DOT/FAA/DS-88/8

Advanced System Design Service
Washington, D.C. 20591

Aeronautical Decision-making For Air Ambulance Administrators

Advanced System Design Service
Federal Aviation Administration
Washington, D.C. 20591

February 1990

Final Report

This document is available to the public through the National Technical Information Service, Springfield, Virginia 22161.

U.S. Department of Transportation
Federal Aviation Administration

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT/FAA/DS-88/8		

4. Title and Subtitle

Aeronautical Decisionmaking for Air Ambulance Program Administrators

5. Report Date
February 1990

6. Performing Organization Code

7. Author (s)

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8. Performing Organization Report No.

SCT 90RR-5

9. Performing Organization Name and Address

Systems Control Technology, Inc.
1611 North Kent Street, Suite 910
Arlington, Virginia 22209

10. Work Unit No. (TRAIS)

11. Contract or Grant No.
DTFA01-87-C-00014 W.O. 5A

12. Sponsoring Agency Name and Address

U.S. Department of Transportation
Federal Aviation Administration
800 Independence Avenue, S.W.
Washington, D.C. 20591

13. Type Report and Period Covered

Final Report

14. Sponsoring Agency Code
ADS - 220, AAM-500

15. Supplementary Notes

AAM - 500 Biomedical and Behavioral Sciences Division
ADS - 220 Rotorcraft Technology Branch, System Technology Division

16. Abstract

This manual discusses five of the most critical administrative aeronautical decision areas. The treatment is brief to ensure that the important, basic aeronautical limits will be read and understood by the largest possible audience. The concerns are:

ACCIDENT CHARACTERISTICS
PILOT CHARACTERISTICS
WEATHER RESTRICTIONS
TRAINING NEEDS
RISK MANAGEMENT

Each of these concerns is discussed in a summary format. The summaries begin with a concise statement of the problem. This statement is followed by a discussion of the governing regulations, an explanation of the underlying reasons for the limitation, and recommended solutions an administrator could implement to reduce the impact of, or eliminate, the risk. This summary material is supplemented by appropriate references for use by the reader who would like to explore one or more of these areas in greater detail.

This administrators' manual is one of an integrated set of five Aeronautical Decisionmaking (ADM) manuals developed by the Federal Aviation Administration in a concerted effort to reduce the number of human factor related helicopter accidents. It can be used as one element of a comprehensive program for improving safety, reducing risk and, hopefully, the high cost of helicopter hull and liability insurance. The other four documents of the set are:

1. ADM for Helicopter Pilots (DOT/FAA/PM-86/45)
2. ADM for EMS Helicopter Pilots -- Learning from Past Mistakes (DOT/FAA/DS-88/5)
3. ADM for EMS Helicopter Pilots -- Situational Awareness Exercises (DOT/FAA/DS-88/6)
4. Risk Management for Air Ambulance Helicopter Operators (DOT/FAA/DA-88/7)

17. Key Words

Human Factors, Human Performance, Aviation Safety, Aviation Training, Air Ambulance, Judgment, Decisionmaking, Helicopter Pilot, Helicopter Operator, Helicopter

18. Distribution Statement

This document is available to the U.S. public through the National Technical Information Service, Springfield, Virginia 22161

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	24	

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PREFACE

"Our helicopter can fly in the heaviest ice storm because the blades on top spin so fast that they knock all the ice off."

"We have no problem flying in fog because we have this big sunlight on the bottom and it can cut through anything."

"We don't have to worry about hitting wires. We have the biggest helicopter made and it can just crash right through them."

These quotations were taken from a speech delivered By Andrew Schneider, medical editor of the Pittsburgh Press, at the annual Awards Luncheon at the 1987 ASHBEAMS* (now AAMS**) conference and published in the November 1987 issue of Hospital Aviation (Reference 1). Mr. Schneider was nearing completion of an 11-month study of the helicopter air ambulance industry. He had surveyed 231 programs, received 230 responses, visited 60 programs, and flown on over 250 missions.

Without doubt, these quotations represent an extreme degree of naivete on the part of the speakers regarding helicopter capabilities. Yet, they were spoken not in jest, but in an attempt to promote helicopter air ambulance usage. Of concern is the possibility that there are equally dangerous, but perhaps more subtle, misconceptions that exist in air ambulance program management. It is the intent of this report to establish a framework within air ambulance programs that will allow these misconceptions to be identified and corrected.

This manual discusses five of the most critical administrative aeronautical decision areas. The treatment is brief in hopes of providing the largest possible audience a basic understanding of aeronautical limitations. The concerns are:

ACCIDENT CHARACTERISTICS
PILOT CHARACTERISTICS
WEATHER
TRAINING
RISK MANAGEMENT

Each of these concerns is discussed in a summary format. The summaries begin with a concise statement of the problem. This statement is followed by a discussion of the governing regulations, an explanation of the underlying reasons for the limitation, and recommended solutions an administrator could implement to reduce , or eliminate, the associated risk. This summary material is supplemented by appropriate references for use by the reader who would like to explore one or more of these areas in greater detail.

* American Society of Hospital-Based Emergency Air Medical Services
** Association of Air Medical Services

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AERONAUTICAL DECISIONMAKING

FOR

AIR AMBULANCE PROGRAM ADMINISTRATORS

1.0 INTRODUCTION

The primary goal of a helicopter air ambulance program is to quickly and safely transport critically ill or traumatized patients to an appropriate care facility. It is the program administrator's responsibility to ensure that these goals are met efficiently and within a specified budget. Each helicopter flight requires an initial dispatch decision as well as vigilant awareness of the factors that influence risk exposure during each particular mission. The decision to cancel, delay, launch, or continue flying once airborne must be based upon a sound and complete set of guidelines instituted and supported by the program administrator.

This document is written as a guide to aid program administrators in the Aeronautical Decisionmaking (ADM) portion of their Emergency Medical Service (EMS) program. ADM is defined as:

> **"The ability to search for and establish the relevance of all available information; evaluate alternative courses of action; and the motivation to choose and execute the course of action which assures safety within the timeframe permitted by the situation.**
> (Jensen and Benel, December 1977, Reference 2)

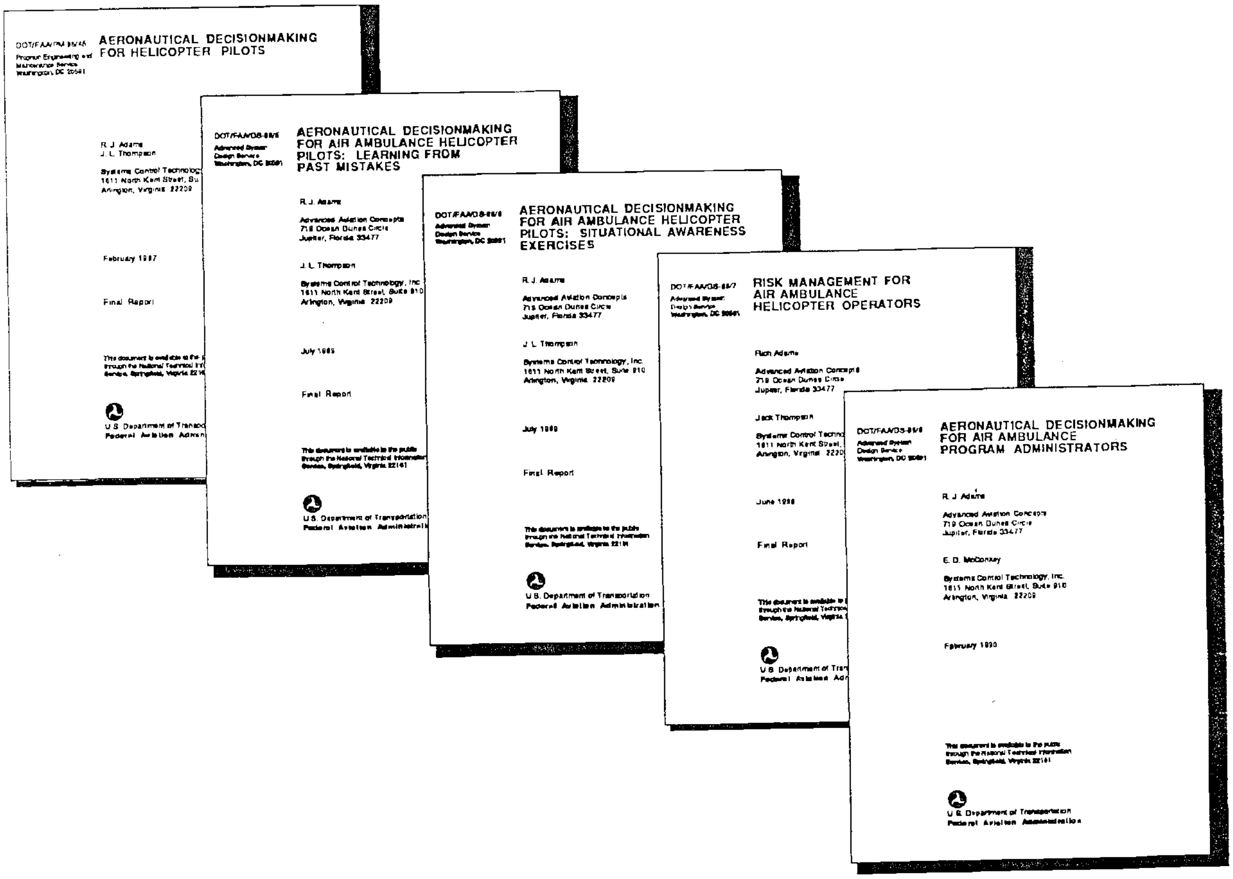
Without question, safety is the single most important objective of an EMS program. Besides the potential cost in lives, injuries, and equipment resulting from a helicopter mishap, the negative impact upon community relations is a major factor that must also be considered. While there were an unusually high number of EMS helicopter accidents in the early- and mid-1980's, subsequent statistics have shown that safe, efficient, and successful programs are possible. In 1987 and 1988 the EMS accident rates were reduced by 75 percent from their 1980-1986 levels (Collett, Hospital Aviation, February 1989, Reference 3). Many good programs have implemented significant safety enhancements to achieve these levels. Many helicopter programs have incorporated some form of ADM, risk management, and stress management as part of these enhancements.

The Federal Aviation Administration (FAA) has recognized the importance of ADM training. This manual is one in a series of five ADM training publications developed specifically for helicopter air ambulance operations. The other four are:

1. ADM for Helicopter Pilots (DOT/FAA/PM-86-45) (NTIS: ADA 180 325)
2. ADM for EMS Helicopter Pilots -- Learning from Past Mistakes (DOT/FAA/DS-88/5) (NTIS: ADA 197 694)
3. ADM for EMS Helicopter Pilots -- Situational Awareness Exercises (DOT/FAA/DS-88/6) (NTIS: ADA 200 274)
4. Risk Management For Air Ambulance Operators (DOT/FAA/DS-88/7) (NTIS: ADA 212 662)

These documents are available from the Helicopter Association International (HAI) (703-683-4646). In addition copies can be obtained from the National Technical Information Service, Springfield, VA 22161, using the NTIS accession numbers listed above.

This ADM document is designed to inform you, the program administrator, of the most critical aspects of an EMS program from an ADM viewpoint. Several accident profiles are included to illustrate flawed decisionmaking. Suggestions are also included as to how to minimize the chances of these same types of accidents occurring in your program. **Success of an EMS program is based upon free and open communications, up and down the lines of responsibility, and requires a team effort.** As a first step, reading this document and understanding potential pitfalls in the decisionmaking process will help increase your program's chances for success.



2.0 ACCIDENT CHARACTERISTICS -- Types and Causes

"While air medical accident rates have been lower the past two years, many of the same mistakes are still being made. For example, the current ratio of weather-related accidents/all accidents over the past two years is identical to the previous 15 years."......
(Collett, Hospital Aviation, February 1989, Reference 3)

The two predominant types of helicopter accidents are wire strikes and spatial disorientation followed by loss of aircraft control. Adverse weather is often a major contributing factor to these accidents.

A review of the previous two years of accident data performed by the National Transportation Safety Board (NTSB) in 1987 indicated that the majority of EMS accidents (67 percent) were weather related (Reference 4). The predominant factor in all of these weather-related accidents is restricted visibility which results in the pilot's inability to continue flight by visual references. When visibility outside the helicopter becomes restricted, the pilot must increasingly rely on instruments inside the helicopter for such things as aircraft altitude, attitude, and airspeed. As will be shown later, this is not necessarily an easy task for today's EMS pilot.

Most (88 percent) of the commercial EMS programs in the United States operate under the FAA's visual flight rules (VFR) only, according to the 1987 NTSB report. How then do qualified, experienced pilots get into situations where they are no longer in visual meteorological conditions (VMC)? Reviewing several accidents may help understand how such an occurrence is possible.

Day--Inadvertent Instrument Meteorological Conditions (IMC): An unexpected, lethal, rolling fog-bank surprised the pilot. He was unable to hold altitude and struck a mountain peak less than 60 seconds after entering the fog bank.

Pre-dawn--Scud running: The helicopter was dispatched in the darkness of pre-dawn with low ceilings, freezing rain, and wet snow conditions. The mission was to reposition the helicopter for a patient transfer. Witnesses near the crash site reported seeing the helicopter transiting the area at about 300 feet above the ground and at a speed of approximately 80 knots. Visibility was about 1/4 mile. The helicopter impacted the ground in a near vertical, nose low attitude at or above cruise speed.

Night--Loss of Control: An 8,500 hour helicopter pilot with an airline transport proficiency (ATP) rating departed with ceilings of 800 feet and 1/3 mile visibility. A surviving flight nurse reported that the helicopter suddenly entered thick fog. She next felt a left turn. Following the turn "all of a sudden there were trees everywhere". The helicopter crashed in a wooded area in a level attitude after completing about 160 degrees of turn. There were two fatalities.

Night--Wire Strike: The FAA Flight Service Station reported "400 feet broken, 700 feet overcast, visibility a mile and a half, light drizzle and fog, 47 is the temperature and 46 is the dew point." The pilot departed the area climbing to an altitude of 2,200 feet above sea level. The highest terrain en route was 1,300 feet. After altering course and descending several times to maintain visual contact with the ground, he finally decided to turn back. He had just initiated a right hand turn when the helicopter struck powerlines. He had inadvertently tried to fly between the phase line which was 53 feet above ground level and a static line which was 66 feet above ground level.

The majority of these accidents happened in weather conditions that would appear to require instrument flight to some degree. Yet most day-to-day helicopter flying is predominantly performed under VFR regardless of the pilots experience, qualifications, or mission. These accidents were the result of five basic limitations associated with helicopter flying:

1. Many helicopters are not instrumented or certified for IFR flight.

2. Helicopter pilots with instrument ratings often have difficulty maintaining currency due to a lack of flying in IMC or inadequate currency training programs.

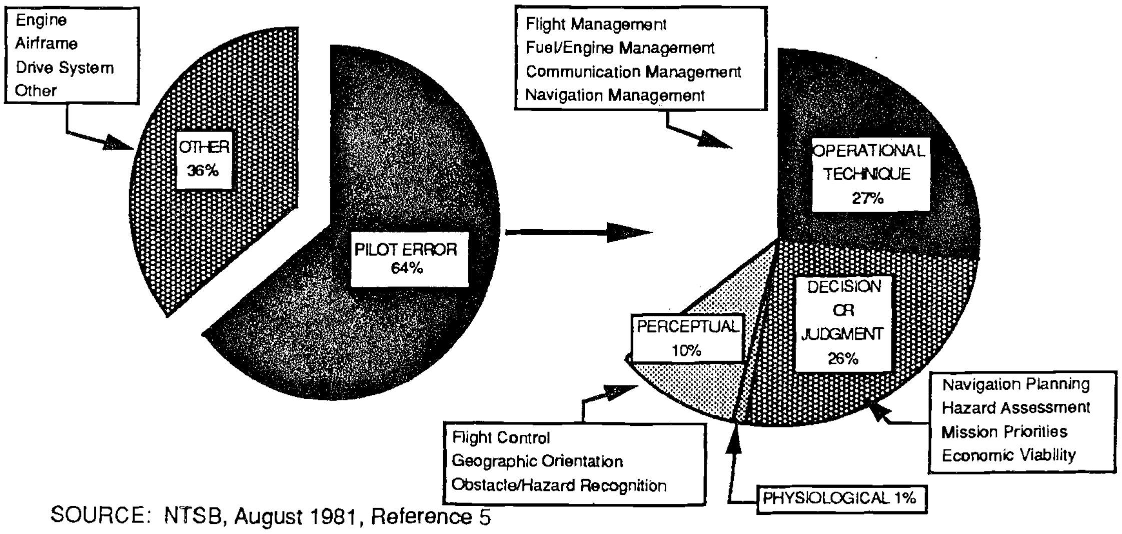
3. Local weather information is often difficult if not impossible to obtain. Helicopter operations are often conducted in locations where reliable forecasts are not available due to the distance between weather reporting stations and/or the time between weather reporting intervals.

4. The slow speed and high maneuverability of helicopters induces some pilots to attempt to fly in weather conditions that they should not, the basic mind-set being "we can always put it down somewhere." In turn, this "can do" attitude may increase customer or supervisory expectations and result in extra pressure to fly in marginal conditions.

5. Working conditions often result in fatigue which impairs judgment and decisionmaking skills.

There are many complex, interrelated causes for most accidents. However, as documented in the accident statistics, applications which require operating in marginal VMC, reduced visibility, and/or at night, significantly increase the operational risk. The human and equipment limitations which contribute to the disorientation and loss of control accidents are particularly important from a program administrator's viewpoint because they can be addressed through specific operating guidelines concerning go/no-go decisions in high risk situations.

HELICOPTER ACCIDENTS



SOURCE: NTSB, August 1981, Reference 5

3.0 PILOT CHARACTERISTICS -- Motivation, Personality, and Fatigue

"In the 59 EMS helicopter accidents reviewed for this study, 40 (68 percent) involved pilot factors or poor judgment as a part of the probable cause."......(NTSB, January 1988, Reference 4)

Why do qualified, experienced, professional, and mature helicopter pilots continue to have accidents related to poor judgment and bad decisionmaking under stress?

Helicopter pilots involved in accidents have consistently proven to be mature, professional, experienced individuals. In the recent 1988 NTSB study of EMS accidents (Reference 4), the pilots having reduced visibility accidents had a median experience level of 5,500 hours. An earlier NTSB investigation of rotorcraft accidents from 1977 through 1979 (Reference 5) analyzed 892 accidents. Nearly three-fourths (74 percent) of the pilots involved in these accidents were commercially rated; the average age was 37; they had 100-500 hours flying time in the type helicopter in which they had the accident, and about 50 hours within the last 90 days. These statistics show that qualified, experienced, professional, and mature helicopter pilots have accidents.

Pilot motivational factors are a very important part of the operational risk problem. Like many other helicopter missions, air ambulance operations are ultimately driven by economics. Helicopter support contracts with hospitals are often re-bid every one or two years. This means that if the hospital is dissatisfied with the current operator from either a mission reliability or economic viewpoint, or some competitive perception that a neighboring hospital is getting more of the transport business, the pilots job may be in jeopardy. Consequently, pilots feel pressure (either actual or self-imposed) to maintain high reliability/availability rates, to dispatch within the specified "maximum" time and complete each mission successfully.

This results in attempts to fly the mission in weather conditions in which many other helicopter pilots performing more benign missions would refuse to fly. To compound the risk, many of these missions are on-site pickups which require landing at unprepared areas, among trees, wires and sometimes on hillsides. Finally, pilots by nature are goal-oriented, "can do" individuals. This characteristic adds additional self-induced pressure to the pilot error equation.

These motivational factors, combined with the slow speed and high maneuverability of the helicopter and the basic mind-set that "we can always put it down somewhere," strongly contribute to a chain of poor decisions which, unless broken, may result in an accident. In essence, the pilot's ingrained attitudes predispose him to making the "Go" decision even when the situation, his training, and standard operating procedures indicate it is not the safe decision.

In addition to the pilot's motivational factors, which can be changed, there are some **basic personality factors** which cannot be easily altered. In 1980 a study of personality traits was performed in Canada. The goal of the tests was to develop tools to select pilot and air traffic controller candidates (Skjenna, 1981, Reference 6). Approximately 25 helicopter student pilots, 80 fixed-wing student pilots and 60 air traffic controllers were tested. The study brought out some interesting points regarding the personality traits of helicopter pilots.

Early in the testing it became apparent that the helicopter pilots were different than the other pilots tested. Helicopter pilots tended to be low in conformity. They expressed a need to control others. The author suggests that persons with this type of personality may be easily influenced.

Specifically, they can succumb to pressures of the situation or be coerced into a high risk situation. In addition, helicopter pilots scored very high in their need for "achievement." This study indicates that the "can do" attitude is an inherent personality characteristic of the successful helicopter pilot.

Finally, there is the issue of **Fatigue.** Fatigue affects the efficiency and accuracy of aircraft operations and is an important cause of helicopter accidents. Of 120 peacetime North Atlantic Treaty Organization military helicopter accidents, fatigue was a major contributory cause in 15 percent (Perry, 1974, Reference 7). A United States Army study covering a 7-year period and 1,270 accidents showed fatigue-related accidents were four times more common in helicopters than in fixed-wing aircraft (Krueger and Jones, 1978, Reference 8).

In specific aeromedical studies performed by Billings (1968, Reference 9), a light helicopter was fitted with a system which recorded rotor speed, collective movements, cyclic movements and throttle movements. Pilots with experience varying from 100 hours to 5,600 hours of helicopter flying were sent on 4-hour powerline patrol flights. The pilots were unaware that their performance was being monitored. As the mission progressed, the pilots tended to allow rotor speed to vary within wider limits. Large amplitude control movements increased during the latter hours of flight, and after 2 hours of flying more control reversals occurred. It did not appear to make any difference whether the helicopter was in the immediate proximity of obstacles or in cruising flight of less stressful nature. In fact, analysis indicated that there was a pronounced decoupling of collective and throttle movements during low workload periods. Previous helicopter flying experience did not have significant effects on fatigue tolerance.

It would appear from the military data and these limited tests that the effect of fatigue on flying skills is measurable. Deteriorated control performance coupled with the lack of suitable instruments and/or lack of outside visual cues compounds the hazards of helicopter operations. The specific flight control deterioration measured in these tests becomes critical to continued safe flight when encountering inadvertent IMC or other stressful situations, particularly when suffering from fatigue.

The administrative risk management program must therefore include adequate provisions for the minimization of both acute and chronic fatigue. The first consideration must be to regulate the duty day workload taking into account short-term workload associated with crew size, noise levels, limited visibility and instrument flight (if applicable). The second consideration should assess long-term workload, scheduling of work and rest cycles, social and emotional factors, and morale in an equitable manner.

Administrative Solutions -- Develop a comprehensive safety program that considers program needs in light of the pilot motivational and personality characteristics which impact safety. Recognize the impact of fatigue on pilot performance and establish duty cycles and pilot staffing levels appropriate to your program's flight frequency. Support and, if possible, reward safe decisions and actions which may have prevented an accident.

4.0 WEATHER -- Regulations vs. Operations

"Poor weather conditions pose the greatest single hazard to EMS helicopter operations" (NTSB, 1988, Reference 5)

The helicopter is a great VFR machine, but, it should not be operated in marginal VMC or IMC unless you have IFR certified equipment, IFR rated pilots, and specified currency and training requirements.

Most helicopter air ambulance programs operate under the FAA's air taxi regulations found in Title 14 of the Code of Federal Regulations, Part 135 (14 CFR Part 135). The FAA's certification requirements are different for Part 135 fixed-wing and helicopter operations. Helicopters are normally assumed to operate in VMC while the fixed-wing aircraft are assumed to operate in both VMC and IMC. As a result, a fixed-wing pilot flying air taxi operations must have an instrument rating (14 CFR Part 135.243). However, a pilot operating a helicopter in an air taxi operation may fly day or night without an instrument rating. Only recently, the FAA in their EMS/Helicopter advisory circular (FAA Advisory Circular 135-14, October 1988, Reference 10), recommended supplemental instrument training for EMS helicopter pilots on the chance that they may inadvertently enter instrument conditions. Nevertheless, FAA regulations and advisories allow a commercial operator to hire a helicopter pilot that has limited training in the control of a helicopter under actual or simulated instrument conditions. The operator may then assign that pilot to fly day or night with patients and medical crew-members in weather conditions that require fixed-wing pilots to fly under IFR.

Experience indicates however that the mere possession of an instrument rating by the pilot does not ensure that weather hazards are reduced. Of the 15 pilots involved in EMS weather-related accidents from 1978-86, 13 had instrument ratings. The median flight time for these pilots was 5,500 hours. But, only one of the 13 was **instrument current**, meaning the pilot had flown a minimum of 6 hours of actual or simulated instrument time including six instrument approach procedures during the previous 6 months. Certainly hiring instrument trained pilots and keeping them instrument current is costly, but how does that cost compare to the cost of an accident? One manufacturer has quoted an "average" hull loss cost of $300,000 per helicopter. This does not even begin to consider the human suffering, liability losses, legal fees, lost public confidence, etc.

There are pros and cons to operating air ambulance helicopters under IFR. These are thoroughly treated in the 1988 NTSB report (Reference 4) and will not be repeated here. However, one conclusion from this report is significant enough to be repeated: "**.........a noncurrent instrument rating significantly increases the possibility of a pilot experiencing spatial disorientation or loss of control when unplanned entry to IMC occurs.**"

Administrative Solutions -- Support no-go or abort decisions which are made by the pilot based upon his/her best judgment. Use weather minimums that are at least as high or higher than those recommended by the FAA in their EMS/Helicopter advisory circular (Reference 10). Be certain that your vendor pilots are current in their ability to fly with reference to instruments whether or not they are instrument rated. Specify, with the vendors concurrence, procedures to be used when "inadvertent IMC" is encountered. Be sure your pilots receive adequate training in local weather phenomena, weather data interpretation, and decisionmaking training.

Learning how to make good judgment decisions under stress.

5.0 TRAINING-- Situational Awareness and Judgment

The instrument certified, twin engine helicopter had completed an emergency medivac from an oil platform at 1:00 a.m. During the return flight to their base airport, the dispatcher called to inform the crew that fog was moving into the area and they had "better hurry."

About 10 miles out, the crew was forced to descend to 250 feet in order to maintain VFR. They set up a heading of 180 degrees to line up with the primary runway and began to search visually for the airport. As visibility and ceilings continued to deteriorate, the pilot asked the copilot to monitor the instruments while he continued to visually search for the runway.

The three million dollar helicopter impacted the ground in a level attitude about 300 yards short of the runway threshold. Instrument meteorological conditions prevailed at the airport at the time of the accident. ***Both crewmembers were instrument qualified and a precision ILS approach was available, yet no attempt was made to use it!***

A helicopter pilot training program that meets only minimum FAA training standards may not adequately meet the demanding needs of the EMS mission.

Current helicopter pilot training and certification requirements date back to Civil Aeronautics Administration (CAA) approval of the Bell 47 for civil use in 1946. At that time, pilots, from the manufacturer's flight test staff and CAA established training and certification requirements (Mashman, 1986, Reference 11). These requirements were based entirely on flying in VMC.

Consider the diversity of today's helicopter operations: air ambulance service, corporate transport, offshore logistics support, law enforcement, herding cattle, stringing powerlines across mountain passes, etc. Then recall that no operational experience existed and no accident cause factor information was available when the current training and certification requirements were drafted.

In the view of one training expert (Morgan, 1986, Reference 12), helicopter flight training continues to lag behind the airplane due to obsolete regulations, a decline in training resources, and increased training expenses. Additionally, in reviewing the NTSB's helicopter accident statistics over the past 20 years, one is able to conclude that, depending upon the mission, 64 to 90 percent of all helicopter accidents are pilot-error related, with the higher percentages being associated with the higher risk, higher workload operations which includes EMS. A significant number of these pilot error accidents are the result of inadequate training, proficiency, and certification requirements.

The FAA is beginning to require additional training for EMS pilots. In Reference 10 the FAA advises that the flight crew have "...... the pilot should be trained in the basic instrument flying skills to recover from inadvertent Instrument Flight Rules (IFR) conditions." However, according to regulation, the FAA requires that a student training for a Private Pilot Airplane Certificate have more instrument training (14 CFR Part 61.107(a) (6)) than is presently required for a commercial helicopter pilot flying a multi-engine helicopter carrying a highly qualified medical team and accident victims at night (14 CFR Part 61.131).

The obvious problems are the lack of specific mission training requirements and the cost of performing adequate currency training. In addition, training in more areas than basic piloting skills and instrument currency is required to run an operationally safe air ambulance program. As illustrated in the example accident, **the ability to recognize a hazardous situation, analyze alternatives, and take the appropriate risk reduction action is a dire**

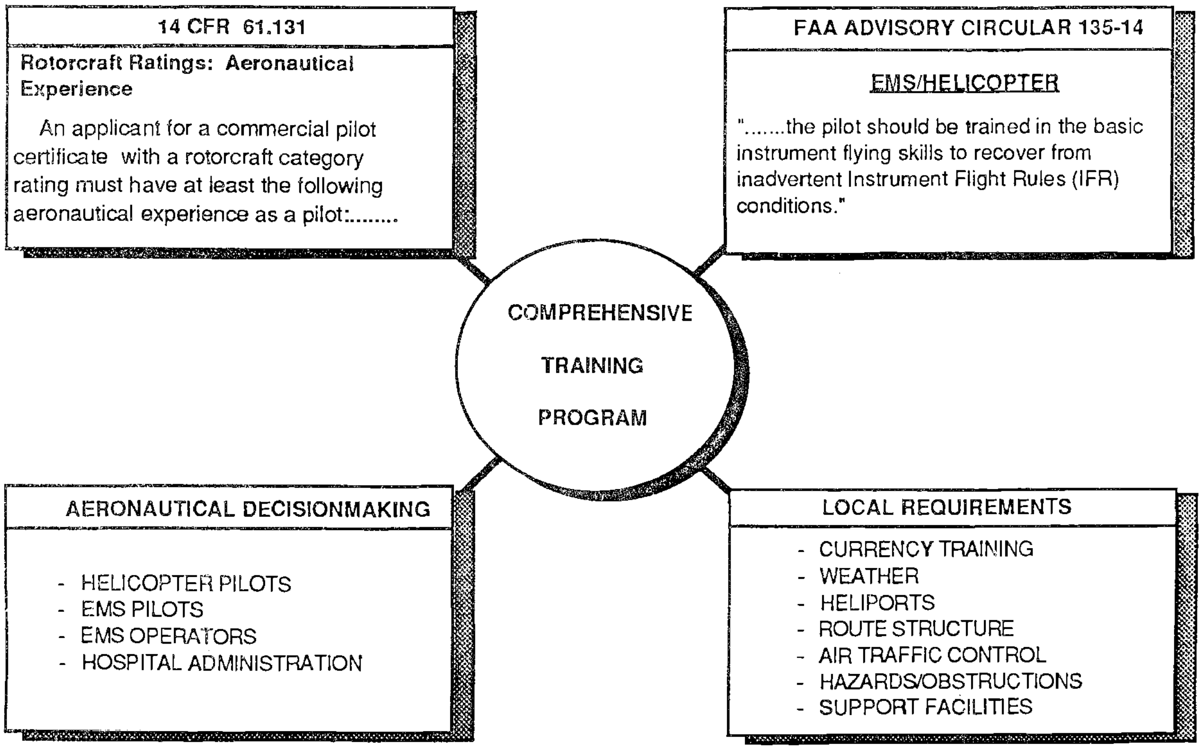
necessity. These steps are the essence of the FAA's definition of good judgment or Aeronautical Decisionmaking (ADM).

The NTSB has recognized that training must go beyond the FAA requirements and does a thorough review of training needs, from their perspective, in their 1988 EMS report (Reference 4). In fact, the NTSB specifically recommends that the FAA:

> ***"Require that the material being developed for the emergency medical service (EMS) pilot supplement to the Aeronautical Decisionmaking manual for helicopter pilots be incorporated into EMS pilot initial and recurrent training."***

Helicopter and EMS industry organizations are concerned with safety issues as well. Both AAMS and the HAI have published guidelines for safe and effective EMS operations (References 13 and 14). These guidelines have been developed by concerned individuals and organizations in the interest of establishing a set of industry-accepted standards for helicopter EMS operations and are worthy of consideration in developing and maintaining a program's operating standards.

Administrative Solutions -- Carefully review pilot training standards and practices both before awarding a contract to an operator and during the performance of the contract. Ask tough questions like: How much do you budget for recurrency training? What training does that provide? What do you do to ensure instrument proficiency? How do you integrate the training into the performance of the contract? In addition to the pilot training program, analyze the safety requirements for each member of your air ambulance team. Review the FAA Advisory Circular, the NTSB recommendations, and the AAMS and HAI guidelines for training both flying and non-flying personnel in your operation.



6.0 RISK MANAGEMENT -- Balancing Costs and Risk

It has been said that understanding a problem goes along way toward its eventual solution. As a result of the efforts of the EMS industry, the recent NTSB special study, the FAA ADM efforts, and the work of the research community, the crux of the EMS accident problem is well defined. From the pilot's perspective, it is first and foremost one of maintaining top-notch flight proficiency and making sound operational judgments. The pilot's life as well as the lives of the medical crew and patients depends upon it. From a manager's viewpoint, a financially workable solution must be developed.

One tenet of Aeronautical Decisionmaking for pilots is that risk management is comprised of two basic elements:

RISK MANAGEMENT = Understanding the Problem + Vigilant Awareness

One way of lowering the cost of a risk management program is to take advantage of existing efforts that are applicable. In this case, the helicopter manufacturers have a program underway that will provide useful risk management guidance. HELIPROPS (Helicopter Professional Pilots Safety Program) has been endorsed by all of the American manufacturers and major foreign manufacturers. Its objective is to reduce accident rates and eventually reduce the cost of liability insurance. More pertinent to the current discussion is the fact that HELIPROPS will be generating materials to support the "vigilant awareness" half of the risk management equation. One helicopter industry safety spokesman explains:

> *"I came across a Japanese word that describes the HELIPROPS concept well, it is 'zanshin' which means **unbroken concentration or continuing awareness.** If we can get that concept across to people by illustrating it with actual past incidents, we think it will help to reduce future accident rates by a significant amount."*

One of the useful outputs of HELIPROPS will be "human AD's." The FAA is quick to issue airworthiness directives (AD) and manufacturers disseminate service bulletins at the slightest hint of mechanical malfunction or defect. Yet mechanical problems accounted for only about 10 percent of all aircraft accidents compared to the 64 to 90 percent attributed to human error. HELIPROPS will explore issuing human AD's to try to reduce this imbalance. These outputs can certainly be an integral part of your risk management program at little or no cost.

Not only does HELIPROPS provide some potentially useful outputs to support risk management, but also, it is founded on the underlying principle of the importance of communication in the accident prevention process. The NTSB recognized the importance of communications at the management level in its recent report (Reference 4):

> *"Effective communication between the helicopter operator management and the hospital EMS program management is essential to safe EMS helicopter operations."*

Two ways to ensure this communication and vigilant awareness are to, first, be instrumental in establishing a safety committee, and second, to commit to participation in the committee meetings. This safety committee should include both helicopter operator and medical EMS staffs. The following list of committee members is provided as a suggestion.

- Helicopter Operator Management
- Chief Pilot or Flight Operations Manager
- Safety Officer
- Maintenance Officer
- Hospital Administration
- Program Director
- Flying Medical Crew
- Non-flying EMS Staff

The specific roles and responsibilities of each of the safety committee members is defined in "Risk Management For Air Ambulance Operators" (DOT/FAA/DS-88/7) and will not be repeated here. However, the basic purpose of the committee is to provide a non-threatening communications channel that openly addresses the EMS program's specific risk exposure and creates jointly acceptable operational guidelines to control these risks. This committee could also be another source of human AD's specific to your location, mission, local weather phenomena, etc.

These tools and techniques offer partial solutions to what is viewed as a major air ambulance management concern, a twofold management structure. Specifically, most hospital-based EMS programs have helicopter crews provided by contract operators. This leads to two major problems which influence pilot risk taking behavior.

First, the pilot is exposed to two conflicting management structures with differing objectives. The contractor/operator's objective is to provide safe and efficient transportation services and make a profit. The hospital's objectives are to provide a humanitarian service, enhance the hospital's image, provide a marketable service, and increase their share of patients. Having effective communications through a safety committee that establishes standard procedures is one way of effectively dealing with issues that arise in trying to meet these potentially conflicting objectives.

Second, since the contractor's management is usually at a distant location, whereas the hospital administration is on-site, the allegiance of the pilot to the people he sees every day becomes stronger than to his/her own management. This problem can be exacerbated if issues arise between the contractor/operator and the hospital administration that involve the pilots. The pilots may wonder whether a remotely located management will support their operational decisions. Again, having a safety committee that addresses such issues can provide all parties with a voice in handling situations that are not adequately covered by policy or standard procedures.

In summary, several basic underlying reasons for helicopter accidents have been reviewed for purposes of creating an understanding, from an administrative perspective, of several basic considerations in EMS program management. First, you should be aware of the increased risks associated with flight in marginal weather conditions. Second, you should realize that the helicopter has limitations beyond which safe flight is not assured. Third, you should now have a better understanding, and maybe even some empathy, for the pilot's predicament in making a go/no-go decision. Finally, understanding this background information will provide a better appreciation for the operational limitations of both man and machine in the demanding air ambulance role.

Administrative Solutions -- This manual is the first attempt at providing aeronautical information and decisionmaking guidance material for hospitals offering helicopter air ambulance service. Many important topics have been introduced, and a few candidate solutions proposed. It is hoped that this will be the beginnings of a much broader, coordinated, continuing effort to reduce the risks associated with the humanitarian goals of using helicopters in life saving roles.

Remember the "zanshin" or vigilant awareness concept. ....Complacency has no place in air ambulance operations.........not in the cockpit, not in management.

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APPENDIX A

GLOSSARY OF TERMS

Aeronautical Decisionmaking (ADM). The ability to search for and establish the relevance of all available information; evaluate alternative courses of action; and the motivation to choose and execute the course of action which assures safety within the timeframe permitted by the situation.

Airline Transport Pilot (with a rotorcraft rating). An applicant must pass a written test demonstrating aeronautical knowledge, hold a commercial pilot certificate or its equivalent, must have had at least 1200 hours of flight time within the past 8 years as well as the other flight time requirements of 14 CFR Part 61.161, and demonstrate to an evaluator the necessary aeronautical skills for reasonable and safe operation of the rotorcraft to include instrument flight.

Ceiling. The height above the earth's surface of the lowest layer of clouds or obscuring phenomena that is reported as "broken," "overcast", or "obscuration", and not classified as "thin" or "partial."

Coordinated Turn. A turn in which the centrifugal force is balanced by the gravitational force.

Dew Point. The temperature to which the air must be cooled to become saturated by the water vapor already present; relative humidity becomes 100 percent when the temperature and dew point are the same.

Federal Aviation Administration (FAA). The Federal agency that regulates the United States air transportation industry.

Hover. Maintaining the helicopter in a nearly motionless state of flight over a reference point at constant altitude and on a constant heading.

Inadvertent Instrument Flight Rules Conditions. When the pilot, in the performance of a mission in accordance with Visual Flight Rules, inadvertently, and without ATC clearance, encounters a weather situation in which continued flight by outside visual reference is no longer possible and flight by reference to aircraft instruments alone is necessary for safe operation of the aircraft.

Instrument Flight Rules (IFR). Rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate type of flight plan.

Instrument Landing System (ILS). A precision instrument approach and landing system which consists of the following electronic components: localizer, glideslope, outer marker, and middle marker. The landing runway must have proper runway markings, and the lowest landing minima require special approach and runway lighting.

Instrument Meteorological Conditions (IMC). Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling that are less than the minima specified for visual meteorological conditions.

Minimums. Weather condition requirements established for a particular operation or type of operation, e.g. VFR flight, IFR flight, IFR takeoff, VFR landing, etc., normally described in a height above ground-level/mean-sea-level and/or visibility required.

Recurrent Training. The training required for crewmembers to remain adequately trained and currently proficient for each aircraft, crewmember position, and type of operation in which the crewmember serves.

Safety. The identification and control of risk according to some set of preconceived parameters.

Scud Running. Pushing the capabilities of the pilot and the aircraft to the limits in poor, or deteriorating, weather conditions by flying lower and lower to the ground in an attempt to maintain visual contact with the terrain and continue the mission.

Spatial Disorientation. The pilot's lack of awareness of the aircraft's position relative to the earth's surface due to confusing sensory input; this occurs when visual flight cues are lost or misinterpreted.

Title 14 Code of Federal Regulations (14 CFR). The set of regulations established by the FAA to regulate and promote safety in aviation.

Visibility. The ability, as determined by atmospheric conditions and expressed in units of distance, to see and identify prominent unlighted objects by day and prominent lighted objects by night. Visibility is reported in fractions of statute miles, hundreds of feet or meters.

Visual Flight Rules (VFR). Rules that govern the procedures for conducting flight under visual conditions. The term "VFR" is also used in the United Sates to indicate weather conditions that are equal to or greater than minimum VFR requirements. In addition, it is used by pilots and controllers to indicate type of flight plan.

Visual Meteorological Conditions (VMC). Meteorological conditions expressed in terms of visibility, distance from cloud, and ceiling equal to or better than specified minimums.