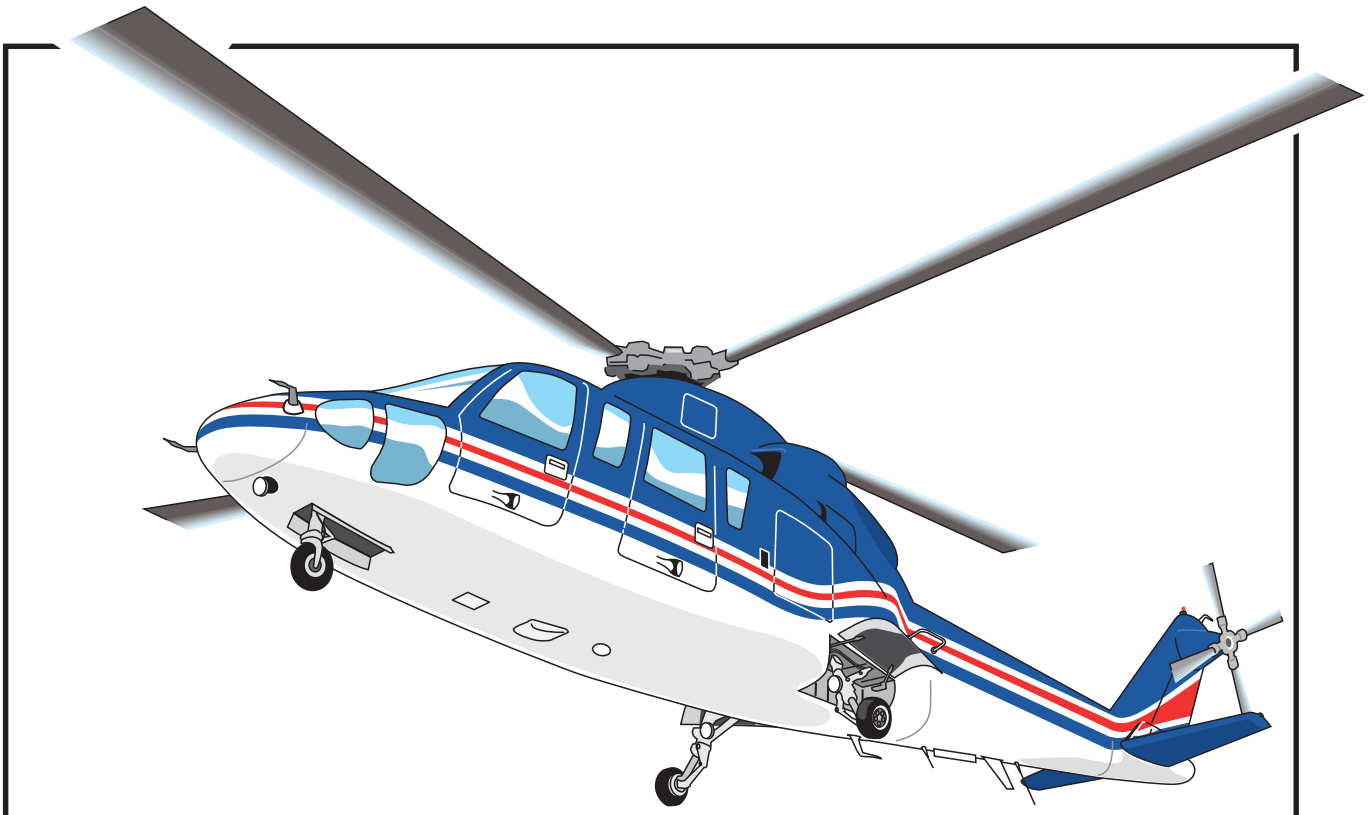
ASRS Directline



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Emergency 911
EMS Helicopter Operations

by
Linda Connell
and
Marcia Patten

"We were on an air ambulance flight…picked up a team of organ removal surgeons in XYZ…and flew them to ABC to remove the heart from a donor. The weather was clear and forecast to remain so. We understood…[that] the heart has a very short lifetime between removal from the donor and installation in the recipient, so when the recovery team arrived back at the ABC airport it would be necessary to expedite as much as possible…The F/O…[and I] readied the aircraft for the return leg and then went into the FBO to wait…Shortly before the medical team's departure from the airport…the fog began to roll into the area. Upon [their] arrival, the visibility was down to 4000 RVR…[but] our operations specifications call for minimum 5000 RVR for departure. I felt it was necessary to depart below minimums based on our medical emergency…I felt the decision to depart below minimums was the only one available to me under the circumstances. If we had waited for improved visibility, the heart would have been ruined, and the receiving patient may have died." (ACN 221023)

Welcome to EMS Operations

The flight described above is hardly the sort a pilot wants to face everyday. Fortunately, most helicopter Emergency Medical Service (EMS) calls are not nearly so dramatic. However, the operational aspects of EMS calls can be the ultimate test of a helicopter pilot's skills. The "scene" calls that may have contributed to the victim's injuries—a vehicle accident, a near-drowning or serious fall at a rocky beach, a backwoods hunting accident, or an aircraft forced-landing in mountainous terrain—also contribute to the risk associated with the EMS flight. Yet these are precisely the situations in which a helicopter may be the most expeditious, or even the only, means of getting medical assistance to the victim and getting the victim to a medical facility.

The first hour following a serious injury is the most time-critical period, during which the patient mortality rate can be reduced by as much as 50 percent if immediate and appropriate medical care can be provided. The benefits of immediate treatment by medical personnel at an on-scene emergency and rapid transport of the patient, especially within this "golden hour," have been well-documented. Hospitals and medical centers have recognized the value of pairing medical crews and helicopters for reaching critically-injured or seriously-ill patients. As a result, the number of hospital helicopter programs has increased dramatically over the last ten to fifteen years.

During the years 1978-1986, this increased use of helicopters for emergency medical and air ambulance services came at a high price. In a study of 59 EMS accidents during this period, the NTSB found that the accident rates for EMS helicopter operations were approximately 3.5 times higher than for other non-scheduled Part 135 Air Taxi helicopter operations. Human error, directly or indirectly, was attributed as the cause of the majority of these accidents. To the credit of the EMS industry, these accident rates decreased significantly following the NTSB report and recommendations.

A recent study undertaken by NASA and the Aviation Safety Reporting System (ASRS) looked at 81 incident reports submitted from 1986 to 1991 involving EMS helicopters. The purpose was to identify and describe the operational aspects of these incidents, and to assess the contribution of human factors to these occurrences.

This article will focus on the human factors most commonly cited: communication interactions, time pressure, distraction, and workload.

Can We Talk...?

Communication and information transfer difficulties were pervasive, and repeatedly emerged as a major contributor to the chain of events leading to the reported incident (78 percent). The most common difficulties were reported as miscommunication during pilot contact with ATC and unsuccessful attempts by a pilot to contact ATC. Further, pilot communications with other pilots, hospital dispatchers, and ground personnel (i.e., police, firefighters, paramedics, park rangers, etc.) were also cited as additional interactions which sometimes interfered with ATC communication:

> ✍ "I was coordinating with dispatcher, medic command (flight following/status reports), and emergency vehicle on scene, and broadcasting position reports and intentions on Unicom. Approach advised (me) that I entered his airspace and did not properly coordinate with his controller… I was working four frequencies and receiving conflicting coordinates from the ground while searching for the landing zone." (ACN 181754)

Communications problems played a major role in reports of both airspace violations and near mid-air collisions (NMACs), which occurred most frequently in Class D airspace during early- to mid-afternoon (1201-1800 hours). This is a reflection of the complex, controlled-airspace environment found in the areas that can support major medical centers, and also the time of day when air traffic is generally heavy and inter-facility patient transfers are most likely to take place.

In 50 percent of airspace violations and 59 percent of NMACs, the EMS pilot was in radio communication with at *least* one ATC facility at the time of the incident. Frequency congestion, misunderstanding of ATC instructions or clearances, busy ATC personnel, and lack of common understanding of the "Lifeguard" call sign priority were cited as problems affecting the information transfer process, and contributing to the reported incident. (See sidebar).

Airspace violations frequently occurred during the takeoff phase of flight and were often due to poor radio reception or transmission associated with the low altitudes used by helicopters. In some instances, poor radio communications were attributed to landing sites surrounded by obstructions, usually the hospital or other buildings:

> ✍ "After takeoff from local hospital, which is out of radio contact with Tower but near their control zone, (I attempted to contact Tower). By the time contact was made, the airspace had been entered. A procedure needs to be established for helicopter operators to take off from areas within an ARSA where radio contact is not possible until after takeoff." (ACN 126017)

> ✍ "I was unable to contact Tower or Approach from the hospital helipad. It [helipad] is down in a hole surrounded by buildings. I departed without clearance into ARSA/Control Zone and immediately contacted Approach…He told me to stay clear of the ARSA until radar contact (had been) established. The problem is that I was already in the ARSA/Control Zone on the pad at the hospital." (ACN 142201)

NMACs occurred frequently in airspace that requires radio communication, specifically, in Class B, C, and D airspace. However, many NMACs were also reported in uncontrolled (Class G) airspace. Helicopters often fly in uncontrolled airspace, usually at low altitude. Several reporters indicated that due to frequent communication problems and delays encountered in Class B, C, and D airspace, they, and apparently many other small GA aircraft (which were usually the other parties in the reported NMACs), remained low-level in uncontrolled airspace, not talking to ATC.

The NTSB found that in-flight encounters with weather at low altitude were the single most common factor in fatal EMS accidents, with most accidents occurring at night. All 15 in-flight weather-related accidents occurred at low-altitude and in uncontrolled airspace, and 10 of those occurred at cruise speed. In the ASRS study, in-flight weather encounters were cited in 14 percent of the reports. Pre-flight weather briefings had been obtained in 80 percent of these incidents, but 75 percent of the briefings did not match the actual weather conditions the pilots encountered. The captain of a 2-pilot crew, both IFR-rated and current, flying an IFR-certified aircraft, described, the potential hazards of inaccurate weather forecasts:

> ✍ "The biggest safety problem I see is lack of accurate weather forecasting from a facility with weather reporting. This is the third time I have been inbound with a patient and have been caught by unforecast weather conditions—not just a little off, but all the way from VFR to low IFR. The last time this happened they reported clear and 10 (miles visibility) when in fact they were 300 (ft ceiling) and 1/2 (mile visibility), and went to 0-0 within an hour. Unexpected IFR or IMC can cause confusion and possibly even an accident with an experienced crew, much less an inexperienced pilot in a VFR small aircraft." (ACN 138253)

Time Trap

Time pressure was cited as an frequent contributor to incidents—the patient's critical condition led to a sense of urgency about the flight, which often resulted in inadequate pre-flight planning. Reporters cited such oversights as not stopping for refueling; failure to obtain or review correct charts; overflying scheduled aircraft maintenance; inadequate or less-than-thorough weather briefings; and inadequate evaluation of weather briefings preceding the go/no-go decision. Patient criticality was reported as a major contributor to time pressure in 44 percent of the reports. Time pressure associated with the patient's condition seemed to be present regardless of whether the patient was already on-board the aircraft or the pilot was en-route for patient pick-up.

Recommendations have been made to try to isolate the EMS pilot from the overall medical situation and the patient's condition. However, the pilot is well-aware that his or her services would not have been requested unless a serious medical situation existed. It is a normal human emotion to respond to an emergency. Given the sense of urgency that seems to be inherent in an EMS operation, and the potential for both verbal and nonverbal expressions of the necessity for speed, that attempt at isolation may be unrealistic or impossible to achieve. In numerous reports of airspace violations and inadvertent IMC encounters, pilots belatedly recognized their lack of separation from the medical circumstances.

> ✍ "[This is] another exercise in getting involved in the medical situation at the scene and how it can affect a pilot's judgment. We can never let the medical necessity override our good judgment and prevent us from being safe." (ACN 141232)

> ✍ "I was involved in patient care when I should have been totally involved in flying." (ACN 146594)

> ✍ "…High risk delivery, mother in distress. I allowed patient's condition to influence my decisions. Got above layer, had to descend IFR in a noncertified but well-equipped aircraft." (ACN 58837)

In crystal-clear 20/20 hindsight, many pilots seem to have come to similar conclusions:

> ✍ "Pilots, especially those in my line of work, should never let the circumstances around them dictate the way they would normally fly. If a flight has to be delayed in order to safely fly that mission, then so be it. No flight is so important that the lives of the flight crew should be jeopardized due to incomplete or inaccurate pre-flight planning." (ACN 100727)

> ✍ "…Quick EMS helicopter responses, numerous interruptions during start-up, added pressure of a dying person, causing pilot to make emotional decisions instead of safe ones and the pilot allowing this to happen. Most likely a pilot would not fly unless under excessive pressure to do so— not by anyone (else), but self-imposed." (ACN 118240)

Distraction

Distraction from the primary task of flying the aircraft was reported in many incidents. Distraction was often cited in terms of external influences—noise interference from medical equipment, aircraft equipment problems or malfunctions, traffic avoidance in high-density traffic areas, interruptions, monitoring of multiple radio frequencies, radio frequency congestion, poor visibility, marginal weather, and impending low-fuel situation. There were also a number of internal sources of distraction, including personal and family concerns, lack of familiarity with the area, involvement in patient condition, confusion about procedure, and misunderstandings about duty delegation.

Up to Your Empennage in Alligators

Workload as such was not cited as a major contributor to EMS incidents. However, workload is a complex concept and is subject to a variety of influences that can lead to activity overload, shedding of tasks, fatigue, and ultimately to incidents such as those reported. An unexpected finding was that cruise flight, when cockpit activity might be expected to be low, appeared to be a magnet for EMS safety incidents. Both airspace violations and NMACs were reported as most frequently occurring in cruise flight and in VFR weather. In-flight weather encounters were also reported as occurring most often in cruise flight. Although cruise is not usually a time of intense aircraft-handling activity (as might be during takeoff or approach), it is a time when the EMS pilot might be attending to tasks inside the cockpit—providing position reports to dispatch, coordinating with the medical center, programming navaids, or communicating with other EMS personnel—rather than specifically watching for conflicting traffic, a cloud layer, or airspace boundaries.

Aircraft equipment can also play a vital role in pilot workload. Although many EMS helicopters are not IFR-certified, most come very well-equipped. This is a double-edged sword for many pilots. The abundance and quality of equipment provides a level of confidence about the pilot's ability to handle inadvertent IMC. However, the complexity of some modern IFR-equipped aircraft can require more than one set of hands and eyes to be used to maximum advantage. A few EMS helicopters are equipped with autopilots. Even 2-pilot crews who might comfortably handle such a well-equipped aircraft may find themselves defeated in legally completing their missions because their aircraft is not IFR-certified.

> ✍ "It is frustrating to have an aircraft that is so well equipped with twin engine reliability and can't even legally depart to VFR on top or to make a simple ILS or LOC/DME approach to conservative minimums." (ACN 58837)

Several accounts indicated that having an IFR rating with currency and following pre-arranged procedures can be literal lifesavers when encountering inadvertent IMC. One fortunate reporter had everything in his favor when he encountered unforeseen weather conditions.

> ✍ "On climbout, I lost all ground references at 400 feet.…Landed in farm field about 1/2 mile from airport. Although fully equipped, aircraft was not IFR certified. This situation had been previously addressed and rehearsed. An instrument rating, planning for inadvertent IFR, and current approach plates kept a bad situation from ending in disaster." (ACN 169746)

Summary and Recommendations

Many of the human factors considerations cited in the EMS incident reports are known to have a significant impact in other aviation environments, and are ongoing topics of human factors research. The pilots themselves recognized some of these considerations and often had suggestions for resolving the problems they encountered.

- There appears to be a need for more concise, less frequent communication between EMS pilots and ATC. Some pilots have recommended that EMS aircraft be assigned discrete transponder codes while operating in airspace requiring ATC communication. In theory, this would allow a pilot to make the initial ATC contact and state his or her intentions, then be tracked on radar with minimal additional radio calls. Other pilots seem to feel that standardization of the "Lifeguard" callsign (see sidebar on "Priority Handling" and "Lifeguard") would go a long way in facilitating EMS flights through some types of airspace. One approach might be for EMS pilots to arrange a friendly discussion with the Tower supervisors in the areas where Lifeguard flights frequently occur. This might provide a mutual understanding of the responsibilities and expectations of both pilots and controllers in Lifeguard radio communications. Another recommendation is to obtain Letters of Agreement (LOAs) with the local ATC facilities most frequently contacted. Many pilots find that an LOA can define routes, altitudes, reporting points, and other operational information that helps to streamline the communication process for both pilots and controllers. This can be especially helpful when a hospital helipad in located within controlled airspace.

  Associated with improvements in ATC communication are improvements in crew communication. Crew Resource Management (CRM) is not just for major airlines or big companies. Clear, assertive communications among all EMS team members—pilots, flight nurses, paramedics, doctors, administrators, dispatchers, and on-scene personnel—are vital if the EMS flight team is to perform its duties efficiently and successfully.

- Another aspect of CRM and Aeronautical Decision Making (ADM) is the concept of task management and delegation. Many incidents were reported as occurring when and where they were least expected—in day VFR, during cruise flight. In two-pilot operations, tasks need to be delegated such that one pilot is always "outside" the aircraft, looking for that potential NMAC or IMC encounter. In single-pilot operations, on-board personnel may need to take an active role in all phases of the EMS operation.

- A recommendation that is often repeated by both EMS pilots and human factors researchers is the need for the pilot to be isolated as much as possible from the patient's condition. There have been many attempts to do this, and the situation continues to improve. Pilots are rarely greeted anymore with a heart-wrenching request to "save a dying child." Typically, the question is simply put to the pilot: "Can we get there and back?" with no mention made as to the nature of the emergency or the patient's condition. This helps remove some of the emotional pressure, and encourage the pilot to make an objective decision about whether the flight can reasonably be completed safely.

- Finally, many of the pilot reporters indicated that an instrument rating and currency were very helpful, if not invaluable, in encounters with unforecast weather. Since most EMS helicopters are IFR-equipped even if they are not IFR-certified, an instrument rating and currency at least provide a pilot with options in case of an in-flight weather encounter.

All efforts need to proceed towards developing solutions and preventive mechanisms within the National Airspace System and the EMS team. Each individual involved in these important emergency operations needs to become a part of the larger effort to improve communication, decrease distraction, decrease time pressure to realistic levels, and assist in workload management.

Lifeguard & Priority Handling

In our survey of the 81 EMS incidents reported to the ASRS, it became evident that "Lifeguard" and "Priority Handling" are phrases in need of clarification. Some EMS pilots seem unclear about the degree of preferential treatment provided by the "Lifeguard" call sign and how this situation compares to "Priority Handling." Similarly, some controllers seem unaware of pilots' operational expectations when "Lifeguard" is used. An ASRS report illustrates the expectation by a pilot that "Lifeguard" call sign will provide immediate priority, and also suggests that the controller had difficulty prioritizing this "Lifeguard" flight:

> ✍ "When requesting departure clearance and using 'Lifeguard' call sign, the controller ignored my transmissions for nearly 4 minutes. I could have departed safely and expeditiously in several directions completely away from the flow of fixed wing traffic." (ACN 159931)

FAA Air Traffic Control Handbook

The FAA Air Traffic Control handbook, Order 7110.65J, provides for "operational priority" for civilian air ambulance flights. It states in paragraph 2-4, Operational Priority:

> "Provide air traffic control service to aircraft on a 'first come, first served' basis as circumstance permit, except the following…
> a.) Provide priority to civilian air ambulance flight (LIFEGUARD). When verbally requested, provide priority to military air evacuation flight (AIR EVAC, MED EVAC) and scheduled air carrier/air taxi flight. Assist the pilot of air ambulance/evacuation aircraft to avoid areas of significant weather and turbulence conditions. When requested by a pilot, provide notifications to expedite ground handling or patients, vital organs, or urgently needed medical materials. 2-4a) Note—Air carrier/taxi usage of "LIFEGUARD" call sign, indicates that operational priority is requested."

Airman's Information Manual

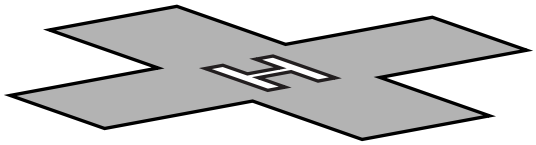
In contrast, the *Airman's Information Manual* offers no guidance as to the nature or degree of "priority" afforded the "Lifeguard" flight. This lack of information, and the possibility of variable controller interpretations of FAA Order 7110.65J when faced with different situations, may create unrealistic expectations for both pilots and controllers.

FAA Air Traffic Procedures Division

In a response to an inquiry from ASRS, the FAA Air Traffic Procedures Division offered the following expanded interpretation of "Lifeguard" and "Priority Handling" terminology.

> "The use of the term 'Lifeguard'…provide[s] priority…Even the expeditious movement of Presidential aircraft or other special air operations are listed behind air ambulance priority in Order 7110.65…

Lifeguard & *Priority Handling*



> "It is a fine line between normal operations and emergency operations, both for the medical personnel as well as for the controllers. While an emergency in the air traffic control world generally means that an aircraft (and therefore its occupants) are endangered, this distinction blurs significantly in air ambulance operations, in which the aircraft is fine but the occupant(s) may be endangered.
>
> "Order 7110.65 requires the controller to "…give first priority to separating aircraft and issuing safety alerts as required in this order. Good judgment shall be used in prioritizing all other provision of this order…In conjunction with paragraph 2-4, therefore, any aircraft that identifies itself as a 'Lifeguard' flight…will and in fact, does, receive a very high priority in the air traffic system."

"Lifeguard" can be confused with another commonly used aviation term, "Priority Handling," which is further explained by FAA Air Traffic Procedures Division:

> "The term and usage of 'Lifeguard' must be contrasted sharply with the term and usage of 'Priority Handling.' 'Priority Handling' means that the pilot requests priority handling, and has no other connotation. Unless the pilot further specifies or clarifies that request, it means nothing more than any other request…Given the ambiguity inherent in the term 'priority handling' and with no other indication or rationale for the request, it is unlikely that the controller would provide service reserved for air ambulance flights.
>
> "Good communications between pilot and controller provides a safer and more efficient operation for all concerned. Awareness of an emergency or near-emergency situation provides the latitude for both the pilot and controller to effectively perform the task at hand…Controllers share with emergency medical personnel a high degree of awareness of the value of human life: it is a natural alliance."

The following table summarizes the information provided concerning the terms "Lifeguard" and "Priority Handling":

Lifeguard	***Priority Handling***
■ Is indicated by including the term "Lifeguard" in the aircraft call sign (e.g., "**Lifeguard** Medic Flight 246").*	■ Is a request, usually following the aircraft call sign (e.g., "Medic Flight 246, requesting priority handling").
■ Indicates that *human life is endangered* to some degree, regardless of other wording in the aircraft call sign.	■ Is treated like any other request until the pilot states the reason for the priority, at which time the controller can provide appropriate assistance.
■ Air ambulance aircraft will receive very high priority when they are identified in the air traffic system.	■ Is not, in itself, justification for an aircraft to receive special handling from the air traffic system.

*As noted by the FAA Procedures Division, "In many locations the actual call sign of air ambulance aircraft can vary widely. Examples are 'DUSTOFF,' 'LIFE FLIGHT,' or 'MEDIC' and often with an associated number such as 'Dustoff one.' These kinds of call signs and air ambulance operations are normally accompanied by excellent communication between the operators and air traffic control, both in the form of recurrent visits/briefings, and Letters of Agreement."