MEDICAL FACTUAL REPORT

Concan, Texas

HWY17MH011

Report Date: August 9, 2018

(12 pages)

NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF RESEARCH AND ENGINEERING
WASHINGTON, D.C.

MEDICAL FACTUAL REPORT

A. CRASH INFORMATION

Location:	U.S. Highway 83 (US-83) in Uvalde County, near Concan, Texas
Vehicle 1:	2007 Dodge Ram pickup truck
Operator:	Private operator
Vehicle 2:	2004 Ford E350 cutaway chassis with a 13-passenger Turtle Top Vanterra medium-size bus body
Operator:	First Baptist Church of New Braunfels.
Date:	Wednesday, March 29, 2017
Time:	Approximately 12:20 p.m. (local time)
NTSB #:	**HWY17MH011**

B. GROUP IDENTIFICATION

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

C. CRASH SUMMARY

For a summary of the crash, refer to the *Crash Summary Report* in the docket for this investigation.

D. RELEVANT STATUTE AND REGULATION

According to Title 21 USC 812, marijuana is a potent central nervous system (CNS) depressant listed as a Schedule I controlled substance.[1] As of May 2017, Texas did not allow the use of medical marijuana or recreational marijuana but was considering legislature to allow the use of medical marijuana. However, as of August 2017, 29 states, the District of Columbia, Guam, and Puerto Rico allow the use of medical marijuana and 8 states and the District of Columbia have legislation allowing retail sales (although not all of these states have completed systems to enable such sales).[2] Unlike alcohol, there are no established drug levels relating an amount of marijuana in a driver's blood to impairment. According to the Governor's Highway Safety Association, as of August 2017, 9 states have zero tolerance traffic laws for non-commercial drivers with findings of tetrahydrocannabinol (THC, the active component in marijuana) or a metabolite; 3 states have zero tolerance traffic laws for THC but no restriction on metabolites; 5 states have specific per se limits indicating impairment while driving for THC (ranging from 1ng/ml to 5 ng/ml), and 1 state (Colorado) has a reasonable inference law for THC set at 5 ng/ml.[3] Texas has no current statute regarding the level of THC that indicates impairment for non-commercial drivers but Texas Penal Code, Title 10, Chapter 49 defines intoxicated as "not having the normal use of mental or physical

[1] U.S. Department of Justice, Drug Enforcement Administration, Office of Diversion Control, http://www.deadiversion.usdoj.gov/21cfr/21usc/812.htm Accessed 8/24/2017.
[2] National Conference of State Legislatures. State Medical Marijuana Laws (08/02/2017) http://www.ncsl.org/research/health/state-medical-marijuana-laws.aspx Accessed 08/24/2017.
[3] Governors Highway Safety Association, Drug Impaired Driving Issues. http://www.ghsa.org/state-laws/issues/Drug-Impaired-Driving Accessed 08/24/2017

faculties by reason of the introduction of alcohol, a controlled substance, a drug, a dangerous drug, a combination of two or more of those substances, or any other substance into the body; or having an alcohol concentration of 0.08 or more." Additionally, Sec. 49.04. Driving While Intoxicated. states "A person commits an offense if the person is intoxicated while operating a motor vehicle in a public place."[4]

E. DETAILS OF THE INVESTIGATION

1. Purpose of Study

This investigation was performed to evaluate the two drivers involved in this accident for any medical conditions, the use of any medications/illicit drugs, and the presence of any toxins.

2. Methods

The following records were reviewed: the church bus driver's Federal Motor Carrier Safety Administration (FMCSA) Commercial Driver's License (CDL) examinations, personal medical records, autopsy, and toxicology reports. The pickup truck driver's ambulance transport report, emergency treatment records, primary care provider records, Texas State Troopers postaccident toxicology report, FAA Bioaeronautical Sciences Research Laboratory toxicology report.

3. Bus Driver - Fatal Injuries

3.1. Personal Medical Records

3.1.1. Primary Care Medical Records

Records from the bus driver's primary care providers from July 2013 through February 2017 were reviewed. The 66-year-old male driver's current medical conditions included type II diabetes treated with oral medication since 2014, high blood pressure, kidney disease, elevated cholesterol, gout, and neck pain (dates of diagnosis were not located). The bus driver's active medical conditions and medications as documented by his primary care provider are listed in Table 1.

Table 1. Bus Driver's Active Medical Conditions and Treatment.

Medical Condition	Treatment*
Diabetes	Metformin - oral glucose lowering medication
High blood pressure / Kidney disease	Lisinopril - blood pressure medication
	Carvedilol - blood pressure medication
	Nifedipine - blood pressure medication
	Chlorthalidone - diuretic
	Spironolactone - diuretic
High cholesterol	Simvastatin - cholesterol lowering medication
Gout	Allopurinol - reduces uric acid
	Indomethacin - anti-inflammatory medication

* These medications are generally not considered impairing

[4] Texas Penal Code. Title 10. Offenses Against Public Health, Safety, and Morals Chapter 49. Intoxication and Alcoholic Beverage Offenses http://www.statutes.legis.state.tx.us/Docs/PE/htm/PE.49.htm Accessed 08/24/2017.

According to the bus driver's most recent routine medical examination, dated February 17, 2017, he was 6 feet tall, weighed 252 pounds, and had a body mass index (BMI) of 34.2 kg/M^2.[5] His documented medical conditions (listed in Table 1 above) were treated and controlled with diet, exercise, and oral medications. This exam documented normal cardiovascular, respiratory and neurological examinations with no focal neurological deficits. Additionally, a February 13, 2017 laboratory report documented his hemoglobin A1C of 6.6 percent.[6] Primary care records did not include information about obstructive sleep apnea (OSA) or the driver's use of continuous positive airway pressure (CPAP).[7,8]

3.1.2. Military Treatment Facility Medical Records

Records regarding the bus driver obtained from a military treatment facility ranging from July 2013 to November 18, 2016 were reviewed. On July 29, 2013, the bus driver was evaluated for fatigue. At that time, he had an Epworth sleepiness scale score of 20 out of 24; scores of 16-24 indicate severe excessive daytime sleepiness.[9,10] He then underwent home polysomnography (a sleep study) which documented an AHI of 22.7, indicating moderate obstructive sleep apnea (OSA).[11] He was prescribed continuous CPAP as treatment. Records from 2015 documented the driver was no longer using CPAP but did not contain further information about his level of fatigue or the ongoing need to use CPAP. There is no documentation that his OSA had resolved and untreated OSA was documented as one of his medical issues during his last documented visit to the military treatment facility to evaluate stable kidney disease on November 18, 2016.

3.2. CDL Medical Examinations

The investigation reviewed four annual FMCSA CDL long form medical examination documents dated from 2014 to February 1, 2017. The 2017 examination documented the bus driver's height as 5 feet 11 inches and weight as 250 pounds. Although the examiner

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[5] A body mass index of 30 or above is considered obese. People who are obese have a large amount of body fat for their height and are it higher risk for many diseases including: heart disease, high blood pressure, type II diabetes, and sleep apnea. https://www.nhlbi.nih.gov/health/educational/lose_wt/bmitools.htm Accessed 08/24/2017

[6] Hemoglobin AIC is a measure of the percentage of hemoglobin molecules that have a glucose molecule attached to them (what percentage have been glycosylated). It is used as a measure of average blood glucose over the preceding several weeks. Non-diabetic levels are below 5.4%. Between 5/5 and 6.4% is considered "pre-diabetes" and above 6.5% indicates diabetes. For diabetic individuals, levels below 7.0% are considered "good control."

[7] Obstructive sleep apnea (OSA) is a chronic disease in which patients experience episodes of airway obstruction while sleeping. During each episode, the person stops breathing for a period of time which causes oxygen levels to drop and carbon dioxide levels to rise. When the buildup of carbon dioxide gets too high, the brain detects it and the person arouses or awakens in order to breathe. The end result is fragmented sleep.

[8] Positive airway pressure treatment PAP including Continuous CPAP, Bilevel BiPAP and Automatic adjusting(APAP) is treatment for OSA that uses a machine to generate positive air pressure that is delivered though a mask the covers the nose or nose and mouth to keep the airways open during sleep.

[9] The Epworth sleepiness scale is a subjective measure of the potential to fall asleep. It is administered as a questionnaire. Generally, a score of 10 or higher is considered an excessive amount of sleepiness depending on the situation.

[10] Johns MW. Reliability and Factor Analysis of the Epworth Sleepiness Scale, Sleep, 15(4):376-381

[11] An apneic episode is the complete absence of airflow though the mouth and nose for at least 10 seconds. A hypopnea episode is when airflow decreases by 50 percent for at least 10 seconds or decreases by 30 percent if there is an associated decrease in the oxygen saturation or an arousal from sleep. The apnea-hypopnea index (AHI) sums the frequency of both types of episodes per hour. An AHI of less than 5 is considered normal. An AHI of 5-15 is mild; 15-30 is moderate and more than 30 events per hour is considered severe sleep apnea.

did not calculate a BMI, this correlates to a calculated body mass index (BMI) of 34.9 kg/m^2.[12] The driver's reported medications included the blood pressure medications carvedilol, lisinopril, and nifedipine; the cholesterol medication simvastatin, and the uric acid lowering medication febuxostat. Because of controlled high blood pressure, the examining certified medical examiner, a chiropractor, limited the driver's certification to one year.[13] On this exam and each of the preceding exams, the bus driver reported only a history of high blood pressure and did not report kidney disease, dialysis, diabetes or elevated blood sugar, or sleep disorders, pauses in breathing while asleep, daytime sleepiness, or loud snoring. At no time did the bus driver indicate he was using metformin or his use of CPAP.

3.3. Interview with Wife

According to an interview with the driver's wife, the bus driver did not usually awaken in the middle of the night. He did use an alarm to wake up. He did snore. He took part in a sleep study and it was recommended that he use a CPAP.[14] However, he was not comfortable using it.

3.4. Autopsy

The autopsy conducted by the Bexar County Medical Examiner's Office identified multiple blunt force injuries and the Uvalde County Justice of the Peace determined the cause of death was blunt force trauma to head and body and the manner was accident. No significant natural disease was documented.

3.5. Toxicology

Forensic toxicological testing conducted by Bexar County Medical Examiner's Laboratory as part of the autopsy detected ibuprofen at levels below the limit of quantitation. Ibuprofen is an over-the-counter and prescription non-sedating pain and fever control medications also known as Motrin.[15]

Forensic toxicological testing conducted by the Bioaeronautical Sciences Research Laboratory did not detect ethanol in the vitreous or carbon monoxide in the blood.[16] Testing detected chlorthalidone in the blood and liver and ibuprofen in the blood. Chlorthalidone is a non-sedating prescription diuretic that had been prescribed to the driver as treatment

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[12] National Institute of Health, National Heart, Lung and Blood Institute BMI Calculator. https://www.nhlbi.nih.gov/health/educational/lose_wt/BMI/bmicalc.htm Accessed 08/24/2017

[13] 49 CFR Part 391.41(b)(6) - Hypertension - Stage 1 hypertension corresponds to a systolic blood pressure of 140-159 mmHg and/or a diastolic blood pressure of 90-99 mmHg. The driver with a blood pressure in this range is at low risk for hypertension-related acute incapacitation and may be medically certified to drive for a one-year period.

[14] The investigation was unable to re-interview the bus driver's wife to obtain additional information about CPAP or bus driver fatigue due to her death 2 weeks after the accident.

[15] National Institute of Health, U.S. Library of Medicine *DailyMed* 2017. MOTRIN IB- ibuprofen tablet. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=5bca517f-94a5-428c-b716-80c6b0b86980 Accessed 08/24/2017

[16] Specimens are analyzed using immunoassay, chromatography, GC/MS, HPLC/MS, or GC/FTIR. Concentrations (ug/mL) at or above those in () can be determined for, but not limited to, the following drugs: amphetamines (0.010), opiates (0.010), marihuana (0.001), cocaine (0.020), phencyclidine (0.002), benzodiazepines (0.030), barbiturates (0.060), antidepressants (0.100), and antihistamines (0.020). Drugs and/or their metabolites, that are not impairing or abused, may be reported from the initial tests. See the CAMI Drug Information Web Site for additional information (http://jag.cami.jccbi.gov/toxicology/)

for his blood pressure.[17] Ibuprofen is described in the above paragraph. Both medications are generally considered not to be impairing.

4. Pickup Truck Driver - Serious Injuries

4.1. Personal Medical Records

4.1.1. Community Health Medical Records

Community health records from August 2014 through September 19, 2016 documented that the 20-year-old driver was generally in good health, was evaluated for school physicals, minor illnesses, and orthopedic injuries. Records documented high blood pressure that was managed with diet. The most recent visit was on September 19, 2016 for follow up of pain following a right lower leg injury. On that visit, he was prescribed sixty (60) 50 mg tramadol tablets for pain. Tramadol is an opioid pain medication and Schedule IV controlled substance available by prescription, commonly marketed with the name Ultram.[18,19] There was no evidence he had refilled or received a new prescription for tramadol since September 2016. The records do not document any other medical conditions, psychiatric conditions, or prescribed medications.

4.1.2. Optometry Records

Records of an optometrist examination for eye glasses dated August 24, 2016 were reviewed. The examination documented the driver's uncorrected distant visual acuity was 20/50 right eye, and 20/40 left eye.[20] He was prescribed eye glasses that corrected his distant vison to 20/25 right eye, 20/20 left eye and 20/20 both eyes.[21]

4.1.3. Behavioral Health Records

Records from psychiatric visits from September to November 2016 documented the 20-year-old male truck driver had been voluntarily hospitalized for the first time for anxiety and depression between September 27, 2016 and October 5, 2016. On discharge, he was diagnosed with a depression and posttraumatic stress disorder (PTSD). During a posthospitalization evaluation dated October 13, 2016 the examining psychiatrist documented the driver was doing well with current medications. Additionally, he had no evidence of substance abuse. His most recent identified outpatient psychiatrist visit was for follow up after the treatment (dated November 14,

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[17] National Institute of Health, U.S. Library of Medicine *DailyMed* 2017. CHLORTHALIDONE- chlorthalidone tablet. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=534700dd-ed21-4381-abbe-300893e0ced7 Accessed 08/24/2017

[18] National Institute of Health, U.S. Library of Medicine *DailyMed* 2017. TRAMADOL HCL- tramadol https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=ae7c54b1-b440-4cca-97e8-e5b825413d32 Accessed 08/29/2017

[19] US Department of Justice, Drug Enforcement Administration, Diversion Control Division, Rules 2014, Schedules of Controlled Substances: Placement of Tramadol Into Schedule IV. https://www.deadiversion.usdoj.gov/fed_regs/rules/2014/fr0702.htm Accessed 08/29/2017

[20] According to the Texas Department of Public Safety: " If you don't wear glasses or contact lenses, you must have 20/40 vision or better in both eyes. You will face no restrictions to your license if you have 20/50 vision or better with your best eye or both eyes together, and your results are accompanied by an eye specialist's note indicating that your vision cannot be improved or repaired." https://www.idrivesafely.com/dmv/texas/drivers-license/pass-texas-dps-eye-test/ Accessed 08/24/2017

[21] According to a postaccident interview the truck driver was not wearing glasses at the time of the accident.

2016). The record of this visit documented the truck driver was doing well on current medical treatment and was not a danger to himself or others. Additionally, the physician documented discussing the benefits and risks of the prescribed medication, including precautions and potential side effects and/or adverse reactions. The examining psychiatrist did not document any other medical concerns, or psychiatric conditions. The truck driver's treatment at the time included counselling and the medications listed in Table 2. The investigation did not identify any further records from this or other psychiatric providers. Finally, the truck driver did not complain of the previously noted leg pain or the use of tramadol and physical examinations did not identify any painful conditions.

Table 2. Pickup Truck Driver's Active Medical / Psychiatric Conditions and Treatment.

Medical Condition	**Treatment***
PTSD	Prazosin - decrease nightmares
	Clonazepam - sedative
Depression	Escitalopram - antidepressant
Insomnia	Zolpidem - sleep aid

* These medications and effects are described below in more detail.

PTSD is a disorder that develops in some people who have seen or lived through an upsetting event. They may relive the traumatic event, experience excess arousal to stimulus and avoid situations that cause symptoms.[22]

Major depressive disorder is characterized by depressed mood or the loss of interest or pleasure in nearly all activities. Symptoms may also include changes in weight, sleep, and psychomotor activity; decreased energy, feeling of worthlessness or guilt; difficulty thinking, concentrating, or making decisions and may include thoughts of death or suicidal ideations.[23] Additionally, major depression itself can be associated with significant cognitive degradation, particularly in executive functioning.[24]

Zolpidem a short acting sleep medication marketed as Ambien.[25] Prazosin is blood pressure medication marketed as Minipress.[26] It has also been used to treat some symptoms of PTSD.[27,28] Escitalopram is an antidepressant and anti-anxiety medication marketed as Lexapro. It is general not considered a sedating medication but does carry

[22] National Institute of Health, National Institute of Mental Health, Post-Traumatic Stress Disorder http://www.nimh.nih.gov/health/topics/post-traumatic-stress-disorder-ptsd/index.shtml Accessed 08/24/2017
[23] American Psychiatric Association. (2013*). Diagnostic and statistical manual of mental disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.
[24] Snyder H. Major depressive disorder is associated with broad impairments on neuropsychological measures of executive function: A meta-analysis and review. Psychol Bull, 2013. 139(1): p. 81-132.
[25] National Institute of Health, U.S. Library of Medicine *DailyMed* 2017. AMBIEN- zolpidem https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=c36cadf4-65a4-4466-b409-c82020b42452 Accessed 08/24/2017
[26] National Institute of Health, U.S. Library of Medicine *DailyMed* 2017. MINIPRESS- prazosin https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=36c4da56-502e-4da1-acf7-8e81ee453dcc Accessed 08/24/2017
[27] Koola M. et al. High-dose prazosin for the treatment of post-traumatic stress disorder. Ther Adv Psychopharmacol. 2014 Feb; 4(1): 43–47
[28] Kung S. et al. Treatment of Nightmares With Prazosin: A Systematic Review. Mayo Clin Proc. 2012 Sep; 87(9): 890–900

the following precaution, "in a study in normal volunteers, escitalopram 10 mg/day did not produce impairment of intellectual function or psychomotor performance. Because any psychoactive drug may impair judgment, thinking, or motor skills, however, patients should be cautioned about operating hazardous machinery, including automobiles, until they are reasonably certain that escitalopram therapy does not affect their ability to engage in such activities."[29] Clonazepam is a potent Schedule IV benzodiazepine sedative used in the treatment of seizure disorders and panic disorder. It carries the warning, "Since clonazepam produces CNS depression, patients receiving this drug should be cautioned against engaging in hazardous occupations requiring mental alertness, such as operating machinery or driving a motor vehicle. They should also be warned about the concomitant use of alcohol or other CNS-depressant drugs during clonazepam therapy."[30] Accepted therapeutic levels range from 5 to 70 ug/L and its half-life range from 19 to 60 hours.[31,32] Finally, a study recorded the blood levels of clonazepam in 164 persons arrested for impaired driving averaged 50 ug/L.[33]

4.2. Ambulance Patient Transport Report

The patient transport report documented the driver was transported by helicopter leaving the scene at 13:45 and arriving at hospital at 14:18. During the transport, he was treated with intravenous fluids, the opioid pain medication fentanyl and the anti-nausea medication ondansetron.

4.3. Emergency Treatment Records

According to hospital treatment records ranging from March 29, 2017 until April 24, 2017 the truck driver was admitted on March 29 and during the course of his hospitalization he was treated for multiple traumatic injuries. In addition to the medications administered during transport, he received multiple medications during the first day of treatment including: fentanyl (an opioid pain medication given first at 14:33), hydromorphone (an opioid pain medication at 15:14), ondansetron (an anti-nausea medication at 15:15), morphine (an opioid pain medication at 16:00), and lidocaine (a local anesthetic at 19:23).

[29] National Institute of Health, U.S. Library of Medicine *DailyMed* 2017, ESCITALOPRAM https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=31ce0b82-58fe-44f3-8887-c55d8df1b773 Accessed 04/26/2017

[30] National Institute of Health, U.S. Library of Medicine *DailyMed* 2017, CLONAZEPAM - https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=acbce0e8-5098-4785-943b-8bdb5ff17fab Accessed 04/26/2017

[31] Federal Aviation Administration. CAMI toxicology Drug Information for: Clonazepam http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=258 Accessed 05/30/2017

[32] Baselt RC Disposition of Toxic Drugs and Chemicals in Man, 10th Edition. Clonazepam. Pages 493-495 Copyright 2014, Biomedical Publications, Seal Beach, California.

[33] Jones AW et al. Concentrations of Scheduled Prescription Drugs in Blood of Impaired Drivers: Considerations for Interpreting the Results. Ther Drug Monit 2007; 29:248–260.

4.4. Postaccident Toxicology Testing

The local hospital laboratory did not detect alcohol in the truck driver's blood collected March 29, 2017 at 14:00.[34] A hospital urine drug of abuse screen collected March 29, 2017 at 19:42 was positive for benzodiazepines, cannabinoid, and opiates.[35]

Postaccident toxicology analysis conducted by the Texas Department of Public Safety Crime Laboratory of a hospital blood specimen collected from the truck driver on March 29, 2017 at 14:20 (approximately 2 hours after the crash) detected delta-9-THC (THC) 7.1 ng/ml, 9-Carboxy-THC (THC-COOH) 31 ng/ml, clonazepam 0.05 mg/L (50 ug/L). Doxylamine and fentanyl were detected but not quantified. Of note, emergency treatment personnel had administered fentanyl during transport of the truck driver from the accident scene to the hospital.

Marijuana is a psychoactive CNS depressant, illicit drug. Delta-9-tetrahydrocanabinol (THC) is the primary active chemical in marijuana with reported therapeutic levels as low as 1.00 ng/ml. THC has an inactive metabolite, 9-Carboxy-tetrahydrocanabinol (THC-COOH).[36] Concentrations of parent drug (THC) and metabolite (THC-COOH) are very dependent on pattern of use as well as dose. Concentrations vary depending on the potency of marijuana and the way the drug is used, however, peak plasma concentrations of 100-200 ng/mL are routinely encountered shortly after smoking. Plasma concentrations of THC decline rapidly and are often less than 5.00 ng/mL at 3 hours. In driving under the influence cases, blood is generally not collected until 1.5 to 4 hours after the incident and the time from last THC intake is often unknown. While the half-life of THC varies significantly based on frequency of use and body habitus, controlled studies demonstrate that detectable THC blood levels decrease by an average of 90.3% from its maximum level within 1.4 hours of last use.[37,38] Most behavioral and physiological effects return to baseline levels within 3-5 hours after drug use, although some investigators have demonstrated residual effects in specific behaviors up to 24 hours, such as complex divided attention tasks. In long term users, even after periods of abstinence, selective attention (ability to filter out irrelevant information) has been shown to be adversely affected with increasing duration of use, and speed of information processing has been shown to be impaired with increasing frequency of use.[39] Furthermore, studies of the effects of cannabis on driving found drivers with an average THC levels of 13.0 ng/ml demonstrated lane weaving similar to that of drivers with a breath alcohol of 0.08 g/210L (blood alcohol of about 0.08%).[40]

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[34] The hospital tested blood only for alcohol and not drugs.
[35] Hospital Laboratory urine drug test reporting cut-off levels: cannabinoids 50 ng/ml, amphetamines 300 ng/ml, barbiturates 200 ng/ml, opiates 300 ng/ml, cocaine 300 ng/ml, benzodiazepines 200 ng/ml, phencyclidine 25 ng/ml, tricyclic antidepressants 1000 ng/ml.
[36] Federal Aviation Administration. CAMI toxicology Drug Information for: Marijuana http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=154 Accessed 08/24/2017
[37] Baselt RC Disposition of Toxic Drugs and Chemicals in Man, 10th Edition. Tetrahydrocannabinol. Pages 1948-1952 Copyright 2014, Biomedical Publications, Seal Beach, California.
[38] Hartman RL et al. Effect of Blood Collection Time on Measured Δ9-Tetrahydrocannabinol Concentrations: Implications for Driving Interpretation and Drug Policy. Clin Chem 2016; 62:2: 367–377
[39] National Highway Traffic Safety Administration. Drugs and Human Performance Fact Sheets. Marijuana. http://www.nhtsa.gov/people/injury/research/job185drugs/cannabis.htm Accessed 08/24/2017
[40] Hartman RL et al. Cannabis Effects on Driving Lateral Control With and Without Alcohol, Drug Alcohol Depend. 2015 Sep 1; 154: 25–37.

Clonazepam is a sedative benzodiazepine described above in section 4.1.3 of this report. Of note, the clonazepam blood level detected by the Texas DPS Laboratory of 0.05 mg/L (50 ug/L) was equal to the average blood of clonazepam found in a study that identified 164 persons arrested for drug impaired driving.[41]

Clonazepam and THC are potent CNS depressants and each drug is likely to enhance the depressant effects of the other.[42]

Doxylamine is a sedating antihistamine available in many over the counter and prescription products for colds and allergy. Doxylamine carries this warning, "May impair mental and/or physical ability required for the performance of potentially hazardous tasks (e.g., driving, operating heavy machinery)."[43] Its effectiveness at causing drowsiness is demonstrated by the fact that it is the active ingredient in an over the counter sleep aids marketed as Unisom.[44] Of note, no doxylamine was detected in the driver's blood on testing by the FAA Bioaeronautical Sciences Research Laboratory.

Fentanyl is a potent Schedule II opioid pain medication that was administered to the truck driver as part of his medical care before specimens were collected for testing.[45]

Postaccident forensic toxicological testing was also conducted by the FAA Bioaeronautical Sciences Research Laboratory on the remaining previously tested blood specimen collected on March 29, 2017 at 14:00 (approximately 2 hours after the crash) and urine collected March 29, 2017 at 19:42.[46] Testing did not detect ethanol in blood but detected 7.1 ng/ml of tetrahydrocannabinol (THC) and 20.2 ng/ml of its inactive metabolite tetrahydrocannabinol carboxylic acid (THC-COOH) in blood and 2.2631 ug/ml of THC-COOH in urine. THC is described above. Additionally, testing identified 0.077 ug/ml of benzoylecgonine and ecgonine methyl ester in urine (these are metabolites of cocaine) but neither compound was detected in blood. Furthermore, doxylamine at 0.857 ug/ml was detected in urine but not in the blood. Finally, 7-amino-clonazepam, citalopram,

[41] Jones AW et al. Concentrations of Scheduled Prescription Drugs in Blood of Impaired Drivers: Considerations for Interpreting the Results. Ther Drug Monit 2007; 29:248–260.
[42] Lexicomp Online® 2017, Lexi-Comp Online™ Interaction Analysis, Hudson, Ohio: Lexi-Comp, Inc.; Accessed 06/02/2017
[43] Federal Aviation Administration. CAMI toxicology drug information for: Doxylamine. http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=53 Accessed 08/24/2017
[44] National Institutes of Health. US National Library of Medicine. *DailyMed*, 2017. UNISOM SLEEPTABS-doxylamine. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=f591d52f-5610-4517-a96f-1ed63deb00bc Accessed 08/29/2017
[45] National Institute of Health, U.S. Library of Medicine *DailyMed* 2017. FENTANYL CITRATE https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=c5d40297-b769-48cc-9f84-f98b7a333507 Accessed 08/24/2017
[46] Specimens are analyzed using immunoassay, chromatography, GC/MS, HPLC/MS, or GC/FTIR. Concentrations (ug/mL) at or above those in () can be determined for, but not limited to, the following drugs: amphetamines (0.010), opiates (0.010), marihuana (0.001), cocaine (0.020), phencyclidine (0.002), benzodiazepines (0.030), barbiturates (0.060), antidepressants (0.100), and antihistamines (0.020). Drugs and/or their metabolites, that are not impairing or abused, may be reported from the initial tests. See the CAMI Drug Information Web Site for additional information (http://jag.cami.jccbi.gov/toxicology/)

dextromethorphan, dextrorphan, lidocaine, hydromorphone, morphine, and norfentanyl were detected in urine.[47]

Benzoylecgonine and ecgonine methyl ester are inactive metabolites of the stimulant cocaine.[48] These metabolites were detected only in the urine and no cocaine was detected. Furthermore, no cocaine or its metabolites were detected in the blood. The sedating antihistamine doxylamine was detected only in the urine but not in blood, it is described above. 7-amino clonazepam is the metabolite of clonazepam and is described above. FAA toxicology identified citalopram but testing does not distinguish between it and the driver's prescribed antidepressant escitalopram that is described above.[49] Dextromethorphan and its metabolite dextrorphan are cough medications that are generally not considered impairing when taken as directed but may produce sedation when used in excess.[50] The presence of lidocaine, hydromorphone, morphine, and norfentanyl (the metabolite of fentanyl) in the urine are consistent with medications given during treatment. (Section 4.3 of this report)

[47] Due to limited blood samples quantification of citalopram, dextromethorphan, dextrorphan, lidocaine, hydromorphone, morphine, and norfentanyl was not performed.
[48] National Highway Traffic Safety Administration, Drugs and Human Performance Fact Sheets, Cocaine. https://one.nhtsa.gov/people/injury/research/job185drugs/cocain.htm Accessed 08/24/2017
[49] According to a FAA Toxicologist, citalopram is a mixture of two enantiomers, R and S. Escitalopram is the R-enantiomer. FAA toxicology testing does not distinguish between the R and S enantiomers.
[50] Federal Aviation Administration, Bioaeronautical Sciences Research Laboratory, Forensic Toxicology's WebDrugs 2017: Dextromethorphan http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=42 Accessed 08/24/2017

F. SUMMARY OF FINDINGS

The bus driver had high blood pressure, kidney disease, elevated cholesterol, and type II diabetes all reportedly well controlled with oral medications that are generally not considered impairing. Additionally, the driver had obstructive sleep apnea treated in the past with CPAP but the investigation was unable determine how serious the condition was or the last time the driver used his CPAP machine. The driver had reported high blood pressure on his CDL examinations but did not report his kidney disease, type II diabetes, sleep apnea or his oral medications and use of a CPAP machine. The autopsy determined he died as a result of blunt force trauma. Toxicology testing detected chlorthalidone in the blood and liver and ibuprofen in the blood. These medications are general considered not to be impairing.

The truck driver had a history of depression and posttraumatic stress disorder and had started treatment with zolpidem, prazosin, escitalopram, and clonazepam five months before the accident. He had no other documented medical conditions. The Texas Department of Public Safety Crime Laboratory conducted toxicological analysis of blood samples collected in the hospital about 2 hours after the accident. Testing identified delta-9-THC (THC) 7.1 ng/ml the primary psychoactive compound found in marijuana, its inactive metabolite 9-Carboxy-THC (THC-COOH) 31 ng/ml, and the sedating / impairing prescription benzodiazepine, clonazepam at 50 ug/L. Doxylamine and fentanyl were detected but not quantified. Furthermore, testing by the FAA's Bioaeronautical Sciences Research Laboratory of the remainder of the blood samples collected in the hospital about 2 hours after the accident identified THC 7.1 ng/ml and its inactive metabolite THC-COOH 20.2 ng/ml in blood and THC-COOH 2.2631 ug/ml in urine. Additionally, testing identified the inactive metabolites of cocaine, benzoylecgonine (0.077 ug/ml) and ecgonine methyl ester in urine but neither compound was detected in blood. Furthermore, doxylamine (0.857 ug/ml) was detected in urine but not in the blood. Finally, 7-amino-clonazepam, citalopram, dextromethorphan, dextrorphan, lidocaine, hydromorphone, morphine, and norfentanyl were detected in the urine but was not confirmed in blood due to limited specimens.

END OF REPORT

(Nicholas Webster, MD, MPH)

(Medical Officer)