

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



ERA23LA300

MEDICAL

Specialist's Factual Report

March 26, 2025

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A. ACCIDENT

Location: Vineyard Haven, Massachusetts
Date: July 15, 2023
Time: About 3:15 PM 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 pilot for potentially impairing or incapacitating medical conditions, substances, and exposures.

2.0 Methods

The Federal Aviation Administration (FAA) medical case review and the pilot's FAA medical certification file were reviewed. Medical records were reviewed from the hospital to which the pilot was transferred for definitive care following the crash (after initial stabilizing treatment at another hospital). The pilot's autopsy report was reviewed, as were toxicology reports from the Massachusetts State Police Crime Laboratory and the FAA Forensic Sciences Laboratory. Selected investigator reports and relevant regulation and medical literature were also reviewed.

D. FACTUAL INFORMATION

1.0 FAA Medical Certification File

1.1 Overview of Reported Cardiac History

According to his FAA medical certification file, the 79-year-old male pilot's medical history included high blood pressure since 1970, treated with medications, as well as coronary artery disease with prior heart attack, and coronary artery bypass graft (CABG) procedures in 1981 and 1996. He also had a history of atrial fibrillation since 2019 treated with blood-thinning medication to reduce the stroke risk posed by the condition.

According to medical records submitted to the FAA in 2006, the pilot's first CABG procedure was performed in June 1981, when the pilot was 37 years old. The procedure involved a single graft connecting the left internal mammary artery to the left anterior descending coronary artery. This was performed because of a 99% narrowing of the proximal portion of the left anterior descending coronary artery (LAD), which was adversely affecting the motion of the anterior apical heart muscle. This problem had been diagnosed by coronary angiography, which had been performed to evaluate symptoms of chest pain. The angiography had not identified significant disease of the other major coronary arteries.

The pilot's second CABG procedure was a triple bypass, performed in January 1996, when he was 52 years old. He had presented for medical care due to recurrent chest pain and had demonstrated electrocardiogram (ECG) findings consistent with a prior heart attack affecting the inferior portion of his heart muscle. Angiography had identified 100% blockage of the posterior descending artery (PDA) branch of the right coronary artery (RCA). Angiography had also identified narrowing of the left circumflex coronary artery (LCX), with 50% narrowing before the first obtuse marginal artery (OM1) branch point, 95% narrowing between the OM1 and second obtuse marginal artery (OM2) branch points, and 90% narrowing after the OM2 branch point. There was also 90% narrowing of OM1. The native LAD was 100% blocked (previously bypassed). The 1996 CABG procedure connected the ascending aorta to the PDA using a segment of saphenous vein. The procedure also connected the ascending aorta to the OM1 and OM2 using a segment of radial artery.

1.2 FAA Medical Certification Timeline

The pilot's first documented aviation medical examination was in 1969. His first documented aviation medical examination after either of his CABG procedures was in 2002. At his 2002 examination, he reported his high blood pressure but not his heart history; the aviation medical examiner (AME) did not note the heart history and issued the pilot a third-class medical certificate. The same AME issued the pilot a third-class medical certificate in 2003 and four second-class medical certificates between 2004 and 2005, with no documentation of the pilot's heart history. The pilot first reported a history of coronary artery disease and prior heart attack at an examination by a different AME in June 2006. This AME deferred the medical certification decision to the FAA.

In October 2006, based on the June 2006 examination and on review of records submitted in support of the pilot's application, the FAA issued the pilot a time-limited third-class medical certificate and granted him an Authorization for Special Issuance of third-class medical certification for history of heart attack, coronary heart disease treated with CABG, high blood pressure, and use of medication. The pilot's next five medical certificates were AME-issued annually between June 2007 and June 2011 in accordance with the terms of this

Authorization. In September 2011, the FAA granted a new Authorization for Special Issuance of third-class medical certification for the same medical history. The pilot's next four medical certificates were AME-issued annually between June 2012 and June 2015 in accordance with the terms of this Authorization. In August 2015, the FAA granted a new Authorization for Special Issuance of third-class medical certification for the same medical history.

In June 2016, based on review of submitted records (no physical examination was due at the time), the FAA issued the pilot a time-limited third-class medical certificate and granted a new Authorization for Special Issuance of third-class medical certification for history of heart attack, angina, coronary artery disease treated with CABG, and use of medication. The Authorization letter stated that the pilot met Conditions AMEs Can Issue (CACI) program criteria for his high blood pressure, but did not explicitly authorize AME issuance of medical certification at the next examination, due June 2017. Instead, the letter indicated that the FAA would decide about granting another Authorization based on review of required information that should be submitted in advance of that examination.

No such Authorization was granted before the pilot's next examination on June 1, 2017, at which the AME incorrectly issued the pilot a third-class medical certificate (after reviewing updated medical records, which the AME found satisfactory). The AME submitted the pilot's medical records to the FAA (including the report of an April 2017 stress echocardiogram). On June 20, 2017, the FAA sent the pilot a letter requesting a narrative from his cardiologist regarding apparently new evidence of ischemia on the stress echocardiogram. The pilot provided a visit note from his cardiologist stating that the cardiologist personally reviewed the study and did not find any evidence of ischemia. In July 2017, the FAA issued the pilot a corrected time-limited third-class medical certificate and granted a new Authorization for Special Issuance of third-class medical certification for history of heart attack, angina, coronary artery disease treated with CABG, high blood pressure, and use of medication.

In June 2018, based on review of submitted records (no physical examination was due at the time), the FAA issued the pilot a time-limited third-class medical certificate and granted a new Authorization for Special Issuance of third-class medical certification for the same medical history. In accordance with this Authorization, the pilot submitted records to the FAA in advance of his next examination, due June 2019. The records documented a new diagnosis of atrial fibrillation, identified in April 2019. At the pilot's June 2019 aviation medical examination, the AME deferred the medical certification decision to the FAA because the FAA had not granted the pilot a new Authorization for Special Issuance. The FAA subsequently requested additional information from the pilot related to his new diagnosis of atrial fibrillation treated with blood-thinning medication.

In August 2019, based on the June 2019 examination and on review of submitted records, the FAA granted the pilot a time-limited third-class medical certificate and a new Authorization for Special Issuance of third-class medical certification for history of heart attack, angina, coronary artery disease treated with CABG, and atrial fibrillation treated with blood-thinning medication. The Authorization letter stated that the pilot met CACI program criteria for high blood pressure. In August 2020, the FAA granted a similar Authorization and issued a new time-limited third-class certificate (no examination was due). In May 2021, the FAA granted a similar authorization that also allowed the AME to issue the pilot a time-limited certificate at his next examination, which took place in June 2021.

In July 2022, the FAA issued the pilot a time-limited third-class medical certificate (not valid after June 30, 2023) and granted a new Authorization for Special Issuance of third-class medical certification for history of heart attack, angina, coronary artery disease treated with CABG, atrial fibrillation treated with blood-thinning medication, and mitral regurgitation. The Authorization letter stated that the pilot met CACI program criteria for high blood pressure, but did not explicitly authorize AME issuance of medical certification at the next examination, due June 2023. Instead, the letter indicated that the FAA would decide about granting another Authorization based on review of required information that should be submitted in advance of that examination. The July 2022 Authorization letter to the pilot stated, "You must present the Authorization to your AME at the time of each FAA medical application." The FAA sent a copy of the letter to the AME that had performed the pilot's June 2021 examination.

The pilot's next aviation medical examination was his most recent examination before the accident. As of the date of that exam, the FAA had not yet received the information required to consider granting another Authorization.

1.3 Most Recent Aviation Medical Examination

The pilot's most recent aviation medical examination was June 1, 2023. The AME who performed the examination had not previously evaluated the pilot. At the examination, the pilot reported 3955 total civilian flight hours. He was 66 inches tall and weighed 160 pounds. He reported a medical history of high blood pressure and atrial fibrillation. He reported using apixaban (a prescription blood-thinning medication that the pilot used to lower the risk of stroke from atrial fibrillation), atorvastatin (a prescription medication commonly used to help control cholesterol and reduce cardiovascular risk), chlorthalidone (a prescription thiazide diuretic medication commonly used to treat high blood pressure), doxazosin (a prescription alpha blocker medication that can be used as part of treatment for high blood pressure or for symptoms of enlarged prostate), eplerenone (a prescription potassium-sparing diuretic medication that can be used as part of treatment for high blood pressure or heart failure), and potassium chloride (a supplement that may be

used to treat low potassium, or to help prevent low potassium in individuals taking diuretics).

Records from the examination did not document that the pilot reported his history of coronary artery disease, heart attack, or CABG, nor did records document that the pilot presented his Authorization letter or otherwise indicated his Special Issuance status to the AME. The AME noted the pilot's atrial fibrillation on physical examination, but did not note the pilot's median sternotomy scar.¹ The AME documented that the pilot met CACI criteria for high blood pressure.² The AME also documented that the pilot's atrial fibrillation had previously been reported to the FAA and was unchanged, asymptomatic, rate controlled, and anticoagulated. Notably, there was no authorized pathway for the AME to issue medical certification to an applicant with atrial fibrillation without first reviewing a letter from the FAA indicating that doing so would be acceptable.³ This was not addressed by the AME's documentation. The AME issued the pilot a third-class medical certificate limited by a requirement to use corrective lenses to meet vision standards at all distances. The AME did not add a time limitation to the certificate.

On June 8, 2023, the FAA received a new set of medical records pertaining to the pilot. By the time the accident occurred on July 15, 2023, the FAA had not yet granted any new Authorization or completed any action to change the status of the pilot's medical certificate.

On July 17, 2023, the FAA sent the pilot a letter stating that the FAA had received a report of his in-flight incapacitation. The letter, which requested additional medical information related to the event and included a reminder about prohibitions

¹ A median sternotomy is a surgical technique involving cutting through the breastbone, which is how the pilot's heart was accessed for his CABG procedures. Median sternotomy typically leaves a large midline chest wall scar. The presence of a sternotomy scar was noted by the AME at the pilot's June 2021 aviation medical examination.

² According to the [CACI Hypertension Worksheet](#) in effect at the time of the pilot's examination, to determine the applicant's eligibility for certification, an AME should review a current, detailed clinical progress note from a treating physician no more than 90 days prior to the AME exam. However, an AME is not required to review a clinical progress note if the AME can otherwise determine that the applicant has had stable clinical blood pressure control on current medication for at least 7 days, without symptoms or medication side-effects, and no treatment changes are recommended. The AME who performed the pilot's last examination did not document reviewing any clinical progress note. An AME may determine that an applicant has CACI-qualified hypertension if the applicant meets all the acceptable certification criteria: treating physician or the AME finds the condition stable on current regimen for at least 7 days and no changes recommended; no symptoms; blood pressure 155/95 or less at examination (the pilot's blood pressure was 145/72); use of up to 3 acceptable medications (the pilot's alpha blocker and diuretic medication classes are acceptable classes); and no side effects from medications. If an AME determines that an applicant has CACI-qualified hypertension, there is no requirement for related documentation to be submitted to the FAA.

³ Such a letter would be an Authorization letter allowing the AME to issue, or other letter from the FAA that monitoring is not required (see the FAA Guide for Aviation Medical Examiners [Atrial Fibrillation Disposition Table](#) in effect at the time of the pilot's examination). The pilot had no such letter.

on operations during medical deficiency, was sent while the pilot was in the hospital, before his death on July 20, 2023.

1.4 Medical Records Periodically Submitted to FAA

The pilot's most recent medical records submitted to the FAA were received on June 8, 2023. These records comprised reports from laboratory studies (collected March 24, 2023), an echocardiogram (performed May 10, 2023), a treadmill stress echocardiogram test (performed May 10, 2023), and a 24-hour Holter monitor study (performed May 10-11, 2023), as well as a letter from the pilot's primary care physician (dated May 17, 2023) and a letter from the pilot's cardiologist (dated May 30, 2023).

The laboratory studies included a complete blood count, comprehensive metabolic panel, thyroid studies, magnesium level, and lipid/cholesterol panel. These showed no significant abnormalities.

The echocardiogram demonstrated a severely enlarged left atrium and a mildly-to-moderately enlarged left cardiac ventricle with mildly increased left ventricular wall thickness and borderline normal left ventricular systolic function (left ventricular ejection fraction 50%). There was motionlessness of the inferior wall of the left cardiac ventricle and abnormal interventricular septal motion. The right atrium and right ventricle were mildly enlarged, with mildly reduced right ventricular systolic function. Estimated pulmonary artery systolic pressure was mildly elevated. Moderate mitral valve regurgitation was present, along with mild tricuspid valve regurgitation and mild aortic valve insufficiency without aortic valve stenosis.

On the treadmill stress echocardiogram test, the pilot exercised for 9 minutes and 13 seconds to stage IV of a standard Bruce protocol, reaching 11 metabolic equivalents and 89% predicted maximum heart rate; these results correspond to an above-average exercise capacity for his age. He had a normal blood pressure response and did not complain of any chest pain during the test, which was terminated due to general fatigue. Resting ECG was interpreted by the cardiologist as showing atrial fibrillation, intraventricular conduction delay, and left anterior fascicular block.⁴ ECG during stress testing was not interpretable for ischemia due to baseline abnormalities. Rare premature ventricular contractions and ventricular couplets were seen on ECG during recovery. The resting and post-stress echocardiograms both showed motionlessness of the entire inferior wall. All remaining scored segments were normal. The interpreting cardiologist concluded that there was no clinical or echocardiographic evidence of exercise-induced

⁴ The resting pretest ECG was contained in the reviewed records and demonstrated findings of intraventricular conduction delay and left anterior fascicular block of a morphology consistent with bifascicular block (right bundle branch block plus left anterior fascicular block). This type of bifascicular block commonly is associated with a history of LAD disease and had been noted previously in the pilot's FAA medical certification file.

myocardial ischemia, and that the findings were similar to the pilot's prior study in 2022.

On the Holter monitor study, the basic rhythm was atrial fibrillation throughout. Interventricular conduction delay was present. The longest pause was 3.4 seconds. The lowest heart rates were in the high 20s/low 30s, during sleeping hours. Average heart rate was 50 beats per minute, and maximum heart rate was 97 beats per minute (a generally acceptable ventricular response rate). There was an intermediate (3.8%) burden of premature ventricular contractions of predominantly one morphology, without any runs of ventricular tachycardia of 4 beats or more. The pilot did not return a symptom diary.

The letter from the pilot's primary care physician (who wrote that he had known the pilot for 2 decades) stated that the pilot underwent an annual complete physical examination visit on May 17, 2023, at which time he was again found to be in overall outstanding health, appearing healthy on physical examination and having well-controlled blood pressures and pulse rates recorded over the previous 7 days. The primary care physician stated that the pilot's high blood pressure was being controlled with the medications chlorthalidone, doxazosin, and eplerenone, with stable results and without side effects of those medications. The physician also noted that the pilot used apixaban without side effects over many years, as well as atorvastatin and potassium chloride, and was extremely compliant with his medications over many years. The physician noted that the pilot continued to be seen annually by a cardiologist, and that the results of his treadmill stress echocardiogram test included outstanding above-average exercise capacity and no evidence for coronary artery obstruction. The primary care physician stated that, in his medical opinion, the pilot continued to be in excellent health with great compliance on medications and monitoring of blood pressure, with outstanding exercise habits and an excellent prognosis.

The letter from the pilot's cardiologist noted the pilot's history of high blood pressure, coronary artery disease with past CABG, and atrial fibrillation. The cardiologist stated that the pilot had an excellent functional capacity, exercised on a treadmill vigorously daily without limitations, had no recurrent angina at a high workload, and continued to be monitored and assessed annually. The cardiologist stated that the treadmill stress echocardiogram test showed that the pilot had the exercise capacity of a typical 40-year-old man, with no evidence of exercise-induced myocardial ischemia. The cardiologist stated that there had been no clinically appreciable change in the pilot's cardiac status over the past several years. The cardiologist also noted that the pilot's atrial fibrillation was asymptomatic and caused no adverse effect on cardiac function, exercise capacity, or heart rate response associated with exercise. The cardiologist stated the Holter monitor study showed adequate heart rate control. The cardiologist noted the pilot was on the blood-thinning medication apixaban for atrial fibrillation. The cardiologist stated that, in

summary, the pilot was in outstanding cardiovascular condition with an excellent prognosis and could continue to exercise without cardiac restrictions.

Overall, records periodically submitted to the FAA supporting the pilot's consideration for continuing medical certification included primary care physician letters every year from 2006 to 2023, treadmill stress echocardiogram tests every year from 2006 to 2023, laboratory reports every year from 2007 to 2023, and cardiologist letters every year from 2008 to 2023. The submitted records also included echocardiograms in 2010, 2011, 2012, 2014, 2016, 2017, 2019, 2020, 2021, 2022, and 2023. Beginning in 2019 (when the pilot's atrial fibrillation was diagnosed), 24-hour Holter monitor study reports were also submitted annually. Other than the new onset of atrial fibrillation identified in April 2019, submitted studies remained relatively stable, and all primary care and cardiology notes characterized the pilot as being in outstanding health with an excellent prognosis. The FAA had not yet completed a review of the records received in 2023 by the time the accident occurred.

2.0 Post-Accident Treatment Records

Following the accident, the pilot was transported to a community hospital, Martha's Vineyard Hospital (MVH), for initial care, prior to being transferred by air ambulance to Boston Medical Center (BMC). Records were reviewed from BMC. These records included medical records from the air ambulance that performed the transfer.

Reviewed records documented that, according to the pilot's wife, the pilot was in his usual state of health until when, during the accident flight, he told her he felt unwell and became pale and unresponsive; she took control of the airplane and landed after about 10-20 minutes. It took about an additional 10 minutes for first responders to extricate the pilot.⁵ He was in cardiac arrest, and cardiopulmonary resuscitation (CPR) was first started after he was extricated. The first rhythm check showed a non-shockable rhythm.⁶ With resuscitative efforts, he regained a pulse, and he was intubated and transported to MVH. At MVH, he experienced cardiac arrest with pulseless electrical activity, and he again regained a pulse with resuscitation. He was started on medication to raise his blood pressure, as it was transiently low, but his blood pressure then became too high, and that medication was stopped. He was transferred to BMC by air ambulance for a higher level of cardiac and trauma care.

The pilot arrived at BMC around 6 PM on the accident date, intubated and sedated. Initial serial ECGs demonstrated atrial fibrillation with a controlled

⁵ These times are according to unverified narrative history information in reviewed records from BMC.

⁶ Reviewed records contained conflicting documentation as to whether this initial rhythm was asystole or pulseless electrical activity.

ventricular rate, without clear findings of acute heart attack (records also documented that the pilot's ECG at MVH was reported as not having had clear findings of acute heart attack). Cardiac biomarkers were elevated, indicative of heart muscle damage. The pilot was not noted to have life-threatening traumatic injuries, although he had multiple bilateral rib fractures after CPR chest compressions. A pulmonary computed tomography angiography study did not show any pneumonia or pulmonary artery clot. The pilot was treated for high potassium in the setting of kidney dysfunction, which was attributed to his post-cardiac-arrest critical illness. He was examined by a neurointensivist with sedation paused and was found to have evidence of anoxic brain injury from his cardiac arrest. He was admitted on a ventilator to the coronary care unit, where he underwent targeted temperature management for neurological protection and was treated with blood thinning medication for possible acute coronary syndrome.⁷ Cardiac catheterization was deferred pending improvement of his neurological status. However, his neurologic status did not improve, his clinical status worsened, and testing (including brain magnetic resonance imaging) indicated he had severe anoxic brain injury, so his care was transitioned to comfort measures only. He was palliatively extubated and died shortly thereafter on July 20, 2023.

During the pilot's hospitalization, an echocardiogram performed on July 16, 2023, showed moderately reduced left heart squeeze (left ventricular ejection fraction 35-40%) with little or no motion of the basal inferior and basal inferolateral segments of the left ventricle; the care team compared these findings to the report of the pilot's May 2023 echocardiogram (images were not available for comparison) and noted worsened left ventricular function without clear evidence of new regional wall motion abnormality. Cardiac monitoring throughout the pilot's hospital stay showed atrial fibrillation without any sustained ventricular arrhythmia. The cause of the pilot's initial cardiac arrest was not definitively diagnosed, but was documented as likely scar-mediated ventricular arrhythmia versus less-likely acute coronary syndrome.

The pilot's medical history and home medications documented in reviewed hospital records were broadly consistent with the history documented in the pilot's FAA medical certification file. Notable exceptions were that one resident note documented the pilot's home medications to include tadalafil, and one pharmacist note indicated that alprazolam was a prior-to-admission medication for the pilot; these medications are discussed further in section D.4.2, "Descriptions of Detected Substances."

⁷ "Acute coronary syndrome" is a collective term for conditions related to sudden reduced coronary blood flow to heart muscle, including but not limited to heart attack. "Heart attack" refers more specifically to sudden reduced coronary blood flow causing heart muscle damage.

3.0 Autopsy

The Commonwealth of Massachusetts Office of the Chief Medical Examiner (OCME) performed the pilot's autopsy. According to the pilot's autopsy report, his cause of death was hypertensive and atherosclerotic cardiovascular disease, and his manner of death was natural. His heart was enlarged, weighing 890 grams (normal heart weight is roughly 250-440 grams for a male of body weight 160 pounds). Left ventricular wall thickness was 2 cm (normal is roughly 0.9-1.6 cm), right ventricular wall thickness was 0.8 cm (normal is roughly 0.2-0.6 cm), and interventricular septal thickness was 2 cm (normal is roughly 1-1.8 cm).⁸ The atria and ventricles were described as not dilated. Coronary artery disease was noted. The LAD had up to 99% narrowing by atherosclerosis (hardened plaque); the bypass graft to the LAD was patent (not blocked). The LCX had up to 99% narrowing by atherosclerosis and also contained a 100% occlusive, 4 cm long, tan-brown blood clot that was described as being located 4.5 cm distal to the ostia. No comment was made about the OM1, OM2, or their grafts, except that the corresponding graft site to the aorta was described as patent. The RCA had up to 90% narrowing by atherosclerosis; the bypass graft (which, according to reviewed FAA records, was to the PDA branch of the RCA) was patent, as was the corresponding graft site to the aorta. The posterior medial aspect of the left cardiac ventricle had a 5 cm × 4 cm × 2 cm area of myocardial fibrosis, and the anterior lateral aspect of the left cardiac ventricle had a 3 cm × 2.6 cm × 1 cm area of myocardial fibrosis. Myocardial fibrosis is scar tissue of the heart muscle that takes weeks to develop after a heart attack.⁹ The aorta displayed moderate-to-severe atherosclerosis. The kidneys displayed tissue changes consistent with chronic high blood pressure. Both lungs exhibited congestion and lower lobe pneumonia. No microscopic examination of tissues was documented.

4.0 Toxicology

4.1 Test Results

According to reviewed post-accident treatment records, hospital testing for ethanol and tricyclic antidepressants was performed at BMC on serum collected from the pilot at 6:09 PM on the accident date; this testing was negative.

At the request of the OCME, the Massachusetts State Police Crime Laboratory performed toxicological testing of antemortem BMC hospital specimens from the pilot. Testing of blood collected at 6:09 PM on the accident date detected fentanyl at 1.5 ng/mL. Screening of the specimen for benzodiazepines also was positive, but the

⁸ 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 Clin Proc.* 1988;63(2):137-146. doi:10.1016/s0025-6196(12)64946-5.

⁹ Schoen FJ. The heart. In: Kumar V, Abbas A, Fausto N, eds. *Robbins and Cotran Pathologic Basis of Disease*. 7th ed. Philadelphia, PA: Elsevier, Inc; 2005:555-618.

specimen quantity was insufficient for further analysis, so this result was not confirmed. Testing of serum/plasma collected at 8:08 PM on the accident date detected the benzodiazepine drug alprazolam at 3.1 ng/mL.

At the request of the NTSB, the OCME provided the FAA Forensic Sciences Laboratory with antemortem serum collected from the pilot during his hospital care at BMC at 10:20 PM on the accident date. The FAA Forensic Sciences Laboratory detected fentanyl, furosemide, atorvastatin, chlorthalidone, doxazosin, and tadalafil, although testing was limited due to limited specimen quantity. Additionally, FAA testing detected alprazolam at 4 ng/mL.

4.2 Descriptions of Detected Substances

Fentanyl is a prescription opioid painkiller. It was administered to the pilot during his medical care after the accident, before the tested specimens were collected, as verified by review of post-accident treatment records.

Furosemide is a prescription loop diuretic medication. It was administered to the pilot during his medical care after the accident, before the FAA-tested specimen was collected, as verified by review of post-accident treatment records.

Atorvastatin is a prescription medication commonly used to help control cholesterol and reduce cardiovascular risk, and was a home medication for the pilot, according to reviewed FAA and hospital records. Chlorthalidone is a prescription thiazide diuretic medication, and doxazosin is a prescription alpha blocker medication; FAA records documented that the pilot used chlorthalidone and doxazosin to help control his high blood pressure. Atorvastatin, chlorthalidone, and doxazosin are not generally considered impairing.

Tadalafil is a prescription medication commonly used to treat erectile dysfunction, as a sexual enhancement aid, and to treat symptoms of an enlarged prostate.¹⁰ It is also sometimes used to treat other conditions, including pulmonary hypertension. Tadalafil was not mentioned in the pilot's FAA medical certification records; in reviewed BMC records, it was documented as a home medication in one resident note. Tadalafil is not typically impairing, although the FAA states that pilots who use it on an as-needed basis should wait 24 hours after use before flying, and that otherwise-qualified pilots who use it daily should undergo a 7-day ground trial before flying, to monitor for side effects.¹¹ Additionally, tadalafil typically carries a

¹⁰ National Institutes of Health National Library of Medicine. Cialis. DailyMed. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=bcd8f8ab-81a2-4891-83db-24a0b0e25895>. Updated November 13, 2024. Accessed February 23, 2025.

¹¹ Federal Aviation Administration. Pharmaceuticals (therapeutic medications) erectile dysfunction and benign prostatic hyperplasia medications. Guide for Aviation Medical Examiners. https://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/ame/guide/pharm/ed/. Updated

warning that use in combination with alpha blocker medication (like doxazosin) may cause symptomatic low blood pressure or fainting in some individuals.¹⁰ The FAA states that, if a pilot uses tadalafil with an alpha blocker, the pilot should not fly until verification that no low blood pressure episodes or other side effects occur.¹¹

Alprazolam, sometimes marketed as Xanax, is a high-potency benzodiazepine drug available as a prescription oral medication commonly used to treat anxiety and panic disorder.¹² Alprazolam sometimes may be used for short-term treatment of insomnia, although the drug is not among the benzodiazepine medications approved for this purpose by the US Food and Drug Administration.¹³ The typical therapeutic range of alprazolam in plasma is about 5-50 ng/mL, and the typical elimination half-life of alprazolam in plasma is about 6-20 hours.¹⁴ Alprazolam can cause sedation and psychomotor impairment, with adverse effects on tracking, attention, and reaction speed.¹⁵ Alprazolam is a federal Schedule IV controlled substance, and alprazolam medication typically carries a warning against engaging in hazardous occupations requiring mental alertness such as operating machinery or driving a motor vehicle.¹² The FAA considers alprazolam to be a “do not fly” medication, and instructs AMEs not to issue medical certificates to pilots who report having an open prescription for chronic use of alprazolam.¹⁶

Reviewed post-accident BMC medication administration records did not show alprazolam as having been administered to the pilot. Reviewed BMC records included records from the air ambulance that transferred the pilot from MVH; the air ambulance records did not list alprazolam among the medications administered to the pilot prior to the air ambulance assuming care (alprazolam is an oral medication and would not typically be the benzodiazepine chosen for emergency administration to an intubated patient). The only mention of alprazolam in reviewed BMC records

August 25, 2017. Accessed February 23, 2025.

¹² National Institutes of Health National Library of Medicine. Xanax. DailyMed. <https://dailymed.nlm.nih.gov/dailymed/drugInfo.cfm?setid=388e249d-b9b6-44c3-9f8f-880eced0239f>. Updated January 18, 2023. Accessed February 23, 2025.

¹³ Neubauer DN. Pharmacotherapy for insomnia in adults. In: Post TW, ed. *UpToDate*. Waltham, MA: UpToDate Inc. <https://www.uptodate.com/contents/pharmacotherapy-for-insomnia-in-adults>. Updated November 12, 2024. Accessed February 27, 2025.

¹⁴ Schulz M, Schmoldt A, Andresen-Streichert H, Iwersen-Bergmann S. Revisited: therapeutic and toxic blood concentrations of more than 1,100 drugs and other xenobiotics. *Crit Care*. 2020;24(1):195. doi:10.1186/s13054-020-02915-5.

¹⁵ Couper F, Huestis M, Fulford J, et al. *Drugs and Human Performance Fact Sheets: 2024*. National Highway Traffic Safety Administration. DOT HS 813 650. December 2024 (Revised). <https://rosap.ntl.bts.gov/view/dot/78924>. Accessed February 23, 2025.

¹⁶ Federal Aviation Administration. Guide for aviation medical examiners: pharmaceuticals (therapeutic medications) do not issue - do not fly. Federal Aviation Administration website. https://www.faa.gov/ame_guide/pharm/dni_dnf. Updated July 10, 2023. Accessed February 23, 2025.

was in a note from a pharmacist reviewing "current home medications and active medication orders" that identified alprazolam as a "prior to admission medication" and recommended discontinuing it if able upon discharge (stating that benzodiazepines increase the risk of cognitive impairment, delirium, falls, and fractures in older patients). The only mention of alprazolam in the pilot's FAA medical certification file was contained within records submitted to the FAA in 2006 related to the pilot's 1996 hospital admission for CABG. In these records, a section of a January 1996, medical/surgical admission history note related to sleep history mentioned that the pilot needed alprazolam to fall asleep.

E. SUMMARY OF MEDICAL FACTS

The 79-year-old male pilot's medical history included high blood pressure since 1970, treated with medications, as well as coronary artery disease with prior heart attack, and coronary artery bypass graft (CABG) procedures in 1981 and 1996. He also had a history of atrial fibrillation since 2019 treated with blood-thinning medication to reduce the stroke risk posed by the condition.

The pilot's 1981 CABG procedure was a single bypass for 99% narrowing of the left anterior descending coronary artery (LAD), which was adversely affecting the motion of the anterior apical heart muscle and was associated with chest pain. The pilot's 1996 CABG procedure was a triple bypass, performed after he presented with chest pain and electrocardiogram (EGC) findings of a prior inferior heart attack, and was newly found to have a 100% blockage of the posterior descending artery (PDA) branch of the right coronary artery (RCA), as well as up to 95% narrowing of the left circumflex coronary artery (LCX), and 90% narrowing of one of the arteries branching off the LCX. The 1996 bypasses were to the PDA and to two of the arteries branching off the LCX.

The pilot's first aviation medical examination after either of his CABG procedures was in 2002. Between 2002 and 2005, there was no documentation that his heart disease was reported to or identified by the FAA. The first aviation medical examination at which the pilot reported a history of coronary artery disease and prior heart attack was in 2006. Between 2006 and 2022, the FAA granted the pilot a series of Authorizations for Special Issuance of third-class medical certification, based on annual medical testing and favorable status reports from the pilot's primary care and cardiology physicians.

The pilot's most recent Authorization for Special Issuance was granted in July 2022. The Authorization letter did not authorize Aviation Medical Examiner (AME) issuance of medical certification at the next examination, due June 2023. Instead, the letter indicated that the FAA would decide about granting the pilot another Authorization based on review of required information that should be submitted in

advance of that examination. The FAA had not yet received that information by the time the examination occurred on June 1, 2023.

At the pilot's June 1, 2023, aviation medical examination, he reported a medical history of high blood pressure and atrial fibrillation. He reported using the medications apixaban, atorvastatin, chlorthalidone, doxazosin, eplerenone, and potassium chloride. Records from the examination did not include any indication that the pilot reported his history of coronary artery disease, heart attack, or CABG to the AME. There also was no indication that the pilot presented his Authorization letter to the AME as required. The AME, who had not previously evaluated the pilot, noted the pilot's atrial fibrillation, documented that the pilot met Conditions AMEs Can Issue criteria for high blood pressure, and did not note any other cardiac history. The AME incorrectly issued the pilot a third-class medical certificate limited by a requirement to use corrective lenses to meet vision standards at all distances.

On June 8, 2023, the FAA received several documents related to the pilot. These included a March 2023 laboratory report, a May 2023 echocardiogram report, a May 2023 treadmill stress echocardiogram report, and a May 2023 report of a 24-hour cardiac monitoring study. Additionally, the FAA received May 2023 letters from the pilot's primary care and cardiology physicians. Similarly to previous such letters in the pilot's FAA medical certification files, these letters characterized the pilot as being in stable, outstanding health, with above-average exercise capacity, great compliance with medications and monitoring, and an excellent prognosis. By the time the accident occurred, the FAA had not granted any new Authorization for Special Issuance or completed any action to change the status of the pilot's medical certificate.

Following the accident, first responders found that the pilot was in cardiac arrest upon extricating him from the airplane. He regained a pulse with resuscitative efforts and was intubated and transported to a community hospital prior to being transferred by air ambulance to Boston Medical Center for a higher level of care. He was not found to have life-threatening traumatic injuries, but he had evidence of anoxic brain injury from his cardiac arrest. He was admitted to the coronary care unit, where he underwent targeted temperature management for neurological protection and was treated with blood thinning medication for possible acute coronary syndrome. Cardiac catheterization was deferred pending improvement of his neurological status. However, his clinical status worsened, and his care was transitioned to comfort measures only. He was palliatively extubated and died on July 20, 2023. During his hospital stay, he did not have any sustained ventricular arrhythmia, nor did he have conclusive electrocardiographic or echocardiographic findings of a new heart attack, although biomarkers indicative of heart muscle damage were elevated following his cardiac arrest. The cause of his initial cardiac arrest was not definitively diagnosed, but was documented as likely scar-mediated ventricular arrhythmia versus less-likely acute coronary syndrome.

The Commonwealth of Massachusetts Office of the Chief Medical Examiner (OCME) performed an autopsy of the pilot. According to the pilot's autopsy report, his cause of death was hypertensive and atherosclerotic cardiovascular disease, and his manner of death was natural. His heart was enlarged, with thickening of the ventricular walls and interventricular septum. Coronary artery disease was noted. The LAD was up to 99% narrowed by plaque; the bypass graft to the LAD was not blocked. The LCX was up to 99% narrowed by plaque and also was blocked by a tan-brown blood clot; the autopsy report did not specify the status of the arteries branching off the LCX or their bypass grafts. The RCA was up to 90% narrowed by plaque; the bypass graft (to the PDA) was not blocked. The posterior medial aspect of the left cardiac ventricle had a 5 cm × 4 cm × 2 cm area of old scar tissue, and the anterior lateral aspect of the left cardiac ventricle had a 3 cm × 2.6 cm × 1 cm area of old scar tissue. There was moderate-to-severe plaque of the aorta. The kidneys displayed tissue changes consistent with chronic high blood pressure. Both lungs exhibited congestion and lower lobe pneumonia.

The pilot's toxicological testing after the accident included negative hospital tests for ethanol and tricyclic antidepressants using serum collected at 6:09 PM on the accident date. Testing performed at the request of the OCME detected alprazolam at 3.1 ng/mL in serum/plasma collected at 8:08 PM on the accident date. Testing performed by the FAA Forensic Sciences Laboratory detected alprazolam at 4 ng/mL, as well as atorvastatin, chlorthalidone, doxazosin, and tadalafil, in serum collected at 10:20 PM on the accident date. Other medications detected by the pilot's toxicological testing were documented in hospital records as having been administered to him after the accident, before tested specimens were collected.

Submitted by:

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