



National Transportation Safety Board

Washington, D.C. 20594
Safety Recommendation

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In reply refer to: A-88-12 through -15

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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 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.

EMS helicopter program management for most hospital-based programs is a hybrid combination of two management structures that provides few advantages and many potential problems. Most EMS helicopter programs lease a helicopter and its pilot crews from a Title 14 Code of Federal Regulations (CFR) Part 135 commercial operator. The hospital, when it awards this contract, receives a helicopter, the pilots to fly the helicopter, and, in theory, none of the associated problems of owning and running a commercial helicopter business. The hospital relies on the operator to take care of these issues. The hospital, in turn, provides the medical personnel and the facility for the helicopter and takes care of the administrative tasks associated with running an emergency medicine department with an EMS helicopter as part of that service.

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

One method used by some EMS helicopter programs to improve communication between the two management structures and staff is the formation of a committee that meets monthly. Normally, the lead pilot or a designated safety officer (usually a pilot) represents the operator during these meetings. The administrator of one program reviewed by the Safety Board which had a functioning safety committee stated that it helped to improve communication. She felt that the process could be improved further by the participation of an operator management representative, such as the chief of operations or chief pilot, on a quarterly or semiannual basis. There is no regulation requiring safety committees, but many EMS helicopter programs have recognized their benefit and are incorporating such committees in their programs.

The Federal Aviation Administration (FAA) has recognized that safety can be influenced by management perspectives and has initiated a program to provide guidance on issues that need to be considered by EMS management. The FAA has awarded a contract to an aeronautical training consulting firm to develop a training package for aeronautical decisionmaking for air ambulance helicopter operations. A training manual will be developed for EMS helicopter pilots, hospital program administrators, and EMS helicopter risk management. The risk management manual will address administrative policies regarding flight operations, helicopter operator procedures, and pilot/crew intrapersonal skills. Those elements that have been identified as common EMS risk elements will be defined and discussed. This manual will be designed for EMS operator management and hospital program administrators.

The FAA also plans to develop an aeronautical decisionmaking manual for hospital program administrators. In this manual, hazardous administrative policies, procedures, and attitudes will be addressed, as will the risk elements present in EMS helicopter accidents. The responsibility of the hospital program administration and sharing of liability for decisions impacting safety will also be discussed. Additionally, incentives and impediments to safe flight operations will be evaluated. This manual will provide hospital administrators with information on EMS helicopter safety and how they can improve it.

The pilot decisionmaking manual will be optimized for the EMS helicopter pilot. It will focus on evaluating typical accident scenarios and on defining risks relative to mission purpose and various flight segments. The goal of this manual will be to educate EMS pilots to the factors that can negatively influence their judgment and to highlight those situations where this is most likely to happen. The manual will supplement the current aeronautical decisionmaking manual for helicopter pilots. ^{2/} The FAA expects all these documents to be available by the fall of 1988.

EMS helicopter safety is related directly to management's commitment to safety and the emphasis placed on running a safe program. If an EMS program has two separate management structures with poor communication between them, the pilots can be put in an untenable position of having to make judgments concerning EMS flights based on concerns other than flight safety (such as pressure of competition from other EMS programs). The hospital EMS program management has a significant role in ensuring the program is run safely, since the EMS operator management is only required to meet the safety regulations specified by the FAA (minimum requirements) unless the hospital specifies otherwise. The hospital's specifications for minimum levels of "safety performance" are usually contained in the contract signed with the EMS helicopter operator.

^{2/} Aeronautical Decision Making for Helicopter Pilots, February 1987, DOT/FA/PM-86/45, available from the FAA.

The Safety Board believes that for EMS programs to operate safely when two separate management structures are involved, effective and regular communication on safety issues between separate managements and the employees is mandatory. One method to achieve this goal is a monthly safety meeting in which safety-related issues are discussed and resolved.

The Safety Board also believes that hospital EMS program management should become knowledgeable about safety issues in EMS helicopter operations because they often become de facto management for the pilots when the pilot management structure is located away from the hospital. Additionally, the Safety Board believes it is necessary for both management teams to develop procedures to isolate flight operations decisions from medical decisions.

Some operators believe that the importance of the EMS mission--transporting seriously ill or injured patients--can affect the pilot's good judgment. The power of the mission itself to influence and perhaps override an EMS pilot's judgment is enhanced by the lack of a strong managerial structure to support the pilot in the working environment. Often the pilot's direct supervisory management is not resident at the hospital and may even be located in a distant city. The isolation from management forces the pilot to look for structure and guidance from other sources, most notably the hospital's EMS program administrator and medical personnel. As a result, close relationships between the medical personnel and the pilots develop.

Hospital management, the EMS medical personnel, and the dispatchers can all intentionally or unintentionally put pressure on the pilots to take a flight in marginal weather conditions. The reasons for these pressures include misunderstanding or lack of understanding of weather-related considerations, genuine zeal to get a job done, or even competition between EMS programs. When the Safety Board visited EMS programs, many pilots acknowledged that EMS program administrators and medical personnel have not always been sensitive to the limitations of the helicopters and pilots. These pilots stated that they have experienced pressure, ranging from mild to extreme, to complete a flight when they felt conditions were not safe. The pilots believed that this problem can be minimized by educating EMS helicopter program management about the limitations of the helicopters and pilots.

The relative influence of these factors on the pilot's judgment and decisionmaking process is hard to measure. Clearly defined and enforced procedures and management practices would help to ensure that the pilot is encouraged to make good decisions. Education of hospital EMS program administrators to these concerns and their observance of these procedures and guidelines would further eliminate many negative pressures the pilot may experience during the decisionmaking process.

Competition between EMS helicopter programs can also lead to pressures to fly when conditions are not safe. It is not unusual for on-scene emergency response crews to call a second EMS operator for patient transport when the first EMS operator declines to fly because of poor weather. It is also not unusual for hospitals that want a patient transported to call several EMS operators in the hope that one will accept the call.

Many EMS helicopter programs across the country have recognized the negative impact on safety this competitive pressure can cause and have taken steps to reduce its influence. For example, two competitor programs interviewed by the Safety Board described their informal agreement not to accept flights in marginal weather without checking with each other. These programs' VFR minimums are quite similar; they stay in communication with each other in making decisions about flight acceptance to ensure

they are not being "played off" against each other. This approach effectively eliminates "pushing minimums" as a competitive strategy between programs. Steps to eliminate "transport shopping" and the conflict it causes help to minimize exposure to hazardous situations.

The Safety Board believes that clearly defined and enforced flight procedures and management practices would help to ensure that the pilot is not encouraged to make unwise decisions. Additionally, education of hospital EMS program administrators about flight safety concerns and their observance of these procedures and guidelines would further eliminate many negative pressures the pilot may experience during the decisionmaking process.

Aviation safety is primarily concerned with preventing accidents, and great strides have been made in achieving this goal; new aircraft are extremely reliable and sophisticated and are easier to fly, and in many cases the pilots are better trained. In spite of this progress, however, accidents continue to occur. Therefore, aviation safety also involves developing ways to enhance the possibility that the aircraft crew and passengers will survive an accident when it does occur.

Although the U.S. Army requires Army aviators to wear protective helmets, fire-resistant flight suits (with natural fiber underwear), and high-top leather boots, this type of protective equipment has not been worn routinely by civilian EMS helicopter pilots and medical personnel. The Army's helicopter accident experience has shown that 31.7 percent of all life-threatening injuries occur to the head and face of helicopter occupants. ^{3/} This accident experience has also shown that the average severity of head injuries in survivable accidents, as measured by the Abbreviated Injury Scale (AIS) ^{4/} for those wearing helmets was 2 to 3 (moderate to serious), although 24 percent of this group received no head injuries at all. Determining the severity of head injuries of those not wearing helmets is difficult in survivable accidents since all Army helicopter pilots and crew wear helmets. Some insight can be gained by looking at the injuries sustained by those who had their helmets come off in the accident sequence during or after initial impact. In this group, the average AIS score was 4 to 5 (severe to critical) with only 5 percent experiencing no injuries. Of this group, 67 percent experienced injury scores of 5 to 6 (critical to virtually unsurvivable). ^{5/} The severity of these injuries was clearly greater than those experienced by aviators whose helmets remained on during the accident sequence.

In those accidents in which postcrash fire occurs, the fire can reach maximum intensity in 20 seconds with temperatures exceeding 2,000 degrees F. Occupants who have survived the impact must exit the helicopter before this point. Flight suits made of flame-resistant fabrics, such as "Nomex," can provide added protection against thermal injury for survivors as they exit the helicopter. Effective use of the flight suits require that natural fiber undergarments be worn because the outer flame-resistant garment can become hot enough to burn exposed skin underneath or to melt synthetic undergarments.

^{3/} U.S. Army Aircraft Crash Survival Design Guide; USARTL-TR-79-22D, June 1980.

^{4/} AIS is a standardized, universally accepted system for assessing impact injury severity by coding individual injuries on a scale of 1 to 6 with 1 being no injury and 6 being virtually unsurvivable. Other numbers (7-9) indicate injury unknown or extent of injury unknown.

^{5/} U.S. Army USAARL Report No. 85-1 SPH-4, U.S. Army Flight Helmet Performance, 1972-1983, November 1984.

Protective footwear is also important to EMS medical personnel and pilots in day-to-day operations and in emergency situations. Boots provide protection at accident scenes where broken glass and sharp metal can be a problem. Boots also can support the ankle in rough terrain and provide thermal protection during a postcrash fire.

Most EMS programs require their medical personnel and pilots to wear uniforms--one-piece jumpsuits, or slacks and shirts--for easy identification of the medical personnel. However, according to ASHBEAMS' safety survey, only 11 percent of the respondents require that the uniforms be made of fire-retardant materials. In addition, only 5 percent of those responding indicated that helmets for pilots and medical personnel are required. The most common reason cited for not requiring helmets was that "it scares the patients." The Safety Board talked to medical personnel who do wear helmets, and they indicated that "scaring patients" has not proven to be a problem in their opinion. One nurse said that at first she was uncomfortable with the helmet, but now she would not fly without one. She felt that the protection provided by the helmet was more beneficial than the minor discomfort of wearing it. The use of protective footwear appears to be more widespread. Approximately 50 percent of the programs surveyed by ASHBEAMS require that special footwear be worn, 47 percent do not. The Safety Board believes that helmets, flame-resistant uniforms, and protective footwear can help reduce or prevent serious injury or death of pilots and medical personnel in survivable accidents. For commercial EMS operations, this is particularly important since 9 percent of the active fleet were involved in reported accidents in 1986.

EMS helicopters seldom fly without medical personnel (sometimes called medical crewmembers) on board. The medical personnel historically have not been considered required crewmembers either by the FAA when reviewing a CFR Part 135 certificate holder's training program or by the Safety Board when an accident occurs. The FAA defines the term crewmembers in CFR Part 1 as "a person assigned to perform duty in an aircraft during flight time." Medical personnel have normally been considered passengers, since they have no direct responsibility for the operation of the helicopter or for its control during flight.

Actual experience, however, indicates that medical personnel do assume crewmember functions and assist the pilots in their duties. EMS-industry sources indicate that medical personnel often help the pilot avoid obstacles on approach and departure; scan for other air traffic while in cruise flight; conduct routine radio calls to hospital dispatch on aircraft position; shut down aircraft power and fuel in the event of pilot incapacitation after an accident; and conduct "Mayday" communications to the dispatch center if an emergency that endangers the crew occurs in flight.

Since the medical personnel on EMS helicopters are not considered crewmembers by the FAA, they are not required to receive the training specified in Part 135 for nonpilot crewmembers. Part 135 specifies that the operator must provide training to nonpilot crewmembers on their basic duties, including basic aircraft indoctrination and emergency procedures. It also requires instruction in the following areas:

- o location, function, and operation of emergency equipment, (ditching equipment, first-aid equipment, portable fire extinguishers);
- o fire in flight or on the surface, and smoke control procedures;
- o ditching and evacuation;

- o illness, injury, or other abnormal situations involving passengers or crewmembers; and
- o hijacking and other unusual situations.

Part 135 also requires review of the operator's previous aircraft accidents and incidents involving actual emergency situations. Additionally, each crewmember is required to gain practical experience during training in: ditching, if applicable; emergency evacuation; fire extinguishment and smoke control; operation and use of emergency exits; and donning and inflation of life vests and the use of other flotation devices, if applicable. Crewmembers must receive recurrent training in these topics every 12 months.

The Safety Board believes that all medical personnel who routinely fly on EMS helicopter missions need to receive specific training on their functions and duties in the helicopter since they often assume many of the responsibilities of crewmembers. This training, in addition to their medical training requirements, should address those items required by Part 135.331, Crewmember Emergency Training. This training should also address, as applicable, those areas of responsibility that are nonmedical, such as medical personnel and pilot communications, aircraft fuel and systems shutdown, landing zone obstacle avoidance, air traffic avoidance, landing zone safety, and radio communications. This training program should be developed jointly by the hospital EMS program management and the EMS helicopter operator management.

Therefore, the National Transportation Safety Board recommends that the American Society of Hospital-Based Emergency Aeromedical Services:

In coordination with the Helicopter Association International, provide specific guidance to each member emergency medical service (EMS) helicopter program on the need for and methods to develop a safety committee composed of representatives from the hospital EMS program administration, the commercial EMS helicopter operator, the pilot and medical personnel, helicopter dispatch (if applicable), and local public safety/emergency response agencies. The safety committee should meet monthly, with management representatives from the operator and hospital attending frequently. One objective of the safety committee should be the elimination of any negative influence caused by competition between EMS helicopter services that operate in the same area. (Class II, Priority Action) (A-88-12)

Develop guidance for hospital emergency medical service (EMS) program administrators on safety issues involved in helicopter EMS operations. Topics addressed should include pilot-in-command authority, marginal weather operations, and pilot-crewmember coordination and communication. (Class II, Priority Action) (A-88-13)

Encourage members who operate emergency medical service (EMS) programs to provide medical personnel, who routinely fly EMS helicopter missions, with protective clothing and equipment to reduce the chance of injury or death in survivable accidents. This clothing and equipment should include protective helmets, flame- and heat-resistant flight suits, and protective footwear. (Class II, Priority Action) (A-88-14)

Develop guidance for members who operate emergency medical service (EMS) programs on recommended training for medical personnel who routinely fly on EMS helicopter missions. This guidance should be developed in conjunction with the Federal Aviation Administration and the Helicopter Association International. Topics that should be addressed include:

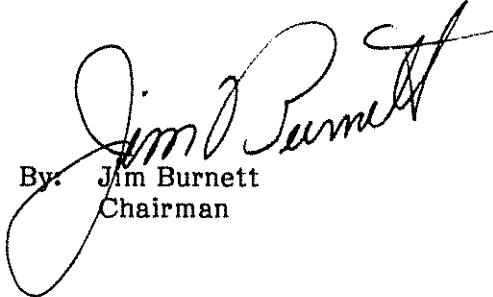
- o Flightcrew and medical personnel coordination and communication including terminology to be used;
- o Helicopter emergency fuel and systems shutdown, landing zone safety and obstacle avoidance, air traffic recognition and avoidance, and radio communications; and
- o Emergency training on the topics listed in Title 14 Code of Federal Regulations Part 135.331, Crewmember Emergency Training.

(Class II, Priority Action) (A-88-15)

Also as a result of its investigation, the Safety Board issued Safety Recommendations A-88-1 through -11 to the Federal Aviation Administration, A-88-16 through -18 to the Helicopter Association International, and A-88-19 to the National Aeronautics and Space Administration.

The National Transportation Safety Board is an independent Federal agency with the statutory responsibility ". . . to promote transportation safety by conducting independent accident investigations and by formulating safety improvement recommendations" (Public Law 93-633). The Safety Board is vitally interested in any actions taken as a result of its safety recommendations and would appreciate a response from you regarding action taken or contemplated with respect to the recommendations in this letter. Please refer to Safety Recommendations A-88-12 through -15 in your reply.

BURNETT, Chairman, GOLDMAN, Vice Chairman, and LAUBER, NALL, and KOLSTAD, Members, concurred in these recommendations.

By: 
Jim Burnett
Chairman