NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Washington, DC

Medical Factual Report

May 31, 2022

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Medical Officer

A. ACCIDENT INFORMATION

Identification: RRD21LR015
Location: San Francisco, California
Date: September 13, 2021 (approximately 15:15 local time)

B. GROUP IDENTIFICATION

No group was formed for the medical evaluation in this accident.

C. DETAILS OF INVESTIGATION

1. Purpose

This investigation was performed to evaluate the train operator and involved passenger for potentially impairing medical conditions and substance use.

2. Methods

Records from the train operator's pre-employment physical evaluation were reviewed, as were reports from his United States Department of Transportation (DOT) post-accident drug and alcohol testing. The involved passenger's autopsy report was reviewed, including associated postmortem toxicology results. Selected investigator reports and relevant regulation and medical literature were also reviewed.

3. Findings

a. Train Operator

I. Pre-Employment Physical Examination

According to records provided by his employer, the 56-year-old male train operator underwent a pre-employment physical evaluation on June 25, 2019. That evaluation included a Federal Motor Carrier Safety Administration commercial driver physical qualification examination, plus

audiometry and additional vision screening.[1] According to records from that evaluation, the train operator was found to have acceptable acuity of his distance vision without corrective lenses.[2] No significant issues were identified, and he was found to be physically qualified to work without limitations or restrictions.[3]

II. DOT Post-Accident Drug and Alcohol Testing

DOT urine drug testing was performed on a urine sample collected from the train operator at 17:25 on the accident date. No tested-for substances were identified.[4] The train operator underwent DOT alcohol breath testing at 17:20 on the accident date, with a negative result.

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b. Involved Passenger

I. Autopsy

The 41-year-old female passenger's autopsy was performed by the City and County of San Francisco Office of the Chief Medical Examiner. According to the autopsy report, the cause of death was multiple blunt force injuries, and the manner of death was accident. The autopsy did not identify significant natural disease.

II. Toxicology

The City and County of San Francisco Office of the Chief Medical Examiner performed toxicological testing of postmortem specimens from the passenger.

Methamphetamine was measured at 1,109 ng/mL in peripheral blood and was also detected in urine. Amphetamine was measured at 97 ng/mL in peripheral blood and was also detected in urine. Ephedrine /

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[1] The components of the commercial driver physical qualification examination are specified at 49 Code of Federal Regulations § 391.43(f). The additional vision screening comprised Ishihara color vision testing and occupational Titmus vision screening.

[2] The train operator's visual acuity was documented in his commercial driver physical qualification exam to be 20/30 in the right eye, 20/20 in the left eye, and 20/20 in both eyes, without the use of corrective lenses. Those measurements were the same as the equivalent measurements documented from Titmus screening of simulated day distance vision. Titmus screening of simulated night distance vision measured visual acuities equivalent to 20/30 in the right eye, left eye, and both eyes. For comparison, normal visual acuity is 20/20. A person with 20/30 vision needs to be within 20 feet to discern the same characters that a person with normal vision can see at 30 feet. There are no federal vision standards for transit train operators. Commercial motor vehicle drivers and locomotive engineers are generally required to have 20/40 visual acuity or better in each eye.

[3] He was also issued a commercial driver medical certificate, without restrictions. The certificate had an expiration date of June 25, 2021. He was not required to maintain commercial driver medical certification for his job.

[4] Tested-for substances on DOT urine drug testing are marijuana metabolites, cocaine metabolites, amphetamines, opioids, and phencyclidine (PCP), in accordance with 49 Code of Federal Regulations § 40.85, as detailed in 49 Code of Federal Regulations § 40.87.

pseudoephedrine and norephedrine / norpseudoephedrine were detected in urine, but not in peripheral blood.[5]

Cocaine was measured at 17 ng/mL in peripheral blood and was also detected in urine. The cocaine metabolite benzoylecgonine was measured at 129 ng/mL in peripheral blood and was also detected in urine. The cocaine metabolites norcocaine and meta-/para-hydroxycocaine were detected in urine, but not in peripheral blood.[6]

Fentanyl was measured at 82 ng/mL in peripheral blood and was also detected in urine. The fentanyl metabolite norfentanyl was measured at 23 ng/mL in peripheral blood and was also detected in urine.

III. Descriptions of Detected Substances

Methamphetamine is a central nervous system (CNS) stimulant drug. Amphetamine is a metabolite of methamphetamine, and is also a CNS 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 Drug Enforcement Administration (DEA) 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.[7,8,9]

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[5] The toxicology report did not distinguish between ephedrine and pseudoephedrine or between norephedrine and norpseudoephedrine. The threshold for reporting ephedrine / pseudoephedrine in peripheral blood was 2.5 ng/mL. The threshold for reporting norephedrine / norpseudoephedrine in peripheral blood was 2.5 ng/mL.

[6] The toxicology report did not distinguish between meta- and para-hydroxycocaine. The threshold for reporting norcocaine in peripheral blood was 2.5 ng/mL. The threshold for reporting meta-/para-hydroxycocaine in peripheral blood was 1 ng/mL.

[7] 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 3, 2022.

[8] 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 April 15, 2022. Accessed May 3, 2022.

[9] 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 March 1, 2020. Accessed May 3, 2022.

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 (there is no evidence that levels above this improve task performance), whereas typical levels seen with medicinal use are between 20 ng/mL and 50 ng/mL.[7]

Effects from methamphetamine/amphetamine abuse follow a typical pattern. An abuser may experience early psychological effects including euphoria, excitation, exhilaration, rapid ideas and speech, increased sex drive, restlessness, hallucinations, delusions, psychosis, sleeplessness/reduced tiredness, an increased feeling of alertness, a heightened sense of wellbeing, a feeling of increased physical strength, and poor impulse control. Early physiologic effects may include rapid heart rate, increased blood pressure, increased breathing rate, elevated temperature, dry mouth, abdominal cramps, twitching, dilated pupils, faster reactions, and increased strength. Later, as initial drug effects wear off, an abuser may experience dysphoria, restlessness, agitation, itching, nervousness, paranoia/hypervigilance, irritability, anxiety/nervousness, aggressive/violent impulses, diminished coordination, hallucinations, delusions, scattered thoughts, psychosis, fatigue, and drug craving. Measuring an abuser's drug level does not help distinguish whether the person is experiencing early versus late effects.[7]

Ephedrine and pseudoephedrine were not distinguished from one another by the toxicology results. Ephedrine may be used to help relieve wheezing and nasal congestion, and is a component of some asthma medications.[10] Pseudoephedrine, sometimes marketed as Sudafed, may be used as a nasal decongestant; it is widely available in a variety of cold and allergy medications.[11] In the United States, medications containing ephedrine and pseudoephedrine are commonly sold "behind the counter" with no requirement for a prescription.[12] Pseudoephedrine is generally not

[10] National Institutes of Health National Library of Medicine. Ephedrine hydrochloride. DailyMed. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=bcb81dc1-d854-30c0-e053-2a95a90a9fc7. Updated March 23, 2022. Accessed May 3, 2022.

[11] National Institutes of Health National Library of Medicine. Sudafed Sinus Congestion. DailyMed. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=c05d7e27-6821-468f-b27d-9c0b02a07b0f. Updated January 18, 2022. Accessed May 3, 2022.

[12] Food and Drug Administration. Legal requirements for the sale and purchase of drug products containing pseudoephedrine, ephedrine, and phenylpropanolamine. Food and Drug Administration website. https://www.fda.gov/drugs/information-drug-class/legal-requirements-sale-and-purchase-drug-products-containing-pseudoephedrine-ephedrine-and. Updated November 24, 2017. Accessed May 3, 2022.

considered impairing, and ephedrine is not typically impairing at the low levels associated with appropriate medicinal use. However, both ephedrine and pseudoephedrine are common starting chemicals for illicit methamphetamine production.[13]

Norephedrine and norpseudoephedrine also were not distinguished from one another by the toxicology results. Norephedrine is a metabolite of ephedrine, and a minor metabolite of amphetamine. Norpseudoephedrine is a metabolite of pseudoephedrine. Norephedrine and norpseudoephedrine are also the isomeric components of phenylpropanolamine, a drug that can be used for nasal decongestion and weight loss, but that is no longer marketed in the United States for human use.[14] Phenylpropanolamine can be used in illicit drug production to make amphetamine and may be present as an adulterant in a variety of illicit drugs.[7,15]

Cocaine is a CNS 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 / mucous membranes. 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 DEA Schedule II controlled substance, with a high potential for abuse and dependence.[7,16]

Impairing effects that occur early after recreational cocaine use may include dizziness, restlessness, poor impulse control, and increased risk taking. Higher doses may produce confusion, delusions, and hallucinations. The onset of effects is typically within seconds of use by most routes, and within an hour of use by ingestion. The duration of early effects depends on route of use and dose, and may last minutes to a couple of hours. As early effects wear off, late effects begin. These may last hours to days and may include low mood, agitation, exhaustion, sleeplessness, inattention, and drug craving. With abstinence after chronic use, withdrawal effects may last weeks, and may include mood and anxiety problems, disorientation, and fatigue. Attention, perception, coordination,

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[13] Vearrier D, Greenberg MI, Miller SN, Okaneku JT, Haggerty DA. Methamphetamine: history, pathophysiology, adverse health effects, current trends, and hazards associated with the clandestine manufacture of methamphetamine. *Dis Mon*. 2012;58(2):38-89. doi:10.1016/j.disamonth.2011.09.004.

[14] Food and Drug Administration. Phenylpropanolamine (PPA) information page. Food and Drug Administration website. https://www.fda.gov/drugs/information-drug-class/phenylpropanolamine-ppa-information-page. Updated October 14, 2016. Accessed May 3, 2022.

[15] Drug Enforcement Administration. Notice - phenylpropanolamine can be used in illicit amphetamine manufacture. Diversion Control Division. https://www.deadiversion.usdoj.gov/chem_prog/advisories/ppa.htm. Updated December 1, 2011. Accessed May 3, 2022.

[16] Drug Enforcement Administration. Cocaine. Drug Fact Sheets. https://www.dea.gov/factsheets/cocaine. Updated June 15, 2020. Accessed May 3, 2022.

decision making, and task execution may be impaired by effects of cocaine and cocaine withdrawal. A cocaine level measured in blood does not reliably predict the degree or nature of related impairment. This is due to multiple variables, including an individual's developed cocaine tolerance and specimen-related artifacts (which in the postmortem setting may include cocaine redistribution and spontaneous degradation). Adverse effects after prolonged cocaine use have been reported even with no measurable cocaine remaining in blood.[7,17]

Benzoylecgonine is a major inactive metabolite of cocaine.[7] Meta- and para-hydroxycocaine are other cocaine metabolites.

Fentanyl is an opioid drug that has CNS 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 in combination with other drugs including methamphetamine and cocaine. Fentanyl is a DEA Schedule II controlled substance, with a high potential for abuse and dependence. It 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.[18,19]

Norfentanyl is a major inactive metabolite of fentanyl.[20] Norfentanyl is also commonly used as an ingredient in illicit fentanyl production.[21]

D. SUMMARY OF MEDICAL FINDINGS

1. Train Operator

   The 56-year-old male train operator underwent a pre-employment physical evaluation on June 25, 2019. That evaluation included a Federal Motor Carrier Safety Administration commercial driver physical qualification examination, plus

[17] Logan BK, Smirnow D, Gullberg RG. Lack of predictable site-dependent differences and time-dependent changes in postmortem concentrations of cocaine, benzoylecgonine, and cocaethylene in humans. *J Anal Toxicol*. 1997;21(1):23-31. doi:10.1093/jat/21.1.23.

[18] Drug Enforcement Administration. Fentanyl. Drug Fact Sheets. https://www.dea.gov/factsheets/fentanyl. Updated July 21, 2020. Accessed May 3, 2022.

[19] National Institutes of Health National Library of Medicine. Duragesic. DailyMed. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=4c3a6171-19e4-40c2-83f3-fb54d4736e4b. Updated April 8, 2022. Accessed May 3, 2022.

[20] Smith HS. Opioid metabolism. *Mayo Clin Proc*. 2009;84(7):613-624. doi:10.1016/S0025-6196(11)60750-7.

[21] Drug Enforcement Administration. Control of the immediate precursor norfentanyl used in the illicit manufacture of fentanyl as a schedule II controlled substance. *Fed Regist*. 2020;85(75):21320-21325.

audiometry and additional vision screening. No significant issues were identified, and he was found to be physically qualified to work without limitations or restrictions.

United States Department of Transportation (DOT) post-accident drug and alcohol testing of the train operator did not identify any tested-for substances.

2. Involved Passenger

According to the 41-year-old female passenger's autopsy report, her cause of death was multiple blunt force injuries. Her autopsy did not identify significant natural disease.

The passenger's postmortem toxicological testing identified multiple substances. Methamphetamine was measured at 1,109 ng/mL in peripheral blood and was detected in urine. Amphetamine was measured at 97 ng/mL in peripheral blood and was detected in urine. Ephedrine / pseudoephedrine and norephedrine / norpseudoephedrine were detected in urine. Cocaine was measured at 17 ng/mL in peripheral blood and was detected in urine. The cocaine metabolite benzoylecgonine was measured at 129 ng/mL in peripheral blood and was detected in urine. The cocaine metabolites norcocaine and meta-/para-hydroxycocaine were detected in urine. Fentanyl was measured at 82 ng/mL in peripheral blood and was detected in urine. The fentanyl metabolite norfentanyl was measured at 23 ng/mL in peripheral blood and was detected in urine.