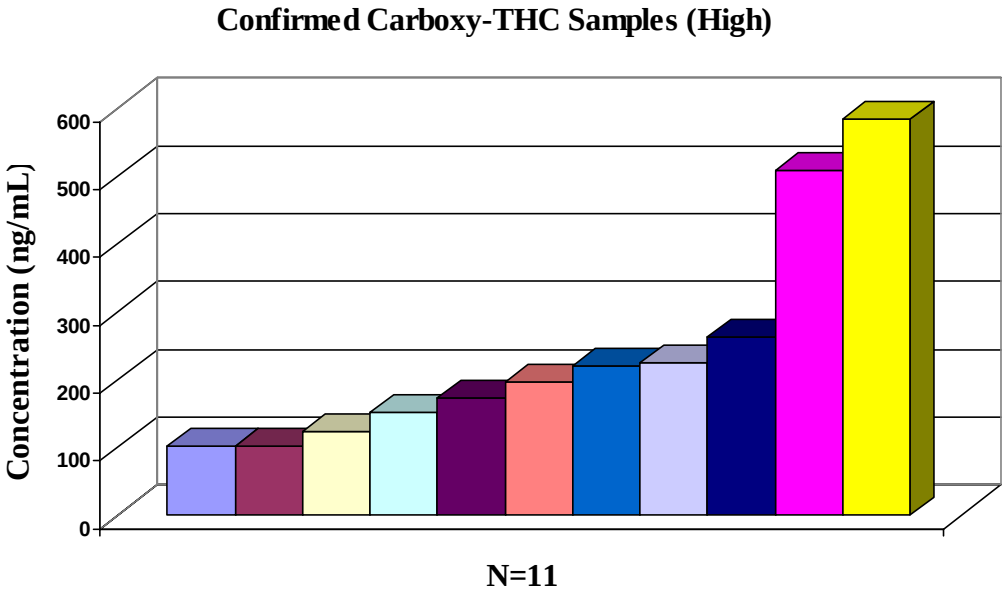

Figure 25. High concentrations for samples (N=11) that were positive for the metabolite of THC (carboxy-THC).

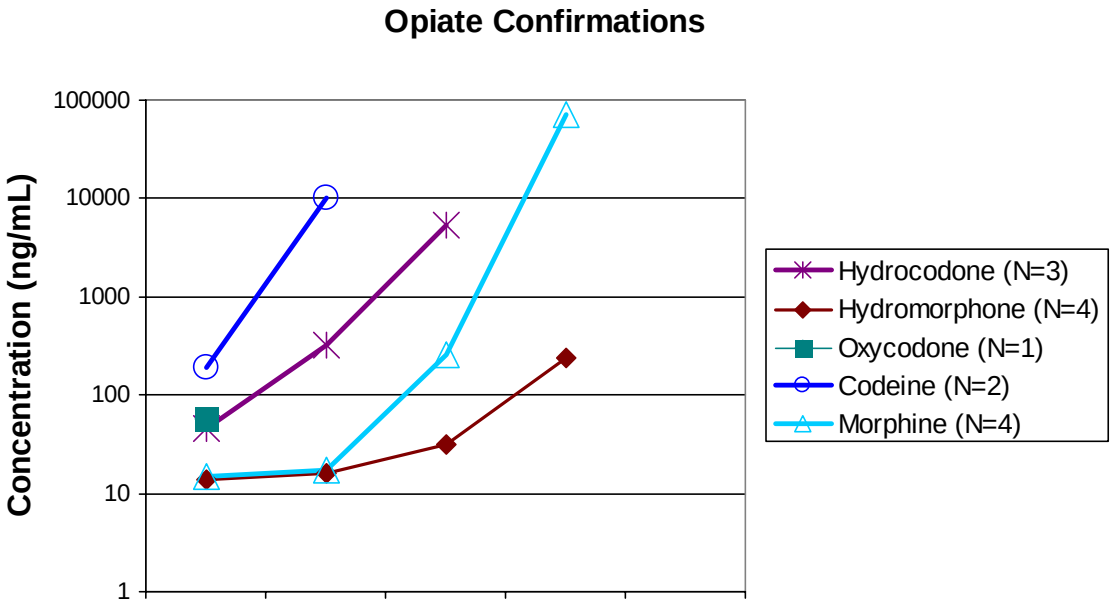

Figure 26. Concentrations of samples positive for one of the opiates being analyzed.

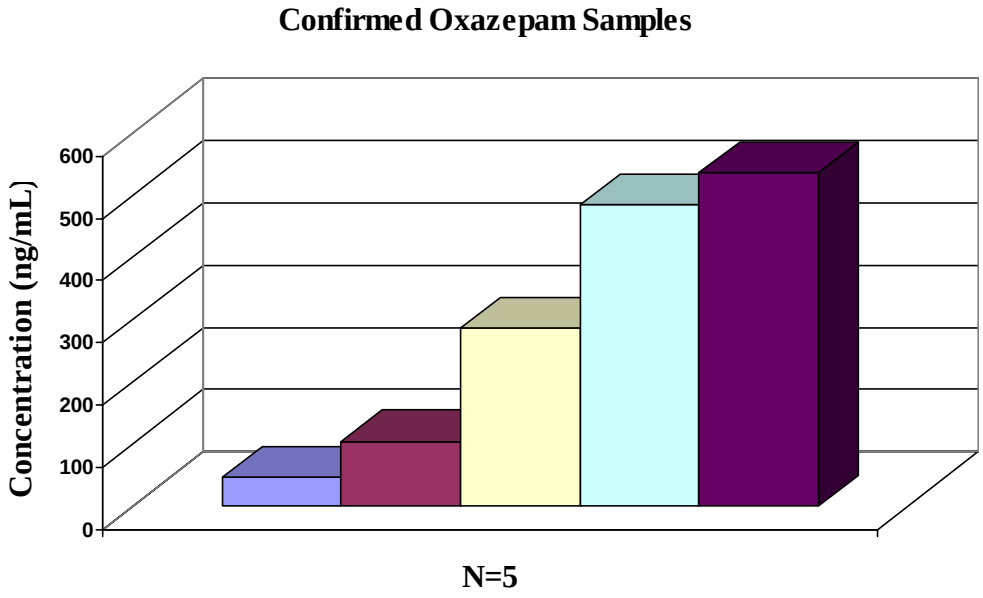

Figure 27. Concentrations for samples (N=5) that were positive for the common metabolite of most benzodiazepines (oxazepam).

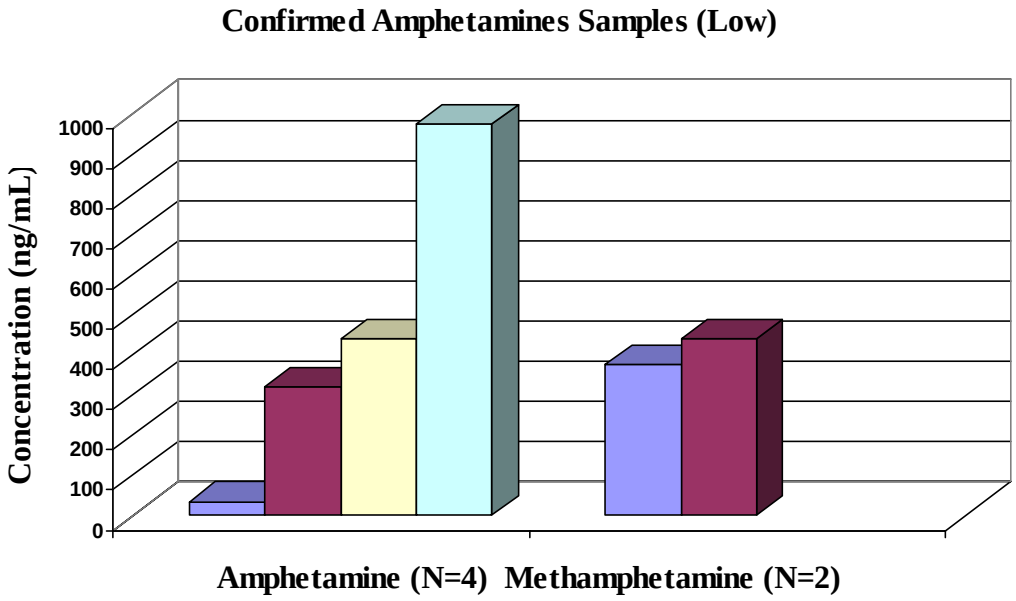

Figure 28. Low concentrations for samples that were positive for either amphetamine or methamphetamine.

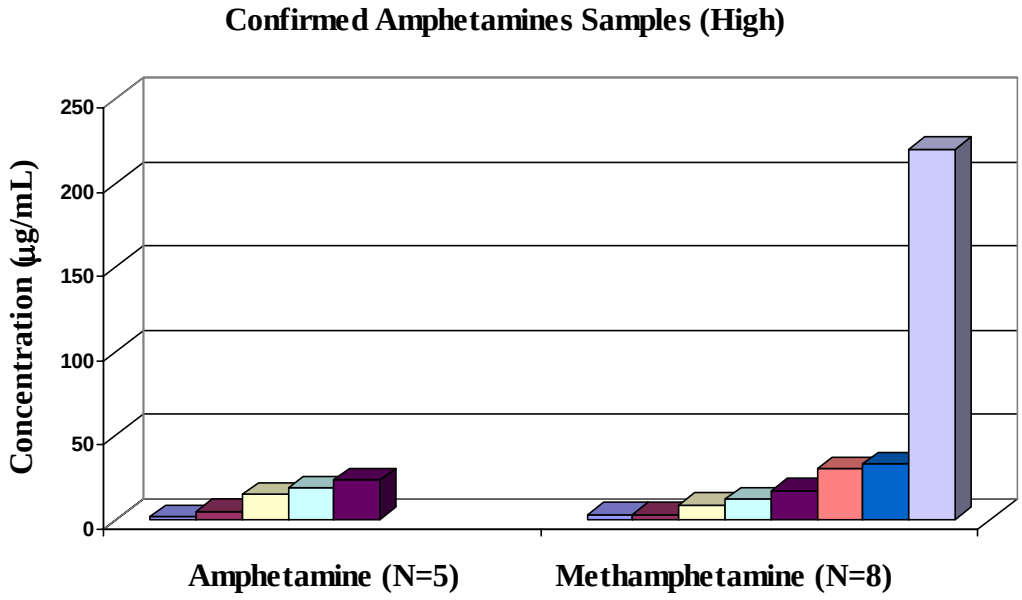

Figure 29. High concentrations for samples that were positive for either amphetamine or methamphetamine.

Of the 66 confirmed positive specimens, 37 (56.1%) were positive for only one drug of abuse. The 29 specimens with multiple confirmations had 23 with 2, 4 with 3, and 2 with 4 (specimens with drugs (or drug classes)). These data are summarized in Table VIII. For the amphetamines and opiates, any specimen that tested positive for more than one drug in the class was treated as positive only for the drug class. For example, if Subject XYZ was confirmed positive for ethanol, hydrocodone, and hydromorphone, she was scored as having been positive for 2 drugs/drug classes. The one specimen that screened positive for PCP was found to be negative on confirmation. This specimen was later found to contain a high level of dextromethorphan, which is known to interfere with the PCP immunoassay. Oxazepam was found only in combination with other drugs, which suggests that a benzodiazepine is used to enhance the high of other drugs, as in marijuana or alcohol; or it is used to lessen the anxiety caused by stimulant abuse, as in cocaine or amphetamines. It also could be used surreptitiously to incapacitate someone, and the pharmacology of the combined drugs was examined in each case to determine if DFSA was a possibility. Marijuana was the most commonly detected drug, whether alone (17 subjects) or in combination (21 cases). This represents 57.6% of all subjects with a confirmed drug of abuse and 26.4% of all subjects in this study.

TABLE VIII. NUMBER OF SPECIMENS POSITIVE FOR ALL DRUG(S) OF ABUSE ANALYZED.

Drug Combination	**# of Samples**
Ethanol	10
Cocaine	3
Marijuana	17
Opiates	5
Amphetamines	2
Ethanol + Cocaine	1
Ethanol + Marijuana	1
Ethanol + Amphetamines	1
Cocaine + Marijuana	12
Cocaine + Opiates	3
Cocaine + Oxazepam	1
Marijuana + Oxazepam	3
Opiates + Oxazepam	1
Cocaine + Marijuana + Oxazepam	2
Cocaine + Marijuana + Amphetamines	2
Cocaine + Marijuana + Oxazepam +Amphetamines	1
Ethanol + Cocaine + Opiates + Amphetamines	1

i. Subject's Self-Reported Drug Use

On the questionnaire, 73 subjects admitted to using at least one of the compounds being analyzed for by USDTL in the 24 hours leading up to the alleged assault (Table IX). Of these 73 subjects, the use of ethanol, either alone or in combination, had the highest number of admissions at 66 (90.4%). Recreational use of the SAMHSA-5 drugs of abuse (cocaine, amphetamines, opiates, PCP, or marijuana) was admitted to by 22 (30.1%) subjects. None of the subjects admitted to using barbiturates, benzodiazepines, PCP, methadone, or opiates. Shown in Table X are the results of the USDTL analysis compared to the self-reporting of the subjects. The cocaine, marijuana, and amphetamine data were used to evaluate the truthfulness of self-reporting of drug use among sexual assault complainants. These drugs were examined because they would not

be given to someone to cause sedation or amnesia. They also would not normally make someone more compliant and less resistant to a sexual assault. It is also difficult to surreptitiously give these drugs, as they are most commonly used by smoking the drug. Opiate and benzodiazepine data were important in determining DFSA as these compounds could have been given surreptitiously, or could have been used by the subject leading to their sedation or amnesia.

TABLE IX. DRUG(S) OF ABUSE ADMITTED TO IN THE QUESTIONNAIRE BY ALL OF THE SUBJECTS.

Drug or Drugs	**Number of Specimens**
Amphetamines	1
Cocaine	2
Ethanol	51
Marijuana	1
Amphetamines + Ethanol	2
Amphetamines + Marijuana	2
Cocaine + Ethanol	4
Cocaine + Marijuana	1
Marijuana + Ethanol	8
Cocaine + Marijuana + Ethanol	1

TABLE X. COMPARISON OF THE DRUG(S) ADMITTED TO BY THE SUBJECTS AND THE RESULTS OF THE DRUG ANALYSIS.

Drug	**Admit to Using**	**Positive, Admitted to Using**	**Positive, Didn't Admit to Using**
Ethanol	66	14	0
Cocaine	8	8	18
THC	13	12	26
Opiates	0	0	10
Benzodiazepines	0	0	5
Amps	5	4	6

All subjects' whose urines were positive for alcohol admitted to its use before the assault. There were many cases where the subject admitted to using alcohol, but it was not found. This is due partly to the short half-life of ethanol and to the delay in reporting for some of the subjects. For marijuana, 40% of the subjects that were positive admitted to its use. Cocaine had 36.4% of the subjects positive admitting to its use, and the amphetamines had 44.4%. When all of these numbers are combined, 39.3% of subjects who were positive for a drug of abuse admit to using the drug.

Race and self-reporting were also compared to the results from the USDTL analysis. In cases where the subject did not complete a questionnaire, the value was considered unknown, as well as when the subject completed the questionnaire but the box was not checked. Table XI compares by race, those subjects who admitted to using a drug and those who had a positive on screening. Any sample that did not fall into the three races studied was not included in this meta-analysis. White subjects did not have a 100% correlation between admitting to using a drug and being found positive. However, Black and Hispanic subjects did not admit to using cocaine, heroin, or amphetamines, but had 20 cases where a urine was positive. This suggests that while there is underreporting for all races, Blacks and Hispanics demonstrate a higher rate of underreporting. This corresponds with previous work done by Fendrich and Vaughn that showed that Hispanics underreport more than Whites and that Blacks underreport twice as much as Whites (177). The validity of self-reporting among this sexual assault complainant population is further discussed below.

TABLE XI. RACIAL GROUP VARIATION IN ADMISSION VS. DETECTION OF DRUGS OF ABUSE. A=ADMIT, P=POSITIVE.

Race	Ethanol		Cocaine		THC		Opiates		BZ		Amps	
	A	P	A	P	A	P	A	P	A	P	A	P
White	52	12	6	20	13	34	0	12	0	4	5	12
Black	2	0	0	2	0	7	0	2	0	0	0	0
Hispanic	7	1	0	2	0	4	0	2	0	1	0	1

Shown in Table XII is the age of the subjects compared to the drugs of abuse that were found. Subjects below the age of 31 were responsible for 74.2% of the confirmed cases of drugs of abuse. Marijuana was found 76.3% of the time in subjects under the age of 26. The stimulants (cocaine and amphetamines) were found 69.4% of the time in subjects below the age of 31. The depressants (opiates and benzodiazepines) were found 53.3% of the time in subjects above the age of 31. These data suggest that women over the age of 31 abuse fewer drugs than women under the age of 31. Also, stimulant use was favored in the younger group, while depressants were found more in women above the age of 31. However, we cannot be sure about this because the depressants may have been given surreptitiously.

TABLE XII. THE NUMBER OF DRUGS OF ABUSE THAT WERE CONFIRMED BY AGE COHORT.

Age	# of Confirms	Ethanol	Cocaine	THC	Opiates	BZ	Amps
18-20	18 (27.2%)	4	5	13	1	0	4
21-25	21 (31.8%)	2	7	16	1	2	3
26-30	10 (15.2%)	2	6	5	1	2	0
31-35	5 (7.6%)	1	3	3	0	0	1
36-40	4 (6.1%)	2	3	0	2	0	1
41 +	8 (12.1%)	3	2	1	5	1	1

ii. Analysis of Subjects Who Returned for the Second Visit

Of the 59 subjects who returned for the second visit, 29 were positive for at least one of the drugs of abuse. The drugs that were found in the first visit do not appear to predict whether the subject would return for the second visit, e.g. cocaine users were no more likely to return than marijuana users. Shown in Table XIII is the comparison of the first visit drug profile to the second visit. If both visits were positive for a drug, it was assumed that the subject commonly used the drug in question. If only the first visit was positive, it was assumed that the subject was either given the drug surreptitiously or had not used that drug since the alleged assault. If only the second visit was positive, it was assumed that the subject had used the drug in the interval between the first and second visit.

Cocaine use declined by almost 50% from the first visit. However, three subjects used cocaine after the assault. Marijuana and amphetamine use were not extremely different and two subjects began using marijuana after the assault. Opiate and benzodiazepine use also did not change dramatically. The subjects who were only

positive on the first visit could have been given the depressants surreptitiously and this will be examined below. However there were only three subjects fitting this profile.

TABLE XIII. ANALYSIS OF THE DRUGS OF ABUSE THAT WERE CONFIRMED IN THE FIRST VISIT AND WHETHER THE SECOND VISIT WAS ALSO POSITIVE.

Confirmed Positives	**Ethanol**	**Cocaine**	**THC**	**Opiates**	**BZ**	**Amps**
1st Visit Positive	8	13	15	3	2	2
2nd Visit Positive with 1st Visit Positive	1	6	12	1	1	1
2nd Visit Positive with 1st Visit Negative	0	3	2	1	1	0

e. <u>The"Date-Rape" Drugs</u>

For the next two sections, only the first visit urine samples were considered. Second visit urine samples were most important for analyzing intra-individual drug usage and if a "date-rape" drug was found only in the second visit, it would skew data on drugs found after the assault to include more cases.

There are five drugs that are reported in the scientific and popular literature to be most often associated with DFSA; clonazepam, flunitrazepam, GHB, ketamine, and scopolamine. Ketamine is used clinically for surgical procedures and prescriptions for it are not normally given. As discussed above, flunitrazepam is illegal in this country. Finding either in the urine of a subject would suggest surreptitious use for the purpose of DFSA or illegal recreational use by the subject. Clonazepam is prescribed as an anticonvulsant, GHB as a sleep aid in very rare cases, and scopolamine is available to prevent the onset of motion sickness. If any of these drugs are found, it may be due to:

valid prescription use by the subject, recreational drug use by the subject, surreptitious drug administration by a potential assailant, or, in the case of GHB, endogenous levels. Interpretation of drug levels as a diagnostic indicator of DFSA is complex, and should take into consideration all the facts, circumstances, and the toxicological findings of the case.

For all subjects who completed a questionnaire, three claimed to have a prescription for clonazepam and it was only found in these three subjects. No one admitted to having a prescription for GHB, or using it recreationally, and GHB was only found in levels considered to be endogenous. Ketamine and scopolamine were not admitted to by any of the subjects and were not found. Flunitrazepam was not admitted to by anyone, but was found in four subjects. The specific cases where flunitrazepam and clonazepam were found are discussed below in the results from individual sites.

f. <u>Prescription and OTC Drugs</u>

There are 24 drugs in this category and, of these, six were not found in any of the first visit urine samples. When evaluating cases that include these drugs, there were several caveats. First, the subject could have a prescription for these drugs and finding the drug would not be unusual. However, the pharmacologic effect of the drug when combined with any other drugs in her system would have to be evaluated as to whether there could have been a decrease in the person's capacity to consent to sexual acts. Secondly, the questionnaire did not specifically ask what OTC drugs the subject was taking. Thus, if diphenhydramine was not admitted to, but found, it is difficult to determine if the subject was taking it for allergies or if a potential assailant surreptitiously gave her the drug. Finally, the concentrations of the drugs found as well as how long

after the assault the subject reported to the clinic need to be evaluated. It is always difficult to interpret quantitation results in urine; however, in cases where the concentrations are high and the time delay between the assault and specimen collection is long (e.g. > 48 hours), it will not be possible to determine if the subject had this drug in their system at the time of the assault, or if she took the drug after the assault.

Shown in Table XIV are the results for the OTC and prescription drugs. The individual cases where these drugs were found are discussed below in the sections for each separate site. Most subjects who admitted to using one of these drugs had these drugs confirmed in their urine. In some cases, the subject admitted to having a prescription for a certain drug, but not taking it the day of the assault. In these cases, the drug may have already been completely eliminated from the subject's system and screened negative. There were other cases where it is unknown why the drug was not found even though the subject admitted to its use.

TABLE XIV. OTC AND PRESCRIPTION DRUGS THAT WERE ADMITTED TO AND WHETHER THEY WERE EVENTUALLY CONFIRMED.

Drug	# Admitting to Use	# Confirmed Positive
Alprazolam	1	1
Amitriptyline	1	2
Butalbital	0	1
Chlorpheniramine	0	4
Citalopram	4	6
Cyclobenzaprine	0	2
Dextromethorphan	1	2
Diphenhydramine	1	3
Doxepin	1	1
Doxylamine	1	4
Fluoxetine	4	5
Imipramine	1	1
Nortriptyline	0	4
Paroxetine	5	3
Sertraline	7	8
Triazolam	0	1
Valproic Acid	1	1

g. Hair Analysis

Hair specimens were collected from all 59 subjects who returned for the second visit. The color of each specimen was first noted and the length of the hair was measured and recorded. Of the total specimens, 9 were red, 10 were black, 14 were blond, and 26 were brown. The lengths ranged from 2 to 45 centimeters, with a mean and standard deviation of 18.93 ± 11.85 centimeters. The proximal 2 centimeters of hair were pulverized, and 50 milligrams of this was weighed out. If the amount of hair available was estimated to be too small, all of the hair was pulverized. The entire specimen had to be used in eight of the 59 hair samples. Upon weighing the pulverized hair, if 50 milligrams was not available, the entire 2 centimeter specimen was used and the weight was recorded. Twenty-one specimens had more than 50 milligrams of pulverized hair

available; the rest were completely consumed for the screening. The weight of the 38 specimens below 50 milligrams ranged from 2 to 47 milligrams with a mean and standard deviation of 30.66 ± 12.61 milligrams.

The screening showed that 21 hair specimens were positive for at least one of the compounds previously analyzed in urine (Table XV). Of these 21, five of the specimens were positive for two or more compounds. However, because the entire specimen had to be used in most of the cases, only 11 could be subjected to confirmatory tests. The confirmation data are presented below, in the discussion of results for separate sites.

TABLE XV. NUMBER OF HAIR SPECIMENS THAT SCREENED POSITIVE FOR AT LEAST ONE OF THE DRUGS BEING ANALYZED.

Drug / Drug Class	Number of Specimens Screened Positive
Amitriptyline	1
Amphetamines	3
Benzodiazepines	6
Citalopram	3
Clonidine	1
Cocaine	8
Cyclobenzaprine	1
Diphenhydramine	1
Doxylamine	6
Imipramine	1
Opiates	4
Sertraline	6

B. Analysis of Samples from Providence Medical Center (Everett, Washington)

a. Demographics

Washington was the last site to begin accepting subjects for this study. Thus, they contributed the fewest number of subjects, 15. Of these 15 subjects, 14 are White and one is Other/Unknown. This makes Washington the least racially diverse site of the four.

However, the census data for the area where the clinic is located (Table XVI) demonstrates that Everett has the highest percentage of Whites of all four sites (178). Thus, the subjects who were recruited reflect the general population of Everett, WA. Of the fifteen subjects, nine (60%) returned for the second visit including the one subject identified as Other/Unknown.

TABLE XVI. RACE OF THE SUBJECTS FROM WASHINGTON AS COMPARED TO THE CENSUS DATA FROM THE AREA WHERE THE CLINIC IS LOCATED.

Race	Everett, WA – 2000 U.S. Census	This Study Sample
White	78.9%	93.0%
Black	3.2%	0.0%
Hispanic	7.5%	0.0%

The age of the subjects ranged from 18 to 42 years of age (Table XVII), with a mean and standard deviation of 24 ± 6.3 years (median age is 22). The age range did not differ significantly ($p>0.05$) from the age range of the entire study. There was also no correlation between the age of the subject and whether they returned for the second visit.

TABLE XVII. DISTRIBUTION OF THE SUBJECTS FROM WASHINGTON INTO THE SIX AGE COHORTS.

Visit	18-20	21-25	26-30	31-35	36-40	41 +
First (N=15)	5	5	3	1	0	1
Second (N=9)	3	3	2	1	0	0

The time interval between the alleged assault and time of reporting to the clinic ranged from 3 hours to 66 hours, with a mean and standard deviation of 25.7 ± 20.3 hours (median time 18). There were two subjects who reported to the clinic after 48 hours and were responsible for skewing the mean away from the median time interval.

Washington had the highest number of subjects who believed they were given a drug surreptitiously. Nine of the fifteen subjects (60%) believed they were given a drug, and four subjects (26.7%) either couldn't remember or believed that it was a possibility. Thus, only two subjects stated that no drug was given to them. Accordingly, we might expect to find a large number of "date-rape" drugs, or drugs that could incapacitate someone, at this site.

b. Drugs of Abuse

Washington had seven subjects that screened positive for one of the six common drugs of abuse or categories discussed above. This represents 8.6% of all of the positive screens in this study. By providing fifteen of the 144 subjects for this study, Washington provided 10.4% of all subjects. Thus their positive screens are in close agreement with the number of subjects that were provided.

Data for the drugs of abuse screen are presented in Table XVIII. One subject's urine screened positive for cocaine, marijuana, benzodiazepines, and amphetamines, but there was only enough specimen volume to be confirmed for cocaine and benzodiazepines. Of the 13 subjects who admitted to drinking alcohol at the time of the assault, nine reported to the clinic more than 12 hours after the assault, which explains why so few specimens could be confirmed for alcohol.

TABLE XVIII. NUMBER OF SUBJECTS WHO WERE CONFIRMED FOR THE DRUGS OF ABUSE BEING ANALYZED.

	Ethanol	**Cocaine**	**THC**	**BZ**	**Opiates**	**Amps**
Admit to Using	13	0	3	0	0	1
Screened Positive	3	3	5	1	2	2
Confirmed Positive	3	3	4	1	1	1

Because the majority of the subjects were White at this site, there is insufficient data to draw any conclusions about differences among racial categories. The age of the subjects with drugs of abuse is shown in Table XIX. However, there are no obvious conclusions that can be drawn from this data. This may account for no significant difference between the age cohorts, or be due simply to Washington's small sample size.

TABLE XIX. DISTRIBUTION OF THOSE SUBJECTS WHO WERE POSITIVE FOR ONE OR MORE OF THE DRUGS OF ABUSE INTO THE SIX AGE COHORTS.

	18-20	**21-25**	**26-30**	**31-35**	**36-40**	**41 +**
Total	5	5	3	1	0	1
Confirmed	2	3	1	0	0	1

c. <u>"Date-Rape" Drugs</u>

The prevalence of the classic "date-rape" drugs (clonazepam, flunitrazepam, GHB, ketamine, and scopolamine) is examined here. One subject from Washington admitted to using clonazepam and the drug was subsequently confirmed. Clonazepam also screened positive in the urine of one subject on the second visit and was confirmed. Finding clonazepam in the urine of someone who has a prescription for it does not indicate that they were sexually assaulted due to its use. However, this subject also admitted to using ethanol at the time of the assault and believed that they were given a

drug surreptitiously. As discussed above, the combination of clonazepam and alcohol can cause severe drowsiness and unconsciousness. If the subject had not been informed by her pharmacist of the dangers of co-administration of clonazepam with alcohol, the combination may have unwittingly caused the resulting unconsciousness and her belief that this was caused by the perpetrator. By DFSA1, this is not a DFSA, but under DFSA2 this case is a DFSA.

The subject who had clonazepam in her system only on the second visit did not believe that any drugs were given surreptitiously. However, the laboratory findings suggested serious recreational drug use on her part. The first visit urine was positive for cocaine, marijuana, benzodiazepines, amphetamines, and sertraline. The second visit was positive for benzodiazepines, opiates, and sertraline. Under DFSA1 this case is not a DFSA. However, under DFSA2 this is a case of DFSA due to the subject's recreational drug use and the presence of depressants.

Flunitrazepam was found in two subjects' urine, both of whom returned for the second visit. For the first subject, flunitrazepam was confirmed in both the first and second visits; for the second subject, confirmed only in the first visit urine.
Neither subject admitted to using flunitrazepam but both suspected that a drug had been given to them surreptitiously. The subject with flunitrazepam in both urine specimens had a higher level on the second visit, which suggests use of flunitrazepam after the assault. Citalopram was also found in the first visit urine, but the second visit was unremarkable. The subject admitted to using alcohol, and unconsciousness could have ensued. However, the finding of flunitrazepam in the second visit urine confuses the situation because if the subject used flunitrazepam recreationally, she could have taken it

after the assault. By DFSA1, this case is not a DFSA due to the subject's recreational use of the "date-rape" drug; by DFSA2, this case is a DFSA.

The second subject with flunitrazepam in her first visit urine also has a confusing drug profile following the assault. The subject admitted to using only alcohol (which was confirmed), but in the first visit urine opiates and marijuana were also found. In the second visit specimen amitriptyline, opiates, and marijuana were found. This suggests recreational drug use by the subject, that was not admitted to, and further complicates the interpretation of whether flunitrazepam was taken on her own accord or not. The subject states that she was at a party drinking, but does not remember anything leading up to the assault. The finding of several depressants in the first visit urine, especially flunitrazepam, can explain why the subject remembered very little from the time of the assault. However, because so many drugs were found in the second visit specimen, it is difficult to determine if the subject was actually given something by a perpetrator, or if her own poly-drug use led to her inability to remember the assault. Based on the criteria for DFSA1, because the subject did not admit to using the drug (flunitrazepam) but it was found, this case is a DFSA. This case is also DFSA under the criteria for DFSA2.

Ketamine and scopolamine were not found in any of the specimens and GHB was never found above the endogenous cut-off level of 10 μg/mL. Due to GHB's short detection time of 10-12 hours (179), and the fact that only four subjects reported to the clinic within 12 hours, suggests that if any of the subjects had been given GHB, the levels would have been undetectable.

d. Prescription and OTC Drugs

Only three of the submitting subjects were positive for prescription and OTC drugs on their first visit. One subject, who believed she was given a drug without her consent, was positive for alprazolam, amitriptyline, chlorpheniramine, amphetamines, cocaine, ethanol, and opiates. She admitted to using ethanol, alprazolam, and possibly amphetamines and then passing out. When she awoke, she was at home in different clothing with two friends, one of whom allegedly made a remark about "how many hours does it take ecstasy to get out of the system." This subject did not return for the second visit, thus eliminating the chance to determine if she commonly uses many drugs. This is another case with extreme poly-drug use (seven drugs) and the combination of alcohol with four drugs that are known to cause sedation. If her statement is true about what the friend said, it is possible that she was given a drug purported to be ecstasy, but which actually contained one or more of these compounds. Based on her statement and the toxicology findings, this is a DFSA by DFSA1 and DFSA2.

Both of the other subjects with OTC and prescription drugs were discussed above in conjunction with clonazepam and flunitrazepam.

e. Hair Analysis

Nine of the subjects provided hair specimens. However, only two provided enough for both screening and confirmation. Although every specimen was over 20 centimeters in length, the weight of the first two centimeters averaged 20 milligrams. This result suggests that the nurses were not cutting a sufficiently large diameter of hair as was suggested. The hair analysis for this site encompassed screening results only, as the two specimens with more than 50 milligrams did not screen positive for any drugs.

Table XX shows the results from the screening, as well as what compounds were previously found in the urine of each subject. Although marijuana was admitted to by several subjects, it never screened positive. The hair analysis did not provide any additional data that could help in determining if any of the cases were DFSA.

Shown in Table XXI are the quantitation results for the first visit and second visit urines, and hair for all drugs being analyzed. For the urine analysis all results are in ng/mL; for hair the results are in ng/mg.

TABLE XX. RESULTS FROM THE ANALYSIS FOR ALL DRUGS IN THE HAIR SPECIMENS PROVIDED BY SUBJECTS FROM WASHINGTON.

Sample #	**Drugs Previously Found in the Urine**	**Drugs Admitted to but not Found in the Urine**	**Drugs Screening Positive in Hair**
1	None	Citalopram	None
2	Marijuana	None	None
3	Marijuana	None	None
4	None	None	None
5	Sertraline, Cocaine, Marijuana, Amphetamines	None	Sertraline
6	Citalopram, Flunitrazepam	None	Citalopram
7	None	Marijuana	None
8	Flunitrazepam, Marijuana, Opiates	None	None
9	None	None	None

TABLE XXI. QUANTITATION RESULTS FOR ALL SUBJECTS FROM WASHINGTON WHO WERE POSITIVE FOR AT LEAST ONE DRUG BEING ANALYZED. ALL VALUES ARE IN NG/ML FOR URINE AND NG/MG FOR HAIR. NA=NOT APPLICABLE

Sample	First Visit Urine	Second Visit Urine	Hair
1	α-OH Alprazolam – 29.7 Amitriptyline – 259.6 Amphetamine – 35 Benzoylecgonine – 20,949 Chlorpheniramine – 8.65 Ethanol – 146 Hydrocodone – 46 Methamphetamine – 439 Nortriptyline – 314.4	NA	NA
2	Benzoylecgonine – 11 THC-COOH – 88	NA	NA
3	None	THC-COOH – 13	None
4	THC-COOH – 24	THC-COOH - 7	None
5	Ethanol – 53	None	None
6	Benzoylecgonine – 87 Oxazepam – 46 Sertraline - 7	7-Aminoclonazepam – 21.4 Oxazepam – 19 Oxycodone – 1,029 Sertraline – 6.7	None
7	Citalopram – 34.2 Flunitrazepam – 26.1	7-Aminoflunitrazepam – 57.6	None
8	7-Aminoclonazepam – 72.1	NA	NA
9	THC-COOH – 264	NA	NA
10	Ethanol – 130 Flunitrazepam – 10.9 Hydromorphone – 690.1 THC-COOH - 586	Amitriptyline – 59.95 Nortriptyline – 305.4 Oxycodone – 87.2 THC-COOH - 231	None

f. Prevalence of DFSA at the Washington Site

For DFSA1, five unique cases were discussed above and the resulting findings were presented. There were six subjects who were not positive for any drugs and three were only positive for cocaine/marijuana/amphetamines. All nine of these subjects are considered to not be DFSA. The final subject admitted to drinking alcohol to a point of impairment and ethanol was the only drug found in her urine. Her second visit specimens were negative for all drugs. Because only ethanol was found (and we assume it cannot be given surreptitiously) this is not a case of DFSA. However, under DFSA2 the case is a DFSA. The results for DFSA1 are presented in Table XXII.

DFSA2 had widely divergent results as compared to DFSA1. The six subjects without any drugs are still considered to not be DFSA and the results for the unique cases were presented above. The three subjects who were only positive for cocaine/marijuana/amphetamines are all considered to be DFSA by DFSA2 due to the subject's own recreational drug use facilitating the sexual assault to occur. The results for DFSA2 are compared to DFSA1 in Table XXII.

Based on the analysis of the questionnaires, it was hypothesized that Washington would have a high prevalence of DFSA due to 86.7% of the subjects believing that DFSA was a possibility. However, the analysis conducted in this study determined that only 13.3% were probably given a drug surreptitiously. In contrast, 46.7% of the subjects were most likely victims of DFSA due to their own recreational drug use or through poly-substance use.

TABLE XXII. ESTIMATE OF THE PREVALENCE OF DFSA AMONG THE SUBMITTING SUBJECTS IN WASHINGTON.

N=15	Yes	No	Unknown
DFSA1	2 (13.3%)	13 (86.7%)	0 (0.0%)
DFSA2	9 (60.0%)	6 (40.0%)	0 (0.0%)

C. Analysis of Samples from Scott & White Memorial Hospital, Temple, Texas

a. Demographics

Texas was the first site to begin submitting specimens and recruited subjects throughout the duration of the study. The clinic provided 31 subjects, of whom 22 are White, 6 are Black, 2 are Hispanic and 1 is Other/Unknown. The racial make-up of the subjects in this study corresponds well for the White and Black census data for Temple, TX, where the clinic is located (Table XXIII) (180). However, the Hispanic population in this study under represents the Hispanic population according to the census data. For the census, Hispanic is considered to be an ethnicity rather than a race. For example you can identify as White for race and Hispanic for ethnicity. This study did not make the distinction between ethnicity and race, and this fact should be considered when comparing our distributions to those from the U.S. census. The results that will be presented should generally reflect the population of this local area in Texas.

TABLE XXIII. RACE OF THE SUBJECTS FROM TEXAS AS COMPARED TO THE CENSUS DATA FROM THE AREA WHERE THE CLINIC IS LOCATED.

Race	Temple, TX – 2000 U.S. Census	This Study Sample
White	62.7%	72.0%
Black	16.5%	19.0%
Hispanic	17.8%	6.0%

Of the 31 subjects, 24 (77.4%) returned for the second visit. Texas had the highest rate of return visits of all of the clinics and provides the best data for examining intra-person drug usage.

The age of the subjects ranged from 18 to 46 years of age (Table XXIV), with a mean and standard deviation of 26 ± 7 years (median age is 25). The age range did not differ significantly ($p>0.05$) from the age range of the entire study. There was also no correlation between the age of the subject and whether they returned for the second visit.

TABLE XXIV. DISTRIBUTION OF THE SUBJECTS FROM TEXAS INTO THE SIX AGE COHORTS.

Visit	18-20	21-25	26-30	31-35	36-40	41 +
First (N=31)	6	12	7	2	3	1
Second (N=24)	5	10	4	2	3	0

The time interval between the assault and when the complainant reported to the clinic ranged from 2 hours to 60 hours, with a mean and standard deviation of 14.4 ± 14.3

hours (median time is 9). As in Washington, there were two subjects who reported to the clinic after 48 hours and were responsible for skewing the mean away from the median time interval.

Because Texas was the first site to receive study kits, the questionnaire had not yet been moved from the second visit to the first visit, and thus anyone who did not return for the second visit (seven subjects) did not complete a questionnaire. This clinic was the reason for the change in the questionnaire, but because it was not immediately initiated, all comparisons of self-reporting and suspicion of DFSA in Texas are done based on the 24 questionnaires received.

Of the 24 subjects, six (25%) believed they were given a drug, two subjects (8.3%) either couldn't remember or believed that it was a possibility, and 16 (66.7%) subjects stated that a drug was not given to them. On this basis alone, we might expect to find fewer "date-rape" drugs or drugs that could incapacitate someone than in Washington where 60% of the subjects believed they had been given a drug. The racial distribution of these respondents did not differ widely from the racial distribution for the site overall.

The age distribution for these 24 subjects and their questionnaire responses are shown in Table XXV. It is interesting to note that no one below 21 years of age or above 35 years of age suspected that they were given a drug. This may be due to several reasons. First, the 21-35 year old age group may have been more educated about DFSA, as the "epidemic" of DFSA has been highly publicized during a time in their lives when they are likely to be attending bars or raves. Second, this age group may just be the highest risk group for DFSA and would be expected to have a higher response due to an

increased amount of DFSA occurring to their age group. However, this age trend was not seen in Washington which may suggest regional differences in DFSA education.

TABLE XXV. DISTRIBUTION INTO THE SIX AGE COHORTS THOSE SUBJECTS WHO EITHER DO OR DO NOT BELIEVE THEY WERE GIVEN A DRUG SURREPTITIOUSLY.

Age Cohort (yrs)	**Do you think you were given a drug surreptitiously?**		
	Yes	**No**	**Maybe/Don't Remember**
18-20	0	4	1
21-25	2	7	1
26-30	3	1	0
31-35	1	1	0
36-40	0	3	0
41 +	0	0	0

b. <u>Drugs of Abuse</u>

Texas had 17 subjects who screened positive for one of the common drugs of abuse in the first visit. This represents 21.0% of all of the positive screens in this study. By providing 31 of the 144 subjects for this study, Texas provided 21.5% of all subjects. Their positive screens are in closer agreement with the number of subjects that were provided than in Washington. This suggests that the drugs found in sexual assault complainants provided by this site correspond closely with all of the sexual assault complainants.

Data for the drugs of abuse screen and the confirmation data are presented in Table XXVI. Of the seventeen subjects with a positive screen, eleven had positive confirmations. Of the 12 subjects who admitted to drinking alcohol at the time of the

assault, six reported to the clinic longer than 12 hours after the assault, which can explain why so few samples were confirmed for alcohol. The other five subjects who admitted to using alcohol but had a negative screen reported to the clinic anywhere from two hours after the assault to 10 hours. It is unknown why ethanol was not detected, but there are several possible reasons. First, the subject reports the time of the assault, and if they drank ethanol within 24 hours of the assault. Thus, if the subject was drinking 20 hours before the assault, they will still admit to drinking, but all tests would have been negative. Secondly, the quantity of ethanol consumed by the subject was unknown. If they had one drink, and reported to the clinic six hours later, it is unlikely that the screen would have been positive. Third, if the subject had previously voided their urine several times before coming to the clinic, and had been consuming water or other non-alcoholic liquids, the urine may have been too dilute to give an accurate measurement.

Data for the marijuana, cocaine, and amphetamine analysis are especially interesting when considering the validity of self-reporting among sexual assault complainants. Only four subjects admitted to using these drugs, but the number of subjects with the drugs confirmed in urine was much higher. When only the confirmed drug data are examined, 71.4% of subjects positive for marijuana, 80% of subjects positive for cocaine, and 50% of subjects positive for amphetamines did not admit to using the drugs. This data shows that sexual assault complainants from this site underreport their usage of illegal drugs to the attending nurse.

TABLE XXVI. NUMBER OF SUBJECTS WHO WERE CONFIRMED FOR THE DRUGS OF ABUSE BEING ANALYZED.

	Ethanol	**Cocaine**	**THC**	**BZ**	**Opiates**	**Amps**
Admit to Using	12	1	2	0	0	1
Screened Positive	1	5	11	2	5	2
Confirmed Positive	1	5	7	1	2	0

The ages of the subjects with confirmed drugs of abuse are shown in Table XXVII. Subjects within 21-30 years of age comprised 81.8% of the confirmations but only 61.3% of the subjects recruited at the site. This disparity was most likely due to that age group attending more bars, parties and raves where drug use was more prevalent than subjects below 21 years of age or above 30 years of age.

TABLE XXVII. DISTRIBUTION OF THOSE SUBJECTS WHO WERE POSITIVE FOR ONE OR MORE OF THE DRUGS OF ABUSE INTO THE SIX AGE COHORTS.

	18-20	**21-25**	**26-30**	**31-35**	**36-40**	**41 +**
Total (N=31)	6	12	7	2	3	1
Confirmed (N=11)	2	4	5	0	0	0

The racial distribution of the subjects with confirmed drugs of abuse is examined in Table XXVIII. Whites comprised 72% of the subjects collected at this clinic and had 72.7% of the confirmations. This demonstrates that the race of the subject at the Texas site did not appear to be a factor in the drugs of abuse that were found in their urine.

TABLE XXVIII. DISTRIBUTION OF THOSE SUBJECTS WHO WERE POSITIVE FOR ONE OR MORE OF THE DRUGS OF ABUSE INTO THE THREE RACE CATEGORIES.

	Ethanol	**Cocaine**	**THC**	**BZ**	**Opiates**	**Amps**
White	1	5	5	1	1	0
Black	0	0	1	0	1	0
Hispanic	0	0	1	0	0	0

Of the eleven subjects confirmed for drugs of abuse, four were positive for more than one of the drugs or drug classes studied (Table XXIX). For all of the multiple confirmations, the subject never admitted to using all of the drugs that were found. One subject admitted to using cocaine, but not marijuana. Another subject admitted to using marijuana, but not cocaine. One did not admit to using anything, while another only admitted to using marijuana. This again demonstrates that sexual assault complainants underreport their illegal drug consumption. It is difficult to understand why one subject would admit to cocaine but not marijuana, and another would do the exact opposite. Both drugs were most likely not given surreptitiously, so one would expect that either the subject would admit to both or admit to none. However, this is not what the laboratory data shows.

TABLE XXIX. NUMBER OF SUBJECTS WHO WERE POSITIVE FOR A COMBINATION OF DRUGS OF ABUSE.

Drug Combination	**# of Specimens**
Cocaine + Marijuana	2
Cocaine + Opiates	1
Cocaine + Marijuana + Oxazepam	1

All 24 of the second visit urine specimens provided were screened and confirmed (Table XXX). The cocaine and marijuana data shown is unremarkable, with some subjects using the drugs both before and after the alleged assault. The opiate and benzodiazepine data are of the most interest for this study, as both were seen only in the first visit. Use of these compounds by a possible assailant or recreationally by the subject may constitute a DFSA. These two cases are described below.

Opiates and benzodiazepines are known depressants and both subjects that were positive only in the first visit believed that they were given a drug surreptitiously. Because the second visit specimens were negative, one could speculate that these were cases of DFSA since the subject had only these compounds in their urine after the assault. The subject confirmed for opiates was positive for oxycodone. She admitted to having a prescription for Percocet® and taking 1.5 tablets before the alleged assault happened.

TABLE XXX. ANALYSIS OF TEXAS FOR THE DRUGS OF ABUSE THAT WERE CONFIRMED IN THE FIRST VISIT AND WHETHER THE SECOND VISIT WAS ALSO POSITIVE.

Confirmed Positives	**Ethanol**	**Cocaine**	**THC**	**Opiates**	**BZ**	**Amps**
1st Visit Positive	1	4	6	1	1	0
2nd Visit Positive w/ 1st Visit Positive	0	2	4	0	0	0
2nd Visit Positive w/o 1st Visit Positive	0	2	1	0	0	0

She believed she was asleep and definitely believed she was impaired. Under our definition for DFSA2, this case definitely applies. This was the only drug found in her urine and most likely put her in a situation where she was unable to give consent to sexual acts due to being unconscious. For DFSA1, this is not a DFSA since the subject had a prescription for the drug found.

The second subject was confirmed for oxazepam on the first visit and was also positive for cocaine, marijuana and doxylamine. She admitted to drinking alcohol and using marijuana, but states that after meeting the alleged assailant she had one more drink and does not remember anything else. Only marijuana was found in her system on the second visit, which suggests that the two depressants are not regularly used. This case falls under DFSA for both DFSA1 and DFSA2 as the victim had detectable levels of two depressants in her system (which she did not admit to using), and admitted to drinking ethanol. The combination could induce a level of unconsciousness that would make consenting to sexual acts impossible.

c. <u>"Date-Rape" Drugs</u>

None of the subjects who provided a questionnaire admitted to using any of the "date-rape" drugs recreationally. Only one subject was positive for any of these drugs on either visit – flunitrazepam on the first visit. She did not return for a second visit, however, and thus did not provide a questionnaire. She reported to the clinic 24 hours after the assault, and was also positive for cocaine and hydromorphone. There are several problems in determining if this case should be classified as a DFSA. First, the extremely high benzoylecgonine level (712,812 ng/mL) suggests recent use of cocaine, most likely after the assault. Reese Jones documents that levels above 100,000 ng/mL are not

uncommon in cocaine addicts or subjects reporting to clinics with cocaine-related medical problems (181). Although flunitrazepam was found in the urine of the subject, it is difficult to determine if the subject took the drug on her own accord with the cocaine. While cocaine may produce a strong sense of euphoria, users are not normally unconscious. The finding of hydromorphone further complicates the case in that two depressants (at levels below 35 ng/mL) were found with one stimulant with extremely high levels. It is unknown if the drugs counteracted each other, but it is possible that the combination of the drugs led to a certain degree of mental incapacitation. For DFSA1, this case is unknown since we do not have a description of the event or what drugs she admitted to taking. For DFSA2, this case is a DFSA since even if the subject voluntarily used these drugs, she was still likely incapacitated and unable to consent to sexual acts.

d. <u>Prescription and OTC Drugs</u>

Six of the submitting subjects were positive for prescription and/or OTC drugs on their first visit. Of these, four subjects returned for the second visit (and thus filled out a questionnaire), and one believed that she had been given a drug surreptitiously. The subjects in each of these cases were evaluated (see below) as to whether DFSA could or could not be ruled out. For the two subjects who did not return for the second visit, only the drugs found will be evaluated as to whether DFSA could be the reason for the assault. One subject who was positive for doxylamine was discussed previously in the drugs of abuse section, and is not repeated here.

The first specimen was positive for doxylamine and nortriptyline at low levels (near LOQ). The subject reported to the clinic 48 hours after the assault, and these levels could have indicated use of the drug before the assault happened. These were the only

two drugs found and the subject did not return for a second visit. Therefore, we do not know if she had a prescription for the antidepressant and was taking the antihistamine due to allergies. It is also impossible to determine if she was drinking at the time of the assault (alcohol with these two drugs may have produced pronounced sedation), or if she believed that she was given a drug surreptitiously. It is unknown if this is a DFSA for both DFSA1 and DFSA2.

The second subject who did not return for the second visit reported to the clinic two hours after the assault and was only positive for sertraline. Again, because no questionnaire was completed and a second urine specimen was unable to be analyzed, it is difficult to determine if the sertraline found was due to prescription use or DFSA. Because the subject reported to the clinic within two hours, it is unlikely that she was sedated prior to the assault. Secondly, sertraline is slowly orally absorbed (peak plasma levels within 4.5 to 8.4 hours) and its use as a "date-rape" drug by itself is most likely limited due to its slow absorption. Its use in DFSA would most likely be as a contributing sedative agent with alcohol or other depressants. However, because no other drugs were found, and the subject reported to the clinic so quickly, this case is most likely not a DFSA for both methods.

The next three cases involve subjects who did return for the second visit. The first case was positive for only diphenhydramine on the first visit and, on the second visit, was negative for all drugs. The subject admitted to drinking alcohol (she reported to the clinic 10 hours after the assault), but ethanol was not detected. In her description of the alleged assault, she stated that her ex-spouse and one of his friends came to her house and assaulted her. She claims that she was not given a drug, but also does not admit to taking

diphenhydramine. She does believe that she was impaired due to the alcohol and, with the combination of the diphenhydramine, was most likely impaired due to synergistic sedation. It is unlikely that the alleged assailant(s) gave the drug to her surreptitiously, but she could have been impaired to such a degree as to be unable to give consent. Therefore, this case is most likely a DFSA under DFSA2 but not DFSA1.

In the first few questionnaires from Texas, the examining nurse did not complete the "assault description" part of the questionnaire. The problem was resolved, but the next subject was the third from this site, and thus no description was provided. She did not believe she was given a drug, and admitted to using alcohol (to the point of being impaired), and having a prescription for valproic acid. Valproic acid was the only drug found in the first visit and the second visit was negative for all drugs. The subject reported within 7 hours after the assault, but alcohol was not found. There was most likely considerable impairment due to alcohol and valproic acid consumption that would have reduced the ability of the subject to consent to any sexual acts. Thus this is considered to be a DFSA under DFSA2 but not DFSA1 since the subject admitted to taking valproic acid.

The final subject was positive for cyclobenzaprine (which she did not admit to taking) in the first visit and was negative for all compounds in the second visit. The site records indicated that she presented two hours after the assault. However, in her description of the event, she stated that she was out on a Friday night at a bar, accepted a drink from a stranger, and lost consciousness soon after consuming the drink. The next thing she remembered is waking up the next day at home, feeling sore in her vaginal and anal regions. Therefore, it does not seem that she reported two hours after the alleged

assault, but possibly two hours after waking up. This discrepancy may explain why alcohol was not found. In her statement, she claimed to become very dizzy before losing consciousness, which is a possibility when combining alcohol with cyclobenzaprine (182). Based on the statements of the subject and the results of the drug analysis, this case is most likely a DFSA under both methods.

e. Hair Analysis

Twenty-four of the subjects provided hair specimens; however, two contained such a small amount that the entire length was used even though it was more than the usual 2 centimeters. Of the 24 specimens, 14 were completely consumed during the screening method, and only ten were available for confirmations. Of these ten, three had presumptive positives on the screen and all three were subsequently confirmed. Shown in Table XXXI are the results from the screening and confirmations as well as what compounds were previously found in the urine of each subject. Subjects that screened positive but had no specimen left, are marked as "specimen consumed" in the confirmation column. Subjects that had specimen left but did not screen positive for any compounds, were not confirmed and are also marked as "not applicable". As in the above site, the hair analysis did not aid in the determination of whether a case was a DFSA. Of the three subject's positive for cocaine, only one admitted to using cocaine, which was found in both visits. This suggests habitual use of the drug and explains why it was found in the hair of the subject.

Shown in Table XXXII are the quantitation results for the first visit and second visit urines, and hair for all drugs being analyzed. For the urine analysis all results are in ng/mL; for hair, the results are in ng/mg.

TABLE XXXI. RESULTS FROM THE ANALYSIS FOR ALL DRUGS IN THE HAIR SPECIMENS PROVIDED BY SUBJECTS FROM TEXAS. SC=SPECIMEN CONSUMED, NA=NOT APPLICABLE.

Sample #	Drugs Previously Found in the Urine	Drugs Screening Positive in Hair	Drugs Confirmed in Hair
1-10	None	None	NA
11	Diphenhydramine	None	NA
12	Cocaine	None	NA
13	Citalopram	Citalopram	SC
14	Doxylamine	Doxylamine	SC
15	Opiates	None	NA
16	Cocaine	Cocaine	SC
17	Cyclobenzaprine	Cyclobenzaprine, Doxylamine, Diphenhydramine	SC
18	Marijuana	None	NA
19	Marijuana	None	NA
20	Cocaine	Chlordiazepoxide	Cocaine, Chlordiazepoxide
21	Marijuana	None	NA
22	Doxylamine, Cocaine, Marijuana, Oxazepam	Amphetamines, Cocaine	Cocaine
23	Cocaine, Marijuana	None	NA
24	Cocaine, Marijuana	Codeine	Cocaine

TABLE XXXII. QUANTITATION RESULTS FOR ALL SUBJECTS FROM TEXAS WHO WERE POSITIVE FOR AT LEAST ONE DRUG BEING ANALYZED. URINE RESULTS ARE IN NG/ML AND HAIR RESULTS ARE IN NG/MG.
NA=NOT APPLICABLE

Sample	First Visit Urine	Second Visit Urine	Hair
1	Benzoylecgonine – 93 THC-COOH - 43	Benzoylecgonine – 87 THC-COOH - 3	Cocaine – 1.05
2	Doxylamine – 9.2 Nortriptyline – 9.2	NA	NA
3	Dextromethorphan – 1185.9	None	None
4	Benzoylecgonine – 179	None	None
5	None	THC-COOH – 101	None
6	Benzoylecgonine – 93 Doxylamine – 375.2 Oxazepam – 286 THC-COOH – 88	THC-COOH - 107	Cocaine – 2.01
7	Benzoylecgonine – 712,812 7Amino-flunitrazepam – 22.4 Hydromorphone - 31	NA	NA
8	Ethanol - 58	Citalopram – 26.2	None
9	None	Doxylamine – 73.4	None
10	Sertraline – 298.4	NA	NA
11	THC-COOH - 77	Benzoylecgonine – 81	None
12	Valproic Acid – 1426.4	None	None
13	Oxycodone – 58	None	None
14	None	Benzoylecgonine - 200	None
15	Cyclobenzaprine – 15	None	None
16	THC-COOH - 21	THC-COOH – 30	None
17	THC-COOH – 79	None	None
18	THC-COOH – 173	NA	NA
19	Benzoylecgonine – 309,076	Benzoylecgonine – 238,004 THC-COOH - 59	Cocaine – 8.54

f. Prevalence of DFSA at the Texas Site

For DFSA1, eight unique cases were discussed above and the resulting findings were presented. There were 15 subjects who were not positive for any drugs and seven were only positive for cocaine/marijuana/amphetamines. All 22 of these subjects are considered to not be DFSA. There was one other subject who was only positive for ethanol and admitted to being slightly impaired. She stated that she was watching TV and passed out, only to awake to find herself naked with her front door open and her telephone lines cut. She reported to the clinic nine hours later but no drugs were found even though she suspected that she was drugged. Thus by DFSA1 this is not a case of DFSA; however, for DFSA2, based on her statements and the finding of levels of alcohol, this is a DFSA. The results for DFSA1 are presented in Table XXXIII.

DFSA2 had many more likely DFSAs as compared to DFSA1. The 15 subjects without any drugs are still considered to not be DFSA and the results for the unique cases were presented above. Of the seven subjects only positive for cocaine/marijuana/amphetamines, two were evaluated to be DFSA, one was unknown, and four were found to be not DFSAs. The results for DFSA2 are compared to DFSA1 in Table XXXIII.

Based on the analysis of the questionnaires, it was hypothesized that Texas would have a prevalence of DFSA of almost 20% due to the subjects who believed they were given a drug. The analysis found that only 6.4% of the subjects were probably given a drug surreptitiously, but an additional 22.6% were victims of DFSA due to their own drug usage. When compared to the results from the Washington site, it is seen that Texas

had fewer DFSAs by both methods which corresponds with Washington having more subjects believing they were the victim of a DFSA than Texas.

TABLE XXXIII. ESTIMATE OF THE PREVALENCE OF DFSA AMONG THE SUBMITTING SUBJECTS IN TEXAS.

N=31	Yes	No	Unknown
DFSA1	2 (6.4%)	27 (87.2%)	2 (6.4%)
DFSA2	9 (29.0%)	20 (64.6%)	2 (6.4%)

D. Hennepin County Medical Center, Minneapolis, Minnesota

a. Demographics

Minnesota recruited the second highest number of subjects at 42. Of these, 26 were White, 6 were Black, 2 were Hispanic and 8 were labeled Other/Unknown. The racial make-up of the subjects in this study does not correspond well with the census data for Hennepin County (Table XXXIV) (183). This may be due to a large number of the subjects in the Other/Unknown category being Native Americans. Hennepin County has about 1.0% of its population identifying as Native American; however, in this study sample, they represented about 10%. Previous work has shown that Native American women are at a much higher risk for sexual assault than those of other ethnicities (184, 185). This might help explain the disproportionate number of Native American women recruited into this study. Of the 42 subjects, 18 (42.8%) returned for the second visit.

TABLE XXXIV. RACE OF THE SUBJECTS FROM MINNESOTA AS COMPARED TO THE CENSUS DATA FROM THE AREA WHERE THE CLINIC IS LOCATED.

Race	Hennepin County - U.S. Census 2000	This Study Sample
White	78.9%	62.0%
Black	9.0%	14.0%
Hispanic	4.1%	5.0%

The age of the subjects ranges from 18 to 56 years of age (Table XXXV), with a mean and standard deviation of 27.1 ± 10.6 years (median age is 22.5). The age range does not differ significantly ($p>0.05$) from the age range of the entire study. There is also no correlation between the age of the subject and whether they returned for the second visit. However, no one over the age of 41 returned.

TABLE XXXV. DISTRIBUTION OF THE SUBJECTS FROM MINNESOTA INTO THE SIX AGE COHORTS.

Visit	18-20	21-25	26-30	31-35	36-40	41 +
First (N=42)	14	12	4	4	3	5
Second (N=18)	4	6	1	4	3	0

The time interval between the assault and reporting to the clinic ranged from 3 hours to 67 hours, with a mean and standard deviation of 17.0 ± 15.4 hours (median time 12.2). For two subjects the time interval could not be determined. As at other sites, there

were several subjects who presented after 48 hours and are responsible for skewing the mean away from the median time interval.

As in Texas, Minnesota did not initially receive study kits with the questionnaire moved from the second visit to the first visit. However, when a second round of kits was sent to the clinic, the protocol was changed. Thus, although only 18 subjects returned for the second visit, 24 questionnaires were received as six subjects entered after the kits were changed.

Of these 24 subjects, eight (33.3%) definitely believed they were given a drug, two subjects (8.3%) either couldn't remember or believed that it was a possibility, and 14 (58.3%) subjects stated that a drug was not given to them. Thus, for the Minnesota site, we could expect based on self-reporting, to find a similar amount of "date-rape" drugs, or drugs that could incapacitate someone, as were found in Texas. The racial distribution and the age distribution (Table XXXVI) of the respondents do not demonstrate any trends as to whether these variables had any effect on the responses received.

TABLE XXXVI. DISTRIBUTION INTO THE SIX AGE COHORTS THOSE SUBJECTS WHO EITHER DO OR DO NOT BELIEVE THEY WERE GIVEN A DRUG SURREPTITIOUSLY.

Age Cohort (yrs)	**Do you think you were given a drug surreptitiously?**		
	Yes	**No**	**Maybe/Don't Remember**
18-20	3	2	1
21-25	2	5	0
26-30	1	1	0
31-35	1	2	1
36-40	1	2	0
41 +	0	2	0

b. Drugs of Abuse

One subject was unable to have screening tests done at the USDTL because she provided only enough urine for analysis in this laboratory. Minnesota had 31 subjects that screened positive for one or more of the common drugs of abuse in the first visit. This represents 38.3% of all of the positive screens in this study. By providing 42 of the 144 subjects for this study, Minnesota provided 29.2% of all subjects. As in the previous two clinics, one would expect the positive screens to correspond to the number of subjects provided. However, Minnesota has a proportionally higher representation of positive screens, suggesting that the drug use of the sexual assault complainant population at the Minnesota site is higher than that from the other sites.

Data for the drugs of abuse screen and the confirmation are presented in Table XXXVII. Of the 31 subjects with a positive screen, 29 had positive confirmations, representing the highest confirmation rate for all the sites. Of the 9 subjects who admitted to drinking alcohol at the time of the assault but were negative for alcohol, six reported to the clinic longer than 8 hours after the assault. The three who reported before eight hours only admitted to having a few drinks and most likely had eliminated the alcohol before providing the urine specimen.

Data for the marijuana and stimulant analysis is especially interesting in considering the validity of self-reporting among sexual assault complainants. Only 38.5% of subjects positive for cocaine, 17.6% of subjects positive for marijuana and none of those positive for amphetamines admitted to using the drug. These drugs are not normally given surreptitiously, and represent good markers for the validity of self-reporting of drug use in this study. This data shows that sexual assault complainants

from this site, as in the above sites, are highly likely to underreport their illegal drug usage.

TABLE XXXVII. NUMBER OF SUBJECTS WHO WERE CONFIRMED FOR THE DRUGS OF ABUSE BEING ANALYZED.

	Ethanol	**Cocaine**	**THC**	**BZ**	**Opiates**	**Amps**
Admit to Using	15	5	3	0	0	0
Screened Positive	7	13	17	1	5	3
Confirmed Positive	6	13	16	0	5	2

The ages of the subjects with confirmed drugs of abuse is described in Table XXXVIII. This clinic has the most drugs that were confirmed in subjects above the age of 31. Nearly 38% of all subjects with drugs in their system were above the age of 31 at this clinic compared to none in Texas and 14% in Washington. This higher number of drugs in subjects above the age of 31 may be the reason Minnesota has a disproportionate amount of subjects with drugs in their system.

TABLE XXXVIII. DISTRIBUTION OF THOSE SUBJECTS WHO WERE POSITIVE FOR ONE OR MORE OF THE DRUGS OF ABUSE INTO THE SIX AGE COHORTS.

	18-20	**21-25**	**26-30**	**31-35**	**36-40**	**41 +**
Total (N=42)	14	12	4	4	3	5
Confirmed (N=29)	9	7	2	4	3	4

The race of the subjects with confirmed drugs of abuse is examined in Table XXXIX. The percent of each race that was positive for drugs of abuse corresponds with

the percent of each race for the subjects at this clinic. Thus, race did not influence whether drugs of abuse were found in subjects at Minnesota.

TABLE XXXIX. DISTRIBUTION OF THOSE SUBJECTS WHO WERE POSITIVE FOR ONE OR MORE OF THE DRUGS OF ABUSE INTO THE THREE RACE CATEGORIES.

	Ethanol	**Cocaine**	**THC**	**BZ**	**Opiates**	**Amps**
White	4	7	9	0	3	1
Black	0	2	4	0	0	0
Hispanic	0	1	1	0	0	0

Of the 29 subjects confirmed for drugs of abuse, 12 were positive for more than one of the drugs or drug classes studied (Table XL). The most often found combination was cocaine and marijuana. However, for all of the multiple confirmations, the subject rarely admitted to using all of the drugs that were found. Of the eight subjects with cocaine and marijuana, only one admitted to using both and one admitted to using only cocaine. The subject found with cocaine and ethanol admitted to using both. This again demonstrates that sexual assault complainants underreport their drug usage. As above, it is difficult to define any patterns to the admission of drug use on the part of these subjects. Marijuana and cocaine are both drugs that are unlikely to have been given surreptitiously, so one would expect that either the subject would admit to both or admit to none. As in Texas, these are not the results being found.

TABLE XL. NUMBER OF SUBJECTS WHO WERE POSITIVE FOR A COMBINATION OF DRUGS OF ABUSE.

Drug Combination	**# of Specimens**
Ethanol + Cocaine	1
Cocaine + Marijuana	8
Cocaine + Opiates	2
Cocaine + Marijuana + Amphetamines	1

All 18 of the second visit urine specimens provided were able to be screened and subjected to confirmation, where necessary (Table XLI). Ethanol and cocaine use both declined by 100% and 50%, respectively. Only one subject with marijuana and one with amphetamine tested positive in the first visit but tested negative on the return visit. As above, opiate and benzodiazepine data are of the most interest for this study, as both could be used to incapacitate someone. Each of the cases (five altogether) where they were found are discussed below.

TABLE XLI. ANALYSIS OF MINNESOTA FOR THE DRUGS OF ABUSE THAT WERE CONFIRMED IN THE FIRST VISIT AND WHETHER THE SECOND VISIT WAS ALSO POSITIVE.

Confirmed Positives	**Ethanol**	**Cocaine**	**THC**	**Opiates**	**BZ**	**Amps**
1st Visit Positive	4	8	7	2	0	1
2nd Visit Positive w/ 1st Visit Positive	0	4	6	1	0	0
2nd Visit Positive w/o 1st Visit Positive	0	0	0	0	1	0

The first subject did not believe that she was given a drug and did not admit to drinking alcohol. She stated that she was walking on the street and was stopped by two men asking her for directions. These men allegedly then forced her to perform oral sex and vaginal intercourse. She reported to the clinic within 10 hours after the assault, and admitted to smoking both marijuana and crack/cocaine. Both were found in the first and second visit urine specimens. Diphenhydramine was also found on the first visit, but in the absence of alcohol, was most likely negligible in producing any amount of sedation. On the second visit, oxazepam was also found, suggesting use of a benzodiazepine after the assault. By DFSA1 this is not a DFSA, but by DFSA2, the drug combination most likely produced a degree of mental and physical incapacitation that facilitated her being unable to identify a dangerous situation which led to the assault and thus this is a DFSA.

The next subject reported to the clinic 20 hours after the alleged assault and described the following circumstances. She was at a friend's house and began feeling sick after having something to drink (it is unclear if it was alcohol). She went into a bedroom to lie down and briefly remembers a man on top of her. She then claims to have blacked out and awoken naked. She does not admit to drinking any alcohol, but does admit to sometimes using cocaine and to having a prescription for oxycodone. On the first visit, cocaine, codeine and morphine were found. On the second visit, codeine, hydrocodone, hydromorphone, and morphine were found. It is unclear why oxycodone was not found, but it is apparent that she is using opiates regularly. Because the opiates were found in the second visit, this case is not a DFSA under DFSA1. Following the criteria for DFSA2, the subject's own drug use facilitated the sexual assault by causing her to become unconscious. Thus this is a DFSA under DFSA2.

The next subject reported to the clinic in 5 hours, and stated that she was at a motel with friends when a stranger was invited to join their party. Her friends eventually left her alone with the alleged assailant, and that is when the assault happened. She admitted to drinking alcohol, but not to the point of impairment. She also said that she had been smoking crack/cocaine and had a prescription for codeine and did not believe that she was given any drug surreptitiously. On the first visit, cocaine, codeine, hydrocodone, and morphine were found. On the second visit, cocaine was the only drug found. The benzoylecgonine level (542.3 μg/mL) was extremely high. Levels of 512 μg/mL have been reported in cases of death following cocaine consumption (186). These levels most likely caused enough stimulation to counteract any sedation from the opiates. Under DFSA1, this is not a DFSA as the subject stated that she was not given any drugs. However, with such high levels of cocaine and the combination with opiates, the subject was most likely mentally incapacitated to such a degree as to be unable to consent to any sexual acts. Thus, this is most likely a case of DFSA under DFSA2.

c. <u>"Date-Rape" Drugs</u>

Two subjects in Minnesota were positive for the classic "date-rape" drugs; one for clonazepam, and another for flunitrazepam. The subject with clonazepam is discussed first. She reported to the clinic eight hours after the assault and admitted to drinking alcohol to the point of being impaired. In her description of the alleged assault, she stated that she was vaginally assaulted by her boyfriend and his friend and, during the assault, passed out for two hours. She also stated that she had prescriptions for clonazepam and imipramine. On the first visit, cocaine, clonazepam, imipramine, desipramine, and marijuana were found. On the second visit, clonazepam, imipramine and desipramine

were found. The marijuana and cocaine levels were both low, probably indicative that they were used many hours before the assault happened. With prescriptions for a benzodiazepine known as a "date-rape" drug and a TCA, this subject should not have been consuming alcohol. However, she does admit that she consumed alcohol to a point where she became impaired. The combination of the alcohol with her prescription drugs is a likely cause of her passing out during the assault. Based on her testimony and the drugs that were found, this is most likely a DFSA under DFSA2. Because she admitted to having prescriptions for the two drugs, this is not a DFSA under DFSA1.

The second subject only had flunitrazepam in the first visit urine specimen and reported to the clinic 35 hours after the assault. She did not return for the second visit and did not complete a questionnaire, further increasing the difficulty of determining if this case was a DFSA. If one assumes that flunitrazepam was surreptitiously given to the subject 35 hours before the urine specimen was provided, then the amount of 7-amino flunitrazepam that was found (15.6 ng/mL), corresponds well to amounts previously found in volunteer subjects in a clinical study following a single dose (64). However, without a statement from the subject and no other data, it is impossible to determine if this was a DFSA for DFSA1. This was a DFSA under DFSA2 since it does not matter if she took the flunitrazepam voluntarily, only that it was found after the assault.

d. <u>Prescription and OTC Drugs</u>

Fourteen of the submitting subjects were positive for prescription and OTC drugs on their first visit. Of the ten subjects who filled out a questionnaire, five believed that they had been given a drug surreptitiously and two believed it to be a possibility. Each of these subjects was evaluated below as to whether DFSA could or could not be ruled out.

For the seven subjects who did not return for the second visit, only the drugs found could be used to evaluate whether the assault was drug facilitated. If a subject did not provide answers for the questionnaire and/or provide a second urine specimen, it is difficult to determine if the drugs found in the first visit specimen are abnormal for that subject. Two subjects previously discussed above are not discussed again.

The subjects without a second visit urine specimen (n=7) are discussed first. The first subject reported to the clinic 30 hours after the assault and was positive for marijuana and triazolam. This specimen contains a benzodiazepine that if combined with alcohol, could induce sedation with possible amnesia. However, it is unknown if the subject was drinking at the time of the assault, or if she had a prescription for triazolam. Thus, we are unable to determine if this is a case of DFSA for both methods. Another subject reported to the clinic 17 hours after the assault and was positive only for the metabolite of fluoxetine. Still another reported to the clinic an unknown time after the assault and was only positive for diphenhydramine. Without knowing more about the circumstances for these cases, it is unable to be determined if they are DFSA under either method.

The next subject did not return for a second visit, but did complete a questionnaire. She claims that she knew the alleged assailant and was at his house when the assault happened and she reported to the clinic 60 hours after the assault. She admitted to drinking alcohol to the point of being impaired, to smoking crack/cocaine, and she believed that she had been given a drug surreptitiously. The analysis found cocaine, sertraline, and chlorpheniramine. If these drugs were given to her before the assault, the combination of alcohol with these two compounds could have led to her

becoming unconscious. Because she did not admit to having a prescription for sertraline and the drug was found, this is a DFSA under both methods.

The next subject reported to the clinic six hours after the alleged assault, and claimed to have been at a party where she was sexually assaulted orally and vaginally by the assailant. She admitted to drinking alcohol, and having a prescription for fluoxetine, and was positive for both. However, she did not believe she was impaired or given any drugs. Since she was regularly taking fluoxetine, combination with alcohol would probably not produce any sedation. She did not believe she was impaired and thus this case is most likely not a DFSA by either method.

The next two subjects did not complete a questionnaire. The first reported to the clinic 18 hours after the assault and was positive for citalopram. The second reported to the clinic 53 hours after the assault and was positive for amitriptyline, nortriptyline, and morphine. These compounds could have produced sedation, but without a statement from the subject, it is unknown if these were cases of DFSA by both methods.

The next five subjects all returned for the second visit and completed a questionnaire. The first reported to the clinic 27 hours after the assault and alleged that she was drinking at a bar with friends (2-3 beers), then went to the assailant's home where she became violently ill. She was then assaulted and believed that the alleged assailant had given her a drug surreptitiously. She admitted to having a prescription for sertraline, and on the first visit, sertraline, cocaine, and marijuana were found. On the second visit, she was still positive for sertraline and marijuana, but was also positive for dextromethorphan. If she was given a drug like GHB, we would be unable to identify it due to the time delay before she reported to the clinic. By DFSA1, this is not a case of

DFSA since only drugs she admitted to were found. However, under DFSA2, this case is a DFSA since compounds that could have produced sedation were found and the subject believed that she was impaired.

The next subject reported to the clinic less than five hours after the assault and claimed that she was at a party when the alleged assault occurred. She describes that she was forced into a bathroom and made to perform oral sex, followed by being penetrated anally. She admitted to having a prescription for sertraline and believed that she was given a drug, but that the drug did not impair her ability to function. On the first visit, sertraline and ethanol were found, and on the second visit only sertraline was found. Based on her description of the events of the alleged assault and the results of the drug analysis, it is unlikely that this is a case of DFSA by either method. She was using sertraline regularly and would probably not have had any sedation from the drug. She also stated that she was not impaired from the ethanol. Thus, because no other compounds were found, she was most likely mentally competent.

The next subject had a drug profile very similar to the subject described above. She reported to the clinic 12 hours after the assault and describes a situation very common among suspected DFSA victims. She claimed she was at a university bar and had about six drinks. She met a man who was allegedly a friend of the bartender. This man had the bartender make her a drink, and after she received the drink, she remembers nothing. The following day, she awoke at a fraternity house naked from the waist down. She admits to having a prescription for sertraline, and believes that the bartender added a drug to her drink. Ethanol and sertraline were found in the first visit, only sertraline in the second. Without the finding of any other sedatives or amnestics, it cannot be

determined if this was a case of DFSA under DFSA1. However, this subject had a high level of alcohol in her system, which suggests that alcohol alone may have caused the subject to lose consciousness. Whether a drug with a short half-life, such as GHB, was used cannot be confirmed; however, under DFSA2 this case is a DFSA.

The next subject reported to the clinic 36 hours after the assault. She alleged that a man with whom she has had past sexual experiences (now married) came to her house and assaulted her. She said she had half of a beer, had been using marijuana, and had a prescription for sertraline. She does not believe she was given any drugs, and sertraline and marijuana were found on both visits. Based on the subject's testimony and the drugs that were found, this is not a DFSA under either method.

The final subject presented to the clinic five hours after the assault. She claims she was walking down a street when she was hit on the head by a stranger and assaulted. She believes that while she was unconscious, he may have injected her with something, because for several days after the assault, she experienced itchiness of the skin and disorientation. She admitted to having prescriptions for citalopram and doxepin. On the first visit, doxepin and cocaine were found, on the second, only doxepin. Based on her story, and the drugs that were found, it appears that the hit on the head could have caused the reported unconsciousness. Further, because she reported to the clinic so quickly after the assault, it is unlikely that the alleged assailant gave her any drug to increase her compliance. Therefore, this is most likely not a case of DFSA by either method.

e. <u>Hair Analysis</u>

Eighteen subjects provided hair specimens and eight of these provided enough for both screening and confirmation. The weight of the first two centimeters averaged about

48.5 milligrams, which suggests that the nurses at this clinic were cutting the amount of hair that was recommended. Table XLII shows the results from the screening and the confirmation tests. If a specimen was completely consumed by the screening or was negative, it was marked as "Specimen Consumed" in the confirmation column. All three subjects who were positive for sertraline in their hair admitted to having a prescription for the drug. There are no previously published reports on the detection of sertraline in hair, and it is unknown if sertraline can be detected in hair following a single dose. Sertraline also screened positive in two subjects who admitted to having a prescription for the drug, but they did not provide enough hair for confirmation to be conducted. One Minnesota subject was confirmed for sertraline, but did not admit to having a prescription for the drug. However, she did not provide a hair specimen, possibly permitting a test of whether sertraline can be found in hair after one dose.

Only one of the four subjects positive for cocaine admitted to using the drug, and two subjects were positive on both visits. It is unknown if the two subjects who were positive only on the first visit and in the hair had only used the drug at the time of the assault. As in the other sites, the hair analysis did not provide any new data to help in determining if any of the cases were DFSA.

Shown in Table XLIII are the quantitation results for the first visit and second visit urines, and hair for all drugs being analyzed. For urine, all results are in ng/mL; for hair, the results are in ng/mg.

TABLE XLII. RESULTS FROM THE ANALYSIS FOR ALL DRUGS IN THE HAIR SPECIMENS PROVIDED BY SUBJECTS FROM MINNESOTA. SC = SPECIMEN CONSUMED

Sample #	Drugs Previously Found in Urine	Drugs Screening Positive in Hair	Drugs Confirmed in Hair
1-2	None	None	None
3	Sertraline, Cocaine, THC	Sertraline	Cocaine and Sertraline
4	Amphetamines	Chlordiazepoxide	SC
5-6	Sertraline	Sertraline	Sertraline
7	None	Citalopram	SC
8	Cocaine, Opiates	Cocaine, Opiates	SC
9	Opiates	Sertraline, Amitriptyline	SC
10-11	THC	None	SC
12	Clonazepam, Cocaine, THC	Cocaine	Cocaine
13	Sertraline, THC	Sertraline	SC
14	Cocaine, Opiates	Cocaine	SC
15	Cocaine, THC	Cocaine, Codeine	Cocaine
16	Cocaine	Cocaine	Cocaine
17	None	Amphetamines	SC
18	Cocaine	Cocaine	SC

TABLE XLIII. QUANTITATION RESULTS FOR ALL SUBJECTS FROM MINNESOTA WHO WERE POSITIVE FOR AT LEAST ONE DRUG BEING ANALYZED. NA = NOT APPLICABLE

Sample	First Visit Urine	Second Visit Urine	Hair
1	Benzoylecgonine – 756 Sertraline – 540.7 THC-COOH - 12	Dextromethorphan – 87 Sertraline – 352.8 THC-COOH - 7	Sertraline – 1.42 Cocaine – 0.73
2	Methamphetamine – 377	None	None
3	Morphine – 15	NA	NA
4	7-Aminoflunitrazepam – 15.6	NA	NA
5	THC-COOH – 509 α-hydroxytriazolam – 81.5	NA	NA
6	Norfluoxetine – 12.8	NA	NA
7	Ethanol – 69 Sertraline – 6.7	Sertraline – 7.9	Sertraline – 3.12
8	Benzoylecgonine – 839 Chlorpheniramine – 29.3 Sertraline – 383.3 THC-COOH – 6	NA	NA
9	THC-COOH – 48	NA	NA
10	Benzoylecgonine – 152 THC-COOH – 5	NA	NA
11	Benzoylecgonine – 436 Codeine – 10,100 Morphine – 70,358	Morphine – 11,251 Hydromorphone – 79.1 Hydrocodone – 21.3 Codeine – 505	None
12	Hydromorphone – 16	Not Provided	NA
13	Ethanol – 130 Sertraline – 595.8	Sertraline – 434.2	Sertraline – 1.83
14	Ethanol – 133	NA	NA
15	Benzoylecgonine – 1,163,485 THC-COOH – 103	NA	NA
16	THC-COOH – 196	NA	NA
17	Diphenhydramine – 192.1	NA	NA
18	THC-COOH – 103	THC-COOH - 148	None
19	THC-COOH – 10	NA	NA
20	Benzoylecgonine – 2,478 7-Aminoclonazepam – 34.8 Desipramine – 5,646 Imipramine – 623.6 THC-COOH – 7	Imipramine – 842.7 Desipramine – 10,828.1 7-Aminoclonazepam - 6	Codeine – 0.22 Cocaine – 1.23

TABLE XLIII (continued)

Sample	First Visit Urine	Second Visit Urine	Hair
21	Sertraline – 1.24 THC-COOH - 78	Sertraline – 1.44 THC-COOH – 99	None
22	Benzoylecgonine – 542,322 Codeine – 191 Hydrocodone – 83.3 Morphine – 17	Benzoylecgonine – 1,290	None
23	Benzoylecgonine – 496,668 Desmethyldoxepin – 478	Desmethyldoxepin – 1,043.8	None
24	Benzoylecgonine – 23,600 THC-COOH – 4	Benzoylecgonine – 346,756 Hydrocodone – 51.3 THC-COOH - 5	Cocaine – 967.2
25	THC-COOH – 225	THC-COOH - 75	None
26	Benzoylecgonine – 262,222 Diphenhydramine – 53.4 THC-COOH – 123	Benzoylecgonine – 789,146 Oxazepam – 643 THC-COOH - 51	None
27	Amphetamine – 18,609 Benzoylecgonine – 72 Methamphetamine – 220,391 THC-COOH – 90	NA	NA
28	None	Zolpidem – 35	None
29	Benzoylecgonine – 122,659 THC-COOH – 92	NA	NA
30	Ethanol – 227	None	None
31	Citalopram – 3,551	NA	NA
32	Ethanol – 78 Norfluoxetine – 1,294.6	NA	NA
33	Amitriptyline – 290.5 Morphine – 256 Nortriptyline – 240.2	NA	NA
34	Benzoylecgonine – 6,311 Ethanol - 51	Benzoylecgonine - 724	Cocaine – 17.6

f. Prevalence of DFSA at the Minnesota site

For DFSA1, 19 unique cases were discussed above and the resulting findings were presented. There were nine subjects who were not positive for any drugs and 11 were only positive for cocaine/marijuana/amphetamines. All 20 of these subjects are considered to not be DFSA. There were three other subjects who were positive for ethanol but stated that they were not given any drugs. Thus, these are not DFSAs by the criteria for DFSA1. The results for DFSA1 are presented in Table XLIV.

DFSA2 had many more likely DFSAs as compared to DFSA1. The nine subjects without any drugs are still considered to not be DFSA and the results for the unique cases were presented above. Of the remaining cases, 10 were evaluated to be DFSA and four were found to be not DFSAs. The results for DFSA2 are compared to DFSA1 in Table XLIV.

Based on the analysis of the questionnaires, it was hypothesized that Minnesota would have a prevalence of DFSA of almost 20% due to the subjects who believed they were given a drug. However, only one case was able to be identified as a DFSA involving surreptitious drug use. The broader definition of DFSA, DFSA2, identified more DFSAs than the subjects in Minnesota identified. This further suggests that sexual assault complainants may not understand that their own drug usage can reduce their mental competence to consent to sexual acts or identify a possibly dangerous situation that may lead to a sexual assault.

The results for DFSA in Minnesota fall between the high rate shown in Washington and the lower rate seen in Texas. The results are not as strong in this site though, because Minnesota had a higher percent of unknown cases than in either Texas or

Washington. Many of these unknown DFSAs could have been better determined if the subject had filled out a questionnaire. The subject's report of the drugs they were using, when combined with the details of the assault and the drugs that are found in our laboratory analysis make it easier to determine if a case is DFSA by both methods.

TABLE XLIV. ESTIMATE OF THE PREVALENCE OF DFSA AMONG THE SUBMITTING SUBJECTS IN MINNESOTA.

N=42	Yes	No	Unknown
DFSA1	1 (2.4%)	35 (83.3%)	6 (14.3%)
DFSA2	18 (42.8%)	19 (45.2%)	5 (12.0%)

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a. Demographics

California recruited the highest number of subjects at 56. Of these, 40 are White, none are Black, 14 are Hispanic and 2 are Other/Unknown. When these numbers are compared to the census data for the area where the clinic is located (Table XLV), it is seen that a somewhat larger proportion of White subjects were collected than are represented in the census (187). The Black population is extremely small in San Diego County and was zero for this study. Unlike in Minnesota, the Other/Unknown category is inconsequential for this clinic. Eight subjects returned for a second visit, making this site the lowest for rate of return.

TABLE XLV. RACE OF THE SUBJECTS FROM CALIFORNIA AS COMPARED TO THE CENSUS DATA FROM THE AREA WHERE THE CLINIC IS LOCATED.

Race	San Diego County CA – 2000 U.S. Census	This Study Sample
White	55.0%	71.0%
Black	5.7%	0.0%
Hispanic	26.7%	25.0%

The age of the subjects ranged from 18 to 55 years of age (Table XLVI), with a mean and standard deviation of 27.4 ± 9.3 years (median age is 23.5). The age range did not differ significantly ($p>0.05$) from the age range of the entire study and there is no correlation between the age of the subject and whether they returned for the second visit.

TABLE XLVI. DISTRIBUTION OF THE SUBJECTS FROM CALIFORNIA INTO THE SIX AGE COHORTS.

Visit	18-20	21-25	26-30	31-35	36-40	41 +
First (N=56)	14	19	4	7	6	6
Second (N=8)	1	3	0	2	1	1

Determining the time interval between the reported assault and the clinic visit was more difficult at this site than at the others, perhaps because of the large number of subjects who were recruited. The time interval for six subjects was never determined. The time intervals ranged from 1.5 hours to 456 hours (N=50), with a mean and standard deviation of 57.8 ± 107.9 hours (median time 14.5). The median time is extremely divergent from the mean time because eight subjects reported to the clinic more than four

days after the assault. California was the only site where subjects presented more than 72 hours after the alleged assault.

When this site was furnished with its study kits, the questionnaire was already placed in the first visit materials. Thus, although the site had the lowest rate of return for its subjects (14.3%), every enrolled subject had a completed questionnaire. For this reason, this site provided the most data for the evaluation of self-reporting of drug use among the sexual assault complainant population.

Of the 56 subjects, five (8.9%) believed they were given a drug, six subjects (10.7%) couldn't remember, or believed that it was a possibility, and 45 (80.4%) subjects stated that no drugs were given to them. Based on the subjects' statements, we would expect to find fewer "date-rape" drugs, or drugs that could incapacitate someone, than at the other sites. Due to the high number of subjects who did not believe that they were given a drug, age and race had no obvious effect on the responses received. Race also did not effect whether the subject returned for a second visit.

b. <u>Drugs of Abuse</u>

All first visit urine specimens and the eight second visit urine specimens were analyzed by USDTL. California had 26 subjects that screened positive for one of the common drugs of abuse in the first visit. This represents 32.1% of all of the positive screens in this study. By providing 56 of the 144 subjects for this study, California provided 38.9% of all subjects. As in the first two clinics presented, one would expect this percentage to correspond to the percent of subjects the clinic provided. However, California represents less positive screens which suggests that the drug use of the sexual

assault complainants at California is lower than the sexual assault complainants elsewhere.

Data for the drugs of abuse screen and the confirmation data are presented in Table XLVII. Of the 26 subjects with a positive screen, 19 had positive confirmations. There were 22 subjects who admitted to drinking alcohol at the time of the assault, but were negative for alcohol. The reasons for why alcohol was not detected despite the subject admitting to its use are discussed above, and also apply to this clinic.

Data for the marijuana, amphetamines, and cocaine analysis is important when considering the validity of self-reporting among sexual assault complainants. Only 38.5% of subjects positive for cocaine, 42.8% of subjects positive for amphetamines, and 17.6% of subjects positive for marijuana admitted to using these drugs. As described above, these drugs represent good markers for the validity of self-reporting of drug use in this study. This data shows that sexual assault complainants from this site are more likely to underreport their drug usage as compared with the other clinics.

TABLE XLVII. NUMBER OF SUBJECTS WHO WERE CONFIRMED FOR THE DRUGS OF ABUSE BEING ANALYZED.

	Ethanol	**Cocaine**	**THC**	**BZ**	**Opiates**	**Amps**
Admit to Using	26	2	5	0	0	3
Screened Positive	4	6	15	3	6	7
Confirmed Positive	4	5	11	3	2	7

The ages of the subjects with confirmed drugs of abuse is described in Table XLVIII. The age data does not demonstrate any apparent trends. The race of the subjects

with confirmed drugs of abuse is examined in Table XLIX. Again, no obvious trends are apparent. White subjects, who encompass 71% of the subjects, represent 73.7% of the subjects with confirmed drugs. The Hispanic population (25% of the specimens) represented 26.3% of the confirmed subjects.

TABLE XLVIII. DISTRIBUTION OF THOSE SUBJECTS WHO WERE POSITIVE FOR ONE OR MORE OF THE DRUGS OF ABUSE INTO THE SIX AGE COHORTS.

	18-20	**21-25**	**26-30**	**31-35**	**36-40**	**41 +**
Total (N=56)	14	19	4	7	6	6
Confirmed (N=19)	5	7	2	1	1	3

TABLE XLIX. DISTRIBUTION OF THOSE SUBJECTS WHO WERE POSITIVE FOR ONE OR MORE OF THE DRUGS OF ABUSE INTO THE THREE RACE CATEGORIES.

	Ethanol	**Cocaine**	**THC**	**BZ**	**Opiates**	**Amps**
White	3	4	10	2	1	6
Black	0	0	0	0	0	0
Hispanic	1	1	1	1	1	1

Of the 19 subjects confirmed for drugs of abuse, nine were positive for more than one of the drugs or drug classes studied (Table L). The combination of drugs of abuse most found was amphetamines with marijuana. For all of the multiple confirmations, the subject rarely admitted to using all of the drugs that were found. Only one subject, who was positive for marijuana and amphetamines, admitted to using both. Two did not admit to using any of the drugs found. There is no trend as to what drugs a sexual assault

complainant will admit to using versus what is later found in their urine. The findings about self-reporting reliability suggest that clinicians interviewing these patients may need to stress the importance of truthfulness, if a reliable assessment about whether the case was a drug-involved sexual assault is to be made.

TABLE L. NUMBER OF SUBJECTS WHO WERE POSITIVE FOR A COMBINATION OF DRUGS OF ABUSE.

Drug Combination	**# of Specimens**
Ethanol + Amphetamines	1
Amphetamines + Marijuana	3
Oxazepam + Opiates	1
Cocaine + Marijuana	1
Cocaine + Marijuana + Amphetamines	1
Cocaine + Marijuana + Oxazepam	1
Cocaine + Marijuana + Amphetamines + Oxazepam	1

All of the second visit urine specimens were screened and confirmed. Two of the second visit urine specimens were confirmed for drugs of abuse. The first specimen was positive for cocaine without the first visit urine specimen being positive. This suggests recreational use of cocaine after the assault. The next specimen was positive for ethanol and amphetamines on both visits. This suggests that these drugs are used recreationally by the subject and that following the assault, her drug use did not change. The opiate and benzodiazepine data are of the most interest for this study, as both could be used to incapacitate someone. Each of the four cases where they were found is examined below. For this site, the evaluation of DFSA using the criteria for DFSA1 was rather limited as only four of the subjects who believed that they were possibly given a drug were able to

be evaluated. For the other subjects who believed they might have been given a drug, they either were negative for all drugs being analyzed or were only positive for cocaine/marijuana/amphetamines. Thus, DFSA1 is only mentioned in the four cases where an analysis is possible. For the other 52 subjects, DFSA has been ruled out based on the criteria for DFSA1.

The first subject reported to the clinic 18 hours after the assault. She alleged that her spouse sexually assaulted her, but does not believe she was impaired or that a drug was given to her surreptitiously. She admits to having a prescription for paroxetine and did not return for the second visit. On the first visit, paroxetine, hydrocodone, hydromorphone, and oxazepam were found; however, it is unknown why opiates and a benzodiazepine were found since the subject did not admit to taking either. Based on these findings, it is quite possible that the subject would have been in a mental state where she was unable to consent to sexual acts and thus this is a DFSA under DFSA2.

The next subject reported to the clinic seven hours after the assault and also claimed to have been a victim of sexual assault from her husband. She admits to having a prescription for fluoxetine and to smoking marijuana and claims that her husband was smoking methamphetamine and blew the smoke into her face. She did not return for the second visit and was positive for amphetamine, methamphetamine, cocaine, marijuana, oxazepam, and chlorpheniramine on the first visit. Besides the methamphetamine, she does not believe that the alleged assailant gave her any drugs. Her amphetamine levels were the second highest of all of the positives in California which suggests that the blowing of smoke into her face, did not cause these high levels. However, most of her testimony may be untrue. She claims that the alleged assailant did not give her any

drugs, so the cocaine and benzodiazepine found were most likely taken by the subject. If she is willing to lie about these two drugs, she may be lying about her methamphetamine use. However, with all of the drugs that were in her system, it is unlikely that she would have been legally able to consent to sexual acts. Thus, even though the subject's statements about the assault may be untrue, it is most likely a DFSA under DFSA2.

The next subject reported to the clinic 4.5 hours after the assault and claims that she was at home sleeping in her bed when she was awakened by a stranger, who proceeded to vaginally and anally assault her. She admitted to having prescriptions for fluoxetine and a medication for depression and anxiety (not named). She claims that the alleged assailant did not give her any drugs and she did not return for the second visit. Her urine was positive for the metabolite of fluoxetine, hydrocodone, and hydromorphone. It is unclear based on her statements if she had a prescription for the opiates, however, she does not believe she was impaired. Based on her statements, one could conclude that she was not impaired and this is not a case of DFSA.

The final subject reported to the clinic five hours after the assault and admitted to using marijuana. No description of the assault was provided, but the subject claims that the alleged assailant did not give her any drugs. On the first visit, she was positive for cocaine, marijuana, and oxazepam. The cocaine level (11.8 μg/mL) was quite high and probably countered any depression from the benzodiazepine. However, due to the combination of drugs found, she was most likely unable to consent to sexual acts and was a victim of DFSA under DFSA2.

c. <u>"Date-Rape" Drugs</u>

One subject was positive for clonazepam. She reported to the clinic 25 hours after the alleged assault and claims that she was at a bar drinking, and then lost all memory of the evening. When she woke up the next morning, she felt sore in her vaginal area. She has a prescription for clonazepam and olanzapine, an antipsychotic known to produce sedation when combined alcohol. She also admits to using cocaine and marijuana, and being around others who smoke methamphetamine. She believes that she was given a drug surreptitiously but did not return for the second visit. On the first visit, she was positive for amphetamine, cocaine, clonazepam, methamphetamine, and marijuana. The combination of olanzapine (which was not analyzed for) and clonazepam with alcohol could have produced sedation and possibly amnesia. This might have led to her behaving "normally" at the bar but left her with no memory of the events that transpired. Based on her valid self-reporting of the drugs she was using, the prescription drugs she was taking when combined with alcohol make this case a DFSA under DFSA2, but not DFSA1.

d. <u>Prescription and OTC Drugs</u>

Seventeen of the submitting subjects were positive for prescription and OTC drugs on their first visit. Of these subjects, one believed that they had been given a drug surreptitiously and two believed it to be a possibility. Each subject is evaluated below as to whether DFSA could or could not be ruled out. Only one of the subjects returned for the second visit. For the remaining sixteen, the drugs that were found as well as what the subject admitted to will be evaluated as to whether DFSA could be the reason for the assault. Three subjects discussed above are not covered here.

The one subject with a second visit specimen will be discussed first. She reported to the clinic seven days after the alleged assault and claimed that she was drinking beer with her boss and the next thing she remembers is waking up and her boss is on top of her sexually assaulting her. She admits that she was impaired from the alcohol, but does not believe that it caused her to pass out. She believes that her boss gave her a drug. She admits to having a prescription for paroxetine. On the first visit, she was positive for doxylamine, nortriptyline, paroxetine, and dextromethorphan. On the second visit, she was positive for cocaine and paroxetine. Because she reported to the clinic seven days after the assault, it is impossible to determine what drugs she had in her system at the time of the assault. The drugs that were detected are primarily excreted within one day after consumption. Doxylamine was found in her hair, but again, it is unknown when this drug was taken. Thus, it is unable to be concluded whether or not this is a DFSA by both methods.

The next thirteen cases all did not return for a second visit. The first subject reported that her ex-boyfriend came to her home, began beating her face and head, and forced her to perform oral sex on him. She does not admit to taking any drugs and does not believe that she was given anything. Chlorpheniramine was the only drug found which supports her story. This case is not a DFSA. Another case involved the same scenario. For this subject, the metabolite of fluoxetine was found. Based on her testimony, this is not DFSA. Another three subjects assaulted by an acquaintance all believe that they were not given any drugs, nor impaired. Nortriptyline was found in the first subject who admitted to being on it for anxiety. Citalopram was the only drug found in the second subject. Citalopram was also found in the third subject, for which she had a

prescription. Based on their statements and the lack of drugs found, none of these cases are DFSA.

The next subject claims to have been assaulted by her friend's boyfriend. She admitted to smoking marijuana and having a prescription for fluoxetine and does not believe she was given a drug. The metabolite of fluoxetine and marijuana were the only drugs found, supporting her story. Again, this is not a case of DFSA.

Another subject claimed to have been sexually assaulted in a Wal-Mart parking lot. She only admits to using sertraline, for which she has a prescription and does not believe she was given any drugs. Sertraline and cyclobenzaprine were found; however, without the presence of alcohol or other sedatives, it is highly unlikely that she was sedated prior to the assault. Based on the subject's statement, this is not a DFSA.

The next two subjects are developmentally disabled women who both reported to the clinic 12 days after the alleged assault. Both state that they were not impaired and that no drugs were given to them. The first subject claims that a man she met on the Internet came to her house and sexually assaulted her. She has a prescription for paroxetine, which was the only drug found. The second subject has a prescription for citalopram, and this was the only drug found. However, due to the delay in reporting for both cases the drugs found do not represent what was in their system at the time of the assault. Based on their statements, neither of these is a DFSA.

The next subject reported to the clinic nine hours after the alleged assault. She claims that she had two glasses of wine and then does not remember anything afterwards. She woke up in bed with her brassiere off. She states that she took Nyquil® for a cold but does not admit to taking any other drugs. She also stated that it was a possibility that

a drug was surreptitiously given to her. Dextromethorphan, doxylamine, amphetamine, methamphetamine, and marijuana were all found in her urine specimen. It is possible that the combination of dextromethorphan and doxylamine from the cold medicine with the alcohol caused her to become unconscious. The other drugs that were found are unexplainable, given the subject's statements. By DFSA1, this is not a DFSA since only drugs the subject admitted to taking were found. However, the combination of drugs she took probably caused the sedation and thus this case is a DFSA under DFSA2.

The next subject did not provide a description of the assault and did not believe that she was impaired or given a drug. She reported to the clinic 5 days after the assault and butalbital was the only drug found. Based on her statement, this is not a DFSA. Another subject reported 19 hours after the assault and claims that she met two women at a dance club and the husband of one of the women drove her to his house and assaulted her. She only admits to drinking alcohol and believes that a drug may have been given to her. Citalopram was found and the subject did not admit to having a prescription for any drugs. Based on her statements, it is possible that the husband or his wife had a prescription for citalopram and it was given to her. This is most likely a DFSA under both DFSA1 and DFSA2.

The next subject reported to the clinic five hours after the alleged assault and claimed that she had been drinking at a hotel and been sexually assaulted. She was on unnamed medications for anxiety, anger, and bulimia. She does not believe that she was impaired or given any drug. Nortriptyline was the only drug found in her urine specimen. Based on her statements and the lack of drugs, this is not a DFSA.

e. <u>Hair Analysis</u>

Shown in Table LI are the results for the hair analysis. Due to California's low rate of return for the second visit, there were only eight hair specimens available. All eight specimens were completely consumed for screening, with only two subjects having more than 40 milligram of hair in the proximal two centimeter segment. The nurses in California were not cutting enough hair and needed more instruction in how much hair forensic toxicologists need to conduct a full analysis. One subject was discussed above in regards to the presumptive finding of doxylamine in her hair. The other two subjects did not admit to using the drugs that were presumptively found. As in the above clinics, the hair analysis did not provide any new information to aid in the determination of whether a case was a DFSA. Shown in Table LII are the quantitation results for the first visit and second visit urines, and hair for all drugs being analyzed. For urine, all results are in ng/mL; for hair, the results are in ng/mg.

TABLE LI. RESULTS FROM THE ANALYSIS FOR ALL DRUGS IN THE HAIR SPECIMENS PROVIDED BY SUBJECTS FROM CALIFORNIA.

Sample #	Drugs Previously Found	Drugs Screening Positive in Hair
1-4	None	None
5	Alprazolam	None
6	None	Doxylamine
7	Amphetamines	Methamphetamine
8	Dextromethorphan, Doxylamine, Nortriptyline, Paroxetine	Doxylamine

TABLE LII. QUANTITATION RESULTS FOR ALL SUBJECTS FROM CALIFORNIA WHO WERE POSITIVE FOR AT LEAST ONE DRUG BEING ANALYZED.

Sample	First Visit Urine	Second Visit Urine	Hair
1	Chlorpheniramine – 145.2	Not Provided	Not Provided
2	Norfluoxetine – 707.4 THC-COOH – 82	Not Provided	Not Provided
3	None	Dextromethorphan – 54.5	None
4	Oxycodone – 85.2	Not Provided	Not Provided
5	Norfluoxetine – 24.2	Not Provided	Not Provided
6	Benzoylecgonine – 18,849 THC-COOH – 13	Not Provided	Not Provided
7	Ethanol – 189	Not Provided	Not Provided
8	Cyclobenzaprine – 39.6 Sertraline – 765.3	Not Provided	Not Provided
9	Paroxetine – 1,234.1	Not Provided	Not Provided
10	Nortriptyline – 649.3	Not Provided	Not Provided
11	THC-COOH – 2	Not Provided	Not Provided
12	Ethanol – 49	Not Provided	Not Provided
13	None	Citalopram – 4,412.4	None
14	Hydrocodone – 5,372 Hydromorphone – 239 Oxazepam – 104 Paroxetine – 3,871.5	Not Provided	Not Provided
15	Citalopram – 7,125	Not Provided	Not Provided
16	Citalopram – 1,365	Not Provided	Not Provided
17	Amphetamine – 23,633 Methamphetamine – 33,271 THC-COOH – 22	Not Provided	Not Provided
18	Amphetamine – 14,777 Benzoylecgonine – 170 Chlorpheniramine – 23.4 Methamphetamine – 30,224 Oxazepam – 536 THC-COOH – 30	Not Provided	Not Provided
19	Hydrocodone – 327 Hydromorphone – 14 Norfluoxetine – 1,176.9	Not Provided	Not Provided
20	Amphetamine – 441 Benzoylecgonine – 19,659 7-Aminoclonazepam – 86.4 Methamphetamine – 8,744 THC-COOH – 153	Not Provided	Not Provided

TABLE LII (continued)			
Sample	**First Visit Urine**	**Second Visit Urine**	**Hair**
21	THC-COOH – 22	Not Provided	Not Provided
22	Dextromethorphan – 232.9 Doxylamine – 273 Nortriptyline – 73.2 Paroxetine – 85.9	Benzoylecgonine – 34 Paroxetine – 36.6	None
23	Benzoylecgonine – 492	Not Provided	Not Provided
24	Amphetamine – 975 Dextromethorphan – 47.6 Doxylamine – 789.7 Methamphetamine – 12,123 THC-COOH – 50	Not Provided	Not Provided
25	Butalbital – 16.1	Not Provided	Not Provided
26	Citalopram – 1,835	Not Provided	Not Provided
27	THC-COOH – 9	Not Provided	Not Provided
28	Nortriptyline – 827.1	Not Provided	Not Provided
29	Citalopram – 135.1	Not Provided	Not Provided
30	Amphetamine – 1,840 Ethanol – 70 Methamphetamine – 3,253	Amphetamine – 482 Ethanol – 99 Methamphetamine – 15,404	None
31	Amphetamine – 5,148 Methamphetamine – 17,455 THC-COOH – 3	Not Provided	Not Provided
32	Benzoylecgonine – 11,802 Oxazepam – 485 THC-COOH – 12	Not Provided	Not Provided
33	Ethanol – 334	Not Provided	Not Provided
34	Amphetamine – 320 Methamphetamine – 3,231	Not Provided	Not Provided

f. Rate of DFSA at the California site

As described above, only four cases were evaluated for DFSA under the criteria for DFSA1 since the remaining 52 were excluded based on toxicological analysis and patient reporting. Of these four, only one was identified as DFSA and one was identified as unknown. The results for DFSA1 are presented in Table LIII.

DFSA2 had many more likely DFSAs as compared to DFSA1. The 24 subjects without any drugs are still considered to not be DFSA and the results for the unique cases were presented above. Of the remaining cases, nine were evaluated to be DFSA and four were found to be not DFSAs. The results for DFSA2 are compared to DFSA1 in Table LIII.

Based on the analysis of the questionnaires, it was hypothesized that California would have a rate of DFSA of almost 20% due to the subjects who believed they were given a drug. However, only one case was able to be identified as a DFSA involving surreptitious drug use. The broader definition of DFSA, DFSA2, identified slightly more DFSAs than the subjects in California identified.

California had the lowest percent of cases of all sites that were able to be identified as DFSA by either method. There was also only one case that was labeled as unknown. The high degree of certainty in this site is mainly due to the fact that every subject was able to complete a questionnaire. This further demonstrates that the information provided by the subject allows for a better analysis of the toxicology results.

TABLE LIII. ESTIMATE OF THE PREVALENCE OF DFSA AMONG THE SUBMITTING SUBJECTS IN CALIFORNIA.

N=56	Yes	No	Unknown
DFSA1	1 (1.8%)	54 (96.4%)	1 (1.8%)
DFSA2	15 (26.8%)	40 (71.4%)	1 (1.8%)

F. Estimate of the Incidence of DFSA for all Clinics

a. DFSA1

The combined rate for all submitting clinics is shown in Table LIV along with the calculated 95% Confidence Intervals (CI). As stated above, DFSA1 is a conservative estimate of DFSA based on criteria that only takes into account those sexual assault complainants who were identified as having been given a drug surreptitiously. Nearly 90% of the submitting subjects were identified as having not been given a drug surreptitiously. For the six subjects who were identified as having been given a drug, five believed they were given a drug, and one thought it was a possibility. For the nine subjects for whom DFSA was classified as Unknown, eight did not complete a questionnaire. For the subject who did complete the questionnaire, they stated that it was a possibility that they were given a drug. Had the other eight subjects completed the questionnaire, it is highly likely that we would have been able to definitely place them into either yes or no. A previous study by McGregor which employed the conservative approach for DFSA, estimated that of 1,421 complainants, 172 (12.1%) were victims of a DFSA (38). However, their work was done based solely on the subject's self-reported suspicion, not on any toxicology results. The research previously done by ElSohly did

not present an estimate of how prevalent DFSA was in their cases and thus no correlation can be shown here. However, in their final paper they suggested that there was "no compelling evidence of a wide-spread classic "date-rape" scenario" (174). Our data supports this conclusion through a more detailed analysis of each subject received.

Shown in Table LV are the age and race of the subjects identified as highly likely of having been the victim of DFSA. The ages for the six subjects are not statistically different ($p > 0.05$) from the ages for all subjects. Only one minority (Black) was identified as having been the victim of surreptitious drugging. This may be due to Black and Hispanic subjects having a lower risk of being surreptitiously given a drug and subsequently assaulted. However, the number of Black and Hispanic subjects admitted into this study may be too low to draw any significant conclusions.

TABLE LIV. COMBINED RATE OF DFSA BY BOTH METHODS FOR ALL SUBMITTING CLINICS.

N=144	**Yes**	**95% CI**	**No**	**95% CI**	**Unknown**	**95% CI**
DFSA1	6 (4.2%)	0.89%, 7.44%	129 (89.6%)	84.58%, 94.59%	9 (6.2%)	2.28%, 10.22%
DFSA2	51 (35.4%)	27.58%, 43.26%	85 (59.0%)	50.97%, 67.09%	8 (5.6%)	1.80%, 9.31%

TABLE LV. AGE AND RACE OF SUBJECTS IDENTIFIED AS VICTIMS OF DFSA.

DFSA = Yes	**Age (years)**		**Race**		
DFSA1 N=6	**Range**	**Mean (s.d.)**	**White**	**Black**	**Hispanic**
	22-42	30.7 (7.6)	5 (83.3%)	1 (16.7%)	0 (0.0%)
DFSA2 N=51	**Range**	**Mean (s.d.)**	**White**	**Black**	**Hispanic**
	18-54	28 (9.0)	37 (72.5%)	3 (5.9%)	5 (9.8%)

b. DFSA2

As shown in Table LIV, DFSA2 has many more cases that were identified as DFSA than the conservative DFSA1. This data demonstrates that DFSA is much more prevalent when the subject's own illegal drug usage, or the combination of prescription drugs with or without alcohol, is included. For the 51 subjects for whom DFSA was highly likely, 18 believed they were given a drug, and six thought it was a possibility. For the eight subjects for whom DFSA was unknown, only one stated that it was a possibility that they were given a drug.

Our data demonstrates that the subjects in this study were more likely to overestimate whether they were given a drug and then assaulted. It was found that many of the subjects who believed they were given a drug, were identified as having been the victim of a DFSA through their own drug usage.

The age and race of the subjects identified as having been the victim of DFSA are shown in Table LV. Again, the ages of these subjects are not statistically different ($p > 0.05$) from the ages for all subjects. Furthermore, the ages of the subjects in DFSA1 when compared to DFSA2 are also not statistically different. This suggests that for the subjects in this study, age did not influence a positive determination of DFSA by either method. The races of the subjects for DFSA2 include more Black and Hispanic subjects. When these numbers are compared to the racial data for all subjects in this study, it is seen that the percent of White, Black, and Hispanic subjects that were positive for DFSA2 relates well to the percent make-up of all subjects. For example, White subjects compromise 71% of the subjects in this study, and compromised 72.5% of the subjects

positive for DFSA2. This suggests that the race of the subject in this study did not influence the determination of DFSA by the criteria for DFSA2.

There are several issues that could have underestimated our results for DFSA. First, subjects who believed DFSA was a possibility reported to the clinic 34.4 ± 72.3 hours after the alleged assault (median time 16.5 hours). While not statistically different from the entire sample population, the time delay is too long to be able to detect drugs with short half-lives, such as GHB. While GHB was never found above endogenous levels in our specimens, it is still possible that some of the subjects were given GHB and then assaulted. If the subjects had reported to the clinic within eight hours, it is possible that we would have been able to determine DFSA in more of the subjects.

The next difficulty was the lack of background information surrounding the complainant and the alleged assault. As was stated above, the questionnaire was originally included in the second visit kit and thus anyone who did not return for the second visit did not complete the questionnaire. The return rate for all clinics was only 41% which is in agreement with a previous study that demonstrated 31% of sexual assault complainants return for a follow-up visit (5). This limitation was eventually corrected; however, 17.4% of the subjects did not complete a questionnaire. The information in the questionnaire would have further helped in the determination of several of the unknown DFSAs.

Along with the completion of the questionnaire, there were several important questions that were not asked. The time interval was never asked on the questionnaire and was only determined at the completion of the study by having each clinic find the records of the subjects and to calculate the time interval. This was a time consuming

project which could have been avoided if it had been asked on the questionnaire. We were also completely reliant on the clinics keeping good records and being able to access them quickly and easily. Second, the relationship of the complainant to the alleged perpetrator was not asked for and this information would have been important in determining if this variable affected the outcome of any other variable. For example, were subjects more likely to have been using hard drugs if the perpetrator was a friend or relative? Finally, the subject's OTC drug use was never asked about and since our analysis included OTC drugs, it would have been important to know which OTC drugs, if any, the subject had used.

G. Prevalence of all Drugs in Submitting Subjects

Out of the 144 subjects, 89 were positive for at least one of the drugs being analyzed. This calculates to 61.81% of our subjects which is similar to ElSohly's result of 61.3% of 3,303 subjects being positive for at least one of the analyzed drugs (174). Our analysis included more OTC and prescription drugs and their work only included subjects who believed they were given a drug. It is unable to be determined how our two rates are in close agreement when the sample selection was so different. It is possible that by analyzing for more drugs in a population of subjects that did not believe they were given a drug increased our rate of positive subjects.

Shown in Table LVI are the percentage of subjects positive for all drugs and the percent positive for the different types of drugs. ElSohly's research found GHB in 3% of the subjects and flunitrazepam in 0.33%. For our work, the notorious "date-rape" drugs were found in seven subjects (4.86%), of which three had a prescription. As stated above, the time delay may have been the reason why GHB was never found in any of our

subjects. However, for ElSohly's research, 73% of their specimens were collected within 24 hours of the assault. For our work, 70.1% of the specimens were collected within 24 hours. This does not explain why they were able to detect GHB more often than our laboratory. This may be due to their findings of endogenous levels of GHB and considering the results positive. For flunitrazepam, it is unable to be determined why our study found a higher percentage than theirs; although it could be due to their conflict of interest that was previously discussed.

TABLE LVI. PERCENT OF SUBJECTS POSITIVE FOR ALL DRUGS AND PERCENT POSITIVE FOR TYPES OF DRUGS.

	% of Subjects Positive	**95% Confidence Interval**
All Drugs Found	61.81	(53.85, 69.77)
Drugs of Abuse	45.83	(37.66, 54)
"Date-rape" Drugs	4.86	(1.34, 8.38)
OTC and Prescription Drugs	27.78	(20.44, 35.12)

The results for each drug or drug class in this study as compared to NIDA's Monitoring the Future (MTF) are shown in Table LVII. MTF attempts to estimate drug use through mail-in questionnaires given to a select part of the population covering a wide-range of ages. Their data presented in the table is for females aged 19 to 30. This age range covers over 57% of the subjects received in our study. This data shows that the subjects for this study admit to using drugs about the same percent as the general population. However, the results for the urinalysis detail that these subjects underreported their drug usage. The self-reporting will be discussed below; however it is

of interest to note that sexual assault complainants' illicit drug usage is reported to the same degree as the general population.

TABLE LVII. MTF DATA COMPARED TO THE SUBJECTS' REPORTED DRUG USE AND THE RESULTS FROM THE TOXICOLOGY ANALYSIS.

	MTF (Annual)	**MTF (30-Day)**	**Admit to use in this study**	**Positive in this study**
Any Illicit Drug	28.9	16.9	18.5	45.8
THC	24.4	13.9	10.9	26.4
Cocaine	5.0	1.8	6.7	18.1
Narcotics	7.5	2.6	0	8.3
Amphetamine	4.7	2.1	4.2	6.2
Methamphetamine	0.9	0.4	4.2	6.9
Barbiturates	3.2	1.2	0	0.69
Alcohol	83.1	62.9	55.5	9.7

NFLIS is a DEA program that collects information about the drugs being analyzed by state and local forensic laboratories across the country. Their data are presented by four regions of the country, West, Midwest, Northeast, and South. Our four clinics compromise the West (Washington and California), Midwest (Minnesota) and South (Texas) regions. For two years during the study (2002 and 2003), NFLIS found that marijuana was the drug analyzed the most (35.22 % of analyzed cases), followed by cocaine (31.42%), and amphetamines (12%) (188, 189). Our study corresponded well with these findings with 26.4% of our cases positive for marijuana, 18% positive for cocaine, and 6.9% for amphetamines. For the specific regions of the country, NFLIS found that the Midwest had the largest percentage of cases positive for marijuana; in our study, the clinic in the Midwest, Minnesota, had the largest percentage of cases positive

for marijuana. For cocaine, NFLIS found the South to have largest percentage while in this study; the Midwest had the largest percentage. NFLIS found that the West had the largest number of amphetamines and this was confirmed in our study.

H. Validity of Self-Reporting Illicit Drug Usage in this Study

When analyzing all data on self-reporting, we are limited in only describing the 119 subjects who returned a questionnaire. Thus, if someone who did not return a questionnaire was positive for one of the drugs, they are not included in the total numbers. For marijuana, 12 subjects admitted to its use and were confirmed positive; however, there were an additional 18 subjects who were also positive; thus the validity of self-reporting marijuana use is only 40%. Although White subjects comprised 87% of the 30 samples, they were the only race to admit to use of the drug. One Black and three Hispanic subjects all denied use though the drug was confirmed in their urine. A study of Chicago households by Fendrich *et al.* found that Black and Hispanic respondents had increased odds of underreporting their marijuana usage (190). Fendrich's study also demonstrated that younger respondents were more truthful in their self-reporting of marijuana. However, there were no significant age differences demonstrated in this study.

Cocaine demonstrated similar results with marijuana, with eight subjects admitting to its use and 14 subjects denying its use. This equates to 36.4% of subjects positive for cocaine truthfully admitting to its use. Again, White subjects comprised a large percent of all positive subjects (68.2%) and had six subjects who admitted to use of cocaine. The two additional subjects who admitted to cocaine use were in the Other/Unknown race category. There were two Hispanic subjects and one Black subject who were positive but did not admit to use of the drug. In Fendrich's study, Black

respondents were more likely to underreport cocaine use as compared to White subjects; Hispanic respondents corresponded well with White subjects (190). In this study, Black and Hispanic subjects both underreported their cocaine use as compared to White subjects. Fendrich's study also demonstrated that the younger the respondent was, the more likely they were to underreport their cocaine usage. In this study, of the eight subjects who admitted to using cocaine, 75% were above the age of 25 which is similar to Fendrich's work.

Self-reporting of amphetamines is similar to both cocaine and marijuana. There were nine subjects who were positive for amphetamines and only 4 admitted to its usage. Thus, those truthfully reporting amphetamine use are only 44.4% of subjects positive for amphetamines. All four subjects who admitted to using amphetamines were White; of the five who were positive but did not admit to using amphetamines, one was Hispanic and four were White. As in the above analyses, only White subjects admitted to using illegal drugs. Age of the subjects did not appear to affect the validity of self-reporting amphetamines. Fendrich's general population study did not include amphetamines and thus no correlation can be described between the two studies.

When all three drugs are combined, 39.3% of subjects positive admit to using the illegal drugs. This rate disproves our hypothesis that sexual assault complainants would be more likely to accurately report the illegal drugs they were using. It was also discovered that none of the eight Black or Hispanic subjects admitted to using any of these illegal drugs, which corresponds well with previous work on race and self-reporting (99, 190). Age did not significantly determine accuracy of self-reporting. Subjects below the age of 26 accurately reported drug usage 35.9% of the time with subjects above

the age of 25 accurately reporting 45.4%. A previous study demonstrated that respondents were more likely to truthfully admit to the use of "soft" drugs such as marijuana, than harder drugs such as cocaine/crack (191). In this study, no such trend was noticed as all three drugs had a relatively equal degree of self-reporting.

To date, no research has been done to determine if sexual assault complainants are more or less likely to underreport their drug usage than other parts of the population. It is generally accepted that self-reporting of drug usage is unreliable; however, underreporting of drug usage, as seen in this study, has been normally associated with people who believe that there is a negative consequence to their answers (192, 193). One study demonstrated that for subjects on a methadone maintenance program, they reported cocaine usage 29% of the time but were positive by urinalysis 68% of the time (194). A study of workers in a steel mill showed that 50% of the subjects who were positive for an illegal drug did not truthfully report their usage (195).

Hser conducted a study of self-reporting drug use among a diverse population containing subjects in a sexually transmitted disease clinic, subjects in an emergency room setting, and recently arrested adults (191). These populations were picked due to being in a perceived "hidden population" not covered by large epidemiological studies, which would also include the sexual assault complainant population. Hser found a large level of underreporting for all three populations, but the degree of underreporting differed. For the STD population and the ER population, 48.8% and 57.5% of the respective populations truthfully reported using any illegal drugs. When marijuana was factored out, the reporting levels dropped to 28.6% and 45.3%. This suggests that these two populations, which the researchers consider more mainstream than the arrestees, are

more likely to truthfully report marijuana than "harder" drugs. The prison population was much more likely to truthfully report their drug usage with 70.8% reporting any drug and 66.7% reporting any drug but marijuana. It is Hser's theory that the prison population was more truthful due to their already stigmatized reputation and the belief that nothing worse could be done to them. Sexual assault complainants are most likely similar to the STD and ER populations which further relates to the low self-reporting seen in this study. Hser also found that heavy users were more likely to truthfully report their drug usage than casual users. However, in this study, we did not attempt to determine heavy versus casual use. If we had determined that most of our subjects were self-identified casual users, this may have helped to explain why underreporting was so prevalent in this study.

It is of the utmost importance that investigators are told every drug that the complainant was using, including illegal drugs of abuse, OTC and prescription drugs. Previous studies have shown that the finding of ethanol or drugs does not negatively affect any legal outcomes for the case and thus it should be stressed to the complainants that their drug usage will not be used against them (2, 12). It has also been shown that respondents who are promised anonymity or who believe their answers have a legitimate purpose are more likely to truthfully report their drug usage (191). For sexual assault complainants, anonymity will never be able to be guaranteed, but the legitimacy of the questions can be stressed by the attending nurse by demonstrating that truthful self-reporting of their drug usage will not hurt their case, but will aid the toxicologists in determining recreationally used drugs versus surreptitiously given drugs.

IV. CONCLUSIONS

A multiple site study was conducted to further identify if DFSA is as prevalent as the news media has stated. Previous studies on the prevalence of DFSA have been marred by biased sampling methods or have been lacking toxicological analyses to support sexual assault complainant statements. This study has attempted to correct both of these problems by accepting all sexual assault complainants and analyzing their urine and hair for a multitude of drugs. This sampling method is in accord with the epidemiologically correct definition of prevalence. The drugs were chosen based on a report by a committee assigned to the task of determining drugs that have either been implicated in DFSA, or whose pharmacology readily lends it to be used to incapacitate a potential victim. The complicated task of identifying those subjects in this study who were victims of DFSA was further broken down into two definitions. The first is more conservative and states that a subject was the victim of a DFSA only if surreptitiously given a drug. The second includes the first, but also takes into account the subject's own illegal drug use and prescription drug misuse.

A total of 144 subjects were enrolled in this study. The return (second visit) rate for the subjects was considerably lower than desired; however, previous studies have shown that a large percentage of sexual assault complainants do not return even for a follow-up clinical visit as is usually suggested. Only two of the four sites enrolled the targeted number of subjects (35), which suggests that the recruitment of sexual assault complainants into research studies following the assault is difficult. This may be due to the complainant still being in shock from the assault or for other unstated reasons. Most studies on sexual assault complainants are done on case files and do not require the actual

involvement of the complainant. In this study, we needed the complainant to answer very personal questions regarding their drug habits, which may have discouraged some from enrolling in the study.

The main hypothesis for this study was that the prevalence of the classic "date-rape" drugs (flunitrazepam, clonazepam, GHB, ketamine, and scopolamine) would be low for the enrolled subjects. This was proven as only 4.9% of the enrolled subjects were positive for the above drugs. Of these drugs, clonazepam was only found in subject's who admitted to having a prescription for it. GHB, ketamine, and scopolamine were never found in any subject, while flunitrazepam was found in several subjects, some of whom were positive on both visits. Therefore, most of the subject's positive for these drugs had taken them by their own accord and not received them surreptitiously. However, as stated above, due to GHB having endogenous levels in the body, it was difficult to determine if GHB was given to subjects who reported greater than 12 hours after the alleged assault. It is possible that some of the subjects who believed they were given a drug were given GHB, but did not report to the clinic quickly enough for our analysis to detect quantities above previously established endogenous levels. This is a problem in DFSA that is not unique to this study and thus should not affect the results from this study.

The self-reporting of drug use by sexual assault complainants was able to be evaluated in this study. There have been no previous studies on how truthful sexual assault complainants are in reporting their drug usage before the assault. One of our hypotheses was that sexual assault complainants would be more honest in admitting the use of illegal drugs than has been previously been shown for other populations.

However, this hypothesis was disproved by the high number of subjects who did not truthfully report their drug usage. Our combined estimates demonstrate that only 40% of the subjects in this study in whom the drugs were detected truthfully admitted to using illegal drugs. Further work needs to be done on the social science aspect to determine the reasons for the underreporting. We have been unable to determine in this study if the subjects believed that the results would harm their case or if by admitting to using drugs, the examining nurse would change the way in which they interacted with the subject. The subjects may have felt threatened by possible laboratory findings even though it was made clear that our testing was anonymous and for research purposes only. Jurisdictions need to consider their drug screening / drug testing protocols with sexual assault complainants. Some now test for, and report, all drugs of abuse. This is often only able to be done after the complainant signs an additional consent form for the drug test. Complainants may feel that their recreational use of illegal drugs could negatively affect the course of the sexual assault prosecution and refuse to consent to the drug test. However, it needs to be clearly explained that the finding of illegal drugs will not hurt their case. At the same time, only through a truthful recounting of the events of the assault can the toxicologist make an educated decision about whether the subject was incapacitated.

Our second hypothesis was that sexual assault complainants would have similar drug profiles as compared to the general public and previous studies. It was shown that when compared to ElSohly's work on sexual assault complainants, the prevalence of drugs in our study was similar to their results. Their study accepted subjects with a reported drug history or who believed that a drug was given to them. This study accepted

all subjects, regardless of history, and analyzed for more drugs. Due to a different sampling method and toxicology analysis, the fit between the two overall drug profiles is fortuitous. However, when the subjects in this study are compared to a national drug monitoring service (MTF), sexual assault complainants demonstrated a higher number of drugs in their system. The caveat in comparing our results to MTF data is that MTF only uses self-reporting of drug use and does not conduct analytical tests on the respondents. Because self-reporting has been shown to be low, it is not surprising that our subjects had such a larger amount of drugs in their system than the general public admits to using.

Although this work is the first to combine both toxicology results with subject reporting, there is still more work to be accomplished. The total number of subjects enrolled was fewer than expected and more will need to be studied to determine if the results for this sample size correspond to a much larger population. It is also important to analyze a more regionally diverse population including clinics from the east coast and in areas with a higher percent of minorities. The questionnaire devised will also have to be updated to include OTC drug usage, subject/assailant relationship, and time interval for reporting. It is also important to again stress the need for the questionnaire to be completed at the initial visit to the clinic, as the return rate for the second visit is low.

More research is also needed by the social sciences to understand why sexual assault complainants underreport their illegal drug usage to such a large extent. This work has shown that is difficult to believe the subject's account when they are not truthful in their drug history. The nursing staff may need to be educated in methods for extracting truthful drug histories by stressing that illegal drug usage may not hinder a

successful prosecution of the subject's case, but rather help in the determination of surreptitious drugging versus recreational drug usage.

Finally, the two definitions for DFSA presented herein, DFSA1 and DFSA2, need to be further examined by the toxicology and legal communities. A consensus needs to be reached as to what comprises DFSA and how to handle the successful prosecution of these cases. Most laws dealing with sexual assault place surreptitious drugging as an aggravating factor to the crime. However, recreational drug usage by the victim that led to their physical or mental incapacitation may also need to be included as an aggravating factor. As demonstrated in this study, the subject's own drug usage was more likely a factor in facilitating a sexual assault rather than surreptitious drugging.

CITED LITERATURE

1. Abbey A, Zawacki T, Buck PO, Clinton AM, McAuslan P. Alcohol and sexual assault. Alcohol Research & Health: the Journal of the National Institute on Alcohol Abuse & Alcoholism 2001;25(1):43-51.

2. Du Mont J, Parnis D. Sexual assault and legal resolution: querying the medical collection of forensic evidence. Medicine & Law 2000;19(4):779-92.

3. Gray-Eurom K, Seaberg D, Wears R. The Prosecution of Sexual Assault Cases: Correlation with Forensic Evidence. Annals of Emergency Medicine 2002;39(1):39-46.

4. Grossin C, Sibille I, Lorin de la Grandmaison G, Banasr A, Brion F, Durigon M. Analysis of 418 cases of sexual assault. Forensic Science International 2003;131(2-3):125-30.

5. Holmes MM, Resnick HS, Frampton D. Follow-up of sexual assault victims. American Journal of Obstetrics & Gynecology 1998;179(2):336-42.

6. Kilpatrick DG, Acierno R, Resnick HS, Saunders BE, Best CL. A 2-year longitudinal analysis of the relationships between violent assault and substance use in women. Journal of Consulting & Clinical Psychology 1997;65(5):834-47.

7. Ledray LE. The clinical care and documentation for victims of drug-facilitated sexual assault. Journal of Emergency Nursing 2001;27(3):301-5.

8. Ledray L. Do All Emergency Physicians Have an Obligation to Provide Care for Victims of Sexual Assault or is There a More Effective Alternative? Annals of Emergency Medicine 2002;39(1):61-64.

9. Putz M, Thomas BK, Cowles KV. Sexual assault victims' compliance with follow-up care at one sexual assault treatment center. Journal of Emergency Nursing 1996;22(6):560-5.

10. Riggs N, Houry D, Long G, Markovchick V, Feldhaus KM. Analysis of 1,076 cases of sexual assault. Annals of Emergency Medicine 2000;35(4):358-62.

11. Statistics BoJ. Rape and Sexual Assault: Reporting to Police and Medical Attention, 1992-2000. Washington, D.C.: U.S. Department of Justice; 2002 August.

12. Wiley J, Sugar N, Fine D, Eckert LO. Legal outcomes of sexual assault. American Journal of Obstetrics & Gynecology 2003;188(6):1638-41.

13. Petruckevitch A, Chung WS, Richardson J, Moorey S, Cotter S, Feder GS, et al. Rape and sexual assault. Understanding the offense and the offender. British Journal of General Practice 2003;53(496):858-62.

14. Forster G, Petrak J, Aylott J. Preventing rape and sexual assault of people with learning disabilities. Medical Education 1999;33(1):24-7.

15. Beebe DK. Sexual assault: the physician's role in prevention and treatment. British Journal of Nursing 1999;8(13):871-6.

16. Burgess AW, Fawcett J. The comprehensive sexual assault assessment tool. Nurse Practitioner 1996;21(4):66.

17. Berkowitz A. College men as perpetrators of acquaintance rape and sexual assault: a review of recent research. Journal of American College Health 1992;40(4):175-81.

18. anonymous. Responding to rape and sexual assault. Nursing Standard 1992;6(18):31.

19. Ledray LE. Counseling rape victims: the nursing challenge. Perspectives in Psychiatric Care 1990;26(2):21-7.

20. Seals T. Sexual assault: myth vs. reality. Journal of Healthcare Protection Management 1985;1(2):11-27.

21. Rhynard J, Krebs M, Glover J. Sexual assault in dating relationships. Journal of School Health 1997;67(3):89-93.

22. Collins KS SC, Joseph S, et. al. Health concerns across a woman's lifespan. In: The Commonwealth Fund 1998 Survey of women's health; May 1999.

23. United States Department of Justice. The Nation's two crime measures.

24. Pesola GR, Westfal RE, Kuffner CA. Emergency department characteristics of male sexual assault. Academic Emergency Medicine 1999;6(8):792-8.

25. Ledray LE, Kraft J. Evidentiary examination without a police report: should it be done? Are delayed reporters and nonreporters unique? Journal of Emergency Nursing 2001;27(4):396-400.

26. Ledray LE, Barry L. SANE expert and factual testimony. Journal of Emergency Nursing 1998;24(3):284-7.

27. Murdoch D, Pihl RO, Ross D. Alcohol and crimes of violence: present issues. International Journal of the Addictions 1990;25(9):1065-81.

28. Mohler-Kuo M, Dowdall GW, Koss MP, Wechsler H. Correlates of rape while intoxicated in a national sample of college women. Journal of Studies on Alcohol 2004;65(1):37-45.

29. Johnson SD, Gibson L, Linden R. Alcohol and rape in Winnipeg, 1966-1975. Journal of Studies on Alcohol 1978;39(11):1887-94.

30. Johnson TJ, Stahl C. Sexual experiences associated with participation in drinking games. Journal of General Psychology 2004;131(3):304-20.

31. SFRC Center. When Drugs are Used to Rape: Rohypnol and Drug-Facilitated Rape.

32. Goulle JP, Anger JP. Drug-facilitated robbery or sexual assault: problems associated with amnesia. Therapeutic Drug Monitoring 2004;26(2):206-10.

33. Goulle Jean-Pierre A, Jean-Pierre. Drug-Facilitated Robbery or Sexual Assault: Problems Associated with Amnesia. Ther. Drug Monit 2004;26(2):206-10.

34. Kintz P, Villain M, Tracqui A, Cirimele V, Ludes B. Buprenorphine in drug-facilitated sexual abuse: a fatal case involving a 14-year-old boy. Journal of Analytical Toxicology 2003;27(7):527-9.

35. Kintz P, Villain M, Ludes B. Testing for the undetectable in drug-facilitated sexual assault using hair analyzed by tandem mass spectrometry as evidence. Therapeutic Drug Monitoring 2004;26(2):211-4.

36. LeBeau M, Andollo W, Hearn WL, Baselt R, Cone E, Finkle B, et al. Recommendations for toxicological investigations of drug-facilitated sexual assaults. Journal of Forensic Sciences 1999;44(1):227-30.

37. LeBeau M, Andollo W, Hearn WL, Baselt R, Cone E, Finkle B, et al. Recommendations for toxicological investigations of drug-facilitated sexual assaults. Forensic Science International 2000;109(3):183-7.

38. McGregor MJ, Lipowska M, Shah S, Du Mont J, De Siato C. An exploratory analysis of suspected drug-facilitated sexual assault seen in a hospital emergency department. Women & Health 2003;37(3):71-80.

39. Milteer R, LeBeau MA, LeBeau M. Recommendations for toxicological investigations of drug-facilitated sexual assaults. Southern Medical Association Journal 2000;93(6):558-61.

40. Negrusz A, Gaensslen RE. Analytical developments in toxicological investigation of drug-facilitated sexual assault. Analytical & Bioanalytical Chemistry 2003;376(8):1192-7.

41. Payne-James J, Rogers D. Drug-facilitated sexual assault, 'ladettes' and alcohol. Journal of the Royal Society of Medicine 2002;95(7):326-7.

42. Schwartz R, Milteer R, LeBeau M. Drug-Facilitated Sexual Assault ('Date Rape'). Southern Medical Journal 2000;93(6):558-561.

43. Weir E. Drug-facilitated date rape. CMAJ Canadian Medical Association Journal 2001;165(1):80.

44. Raphael R. A Fatal, Unknowing Dose. abcNEWS.com 2002 June 25, 2002.

45. Vachss A. Lethal Cocktail:The Tragedy and the Aftermath of GHB. The Detroit News 1999.

46. Soto O. Drug-Assisted Date Rapes on Rise, Hard to Prosecute. San Diego Union-Tribune 2001 June 3, 2001.

47. Leinwand D. Use Of 'Date Rape' Drug Surges. USA Today 2002 January 28, 2002.

48. Slaughter L. Involvement of Drugs in Sexual Assault. Journal of Reproductive Medicine 2000;45:425-30.

49. ElSohly MA, Salamone SJ. Prevalence of Drugs Used in Cases of Alleged Sexual Assault. Journal of Analytical Toxicology 1999;23(May/June):141-6.

50. Anglin D, Spears KL, Hutson HR. Flunitrazepam and its involvement in date or acquaintance rape. Academic Emergency Medicine 1997;4(4):323-6.

51. Daderman AM, Strindlund H, Wiklund N, Fredriksen SO, Lidberg L. The importance of a urine sample in persons intoxicated with flunitrazepam--legal issues in a forensic psychiatric case study of a serial murderer. Forensic Science International 2003;137(1):21-7.

52. Dowd SM, Strong MJ, Janicak PG, Negrusz A. The behavioral and cognitive effects of two benzodiazepines associated with drug-facilitated sexual assault. Journal of Forensic Sciences 2002;47(5):1101-7.

53. Drummer OH, Syrjanen ML, Cordner SM. Deaths involving the benzodiazepine flunitrazepam. American Journal of Forensic Medicine & Pathology 1993;14(3):238-43.

54. Drummer OH, Ranson DL. Sudden death and benzodiazepines. American Journal of Forensic Medicine & Pathology 1996;17(4):336-42.

55. Edman G, Daderman AM. Flunitrazepam (Rohypnol) abuse in combination with alcohol causes premeditated, grievous violence in male juvenile offenders. Psychiatry Research 2001;103(1):27-42.

56. Elian AA. Detection of Low Levels of Flunitrazepam and its Metabolites in Blood and Bloodstains. Forensic Science International 1999;101:107-111.

57. ElSohly MA, Feng S, Salamone SJ, Wu R. A sensitive GC-MS procedure for the analysis of flunitrazepam and its metabolites in urine. Journal of Analytical Toxicology 1997;21(5):335-40.

58. Fredriksson B, Kristiansson M, Nilsson LH, Lidberg L, Daderman AM. Flunitrazepam abuse and personality characteristics in male forensic psychiatric patients. Journal of the American Academy of Psychiatry & the Law 2002;30(2):238-51.

59. LeBeau MA, Montgomery MA, Wagner JR, Miller ML. Analysis of biofluids for flunitrazepam and metabolites by electrospray liquid chromatography/mass spectrometry. Journal of Forensic Sciences 2000;45(5):1133-41.

60. Marc B, Baudry F, Vaquero P, Zerrouki L, Hassnaoui S, Douceron H. Sexual assault under benzodiazepine submission in a Paris suburb. Archives of Gynecology & Obstetrics 2000;263(4):193-7.

61. Milteer R, LeBeau MA, Elian AA. A novel method for GHB detection in urine and its application in drug-facilitated sexual assaults. Southern Medical Association Journal 2000;93(6):558-61.

62. Morland H, Smith-Kielland A. Urine screening for flunitrazepam: applicability of Emit immunoassay. Clinical Chemistry 1997;43(7):1245-6.

63. Negrusz A, Moore C, Deitermann D, Lewis D, Kaleciak K, Kronstrand R, et al. Highly sensitive micro-plate enzyme immunoassay screening and NCI-GC-MS confirmation of flunitrazepam and its major metabolite 7-aminoflunitrazepam in hair. Journal of Analytical Toxicology 1999;23(6):429-35.

64. Negrusz A, Moore CM, Stockham TL, Poiser KR, Kern JL, Palaparthy R, et al. Elimination of 7-aminoflunitrazepam and flunitrazepam in urine after a single dose of Rohypnol. Journal of Forensic Sciences 2000;45(5):1031-40.

65. Negrusz A, Moore CM, Hinkel KB, Stockham TL, Verma M, Strong MJ, et al. Deposition of 7-aminoflunitrazepam and flunitrazepam in hair after a single dose of Rohypnol. Journal of Forensic Sciences 2001;46(5):1143-51.

66. Salamone SJ, Honasoge S, Brenner C, McNally AJ, Passarelli J, Goc-Szkutnicka K, et al. Flunitrazepam excretion patterns using the Abuscreen OnTrak and OnLine immunoassays: comparison with GC-MS. Journal of Analytical Toxicology 1997;21(5):341-5.

67. Snyder H, Schwenzer KS, Pearlman R, McNally AJ, Tsilimidos M, Salamone SJ, et al. Serum and urine concentrations of flunitrazepam and metabolites, after a single oral dose, by immunoassay and GC-MS. Journal of Analytical Toxicology 2001;25(8):699-704.

68. Stokes SA, Woeckener A, Daderman AM. Violent behavior, impulsive decision-making, and anterograde amnesia while intoxicated with flunitrazepam and alcohol or other drugs: a case study in forensic psychiatric patients. Annals of Emergency Medicine 1998;31(6):723-8.

69. Walshe K, Barrett AM, Kavanagh PV, McNamara SM, Moran C, Shattock AG. A sensitive immunoassay for flunitrazepam and metabolites. Journal of Analytical Toxicology 2000;24(4):296-9.

70. Waltzman ML. Flunitrazepam: a review of "roofies". Pediatric Emergency Care 1999;15(1):59-60.

71. Wang PH, Liu C, Tsay WI, Li JH, Liu RH, Wu TG, et al. Improved screen and confirmation test of 7-aminoflunitrazepam in urine specimens for monitoring flunitrazepam (Rohypnol) exposure. Journal of Analytical Toxicology 2002;26(7):411-8.

72. Rothschild AJ. Disinhibition, amnestic reactions, and other adverse reactions secondary to triazolam: a review of the literature. Retrospective assessment of fibromyalgia therapeusis. Journal of Clinical Psychiatry 1992;53 Suppl(10):69-79.

73. Cupp MJ, Woods JH. Abuse liability of flunitrazepam. Annals of Pharmacotherapy 1998;32(1):117-9.

74. Rickert VI, Wiemann CM, Berenson AB. Flunitrazepam: more than a date rape drug. Journal of Pediatric & Adolescent Gynecology 2000;13(1):37-42.

75. Calhoun SR, Wesson DR, Galloway GP, Smith DE. Abuse of flunitrazepam (Rohypnol) and other benzodiazepines in Austin and south Texas. Journal of Psychoactive Drugs 1996;28(2):183-9.

76. Li J. A tale of novel intoxication: a review of the effects of gamma-hydroxybutyric acid with recommendations for management.

77. Couper FJ, Logan BK. Determination of gamma-hydroxybutyrate (GHB) in biological specimens by gas chromatography--mass spectrometry. Journal of Analytical Toxicology 2000;24(1):1-7.

78. Couper FJ, Logan BK. GHB and driving impairment. Journal of Forensic Sciences 2001;46(4):919-23.

79. Elliott SP. Gamma hydroxybutyric acid (GHB) concentrations in humans and factors affecting endogenous production. Forensic Science International 2003;133(1-2):9-16.

80. Bosman IJ, Lusthof KJ. Forensic cases involving the use of GHB in The Netherlands. Forensic Science International 2003;133(1-2):17-21.

81. Woolverton WL, Rowlett JK, Winger G, Woods JH, Gerak LR, France CP. Evaluation of the reinforcing and discriminative stimulus effects of gamma-hydroxybutyrate in rhesus monkeys. Drug & Alcohol Dependence 1999;54(2):137-43.

82. Kam PC, Yoong FF. Gamma-hydroxybutyric acid: an emerging recreational drug. Anaesthesia 1998;53(12):1195-8.

83. Stillwell ME. Drug-facilitated sexual assault involving gamma-hydroxybutyric acid. Journal of Forensic Sciences 2002;47(5):1133-4.

84. Kintz P, Cirimele V, Jamey C, Ludes B. Testing for GHB in hair by GC/MS/MS after a single exposure. Application to document sexual assault. Journal of Forensic Sciences 2003;48(1):195-200.

85. Elian AA. A Novel Method for GHB Detection in Urine and its Application in Drug-Facilitated Sexual Assaults. Forensic Science International 2000;109:183-187.

86. Nicholson KL, Balster RL. GHB: a new and novel drug of abuse. Drug & Alcohol Dependence 2001;63(1):1-22.

87. Ferrara SD, Tedeschi L, Frison G, Castagna F, Gallimberti L, Giorgetti R, et al. Therapeutic gamma-hydroxybutyric acid monitoring in plasma and urine by gas chromatography-mass spectrometry. Journal of Pharmaceutical & Biomedical Analysis 1993;11(6):483-7.

88. Hornfeldt C, Lothridge K, Upshaw Downs JC. Forensic Science Update: Gamma-Hydroxybutryate (GHB). Forensic Science Communications 2002;4(1).

89. LeBeau M, Miller M, Levine B. Effect of Storage Temperature on Endogenous GHB Levels in Urine. Forensic Science International 2001;119:161-167.

90. 3 Convicted in Date-Rape Drug Trial. The Associated Press.

91. Yeatman D, Reid K. A Study of Urinary Endogenous Gamma-Hydroxybutyrate (GHB) Levels. Journal of Analytical Toxicology 2003;27:40-42.

92. de la Torre R, Farre M, Roset PN, Pizarro N, Abanades S, Segura M, et al. Human pharmacology of MDMA: pharmacokinetics, metabolism, and disposition. Therapeutic Drug Monitoring 2004;26(2):137-44.

93. Badon LA, Hicks A, Lord K, Ogden BA, Meleg-Smith S, Varner KJ. Changes in cardiovascular responsiveness and cardiotoxicity elicited during binge administration of Ecstasy. Journal of Pharmacology & Experimental Therapeutics 2002;302(3):898-907.

94. Worsey J, Goble NM, Stott M, Smith PJ. Bladder outflow obstruction secondary to intravenous amphetamine abuse. British Journal of Urology 1989;64(3):320-1.

95. Emonson DL. The use of amphetamines in U.S. Air Force tactical operations during Desert Shield and Storm.

96. Couper FJ, Pemberton M, Jarvis A, Hughes M, Logan BK. Prevalence of drug use in commercial tractor-trailer drivers. Journal of Forensic Sciences 2002;47(3):562-7.

97. Vanderbeek RD, Shoblock JR. Differential interactions of desipramine with amphetamine and methamphetamine: evidence that amphetamine releases dopamine from noradrenergic neurons in the medial prefrontal cortex. Aviation Space & Environmental Medicine 1995;66(3):260-3.

98. Joksimovic J, Tomic M. Acute amphetamine and/or phencyclidine effects on the dopamine receptor specific binding in the rat brain. Neurochemistry International 2000;36(2):137-42.

99. Fendrich M, Wislar JS, Johnson TP, Hubbell A. A contextual profile of club drug use among adults in Chicago. Addiction 2003;98(12):1693-703.

100. Yacoubian GS, Jr., Boyle C, Harding CA, Loftus EA. It's a rave new world: estimating the prevalence and perceived harm of ecstasy and other drug use among club rave attendees. Journal of Drug Education 2003;33(2):187-96.

101. Rome ES. It's a rave new world: rave culture and illicit drug use in the young. Cleveland Clinic Journal of Medicine 2001;68(6):541-50.

102. Gross SR, Barrett SP, Shestowsky JS, Pihl RO. Ecstasy and drug consumption patterns: a Canadian rave population study. Canadian Journal of Psychiatry - Revue Canadienne de Psychiatrie 2002;47(6):546-51.

103. Rejali D, Glen P, Odom N. Pneumomediastinum following Ecstasy (methylenedioxymetamphetamine, MDMA) ingestion in two people at the same 'rave'. Journal of Laryngology & Otology 2002;116(1):75-6.

104. Ravenel SD. Practice parameter for the use of stimulant medications. Journal of the American Academy of Child & Adolescent Psychiatry 2002;41(10):1146-7; author reply 1147.

105. Moussouttas M. Cannabis use and cerebrovascular disease. Neurologist 2004;10(1):47-53.

106. Grotenhermen F. Pharmacokinetics and pharmacodynamics of cannabinoids. Clinical Pharmacokinetics 2003;42(4):327-60.

107. Block RI, Erwin WJ, Farinpour R, Braverman K. Sedative, stimulant, and other subjective effects of marijuana: relationships to smoking techniques. Pharmacology, Biochemistry & Behavior 1998;59(2):405-12.

108. Hillard CJ, Harris RA, Bloom AS. Effects of the cannabinoids on physical properties of brain membranes and phospholipid vesicles: fluorescence studies. Journal of Pharmacology & Experimental Therapeutics 1985;232(3):579-88.

109. Rettori V, Aguila MC, Gimeno MF, Franchi AM, McCann SM. In vitro effect of delta 9-tetrahydrocannabinol to stimulate somatostatin release and block that of luteinizing hormone-releasing hormone by suppression of the release of prostaglandin E2. Proceedings of the National Academy of Sciences of the United States of America 1990;87(24):10063-6.

110. Pertwee RG, Ross RA. Cannabinoid receptors and their ligands. Prostaglandins Leukotrienes & Essential Fatty Acids 2002;66(2-3):101-21.

111. Mathew RJ, Wilson WH, Humphreys D, Lowe JV, Weithe KE. Depersonalization after marijuana smoking. Biological Psychiatry 1993;33(6):431-41.

112. Ghodse AH, Hollister LE. Cannabis--1988. British Journal of Psychiatry 1992;161:648-53.

113. Halikas JA, Weller RA, Morse CL, Hoffmann RG. A longitudinal study of marijuana effects. International Journal of the Addictions 1985;20(5):701-11.

114. Sauder G, Jonas JB. Topical anesthesia for penetrating trabeculectomy. Graefes Archive for Clinical & Experimental Ophthalmology 2002;240(9):739-42.

115. Kiyatkin EA. Cocaine enhances the changes in extracellular dopamine in nucleus accumbens associated with reinforcing stimuli: a high-speed chronoamperometric study in freely moving rats. European Journal of Neuroscience 1993;5(3):284-91.

116. Ritz MC, Lamb RJ, Goldberg SR, Kuhar MJ. Cocaine receptors on dopamine transporters are related to self-administration of cocaine. Science 1987;237(4819):1219-23.

117. Reith ME, Li MY, Yan QS. Extracellular dopamine, norepinephrine, and serotonin in the ventral tegmental area and nucleus accumbens of freely moving rats during intracerebral dialysis following systemic administration of cocaine and other uptake blockers. Psychopharmacology 1997;134(3):309-17.

118. Lee MA, Meltzer HY. Blunted oral body temperature response to MK-212 in cocaine addicts. Drug & Alcohol Dependence 1994;35(3):217-22.

119. D'Mello GD, Stolerman IP. Comparison of the discriminative stimulus properties of cocaine and amphetamine in rats. British Journal of Pharmacology 1977;61(3):415-22.

120. Elsworth JD, Redmond DE, Jr., Roth RH, Young T. Clinical aspects of phencyclidine (PCP). Journal of Neuroscience 1997;17(5):1769-75.

121. Dove HW. Phencyclidine: pharmacologic and clinical review. Psychiatric Medicine 1984;2(2):189-209.

122. Elsworth JD, Taylor JR, Redmond DE, Jr., Roth RH, Jentsch JD. Enduring cognitive deficits and cortical dopamine dysfunction in monkeys after long-term administration of phencyclidine.[see comment]. Advances in Pharmacology 1998;42:810-4.

123. Marwaha J. Candidate mechanisms underlying phencyclidine-induced psychosis: an electrophysiological behavioral, and biochemical study. Biological Psychiatry 1982;17(2):155-98.

124. Slowe SJ, Matthes HW, Kieffer B. Loss of morphine-induced analgesia, reward effect and withdrawal symptoms in mice lacking the mu-opioid-receptor gene.[see comment]. Brain Research 1997;778(1):73-88.

125. Maldonado R, Simonin F, Valverde O, Slowe S, Kitchen I, Befort K, et al. Comparison of analgesic potencies of mu, delta and kappa agonists locally applied to various CNS regions relevant to analgesia in rats. Nature 1996;383(6603):819-23.

126. Kubota A, Iwama T, Wada T, Yasui M, Fujibayashi K, Takagi H, et al. Systematic examination in the rat of brain sites sensitive to the direct application of morphine: observation of differential effects within the periaqueductal gray. Life Sciences 1983;33 Suppl 1:689-92.

127. Rickels K, Rynn M. Pharmacotherapy of generalized anxiety disorder. Journal of Clinical Psychiatry 2002;63 Suppl 14:9-16.

128. Nyback HV, Walters JR, Aghajanian GK, Roth RH. Tricyclic antidepressants: effects on the firing rate of brain noradrenergic neurons. European Journal of Pharmacology 1975;32(02):302-12.

129. Carlsson A, Lindqvist M. Effects of antidepressant agents on the synthesis of brain monoamines. Journal of Neural Transmission 1978;43(2):73-91.

130. Lader M. The problems of safety and compliance with conventional antidepressant drugs. Acta Psychiatrica Scandinavica, Supplementum 1983;308:91-5.

131. Taylor JE, Richelson E. High affinity binding of tricyclic antidepressants to histamine H1-receptors: fact and artifact. European Journal of Pharmacology 1980;67(1):41-6.

132. Richelson E. Tricyclic antidepressants and histamine H1 receptors. Mayo Clinic Proceedings 1979;54(10):669-74.

133. Self T. Interactions with tricyclic antidepressants: declining use increases need for awareness. Journal of Critical Illness 2000.

134. Czarnecka E, Kowalczyk K, Kozbial H. Interaction between central effects of ethanol and tricyclic antidepressants, imipramine and amitriptyline in mice and rats. Polish Journal of Pharmacology & Pharmacy 1989;41(3):231-7.

135. Czarnecka E, Pietrzak B. The effect of doxepin on the central action of ethanol. Polish Journal of Pharmacology & Pharmacy 1991;43(6):471-8.

136. Sabelli HC, Fawcett J, Javaid JI, Bagri S. The methylphenidate test for differentiating desipramine-responsive from nortriptyline-responsive depression. American Journal of Psychiatry 1983;140(2):212-4.

137. Bryson HM, Wilde MI. Amitriptyline. A review of its pharmacological properties and therapeutic use in chronic pain states. Drugs & Aging 1996;8(6):459-76.

138. Pinder RM, Brogden RN, Speight TM, Avery GS. Doxepin up-to-date: a review of its pharmacological properties and therapeutic efficacy with particular reference to depression. Drugs 1977;13(3):161-218.

139. Zetin M, Hansen J. Rational antidepressant selection. Comprehensive Therapy 1994;20(4):209-23.

140. Varia I, Rauscher F. Treatment of generalized anxiety disorder with citalopram. International Clinical Psychopharmacology 2002;17(3):103-7.

141. Tollefson GD, Holman SL, Sayler ME, Potvin JH. Fluoxetine, placebo, and tricyclic antidepressants in major depression with and without anxious features. Journal of Clinical Psychiatry 1994;55 Suppl A(2):90-7; discussion 98-100.

142. Sheehan DV, Mao CG. Paroxetine treatment of generalized anxiety disorder. Psychopharmacology Bulletin 2003;37 Suppl 1:64-75.

143. Mendlewicz J, Lecrubier Y, Dunn RL. Antidepressant selection: proceedings from a TCA/SSRI Concensus Conference. Longitudinal patterns of antidepressant prescribing in primary care in the UK: comparison with treatment guidelines. Acta Psychiatrica Scandinavica, Supplementum 2000;403:5-8.

144. Zohar J, Westenberg HG. Anxiety disorders: a review of tricyclic antidepressants and selective serotonin reuptake inhibitors. Acta Psychiatrica Scandinavica, Supplementum 2000;403:39-49.

145. Krishnan KR, Helms MJ, Steffens DC. Are SSRIs better than TCAs? Comparison of SSRIs and TCAs: a meta-analysis. Depression & Anxiety 1997;6(1):10-8.

146. Masand PS, Gupta S. Selective serotonin-reuptake inhibitors: an update SSRI-induced sexual dysfunction treated with sildenafil. Harvard Review of Psychiatry 1999;7(2):69-84.

147. Stanko JR. Review of oral skeletal muscle relaxants for the craniomandibular disorder (CMD) practitioner. Cranio 1990;8(3):234-43.

148. Reeves RR, Pinkofsky HB, Carter OS. Carisoprodol: a drug of continuing abuse. Journal of the American Osteopathic Association 1997;97(12):723-4.

149. Reeves RR, Carter OS, Pinkofsky HB, Struve FA, Bennett DM. Carisoprodol (soma): abuse potential and physician unawareness. Journal of Addictive Diseases 1999;18(2):51-6.

150. Preston EJ, Miller CB, Herbertson RK. A double-blind, multicenter trial of methocarbamol (Robaxin™) and cyclobenzaprine (Flexeril™) in acute musculoskeletal conditions. Today's Ther Trends 1984;1(4):1-11.

151. Johns MW. Sleep and hypnotic drugs. Drugs 1975;9(6):448-78.

152. Hutchinson MA, Smith PF, Darlington CL. The behavioural and neuronal effects of the chronic administration of benzodiazepine anxiolytic and hypnotic drugs. Progress in Neurobiology 1996;49(1):73-97.

153. Weinberger J, Nicklas WJ, Berl S. Mechanism of action of anticonvulsants. Role of the differential effects on the active uptake of putative neurotransmitters. Neurology 1976;26(2):162-6.

154. Daderman AM, Fredriksson B, Kristiansson M, Nilsson LH, Lidberg L. Violent behavior, impulsive decision-making, and anterograde amnesia while intoxicated with flunitrazepam and alcohol or other drugs: a case study in forensic psychiatric patients. Journal of the American Academy of Psychiatry & the Law 2002;30(2):238-51.

155. Roberts T. Andrew Luster: Caught. CBSNews.com 2003 June 18, 2003.

156. Drover DR. Comparative pharmacokinetics and pharmacodynamics of short-acting hypnosedatives: zaleplon, zolpidem and zopiclone. Clinical Pharmacokinetics 2004;43(4):227-38.

157. Terzano MG, Rossi M, Palomba V, Smerieri A, Parrino L. New drugs for insomnia: comparative tolerability of zopiclone, zolpidem and zaleplon. Drug Safety 2003;26(4):261-82.

158. Roth T, Roehrs T, Koshorek G, Sicklesteel J, Zorick F. Sedative effects of antihistamines. Clinical Therapeutics 1997;19(1):39-55; discussion 2-3.

159. Carruthers SG, Shoeman DW, Hignite CE, Azarnoff DL. Correlation between plasma diphenhydramine level and sedative and antihistamine effects. Clinical Pharmacology & Therapeutics 1978;23(4):375-82.

160. Shih YC, Prasad M, Luce BR. The effect on social welfare of a switch of second-generation antihistamines from prescription to over-the-counter status: a microeconomic analysis. Clinical Therapeutics 2002;24(4):701-16.

161. Welch MJ, Meltzer EO, Simons FE. H1-antihistamines and the central nervous system. Clinical Allergy & Immunology 2002;17:337-88.

162. Mansfield L, Mendoza C, Flores J, Meeves SG. Effects of fexofenadine, diphenhydramine, and placebo on performance of the test of variables of attention (TOVA).[erratum appears in Ann Allergy Asthma Immunol. 2003 Aug;91(2):167]. Annals of Allergy, Asthma, & Immunology 2003;90(5):554-9.

163. Hirschowitz BI, Molina E. Anticholinergic potency of diphenhydramine (Benadryl) measured against bethanechol in the gastric fistula dog. Journal of Pharmacology & Experimental Therapeutics 1983;226(1):171-3.

164. Gowing L, Farrell M, Ali R, White J. Alpha2 adrenergic agonists for the management of opioid withdrawal.[update of Cochrane Database Syst Rev. 2001;(1):CD002024; PMID: 11279747]. Cochrane Database of Systematic Reviews 2003(2):CD002024.

165. Ryhanen P, Hanhela R, Jouppila R, Vuopala U. Circulatory changes during and after surgical anesthesia in hypertensive patients treated with clonidine, methyldopa and reserpine. International Surgery 1984;69(1):29-33.

166. Arenas-Lopez S RS, Tibby S, et.al. Use of oral clonidine for sedation in ventilated pediatric intensive care patients. Intensive Care Med 2004;30:1625-1629.

167. Galeotti N, Bartolini A, Ghelardini C. Alpha-2 agonists induce amnesia through activation of the Gi-protein signalling pathway. Neuroscience 2004;126(2):451-60.

168. Tariot PN, Newhouse PA, Broks P. Modelling dementia: effects of scopolamine on memory and attention. Brain Research 1988;472(4):371-89.

169. Preston GC, Traub M, Poppleton P, Ward C, Stahl SM, Yasuhara A. Epilepsy with continuous spike-waves during slow sleep and its treatment. Neuropsychologia 1988;26(5):685-700.

170. Yoshida H, Hatanaka T, Sugimoto T, Kobayashi Y, Dyken E, Willmore LJ. Divalproex and epilepsy. Epilepsia 1991;32(1):59-62.

171. Juhascik M, Le NL, Tomlinson K, Negrusz A, Moore C, Gaensslen RE. Development of an analytical approach to the specimens collected from victims of sexual assault. Journal of Analytical Toxicology 2004;28(6):400-06.

172. Ropero-Miller JD, Lambing MK, Winecker RE. Simultaneous quantitation of opioids in blood by GC-EI-MS analysis following deproteination, detautomerization of keto analytes, solid-phase extraction, and trimethylsilyl derivatization. Journal of Analytical Toxicology 2002;26(7):524-8.

173. Smith K. Drugs Used in Acquaintance Rape. Journal of the American Pharmaceutical Association 1999;39(3):519-525.

174. Hindmarch I, ElSohly MA, Gambles J, Salamone SJ. Forensic urinalysis of drug use in cases of sexual assault. Journal of Clinical Forensic Medicine 2001;8(4):197-205.

175. LeBeau M, A M, editors. Drug-Facilitated Sexual Assault. San Diego: Academic Press; 2001.

176. http://www.census.gov/.

177. Fendrich M., C. V. Diminished Lifetime Substance Use over Time: An Inquiry into Differential Underreporting. Public Opinion Q 1994;58(1):96-124.

178. http://quickfacts.census.gov/qfd/states/53/53061.html.

179. Kavanagh PV, Kenny P, Feely J. The urinary excretion of gamma-hydroxybutyric acid in man. Journal of Pharmacy & Pharmacology 2001;53(3):399-402.

180. http://www.city-data.com/city/Temple-Texas.html.

181. Jones RT. Pharmacokinetics of cocaine: considerations when assessing cocaine use by urinalysis. NIDA Research Monograph 1997;175:221-34.

182. Katz WA, Dube J. Cyclobenzaprine in the treatment of acute muscle spasm: review of a decade of clinical experience. Clinical Therapeutics 1988;10(2):216-28.

183. http://quickfacts.census.gov/qfd/states/27/27053.html.

184. Wahab S, Olson L. Intimate Partner Violence and Sexual Assault in Native American Communities. Trauma, Violence, & Abuse 2004;5(4):353-66.

185. Malcoe LH, Duran BM, Montgomery JM. Socioeconomic disparities in intimate partner violence against Native American women: a cross-sectional study. BMC Medicine 2004;2(1):1-14.

186. Furnari C, Ottaviano V, Sacchetti G, Mancini M. A fatal case of cocaine poisoning in a body packer. Journal of Forensic Sciences 2002;47(1):208-10.

187. http://quickfacts.census.gov/qfd/states/06/06073.html.

188. Strom K, Wong L, Fornnarino L, Eicheldinder C, Bethke A, Ancheta J, et al. The National Forensic Laboratory Information System: 2002 Annual Report. Washington, D.C.: U.S. Drug Enforcement Administration; 2003.

189. Strom K, Wong L, Fornnarino L, Eicheldinder C, Bethke A, Ancheta J, et al. The National Forensic Laboratory Information System: 2003 Annual Report. Washington, D.C.: U.S. Drug Enforcement Administration; 2004.

190. Fendrich M, Johnson TP, Wislar JS, Hubbell A, Spiehler V. The utility of drug testing in epidemiological research: results from a general population survey. Addiction 2004;99(2):197-208.

191. Hser YI, Maglione M, Boyle K. Validity of self-report of drug use among STD patients, ER patients, and arrestees. American Journal of Drug & Alcohol Abuse 1999;25(1):81-91.

192. Magura S, Goldsmith D, Casriel C, Goldstein PJ, Lipton DS. The validity of methadone clients' self-reported drug use. International Journal of the Addictions 1987;22(8):727-49.

193. Sherman MF, Bigelow GE. Validity of patients' self-reported drug use as a function of treatment status. Drug & Alcohol Dependence 1992;30(1):1-11.

194. Preston KL, Silverman K, Schuster CR, Cone EJ. Comparison of self-reported drug use with quantitative and qualitative urinalysis for assessment of drug use in treatment studies. NIDA Research Monograph 1997;167:130-45.

195. Cook RF, Bernstein AD, Andrews CM. Assessing drug use in the workplace: a comparison of self-report, urinalysis, and hair analysis. NIDA Research Monograph 1997;167:247-72.