

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



DCA23LA109

MEDICAL

Specialist's Factual Report

May 3, 2024

TABLE OF CONTENTS

A. ACCIDENT.....	3
B. MEDICAL SPECIALIST.....	3
C. DETAILS OF THE INVESTIGATION	3
1.0 PURPOSE	3
2.0 METHODS.....	3
D. FACTUAL INFORMATION.....	3
1.0 RAMP AGENT	3
1.1 FAA Medical Case Review	3
1.2 Personal Medical Records	4
1.3 Autopsy	5
1.4 Toxicology	5
1.4.1 Postmortem Toxicology Results	5
1.4.2 Descriptions of Detected Substances	6
2.0 CAPTAIN	9
2.1 FAA Medical Certification File.....	9
2.2 Post-Accident Drug and Alcohol Testing	9
3.0 FIRST OFFICER	9
3.1 FAA Medical Certification File.....	9
3.2 Post-Accident Drug and Alcohol Testing	9
E. SUMMARY OF MEDICAL FACTS.....	10

A. ACCIDENT

Location: Montgomery, Alabama
Date: December 31, 2022
Time: About 1539 local time

B. MEDICAL SPECIALIST

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

C. DETAILS OF THE INVESTIGATION

1.0 Purpose

This investigation was performed to evaluate the fatally injured ramp agent (ramp agent) and the captain and first officer (FO) of the involved airplane for potentially impairing medical conditions and/or substances.

2.0 Methods

The ramp agent's autopsy report, Federal Aviation Administration (FAA) postmortem toxicology report, and selected personal medical records were reviewed. The FAA medical case review for the accident and the FAA medical certification files of the captain and FO were reviewed, as were reports of the captain and FO's United States Department of Transportation (DOT) post-accident drug and alcohol tests, comprising Medical Review Officer (MRO) reports of drug test results as well as DOT alcohol testing forms. Selected National Transportation Safety Board (NTSB) investigator reports and relevant regulation and medical literature were also reviewed.

D. FACTUAL INFORMATION

1.0 Ramp Agent

1.1 FAA Medical Case Review

According to the FAA medical case review, the 34-year-old female ramp agent was not a pilot and did not have an FAA medical certification file. Her position did not require FAA medical certification.

1.2 Personal Medical Records

Medical records were reviewed from the university health system with which the ramp agent's neurologist was affiliated. According to these records, the ramp agent's medical history included relapsing-remitting multiple sclerosis (MS) that first manifested in 2014, diabetes mellitus diagnosed in 2016, and obesity.

The ramp agent's most recent in-person visit with her neurologist was in August 2021 for follow up of MS.¹ At that visit, the ramp agent was 67 inches tall and weighed 203 pounds. Her home medications were documented as fingolimod, liraglutide, metformin, gabapentin, amitriptyline, and vitamin D3.² The neurologist documented a physical examination including a detailed neurological examination. The ramp agent's cognition was documented as normal, including attention, concentration, and orientation; her affect was also documented as normal. The neurologist noted that the ramp agent's MS was stable and that she was doing great with her diabetes management, with a hemoglobin A1c (HbA1c) of 6.9 as of July 2021.³

Brain magnetic resonance imaging (MRI) performed on the August 2021 neurology visit date showed multiple abnormal areas in the cerebral hemispheres, posterior fossa, and cerebellum, appearing consistent with demyelination, as well as evidence of prior bilateral optic neuritis. Similar MRI findings had also been present on prior imaging. New findings on the August 2021 MRI comprised new abnormal areas in the bifrontal lobes, as well as an area with the appearance of active demyelination in the left lateral periventricular white matter.

The ramp agent's next visit with her neurologist was a telehealth visit in February 2022. This was her most recent documented visit before the accident. At that visit, her documented home medications were the same as at her previous visit, with the addition of insulin glargine and insulin aspart (prescription long- and short-

¹ MS is a chronic disease in which a person's own immune system attacks myelin, a protective sheath that surrounds and supports the function of nerve fibers (white matter) in the central nervous system. MS symptoms vary from person to person depending on the severity and location of the resultant tissue damage, and may include weakness, numbness, clumsiness, nerve pain, vision problems, fatigue, mood changes, and cognitive dysfunction. In relapsing-remitting MS, symptoms typically come in attacks interspersed with periods of partial or complete recovery. Additional information about MS is available from the [National Institute of Neurological Disorders and Stroke website](#).

² Fingolimod is a prescription disease-modifying drug used to treat relapsing forms of MS. Liraglutide is a prescription injection commonly used for diabetes treatment and weight management. Metformin is a prescription oral diabetes medication. Gabapentin is a potentially impairing prescription medication that can be used to treat nerve pain or seizures. Amitriptyline is a potentially impairing prescription medication that can be used to treat nerve pain or depression. Reviewed records indicated the ramp agent was using gabapentin and amitriptyline for pain control.

³ HbA1c is an indirect measure of a person's average blood sugar over approximately the preceding 3 months. For a person with diabetes, HbA1c of less than 7% generally indicates good diabetes control.

acting insulin injections, respectively, commonly used in combination for blood sugar control in diabetes). The neurologist documented the history provided by the ramp agent: "She has times at work when her legs go to spaghetti or her arms don't cooperate. These typically last up to a few hours. Sleeping it off helps. She has been lifting more lately - up to 75 [pounds] at a time at the airport. She has to lift up to 50 bags that are [over] 50 [pounds]. This is a struggle for her. Her vision went out about 2 weeks ago, it got better 2 days ago. She [had recent life stressors]. Her sugar was up. Thinks it was stress related. It is back to her baseline." The neurologist documented that there was no evidence of new MS relapse, and that the ramp agent's MS continued to be stable on fingolimod, which she had started in January 2016, and which seemed to be a good fit for her so far. The neurologist made no changes to the ramp agent's MS treatment, noted that she was doing well with the medications for her symptoms, and remarked that another brain MRI would be due at her next visit. The neurologist also noted, "If needed, will gladly provide letter for work for lighter duty. It is a struggle physically for her with her MS to complete baggage handling duties for extended periods."

1.3 Autopsy

The Alabama Department of Forensic Sciences performed the ramp agent's autopsy. According to the ramp agent's autopsy report, her cause of death was multiple blunt-force injuries and her manner of death was accident. Due to her injuries, her brain was not available for examination. Her autopsy did not identify significant natural disease. No significant internal injuries of her chest or abdomen were documented, nor was the collection site of the blood that was sent for toxicological testing.

1.4 Toxicology

1.4.1 Postmortem Toxicology Results

The FAA Forensic Sciences Laboratory performed toxicological testing of postmortem specimens from the ramp agent.⁴ Delta-9-tetrahydrocannabinol (delta-9-THC) was detected in urine and at 7.4 ng/mL in cavity blood. 11-hydroxy-THC was detected in urine but not in cavity blood.⁵ Carboxy-delta-9-THC was detected in urine and at 22.6 ng/mL in cavity blood. Additionally, carboxy-delta-8-THC was detected in urine and at 13.1 ng/mL in cavity blood. Urine glucose was normal.⁶

⁴ The FAA Forensic Sciences Laboratory has the capability to test for around a thousand substances including toxins, prescription and over-the-counter medications, and illicit drugs.

⁵ According to an e-mail from an FAA forensic toxicologist, FAA testing does not differentiate 11-hydroxy-delta-9-THC from 11-hydroxy-delta-8-THC, either/both of which are reported as 11-hydroxy-THC.

⁶ Urine glucose (sugar) was measured at 10 mg/dL. Glucose in random fresh urine is normally 25 mg/dL or less. Urine glucose is raised by high blood glucose only if the blood glucose surpasses a certain threshold, which varies among individuals, but which is typically significantly higher than normal blood glucose. The FAA Forensic

1.4.2 Descriptions of Detected Substances

Delta-9-THC is the primary psychoactive chemical in cannabis, including marijuana and hashish. Delta-9-THC may be smoked, vaped, or ingested recreationally by users seeking mind-altering effects. It may also be used medicinally to treat symptoms including illness-associated nausea and appetite loss. Psychoactive effects of THC vary depending on the user, dose, and route of administration, and may impair motor coordination, reaction time, decision making, problem solving, and vigilance.^{7,8} 11-hydroxy-delta-9-THC is a psychoactive metabolite of delta-9-THC.⁵ Carboxy-delta-9-THC is a non-psychoactive metabolite of 11-hydroxy-delta-9-THC.

A person's instantaneous blood concentration of delta-9-THC does not directly predict that person's impairment.^{7,8} Attempts at predicting impairment from measured concentrations of delta-9-THC and its metabolites often focus on estimating whether the time of last cannabis use was recent enough to indicate probability of related acute psychoactive effects.^{7,9,10} Acute impairing effects of delta-9-THC typically last at least 1-2 hours after use, with return to baseline within about 3-7 hours, although some residual effects may persist longer, and the duration of acute effects may be increased at higher doses or when used orally.^{7,11} An occasional user's blood delta-9-THC concentration may fall to a very low or undetectable level within hours after smoking, whereas a frequent user's blood delta-9-THC concentration may remain detectable for days or weeks of abstinence while delta-9-THC stored in fatty

Sciences Laboratory considers glucose levels in postmortem urine to be abnormal if above 100 mg/dL. The choice of this value is discussed in FAA Aerospace Medicine Technical Report [DOT/FAA/AM-00/22](#).

⁷ Couper FJ, Logan BK. Drugs and Human Performance Fact Sheets. National Highway Traffic Safety Administration. DOT HS 809 725. April 2014 (Revised). <https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/809725-drugshumanperformfs.pdf>. Accessed December 22, 2023.

⁸ Compton RP. Marijuana-Impaired Driving: A Report to Congress. National Highway Traffic Safety Administration. DOT HS 812 440. July 2017. <https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/documents/812440-marijuana-impaired-driving-report-to-congress.pdf>. Accessed December 22, 2023.

⁹ Huestis MA, Henningfield JE, Cone EJ. Blood cannabinoids. II. Models for the prediction of time of marijuana exposure from plasma concentrations of delta 9-tetrahydrocannabinol (THC) and 11-nor-9-carboxy-delta 9-tetrahydrocannabinol (THCCOOH). *J Anal Toxicol*. 1992;16(5):283-290. doi:10.1093/jat/16.5.283.

¹⁰ Kosnett MJ, Ma M, Dooley G, et al. Blood cannabinoid molar metabolite ratios are superior to blood THC as an indicator of recent cannabis smoking. *Clin Toxicol (Phila)*. 2023;61(5):355-362. doi:10.1080/15563650.2023.2214697.

¹¹ McCartney D, Arkell TR, Irwin C, McGregor IS. Determining the magnitude and duration of acute Δ^9 -tetrahydrocannabinol (Δ^9 -THC)-induced driving and cognitive impairment: a systematic and meta-analytic review. *Neurosci Biobehav Rev*. 2021;126:175-193. doi:10.1016/j.neubiorev.2021.01.003.

tissues redistributes into blood.^{7,12 - 15} Delta-9-THC and its metabolites have modest potential for postmortem redistribution.^{16,17,18} Interpretation of delta-9-THC concentrations measured in cavity blood is further complicated by cavity blood's potential to sometimes be diluted or contaminated by other body fluids or by diffusion of delta-9-THC from nearby body tissues.¹⁹

Marijuana, marijuana extract, and THC in cannabis (not including hemp, as defined based on delta-9-THC content, per the Agriculture Improvement Act of 2018) are defined in federal regulation as Schedule I controlled substances.^{20,21,22} In Alabama, medical cannabis legislation was passed in 2021, but the state's medical cannabis program remains under development, and marijuana possession for recreational purposes is unlawful.^{23,24,25} Regardless of state cannabis laws, the United

¹² Huestis MA. Human cannabinoid pharmacokinetics. *Chem Biodivers*. 2007 Aug;4(8):1770-804. doi: 10.1002/cbdv.200790152.

¹³ Bergamaschi MM, Karschner EL, Goodwin RS, et al. Impact of prolonged cannabinoid excretion in chronic daily cannabis smokers' blood on per se drugged driving laws. *Clin Chem*. 2013;59(3):519-526. doi:10.1373/clinchem.2012.195503.

¹⁴ Spindle TR, Cone EJ, Schlienz NJ, et al. Acute pharmacokinetic profile of smoked and vaporized cannabis in human blood and oral fluid. *J Anal Toxicol*. 2019;43(4):233-258. doi:10.1093/jat/bky104.

¹⁵ Vandrey R, Herrmann ES, Mitchell JM, et al. Pharmacokinetic profile of oral cannabis in humans: blood and oral fluid disposition and relation to pharmacodynamic outcomes. *J Anal Toxicol*. 2017;41(2):83-99. doi:10.1093/jat/bkx012.

¹⁶ Hoffman MA, Trochta A, Gary RD, Fitzgerald RL, McIntyre IM. An evaluation of postmortem concentrations of Δ9-tetrahydrocannabinol (THC) and 11-nor-9-carboxy-Δ9-tetrahydrocannabinol (THCCOOH). *Forensic Sci Int*. 2020;315:110414. doi:10.1016/j.forsciint.2020.110414.

¹⁷ Holland MG, Schwöpe DM, Stoppacher R, Gillen SB, Huestis MA. Postmortem redistribution of Δ9-tetrahydrocannabinol (THC), 11-hydroxy-THC (11-OH-THC), and 11-nor-9-carboxy-THC (THCCOOH). *Forensic Sci Int*. 2011;212(1-3):247-251. doi:10.1016/j.forsciint.2011.06.028.

¹⁸ Lemos NP, Ingle EA. Cannabinoids in postmortem toxicology. *J Anal Toxicol*. 2011;35(7):394-401. doi:10.1093/anatox/35.7.394.

¹⁹ Kemp PM, Cardona PS, Chaturvedi AK, Soper JW. 2013. Distribution of Δ9-Tetrahydrocannabinol and 11-Nor-9-Carboxy-Δ9-Tetrahydrocannabinol Acid in Postmortem Biological Fluids and Tissues From Pilots Fatally Injured in Aviation Accidents. Federal Aviation Administration. DOT/FAA/AM-13/24. December 2013. <https://rosap.ntl.bts.gov/view/dot/26810>.

²⁰ [21 Code of Federal Regulations 1308.11](#).

²¹ [7 United States Code 1639o](#).

²² United States Department of Agriculture. Farm Bill home. Farm Service Agency. <https://www.fsa.usda.gov/programs-and-services/farm-bill/index>. Accessed February 8, 2024.

²³ [Alabama Code](#) Title 13A Chapter 12 Article 5.

²⁴ Alabama Medical Cannabis Commission. <https://amcc.alabama.gov>. Accessed February 8, 2024.

²⁵ National Conference of State Legislatures (NCSL). State medical cannabis laws. NCSL website.

States DOT has stated, "marijuana remains a drug listed in Schedule I of the Controlled Substances Act. It remains unacceptable for any safety-sensitive employee subject to drug testing under the Department of Transportation's drug testing regulations to use marijuana."^{26,27} DOT drug testing includes testing for carboxy-delta-9-THC.²⁸ The ramp agent was not considered a safety-sensitive employee for purposes of FAA/DOT drug and alcohol testing requirements, so was not subject to those requirements.²⁹

Carboxy-delta-8-THC is a non-psychoactive metabolite of the chemical 11-hydroxy-delta-8-THC, which itself is a psychoactive metabolite of delta-8-THC.⁵ Delta-8-THC (which was not detected in this case) is pharmacologically similar to delta-9-THC, with similar impairing psychoactive effects. It is widely available from retailers in a variety of products for oral consumption, smoking, and inhalation. Very little delta-8-THC is present in the cannabis plant, so delta-8-THC used in consumer products is typically chemically manufactured from cannabidiol (CBD), another chemical in the cannabis plant.^{30,31,32} Delta-8 THC products are marketed with a variety of claims, but have not been evaluated or approved by the United States Food and Drug Administration for safe use in any context.³³

<https://www.ncsl.org/health/state-medical-cannabis-laws>. Updated June 22, 2023. Accessed February 8, 2024.

²⁶ United States Department of Transportation. DOT "medical marijuana" notice. Office of Drug and Alcohol Policy and Compliance. <https://www.transportation.gov/odapc/medical-marijuana-notice>. Updated November 19, 2019. Accessed February 8, 2024.

²⁷ United States Department of Transportation. DOT "recreational marijuana" notice. Office of Drug and Alcohol Policy and Compliance. <https://www.transportation.gov/odapc/dot-recreational-marijuana-notice>. Updated February 1, 2017. Accessed February 8, 2024.

²⁸ [49 Code of Federal Regulations 40.85](#).

²⁹ [14 Code of Federal Regulations Part 120](#) and [49 Code of Federal Regulations Part 40](#).

³⁰ Wurz GT, Montoya E, DeGregorio MW. Examining impairment and kinetic patterns associated with recent use of hemp-derived Δ8-tetrahydrocannabinol: case studies. *J Cannabis Res*. 2022;4(1):36. doi:10.1186/s42238-022-00146-9.

³¹ Tagen M, Klumpers LE. Review of delta-8-tetrahydrocannabinol (Δ8-THC): Comparative pharmacology with Δ9-THC. *Br J Pharmacol*. 2022;179(15):3915-3933. doi:10.1111/bph.15865. Erratum in: *Br J Pharmacol*. 2023;180(1):130.

³² United States Centers for Disease Control and Prevention (CDC). Increases in availability of cannabis products containing Delta-8 THC and reported cases of adverse events. CDC Health alert Network. <https://stacks.cdc.gov/view/cdc/109759>. Updated September 14, 2021. Accessed February 8, 2024.

³³ United States Food and Drug Administration (FDA). 5 things to know about delta-8 tetrahydrocannabinol - delta-8 THC. FDA Consumer Updates. <https://www.fda.gov/consumers/consumer-updates/5-things-know-about-delta-8-tetrahydrocannabinol-delta-8-thc>. Updated May 4, 2022. Accessed February 8, 2024.

Questions remain surrounding delta-8-THC's legal status at a federal level, largely hinging on whether delta-8-THC synthesized from CBD in hemp is exempt from controlled substance status as a (perhaps inadvertent) result of the Agriculture Improvement Act of 2018.^{30,34} At a state level, Alabama enacted legislation in 2023 to prohibit delta-8-THC from being possessed by, or sold/distributed/marketed to, individuals under 21 years old.²³

2.0 Captain

2.1 FAA Medical Certification File

According to the 47-year-old male captain's FAA medical certification file, his most recent aviation medical examination before the accident date was on October 12, 2022. No significant issues were identified, and he was issued a first-class medical certificate limited by a requirement to wear corrective lenses for near and distant vision.

2.2 Post-Accident Drug and Alcohol Testing

The captain underwent a DOT post-accident alcohol breath test at 1821 on the accident date. This test was negative. The captain also underwent a DOT post-accident urine drug test on the accident date. The MRO verified the captain's urine drug test results as negative for tested-for substances.³⁵

3.0 First Officer

3.1 FAA Medical Certification File

According to the 27-year-old male FO's FAA medical certification file, his most recent aviation medical examination before the accident date was on April 18, 2022. No significant issues were identified, and he was issued a first-class medical certificate limited by a requirement to wear corrective lenses.

3.2 Post-Accident Drug and Alcohol Testing

The FO underwent a DOT post-accident alcohol breath test at 1838 on the accident date. This test was negative. The FO also underwent a DOT post-accident urine drug test on the accident date. The MRO verified the FO's urine drug test results as negative for tested-for substances.³⁵

³⁴ [85 Federal Register 51639](#).

³⁵ Tested-for substances on DOT urine drug testing are marijuana metabolites, cocaine metabolites, amphetamines, opioids, and phencyclidine (PCP), in accordance with [49 Code of Federal Regulations § 40.82](#), as detailed at [49 Code of Federal Regulations § 40.85](#).

E. SUMMARY OF MEDICAL FACTS

The 34-year-old female ramp agent's medical history included relapsing-remitting multiple sclerosis (MS), diabetes mellitus, and obesity. Her most recent in-person visit with her neurologist was in August 2021 for follow up of MS. At that visit, her home medications were documented as fingolimod, liraglutide, metformin, gabapentin, amitriptyline, and vitamin D3. Her cognition was documented as normal, including attention, concentration, and orientation; her affect was also documented as normal. The neurologist noted that the ramp agent's MS was stable and that she was doing great with her diabetes management. A brain MRI showed multiple abnormal areas consistent with demyelination, similar to prior imaging. Additionally, there were new abnormal areas in the bifrontal lobes, and evidence of active demyelination in the left lateral periventricular white matter.

The ramp agent's next visit with her neurologist was a telehealth visit in February 2022. This was her most recent documented visit before the accident. At the visit, her documented home medications were the same as at her previous visit, with the addition of insulin glargine and insulin aspart. The neurologist documented that the ramp agent reported having times at work when her legs go to spaghetti or her arms don't cooperate, lasting up to a few hours. She reported struggling with the heavy lifting required for baggage handling. She reported recent vision loss and high blood sugars that had resolved. The neurologist documented that there was no evidence of new MS relapse, and that the ramp agent's MS continued to be stable on fingolimod. The neurologist made no changes to the ramp agent's MS treatment, noted that she was doing well with the medications for her symptoms, and remarked that another brain MRI would be due at her next visit.

According to the ramp agent's autopsy report, her cause of death was multiple blunt-force injuries and her manner of death was accident. Due to her injuries, her brain was not available for examination. Her autopsy did not identify significant natural disease. Her postmortem toxicological testing detected delta-9-tetrahydrocannabinol (delta-9-THC) in urine and at 7.4 ng/mL in cavity blood. 11-hydroxy-THC was detected in urine but not in cavity blood. Carboxy-delta-9-THC was detected in urine and at 22.6 ng/mL in cavity blood. Carboxy-delta-8-THC was detected in urine and at 13.1 ng/mL in cavity blood. Urine glucose was normal.

Both involved pilots held first-class FAA medical certificates. Both underwent United States Department of Transportation (DOT) post-accident drug and alcohol tests, which were negative for tested-for substances according to Medical Review Officer reports and DOT alcohol testing forms.

Submitted by:
Turan Kayagil, MD, FACEP
Medical Officer