FLIGHT SAFETY FOUNDATION
CABIN CREW SAFETY
Vol. 37 No. 3 *For Everyone Concerned With the Safety of Flight* May–June 2002

Report Recommends Jumping Onto Evacuation Slide as Best Egress Method for Adults Carrying Infants and Young Children

The report by the U.S. Federal Aviation Administration Civil Aerospace Medical Institute said that flight attendant emergency-evacuation briefings should include instructions to parents about the proper methods of boarding evacuation slides and of protecting the child's head and neck during the boarding maneuver.

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FSF Editorial Staff

Because of projections by the U.S. Federal Aviation Administration (FAA) that the number of infants[1] injured and killed in transport aircraft accidents could increase as much as 46 percent from 2000 through 2009, the FAA Civil Aerospace Medical Institute (CAMI) conducted a study to identify the best methods of evacuating infants and young children using an emergency-evacuation slide.[2]

The 2001 CAMI study followed a 1995 FAA report — based on surveys of air carriers, industry experience and a survey of passengers — that estimated that infant enplanements account for about 1 percent of all passenger enplanements and a 1998 FAA estimate that there would be 80 million infant enplanements from 2000 through 2009.

A review of CAMI biomedical data identified 29 transport aircraft accidents between 1970 and 1995 that required the emergency evacuation of 67 infants; of that number, 23 infants (34 percent) were injured or killed. (Eight infants were killed, nine infants were seriously injured, and six infants received minor injuries; 44 infants were not injured.)

The report on the 2001 CAMI study said that few data exist for emergency evacuations by adults carrying infants and young children.

For example, CAMI's telephone survey of major airlines revealed that, "in general, there are no recommended procedures" for emergency-evacuation procedures with infants, the report said.

"A briefing for a course of emergency action, beyond recommended brace positions for an impact, is not standardized [and is not] described in most flight attendant emergency procedures manuals," the report said.

Nevertheless, one airline's flight attendant emergency procedures manual says that an adult carrying an infant or a small child should "jump onto the evacuation slide, arms locked around the child, who is cradled on the adult's lap," the report said.

CAMI provides information about the risk of injury to infants being carried by adults during emergency evacuations and about the effects of egress by adults carrying infants on "the safe and efficient egress of other passengers."

The study was conducted in the CAMI Aircraft Cabin Evacuation Facility using a right-front Type 1 exit and a Boeing 737 evacuation slide.[3] (A future study was planned to review evacuations using a Type III overwing exit.)[4] Information obtained from the study was to be used in

developing pre-evacuation briefings to be delivered by flight attendants.

Study participants were six groups of 32 adult evacuees — U.S. Navy personnel and U.S. Air Force personnel who were attending egress training at CAMI and airline industry representatives attending CAMI cabin safety workshops. Within each group of 32, there were eight participants designated as "infant-carriers" — a total of 48 infant-carriers from all six groups. They ranged in age from 18 years to 43 years and were assigned to carry dummies representing infants ranging in age from two months to 24 months. Of the 48 infant-carriers, 27 were men and 21 were women. Twenty-five of the infant-carriers were parents.

Before their participation in the infant-evacuation study began, members of each of the six groups evacuated the simulator twice without the infant-dummies, once in clear air and once in theatrical smoke, to fulfill military-training requirements or cabin-safety-workshop requirements.

Then, as part of the infant-evacuation study, each of the six groups evacuated the simulator six times. For the first and the last of the six evacuations, the participants were not told how to carry the infant-dummies or how to board the evacuation slide. For each of the other four evacuations, the infant-carriers were given individual instructions printed on index cards telling them whether to carry the infant-dummies horizontally or vertically (photo, bottom left; photo, top right; photo, bottom left page 3; photo, top right page 3) and whether to board the evacuation slide either by jumping onto it or by sitting on it and then sliding (photo, top left page 4; photo, bottom right page 4). The infant-carriers were given different instructions for each of the evacuations. For the last evacuation, the airplane cabin was filled with theatrical smoke. The evacuations were videotaped for analysis, and the participants were questioned about which carrying/boarding maneuver they considered safest and most comfortable and which carrying/boarding maneuver they would recommend to parents.

A dummy representing a two-month-old child is held horizontally. (Source: U.S. Federal Aviation Administration Civil Aerospace Medical Institute)

A dummy representing an 18-month-old child is held vertically. (Source: U.S. Federal Aviation Administration Civil Aerospace Medical Institute)

"For the first experimental trial, infant-carriers were instructed to hold the infant-dummies on their laps and to evacuate carrying the dummies when the start buzzer sounded," the report said. "A member of the research team acted as the 'flight attendant,' removing the door cover at the start signal and aggressively encouraging the quick evacuation of the plane. Subjects reboarded, were seated and [were] given the instruction cards that described how to carry the infant-dummy and how to board the evacuation slide. Each infant-carrier received a different instruction for each of the four instruction-card trials. On the last (sixth) trial, [theatrical] smoke was introduced into the cabin, but no instructions were given as to carrying and boarding maneuvers."

Later, the video recordings were reviewed to determine egress times (the amount of time each subject required to clear the exit opening after the previous subject was clear) for each participant in the study. The data were analyzed according to the participant's gender, whether the infant-dummy was carried vertically or horizontally, whether the subject jumped onto the evacuation slide or sat on the slide, and the size of the infant-dummy (two months, six months, 18 months or 24 months). Infant-carriers were asked to assess the degree of difficulty involved in each carrying/boarding maneuver; the assessment involved use of a continuous scale that ranged from "very difficult" to "very easy."

The report said that the study's findings included the following:

- Jumping onto the evacuation slide resulted in "significantly faster" egress than boarding the evacuation slide by sitting on it and then sliding;

- Military participants boarded the slide more quickly than the airline industry representatives, regardless of whether they were jumping onto the evacuation slide or sitting on it;

  "Although the workshop attendees were more familiar with evacuation procedures in general and probably had more practice at boarding an evacuation slide, they were still significantly slower than the military groups, which could be attributed to the physical fitness of the military [participants]," the report said;

A dummy representing an 18-month-old child is held horizontally. (Source: U.S. Federal Aviation Administration Civil Aerospace Medical Institute)

A dummy representing a six-month-old child is held horizontally. (Source: U.S. Federal Aviation Administration Civil Aerospace Medical Institute)

- All participants said afterward that boarding the evacuation slide was easier when jumping onto the slide than when sitting on it and then sliding;

- Female participants found carrying the 24-month-old dummy and boarding the evacuation slide easier than did male participants; and,

- The size of the infant dummies did not affect the infant-carriers' assessment of which boarding maneuver (jumping or sitting) and which carrying position (vertical or horizontal) were most comfortable. Nevertheless, the size of the infant-dummies influenced the infant-carriers' recommendations of which boarding maneuver and which carrying position they believed parents should use. For two-month-old dummies, six-month-old dummies and 24-month-old dummies, the infant-carriers recommended — in almost equal numbers — the jumping maneuver with the child held in a vertical position or the jumping maneuver with the child held in a horizontal position. For 18-month-old

An infant-carrier uses one hand to steady himself as he prepares to sit on an evacuation slide. The infant-dummy is held vertically, and its back is unsupported. (Source: U.S. Federal Aviation Administration Civil Aerospace Medical Institute)

dummies, they recommended the sitting maneuver with the child held in a horizontal position. The report said that the reasons for the preference were unclear.

The results showed that, during the first evacuation, with no instructions about boarding maneuvers or carrying positions, 75 percent of infant-carriers held the infant-dummies vertically and jumped onto the slide, 23 percent held the infant-dummies horizontally and jumped onto the slide and 2 percent held the infant-dummies horizontally and sat to board the slide.

During the final evacuation, with theatrical smoke in the cabin and with no instructions about boarding maneuvers or carrying positions, 52 percent of the infant-carriers held the infant-dummies vertically and jumped onto the slide, 40 percent held the infant-dummies horizontally and jumped onto the slide, and 8 percent held the infant-dummies vertically or horizontally and sat to board the slide.

In their comments afterward, four infant-carriers said that sitting on the evacuation slide to board probably would be safer than jumping, although they acknowledged that sitting took longer and that they believed jumping was easier.

Some infant-carriers said that they had difficulty getting to the sitting position because people were pushing them from behind, and some said that they had more momentum on the slide when they jumped.

"[I] worried about being trampled while sitting, though sitting seemed safest for [the] baby," one participant said after the study.

"Sitting slowed me down; prefer jumping," said another.

Nevertheless, the report said that both jumping onto the evacuation slide and sitting to board it presented risks of injury.

"Comments by [participants] suggest a concern that, although sitting and sliding seemed very slow, some parents may have anxiety about jumping onto the slide while holding a child," the report said. "This was shown by [participants] thinking that they could better protect the child's head and neck from injury by sitting to board the slide, even though they were afraid of being trampled or thrown off balance as they attempted to sit."

An infant-carrier jumps onto an evacuation slide while holding a dummy representing a six-month old child. The infant-dummy is held vertically, and its head, neck and back are supported. (Source: U.S. Federal Aviation Administration Civil Aerospace Medical Institute)

When some infant-carriers sat to board the evacuation slide, they used one hand to steady themselves and could not adequately support the infant-dummy with the other hand, the report said.

The report said that although an analysis of the data might result in a recommendation to jump onto an evacuation slide, "it is also critical to consider how a parent might react in an emergency."

"Those who are not confident in their ability to jump safely with their children onto the slide will be more likely to take the time to sit down on the slide to board, thereby slowing the progress of the evacuation," the report said.

Nevertheless, results of the study showed that jumping onto the slide is the most efficient boarding maneuver and that the best carrying position is the one that provides the most protection for the child, either by cradling the child's head and neck with the hand (when the child is held vertically) or by cradling the child's head and neck in the arm (when the child is held horizontally). The child's arms, legs and feet should be enfolded as much as possible by the adult's arms.

"The aim, then, for an emergency evacuation briefing would be to instruct parents about properly boarding the slide to increase their confidence and proficiency," the report said.♦

[FSF editorial note: This article, except where specifically noted, is based on *Caring for Precious Cargo, Part I: Emergency Aircraft Evacuations With Infants Onto Inflatable Escape Slides* DOT/FAA/AM-01/18, a report of the U.S. Federal Aviation Administration Civil Aerospace Medical Institute (CAMI). The report was written by Cynthia L. Corbett of CAMI. The 16-page report contains appendixes, figures, photographs and tables.]

Notes

1. In this report, the terms "infants" and "small children" refer to children less than two years of age.

2. U.S. Federal Aviation Regulations (FARs) Part 25.810 says that aircraft exits more than six feet (1.8 meters) above the ground must have an approved means of assisting passengers to the ground quickly and safely in the event of an emergency. The requirement has been met through the use of self-supporting slides or the equivalent that are automatically deployed and (in most occurrences) are automatically erected within six seconds after deployment begins. The slides also must be long enough to be self-supporting on the ground even in the event of a landing-gear collapse and must be usable in a 25-knot wind with the assistance of one person.

3. A Type I exit is defined in Part 25.807 as "a floor-level exit with a rectangular opening of not less than 24 inches [61 centimeters] wide by 48 inches [122 centimeters] high, with corner radii not greater than eight inches [20 centimeters]."

4. A Type III exit is defined in Part 25.807 as "a rectangular opening of not less than 20 inches [51 centimeters] wide by 36 inches [91 centimeters] high with corner radii not greater than seven inches [18 centimeters] and with a step-up inside the airplane of not more than 20 inches. If the exit is located over the wing, the step-down outside the airplane may not exceed 27 inches [69 centimeters]."

Further Reading From FSF Publications

U.S. National Transportation Safety Board. "Safety Study: Emergency Evacuation of Commercial Airplanes." *Flight Safety Digest* Volume 19 (December 2000).

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Koenig, Robert L. "Tests Examine Techniques for Alternative Uses of Flotation Seat Cushions." *Cabin Crew Safety* Volume 31 (January–February 1996).

Gowdy, Van; DeWeese, Richard. "FAA Tests Indicate Most Child Restraint Devices Inadequate in Airline Passenger-seat Use." *Cabin Crew Safety* Volume 29–30 (November–December 1994, January–February 1995).

Elliott, Jeanne M. "The Case for Effective Child Restraint." *Cabin Crew Safety* Volume 26 (January–February 1991).

Enders, John H. "Improved Child Protection Endorsed." *Cabin Crew Safety* Volume 25 (July–August 1990).

Barthelmess, Sharon. "Positions Brace Passengers for Impact to Reduce Injuries and Fatalities." *Cabin Crew Safety* Volume 23 (January–February 1988).

Call for Nominations

Flight Safety Foundation Heroism Award

The **FSF Heroism Award** was established by the Foundation in 1968 to recognize civil aircraft crewmembers or ground personnel whose heroic actions exceeded the requirements of their jobs and, as a result, saved lives or property. Selection of award recipients is determined by the degree of personal risk involved in the heroic act; the nature of the courage, perseverance and other personal characteristics that were displayed; and the degree to which the heroism was outside normal levels of duty and ability.

The award is presented only in years in which a nominee clearly meets the award's standard for heroism.

Since 1978, the award has been sponsored by the company now known as Kidde Aerospace and Defense; in that same year, Wilkinson Sword Ltd. was commissioned to craft a permanent symbol of the award — The Graviner Sword, a 4.2-foot (1.3-meter) Scottish highland clan broadsword, modeled after a 15th-century two-handed battle sword. The award includes a miniature replica of The Graviner Sword, US$1,000 and a handsome, wood-framed, hand-lettered citation.

The nominating deadline is July 31, 2002; the award is presented at the FSF International Air Safety Seminar (IASS).

Submit your nomination(s) via our Internet site.
Go to http://www.flightsafety.org/hero.html

For more information, contact Kim Granados, membership manager, by e-mail: granados@flightsafety.org or by telephone: +1 (703) 739-6700, ext. 126.

Want more information about Flight Safety Foundation?

Contact Ann Hill, director, membership and development, by e-mail: hill@flightsafety.org or by telephone: +1 (703) 739-6700, ext. 105.

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