## K32 Houston Cocktail: Cases of Driving Under the Influence of Hydrocodone, Alprazolam, and Carisoprodol

*Dayong Lee, PhD*, Houston Forensic Science Center, Houston, TX 77002; Peter R. Stout, PhD, Houston Forensic Science Center, Houston, TX 77002*

**Learning Overview:** After attending this presentation, attendees will have learned about the prevalence, blood toxicological profile, and demographic distributions of apprehended drivers in Houston, TX, who tested positive concurrently for hydrocodone, alprazolam, and carisoprodol—a dangerous combination known as the "Houston Cocktail" or "Holy Trinity."

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by providing important regional information on the toxicological and demographic patterns of impaired driving cases in Houston that involved the specific combination of the opioid, benzodiazepine, and muscle relaxant. The long-term objective is to raise awareness and aid in implementing enforcement and prevention programs of the impaired driving cases involving the Houston Cocktail.

Concurrent use of opioids, benzodiazepines, and skeletal muscle relaxants potentiates the "high" drug effect and respiratory depression via interactions of μ-opioid and **Gamma-Aminobutryic Acid** ($GABA_A$) receptors.[1] In the early 2000s when abuse of prescription drugs began to spike, a potent combination including hydrocodone, alprazolam, and carisoprodol emerged that may give users heroin-like euphoria. *Houston Chronicle* reported more than 144,000 prescriptions for the three drugs in combination, while medically unwarranted, were dispensed in 2009 and almost 70% came from Harris County, where Houston is located.[2]

This research evaluated Driving While Intoxicated (DWI) or Driving Under the Influence of Drugs (DUID) cases that tested positive for hydrocodone, alprazolam, and carisoprodol, between 2015 and 2019; no cases in 2014 were tested positive for all three drugs. The blood samples were collected from drivers and submitted by the Houston Police Department (HPD). They were subsequently analyzed for alcohol and drugs by reference laboratories or the Houston Forensic Science Center (HFSC). Toxicological findings and demographic information, including age, sex, and race, were evaluated for the impaired driving cases, which tested positive for hydrocodone, alprazolam, and carisoprodol simultaneously in blood. The drugs were analyzed by gas chromatography/mass spectrometry or liquid chromatography/tandem mass spectrometry. The limits of detection were 5–20ng/mL for alprazolam and hydrocodone and 0.2 or 0.5μg/mL for carisoprodol, depending on the laboratories; carisoprodol and meprobamate in 12 cases analyzed by HFSC were reported qualitatively with the cutoff of 0.5μg/mL.

A total of 80 DWI/DUID cases positive for hydrocodone, alprazolam, and carisoprodol in blood were identified in which the traffic offense occurred between May 2015 and December 2019 (no positive cases in January–April 2015). The number of the Houston Cocktail cases increased from 9 in 2015 to 22 in 2019. However, because the total number of DWI/DUID cases also increased over the years, the proportion of the Houston Cocktail cases in the drug-positive DWI/DUID cases decreased from 3% in 2015 to 2% in 2019. Among the 80 Houston Cocktail cases, the mean (median, range) concentrations were 75 (61, 6.9–322) ng/mL for hydrocodone, 58 (48, 5.8–180) ng/mL for alprazolam, and 3.9 (3.0, 0.3–14; $n$=68) μg/mL for carisoprodol; 80 (100%) and 23 (29%) cases were also positive for meprobamate (mean 13; range 1.2–41μg/mL) and hydromorphone (1.8; 1.0–3.3ng/mL), respectively. Forty-six percent of those cases were female and 54% were male; 44% were Black, 46% were White, and 10% were other races as identified by the arresting officer. Mean (median) age of the drivers was 36 (34) years, ranged from 22 to 60 years. The majority (55%) were between 31–40 years of age; 23% between 22–30 years of age, 14% in the 41–50 years of age range, and 9% between 51–60 years of age. Twenty–three percent of the cases were positive for the Houston Cocktail only; 21% had one other drug/metabolite, 28% two, 18% had three, and 11% had four or more additional drugs/metabolites. Of the 80 cases, cannabinoids were the most frequently detected analytes (35%), followed by codeine (11%).

Between 2000 and 2009, the Texas Poison Center received 1,295 ingestion cases of the hydrocodone-alprazolam-carisoprodol combination, 34% of which came from Harris County.[3] The common adverse effects included drowsiness, slurred speech, tachycardia, confusion, respiratory depression, and coma.[3] The Houston Cocktail-positive drivers were distinguished from the general drug-positive drivers by a larger representation of females and younger users. The present study showed that despite a significant health risk, drivers in Houston continue to use this deadly drug combination. The risk is further exacerbated by the fact that most drivers had yet other drugs in their systems besides the three drugs.

**Reference(s):**

1. Horsfall and Sprague. The pharmacology and toxicology of the "Holy Trinity." *Basic Clin Pharmacol Toxicol*. 2017;120:115-119.
2. Olsen. Dangers of prescription drug abuse hit home. *Houston Chronicle*. July 18. 2010. https://www.chron.com/news/houston-texas/article/Dangers-of-prescription-drug-abuse-hit-home-1607219.php.
3. Forrester. Ingestions of hydrocodone, carisoprodol, and alprazolam in combination reported to Texas Poison Centers. *J Addict Dis*. 2011;30:110-115.

**Driving While Intoxicated, Houston Cocktail, Holy Trinity**