NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Washington, DC

Medical Factual Report

January 26, 2017

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Medical Officer

A. **ACCIDENT: DCA16FR007 - Chester, Pennsylvania**

Accident Type:	Collision between National Railroad Passenger Corporation (Amtrak) southbound train 89 and maintenance of way backhoe
Location:	Chester, Pennsylvania near milepost 15.7 on Amtrak's PW Line
Date:	April 3, 2016
Time:	07:50 a.m.
Vehicle #1:	(Striking train) National Railroad Passenger Corporation (Amtrak) southbound train 89
Vehicle #2:	Amtrak maintenance of way (MOW) backhoe

B. **GROUP IDENTIFICATION:**

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

C. **RELEVANT REGULATIONS**

Per Title 49 *Code of Federal Regulations* (CFR) Part 240.121, triennially, railroad engineers are required to meet vision and hearing standards.

In addition to FRA requirements, Amtrak requires that each of its locomotive engineers undergo a medical evaluation before employment and pass annual medical evaluations. These evaluations consists of a medical history, a medication review, sleep apnea screening, determination of vital signs, a physical examination by a licensed health care provider, vision testing, an audiogram, a urine dip test, a urine drug screen, and an electrocardiogram.[1] Furthermore, Amtrak evaluates the health of the maintenance of way (MOW) workers with pre-employment, return-to-work, fitness-for-duty exams, but does not require periodic examinations.[2]

[1] The Amtrak periodic medical examination and its DOT compliant drug testing program screen for the same classes of drugs: marijuana, cocaine, opiates (including only morphine, codeine, and heroin), amphetamines (including methamphetamines and ecstasy (MDMA, MDA and MDEA)), and phencyclidine (PCP).

[2] A fitness-for-duty physical exam is conducted when a supervisor has an objective basis to doubt whether the employee's physical condition or mental state will allow him/her to perform his/her job safely.

However, some MOW workers operate commercial motor vehicles and are subject to periodic commercial motor vehicle medical certification examinations.

Additionally, the FRA works to ensure that the effects of drugs do not impair safety sensitive personnel operating trains and has policies in place to guide and monitor drug use and abuse. According to 49 CFR 219.102, prohibition on abuse of controlled substances. No regulated employee may use a controlled substance at any time whether on duty or off duty, except as permitted by Part 219.103.

49 CFR 219.103(a) allows the use of controlled and other substances if:

(1) The treating medical practitioner or a physician designated by the railroad has made a good faith judgment, with notice of the employee's assigned duties and on the basis of the available medical history, that use of the substance by the employee at the prescribed or authorized dosage level is consistent with the safe performance of the employee's duties;

(2) The substance is used at the dosage prescribed or authorized; and

(3) In the event the employee is being treated by more than one medical practitioner, at least one treating medical practitioner has been informed of all medications authorized or prescribed and has determined that use of the medications is consistent with the safe performance of the employee's duties (and the employee has observed any restrictions imposed with respect to use of the medications in combination).

Furthermore, according to 49 CFR Part 219 (Control of Alcohol and Drug Use); safety sensitive railroad employees are subject to pre-employment, random, for-cause and postaccident drug testing.[3,4] However, at the time of the accident, MOW workers were subject to pre-employment urine drug testing and testing during any medical examination but were excluded from the random drug testing program. On May 25, 2016 (about seven weeks after the accident), the FRA announced that effective April 1, 2017, MOW workers will be added to the drug and alcohol testing program and will be subject to random drug testing.[5]

Thus, both fatally injured MOWs in this accident were subject to drug testing during occupational medicine examinations but were not subject to random drug testing.

D. DETAILS OF INVESTIGATION

Purpose

This investigation was performed to evaluate the locomotive engineer and the Amtrak MOW employees for any medical conditions, use of medications/illicit drugs, and the presence of any toxins.

[3] Federal Railroad Administration drug policy is guided by 49 CFR part 219, Control of Alcohol and Drug Use and directs routine drug testing of urine specimens for marijuana, cocaine, opiates (including only morphine, codeine, and heroin), amphetamines (including methamphetamines and ecstasy (MDMA, MDA and MDEA)), and PCP. Additionally, depending on the accident severity, FRA required postaccident testing may include urine and blood tests for amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, MDMA/MDA, methadone, opiates/opioids, phencyclidine, tramadol, brompheniramine, chlorpheniramine, diphenhydramine, doxylamine, and pheniramine.

[4] Amtrak postaccident drug testing for employees not covered by FRA mandated testing includes the following drug categories: amphetamines, barbiturates, benzodiazepines, marijuana, cocaine metabolites, ecstasy, methadone, opiates, phencyclidine, tramadol, codeine, and morphine.

[5] U.S. Department of Transportation, Federal Railroad Administration, 2016 New FRA Rules Strengthen Protections for Maintenance of Way Workers, Expand Drug and Alcohol Testing. https://www.fra.dot.gov/eLib/details/L17474 Accessed 01/12/2017.

Methods

The crew and MOW workers' occupational health records, toxicology test result history, postaccident toxicology reports, hospital treatment records, and autopsy reports for the deceased were reviewed. Additionally, the investigation reviewed toxicology results for four surviving MOW workers, the train's conductor, and two assistant conductors.

Engineer

Medical Information

According to occupational medicine records, the 47-year-old engineer's most recent medical examination was dated June 10, 2015. The records from that exam documented he was 73 inches tall and weighed 240 pounds. No abnormalities were noted on the hearing test. Vision testing revealed the operator's uncorrected visual acuity was 20/30 in both eyes, 20/30 in right eye and 20/30 left eye.[6] No abnormalities were noted in visual fields or color vision testing. He reported the use of medications for occasional headaches. In accordance with Amtrak guidance, he had a complete physical examination and the record documented he met medical standards for employment.

Prior Drug Testing Information

The investigation reviewed the engineer's prior Amtrak drug test results. One test was for a rules violation and the other two were part of periodic examinations. The engineer was in the pool of operators subject to random urine drug testing but the investigation did not identify any results from random testing during his approximately 2 years of service as an engineer. The results are listed in Table 1.

Table 1. Engineer's Prior Urine Drug Test Results

Test Date	Reason	Results
02/17/2016	Rules Violation	Negative *
06/10/2015	Periodic	Negative *
04/18/2014	Pre-Employment	Negative

* - The report documented that the samples were dilute.[7]

Postaccident Treatment Records

According to the engineer's emergency treatment records, a physical examination, laboratory studies and radiological examinations identified a back strain and did not identify any other significant injuries. A hospital urine drug screen collected April 3, 2016 at 10:17 was positive for cannabinoids but negative for amphetamines, barbiturates, benzodiazepines, cocaine, opiates, and phencyclidine. (Cannabinoids indicate the use of marijuana, which is described in the engineer's toxicology section of this report). Additionally, during his hospital

[6] According to 49 Code of Federal Regulations Part 240.121(c), Each person shall have visual acuity that meets or exceeds the following thresholds: (1) for distant viewing either
(i) Distant visual acuity of at least 20/40 (Snellen) in each eye without corrective lenses or
(ii) Distant visual acuity separately corrected to at least 20/40 (Snellen) with corrective lenses and distant binocular acuity of at least 20/40 (Snellen) in both eyes with or without corrective lenses.

[7] A dilute specimen is a urine specimen with creatinine and specific gravity values that are lower than expected for human urine. DOT rule 49 CFR 40.197 states an employer may but is not required to retest an individual with a dilute urine if the urine creatinine is greater than 5 mg/dl.

treatment the engineer received 2 mg of intravenous morphine for pain control at 1135 a.m.

Toxicology

FRA postaccident toxicology collected April 03, 2016 (blood was collected at 1:18 pm and urine at 1:30 p.m.), testing was conducted by Quest laboratories and results are listed in the Table 2.[8]

Table 2. Engineer Postaccident Toxicology

Specimen	Results - Quantity	Scientific Name
Blood	Marijuana Parent - 2.2 ng/ml	Tetrahydrocannabinol
	Marijuana Metabolite - 16.1 ng/ml	Carboxy-tetrahydrocannabinol
Urine	Marijuana Metabolite – 48.6 ng/ml	Carboxy-tetrahydrocannabinol
	Morphine – 1256 ng/ml	Morphine

According to Title 21 USC 812, The Controlled Substance Act, marijuana is listed as a Schedule I controlled substance.[9] Although its use is permitted in a number of states and the District of Columbia for medicinal and recreational purposes, it is unacceptable for any safety-sensitive employee subject to drug testing under the Department of Transportation's drug testing regulations to use marijuana.[10,11] Tetrahydrocannabinol (THC) is the psychoactive compound found in marijuana and carboxy-tetrahydrocannabinol (THC-COOH) is its inactive metabolite. THC has mood-altering effects including euphoria, relaxed inhibitions, disorientation, image distortion, and psychosis. Significant performance impairments are usually observed for at least one to two hours following marijuana use, and residual effects have been reported up to 24 hours.[12] Chronic marijuana using volunteers confined to a secure facility have been found to have THC and THC-COOH levels as high as 2 ng/ml and 14 ng/ml respectively 7 days after confinement without access to the drug.[13] Morphine is a narcotic pain medication and Schedule II controlled substance available in injectable and oral preparations.[14] The engineer was treated with 2 mg of intravenous morphine approximately 2 hours before the urine was collected.

[8] Quest Laboratory testing included urine testing for amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, MDMA/ MDA, methadone, opiates / opioids, phencyclidine, tramadol, brompheniramine, chlorpheniramine, diphenhydramine, doxylamine, and pheniramine. Blood was tested for alcohol and cannabinoids.
[9] U.S. Department of Justice, Drug Enforcement Administration, Office of Diversion Control, http://www.deadiversion.usdoj.gov/21cfr/21usc/812.htm Accessed 01/26/2017
[10] U.S. Department of Transportation, Drug and Alcohol Testing, DOT 'Medical' Marijuana Notice, https://www.transportation.gov/odapc/medical-marijuana-notice Accessed 09/19/2016
[11] U.S. Department of Transportation, Drug and Alcohol Testing, DOT 'Recreational' Marijuana Notice, https://www.transportation.gov/odapc/dot-recreational-marijuana-notice Accessed 09/19/2016
[12] National Highway Traffic Safety Administration. Drugs and Human Performance Fact Sheets. Marijuana. http://www.nhtsa.gov/people/injury/research/job185drugs/cannabis.htm Accessed 07/26/2016
[13] Bergamaschi M, Karschner E, Goodwin R, Scheidweiler K, Hirvonen J, Queiroz R, Huestis M. Impact of Prolonged Cannabinoid Excretion in Chronic Daily Cannabis Smokers' Blood on Per Se Drugged Driving Laws *Clinical Chemistry* 59:3 (2013): 519–526
[14] National Library of Medicine (U.S.). 2017. *DailyMed*. Bethesda, MD: U.S. National Library of Medicine, National Institutes of Health, Health & Human Services. MS CONTIN- morphine sulfate tablet. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=e0472c35-3f44-42e2-9b75-37b2e9ff65f6 Accessed 09/19/2016

Backhoe Equipment Operator – Fatal

Medical Information

According to occupational medicine records, the 61-year-old backhoe operator's most recent examination was conducted as part of a job application dated September 26, 2014. At the time the exam recorded, he was 72 inches tall and weighed 259 pounds. No abnormalities were noted on the hearing test or vision testing. The operator reported high blood pressure treated with the prescription blood pressure medications. His only reported prescription medications were amlodipine and chlorthalidone. Amlodipine and chlorthalidone are prescription blood pressure medications respectively marketed as Norvasc and Thalitone.[15,16] The examining physician marked the box indicating he met medical standards for employment.

Prior Drug Testing Information

The backhoe operator was not subject to random urine drug testing but was tested as part of physical examinations during jobs applications. The results of the prior drug tests are listed in Table 3.

Table 3. Backhoe Operator's Prior Urine Drug Test Results

Test Date	Reason	Results
09/26/2014	Periodic	Negative
01/31/2014	Periodic	Negative

Autopsy Information

According to the County of Delaware, Office of the Medical Examiner autopsy report, the cause of death was multiple blunt force injuries and the manner was accident. The autopsy was limited due to extensive trauma and no natural disease was identified.

[15] National Library of Medicine (U.S.). 2017. *DailyMed*. Bethesda, MD: U.S. National Library of Medicine, National Institutes of Health, Health & Human Services. NORVASC- amlodipine. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=abd6a2ca-40c2-485c-bc53-db1c652505ed Accessed 01/25/2017

[16] National Library of Medicine (U.S.). 2017. *DailyMed*. Bethesda, MD: U.S. National Library of Medicine, National Institutes of Health, Health & Human Services. THALITONE- chlorthalidone. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=e2eb7dad-3ea3-439c-dcbb-d1d61aa49dfc Accessed 01/25/2017

Toxicology

Quest laboratories and the FAA Bioaeronautical Sciences Research Laboratory conducted postaccident toxicology on specimens collected April 03, 2016; results are listed in the Table 4.

Table 4. Backhoe Operator Postaccident Toxicology

Laboratory	Specimen	Positive Results
Quest	Urine	Cocaine - 2039 ng/ml
		Benzoylecgonine - 32639 ng/ml
	Vitreous	Benzoylecgonine - 328.3 ng/ml
FAA	Urine	Cocaine -1459 ng/ml
		Benzoylecgonine - 21552 ng/ml
		Cocaethylene - 624 ng/ml
		Ecgonine Methyl Ester
		Levamisole
		Amlodipine
		Chlorthalidone
		Gabapentin
	Muscle	Cocaine
		Benzoylecgonine - 355 ng/g
		Cocaethylene
		Ecgonine Methyl Ester
		Amlodipine
		Chlorthalidone
		Gabapentin

Cocaine is a strong central nervous system stimulant. Initial effects include euphoria, excitation, general arousal, dizziness, increased focus, and alertness. At higher doses, effects may include psychosis, confusion, delusions, hallucinations, fear, antisocial behavior, and aggressiveness. Late effects, beginning within 1 to 2 hours after use, include dysphoria, depression, agitation, nervousness, drug craving, general central nervous system depression, fatigue, and insomnia. Additional performance effects are expected after higher doses, with chronic ingestion, and during drug withdrawal including agitation, anxiety, distress, inability to focus on divided attention tasks, inability to follow directions, confusion, hostility, time distortion, and poor balance and coordination.[17] Cocaine is rapidly metabolized by the body into inactive compounds including benzoylecgonine and ecgonine methyl ester.[18,19] In a study of urinary excretion of cocaine and its metabolites after controlled administration, only one of six subjects was found to have a detectable urine concentration above 10 ng/ml.[20] Additionally, cocaethylene is produced in the body when cocaine and ethanol are ingested together. This biologically active

[17] National Highway Traffic Safety Administration Drugs and Human Performance FACT SHEETS: Cocaine http://www.nhtsa.gov/people/injury/research/job185drugs/cocain.htm Accessed 01/26/2017

[18] Federal Aviation Administration, Office of Aerospace Medicine, Forensic Toxicology's WebDrugs, Benzoylecgonine http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=17 Accessed 01/26/2017

[19] Federal Aviation Administration, Office of Aerospace Medicine, Forensic Toxicology's WebDrugs, Ecgonine Methyl Ester http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=56 Accessed 01/26/2017

[20] Huestis MA, et al. Cocaine and Metabolites Urinary Excretion after Controlled Smoked Administration J Anal Toxicol. 2007 October; 31(8): 462–468.

molecule is nearly as psychoactive as cocaine.[21] Levamisole is a veterinary medicine used as a cutting agent (a compound used to dilute the purity of the cocaine) in over half of all cocaine entering the US and sampled by the DEA.[22]

Amlodipine and chlorthalidone are prescription blood pressure medications that were reported by the backhoe operator on his medical certification examination and are described in the backhoe medical information section of this report.

Gabapentin is an antiseizure medication that is also used to treat chronic pain and is marketed under various names including Neurontin.[23] It is a central nervous system depressant and may cause sedation. It carries the warning "Prescribers and patients should be aware that patients' ability to assess their own driving competence, as well as their ability to assess the degree of somnolence caused by gabapentin, can be imperfect."[24] Of note, the backhoe operator had not reported this medication on his most recent medical certification examination.

Maintenance Supervisor – Fatal

Medical Information

According to occupational medicine records, the 59-year-old maintenance supervisor's was also commercial motor vehicle driver and his most recent medical examination conducted as part of his licensing requirements was dated June 17, 2015. On this examination, his recorded weight was 186 pounds and his height was 65 inches. No abnormalities were noted on the hearing test or vision testing. He reported no use of medications or chronic medical conditions. The examiner found him qualified as a commercial motor vehicle operator with the restriction of wearing corrective lenses.

Prior Drug Testing Information

The Maintenance supervisor had a commercial driver's license and records indicate he was subject to periodic testing as part of these medical examinations. There is no evidence that he was subject to random drug testing. The results of prior urine drug tests are listed in Table 5.

Table 5. Maintenance Supervisor's Prior Urine Drug Test Results

Test Date	Reason	Results
06/17/2015	Periodic	Negative
05/08/2013	Periodic	Negative
01/23/2013	Return to duty	Negative
04/25/2011	Periodic	Negative
06/29/2009	Periodic	Negative
01/29/2002	Periodic	Negative
11/25/1996	Return to duty	Negative

[21] Federal Aviation Administration, Office of Aerospace Medicine, Forensic Toxicology's WebDrugs Cocaethylene http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=34 Accessed 01/26/2017

[22] Kachiu CL, et.al. Complications Associated With Use of Levamisole-Contaminated Cocaine: An Emerging Public Health Challenge Mayo Clin Proc. June 2012;87(6):581–586 Available online at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3498128/

[23] Drugs.Com, Food and Drug Administration, Professional Information, . http://www.drugs.com/pro/gabapentin.html Accessed 1/26/2017

[24] Drugs.Com, Gabapentin and Alcohol / Food Interactions http://www.drugs.com/food-interactions/gabapentin.html Accessed 1/26/2017

Autopsy Information

According to the County of Delaware, Office of the Medical Examiner autopsy report, the cause of death was multiple blunt force injuries and the manner was accident. The report described a mildly enlarged heart with the ventricular wall thicknesses measuring 1.5 and 0.4 cm for the left and right ventricles respectively. (Average left and right ventricular thickness are reported to be 1.23 cm (SD 0.16 cm) and 0.38 cm (SD 0.09 cm) respectively).[25] Additionally, the report identified severe coronary artery disease with 85 to 95 percent focal narrowing of the left anterior descending coronary artery but did not describe any scarring in the heart muscle. The autopsy did not identify any other natural disease.

Toxicology

Quest laboratories and the FAA Bioaeronautical Sciences Research laboratory conducted postaccident toxicology on specimens collected April 03, 2016; results are listed in the Table 6.

Table 6. Maintenance Supervisor Postaccident Toxicology

Laboratory	Specimen	Results
Quest	Blood (chest cavity)	Oxycodone - 8.1 ng/ml
		Morphine - 34.5 ng/ml
FAA	Blood	Codeine
		Morphine
		Oxycodone
	Liver	Codeine - 4.0 ng/g
		Morphine - 77.0 ng/g
		Oxycodone

Codeine is a narcotic pain medication and Schedule II controlled substance marketed under various names including Tylenol #3, Fioricet, and Codrix.[26] Morphine is a narcotic pain medication and Schedule II controlled substance available in injectable and oral preparations.[27] Blood levels of morphine following intravenous administration of a single dose of 0.125 mg/kg morphine to 11 subjects averaged 437 ng/ml at 30 minutes with a rapid decline to 23 ng/ml at two hours. The half-life of morphine ranges from 1.5 to 3.5 hours.[28] The presence of a ratio of morphine /codeine greater than one in tissues can be an indicator of heroin use.[29] Oxycodone is a narcotic pain medication available by prescription

[25] Kitzman DW, Scholz DG, Hagen PT, Ilstrup DM, Edwards WD. Age-related changes in normal human hearts during the first 10 decades of life. Part II (Maturity): A quantitative anatomic study of 765 specimens from subjects 20 to 99 years old. Mayo Clinic Proc., 1988. 63(2): p. 137-46.

[26] National Library of Medicine (U.S.). 2017. *DailyMed*. Bethesda, MD: U.S. National Library of Medicine, National Institutes of Health, Health & Human Services. CODRIX- acetaminophen and codeine phosphate tablet. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=31d4cf3e-a903-4a43-bd44-73fbffc424b3 Accessed 09/19/2016

[27] National Library of Medicine (U.S.). 2017. *DailyMed*. Bethesda, MD: U.S. National Library of Medicine, National Institutes of Health, Health & Human Services. MS CONTIN- morphine sulfate tablet. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=e0472c35-3f44-42e2-9b75-37b2e9ff65f6 Accessed 09/19/2016

[28] Baselt RC Disposition of Toxic Drugs and Chemicals in Man, 10th Edition. Morphine, pages 1399-1403 Copyright 2014, Biomedical Publications, Seal Beach, California.

[29] Konstantinova SV, et.al. Morphine to codeine concentration ratio in blood and urine as a marker of

as a Schedule II controlled substance marketed in combination with acetaminophen under various names including Percocet and Oxycontin.[30] Plasma concentrations following administration of 4.5 mg oxycodone hydrochloride plus 0.38 mg terephthalate (normal release oxycodone) averaged 18 ng/mL (range, 9 -37) at 1 hour, 16 ng/mL at 2 hours, 9 ng/ml at 4 hours and 5 ng/mL at 8 hours. The half-life is reported to be 3 to 6 hours.[31] Additionally, psychological effects of opiates include euphoria, feeling of well-being, relaxation, drowsiness, sedation, lethargy, disconnectedness, self-absorption, mental clouding, and delirium.[32] Finally, codeine, oxycodone and morphine are CNS depressants and may enhance the adverse toxic effects of each medication alone.[33]

Postaccident Toxicology Results for other MOW and Train Crew

Amtrak conducted company mandated postaccident toxicology testing for four surviving MOW employees as well as FRA mandated testing or the train's conductor and two assistant conductors.[34,35] No drugs were detected in these tests.

E. SUMMARY OF FINDINGS

Amtrak had determined the engineer was medically qualified to operate the train. Postaccident emergency room evaluation identified a back strain but no other significant medical conditions. Although three prior urine drug tests over the past three years were negative, the most recent two tests documented the samples were dilute. The investigation did not identify results for any random drug tests during the two years the engineer was employed by Amtrak. Postaccident toxicology testing of blood obtained about 5 hours after the accident detected tetrahydrocannabinol (THC) at 2.2 ng/ml and carboxy-tetrahydrocannabinol (THC-COOH) at 16.1 ng/ml in the engineer's blood.

Amtrak had determined the backhoe operator was medically qualified to operate the backhoe. Two prior periodic drug tests conducted during occupational medicine examinations in 2014 were negative. His postaccident toxicology detected cocaine and its metabolites, levamisole, amlodipine, chlorthalidone, and gabapentin in muscle and urine.

The maintenance supervisor was medically qualified as commercial motor vehicle operator. Seven urine drug tests since 1996 conducted during periodic examinations were negative. His postaccident toxicology was positive for oxycodone at 8.1 ng/ml and morphine at 34.5 ng/ml in cavity blood and codeine at 4.0 ng/g, morphine at 77.0 ng/g, and oxycodone in liver.

The maintenance supervisor and backhoe operator were subject to drug testing at the time of their occupational medicine examinations but were not subject to random drug testing.

Amtrak's company mandated postaccident toxicology testing for the four surviving MOW employees as well as FRA mandated testing for the train's conductor and two assistant conductors was negative.

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illicit heroin use in forensic autopsy samples, Forensic Science International 217 (2012) 216–221

[30] Baselt RC Disposition of Toxic Drugs and Chemicals in Man, 10th Edition. Oxycodone, pages 1528-1531 Copyright 2014, Biomedical Publications, Seal Beach, California.

[31] Baselt RC Disposition of Toxic Drugs and Chemicals in Man, 10th Edition. Oxycodone, pages 1528-1531 Copyright 2014, Biomedical Publications, Seal Beach, California.

[32] National Highway Traffic Safety Administration, Drugs and Human Performance Fact Sheets. Morphine. https://one.nhtsa.gov/people/injury/research/job185drugs/morphine.htm Accessed 01/25/2017

[33] Lexicomp Online®, Lexi-Comp Online™ Interaction Analysis, Hudson, Ohio: Lexi-Comp, Inc.; Accessed 01/25/2017

[34] Amtrak postaccident drug testing includes the following: amphetamines class, barbiturates, benzodiazepines, marijuana, cocaine metabolites, ecstasy, methadone, opiates, phencyclidine, tramadol, codeine, and morphine.

[35] FRA postaccident testing was conducted by Quest Labs, which tested urine for amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine, MDMA/ MDA, methadone, opiates / opioids, phencyclidine, tramadol, brompheniramine, chlorpheniramine, diphenhydramine, doxylamine, and pheniramine. Blood was tested for alcohol.