



# FLIGHT SAFETY FOUNDATION

## CABIN CREW SAFETY

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## U.S. Domestic Air Carriers Experienced Major Increase in In-flight Medical Emergency Rate

*A study by the U.S. Federal Aviation Administration Civil Aeromedical Institute found little change in the rate of diversions for in-flight medical problems during the 1990–1993 period, but a doubling of the in-flight medical emergency rate. One possible reason was that legal and policy changes led airlines to provide service to passengers with medical conditions that previously would have barred them from flying.*

Robert L. Koenig  
Aviation Writer

Heart problems, neurological events and respiratory troubles accounted for most diversions of U.S. domestic air-carrier flights related to in-flight medical emergencies from 1990 to 1993, a study has found. The study report said that the flight “diversion rate” caused by medical emergencies had remained “fairly constant” in that period, with about 8 percent of in-flight emergencies resulting in diversion each year. But the researchers discovered that the rate of reported in-flight medical emergencies more than doubled from 1990 to 1993.

The study report by the U.S. Federal Aviation Administration (FAA) Civil Aeromedical Institute (CAMI) in Oklahoma City, Oklahoma, U.S., also revealed that 86 percent of the passengers whose medical problems led to flights being diverted were hospitalized after the plane landed. The study report, *Inflight Medical Care: An Update*, was written by CAMI researchers Charles A. DeJohn, Stephen J.H. Veronneau and Jerry R. Hordinsky.

Researchers concluded that aircraft flight crews had “complied with medical advice” in about 97 percent of the reviewed cases of in-flight medical emergencies involving U.S. domestic carriers during that three-year period.



One possible explanation for the apparent increase in the number of passengers who are medically at risk, the researchers said, was the initial influence of the Americans with Disabilities Act (ADA) of 1990 — a U.S. law that prohibits airlines and other transport systems from denying access to public transportation on the basis of disability.

The latest CAMI study confirms some of the conclusions of previous research of in-flight medical emergencies in U.S. air carriers. A quarter of a century ago, a survey of one major airline found that, typically, about one out of every million passengers suffered a medical emergency serious enough to require an unscheduled landing of the aircraft.<sup>1</sup> A two-year FAA survey of U.S. domestic flights in the late 1980s found 2,322 incidents of in-flight medical emergencies, averaging about three such emergencies per day nationwide. That survey found that 8.8 percent of flights, in which there was a medical emergency, were diverted annually.<sup>2</sup>

In 1985–1986, researchers studied in-flight emergencies involving arriving passengers at Los Angeles (California, U.S.) International Airport during a six-month period. Their report found that 0.003 percent of the 8.5 million arriving passengers

had developed symptoms in flight that required follow-up assistance on the ground. About 10 percent of those passengers were then hospitalized.<sup>3</sup>

To update and add to the previous research in this field, the CAMI researchers conducted an intensive survey of in-flight medical care aboard domestic U.S. air carriers from 1990 to 1993. Their main effort was to determine which types of medical emergencies occurred most frequently during flights, and which categories of medical problems had the highest probability of leading to a diversion of the aircraft to an unscheduled landing.

CAMI obtained the survey's raw data from two airlines and two in-flight medical care delivery companies. Together, they supplied data for nine major carriers that accounted for 64.6 percent of the total number of enplanements for U.S. scheduled air carriers from 1990 to 1993.

The researchers began by reviewing a total of 14,334 in-flight medical emergencies to determine which medical problems occurred most often. Then they studied a subset of 2,388 cases (which included 190 diversions) to determine the diversion rate for all categories of in-flight medical emergencies. Finally, the researchers used another subset of 2,321 cases to find the diversion rates by category of medical problem.

A diversion was defined as "any flight that results in an aircraft landing at an airport other than the intended destination." In general, there were two reasons for such diversions:

- A passenger with "an obvious serious medical problem requiring immediate hospitalization"; and,
- The crew's inability to properly assess or treat a passenger, resulting in uncertainty about what to do.

The CAMI researchers assessed the trends in the frequency of diversions for medical reasons, and evaluated the effectiveness of in-flight medical advice by comparing the number of flight diversions that resulted in hospitalizations with the number of diversions that did not result in hospitalizations.

The survey found that the medical emergencies most often encountered on flights were related to neurological (nervous system), syncopal (partial or complete loss of consciousness) and cardiac (heart) problems. But the three categories of medical emergencies that led to the greatest numbers of diverted flights were cardiac, neurological and respiratory (breathing) problems.

The researchers found that the categories of health problems that had the greatest potential for causing a diversion were obstetrical-gynecological (including childbirth), cardiac and neurological problems.

"Although neurological emergencies were the most frequent, and cardiac emergencies accounted for the most diversions," the report summarized, an "obstetrical-gynecological emergenc[y] had the greatest potential of resulting in a diversion."

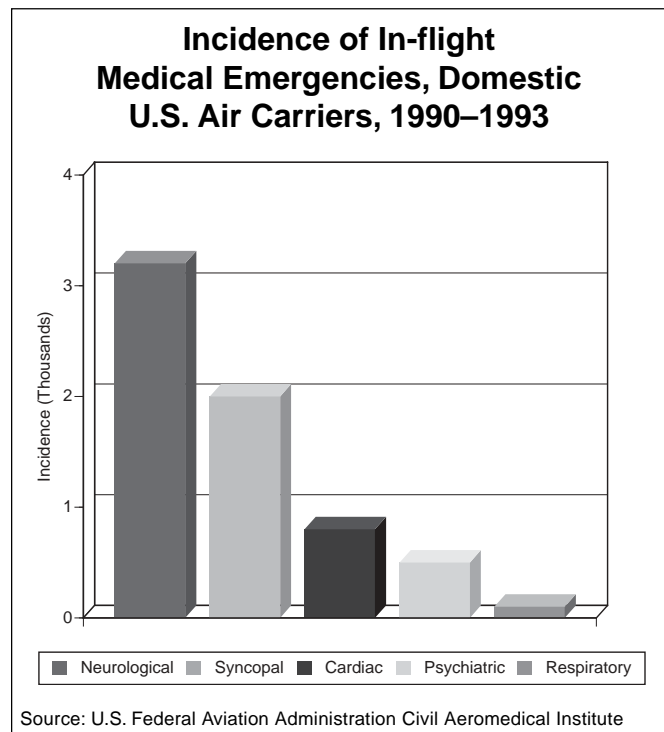
Of the 14,334 in-flight medical emergencies from 1990 to 1993 that researchers studied, the top five categories in descending order of frequency (Figure 1) were: neurological, syncopal, cardiac, psychiatric and respiratory.

Among the other frequently occurring medical categories (in descending order) were: traumatic injury, gastrointestinal, allergic, obstetrical-gynecological and medical conditions involving the ears, eyes, nose and throat.

Researchers identified 171 diversions in a sample that represented about 23 percent of all U.S. domestic air carrier activity, based on enplanements, from 1990 to 1993. The sample was derived from the experiences of one airline and one firm that delivers in-flight medical care to six U.S. air carriers. The top five categories of medical problems that led to flight diversions (Figure 2, page 3) were, in descending order of frequency: cardiac, neurological, respiratory, syncopal and obstetrical-gynecological.

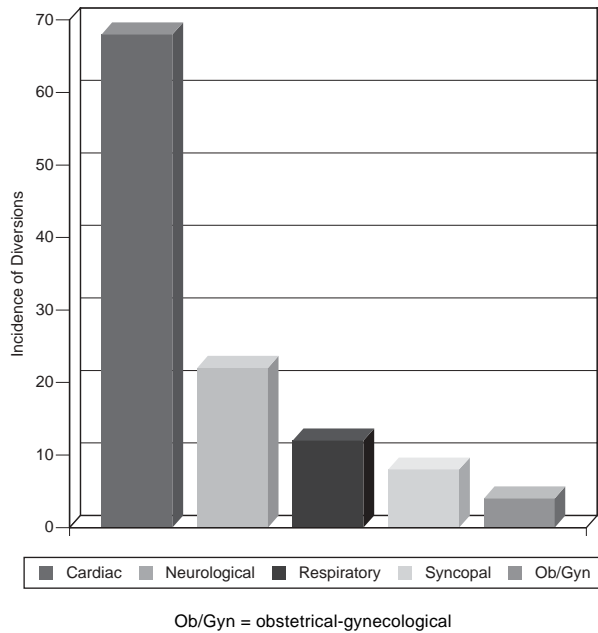
Other medical categories (in descending order of frequency) that led to diversions included: gastrointestinal, allergic, psychiatric and traumatic injury. Other causes accounted for only 25 diversions.

To find out which types of medical emergencies had the greatest diversion rates — that is, tended to result most often in flight



**Figure 1**

### In-flight Diversions by Category Of Medical Problem, Domestic U.S. Air Carriers, 1990–1993



Source: U.S. Federal Aviation Administration Civil Aeromedical Institute

**Figure 2**

diversions — the researchers divided the number of diversions by the frequency of specific categories of medical problems. Again, the data were taken from the sample representing about 23 percent of all U.S. domestic enplanements.

CAMI researchers found that the five medical categories with the highest diversion rates (Figure 3) were, in descending order of frequency: obstetrical-gynecological, cardiac, neurological, respiratory and allergic.

The medical categories with much lower diversion rates were (in descending order): miscellaneous psychiatric, syncopal, injury and gastrointestinal. In all, about 8 percent of the in-flight medical emergencies studied for the period 1990–1993 resulted in diversions, the researchers said.

The analysis of the data indicated that “the number of in-flight medical emergencies has generally increased over time, while the number of diversions decreased slightly from 1990 to 1991, then increased from 1991 to 1993,” the report said (Figure 4, page 4). “... The diversion rate decreased slightly from 1990 to 1991, then remained essentially constant from 1991 to 1993.”

Although the number of enplanements “did not appreciably change with time, the emergency rate per 100,000 enplanements ... more than doubled [between 1990 and 1993],” the report found (Figure 5, page 4).

Data from one company that provides in-flight medical consultation for five major U.S. air carriers, accounting for 10.7 percent of all U.S. domestic air carrier activity from 1990 to 1993, indicated that, in 97 percent of the situations analyzed, flight crews complied with physicians’ recommendations to divert the flight. The CAMI study suggested that the 3 percent of emergencies in which airline flight crews did not fully comply with medical advice may be misleading.

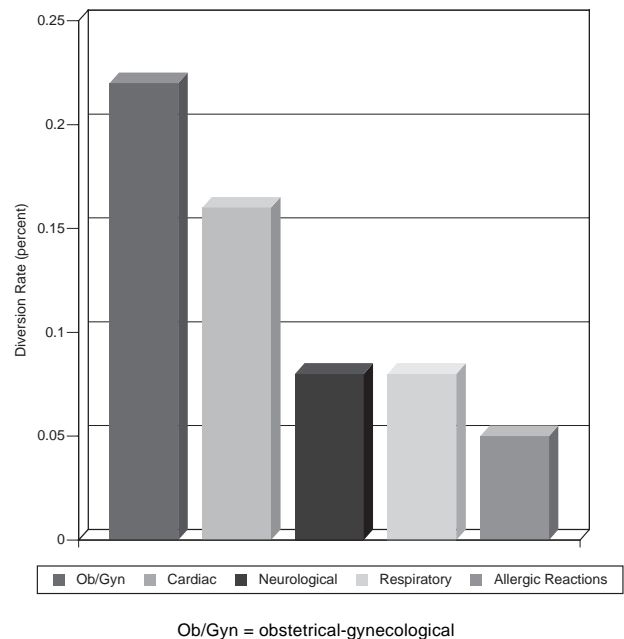
“This small percentage of cases may represent unique situations where the recommendation to divert was a matter of record, but the circumstances onboard the aircraft dictated that this would not be the best course of action,” the study said.

For example, in some cases the physician or other medical adviser may not have been timely enough in making the recommendation to divert the flight. In such cases, the report suggested, “continuation to the destination might have been in the best interest of the patient.

“Alternatively, the condition of the patient may have improved following the recommendation to divert, making the diversion unnecessary.” Nevertheless, not enough data were available for CAMI researchers to determine in which cases the decision was justified not to divert.

In 86 percent of the cases examined, the passenger was hospitalized after the diversion. Every medical-related

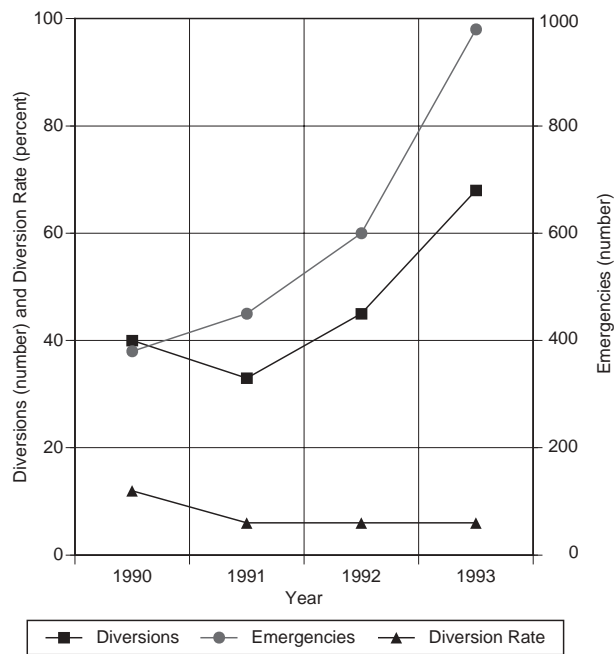
### In-flight Diversion Rate by Category Of Medical Problem, Domestic U.S. Air Carriers, 1990–1993



Source: U.S. Federal Aviation Administration Civil Aeromedical Institute

**Figure 3**

### In-flight Medical Emergencies, Diversions and Diversion Rate, Domestic U.S. Air Carriers, 1990–1993



Source: U.S. Federal Aviation Administration Civil Aeromedical Institute

**Figure 4**

diversion analyzed by researchers resulted in a hospital admission in 1990 and 1991, but only 73.7 percent of such diversions resulted in hospital admissions in 1992, and 88 percent of diversions resulted in admissions in 1993.

The CAMI survey’s findings about the leading medical causes of flight diversions are similar, though not identical, to the conclusions of previous surveys of in-flight medical emergencies.

For example, the 1985–1986 evaluation of passengers arriving at Los Angeles International and a 1986–1987 study<sup>4</sup> of medical emergencies handled through the Seattle-Tacoma (Washington, U.S.) International Airport found a higher incidence of cardiac problems than did the CAMI study.

Nevertheless, the researchers said that “cardiac emergencies are common to all three studies,” and “the top three categories found in the Los Angeles and Seattle-Tacoma studies were identical and occurred with similar relative frequency.” Those three medical categories were cardiac, gastrointestinal and respiratory problems.

The CAMI researchers de-emphasized the variations among the surveys’ results, saying that the disparities were “probably due to differences in data collection methods and the classification of in-flight emergencies.”

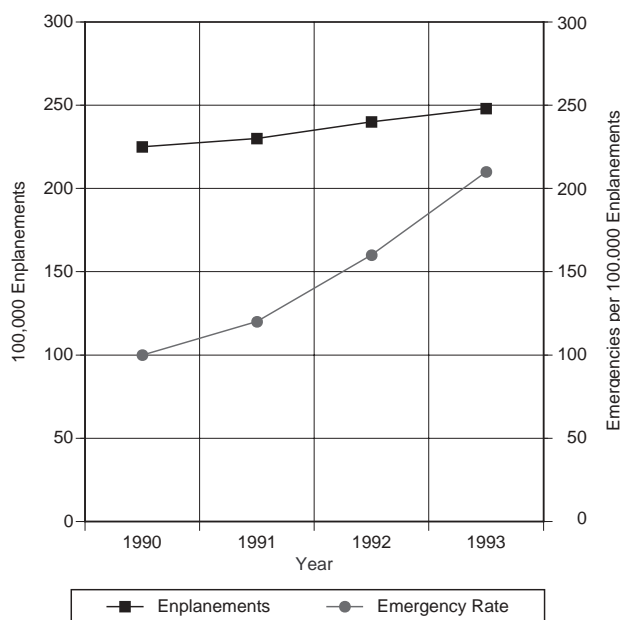
For example, the CAMI study counted as “in-flight medical emergencies” only the incidents reported by air carriers and in-flight medical-care providers. In contrast, the Los Angeles study surveyed all arriving passengers who had complained of in-flight medical problems, and the Seattle-Tacoma study surveyed all persons who reported medical problems while at the airport. Also, the systems for classifying categories of medical problems differed somewhat in each study.

But the data suggested that “the incidence of in-flight emergencies has steadily increased” since 1990. Because the number of enplanements did not increase greatly during that period, researchers concluded that “the increases in emergencies and resulting diversions are probably not explained by an increase in the number of airline passengers.”

Although the CAMI researchers could only speculate on the explanation for the increase in the total number of medical emergencies, they suggested that it “may be related to an increase in the number of medically at-risk passengers.” The CAMI suggestion that a greater number of persons with medical problems are now taking commercial flights is supported by some other research studies.

In 1991, one report found that many persons with medical conditions who previously would have avoided flying are now traveling on commercial aircraft.<sup>5</sup> Another study also suggested

### In-flight Medical Emergency Rate Per 100,000 Enplanements, Domestic U.S. Air Carriers, 1990–1993



Source: U.S. Federal Aviation Administration Civil Aeromedical Institute

**Figure 5**

that the number of medical patients on flights appears to be increasing each year.<sup>6</sup>

The CAMI researchers suggested that two possible explanations for the increasing number of medically at-risk airline passengers during the 1990s may be related to the ADA. That law bars any eligibility criteria that screen individuals with disabilities from access to public transport. It says that the failure to modify such criteria is a form of discrimination.

After the ADA was signed into law, several studies were conducted to find ways of decreasing the risks for — and enhancing the safety of — airline passengers with medical conditions. “The research resulted in several technical advances, some of which included more reliable clinical assessment of oxygen needs and the availability of lightweight, portable [and] efficient oxygen-delivery systems,” the CAMI study said.

“It appears that the ADA, subsequent research and technical advances have resulted in an acceptance by the airlines of the concept of modifying policies, practices and procedures as necessary to provide their services to passengers who are disabled,” the researchers suggested.

Those changes may benefit many of the 43 million U.S. travelers who have physical or mental disabilities, the CAMI report said, but the changes also “may have accounted for increases in the numbers of in-flight medical emergencies and related diversions” during the last few years.

[Qantas Airways has reported that its use of heart defibrillators has lowered the number of diversions resulting from cardiac arrest, the category with the second-highest diversion rate. “The devices can save a passenger’s life by shocking the heart back to a normal beat,” the airline said. “If they fail to restart the heart or show that there’s no hope (of survival) in flight, an expensive divert can be avoided.”<sup>7</sup>

[Virgin Atlantic Airways, American Airlines and Air Zimbabwe also carry defibrillators on international flights, as will Cathay Pacific Airways by the end of 1997.<sup>8</sup>]

Efforts by CAMI researchers to determine the adequacy of medical advice in in-flight emergencies were thwarted by a lack of detail in the reporting. “Complete data on patient outcome, for diverted and nondiverted flights, would be required to evaluate diversion decisions,” the report said. “Unfortunately, these data were not available for our survey.”

In general, the researchers tried to analyze the adequacy of medical advice by determining the ratio between the number of hospital admissions and the number of diversions.

“It might appear that the ideal ratio would be 1.0. However, this is not necessarily the case,” the CAMI report said. “If the ratio is 1.0, this means that each diversion surveyed resulted in an admission, as was the case for the years 1990 and 1991.

“However, there may have been incidents where flights did not divert, but should have, possibly resulting in a hospital admission upon arrival at destination. Such incidents would not be reflected in the diversion statistics and would not affect the ratio.”

In theory, the CAMI report suggested that “the ‘ideal’ hospitalization rate, based on the number of diversions, should probably approach 1.0 but be slightly less than that. This would be slightly liberal, and would ensure that all serious emergencies were appropriately diverted.”

One reason why all in-flight emergencies did not result in hospitalization is that some medical cases improve when the aircraft descends and lands. For example, certain pulmonary conditions improve once the passenger emerges from the pressurized cabin atmosphere. And some psychiatric problems, such as conditions that are exacerbated by flying in a crowded or enclosed space, are alleviated after the passenger leaves the aircraft.

The researchers noted that there is no convenient way to monitor fully the incidence of in-flight medical emergencies, because the U.S. government does not require airlines to report regularly on the medical emergencies or on the flight diversions that result from such problems.

“Future research on the quality of in-flight medical care will require standardized, industrywide data on the frequency of in-flight medical emergencies and related diversions, including the cost of those

diversions,” the report said. “Additionally, outcomes following hospital admissions are necessary to assess the appropriateness of in-flight medical advice.”

The CAMI study recommended that airline medical directors and the leaders of companies that deliver in-flight medical care cooperate to help researchers determine what happens to the passengers who necessitate flight diversions. To the extent that experts can determine the progress of such patients after they are admitted to hospitals, the study says, such cooperation will help “assess the appropriateness of in-flight medical advice.”

But determining the fate of such passengers involves delicate privacy issues. The report concluded: “To obtain such cooperation, confidentiality and anonymity must be guaranteed through arrangements made prior to commencing research.”♦

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Editorial note: This article was adapted from *Inflight Medical Care: An Update*, by Charles A. DeJohn, Stephen J.H. Veronneau and Jerry R. Hordinsky of the U.S. Federal Aviation Administration Civil Aeromedical Institute. Report no. DOT/FAA/AM-97-2, February 1997. The nine-page report includes 11 graphs and tables, as well as a list of references.

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## Further Reading from FSF Publications

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## About the Author

*Robert L. Koenig is a Berlin, Germany-based correspondent who specializes in transportation and science issues. He has written on aviation matters for Science magazine and the Journal of Commerce. Before his move to Germany, he was a Washington, D.C., newspaper correspondent for the St. Louis Post-Dispatch, for which he covered transportation issues. He won the National Press Club's top award for Washington correspondents in 1994. Koenig has master's degrees from the University of Missouri School of Journalism and from Tulane University in New Orleans, Louisiana.*

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