

National Transportation Safety Board

Office of Research and Engineering

Washington, DC 20594



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MEDICAL

Specialist's Factual Report

June 24, 2024

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A. CRASH

Location: Highland, Illinois
Date: July 12, 2023
Time: About 1:48 AM local time

B. MEDICAL SPECIALIST

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C. DETAILS OF THE INVESTIGATION

1.0 Purpose

This investigation was performed to evaluate the surviving 59-year-old male bus driver (driver) for potentially impairing substances and potentially impairing medical conditions.

2.0 Methods

Multiple records related to the driver were reviewed, including pre-crash records from the urgent care clinic where the driver had his most recent commercial motor vehicle (CMV) driver medical fitness examination, pre-crash records from the driver's primary care physician, pre-crash pharmacy records, pre-crash records related to the driver's use of a continuous positive airway pressure (CPAP) device for treatment of obstructive sleep apnea (OSA), post-crash emergency medical services (EMS) and aeromedical transport records, and post-crash hospital and rehabilitation hospital records.

Additionally, at the request of the National Transportation Safety Board (NTSB), the Federal Aviation Administration (FAA) Forensic Sciences Laboratory performed toxicological testing of blood and urine specimens from the driver's initial post-crash medical care; the FAA toxicology report was reviewed. The driver did not undergo United States Department of Transportation post-accident drug or alcohol testing.

NTSB investigators identified that the driver had been involved in a May 2018 crash under circumstances that appeared to have similarities to the 2023 crash. Additional information about the circumstances of the 2018 crash is documented in the NTSB Human Performance Specialist's factual report. Selected medical records relating to the 2018 crash were reviewed for medical evidence relevant to the 2023 crash. These comprised hospital records, workers' compensation claim records

containing medical records related to the 2018 crash, and records from the urgent care clinic where the driver had his CMV driver medical fitness examination for return to duty after the 2018 crash.

D. FACTUAL INFORMATION

1.0 Pre-Crash Medical Records

1.1 Urgent Care Records and Driver Medical Certification

Records were requested from the 3 years prior to the crash from the urgent care clinic at which the driver underwent his most recent CMV driver medical fitness examination. Received records included Medical Examination Report (MER) Forms from multiple CMV driver medical fitness examinations since 2020. Multiple such examinations documented that the driver had a history of high blood pressure treated with one common first-line prescription medication, diabetes treated with one common first-line prescription medication (an oral medication with low risk of causing low blood sugar), and obstructive sleep apnea (OSA) treated with a continuous positive airway pressure (CPAP) device.¹ The driver's responses to MER Form questions about his health history did not include any reported history of head/brain injury/illness, seizure, or stroke.²

The driver's most recent CMV driver medical fitness examination before the crash was on April 24, 2023. At that time, the driver reported his high blood pressure/medication, diabetes/medication, and use of CPAP for OSA. The examining physician found the driver to meet standards for medical certification, wearing corrective lenses, with periodic monitoring required for high blood pressure. The driver was issued a 1-year medical certificate.

Reviewed records from the urgent care clinic included various CPAP compliance reports which were provided by the driver at CMV driver medical fitness examinations. The most recent such report was provided by the driver to the examiner at the April 24, 2023, CMV driver medical fitness examination. This report covered the preceding 90 days and indicated that the driver was generally adherent with CPAP treatment during that period.³

¹ In OSA, a person's upper airway soft tissues collapse during sleep, causing the person to have repeated episodes during which breathing temporarily stops (apnea) and/or becomes ineffective (hypopnea). CPAP treatment can reduce these episodes.

² An example MER Form, including medical history and examination components, may be viewed at [49 Code of Federal Regulations 391.43\(f\)](#).

³ The driver's April 2023 compliance report showed CPAP usage of at least 4 hours per night on more than 70% of nights over the preceding 90 days. There is no Federal Motor Carrier Safety Administration (FMCSA) standard for minimum CPAP compliance in CMV drivers with OSA. In 2016, the FMCSA Motor Carrier Safety Advisory Committee (MCSAC) and Medical Review Board (MRB) jointly recommended that CPAP usage of at least 4 hours

1.2 Primary Care Records

Records were requested from the 3 years prior to the crash from the practice of the driver's most recent primary care physician. Received records included notes from several visits since 2020. The records documented the driver's history of high blood pressure and diabetes, treated with the same medications that the driver had reported at his CMV driver medical fitness examinations. Additionally, the primary care records documented obesity, as well as high cholesterol treated (since late 2022) with one common first-line prescription medication. Documented medications did not include any medications that are generally considered impairing. The driver's occupation as a bus driver was documented. The reviewed primary care records did not document the driver's history of OSA. No history of concussion, stroke, or seizure was documented.

The driver's most recent primary care visit before the crash was in May 2023, for routine follow up of his diabetes. His hemoglobin A1c (HbA1c) was measured on the date of that visit, and his physician noted that it was on-goal.⁴ The physician also noted that the driver's high blood pressure was stable on treatment. No changes were made to the driver's medications.

1.3 Pharmacy Record

Reviewed pre-crash records from a pharmacy used by the driver documented the three prescription medications that were documented in his primary care records (medications for high blood pressure, diabetes, and high cholesterol). The most recent fill date of these three medications documented in the reviewed pharmacy records was 120 days before the crash, for a 90-day supply.

1.4 CPAP Usage Before Crash

A report of the driver's CPAP compliance was obtained for June 27, 2023, through the July 12, 2023, crash date. According to this report, the driver's CPAP usage totaled 4 hours or greater on 64% of 24-hour noon-to-noon periods for the 14 such periods prior to the crash period. The reported apnea-hypopnea index (AHI)

per night on 70% of nights be considered a minimum threshold for adequate adherence to treatment, but this recommendation was advisory only (additional information may be found in the 2024 FMCSA [Medical Examiner's Handbook](#)). According to the NTSB Human Performance Specialist's factual report, a Greyhound-developed safety manual documented the company's internal policy that, for its drivers with OSA, all CPAP compliance reports must "be at a minimum of 70% before [medical] cards can be issued" (no hours-per-night threshold stated). This guidance is distributed by Greyhound to specific clinics approved by the company to perform medical fitness examinations for its drivers. Additional information about Greyhound's OSA policies is contained in the NTSB Human Performance Specialist's factual report.

⁴ HbA1c is an indirect measure of a person's average blood sugar over approximately the preceding 3 months. In general, HbA1c of less than 7% indicates control of diabetes. The driver's HbA1c was less than 7% on the date of his May 2023 primary care visit.

over this date range was normal on CPAP.⁵ According to a graphical record of the times of the driver's CPAP use, in the 72 hours before the crash, he used CPAP from shortly past 10 PM on July 9 to shortly past 5 AM on July 10 (about 7 hours), and from shortly past 11 PM on July 10 to about 5:30 AM on July 11 (almost 6.5 hours).⁶

2.0 Post-Crash Medical Records

2.1 Prehospital Records

According to emergency medical services (EMS) records from an advanced life support ambulance that responded to the crash, paramedics assumed care of the driver from fire department personnel at 2:52 AM (about an hour after the crash). At that time, the driver was responsive only to pain and was not communicating verbally. His blood sugar was checked at 2:55 AM and was 183 mg/dL.⁷ An electrocardiogram was performed at 3:09 AM and did not show rhythm disturbance. Paramedics recorded the driver's Glasgow Coma Scale (GCS) score as 10 at 2:55 AM, 3:09 AM, and 3:20 AM, based on spontaneous eye opening, making incomprehensible sounds (inconsolable/agitated), and withdrawing from painful stimuli.⁸ The driver was noted to cry out when his lower extremity was palpated. At 3:12 AM, paramedics gave the driver an intravenous analgesic dose of a dissociative anesthetic medication for pain control. A helicopter EMS crew subsequently arrived on scene and assumed care of the driver.

According to records from the helicopter EMS crew, their first contact with the driver was at 3:18 AM. At that time, the driver had an altered level of consciousness, would open his eyes when stimulated with a sternal rub, and was following some commands, but was not responding verbally. No obvious external evidence of head trauma was noted. A GCS score of 9 (opens eyes to painful stimulation, no verbal/vocal response, obeys commands) was documented at 3:24 AM. The driver was transported by helicopter to the hospital emergency department (ED). During the flight, the driver's level of consciousness gradually improved, and he did not

⁵ The severity of OSA often is classified by the AHI, which is the number of apnea and hypopnea episodes that occur per hour of sleep. An AHI of less than 5 is normal. Mild OSA corresponds to an AHI of 5 to less than 15, moderate OSA corresponds to an AHI of 15 to 30, and severe OSA corresponds to an AHI of more than 30.

⁶ The specific times of day recorded by the CPAP machine are unvalidated.

⁷ Generally, a person's blood sugar varies throughout the day in response to multiple factors (for example, blood sugar may increase in response to eating a meal or being under physiological stress). In many adults with diabetes, target peak blood sugar after eating is less than 180 mg/dL. Blood sugar typically is considered to be low if below 70 mg/dL.

⁸ The GCS is a widely used tool for describing a person's level of consciousness. Total GCS score is a sum of a score of 1-4 for eye opening, 1-5 for best verbal response, and 1-6 for best motor response. Higher scores are better, with total scores ranging from 3 at worst (no eye opening and no verbal or motor response) to 15 at best (spontaneous eye opening, oriented, obeys commands).

receive additional medication. His GCS score at 3:44 AM was 12 (opens eyes to verbal stimulation, confused, localizing pain), and at 4:10 AM his GCS score was 14 (opens eyes spontaneously, confused, obeys commands). When the driver's care was transferred to the emergency department, he was documented by EMS as alert and answering questions but slow to respond.

2.2 Hospital Records

According to hospital records, the driver's arrival triage vital signs were recorded at 4:21 AM. The ED provider noted that the driver had a GCS score of 14 for confusion but did not appear to have any focal neurologic deficit and did not have external evidence of head injury on physical examination. The driver had tenderness of multiple body areas and was evaluated for injuries with computed tomography (CT) and plain film imaging. Hospital records documented that the driver was given a benzodiazepine medication for agitation to facilitate obtaining imaging. Initial CT imaging began at 4:31 AM. No findings of acute injury were noted on any of the driver's imaging studies. A non-contrast head CT was among these studies; the radiology interpretation of the head CT did not note any abnormality. Laboratory studies did not identify any evidence of significant metabolic disturbance.

An ED note at 9:59 AM documented that the driver had had an unspecified mental status change and that a repeat non-contrast head CT would be obtained. The repeat head CT was performed at 10:13 AM. The radiology interpretation, which was cosigned by an attending neuroradiologist, did not note any abnormalities.

The driver remained in the ED for hours pending imaging results and sobriety from the effects of the medications he had been administered after the crash. While the driver was in the ED, he was seen in consultation by the hospital trauma surgery service. The trauma surgery consultation note documented that the driver had pain in multiple sites and some confusion, but did not have external evidence of head injury, abrasions or lacerations, or any acute concerns identified on imaging and labs. An ED note at 12:22 PM documented that the driver was cleared for discharge from a trauma surgery perspective. However, an ED note at 3:16 PM documented that the driver was unable to walk and almost fell. The trauma surgery service decided to admit the driver for observation.

While in the hospital, the driver was evaluated by hospital occupational therapy (OT) and physical therapy (PT) providers. OT documented that the driver had impaired cognition with decreased short-term memory based on screening (Montreal Cognitive Assessment). PT documented that the driver appeared to have soft tissue strain injuries based on physical examination. PT and OT documented that the driver's mobility and functional status was worse than his reported prior baseline, at which he had been independent with walking and activities of daily living. Inpatient

rehabilitation was recommended, and the driver was discharged to a rehabilitation hospital on July 14, 2023.⁹

Documentation of the driver's past medical history and home medications in reviewed hospital records was generally consistent with documentation in reviewed pre-crash medical records. No incidental findings of significant natural disease were identified in the radiology interpretations of hospital imaging studies performed to evaluate the driver's injuries.

2.3 Toxicology

According to post-crash hospital records, a blood specimen collected from the driver at 4:58 AM on the crash date tested negative for ethanol. A urine drug screen collected at 5:10 AM on the crash date did not detect any tested-for substances.¹⁰

At the request of the NTSB, the FAA Forensic Sciences Laboratory performed toxicological testing of blood and urine specimens from the driver's initial post-crash medical care. FAA testing detected the driver's prescribed blood pressure and diabetes medications in blood and urine. These medications are not generally considered impairing. All other substances detected by FAA toxicological testing could be attributed to medications administered to the driver during his initial post-crash care, as corroborated by review of his post-crash EMS and hospital records.

2.4 Rehabilitation Hospital Records

Records were reviewed from the rehabilitation hospital to which the driver was admitted on July 14, 2023, after his discharge from the hospital where he received his initial post-crash care. According to pre-admission information documented in rehabilitation hospital records, the driver's diagnoses included altered mental status after motor vehicle collision and acute pain related to trauma. The admitting physical medicine and rehabilitation physician documented that the driver had debility in the setting of his motor vehicle collision, with musculoskeletal pain resulting in decreased mobility, traumatic brain injury (likely concussion), and impaired cognition.

While in the rehabilitation hospital, the driver worked with PT, OT, and speech and language pathology providers for treatment of his cognitive and functional/mobility impairment. An internal medicine physician followed the driver in consultation for his diabetes and other pre-existing medical issues. Screening performed in the rehabilitation hospital did not identify depression.

⁹ As documented in the trauma surgery discharge summary, the driver's discharge diagnoses included unspecified altered mental status, as well as examination following motor vehicle collision with no apparent injury.

¹⁰ Tested-for substances on the hospital urine drug screen were amphetamines, barbiturates, benzodiazepines, cannabinoids, cocaine metabolite, fentanyl, methadone, opiates, oxycodone, and phencyclidine.

Rehabilitation hospital records documented that the driver underwent magnetic resonance imaging (MRI) of his brain on July 28, 2023 (16 days after the crash). The reason for this imaging was documented as left-sided weakness, although reviewed records did not otherwise document that the driver had a focal neurological deficit. The impression of the interpreting neuroradiologist was that the MRI showed no acute findings. A few punctate hyperintensities were seen in the white matter of both brain hemispheres, and an old lacunar infarct (stroke) was seen in the right thalamus. The infarct was noted by the admitting physician to be an incidental finding.

The driver progressed towards his rehabilitation goals and was discharged home after 3 weeks in the rehabilitation hospital.

3.0 Records Related to 2018 Crash

Following the 2018 crash, the driver was taken to a community hospital ED. The ED physician note and radiology imaging reports from this visit were included in reviewed workers' compensation claim records maintained by Greyhound's claims management provider. According to the 2018 ED physician note, the driver was initially awake, alert, and oriented, without evidence of confusion. He complained of leg pain; imaging for fracture was negative. He was not found to have any external evidence of head injury on physical examination. He received an oral dose of a benzodiazepine medication and an anti-inflammatory pain medication. Several hours after his arrival, he was set to be discharged home; however, when his wife arrived to pick him up, she noted he seemed confused. On reassessment, the ED physician also noted confusion, and documented a concern that the driver may have had a mini-stroke prior to the crash, or a head injury and post-concussive symptoms after the crash. The ED physician ordered additional diagnostic studies, including a head CT, which did not show any acute intracranial abnormality. The ED physician arranged for the driver, who had persistent symptoms, to be transferred to a hospital ED closer to the driver's home for further neurological evaluation.

Records were obtained and reviewed from the receiving hospital to which the driver was transferred following the 2018 crash. The ED physician at the receiving hospital documented that the driver had a GCS score of 14, with cognitive delay and waxing/waning amnesia to pre- and post-crash events, without focal neurological deficits or external evidence of head trauma. The driver was admitted by the hospital medicine service and underwent a brain MRI and an electroencephalogram (EEG). The brain MRI was performed on the date of the 2018 crash and was interpreted by the radiologist as showing no acute abnormalities; there was minimal hyperintensity in the periventricular white matter compatible with chronic small vessel disease. The EEG was also performed on the date of the crash and was interpreted to be normal for awake, drowsy, and sleep states, without evidence of seizure activity. The driver was discharged home after 2 days in the hospital. According to the admitting

physician's discharge note, the driver's mental status had improved. The driver's discharge diagnoses included acute encephalopathy secondary to post-concussive syndrome.

Workers' compensation claim records included documentation of an urgent care visit by the driver the day after his hospital discharge, for back pain. At that visit, the provider noted that the driver was still confused; he was unable to identify the day of the week, had difficulty recounting his medical history, and had a blunt affect. The urgent care provider noted that the driver's wife had set up a follow-up appointment with a neurologist and instructed the driver to keep that appointment and remain off work until re-evaluated.

Workers' compensation claim records also included documentation of the driver's neurology visit, which took place in June 2018. In the visit note, the neurologist documented that the driver complained of memory loss, and that his wife had noticed forgetfulness and changes to his behavior. The neurologist reviewed records from the driver's post-crash hospitalization, including the MRI results. The neurologist did not identify focal neurological deficits on the driver's physical examination. The neurologist administered cognitive screening (score not abnormal) and a post-concussion symptoms questionnaire (multiple symptoms in prior 24 hours reported), and documented on a State of Nevada "Physician's Progress Report - Certification of Disability" (D-39) form that the driver had findings of cognitive impairment and behavioral changes.¹¹ No certification of disability or release to duty was recorded on the D-39 form, which indicated that determination of the driver's condition was pending. The neurologist provided instructions for the driver to schedule a sleep-deprived extended EEG test and to follow up with neurology after testing was complete.¹²

The driver's workers' compensation claim was denied five days later, on the date that the neurology visit documentation was faxed to Greyhound's claims management provider. There was no indication in reviewed workers' compensation records that the driver completed a sleep-deprived EEG or had further follow up with the neurologist. The driver contested the claim denial, and workers' compensation records indicate that there was ongoing dispute related to the driver's permanent disability status, for which the driver had requested an independent medical

¹¹ Current versions of State of Nevada workers' compensation forms and worksheets, including the D-39 form, may be viewed at https://dir.nv.gov/WCS/Workers_Compensation_Forms_and_Worksheets/.

¹² Separate records provided by Greyhound included a copy of another D-39 form that carried the date of the June 2018 neurology visit and the signature of the neurologist, with the visit note attached. Unlike the D-39 form in the records of Greyhound's claims management provider, the other D-39 form was marked to indicate no ratable disability, no planned treatment, no further required diagnostic studies, and no next visit date, with the driver released to full duty on the date of the visit. The D-39 appeared to be marked as having been transmitted from the neurologist's office in September 2018. There was no indication in reviewed records that this form was reviewed as part of the driver's return-to-duty medical fitness evaluation.

examination. Reviewed workers' compensation records did not indicate that this examination had yet been scheduled.

A September 2018 CMV driver medical fitness examination was the first such examination documented in reviewed urgent care records from after the 2018 crash. The driver reported his history of head injury at that examination. The examiner noted the history and commented that there was no history of coma, seizure, stroke, or mini-stroke, and that the driver was asymptomatic.¹³ A sleep evaluation worksheet completed at the visit identified the driver as being at risk for OSA. The examiner issued him a 3-month medical certificate and instructed him to obtain a sleep study. The driver underwent a two-night home sleep study in December 2018; his AHI was in the mild OSA range on the first night, and the moderate OSA range on the second night. The driver did not report his history of head injury at his next CMV driver medical fitness examination in December 2018, or at any subsequent such examination in reviewed records.

E. SUMMARY OF MEDICAL FACTS

1.0 2023 Crash

The driver had a history of high blood pressure treated with one common first-line prescription medication, diabetes treated with one common first-line prescription oral medication, obstructive sleep apnea (OSA) treated with a continuous positive airway pressure (CPAP) device, high cholesterol treated with one common first-line prescription medication, and obesity. The driver's most recent CMV driver medical fitness examination before the crash was on April 24, 2023. The examining physician reviewed the driver's CPAP adherence records from the preceding 90 days. The examiner found the driver to meet standards for medical certification, wearing corrective lenses, with periodic monitoring required for high blood pressure. The driver was issued a 1-year medical certificate. The driver's most recent primary care visit before the crash was in May 2023, for routine follow up of his diabetes. His hemoglobin A1c (HbA1c) was on-goal at that time and his high blood pressure was documented as being stable on treatment. The driver's CPAP usage totaled 4 hours or greater on 64% of 24-hour noon-to-noon periods for the 14 such periods prior to the crash period. The reported apnea-hypopnea index on CPAP over this date range was normal. In the 72 hours before the crash, the driver used CPAP from shortly past 10 PM on July 9 to shortly past 5 AM on July 10 (about 7 hours), and from shortly past 11 PM on July 10 to about 5:30 AM on July 11 (almost 6.5 hours).

¹³ The driver answered "yes" to an MER Form question about whether he had ever had "stroke, mini stroke (TIA), paralysis, or weakness." However, the examiner noted this to be crash-related and separately documented the absence of any stroke or mini-stroke history. No other MER Form reviewed for this investigation included a "yes" answer to this question.

Upon paramedics' arrival after the crash, the driver was initially responsive only to pain and was not communicating verbally. He was transported to the hospital emergency department (ED) by air ambulance, and his mental status improved during transport. In the hospital, he was alert but had some persistent confusion. He had no obvious external physical evidence of head injury and his head computed tomography (CT) imaging did not identify any abnormality. Head CT was repeated several hours later due to a mental status change; again, no abnormality was identified. The driver was initially cleared for discharge from the perspective of the hospital trauma surgery service; however, the driver was unable to walk safely, so was admitted. While in the hospital, the driver was evaluated by hospital occupational therapy (OT) and physical therapy (PT) providers. OT documented that the driver had impaired cognition with decreased short-term memory. PT documented that the driver appeared to have soft tissue strain injuries based on physical examination. PT and OT documented that the driver's mobility and functional status was worse than his reported prior baseline, at which he had been independent with walking and activities of daily living. Inpatient rehabilitation was recommended, and the driver was discharged to a rehabilitation hospital on July 14, 2023.

The admitting physician at the rehabilitation hospital documented that the driver had debility in the setting of his motor vehicle collision, with musculoskeletal pain resulting in decreased mobility, traumatic brain injury (likely concussion), and impaired cognition. While in the rehabilitation hospital, the driver worked with PT, OT, and speech and language pathology providers for treatment of cognitive and functional/mobility impairment. The driver progressed towards his rehabilitation goals and was discharged home after 3 weeks in the rehabilitation hospital.

Rehabilitation hospital records documented that the driver underwent magnetic resonance imaging (MRI) of his brain on July 28, 2023 (16 days after the crash). The reason for this imaging was documented as left-sided weakness, although reviewed records did not otherwise document that the driver had a focal neurological deficit. The MRI showed no acute findings. A few punctate hyperintensities were seen in the white matter of both brain hemispheres, and an old lacunar infarct (stroke) was seen in the right thalamus. The infarct was noted as an incidental finding by the admitting physician at the rehabilitation hospital.

A blood specimen collected from the driver at 4:58 AM on the crash date tested negative for ethanol at the hospital. A hospital urine drug screen collected at 5:10 AM on the crash date did not detect any tested-for substances. At the request of the NTSB, the FAA Forensic Sciences Laboratory performed toxicological testing of blood and urine specimens from the driver's initial post-crash medical care. FAA testing detected the driver's prescribed blood pressure and diabetes medications in blood and urine. These medications are not generally considered impairing. The driver did not undergo United States Department of Transportation post-accident drug or alcohol testing.

2.0 2018 Crash

Following his May 2018 crash, the driver was taken to a community hospital ED. He was initially alert without obvious confusion or external physical evidence of head injury. After his evaluation he was set to be discharged, but was then noted to be confused. The ED physician ordered additional diagnostic studies, including a head CT, which did not show any acute intracranial abnormality. The driver was transferred to another hospital, where he was admitted and underwent a brain MRI and an electroencephalogram (EEG) on the 2018 crash date. The brain MRI showed no acute abnormalities; there was minimal hyperintensity in the periventricular white matter compatible with chronic small vessel disease. The EEG was normal, without evidence of seizure activity. The driver was discharged home after 2 days in the hospital, diagnosed with acute encephalopathy secondary to post-concussive syndrome.

The driver's subsequent follow-up included a neurology visit in June 2018, at which he was noted to have some cognitive impairment and behavioral changes without focal neurological deficits. The driver was given instructions for additional EEG testing and neurology follow up. However, his worker's compensation claim was denied shortly thereafter. The driver contested this denial and his workers' compensation claim was unresolved as of the 2023 crash date.

A September 2018 CMV driver medical fitness examination was the first such examination in reviewed urgent care records from after the 2018 crash. The driver reported his history of head injury at that examination only. The examiner noted that the driver was asymptomatic and had no history of coma, seizure, stroke, or mini-stroke. The driver was identified as being at risk for OSA and was issued a 3-month medical certificate with instructions to obtain a sleep study. Results of a two-night home sleep study in December 2018 were in the mild OSA range on the first night and the moderate OSA range on the second night.

Submitted by:

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