



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

Log 2036c

Date: February 29, 1988

In reply refer to: A-88-19

Dr. James C. Fletcher
Administrator
National Aeronautics and
Space Administration
Washington, D.C. 20546

The National Transportation Safety Board investigated and evaluated 59 emergency medical service (EMS) helicopter accidents that occurred between May 11, 1978, and December 3, 1986. While exploring this rapidly growing commercial EMS industry and its operations, the Safety Board concentrated on the influence of weather on EMS operations, EMS helicopter operations under instrument flight rules/visual flight rules (IFR/VFR), pilot and medical personnel training requirements, and EMS helicopter design standards and aircraft reliability. In addition, the Safety Board reviewed EMS helicopter crashworthiness and its influence on accident survival and the influence of EMS helicopter program management on Safety. 1/

The Safety Board used a variety of information sources in conducting the study. All commercial EMS helicopter accidents investigated by the Safety Board were identified and reviewed to identify common elements in accident causation and severity. The Safety Board visited and flew with nine selected EMS helicopter programs across the country to observe operations and to receive input from pilots, program administrators, and medical personnel. The Safety Board also examined the influence of current Federal regulations on EMS helicopter operations, reviewed EMS industry-recommended guidelines and standards, and conducted an extensive literature search and review.

The study did not include public-use helicopter operators (police departments or State/local government agencies) because of insufficient accident data upon which to base any meaningful conclusions. Public-use aircraft operators are not required to report accidents or incidents to the Federal Aviation Administration (FAA) or the Safety Board. 2/ Therefore, the data and conclusions presented in the report are applicable only to the commercial EMS helicopter fleet.

Pilot fatigue has been suggested by some in the EMS helicopter industry to be the primary cause of the industry's poor safety experience. While fatigue can have a negative impact on pilot performance, its presence is often difficult to substantiate. Fatigue is insidious, and this is its most dangerous aspect, since the pilot's abilities, once

1/ For more detailed information, read Safety Study "Emergency Medical Service Helicopter Operations" (NTSB/SS-88/01).

2/ Legislation currently before Congress would require that certain public-use aircraft accidents be reported to the Safety Board.

compromised by fatigue, may not be sufficient to meet the demands of even routine flights. Fatigue can also affect the pilots' perception of their own performance capabilities.

The National Aeronautics and Space Administration (NASA) at the Ames Research Center in California has developed methods to measure the influence of pilot fatigue and workload on helicopter pilot performance. NASA has found that the impact of fatigue, stress, and workload on pilot performance in the flight environment can be objectively measured by looking at physiological factors (body temperature, heart rate, etc.). Additionally, significant information can be obtained by subjective measurements such as pilot alertness, communication ability, etc. Currently, many of these techniques are being applied by NASA in a research project involving the California Highway Patrol, "Helicopter Crew Workload and Coordination: Law Enforcement." Application of these techniques in a research program to measure the effect of stress, fatigue, and workload on EMS helicopter pilot performance would provide much needed information on the most effective ways to minimize the negative impact of stress and fatigue on the EMS helicopter pilot.

A recent survey of 250 EMS helicopter pilots in this country concluded that sleep loss "has a profound impact on safety in performance as a function of work/rest schedules. If pilots are able to obtain a sufficient amount of quality sleep, their perceived levels of flight/job performance rise. Maintaining alertness and adequate motor skills, such as precise hand-eye coordination, is also related to sleep to a significant degree." ^{3/}

EMS helicopter pilots and other professionals involved with health care work on shift schedules. Most EMS helicopter programs provide 24-hour service, 365 days a year, which requires that there always be a pilot on duty. Shift work, however, can disrupt the normal sleep/rest cycles. Circadian rhythm ^{4/} disruption and the resulting fatigue is complex and difficult to substantiate for shift workers. Yet the negative impact of factors such as sleep loss disruption in pilots has been recognized for many years, and the FAA has developed regulations for flight time and duty time designed to provide a minimum standard of protection against such factors. Unfortunately, these regulations do not take into account circadian (time of day) issues. Title 14 Code of Federal Regulations 135.267, Flight Time Limitations and Rest Requirements, specifies that a pilot must receive 10 consecutive hours of rest in any 24-hour period if the combined duty and rest periods total 24 hours. Furthermore, each flight crewmember must have 13 rest periods of at least 24 consecutive hours every 90 days.

However, Part 135.271, Helicopter Hospital Emergency Medical Evacuation Service, ^{5/} requires that the EMS pilot must receive 8 hours of consecutive rest every 24 hours and 10 hours of consecutive rest before reporting to the hospital for availability for flight time. An EMS pilot may not be on duty longer than 72 hours.

^{3/} Rayman, Russel B., "Aerospace Medicine," Chapter 13: Aircrew Health Maintenance, Philadelphia, 1985.

^{4/} Circadian rhythms are biological rhythms that have a period of approximately 24 hours.

^{5/} Part 135.271 was developed specifically for EMS helicopter operators because it was discovered that most EMS programs had received exemptions from Part 135.267, allowing them greater flexibility in setting flight time/duty time schedules for their pilots. However, Part 135.271 was intended to apply only to emergency flights; EMS operators nationwide have apparently been applying the less stringent Part 135.271 rule to all operations.

Although the flight time/duty time rules provide standards for the number of hours EMS air crew can be on duty, they provide no guidance on how the EMS pilot schedules are arranged. Due to the need for 24-hour service, many EMS programs have pilots working 24-, 36-, 48-, and even 72-hour shifts. ^{6/} These are often very disruptive to the pilot's normal rest and sleep patterns. Additionally, without time for pilots to recover from and adjust to the shift work, chronic fatigue can set in and pilots may not recover until they receive adequate rest.

Although fatigue has been suggested by industry representatives as the main cause of EMS helicopter accidents, this was not substantiated by review of the 59 EMS helicopter accidents in the Safety Board database. The Safety Board believes, however, that EMS helicopter pilots work in an environment and operate on a schedule that are conducive to acute and chronic fatigue that can influence the pilots' ability to operate the aircraft safely.

EMS pilots feel that lack of adequate sleep is the primary reason they become fatigued. Ensuring adequate rest, however, in the EMS environment is difficult because most EMS programs operate 24 hours a day, 365 days a year. This schedule requires that pilots fly a rotating shift schedule that can cause circadian rhythm disruption, sleep loss, and fatigue. Research has shown that it is difficult to design a work schedule to minimize the circadian rhythm disruption with only three pilots; however, many EMS programs do not have activity levels which economically justify the addition of a fourth pilot.

The Safety Board believes that the best indicator of the number of pilots required is the individual program's activity level. Additional pilots should be added before the current pilots are unable to maintain the required continuous rest period (if using 24-hour or longer shifts) specified by the FAA. Additionally, the Safety Board believes that both the hospital EMS program management and the EMS operator management need to recognize the influence of chronic fatigue on EMS helicopter pilot performance and should seek input from pilots and from experts in the construction of work/rest cycles and the optimum pilot staffing levels.

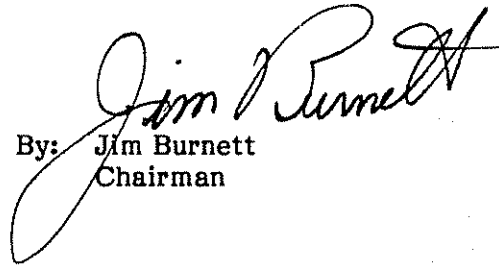
Therefore, the National Transportation Safety Board recommends that the National Aeronautics and Space Administration:

Develop and conduct a research program in cooperation with the Federal Aviation Administration to measure the effect of emergency medical service (EMS) pilot workload, shift lengths, and circadian rhythm disruptions on EMS helicopter pilot performance. (Class II, Priority Action) (A-88-19)

Also as a result of its investigation, the Safety Board issued Safety Recommendations A-88-1 through -11 to the Federal Aviation Administration, A-88-12 through -15 to the American Society of Hospital-Based Emergency Aeromedical Services, and A-88-16 through -18 to the Helicopter Association International.

^{6/} Cauthorne and Fedorowicz, "Work/Rest Schedules and Their Potential Impact on Flight Crew Performance," Hospital Aviation, March 1985. An American Society of Hospital-Based Emergency Aeromedical Services safety survey of the EMS helicopter industry found that the most common pilot schedule is 24 hours on duty two to three times a week (27 percent of all programs); the second most common is 48 hours on duty one to two times a week (18 percent of all programs); 12 percent of the programs use a 12-hour duty period four to five times a week. Only one program reported a 72-hour duty period.

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER, NALL, and KOLSTAD, Members, concurred in this recommendation.


By: Jim Burnett
Chairman