# Medical Helicopter Accidents in the United States: A 10-Year Review

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**Objective:** **There has been a significant proliferation of medical helicopters and medical helicopter operations in the United States over the last decade. The purpose of this study was to determine whether the proliferation of medical helicopter operations in the United States was associated with a subsequent increase in the number of accidents**

**Methods:** **We used univariate descriptive analysis of all pertinent medical accident files obtained from United States aviation databases for a 10-year period (1993–2002).**

**Results:** **There were 84 medical helicopter accidents involving 260 persons (passengers, patients, crew, and pilots) during the 10-year study period. Of these, there were 72 fatalities and 64 injuries. The incidence of fatalities was 0.86 fatalities per accident. The incidence of nonfatal injuries was 0.76 per accident. Fifty-two percent of all reported accidents occurred during the last 3 years of the study period (2000–2002).**

**Conclusion:** **There was a steady and marked increase in the number of medical helicopter accidents in the United States during the 10-year period (1993–2002). These findings are worrisome in light of recent research that has indicated use of medical helicopters may be excessive and nonbeneficial for most patients.**

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The use of medical helicopters for emergency transport of ill and injured patients has increased significantly over the past 20 years. In addition, there has been a marked increase in the number of medical helicopters and medical helicopter operations.[1] This trend has been particularly evident in the United States, where medical helicopter transport has become a standard of care for certain patient conditions.[2] Although emergency patient transport by any conveyance method contains risks, the use of rotary wing aircraft carries additional risks for the crew and the patient not usually encountered with other transport modalities. The purpose of this study was to determine whether the proliferation of medical helicopter operations in the United States was associated with an increase in the number of accidents involving medical helicopters using univariate descriptive analysis.

## METHODS

Several databases exist that track incidents and accidents involving medical helicopters. All significant aircraft accidents in the United States and several other countries are investigated by the National Transportation Safety Board (NTSB). The NTSB is an independent federal agency that investigates every civil aviation accident in the United States and significant accidents in the other modes of transportation, conducts special investigations and safety studies, and issues safety recommendations to prevent future accidents. After these investigations, the NTSB issues a preliminary report within a few days of the accident. When all factual information has been gathered, the preliminary report is replaced with a final description of the accident and its probable cause. The online NTSB database contains records for all aircraft accidents investigated by the NTSB from 1962 to the present.[3]

The Air and Surface Transport Nurses Association maintains a database of medical aircraft accidents and incidents (helicopter and fixed wing). This database, called the Concern Network, contains records ranging from 1997 to the present.[4]

To find relevant accidents, we used the NTSB query function and evaluated all helicopter accidents in the United States from January 1, 1993, to December 31, 2002. Each record was evaluated to determine whether the aircraft involved was a medical helicopter. The NTSB database was then compared with the Concern Network database. If discrepancies were noted, the medical helicopter operation in question was contacted for details related to the accident. For purposes of this study, a medical helicopter accident was defined as any incident that significantly damaged the aircraft, resulted in an injury to any person that required medical evaluation, resulted in death of any person, or impacted patient care. Incidents where the aircraft struck a bird while in flight or made a precautionary landing because of possible mechanical problems were excluded. We extracted information from the databases, including date of accident, time of accident, air ambulance operator, location of accident, type of aircraft, total persons involved (passengers, patients, crew, and pilots), fatalities, injuries requiring medical evaluation, cause of accident, and status of the investigation.

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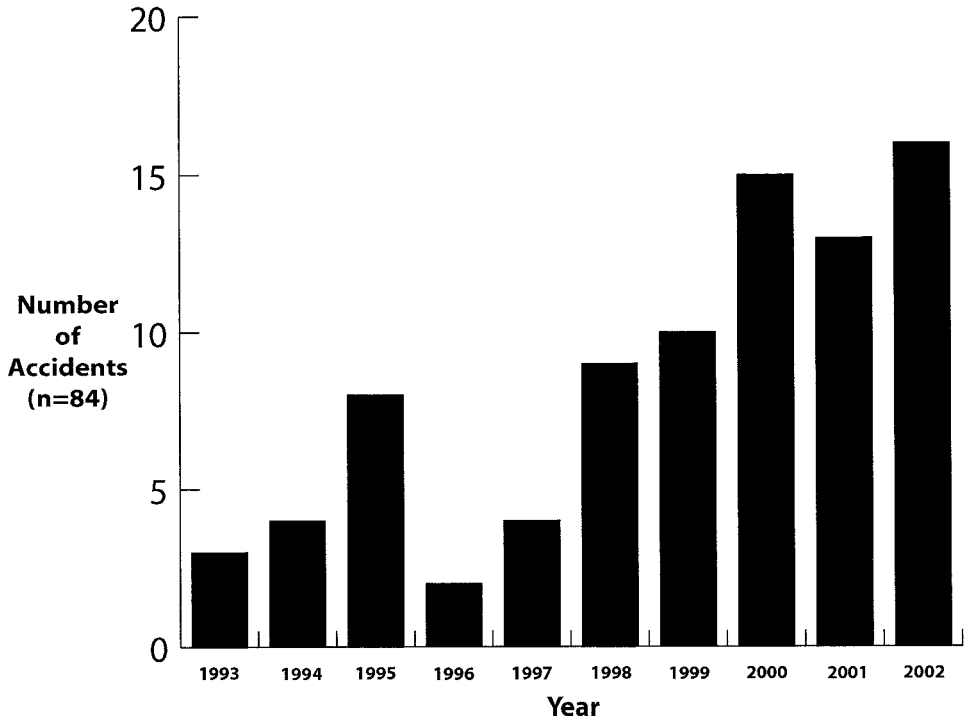


**Fig. 1.** *U.S. medical helicopter accidents by year (1993–2002).*

## RESULTS

We identified 84 medical helicopter accidents for the study period and analyzed these by year (Fig. 1). Of these, 80 (95%) were detailed in the NTSB database and 4 (5%) were detailed in the Concern Network database. There was considerable overlap of reporting between the two databases for the years 1997 to 2002. The 84 accidents involved 260 persons (passengers, patients, crew, and pilots). There were 72 fatalities and 64 injuries (Fig. 2). The incidence of fatalities was 0.86 fatalities per accident. The incidence of nonfatal injuries was 0.76 per accident. Of the 84 accidents, 37 (44%) did not result in injuries or fatalities, 19 (23%) resulted in fatalities only, 30 (36%) resulted in injuries only, and 8 (10%) resulted in a mixture of fatalities and injuries. The helicopter type involved in the most accidents was the Bell 206 Long Ranger (20% of accidents) followed by the Eurocopter BK-117 (14% of accidents). The major cause of reported accidents was pilot error (64%) (Fig. 3). Incidents were as likely during daylight hours (7 AM–6 PM) (52%) as during night hours (7 PM–6 AM) (48%).

## DISCUSSION

In all medical endeavors, safety of the patient and medical personnel has been a paramount concern. We initially reported a worrisome trend in U.S. medical helicopter accidents for a 5-year period.[5] Our study shows a marked increase in the number of medical helicopter accidents for the 10-year study period. In particular, over half (52%) of all accidents in the study period occurred during the last 3 years of the study (2000–2002). These results appear reflective of a trend first identified by the NTSB in 1988. The NTSB recognized an alarming increase in medical helicopter accidents in the 1980s. Specifically, there were 14 major medical helicopter accidents in 1986 that destroyed or significantly damaged 9% of the U.S. medical helicopter fleet. After this, they undertook a safety study of helicopter air operations and found an accident rate almost twice that of nonscheduled air taxi helicopters and a fatal accident rate 3.5 times greater.[6] After publication of their study, an improvement in medical helicopter accident rates occurred.

Rhee and colleagues compared German and U.S. air ambulance accident rates for the years 1982 to 1987. They found that U.S. medical helicopters had 4.7 fatal accidents per 100,000 flight hours compared with 4.1 fatal accidents per 100,000 flight hours for German medical helicopters. These rates were considerably higher than those for nonscheduled U.S. air taxi helicopters (1.6 fatalities per 100,000 flight hours).[7] Other countries have experienced an increase in fatal accidents in medical helicopters and have focused on refining guidelines for their use.[8]

The increased number of medical helicopter accidents we have reported is noteworthy in that several recent studies have shown that medical helicopters in the United States and other countries are overused. Shatney and colleagues reported a retrospective review of 947 consecutive trauma patients transported to their trauma center in the Silicon Valley of California, where they found that only 22.8% of study patients possibly benefited from helicopter transport. They fur-



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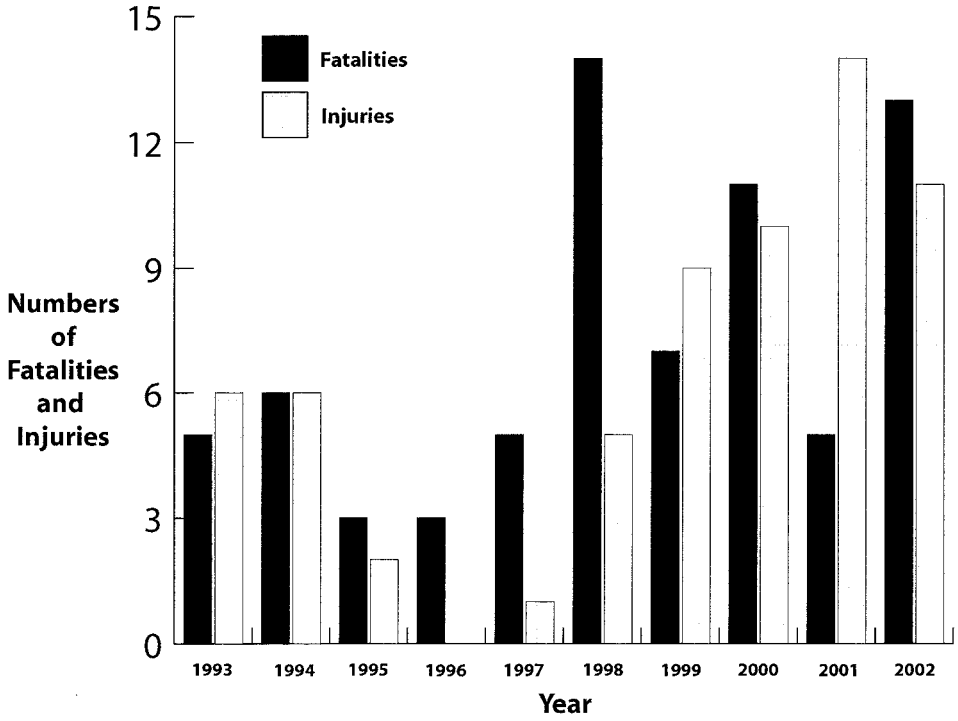


**Fig. 2.** *U.S. medical helicopter fatalities and injuries by year (1993–2002).*

ther found that 33.5% of patients transported by helicopter were discharged from the emergency/casualty department and not admitted to the hospital.[9] Eckstein and colleagues retrospectively evaluated helicopter transport of 189 pediatric trauma patients in the Los Angeles, California, area. They found that 85% of patients were considered to have minor injuries. Of the patients transported by helicopter in their study, 33% were discharged from the emergency/casualty department and not admitted to the hospital.[10] Wills and colleagues reviewed 184 medical records of patients transported from the accident scene to the hospital in New South Wales, Australia. An expert panel reviewed all helicopter patient retrievals and found that 17.3% of patients benefited from helicopter transport and 1.7% of patients were felt to have been potentially harmed. Seven percent of patients were discharged from the emergency/casualty department and not

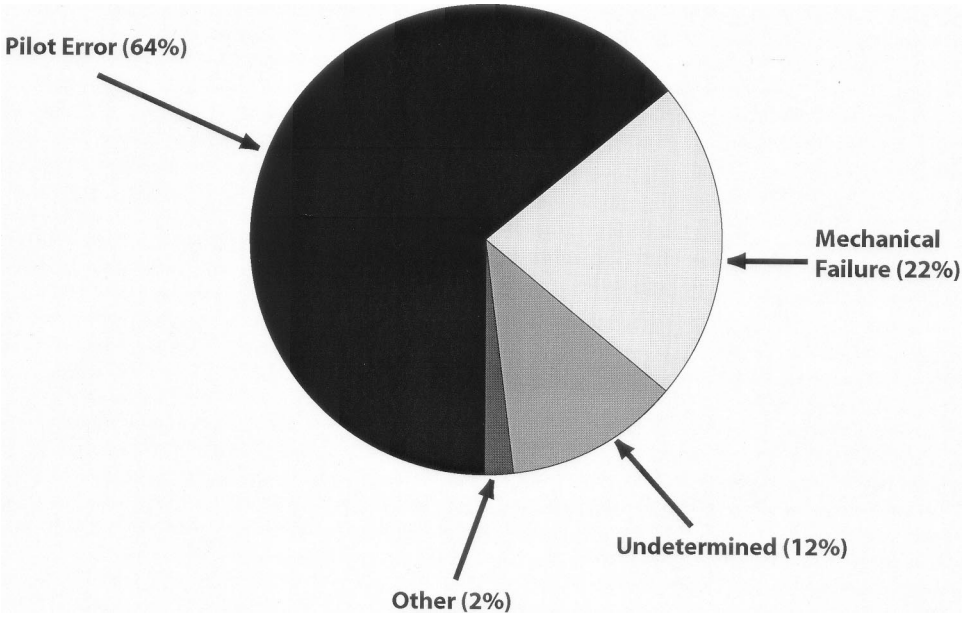


**Fig. 3.** *U.S. medical helicopter accidents by cause.*



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admitted to the hospital, and 36% were discharged from the hospital within 48 hours.[11] In a prospective case study, Wong and Lau reported that 34.1% of patients transported from the scene in Hong Kong by helicopter were discharged from the emergency/casualty department and not admitted to the hospital.[12] In a Norwegian study, an expert panel evaluated helicopter transport of 370 patients. They found that only 41 patients (11%) were judged to have benefited from helicopter evacuation.[13] Similar results were found in Finland, where 84% of patients failed to realize any benefit from helicopter transport.[14] Brazier and colleagues found no evidence of any improvement in patient outcomes for patients transported by the London Helicopter Emergency Medical Service in a prospective cohort comparison.[15] Cunningham and colleagues studied all patients transported by helicopter and ground ambulance for a 6-year period and found that "only a very small subset of patients transported by helicopter appear to have any chance of improved survival based on their helicopter transport."[16] All of these factors (accident rate, overuse) must be considered, as medical helicopters are significantly more expensive to operate than comparable ground ambulances.[17]

### Limitations

This study is limited in that it presented only raw data. Our findings would have been more meaningful if we could have determined the total number of medical helicopters in operation, the total number of patient transports by medical helicopter, and the total number of flight hours during the study period. Unfortunately, no national medical operational database exists, and we found medical helicopter operations reluctant to share their operational data. The increase in the accident rate that we have seen may simply be a result of the marked increase in the number of helicopter operations in the United States and not a decline in operational safety. However, these findings are worrisome and require additional prospective study. Furthermore, additional studies are warranted to further refine triage and transport protocols to ensure that helicopter transport is offered only to patients in whom the potential benefits outweigh the risks. A nationalized database with standardized reporting of medical helicopter accidents and operational data would provide information whereby objective and relevant assessment of medical helicopter safety and efficacy would be more meaningful.

## CONCLUSION

There has been a significant increase in the number of medical helicopter accidents during our 10-year study period. Although our study presents only raw data, the findings and trends are worrisome. Further studies are warranted to ensure that medical helicopters are and remain safe. A nationalized and standardized database of medical helicopter accident and operational data are needed. In addition, additional outcome studies are needed to accurately determine which, if any, patients benefit from medical helicopter transport.

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## EDITORIAL COMMENT

The authors of this article have a long history of criticizing the air medical industry's flight safety record and the efficacy associated with patient transport/outcome to challenge the cost versus benefit of air medical transport. Two previous publications[1,2] are incorporated into this present article, almost verbatim in parts, with additional "raw data" from the National Transportation Safety Board to accumulate details of 83 medical helicopter accidents over the 10-year period ending in 2002. With crashes as the dependent "variable," the author's sought to determine the relationship with



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the "proliferation of air medical programs" as the independent variable. They then extrapolate this to critique the value of air medical transport in light of several cited publications critical of its use.

Certainly, this is one way to look at the issue, and it serves to reinforce the author's biases concerning the impact of air medical transport on current levels of prehospital care as well as their contention that the use of air medical transport does little to improve outcomes in the majority of patients. The authors correctly acknowledge the limitations of this type of "research" and call for additional outcome studies to determine the true benefit of air medical transport. This last statement may be the most relevant point made in the article.

Noticeably not referenced by the authors is the more definitive and comprehensive publication on Emergency Medical Services helicopter safety by Blumen.[3] This supplement to the *Air Medical Physician Handbook* evaluated risk and safety using similar "raw data" for the entire period of civilian air medical transport in the United States from 1972 to 2002. More importantly, Blumen is able to incorporate usage data, programs, and helicopters to generate the information necessary to place the risk associated with transport in perspective.

So what do these data tell us? There is a risk associated with air medical transport. It appears to be greater for crew members than for patient passengers, and it is often greatest during weather-related problems encountered during the in-flight phase of air medical transport (rather than takeoff or landing). The period of most crash risk was in the 1980s, but recently, for the past 3 years to be exact, the rate of accidents has increased. The cause of this is uncertain.

In the interest of full disclosure, I direct a large, multi-helicopter, hospital-based air medical transport program, and I am as concerned about safety and outcome as anyone in our industry. In our operations, we practice a culture of safety that is without compromise. A two-pilot cockpit with full instrument flight rules capability is the standard on each flight. We practice an aggressive style of medical care using a physician/registered nurse medical crew and sophisticated intervention, such as prehospital ultrasound. We have examples of "spectacular saves," that is, care provided in the field that clearly resulted in a positive result that could have been accomplished in no other fashion.

Anecdote is not a substitute for science, however. Just as Blumen has placed risk in perspective, it is incumbent on the rest of us to "prove our bias" in the context of safety, to determine the relationship of transport to treatment and outcome.

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## EDITORIAL COMMENT

This article by Bledsoe and Smith highlights an important issue related to the type and appropriateness of emergency patient transport, that is, the safety of helicopter flights versus benefits to patient care. The increasing use of helicopters, particularly for initial response at trauma scenes, has resulted in increased risk to the patient and the transport staff, including death. There has been a significant increase in helicopter accidents in the last 3 years. Because almost one third of the patients transported by helicopter are discharged from the emergency department without admission, a better triage for and accountability of helicopter use must be developed.

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