National Transportation Safety Board
Office of Research and Engineering
Washington, DC 20594

HWY23FH013

MEDICAL

Specialist's Factual Report

May 14, 2024

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A. CRASH

Location: Millersburg, Oregon
Date: May 18, 2023
Time: About 1445 local time

B. MEDICAL SPECIALIST

Specialist: Turan Kayagil, MD, FACEP
National Transportation Safety Board
Washington, DC

C. DETAILS OF THE INVESTIGATION

1.0 Purpose

This investigation was performed to evaluate the surviving 52-year-old male driver of the 2018 Freightliner truck-tractor (driver) for potentially impairing substances and potentially impairing medical conditions.

2.0 Methods

Records from the driver's most recent commercial motor vehicle (CMV) driver medical fitness examination were reviewed, comprising the Medical Examination Report Form and Medical Examiner's Certificate. Post-crash medical records, selected Oregon State Police (OSP) reports, and toxicology reports pertaining to the driver were also reviewed. Additionally, relevant regulation and medical literature were reviewed.

D. FACTUAL INFORMATION

1.0 Medical Certification

The driver's most recent CMV driver medical fitness examination before the crash was on July 29, 2021. At that time, he reported no medication use and no active medical conditions. The examiner found the driver to meet standards for 2-year medical certification and issued him a medical certificate without restrictions.

2.0 Post-Crash Medical Records

Following the crash, the driver was transported by emergency medical services to a hospital emergency department for evaluation and treatment. No issues requiring inpatient hospitalization were identified, and the driver was discharged the

day of the crash after a period of observation. Imaging studies performed to evaluate the driver's injuries did not identify evidence of significant natural disease. The driver underwent toxicological testing as part of his hospital evaluation; these results are discussed in section D.4.1.1 below. The driver's discharge diagnoses included polysubstance use disorder. According to hospital records, the driver did not report specifics regarding his substance use history.

3.0 Oregon State Police Reports

According to OSP reports, following the crash the driver initially denied drug use and declined to undergo field sobriety testing or a blood draw for law enforcement toxicological testing. However, he provided consent for police to search his clothing, and a small cylindrical object containing a white crystalline substance resembling methamphetamine was found in one of his pockets. The driver told police that the substance was "speed." When asked if this meant methamphetamine, the driver nodded in agreement. When asked if there was going to be methamphetamine in his blood, the driver answered, "probably." A judge subsequently granted a warrant for the driver's specimens. Law enforcement toxicological specimens were collected while the driver was in the emergency department, and hospital blood specimens were also secured for such testing. The results of law enforcement toxicology testing are discussed in section D.4.1.2 below.

Chemical testing by OSP confirmed the identity of the white crystalline substance as methamphetamine.[1]

4.0 Post-Crash Toxicology

4.1 Results

4.1.1 Hospital Toxicology

A hospital alcohol test performed on a plasma specimen collected at 1613 on the crash date did not detect alcohol.

A hospital urine drug screen performed on a specimen collected at 1736 on the crash date was presumptively positive for amphetamines, cocaine metabolites, and fentanyl. Quantitative testing of the urine specimen confirmed the presence of methamphetamine at more than 10,000 ng/mL, the methamphetamine metabolite amphetamine at more than 5,000 ng/mL, the cocaine metabolite benzoylecgonine at more than 1,000 ng/mL, fentanyl at 378.2 ng/mL, and the fentanyl metabolite norfentanyl at more than 1,000 ng/mL.[2] Additionally, the hospital urine specimen

[1] This chemical testing was performed using a portable Raman spectroscopy device.

[2] The quantitative report included the disclaimer "For medical purposes only; not valid for forensic use."

tested positive for a medication that had been administered to the driver after the crash, as confirmed by review of his post-crash medical records. Hospital records indicated that the driver had not been given fentanyl as part of his post-crash medical care.

4.1.2 Law Enforcement Toxicology

NMS Labs performed toxicological testing of four law enforcement blood specimens at the request of the OSP. The table lists results from this testing. Results are listed by specimen collection time on the date of the crash, as documented in the toxicology reports. All results are approximate values in units of nanograms per milliliter (ng/mL).

	@1611	@1651	@2037	@2116
methamphetamine	430	430	330	350
amphetamine	110	110	97	94
cocaine	-	17	-	-
benzoylecgonine	360	660	520	510
fentanyl	8.6	10	7.5	6.8
norfentanyl	4.8	4.4	4.5	4

Table: NMS Labs Toxicology Results (ng/mL) by Blood Collection Time

In addition to the results shown in the table, all four law enforcement blood specimens tested positive for a medication that was administered to the driver after the crash, as confirmed by review of post-crash medical records. All four specimens also screened positive for caffeine, without secondary testing to confirm this result.

The OSP Forensic Laboratory performed toxicological testing of a urine specimen that was collected from the driver at 2130 on the crash date. This testing detected methamphetamine (d-isomer) and its metabolite amphetamine, cocaine and its metabolites benzoylecgonine and ecgonine methyl ester, and fentanyl and its metabolite norfentanyl. Additional substances were detected that could be attributed to medications administered to the driver after the crash, as confirmed by review of post-crash medical records.

4.1.3 Department of Transportation Post-Accident Testing

The driver did not undergo United States Department of Transportation post-accident drug or alcohol testing.

4.2 Descriptions of Detected Substances

4.2.1 Methamphetamine and Amphetamine

Methamphetamine is a central nervous system stimulant drug. Amphetamine is a metabolite of methamphetamine and is also a central nervous system stimulant. Both methamphetamine and amphetamine are available as prescription medications used to treat attention deficit hyperactivity disorder, narcolepsy, and occasionally obesity; each may also be a metabolite of certain other medications. Methamphetamine and amphetamine are federal Schedule II controlled substances, with a high potential for abuse and dependence. At low doses used as part of appropriate medical treatment, the drugs may improve reaction time, cognitive function, and fatigue, but may cause people to make higher-risk choices. At higher doses, the drugs may have a variety of impairing effects on psychomotor function, cognition, and perception. The drugs typically carry warnings that they may impair the ability to engage in potentially hazardous activities. Such impairment can result from drug or withdrawal effects.[3,4,5]

In addition to being used medicinally, methamphetamine and amphetamine are frequently produced illicitly and abused recreationally by ingestion, snorting, smoking, rectal insertion, or injection. Seeking an intense euphoric effect, abusers typically use much higher doses than are used medicinally. Consequently, methamphetamine blood levels can sometimes be used to distinguish abuse from medicinal use. In living people, methamphetamine blood levels above 200 ng/mL generally represent abuse, whereas typical levels seen with medicinal use are between 20 ng/mL and 50 ng/mL. The typical elimination half-life of methamphetamine is about 6-15 hours.[3,6]

Methamphetamine and amphetamine abuse may impair driving performance at any stage from early drug effects through withdrawal. Attention, perception, judgment, and motor function may be adversely affected. Driving behaviors that have

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[3] Couper FJ, Logan BK. Drugs and Human Performance Fact Sheets. National Highway Traffic Safety Administration. DOT HS 809 725. April 2014 (Revised). https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/809725-drugshumanperformfs.pdf. Accessed May 13, 2024.

[4] National Institutes of Health National Library of Medicine. Methamphetamine hydrochloride. DailyMed. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=f31f580f-1f08-4a0f-b078-0b9e3308f712. Updated July 5, 2023. Accessed May 13, 2024.

[5] National Institutes of Health National Library of Medicine. Amphetamine sulfate. DailyMed. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=79b9db39-7cdc-5607-f0ce-ac2a2cfd59d5. Updated June 8, 2023. Accessed May 13, 2024.

[6] Schulz M, Schmoldt A, Andresen-Streichert H, Iwersen-Bergmann S. Revisited: therapeutic and toxic blood concentrations of more than 1,100 drugs and other xenobiotics. *Crit Care*. 2020;24(1):195. doi:10.1186/s13054-020-02915-5.

been observed in drivers impaired by effects of methamphetamine have included leaving the lane of travel, speeding, pulling into oncoming traffic, erratic driving, failing to stop when required, colliding with other vehicles, and running off the road.[3,7]

4.2.2 Cocaine, Benzoylecgonine, and Ecgonine Methyl Ester

Cocaine is a central nervous system stimulant drug that is commonly used illicitly by recreational users who may snort it, smoke it, inject it, ingest it, or apply it to gums or mucous membranes. Cocaine users may seek euphoric effects, feelings of increased alertness, strength, and decisiveness, and appetite suppressant effects. Cocaine is also occasionally used in healthcare settings as a topical agent to produce local anesthesia and vasoconstriction during ear, nose, and throat procedures. Cocaine is a federal Schedule II controlled substance, with a high potential for abuse and dependence. Benzoylecgonine and ecgonine methyl ester are inactive metabolites of cocaine.[3,8]

Impairing effects that occur early after recreational cocaine use may include dizziness, restlessness, poor impulse control, and increased risk taking. Attention, perception, coordination, decision making, and task execution may be impaired by effects of cocaine and cocaine withdrawal. Symptoms from crashing or withdrawing after stopping cocaine use may last for days to weeks. Cocaine has a myriad of physiological effects, ranging from stimulant effects during use to depressant effects during withdrawal. Behaviors observed in drivers who have used cocaine commonly include aggressive driving with speeding and loss of control. As cocaine effects wear off, sleepiness and inattention may adversely affect driving performance.[3]

Cocaine is metabolized with a typical elimination half-life of about 35 to 90 minutes (possibly longer in chronic heavy users), and the major inactive metabolite benzoylecgonine is eliminated from blood with a typical half-life of about 7.5 hours.[9] The concentration of cocaine measured in a person's blood does not directly predict that person's impairment, due to multiple factors. These factors include individual tolerance, the potential for adverse effects to persist even after cocaine has become undetectable, and the potential for cocaine to undergo breakdown in a specimen even after the specimen is collected.[3,10] After single recreational doses of cocaine,

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[7] Logan BK. Methamphetamine and driving impairment. *J Forensic Sci*. 1996;41(3):457-464.

[8] Drug Enforcement Administration. Cocaine. Drug Fact Sheets. https://www.dea.gov/factsheets/cocaine. Updated March 3, 2023. Accessed May 13, 2024.

[9] Moolchan ET, Cone EJ, Wstadik A, Huestis MA, Preston KL. Cocaine and metabolite elimination patterns in chronic cocaine users during cessation: plasma and saliva analysis. *J Anal Toxicol*. 2000;24(7):458-466. doi:10.1093/jat/24.7.458.

[10] Isenschmid DS, Levine BS, Caplan YH. A comprehensive study of the stability of cocaine and its metabolites. *J Anal Toxicol*. 1989;13(5):250-256. doi:10.1093/jat/13.5.250.

typical blood concentrations of cocaine are about 200-400 ng/mL; regular users may reach significantly higher concentrations.[3,11]

In one study, 734 drivers suspected of driving under the influence who tested positive for both cocaine and benzoylecgonine without other identified psychoactive substances had a median cocaine plasma concentration of 379 ng/mL with a range of 5-2,000 ng/mL, and a median benzoylecgonine plasma concentration of 682 ng/mL with a range of 5-2,000 ng/mL. In the same study, 691 drivers suspected of driving under the influence who tested positive for benzoylecgonine without cocaine or other identified psychoactive substances had a median benzoylecgonine plasma concentration of 128 ng/mL with a range of 8-1,168 ng/mL.[12] Plasma and blood concentrations of cocaine are about equivalent.

4.2.3 Fentanyl and Norfentanyl

Fentanyl is an opioid drug that has central nervous system depressant effects. It may be used medicinally as a powerful prescription painkiller, or illicitly by users seeking a euphoric effect. Fentanyl used medicinally may be administered by injection, as a skin patch, by mouth, under the tongue, inside the cheek, or as a nasal spray. Fentanyl used illicitly may be injected, snorted, smoked, ingested, or taken under the tongue or inside the cheek. Illicit fentanyl may be sold alone or may be an adulterant in other illicit drugs. Fentanyl is a federal Schedule II controlled substance, with a high potential for abuse and dependence. Norfentanyl is an inactive metabolite of fentanyl.[13]

Fentanyl can cause drowsiness, confusion, and dizziness. Fentanyl medication typically carries a warning that it may impair the mental or physical abilities required for the performance of potentially dangerous activities.[13,14] Fentanyl may cause significant cognitive and psychomotor impairment even in the absence of marked sedation.[15]

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[11] Baselt RC. *Disposition of Toxic Drugs and Chemicals in Man*. 11th ed. Biomedical Publications; 2017.

[12] Musshoff F, Madea B. Cocaine and benzoylecgonine concentrations in fluorinated plasma samples of drivers under suspicion of driving under influence. *Forensic Sci Int*. 2010;200(1-3):67-72. doi:10.1016/j.forsciint.2010.03.032.

[13] Drug Enforcement Administration. Fentanyl. Drug Fact Sheets. https://www.dea.gov/factsheets/fentanyl. Updated October 2, 2023. Accessed May 13, 2024.

[14] National Institutes of Health National Library of Medicine. Actiq. DailyMed. https://dailymed.nlm.nih.gov/dailymed/druglnfo.cfm?setid=90b94524-f913-48b3-3771-7b2fcffd888a. Updated December 18, 2023. Accessed May 13, 2024.

[15] Schneider U, Bevilacqua C, Jacobs R, et al. Effects of fentanyl and low doses of alcohol on neuropsychological performance in healthy subjects. *Neuropsychobiology*. 1999;39(1):38-43. doi:10.1159/000026558.

Typical fentanyl blood levels associated with medicinal treatment vary significantly and have significant overlap with potentially toxic levels, depending on factors such as individual tolerance. The elimination half-life of fentanyl is also variable, with a potential for the drug to rapidly redistribute to tissue, and to accumulate and be gradually released back into blood over time.[6,11,16] In one study, 20 drivers suspected of driving under the influence who tested positive for fentanyl without other identified drug use had a median fentanyl blood concentration of 3.7 ng/mL with a range of 2-16 ng/mL. Observed driving behaviors in these individuals included erratic driving, departing the roadway, and striking other vehicles.[16]

4.2.4 Caffeine

Caffeine is a central nervous system stimulant that is commonly ingested, including in coffee, tea, soft drinks, and chocolate; it is also an ingredient in certain anti-drowsiness medications and headache medications.[17,18] Caffeine is not generally considered impairing. However, it may be a potentiating ingredient in some illicit preparations of stimulant drugs including methamphetamine and cocaine.[19]

E. SUMMARY OF MEDICAL FACTS

The driver's most recent commercial motor vehicle (CMV) driver medical fitness examination before the crash was on July 29, 2021. At that time, he reported no medication use and no active medical conditions. He was issued a 2-year medical certificate without restrictions.

Following the crash, the driver was evaluated in a hospital emergency department. No issues requiring inpatient hospitalization were identified. Imaging studies performed to evaluate the driver's injuries did not identify evidence of significant natural disease.

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[16] Rohrig TP, Nash E, Osawa KA, et al. Fentanyl and driving impairment. *J Anal Toxicol*. 2021;45(4):389-396. doi:10.1093/jat/bkaa105.

[17] National Institutes of Health National Library of Medicine. NoDoz Alertness Aid. DailyMed. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=e700e809-29b5-799e-e053-2a95a90a235c. Updated December 15, 2023. Accessed May 13, 2024.

[18] National Institutes of Health National Library of Medicine. Fioricet. DailyMed. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=c018be7d-f7b8-45e2-97b8-8e7a71740657. Updated January 1, 2021. Accessed May 13, 2024.

[19] Scorza C, Prieto JP, Fabius S. Caffeine as an active adulterant: implication for drugs of abuse consumption. In: Patel VB, Preedy VR, eds. *Handbook of Substance Misuse and Addictions*. Springer; 2022:1-12. https://doi.org/10.1007/978-3-030-92392-1_82.

A hospital alcohol test performed on a plasma specimen collected at 1613 on the crash date did not detect alcohol. A hospital urine drug screen performed on a specimen collected at 1736 on the crash date was presumptively positive for amphetamines, cocaine metabolites, and fentanyl. Quantitative testing of the urine specimen confirmed the presence of methamphetamine at more than 10,000 ng/mL, the methamphetamine metabolite amphetamine at more than 5,000 ng/mL, the cocaine metabolite benzoylecgonine at more than 1,000 ng/mL, fentanyl at 378.2 ng/mL, and the fentanyl metabolite norfentanyl at more than 1,000 ng/mL.

NMS Labs performed toxicological testing of four blood specimens at the request of the Oregon State Police (OSP). The specimens were collected at 1611, 1651, 2037, and 2116 on the crash date. In order of specimen collection time, methamphetamine was detected at 430 ng/mL, 430 ng/mL, 330 ng/mL, and 350 ng/mL. Amphetamine was detected at 110 ng/mL, 110 ng/mL, 97 ng/mL, and 94 ng/mL. Benzoylecgonine was detected at 360 ng/mL, 660 ng/mL, 520 ng/mL, and 510 ng/mL. Fentanyl was detected at 8.6 ng/mL, 10 ng/mL, 7.5 ng/mL, and 6.8 ng/mL. Norfentanyl was detected at 4.8 ng/mL, 4.4 ng/mL, 4.5 ng/mL, and 4 ng/mL. Cocaine was detected in the specimen collected at 1651 only, at 17 ng/mL.

The OSP Forensic Laboratory performed toxicological testing of a urine specimen that was collected from the driver at 2130 on the crash date. This testing detected methamphetamine (d-isomer) and its metabolite amphetamine, cocaine and its metabolites benzoylecgonine and ecgonine methyl ester, and fentanyl and its metabolite norfentanyl.

Additionally, the driver's post-crash toxicology testing identified medications that had been administered to the driver after the crash, and presumptively identified caffeine. Hospital records indicated that fentanyl was not administered to the driver after the crash.

The driver did not undergo United States Department of Transportation post-accident drug or alcohol testing. According to OSP reports, methamphetamine was found in a pocket of the driver's clothing following the crash; the identity of the substance was confirmed by chemical testing.

Submitted by:

Turan Kayagil, MD, FACEP
Medical Officer