



National Transportation Safety Board

Washington, D.C. 20594

Safety Recommendation

Date: October 20, 2009

In reply refer to: M-09-14 through -16

Admiral Thad W. Allen
Commandant
U.S. Coast Guard
2100 Second Street, SW
Washington, DC 20593-0001

Accident Experience

The National Transportation Safety Board (NTSB) has investigated a number of accidents and incidents in all modes of passenger transportation involving operators with sleep disorders. These accidents include two major marine accidents involving pilots with obstructive sleep apnea (OSA).

On June 23, 1995, about 1:42 a.m., a pilot directing the maneuvering of the cruise ship *Star Princess*, which was carrying 1,568 passengers and 639 crewmembers through Alaska's Inside Passage, grounded the ship on a submerged, but well-known, charted and marked rock.¹ The vessel's bottom sustained significant damage on the starboard side and was subsequently piloted to safe anchorage to assess damage and disembark passengers. No injuries or deaths resulted, but the total cost from required repairs and the delay before the vessel could return to service was estimated at over \$27 million. The pilot was obese, a loud snorer, and excessively sleepy during the day, and an evaluation performed at a sleep disorders center approximately 4 months following the accident resulted in a diagnosis of severe OSA. The NTSB determined that the probable cause of the grounding was the pilot's poor performance, which may have been exacerbated by chronic fatigue caused by OSA.

The issue of OSA re-emerged during the investigation of the 2007 allision of the *Cosco Busan* with the fendering system of the San Francisco-Oakland Bay Bridge.² In this investigation, the NTSB found that the pilot had reported a history of OSA to the U.S. Coast Guard. Though investigators did establish through review of the pilot's medical records that the

¹ *Grounding of the Liberian Passenger Ship Star Princess on Poundstone Rock, Lynn Canal, Alaska, June 23, 1995*, Marine Accident Report NTSB/MAR-97/02 (Washington, DC: National Transportation Safety Board, 1997).

² *Allision of Hong Kong-Registered Containership M/V Cosco Busan with the Delta Tower of the San Francisco-Oakland Bay Bridge, San Francisco, California, November 7, 2007*, Marine Accident Report NTSB/MAR-09/01 (Washington, DC: National Transportation Safety Board, 2009).

OSA itself was treated, and not contributory to the accident, the Coast Guard had not required any additional documentation to establish the adequacy of the pilot's treatment for the disorder.

Accidents and incidents in other transportation modes have also highlighted the critical importance of screening for and effectively treating OSA among transportation operators. In a recent aviation incident, both commercial pilots fell asleep, passing over their intended destination airport in Hilo, Hawaii.³ The NTSB determined that the probable cause of this incident was the captain and first officer inadvertently falling asleep during the cruise phase of flight. The captain, who had multiple risk factors for OSA, was subsequently diagnosed with the disorder, and his undiagnosed (and untreated) OSA was found to be a factor in the incident. In a fatal rail accident in Clarkston, Michigan, the engineer of a train that proceeded through a stop indication, striking another train, was found to be at very high risk for OSA but had never been formally diagnosed or treated, and the conductor was found to have been diagnosed with OSA but had not been tested to determine if his treatment was effective.⁴ The probable cause of that rail accident was determined to be the crewmembers' fatigue, which was primarily due to the engineer's untreated and the conductor's insufficiently treated OSA. In a highway accident near Jackson, Tennessee, a tractor-trailer driver with clear risk factors for and a diagnosis of OSA collided with a Tennessee Highway Patrol vehicle trailing construction vehicles, killing the state trooper inside.⁵ The NTSB found that the driver's (unreported) OSA, his untreated hypothyroidism, or complications from either or both conditions predisposed him to impairment or incapacitation, including falling asleep at the wheel while driving. The NTSB determined that the probable cause of the accident was the driver's incapacitation, owing to the failure of the medical certification process to detect and remove a medically unfit driver from service.

Previous Recommendations

As a result of the *Star Princess* accident, the NTSB issued the following recommendation to the Coast Guard:

Review, in consultation with experts in occupational health, your medical standards, guidelines, and examination forms to ensure that they require the disclosure and appropriate evaluation of the history or presence of any medical conditions, symptoms, or medication use that would affect an individual's fitness to pilot a vessel. (M-97-42)

This recommendation was classified "Closed—Acceptable Action" after the Coast Guard revised Form 719K (Merchant Mariner Physical Examination Report) in January 2002.

³ Aviation Accident Brief, Hilo, Hawaii, February 13, 2008:

<http://www.nts.gov/ntsb/brief2.asp?ev_id=20080222X00229&ntsbno=SEA08IA080&akey=1>.

⁴ *Collision of Two Canadian National/Illinois Central Railway Trains near Clarkston, Michigan, November 15, 2001*, Railroad Accident Report NTSB/RAR-02/04 (Washington, DC: National Transportation Safety Board, 2002).

⁵ *Work Zone Collision Between a Tractor-Semitrailer and a Tennessee Highway Patrol Vehicle, Jackson, Tennessee, July 26, 2000*, Highway Accident Report NTSB/HAR-02/01 (Washington, DC: National Transportation Safety Board, 2002).

Also as a result of the *Star Princess* accident, the NTSB made the following recommendation to the Coast Guard, the State Pilot Commissions, the Alaska Coastwise Pilot Association, the San Diego Bay Pilots Association, Inc., and the American Pilots' Association:

Advise pilots about the effect of fatigue on performance and about sleeping disorders such as sleep apnea (Safety Recommendations M-97-41, -44, -49, -51, and -54).

These recommendations were classified "Closed—Acceptable Action" after the addressees took action to ensure that pilots were informed about the circumstances of the *Star Princess* accident, the effects of fatigue, and the relevance of the medical condition identified.

Obstructive Sleep Apnea

OSA is a condition in which individuals obstruct their own airways while sleeping, typically resulting in hypoxia at night, interruptions in breathing lasting several seconds at a time, loud snoring, and non-restful sleep. They are frequently entirely unaware of the condition. Individuals with the disorder may have extreme daytime sleepiness and often fall asleep within minutes in a quiet or monotonous environment. OSA is associated with significant cognitive and psychomotor deficits, which are at least partially reversible with appropriate treatment.⁶ Such deficits are particularly problematic during many marine operations, in which critical decisions must often be made under demanding conditions. Accident rates have been shown to be considerably higher in drivers with OSA than in those without the disorder, with one case-control study demonstrating a more than six-fold higher risk of traffic accidents in drivers with OSA, after controlling for other possible confounding factors.⁷ In addition to the substantial risks of impairment or incapacitation as a direct result of the fatigue associated with OSA, the untreated disorder increases the likelihood of other operationally relevant medical conditions, including stroke, heart failure, coronary artery disease, and diabetes.

The condition is formally diagnosed through polysomnography, extensive monitoring done as part of a sleep study in which the patient sleeps under controlled conditions. If diagnosed, OSA can be effectively treated, usually through the use of a continuous positive airway pressure (CPAP) device worn at night to deliver air pressure that forces the airway open. Most modern CPAP devices are capable of recording detailed information regarding use. In some cases, surgery may be recommended to modify the individual's anatomy to allow the airway to remain unobstructed during sleep.

Obesity and high blood pressure are significantly associated with an increased risk for OSA. In one study, the prevalence of OSA was more than 50 percent in patients with an average body mass index (BMI)⁸ of 40.0.⁹ Another study found that 96 percent of male patients with

⁶ L. Ferini-Strambi and others, "Cognitive Dysfunction in Patients with Obstructive Sleep Apnea (OSA): Partial Reversibility after Continuous Positive Airway Pressure (CPAP)," *Brain Research Bulletin*, vol. 61, no. 1 (2003), pp. 87–92.

⁷ J. Teran-Santos, A. Jimenez-Gomez, and J. Cordero-Guevara, "The Association Between Sleep Apnea and the Risk of Traffic Accidents, Cooperative Group Burgos-Santander," *New England Journal of Medicine*, vol. 340, no. 11 (1999), pp. 847–51.

⁸ Body mass index is a person's weight in kilograms divided by height in meters squared. An index of 30 or more is defined as obese by the National Institutes of Health.

resistant hypertension (high blood pressure poorly controlled despite the use of three or more antihypertensive agents) had unsuspected OSA.¹⁰ A 2006 consensus statement from the Joint Task Force of the American College of Chest Physicians, American College of Occupational and Environmental Medicine, and the National Sleep Foundation on screening for OSA recommended that a BMI of 35 or higher and hypertension that cannot be controlled on less than two medications trigger a formal evaluation for OSA.¹¹ Although these guidelines were directed at commercial drivers, they serve to highlight the risk associated with obesity and high blood pressure.

A 2002 review of the epidemiology of OSA estimated that roughly 7 percent of adults have at least moderate OSA.¹² The U.S. Coast Guard Medical Evaluations Branch reviews approximately 25 percent of the applications from the nearly 300,000 mariners who require certification examinations.¹³ The Medical Evaluations Branch reports that about 2.5 percent of the mariner applications that come for medical review by an evaluator have an established diagnosis of OSA, and since all applications with a diagnosis of OSA require such review, it is likely that less than 1 percent of the certified mariner population subject to medical examination has reported such a diagnosis. The Medical Evaluations Branch also notes that more than 10 percent of mariners undergoing medical review have a BMI greater than 40. The percentage of mariners subject to medical examination with a BMI greater than 40 who do not undergo medical review is unknown. Given the prevalence of OSA in the general population, the prevalence of markedly elevated BMI in the mariner population undergoing medical review, and the strong association between obesity and OSA, it is likely that the actual prevalence of OSA in the mariner population is several times higher than the number of reported cases would indicate.

U.S. Coast Guard Guidance

The recently revised *Navigation and Vessel Inspection Circular on Medical and Physical Evaluation Guidelines for Merchant Mariner Credentials* (NVIC 04-08) contains guidelines for the evaluation of mariners diagnosed with OSA and suggests the following action for mariners with such a diagnosis:

Submit all pertinent information and current status report from a qualified sleep medicine specialist. Include sleep study with a polysomnogram, use of medications and titration study results. If surgically treated, should have post-operative polysomnogram to document cure or need for further treatment.

⁹ O. Resta and others, "Sleep-Related Breathing Disorders, Loud Snoring and Excessive Daytime Sleepiness in Obese Subjects," *International Journal of Obesity and Related Metabolic Disorders*, vol. 25, no. 5 (2001), pp. 669–75.

¹⁰ A.G. Logan and others, "High Prevalence of Unrecognized Sleep Apnoea in Drug-Resistant Hypertension," *Journal of Hypertension*, vol. 19 (2001), pp. 2271–2277.

¹¹ N. Hartenbaum and others, "Sleep Apnea and Commercial Motor Vehicle Operators: Statement from the Joint Task Force of the American College of Chest Physicians, American College of Occupational and Environmental Medicine, and the National Sleep Foundation," *Journal of Occupational and Environmental Medicine*, vol. 48, no. 9 (supplement) (2006), pp. S4–37.

¹² T. Young, P.E. Peppard, and D.J. Gottlieb, "Epidemiology of Obstructive Sleep Apnea: A Population Health Perspective," *American Journal of Respiratory and Critical Care Medicine*, vol. 165, no. 9 (2002), pp. 1217–39.

¹³ Personal communication with Chief, Medical Evaluations Branch, U.S. Coast Guard National Maritime Center.

NVIC 04-08 does not contain guidance regarding the identification of mariners at risk for the disorder.

Current Coast Guard Form 719K does not ask questions specific to OSA, though it does specifically require an entry regarding “sleepwalking.” The Coast Guard is revising the form, and a recent draft of that revision includes a specific question regarding OSA, among questions on other sleep disorders. The draft form does not at this writing, however, include any questions about symptoms of OSA, including daytime sleepiness or snoring.

Other Modal Agencies

Actions taken by federal agencies regulating modes other than marine vary. The Federal Aviation Administration (FAA) provides written guidance to aviation medical examiners for the submission of appropriate medical information for pilots who have reported a history of OSA¹⁴ but does not screen pilots for the presence of the disorder and has no question on the Application for Airman Medical Certificate concerning a history of OSA or the presence of symptoms, such as snoring or excessive daytime sleepiness, related to OSA. The FAA does not provide any guidance to AMEs regarding risk factors for sleep disorders or any symptoms (for example, snoring) that might be related to OSA.

The Federal Transit Administration (FTA) has no formal medical standards for transit operators; each authority independently arranges medical programs for its operators, and many operators are required, either due to their functions or by the authority for which they work, to maintain a current commercial driver license. The NTSB is not aware of any existing programs that routinely screen transit operators for OSA.

The Federal Motor Carrier Safety Administration (FMCSA) includes a specific question on the current form completed by commercial drivers undergoing examination for medical certification that specifically asks about sleep disorders, OSA, daytime sleepiness, and snoring. Further, the FMCSA Medical Review Board in 2008 recommended that the FMCSA require screening for OSA in all drivers with a BMI over 30, but the FMCSA has yet to act on that recommendation.

The NTSB has issued safety recommendations to the FAA and the FTA, and is now issuing recommendations to the FMCSA, to ensure that operators in the relevant modes are appropriately screened, evaluated, and treated for OSA. On August 7, 2009, in connection with the Hilo, Hawaii, incident, the NTSB issued Safety Recommendations A-09-61 through -63 to the FAA.¹⁵ On July 14, 2009, in its report on the Newton, Massachusetts, rail collision, the NTSB made similar safety recommendations to the FTA (R-09-08 and -09) and to the regional rail transit authorities (R-09-10 and -11).¹⁶ The NTSB is also issuing two safety recommendations to the FMCSA (H-09-15 and -16).

In addition, in response to NTSB recommendations issued in 2002 (R-02-24 through -26), the Federal Railroad Administration is working on new forms and guidance regarding

¹⁴ 2009 Guide for Aviation Medical Examiners:

<http://www.faa.gov/about/office_org/headquarters_offices/avs/offices/aam/ame/guide/>.

¹⁵ Safety recommendation letter available at <http://www.nts.gov/Recs/letters/2009/A09_61_66.pdf>.

¹⁶ NTSB/RAR-09/02.

medical certification; drafts from this work have a specific question regarding sleep disorders, OSA, and snoring and provide guidelines on screening specifically for OSA.

Summary

The relative risk of accident involvement for individuals with OSA is clearly elevated and quite clearly associated with the untreated disease. The disease is probably under-diagnosed and under-reported in the mariner population. OSA is commonly unrecognized by individuals who have it, the risk of cognitive impairment is increased in those individuals, and the likelihood of both critical errors and of actually falling asleep during marine operations is substantially elevated with the diagnosis; therefore, effective screening for the disorder is warranted. The Coast Guard has guidance through which mariners who are effectively treated for their OSA can routinely be approved for continued medical certification. Some objective information already gathered by the Coast Guard (for example, height, weight, blood pressure) might be applied using the 2006 consensus statement on screening to achieve effective requirements for screening mariners for OSA; however, the most effective screening would require that the Coast Guard gather some additional, easily collected information and develop additional guidance.

Recommendations

Therefore, the National Transportation Safety Board makes the following recommendations to the U.S. Coast Guard:

Modify Form 719K (Merchant Mariner Physical Examination Report) to elicit specific information about any previous diagnosis of obstructive sleep apnea and about the presence of specific risk factors for that disorder. (M-09-14)

Implement a program to identify licensed mariners subject to the *Navigation and Vessel Inspection Circular on Medical and Physical Evaluation Guidelines for Merchant Mariner Credentials* (NVIC 04-08) and who are at high risk for obstructive sleep apnea, and require that those mariners provide evidence through the medical certification process of having been appropriately evaluated and, if treatment is needed, effectively treated for that disorder before being granted unrestricted medical certification. (M-09-15)

Develop and disseminate guidance for mariners, employers, and physicians regarding the identification and treatment of individuals at high risk of obstructive sleep apnea (OSA), emphasizing that mariners who have OSA that is effectively treated are routinely approved for continued medical certification. (M-09-16)

Please refer to Safety Recommendations M-09-14 through -16 in your reply. If you would like to submit your response electronically rather than in hard copy, you may send it to the following e-mail address: correspondence@ntsb.gov. If your response includes attachments that exceed 5 megabytes, please e-mail us asking for instructions on how to use our secure mailbox. To avoid confusion, please use only one method of submission (that is, do not submit both an electronic copy and a hard copy of the same response letter).

Chairman HERSMAN, Vice Chairman HART, and Member SUMWALT concurred in these recommendations.

[Original Signed]

By: Deborah A.P. Hersman
Chairman