NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Washington, DC

May 14, 2018

Medical Factual

Mary Pat McKay, MD, MPH
Chief Medical Officer, NTSB
Chair, Medical Factors Group

A. ACCIDENT: RRD18MR003

Accident Type:	Train Collision
Location:	Cayce, SC
Date:	February 4, 2018
Time:	2:27 am
Train#1:	91
Carrier#1:	Amtrak (National Railroad Passenger Corporation)
Train #2:	F777 03
Carrier#2:	CSX

B. GROUP IDENTIFICATION:

Mary Pat McKay, MD, MPH
Group Chair
Chief Medical Officer
National Transportation Safety Board

Ann Kuhnen, MD, MPH
Corporate Medical Director
National Railroad Passenger Corporation (Amtrak)

Craig S. Heligman, MD, MS
Chief Medical Officer
CSX Transportation, Inc.

C. ACCIDENT SUMMARY

On February 4, 2018, about 2:37 a.m. eastern standard time, southbound Amtrak train 91, operating on a track warrant, was diverted from the main track through a reversed hand-throw switch into a siding and collided head-on with a stationary CSX local freight train F777 03. The accident occurred on the CSX Columbia Subdivision in Cayce, South Carolina.

The engineer and conductor of the Amtrak train died because of the collision. At least 92 passengers and crew members on the Amtrak train were transported to medical facilities. The engineer of the stopped CSX train had exited the lead locomotive before the Amtrak train entered the siding, ran to safety, and was not injured. The conductor on the CSX lead locomotive saw the Amtrak train approaching in the siding and ran to the back of locomotive. The conductor was thrown off the locomotive and sustained non-life-threatening injuries.

D. DETAILS OF INVESTIGATION

1. Purpose of Study

To evaluate the medical conditions, medication use, and other substances among the train crews involved in this accident.

2. Methods

The group reviewed the Amtrak medical records, autopsy reports, and toxicology results regarding each of the crewmembers riding in the locomotive at the time of the accident; a conductor and an engineer. In addition, personal medical records regarding the engineer were reviewed, including information downloaded from his glucometer. Occupational medical records for the crew of the CSX train were also reviewed.

3. Relevant regulation and protocols

A. Federal Regulation

Per the Code of Federal Regulations (Title 49 CFR parts 240.121 and 242.117), triennially, railroad engineers and conductors are required to meet vision and hearing standards. Federal regulations do not require any other medical evaluation or testing; no review of medical conditions, medications in use, or other physical examination is required.

Mandated FRA post accident toxicology testing includes testing for about 50 substances. See Attachment A for a complete list.

B. Amtrak Medical Protocols

Amtrak requires engineers to annually undergo a medical history, assessment of medications, and physical examination which includes determination of vital signs and urine testing. As part of this evaluation, the employee may be asked to provide medical records, and Amtrak may also request additional medical

evaluations or tests. Conductors undergo the same evaluation triennially as part of their certification process.

As of May 1, 2017, Amtrak put into place a new requirement that safety sensitive employees undergo occupational medical screening for sleep apnea during their periodic medical evaluations. This process includes questions to the employee about symptoms and a physical examination by a physician to determine risk. In addition, those safety sensitive employees diagnosed with a sleep disorder must provide evidence of ongoing compliance with treatment on at least an annual basis.

CSX Medical Protocols

CSX requires engineers and conductors to triennially undergo a medical evaluation as part of their certification process. This includes responding in writing to a question that asks "During the last three (3) years, or since you have last worked for CSXT (whichever is longer), have you been treated by a physician for any condition(s) which could affect your ability to safely perform the essential functions of your job? Yes No. If yes, please specify." (CSX Medical Screening Report)

Employees then undergo FRA required vision and hearing testing which includes a filling out a hearing test case history which asks a number of questions about exposure to noise and includes the question "Do you take prescription drugs? N/A Yes No." No further review of medical conditions, medications, or physical examination is carried out. A nurse then makes a determination and attests to the following (for FRA mandated examinees):

> I have/have not detected any medical conditions which would place the examinee at increased risk of material impairment of the examinee's health from performing the duties of his/her current position, as outlined on the job description provided by the hiring manager.

E. FINDINGS

1. Amtrak Conductor

a. Toxicology

The Amtrak conductor's FRA post accident testing identified diphenhydramine in urine and 0.0297 ug/ml of diphenhydramine in blood. See Attachment B.

Testing performed at the request of the NTSB by the FAA's Bioaeronautical Sciences Research Laboratory detected 0.025 ug/ml of diphenhydramine in heart blood. Diphenhydramine was also detected in liver tissue. See Attachment C.

Diphenhydramine is a sedating antihistamine available over the counter in a wide variety of products such as Benadryl and Unisom. It used to treat cold and allergy symptoms and is also commonly the active ingredient in non-prescription sleep aids. Diphenhydramine carries the following warning: may impair mental and/or physical ability required for the performance of potentially hazardous tasks (e.g., driving, operating heavy machinery). Altered mood and impaired cognitive and psychomotor performance may also be observed. In a driving simulator study, a single dose of diphenhydramine impaired driving ability more than a blood alcohol concentration of 0.100%.[1] The range of blood levels believed to cause effects is 0.025 to 0.1120 ug/ml.[2] However, diphenhydramine undergoes post mortem redistribution and central levels, such as in heart blood, may be as much as 3 times higher than peripheral levels.[3]

b. Amtrak Occupational Medical Records

The Amtrak conductor was 36 years old at the time of the accident. His most recent occupational certification exam had been conducted on May 5, 2016. At that time, he reported no chronic medical conditions and no abnormalities were identified on the physical exam. His medications were reviewed with the physician but not recorded. He was determined to be fit for duty. These findings were the same as those during medical examinations conducted in 2008, 2011, and 2013.

c. Autopsy

According to the autopsy performed by the Department of Pathology and Laboratory Medicine at Lexington Medical Center, the cause of death was massive blunt force trauma and the manner of death was accidental. No significant natural disease was identified.

2. Amtrak Engineer

a. Toxicology

The Amtrak engineer's FRA required post-accident toxicological testing did not identify any tested-for substances. See Attachment D.

Testing performed at the request of the NTSB by the FAA's Bioaeronautical Sciences Research Laboratory detected sitagliptin and atorvastatin in urine and blood. Sitagliptin is a medication used to treat diabetes and atorvastatin is used to treat high cholesterol. Neither are considered impairing.[4][5] In addition, clinical

[1] Weiler JM, B.J., Woodworth GG, Grant AR, Layton TA, Brown TL, McKenzie DR, Baker TW, Watson GS., Effects of fexofenadine, diphenhydramine, and alcohol on driving performance. A randomized, placebo-controlled trial in the Iowa Driving Simulator. Ann Intern Med. 2000;132(5): 354-63.
[2] Federal Aviation Administration. CAMI Forensic Toxicology Drug Information. Diphenhydramine. http://jag.cami.jccbi.gov/toxicology/DrugDetail.asp?did=50 Accessed 4/24/2018.
[3] Han E, et. al., Evaluation of postmortem redistribution phenomena for commonly encountered drugs, Forensic Science International. 2012; 219; 265–271
[4] National Institutes of Health. US National Library of Medicine. DailyMed. Janumet. (Sitagliptin and metformin combination) https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=d19c7ed0-ad5c-426e-b2df-722508f97d67 Accessed 5/3/2018.

testing demonstrated a hemoglobin A1C at 7.5% and NMS Labs found the vitreous contained unremarkable post mortem glucose and electrolytes.[6] See Attachment E.

b. Amtrak Occupational Medical Records

The engineer was 54 years old at the time of the accident. He underwent a pre-employment physical for Amtrak in May 2013. At that time, he was examined using standards for commercial drivers. He was asked about his medical history and reported having been diagnosed and treated for diabetes and high cholesterol since 2006. At the time, he reported his medications as Janumet (which contains a combination of sitagliptin and metformin) and glimepiride (also called Amaryl) to treat his diabetes and atorvastatin (also called Lipitor) to treat his high cholesterol.[7] These drugs are not generally considered impairing although overtreatment of diabetes with medications can lead to symptomatic hypoglycemia which can cause shakiness, irritability or psychomotor slowing and may progress to unconsciousness in a matter of minutes. The engineer was found to have high frequency hearing loss but the remainder of the physical examination was unremarkable and the engineer received a two year certificate, the maximum for commercial drivers.

In May 2014, the engineer was re-examined. He again reported his diabetes and was found to be hypertensive on the physical exam (164/98). Determination of his fitness for duty was referred to Amtrak Medical. No further documentation is present in the records.

In April 2016, the engineer underwent an Amtrak medical examination. On this form, there is no written question requesting the engineer report his medications. However, the examiner is asked to make a determination as to whether the employee is using any impairing medication. The engineer's examiner checked "no" and determined he met medical standards after documenting unchanged hearing loss, a normal blood pressure, and no other abnormalities on the physical examination, EKG, and urine dip test.

In May 2017 the engineer had another Amtrak medical examination. The examiner determined he was not using impairing medication (although no medications are listed). There is a comment from the examining physician that his

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[5] National Institutes of Health. US National Library of Medicine. DailyMed. Atorvastatin. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=6ccdb6f3-22c7-5b48-46bc-ce4a4c65eb4d Accessed 5/3/2018.

[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] National Institutes of Health. US National Library of Medicine. DailyMed. Glimepiride. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=60e9397e-83b9-489e-9683-6f87e458bbaa Accessed 5/3/2018.

hemoglobin A1C was 7.3% and he had no episodes of hypoglycemia. The examiner determined the engineer met medical standards after documenting unchanged hearing loss, a normal blood pressure, and no other abnormalities on the physical examination, EKG, and urine dip test. At this examination, the engineer was screened for sleep apnea with the Epworth Sleepiness Scale. He scored a 7 out of 24, indicating "higher normal daytime sleepiness."[8]

c. Autopsy

According to the autopsy performed by the Department of Pathology and Laboratory Medicine at Lexington Medical Center, the cause of death was massive blunt force trauma and the manner of death was accidental. As a result of the extent of injury, the brain was not available for examination. No significant natural disease was identified.

d. Personal Medical Records

According to records obtained from the Amtrak engineer's primary physician for visits between March 2017 and December 2017, the engineer had type 2 diabetes and high cholesterol. At the time of his last visit, dated December 8, 2017, the engineer was taking atorvastatin to treat his high cholesterol, a combination medication of sitagliptin and metformin (also called Janumet) and dapagliflozin (also called Farxiga) to treat his diabetes. His hemoglobin A1C at that visit was 7.2%.

e. Glucometer Download

The engineer routinely checked his blood sugar several times a day. His glucometer was identified in his belongings in the wreckage of the locomotive. The non-volatile memory was downloaded (See Blood Glucose Meter – Specialist's Factual Report for a description of the process). Over the 5 days preceding the collision, the engineer's average glucose was 159 gm/dl with four readings above the desired range, 180 gm/dl. The last reading, timed at 9:23 pm on February 3, was 199 gm/dl. There were no readings below 70 gm/dl in the 3 weeks preceding the accident.[9]

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[8] The Epworth Sleepiness Scale. About the ESS. http://epworthsleepinessscale.com/about-the-ess/ Accessed 5/9/2018.

[9] When glucose levels in the brain get too low, brain function begins to slow. Patients may experience shakiness and irritability or just suddenly have psychomotor slowing. Many are not aware of early signs. Left untreated, low glucose levels lead to unconsciousness. This process may happen over minutes. There is not a direct correlation between measurable blood glucose levels and brain effects; some people may become symptomatic at 65 gm/dl and others function normally with blood glucose levels as low as 40 gm/dl. However, it is clear that symptoms from hypoglycemia degrade performance. Symptomatic hypoglycemia is most often caused by having too much effective diabetes medication relative to the amount of consumed carbohydrates. For instance, patients who significantly delay or skip meals put themselves at increased risk of hypoglycemia.

Above about 180 gm/dl of glucose in the blood, the body struggles to cope with it; kidney filters fail and glucose begins to enter the urine. Above about 200-250 gm/dl, the consistency of the vitreous in the eye changes and vision begins to blur. Hyperglycemia causes insidious effects on the brain, slowing processing time and causing psychomotor slowing and subjective fatigue. As levels rise above 500 gm/dl, coma will

3. CSX conductor

a. Toxicology

The CSX conductor's FRA post accident alcohol and drug testing was negative. All previous FRA drug and alcohol testing was also negative. See Attachment F.

b. CSX Occupational Medical Records

The CSX conductor was 37 years old at the time of the accident.

According to his occupational medical records from CSX, the conductor underwent pre-employment exam in April 2014 that included a series of questions about previously diagnosed medical conditions, review of recent medication use, evaluation of vital signs, a urine dip test, and a physical examination. No chronic medical conditions, regular medication use, or physical abnormalities were identified.

The CSX conductor was intermittently furloughed and underwent evaluations in May 2016 and May 2017 that included only the CSX question about having been "treated by a physician for any condition(s) which could affect your ability to safely perform the essential functions of your job?" and a yes-no question about prescription drug use. Each time, the conductor answered no to both those health questions, passed vision and hearing testing, and was found fit for duty.

4. CSX Engineer

a. Toxicology

The CSX engineer's FRA post accident alcohol and drug testing was negative. All of his previous FRA mandated drug and alcohol testing was also negative. See Attachment G.

b. CSX Occupational Medical Records

The CSX engineer was 44 years old at the time of the accident.

The CSX engineer underwent an employment physical performed by a physician in November 2000 that included a review of medications, medical history, vital signs, and a physical exam. He was determined to be fit for duty.

In November 2001, March 2005, and May 2007, he underwent vision and hearing testing performed by a technician. The May 2007 hearing evaluation included some medical history questions the CSX engineer circled that he had "used prescription drugs" and had "high blood pressure" in the preceding 12 months. In April 2008, the engineer again had a hearing evaluation and again responded "yes" to the question about prescription drugs. At each of these evaluations and all of the rest of the evaluations, the engineer was asked and responded "no" to

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eventually result. This process takes several hours to days in type 2 diabetes but can occur must faster in some patients with type 1 diabetes.

the question, “During the last three (3) years, or since you have last worked for CSXT (whichever is longer), have you been treated by a physician for any condition(s) which could affect your ability to safely perform the essential functions of your job?”

Between February and July 2010, the engineer was on medical leave for a foot problem that required surgery. In July 2010, the engineer again underwent a technician performed evaluation of his vision and hearing; this time he was asked to list his medications and reported using lisinopril and Prevacid. Lisinopril is a blood pressure medication also marketed with the name Zestril.[10] Prevacid is a heartburn medication whose generic name is lansoprazole.[11] Neither of these medications are considered impairing.

In April 2013, the engineer again underwent technician performed vision and hearing testing and reported the use of prescription drugs. The names of the drugs were not obtained.

In March 2016, the engineer again underwent technician performed vision and hearing and responded “yes” to the question about prescription drugs and “no” to the question about being treated by a physician for a condition that could affect his ability to safely perform his job. For the first time, the record contains a document signed by a registered nurse which stated, “I have/have not detected any medical conditions which would place the examinee at increased risk of material impairment of the examinee's health from performing the duties of his/her current position, as outlined on the job description provided by the hiring manager.”

At no time after November 2000 were vital signs obtained or any physical examination of any body part other than the eyes or ears carried out during the engineer’s certification exams.

F. SUMMARY OF MEDICAL FINDINGS

The 36 year old male Amtrak conductor had reported no chronic medical conditions to his employer and routine examinations in 2008, 2011, 2013 and 2016 identified no abnormalities. Each time, his medications were reviewed with the physician but not recorded and he was determined to be fit for duty. Post accident toxicology testing in two labs identified diphenhydramine in urine and liver as well as 0.0297 ug/ml and 0.025 ug/ml of diphenhydramine in blood (two separate tests). He was fatally injured in the accident and no significant natural disease was identified by autopsy.

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[10] National Institutes of Health. US National Library of Medicine. DailyMed. Lisinopril. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=27ccb2f4-abf8-4825-9b05-0bb367b4ac07 Accessed 5/3/2018.

[11] National Institutes of Health. US National Library of Medicine. DailyMed. Prevacid. https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=71ba78cb-7e46-43eb-9425-fa130f537f84 Accessed 5/3/2018.

The 54 year old male Amtrak engineer underwent a pre-employment physical for Amtrak in May 2013. At that time, he was examined using standards for commercial drivers. He was asked about his medical history and reported having been diagnosed and treated for diabetes and high cholesterol since 2006. At the time, he reported his medications as Janumet (which contains a combination of sitagliptin and metformin) and glimepiride (also called Amaryl) to treat his diabetes and atorvastatin (also called Lipitor) to treat his high cholesterol. His physical examination was unremarkable. He was re-examined in May 2014, April 2016, and May 2017 and reported the same conditions each time. At each exam, he was found to be fit for duty. Post accident toxicology testing identified sitagliptin and atorvastatin in urine and blood. Personal medical records including a visit in December 2017, review of his glucometer readings, and clinical testing of post accident blood were consistent with good control of his diabetes with a hemoglobin A1C of 7.2-7.5% and his use of atorvastatin to treat his high cholesterol, a combination medication of sitagliptin and metformin (also called Janumet) and dapagliflozin (also called Farxiga) to treat his diabetes.

The 37 year old male CSX conductor underwent a pre-employment physical in April 2014 and reported no chronic medical conditions and no medication use at that time. No physical abnormalities were identified. He underwent evaluations following return to work after furlough in May 2016 and May 2017 at which time he answered "No" to a question that asked, "Have you been treated by a physician for any condition(s) which could affect your ability to safely perform the essential functions of your job?" and another that asked, "Do you take prescription drugs?". The only physical exam performed was vision and hearing testing, which he passed. At each exam, he was found to be fit for duty. Post accident FRA mandated toxicology testing was negative.

The 44 year old male CSX engineer underwent a pre-employment medical exam in 2000 where he reported no chronic medical conditions, no medication use, and an unremarkable physical exam. He underwent certification exams in November 2001, March 2005, and May 2007, and each time responded "No" to "Have you been treated by a physician for any condition(s) which could affect your ability to safely perform the essential functions of your job?". In May 2007, for the first time he answered "Yes" to "Do you take prescription drugs?" but no drug names were recorded. When the engineer returned to work in 2010 after a period of leave for foot surgery he was asked to list his medications which included lisinopril and Prevacid, but no physical exam other than vision and hearing testing was carried out. In April 2013 and May 2016, similar exams were conducted without asking for the names of his medications. At each examination, he was found to be fit for duty. Post accident FRA mandated toxicology testing was negative.

FRA SUMMARY OF ANALYSES PERFORMED ON SPECIMENS FOR TOXICOLOGY UNDER THE FRA POST-ACCIDENT TESTING PROGRAM

Revised 1-2-2013

The following summarizes the procedures for analysis of blood and urine specimens submitted under the FRA Post-Accident Program.

Urine Integrity Test: Urine is tested for pH, specific gravity, and creatinine. If the pH or temperature is out of range, the specific gravity is less than 1.0030, the creatinine is less than 20 mg/dL, the sample appears adulterated, or as directed by FRA, both the urine and the blood specimens may be tested for drugs.

Analysis of Drugs/Initial Testing: Initial testing is performed on urine by combination of EIA, ELISA and GC/MS (for sedating antihistamines). If urine is unavailable or unsuitable, testing is performed on blood using ELISA and GC/MS for antihistamines. Ethanol screening is performed on blood by GC-Head Space. If the tests are negative (that is, the results are below the cut-off), no further analyses are performed routinely.

Drug or Metabolite[a]	Cutoffs (ng/mL)[b] Urine	Blood
Amphetamines	300	50
Barbiturates	200	100
Benzodiazepines	100	50
Cocaine	150	20
Cannabinoids	20	10
Methadone	300	50
Opiates	300	50
Oxycodone	100	50
Phencyclidine	25	2.5
Propoxyphene	300	50
Tramadol	100	100
Fentanyl	0.5	0.5
Sedating Antihistamines	50	50

Analysis of Drugs/Confirmation: If the initial screening test is positive, the urine and/or the blood specimens are confirmed using GC/MS, LC/MS, and GC (for ethanol). Normally, blood analysis is not required if urine results are negative. Except as noted, only positive confirmed findings at or above the cutoff are reported; they are expressed as quantitative results based on the confirmatory analysis.

Specific Drug or Metabolite		Confirmation Cutoffs (ng/mL)[b] Urine	Blood
Amphetamines			
	Amphetamine	100[c]	20
	Methamphetamine	100[c]	20
	MDMA	200	20
	MDA	200	20
Barbiturates			
	Pentobarbital	200	100
	Secobarbital	200	100
	Amobarbital	200	100
	Butalbital	200	100
	Phenobarbital	1000	1000
Benzodiazepines			
	Nordiazepam	50	20
	Oxazepam	50	20
	Temazepam	50	20
	Hydroxyethylflurazepam	50	20
	alpha-Hydroxyalprazolam	50	N/A
	alpha-Hydroxytriazolam	50	N/A
	Aminoclonazepam	50	N/A
	Lorazepam	50	20
	Diazepam	N/A	20
	Flurazepam	N/A	20
	Alprazolam	N/A	10
	Triazolam	N/A	10
	Clonazepam	N/A	10
Cannabinoids			
	Delta-9-tetrahydrocannabinol (THC)[c]	N/A	1
	THCA (a metabolite of THC)	15	5
Cocaine			
	Cocaine	50	10
	Benzoylecgonine (a metabolite of cocaine)	100	10
Opiates			
	Morphine (total)	300	N/A
	Morphine (unconjugated)	N/A	5
	Codeine (total)	300	N/A
	Codeine (unconjugated)	N/A	5
	6-Monoacetylmorphine (6-MAM)	2	3
Synthetic/ **Semi-Synthetic Opioids**			
	Hydrocodone	300	5
	Hydromorphone	300	5
	Methadone	200	25
	Methadone Metabolite (EDDP)	200	25
	Oxycodone	100	5
	Oxymorphone	100	5
	Fentanyl	0.5	0.5
	Propoxyphene	N/A	50
	Norpropoxyphene	200	50
Phencyclidine		25	2.5
Tramadol			
	Tramadol	100	100
	Desmethyltramadol	100	100
Sedating Antihistamines			
	Diphenhydramine	50	50
	Doxylamine	50	50
	Chlorpheniramine	50	50
	Brompheniramine	50	50
	Pheniramine	50	50

Attachment A: FRA Toxicology Testing Description

Analysis for Alcohol: The blood specimen (or urine if blood is unavailable) is analyzed for ethyl alcohol by gas chromatography (GC). If the blood specimen is positive, the analysis is repeated using a separate portion of the specimen and the urine is also analyzed by gas chromatography. In fatalities, vitreous (if available) is also analyzed.

Substance	Initial Test Cutoff (g/100 mL)	Confirmation Cutoff (g/100 mL)
Ethyl Alcohol	0.01	0.01

Analysis in the Case of a Fatality: If urine or blood is not available, or as directed by the FRA, other body fluids and/or tissue specimen(s) may be analyzed.

Special Assays: On direction from the FRA, additional testing for controlled substances and/or their metabolites may be conducted. If such tests are performed, they are specifically described on each individual report.

[1] *Metabolites and/or analogs of these compounds may also be detected.*
[2] *These cutoffs are subject to periodic review and update.*
[3] *THC is the active constituent of marijuana or hashish preparations.*
[4] *LOQ: Limit of quantitation.*
[5] *A confirmed urine positive for methamphetamine will result in a d&l isomer analysis and is reported as the % of each isomer present.*

Attachment B: Amtrak Conductor FRA Toxicology Testing

Quest Diagnostics

1777 Montreal Circle, Tucker, GA 30084 800-729-6436

FEDERAL RAILROAD ADMINISTRATION POST-ACCIDENT FORENSIC TOXICOLOGY REPORT

REFERENCE INFORMATION

RAILROAD:	AMTRAK		
ACCIDENT:	Cayce, SC.	2/4/2018	2:30AM
FRA CASE:	2030		
EMPLOYEE:	[redacted] Amtrak Conductor		
SPECIMEN SET ID NO:	999204		

SPECIMEN(S) TESTED — FATALITY

URINE: NO URINE RECEIVED

BLOOD: LAB ACCESSION # 911213C

SAMPLES RECEIVED BUT NOT TESTED: LIVER, GASTRIC, BRAIN, KIDNEY, LUNG, VITREOUS

LABORATORY TESTING INFORMATION

Drug	Urine	Blood
Sedating Antihistamines		
Brompheniramine	*	NEGATIVE
Chlorpheniramine	*	NEGATIVE
Diphenhydramine	*	**POSITIVE**
Doxylamine	*	NEGATIVE
Pheniramine	*	NEGATIVE

* Testing Not Performed

TESTING PERFORMANCE EXPLANATION

Testing of specimens was in accordance with the FRA Post-Accident Testing Program. Additional descriptive information of testing procedures are summarized on the attachment "Summary of Analyses Performed on Specimens for Toxicology under FRA Post Accident Program" (Revised 02/07/18), which is an integral part of this report.

SPECIMEN DISPOSITION

Negative specimens will be retained by Quest Diagnostics, for no less than six months from the report date. Positive specimens will be retained for not less than two years.

RESULTS

BLOOD: DIPHENHYDRAMINE=29.7 ng/mL

CERTIFICATION

I certify that I am a laboratory certifying official at Quest Diagnostics, and the results identified above were correctly determined in accordance with the FRA Post-Accident Testing Program.

Brian [redacted]

2/9/18
Date

Quest Diagnostics

1777 Montreal Circle, Tucker, GA 30084 800-729-6436

FEDERAL RAILROAD ADMINISTRATION POST-ACCIDENT FORENSIC TOXICOLOGY REPORT

REFERENCE INFORMATION

RAILROAD:	AMTRAK		
ACCIDENT:	Cayce, SC.	2/4/2018	2:30AM
FRA CASE:	2030		
EMPLOYEE:	[redacted] Amtrak Conductor		
SPECIMEN SET ID NO:	999204		

SPECIMEN(S) TESTED

FATALITY

URINE: NO URINE RECEIVED

BLOOD: LAB ACCESSION # 911213C

SAMPLES RECEIVED BUT NOT TESTED: LIVER, GASTRIC, BRAIN, KIDNEY, LUNG, VITREOUS

LABORATORY TESTING INFORMATION

Drug	Urine	Drug	Blood
Amphetamines	*	Amphetamine	NEGATIVE
Barbiturates	*	Barbiturates	NEGATIVE
Benzodiazepines	*	Benzodiazepines	NEGATIVE
Cannabinoids	*	Cannabinoids	NEGATIVE
Cocaine	*	Cocaine	NEGATIVE
MDMA/MDA	*	MDMA/MDA	NEGATIVE
Methadone	*	Methamphetamine	NEGATIVE
Opiates/Opioids	*	Methadone	NEGATIVE
Phencyclidine	*	Opiates/Opioids	NEGATIVE
Tramadol	*	Phencyclidine	NEGATIVE
Ethyl Alcohol	*	Tramadol	NEGATIVE
		Ethyl Alcohol	NEGATIVE

*** Testing Not Performed**

TESTING PERFORMANCE EXPLANATION

Testing of specimens was in accordance with the FRA Post-Accident Testing Program. Additional descriptive information of testing procedures are summarized on the attachment "Summary of Analyses Performed on Specimens for Toxicology under FRA Post Accident Program" (Revised 02/07/18), which is an integral part of this report.

SPECIMEN DISPOSITION

Negative specimens will be retained by Quest Diagnostics, for no less than six months from the report date. Positive specimens will be retained for not less than two years.

RESULTS

NO DRUGS & NO ALCOHOL IDENTIFIED

CERTIFICATION

I c[redacted]a laboratory certifying official at Quest Diagnostics, and the results identified above were correctly determined in accordance with the FR[redacted]nt Testing Program.

Br[redacted]

2/13/18
Date

U.S. Department of Transportation
Federal Aviation Administration

Mike Monroney Aeronautical Center
P.O. Box 25082
Oklahoma City, Oklahoma 73125

Friday, April 20, 2018

National Transportation Safety Board, Rail Division
490 L'Enfant Plaza East, S.W.
Washington, DC 20594

Amtrak Conductor

ACCIDENT # 0012 **INDIVIDUAL#:** 002 **NAME:** [redacted] **MODE:** RAIL

DATE OF ACCIDENT 02/04/2018 **DATE RECEIVED** 02/06/2018 **PUTREFACTION:** No

N # **NTSB #** RRD18MR003 **CAMI REF #** 201800012002

LOCATION OF ACCIDENT Cayce, SC

SPECIMENS Blood (Heart), Brain, Gastric, Heart, Kidney, Liver, Lung, Muscle, Spleen, Vitreous

FINAL FORENSIC TOXICOLOGY FATAL ACCIDENT REPORT

CARBON MONOXIDE: The carboxyhemoglobin (COHb) saturation is determined by spectrophotometry with a 10% cut off and confirmed by chromatography.

- NOT PERFORMED

CYANIDE: The presence of cyanide is screened by Conway Diffusion, when the COHb level is equal to or greater than 10% or upon special request. Cyanides are quantitated by spectrophotometry and confirmed by chromatography. The reporting cutoff for cyanide is 0.25 ug/mL. Normal blood cyanide concentrations are less than 0.15 ug/mL, while lethal concentrations are greater than 3 ug/mL.

- NOT PERFORMED

VOLATILES: The volatile concentrations are determined by headspace gas chromatography at a cut off of 10 mg/dL. Where possible, positive ethanol values are confirmed by Radiative Energy Attenuation.

- NO ETHANOL detected in Blood (Heart)

DRUGS: Specimens are analyzed using immunoassay, chromatography, mass spectrometry, or spectrophotometry. 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/).

- 0.025 (ug/mL, ug/g) Diphenhydramine detected in Blood (Heart)
- Diphenhydramine detected in Liver

Russell Lewis, Ph.D., F-ABFT
Supervisor, Forensic Sciences
Bioaeronautical Sci. Research Lab
CAMI, FAA

Attachment D: Amtrak Engineer FRA Toxicology Testing

Quest Diagnostics

1777 Montreal Circle, Tucker, GA 30084 800-729-6436

FEDERAL RAILROAD ADMINISTRATION POST-ACCIDENT FORENSIC TOXICOLOGY REPORT

REFERENCE INFORMATION

RAILROAD:	AMTRAK		
ACCIDENT:	Cayce, SC.	2/4/2018	2:30AM
FRA CASE:	2030		
EMPLOYEE:	[redacted] Amtrak Engineer		
SPECIMEN SET ID NO:	900052		

SPECIMEN(S) TESTED

URINE:	LAB ACCESSION #	911184C
BLOOD:	LAB ACCESSION #	911184C

SAMPLES RECEIVED BUT NOT TESTED: LIVER, GASTRIC, BRAIN, KIDNEY, LUNG, VITREOUS, BILE, SPLEEN

LABORATORY TESTING INFORMATION

Drug	Urine	Blood
Sedating Antihistamines		
Brompheniramine	NEGATIVE	*
Chlorpheniramine	NEGATIVE	*
Diphenhydramine	NEGATIVE	*
Doxylamine	NEGATIVE	*
Pheniramine	NEGATIVE	*

* Testing Not Performed

TESTING PERFORMANCE EXPLANATION

Testing of specimens was in accordance with the FRA Post-Accident Testing Program. Additional descriptive information of testing procedures are summarized on the attachment "Summary of Analyses Performed on Specimens for Toxicology under FRA Post Accident Program" (Revised 02/07/18), which is an integral part of this report.

SPECIMEN DISPOSITION

Negative specimens will be retained by Quest Diagnostics, for no less than six months from the report date. Positive specimens will be retained for not less than two years.

RESULTS

NO DRUGS WERE IDENTIFIED

CERTIFICATION

I certify that I am a laboratory certifying official at Quest Diagnostics, and the results identified above were correctly determined in accordance with the FRA Post-Accident Testing Program.

[redacted]

Brian A. Brunell, Certifying Scientist

2/9/18

Date

Quest Diagnostics

1777 Montreal Circle, Tucker, GA 30084 800-729-6436

FEDERAL RAILROAD ADMINISTRATION POST-ACCIDENT FORENSIC TOXICOLOGY REPORT

REFERENCE INFORMATION

RAILROAD:	AMTRAK		
ACCIDENT:	Cayce, SC.	2/4/2018	2:30AM
FRA CASE:	2030		
EMPLOYEE:	[redacted] Amtrak Engineer		
SPECIMEN SET ID NO:	900052		

SPECIMEN(S) TESTED

URINE:	LAB ACCESSION #	911184C
BLOOD:	LAB ACCESSION #	911184C

SAMPLES RECEIVED BUT NOT TESTED: LIVER, GASTRIC, BRAIN, KIDNEY, LUNG, VITREOUS, BILE, SPLEEN

LABORATORY TESTING INFORMATION

Drug	Urine	Drug	Blood
Amphetamines	NEGATIVE	Amphetamine	*
Barbiturates	NEGATIVE	Barbiturates	*
Benzodiazepines	NEGATIVE	Benzodiazepines	*
Cannabinoids	NEGATIVE	Cannabinoids	*
Cocaine	NEGATIVE	Cocaine	*
MDMA/MDA	NEGATIVE	MDMA/MDA	*
Methadone	NEGATIVE	Methamphetamine	*
Opiates/Opioids	NEGATIVE	Methadone	*
Phencyclidine	NEGATIVE	Opiates/Opioids	*
Tramadol	NEGATIVE	Phencyclidine	*
Ethyl Alcohol	*	Tramadol	*
		Ethyl Alcohol	NEGATIVE

* Testing Not Performed

TESTING PERFORMANCE EXPLANATION

Testing of specimens was in accordance with the FRA Post-Accident Progam. Additional descriptive information of testing procedures are summarized on the attachment :Summary of Analysis Performed on Specimens for Toxicology under FRA Post Accident Program" (Revised 02/07/18), which is an integral part of this report.

SPECIMEN DISPOSITION

Negative specimens will be retained by Quest Diagnostics, for no less than six months from the report date. Positive specimens will be retained for not less than two years.

RESULTS

NO DRUGS & NO ALCOHOL IDENTIFIED

CERTIFICATION

I certify that I am a laboratory certifying official at Quest Diagnostics, and the results identified above were correctly determined in accordance with the FRA Post-Accident Testing Program.

[redacted]

Brian A. Brunelli, Certifying Scientist

2/8/18

Date

U.S. Department of Transportation
Federal Aviation Administration

Mike Monroney Aeronautical Center
P.O. Box 25082
Oklahoma City, Oklahoma 73125

Wednesday, May 09, 2018

National Transportation Safety Board, Rail Division
490 L'Enfant Plaza East, S.W.
Washington, DC 20594

Amtrak Engineer

ACCIDENT # 0012 **INDIVIDUAL#:** 001 **NAME:** [redacted] **MODE:** RAIL

DATE OF ACCIDENT 02/04/2018 **DATE RECEIVED** 02/06/2018 **PUTREFACTION:** No

N # **NTSB #** RRD18MR003 **CAMI REF #** 201800012001

LOCATION OF ACCIDENT Cayce, SC

SPECIMENS Bile, Blood (Heart), Brain, Gastric, Heart, Kidney, Liver, Lung, Muscle, Spleen, Urine, Vitreous

FINAL FORENSIC TOXICOLOGY FATAL ACCIDENT REPORT

CARBON MONOXIDE: The carboxyhemoglobin (COHb) saturation is determined by spectrophotometry with a 10% cut off and confirmed by chromatography.

- INSUFFICIENT SPECIMEN FOR ANALYSIS

CYANIDE: The presence of cyanide is screened by Conway Diffusion, when the COHb level is equal to or greater than 10% or upon special request. Cyanides are quantitated by spectrophotometry and confirmed by chromatography. The reporting cutoff for cyanide is 0.25 ug/mL. Normal blood cyanide concentrations are less than 0.15 ug/mL, while lethal concentrations are greater than 3 ug/mL.

- NOT PERFORMED

VOLATILES: The volatile concentrations are determined by headspace gas chromatography at a cut off of 10 mg/dL. Where possible, positive ethanol values are confirmed by Radiative Energy Attenuation.

- NO ETHANOL detected in Urine

DRUGS: Specimens are analyzed using immunoassay, chromatography, mass spectrometry, or spectrophotometry. 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/).

- Sitagliptin detected in Blood (Heart)
- Sitagliptin detected in Urine
- Atorvastatin detected in Blood (Heart)
- Atorvastatin detected in Liver

Russell Lewis, Ph.D., F-ABFT
Supervisor, Forensic Sciences
Bioaeronautical Sci. Research Lab
CAMI, FAA

U.S. Department of Transportation
Federal Aviation Administration

Mike Monroney Aeronautical Center
P.O. Box 25082
Oklahoma City, Oklahoma 73125

Wednesday, May 09, 2018

National Transportation Safety Board, Rail Division
490 L'Enfant Plaza East, S.W.
Washington, DC 20594

Amtrak Engineer

ACCIDENT # 0012 **INDIVIDUAL#:** 001 **NAME:** [redacted] **MODE:** RAIL

DATE OF ACCIDENT 02/04/2018 **DATE RECEIVED** 02/06/2018 **PUTREFACTION:** No

N # **NTSB #** RRD18MR003 **CAMI REF #** 201800012001

LOCATION OF ACCIDENT Cayce, SC

SPECIMENS Bile, Blood (Heart), Brain, Gastric, Heart, Kidney, Liver, Lung, Muscle, Spleen, Urine, Vitreous

CLINICAL REPORT

CLINICAL: Vitreous and Urine are tested for the presence of glucose with reagent strips and by enzymatic spectrophotometric analysis. Postmortem vitreous glucose levels above 125 mg/dL are considered abnormal and postmortem urine levels above 100 mg/dL are considered abnormal. Hemoglobin A1C is analyzed using a latex immunoagglutination inhibition methodology. Hemoglobin A1C blood levels above 6% are considered abnormal. Urine specimens are defined as "dilute" if the creatinine concentration is < 20 mg/dL and the specific gravity is < 1.003. Concentrations of serotonin metabolites 5-hydroxytryptophol (5-HTOL) and 5-hydroxyindole-3-acetic acid (5-HIAA) are measured by LC/MS. A 5-HTOL/5-HIAA ratio value < 15 pmol/nmol is not consistent with ethanol ingestion, while a ratio value > 15 pmol/nmol is indicative of ethanol ingestion.

- 3949 (mg/dL) Glucose detected in Urine
- 7.5 (%) Hemoglobin A1C detected in Blood

The following tests were performed by NMS Labs:

- Glucose (Vitreous Fluid) < 35 (mg/dL)
- 0.81 (mg/dL) Creatinine (Vitreous Fluid)
- 143 (mmol/L) Sodium (Vitreous Fluid)
- 8.2 (mmol/L) Potassium (Vitreous Fluid)
- 122 (mmol/L) Chloride (Vitreous Fluid)
- 13 (mg/dL) Urea Nitrogen (Vitreous Fluid)

Russell Lewis, Ph.D., F-ABFT
Supervisor, Forensic Sciences
Bioaeronautical Sci. Research Lab
CAMI, FAA

Attachment F: CSX Conductor Toxicology Testing

UNIVERSITY SERVICES MRO

Toxicology Services Group

* Medical Review Officer Final Report *

TO: CSX FRA POST ACCIDENT
BOYD NICHOLSON
500 WATER ST., J-290
JACKSONVILLE, FL 32202

FOR: CSX FRA POST ACCIDENT
BOYD NICHOLSON
500 WATER ST., J-290
JACKSONVILLE, FL 32202

Date Reported: 02/15/2018

Date MRO Verified: 02/15/2018 02:32 PM

Name of Individual Tested: [redacted] CSX Conductor

Identification Number: 269039

Collection Date: 02/04/2018 07:08 AM

Specimen Number: 308394

Reason for Test: POST ACCIDENT
FRA Post Accident

Date Ply2 Received:2/15/18

Specimen Type: URINE

Date Ply2 Entered: 2/15/18 2:31:22PM

Collection Location: LEXINGTON MEDICAL
2720 SUNSET BOULEVARD

Lab Acct #:

Lab Accession #: 911137C

WEST COLUMBIA, SC 29169

Date MRO Interviewed:

Laboratory Performing Analysis: QUEST DIAGNOSTICS

Status of Drug Test: NEGATIVE
FRA CASE 2030
ACCIDENT SITE CAYCE SC
BLOOD ALCOHOL NEGATIVE

[redacted]

RANDY BARNETT, DO

Administrative review performed by: CK

Drug Panel: 1-11
Drugs Tested: Amphetamines (Amphetamine, Methamphetamine, Ecstasy), Cocaine, Marijuana, Phencyclidine, Opioids (Codeine, Morphine, 6-MAM, Hydrocodone, Hydromorphone, Oxycodone, Oxymorphone)

Attachment G: CSX Engineer FRA Toxicology Testing

UNIVERSITY SERVICES MRO

Toxicology Services Group

* Medical Review Officer Final Report *

TO: CSX FRA POST ACCIDENT
BOYD NICHOLSON
500 WATER ST., J-290
JACKSONVILLE, FL 32202

FOR: CSX FRA POST ACCIDENT
BOYD NICHOLSON
500 WATER ST., J-290
JACKSONVILLE, FL 32202

Date Reported: 02/15/2018

Date MRO Verified: 02/15/2018 02:29 PM

Name of Individual Tested: [redacted] CSX Engineer

Identification Number: 379614

Collection Date: 02/04/2018 07:41 AM

Specimen Number: 308393

Reason for Test: POST ACCIDENT
FRA Post Accident

Date Ply2 Received:2/15/18

Specimen Type: URINE

Date Ply2 Entered: 2/15/18 2:29:17PM

Collection Location: LEXINGTON MEDICAL
2720 SUNSET BOULEVARD

Lab Acct #:

Lab Accession #: 911119C

WEST COLUMBIA, SC 29169

Date MRO Interviewed:

Laboratory Performing Analysis: QUEST DIAGNOSTICS

Status of Drug Test: NEGATIVE
FRA CASE 2030
ACCIDENT SITE CAYCE SC
BLOOD ALCOHOL NEGATIVE

[redacted]

RANDY BARNETT, DO

Administrative review performed by: CK

Drug Panel: 1-11
Drugs Tested: Amphetamines (Amphetamine, Methamphetamine, Ecstasy), Cocaine, Marijuana, Phencyclidine, Opioids (Codeine, Morphine, 6-MAM, Hydrocodone, Hydromorphone, Oxycodone, Oxymorphone)