SOFT-DFC Snapshot – Ethanol

By Elizabeth Fisher for the SOFT DFC Committee

SOFT-DFC Snapshots are short reports of critical information about the more common drugs associated with drug-facilitated crimes (DFCs). They are not complete literature reviews about the drug or drug class. One key aspect is their focus on the ability to detect a drug after a single-dose administration, as is often the situation in DFC investigations. As such, these summaries also point out instances in which available data is limited in the hopes that this will encourage further research studies. Finally, SOFT-DFC Snapshots point to the use of these drugs in actual DFC cases, as cited in the medical and open literature.

Ethanol presents as a clear, colorless, volitale liquid that acts as a central nervous system depressaent. It is the most commonly consumed drug behind caffeine.[1] Ethanol is the most prevalent finding reported in drug-facilitidated crimes either alone or in combination with other drugs. Its zero-order kinetics is helpful in making estimations of blood alcohol content during the post-absorption phase. These estimations can assist in DFC investigations, especially in cases of delayed reporting.

Drug Class:[4]	Central Nervous System Depressant (Sedative-Hypnotic)
Generic Name:	Ethyl Alcohol, Alcohol
Dosage Forms:	0.6 fluid ounces or 14 grams of pure ethanol (one standard drink)[2]
FDA Approval:	Ethanol is approved under Title 21 as a food that is generally considered safe for human consumption[3] and as an acceptable inactive ingredient in over-the-counter drug formulations as long as the specific volume contained is expressely stated. If it is to be taken orally and contains more than 5% ethanol it must include a warning for children under 12. If it is to be taken orally and contains more than 0.5% ethanol it must have a warning for children under 6.[4]
Metabolism/Elimination:	Ethanol is generally taken orally with approximately 20% being absorbed in the stomach and the rest through the small intestine. The amount absorbed through the stomach is determined by the rate of gastric emptying which is influenced by several factors including (but not limited to) the type of food in the stomach, drugs that influence gastric emptying, and type of alcohol consumed. The majority of ethanol is metabolized by oxidative pathways (alcohol dehydrogenase, catalase, cytochrome P450) forming the metabolite acetaldehyde. Acetaldehyde is metabolized by aldehyde dehydrogenase, ultimately ending as carbon dioxide and water.[5]

Single Dose Studies:

Urine:

The SOFT DFC Committee[6] and the AAFS Standards Board[7] have established the importance of testing urine samples from alleged victims of drug-facilitated crimes for ethanol, at a decision point concentration of 0.01 g/dL or lower. Urine is easily collected, straightforward to analyze, and provides a longer window of detection of ingestion compared to blood.

In one study, after consuming a moderate dose (0.54-0.85 g/kg) of ethanol, approximately 2% was still detectable in urine 7 hours post dose. The elimination rate of whole body clearance is approximately 7-8 g/hr.[8]

In an attempt at simulating real world situations, one study looked at samples collected after an evening of drinking by collecting at bedtime, the next morning and the next afternoon. The samples collected the next morning still had measurable levels of alcohol in the urine even though breath testing was negative. By later in the morning and into the afternoon, ethanol was no longer detected in the urine emphasizing the importance of quick collection.[9]

Ethanol Glucuronide may also be an analyte of interest due to its long elimination half-life of 2.5 hours extending the detection window of ethanol use by 15-25 hours. Some observations showed it detected as long as 80 hours.[11]

Blood/Plasma/Serum:

Blood, plasma, and serum specimens allow for more meaningful quantitative assessments of positive findings, but ethanol's detection window in blood is very dose dependant.

Elimination rates of ethanol can range from 0.010 – 0.020 g/100mL/hour for an average drinker and upto 0.025 – 0.035 g/100mL/hour for chronic drinkers. Differences in elimination curves have also been noted between genders.[12]

DFC Cases:

A 2021 study from New Zealand found in 161 submitted DFS samples, that 51 were positive for ethanol in the blood with a range of sampling times of 6 – 9 hours post incident. 76 were positive for ethanol in the urine with a range of sampling times of 6 – 19 hour post incident. Incident times were based on the victim's report of the incident.[10]

A 2012 study of victims seeking treatment after reported sexual assaults found that of the 264 patients, 155 tested positive for ethanol and/or drugs. Of the patients that reported within 12 hours (median time 4.4h), 102 were positive for ethanol at an average level of 0.187g/100mL at the

time of the incident as determined by back-calculation. Most victims reported a public place of assault or stranger assailant and 57 of those patients suspected proactive DFSA.[13]

A 2001 study reported on submitted samples from alleged sexual assault victims from across the United States. Of the 3303 samples, 73% were collected with 24h and 98.8% within 72h of incident. Of the 2026 samples that tested positive, ethanol was the most common drug found at a rate of 67%; either alone or in combination with other drugs. Ethanol alone was found in 895 of the samples.[14]

A study from London examining DFSA cases between January 2000 and December 2022, found that most positive cases contained ethanol (81%). Of the 1014 case submitted, 391 were collected within 12h of the incident. The majority of the cases were from alleged incidents originating in social situations involving alcohol. Of the 391 ethanol cases, 233 of those cases were back-extropolated to a level greater than 0.15 g/100mL at the time of the incident.[15]

A 2018 study of 1000 cases of alleged DFSA in the United States from March 2015 – June 2016 found that ethanol was present in 30.9% of the cases. The level of ethanol ranged from 0.0092 – 0.366 g/100mL. For cases with only urine, the BAC was calculated from UAC. Of the 155 cases submitted that contained blood and urine, only 65 found ethanol in both matrices.[16]

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