FLIGHT SAFETY FOUNDATION
HELICOPTER SAFETY
Vol. 14 No. 1 January/February 1988

Helicopter EMS Accidents Demand Additional Scrutiny

The helicopter has added a new dimension to emergency medical services in recent years, and the author takes the position that this demanding segment of helicopter operations has added an equally new dimension to accident statistics. He calls for increased attention to the stressors that hinder the pilot, and play a much greater role in EMS accidents than investigators currently attribute causes/factors.

by

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"The helicopter is the only form of transport invented by man that has saved more lives than it has taken. The same cannot be said even of fixed-wing aircraft, let alone road vehicles, mains or ships. When major disasters threaten life, helicopters often appear to pluck trapped, injured or helpless people from the jaws of certain death. Earthquakes, hotel fires, oil platform disasters and ship sinkings are just a few examples of where helicopters may represent the only chance of survival.

"But there is a general opinion outside the industry that the pilots that fly these mercy missions do so despite their machines rather than because of them. Helicopters hit the headlines when they crash, not when they save. When a helicopter crashes on its way to or from a rescue, the irony is intensified, and irony is one of the favorite subjects of the general news media.

"This is why the accident rate of emergency medical service (EMS) helicopters must be reduced very quickly, or the concept may destroy itself (1)."

Current Consensus

There is some consensus is that the current EMS helicopter safety record is a poor one; unfortunately, that appears to be one of the few points of consensus in the EMS scene. There is not even agreement about the total number of EMS accidents. During 1986 in the U.S., for example, one hospital magazine reported that there were 16 total fatal EMS accidents during the year; another medical publication reported 22; and CBS television's *Sixty Minutes* reported 28. There were more discrepancies - 14 accidents or 17 accidents - reported by the U.S. Federal Aviation Administration (FAA) in two separate forums. Other media have reported the number of EMS fatal helicopter accidents as 13, 15, 19, 21 and 25 (2).

EMS accident data definitions have been determined by the same parties whose performance is subject to evaluation by the statistics. They predictably choose the data that reflect least poorly on their public image. For example, hospital managers prefer to count only accidents involving hospital-based helicopters. Others would reduce that number further by counting only accidents that occur when the helicopter has a patient on board. There is a reluctance to count military EMS accidents that might occur in the U.S. Military Assistance to Safety and Traffic "MAST" program, or when providing assistance in civilian search-and-rescue (SAR) operations.

The result of this controversy has been to obscure the fundamental causes of EMS helicopter accidents with a smokescreen of self-interest, precluding open communication of data that should form the basis of scientific analysis of all EMS mishaps. As a result, prevention programs are less effective because some causes/factors are hidden from scrutiny.

Challenge for Investigators

The data collected under current investigation policies and procedures concentrate on mechanical, environmental and flight crew information. Investigators may spend days sifting wreckage for evidence of mechanical failure, but human factors and management information may not be given sufficient attention.

Most information relating to human cause factors in EMS operations is anecdotal - for example, pilot judgement, dispatcher competence or management-induced pressures. After exposure to enough EMS "sea stories," even the most inflexible statistician may develop a "gut" feeling that these factors deserve more than the "pilot-effort" cause/factor frequently applied.

Participants in EMS helicopter operations are subjected to more severe and unique stressors than their counterparts in traditional aviation operations. These stressors often compound and result in operator overload.

General Stressors

The following stressors occur routinely during helicopter EMS operations.

Stability. Helicopters, unlike fixed-wing aircraft, are inherently unstable. Whereas the simplest single-engine airplanes have been equipped with autopilots for years, they are only now becoming available in the most advanced helicopters. Flying a helicopter is physically demanding.

Flight Instrumentation. Helicopters often are not equipped for flight in instrument meteorological conditions (IMC). Even when so equipped, instrument limitations reduce a helicopter's capabilities in the very flight conditions where they are most needed. For example, during low visibility take-offs or landings, airspeed indicators are unreliable at the slow speeds characteristic of the helicopter in those flight regimes. Attitude indicators do not differentiate between forward, sideways or backward flight and are especially inadequate in displaying proper pitch attitude during take-off and climbout (nose low) or landing approach (nose high).

Visibility. Pilot visibility in helicopters is compromised when it's most needed - during approach and landing. The helicopter's normal nose-high pitch angle restricts the pilot's view of the landing area to what is visible through the chin bubble.

Even when conditions seem ideal, the rotor wash may stir up enough snow, sand, water or dust to reduce the pilot's visibility to zero at a critical point during take-off or landing.

Weather Capability. Helicopters are notoriously intolerant of bad weather. Despite such mechanical devices as intake screens and particle separators, helicopter turbine engines are extremely sensitive to snow, sleet, hail and even heavy rain. Main rotor icing can cause loss of lift and force a helicopter down in minutes.

Navigation Aids. Air navigation aids in the U.S., for "ample, have been designed to meet the needs of fixed-wing aircraft.

Helicopter pilots traditionally have relied on grid charts, automobile road maps and other visual navigation aids. They may be satisfactory under daylight VFR conditions, but they are inadequate at night and in marginal weather conditions. Few helipads offer such simple devices as lead-in lights, or advanced instrument landing aids taken for granted at airports used by fixed-wing aircraft.

Main Rotor Design. Additional pilot workload may result from lack of standardization in main rotor design. The popular Aerospatiale series of helicopters have main rotor systems that turn clockwise, rather than the anti-clockwise motion common to most other helicopters. As a result, counter-rotational control forces are opposite. A pilot accustomed to operating "left pedal" will need "right pedal" in an Aerospatiale model helicopter. That might not present a problem during normal operations. However, in an emergency, inappropriate training transference may aggravate an already demanding situation.

Stressors Peculiar to EMS

Aeronautically Uneducated Management. Hospital, and some public, EMS operations often are directed by staff whose knowledge of aviation may be very limited. Dispatchers are usually concerned with the medical situation, not the aviation one. Some may not have rudimentary knowledge of helicopter capabilities or limitations, and even less understanding about fuel planning, weight-and-balance, meteorology, instrument flight procedures, navigation and aviation regulations. Some hospital administrators believe that helicopters can go anywhere and do anything at any time; they see it as an ambulance that isn't hampered by traffic.

Duty Time and Fatigue. Many U.S. EMS helicopter operations employ one aircraft and three pilots on a seven-day-a-week schedule. Duty schedules are most frequently 12 hours on, 12 hours off, on a four-to-10 day rotation cycle, with "rest facilities" available for the duty pilot's use when not otherwise occupied. There is no limitation on the number of flights a pilot can be required to conduct under single-pilot IFR, or marginal VFR conditions during a duty cycle.

U.S. Federal Aviation Regulations (FARs) require that "each flight crew member must receive at least eight consecutive hours of rest during any 24-consecutive-hour period of a HEMES (Helicopter Hospital Emergency Medical Evacuation Service) assignment. A flight crew member must be relieved of

the HEMES assignment if he or she has not or cannot receive at least eight consecutive hours of rest during any 24-consecutive-hour period ... (3). (Note that it is "rest," not "sleep," stipulated by the FARs.) However, FAA representatives recently said Section 135.27 I(d) applied to operations conducting life and death emergency flights only, excluding "routine patient transfer flights, etc." The FAA has proposed that EMS helicopter operators maintain two sets of flight and duty-time records to ensure compliance with the interpretation (4).

Opportunities for violations of flight and duty-times often occur at hospitals which operate their own in-house EMS helicopter operation under the provisions of Part 91 of the U.S. FARs, as opposed to contracting with a Part 135 certificated commercial helicopter operator. Part 91 is silent regarding duty-time limitations.

Operating Facilities. Some hospitals have airport-quality helipads. At others, helicopters must use automobile parking lots, driveways or other areas frequently confined by buildings, overhead utility lines, liquid oxygen tanks and other potential hazards to safe operation.

Accident trauma victims must be retrieved from locations that may hide snares for the unwary pilot, particularly at night and during periods of reduced visibility. Ground personnel may be too busy attending to the injured and controlling bystanders. They may be unable to assist the helicopter, even if they have been properly trained to note wind direction and velocity, obstructions to approach and departure paths, and are equipped with radios with proper frequencies for communication.

Mission Pressure. Hospital managers often adopt a policy of not informing pilots of the nature of the patient's medical condition to minimize mission pressures. Nonetheless, pilots have been called "murderers" for refusing to fly under unsafe flight conditions.

Aircraft Configuration. A helicopter in EMS operation frequently requires removal of the co-pilot seat to make room for a litter. Consequently, the pilot may share his workplace with a distracting patient. An EMS pilot said, "You don't know what distraction is until you try to fly a night, low-visibility approach to a postage-stamp-sized hospital pad with an EMT performing cardiopulmonary resuscitation six inches from the collective."

Post-Mission Letdown. Several accidents have occurred after completion of the EMS mission while enroute to base. Considering the high degree of stress encountered during an EMS mission, post-mission letdown can introduce physical and psychological conditions that lead to errors in judgement.

Develop Specific Guidelines for EMS Accident Investigation

A step toward development of guidelines aimed at preventing EMS helicopter accidents is recognition that these operations are a unique category of aviation; an accident data category should be established for EMS operations. The EMS category should apply to accidents that occur enroute to, or from, medical transport missions or any flights that relate to an EMS service. It would include EMS missions performed by nonhospital based agencies, e.g., police, fire departments and military services. Accidents that occur during routine nonEMS operations, such as maintenance, test and training flights, would be reported in accordance with current U.S. National Transportation Safety Board (NTSB) procedures (5).

Standardize Definitions And Operational Regulations

Existing NTSB definitions of significant criteria should be adopted for uniformity. Federal regulations define criteria for evaluating categories of aircraft accidents (6). These objective definitions provide common criteria for "accident," "incident," "fatal injury," "serious injury" and "substantial damage."

Under currently accepted interpretations of U.S. FARs, the FAA may consider hospital-based EMS flights to be operating under the "not-for-hire" provisions of FAR Part 9 1. By doing so, the hospital-operator is relieved of the necessity for dispatch record-keeping, reporting certain mechanical and operational irregularities, and flight following (7).

As a result, a substantial amount of data relevant to EMS operations in general, and certain operators' specific practices in particular, are withheld from scrutiny. The FAA is currently reviewing the propriety of conducting EMS operations under Part 91. Until all EMS operations are brought under the requirements of Part 135, its more stringent reporting requirements should be demanded of all EMS operations.

"Incident" classifications must be included in any analysis of accident causes. Only two factors differentiate an incident from an accident - dumb luck and superb skill - not necessarily in that order and often in concert. From the investigator's standpoint, the live crew can describe what happened, why and how an accident was avoided (8).

Data Differentiates Part 91 or Part 135 Operations

Table 1 represents the effect of applying the proposed criteria to EMS helicopter mishap data as of July 31, 1987. The data are as complete and accurate a collection as could he assembled from cooperative sources, including the NTSB, FAA, U.S. Army (for MAST accidents), the American Society of Hospital Based Emergency Aviation Medical Services (ASHBEAMS), the Aviation Safety Institute and personal contacts within the public safety community. No claim is made that the data in Table 1 are complete.

One trend obvious from the data is the increased reporting of incidents since 1985. Credit for this is primarily due to the efforts of the Aviation Safety Institute in collecting and tabulating inputs from the National EMS Pilots' Association. Although much of the incident data is anecdotal, it provides insight into management differences that occur because of the regulations under which the operations are conducted-Part 91 or Part 135.

Target Prevention by Thorough Investigation

Issues addressed in this article are not unique to helicopter EMS operations nor exhaustive of all possible contributory causes/factors. However, the nature of helicopter EMS operations provides unique opportunities for compounding contributory factors during a single flight.

Current accident experience in EMS helicopter operations demands epidemiological analysis to determine the significance of causes/factors as a prerequisite to prevention. The accident investigator has a unique responsibility to uncover all the facts; many of them will require expansion of the traditional scope of causation to include factors not currently considered. The task isn't likely to be easy.

Consider, for example, the facts reported by the NTSB investigator-in-charge in his preliminary report of a recent EMS helicopter incident.

The Emergency Medical Services flight originated... at 0147 hours. At 0220 hours, the MBBIBK-11 7A3 helicopter collided with wires while on final approach to a hover to an asphalt road in the vicinity of a traffic accident. The automobile accident victim was then transported by ambulance to a hospital with a Class I trauma center in approximately 20 minutes. The time to transport the patient via helicopter would have been four minutes (9).

Perhaps the accident investigator should question the reasonableness of dispatching the flight in the first place. •

References

1. "Editorial Comment." (1987). *Helicopter World.* Jan.-March.

2. Godbey, Seth B. (1987). "Critical Cares." *AOPA Pilot* Aircraft Owners and Pilots Association. Vol. 30 No. 4. 4 1.

3. Title 14. U.S. Code of Federal Regulations. Section 135.271(d).

4. *AirNet Newsletter.* (1987). National EMS Pilots Association. Pearland, Texas. Vol. 2. No. 7.1.

5. Tide 49. U.S. Code of Federal Regulations. Section 830.5 et seq.

6. Ibid. Section 830.2.

7. Title 14. U.S. Code of Federal Regulations. Sections 135.63, 135.65, 135.67 and 135.79.

8. Gailpault, J.B. and Rimson, I.J. (1979). "Incident Analysis: A Key to Accident Prevention." Proceedings of the Tenth International Seminar of the International Society of Air Safety Investigators. Vol. 12. No. 3. 8-10.

9. NTSB Preliminary Report. (1987). Form 6120-19A. No. LAX871A260. July 8.

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Table 1

Year (a)	Mishaps (b) Acc./Inc.	Fatal Accidents (b) Civ./Pub.	Fatal Fatalities (b) Civ./Pub.	Injury Accidents (c) Civ./Pub.	Injury Injuries (b) Div./Pub.
1972	1/0	0/1	0/2	0/0	0/0
1974	1/0	0/1	0/1	0/0	0/0
1975	1/0	0/0	0/0	0/1	0/1
1976	2/0	1/0	4/0	0/0	0/0
1977	0/1	0/0	0/0	0/0	0/0
1978	1/0	0/0	0/0	0/0	0/0
1979	2/0	0/0	0/0	1/0	1/0
1980	3/0	2/0	6/0	0/0	1/0
1981	4/2	1/0	6/0	2/0	3/0
1982	10/2	2/2	7/8	1/0	1/0
1983	11/2	2/1	4/2	4/2	10/5
1984	7/2	2/0	4/0	2/0	11/0
1985	12/5	6/0	12/0	3/0	13/0
1986	16/1*	5/2	14/8	7/0	17/0
1987	9/9*	3/3	8/12	0/0	2/0
To Date (7/31/87)	78/39*	23/9	63/29	20/3	59/6

Note (a): “Accidents/Incidents” (*1986 and later mishaps not yet classified by NTSB are subject to categorical adjustment.)
(b): Civil/Public Aircraft Civil Aircraft are those in the “private sector.” “Public aircraft” are those operated by or for a government, governmental agency or entity. (See Part I of the U.S. Federal Aviation Regulations: “Definitions.”) Public aircraft accidents are included only when engaged in verified civilian EMS missions.
(c): Does not include accidents in which both fatalities and survivable injuries occurred.

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