



Report Recommends New Efforts to Educate Airplane Passengers About Evacuations With Infants or Young Children

Information gathered during a two-part study by the U.S. Federal Aviation Administration is intended for use in the development of pre-evacuation passenger briefings and other passenger-education materials.

—
Jean Christensen

As part of a continuing effort to identify the best methods of evacuating infants and young children¹ from transport airplanes, the U.S. Federal Aviation Administration (FAA) Civil Aerospace Medical Institute (CAMI) conducted a study² of evacuations from an aircraft with Type III overwing exits.³ CAMI found that in most instances, adult passengers carrying infants should climb through this type of exit, but that in instances involving larger children in this age group, the best strategy sometimes is to pass them through the exit opening to another person.

The study, described in a report published in March 2005, is the second of two parts. The first part, described in a 2001 report,⁴ focused on evacuations involving Type I floor-level exits with evacuation slides.^{5,6}

The research was conducted “to identify a procedure or set of procedures to recommend” to passengers with infants or young children who might be required to evacuate an airplane in an emergency, the report said. Information derived from the study is intended for use in developing passenger-education materials and pre-evacuation briefings.



Passenger knowledge is a key factor influencing passenger response during airplane accidents, and detailed airplane evacuation information is required for parents or other adults responsible for infants and young children, the report said. Nevertheless, there are few recommended procedures for the evacuation of infants or young children during aircraft emergencies.

When an evacuation of an airplane is required, “passengers must engage in rapid and appropriate behaviors under stressful conditions,” the report said. “Parents may feel even more stress during an emergency than other passengers who do not have the responsibility of caring for a child. Since providing detailed information and specific instructions to people before and during an emergency has been shown to prompt action, reduce stress and support the problem-solving process, it is clear that passenger knowledge is a key factor in determining how they will respond in an accident.”

The report cited a May 10, 2001, accident involving a Spanair McDonnell Douglas MD-83 on a runway at Liverpool (England)

Airport in which the evacuation was delayed “because of uncertainty as to the best method for evacuating small children or infants down the escape slides.”⁷

The accident report by the U.K. Air Accidents Investigation Branch (AAIB) said that neither Spanair’s passenger safety briefing nor the safety cards at each passenger seat contained information about emergency evacuation with infants or young children. The evacuation was successful, but possibly because only 45 passengers were on the flight, which could have carried 170 passengers; if the cabin had been full, uncertainty about evacuating young children might have resulted in unacceptable delays, the AAIB report said.

Recommendations Call for Development of Guidelines

The AAIB report recommended that FAA, the U.K. Civil Aviation Authority and the European Joint Aviation Authorities “provide guidance as to the recommended best practice for the evacuation of infants and small children down escape slides with minimum delay.”

The CAMI study — which had begun before the AAIB accident report was published — involved six groups of 32 adults. Each group took part in five evacuation trials, with eight adults in each trial carrying dummies that represented infants. Thirty-two men and 16 women, ranging in age from 19 years to 45 years, were selected to carry the dummies. Thirty-nine of the 48 infant-carriers were parents. Four groups comprised U.S. Air Force and U.S. Navy personnel attending egress training at CAMI, and the other two groups were airline industry representatives attending CAMI cabin safety workshops. The dummies represented two-month-old to 24-month-old infants and young children, and ranged in length from 16.75 inches [42.55 centimeters] to 31 inches [78.74 centimeters], and in weight from 10.51 pounds [4.77 kilograms] to 29.92 pounds [13.57 kilograms].

The simulated evacuations used a Boeing 720 Type III exit assembly, installed on the right side of the CAMI Aircraft Cabin Evacuation Facility (ACEF) in Oklahoma City, Oklahoma, U.S. The exit was 20 inches [51 centimeters] wide and 38 inches [97 centimeters] high, with a step-up distance of 19 inches [48 centimeters] inside and a step-down distance of 27 inches [69 centimeters] outside. Tumbling mats were placed on the ground outside the simulator to protect participants. The interior was configured like a Boeing 737, with six-abreast seating. A research team member opened the exit cover from outside the ACEF, and another team member acted as the flight attendant, supervising the evacuation from behind the line of passengers.

In the first of the five evacuation trials, no instructions were given as to how the adults should carry the dummies through the exit. For the next three trials, instructions were

printed on index cards. The instructions said either to carry the dummy vertically, carry the dummy horizontally or pass the dummy through the exit to a participant already outside the ACEF. Participants received a different set of instructions for each of the three trials. For the final trial, theatrical smoke was released in the cabin, and no carrying instructions were given.

The speed of egress was measured in two ways: first, the time for each evacuee to completely clear the exit opening after the previous person had cleared the opening (including the time for the next person to get to the exit and to climb through); and second, the actual time to climb through the exit opening. The ability to maneuver through the opening was the most significant determinant of evacuation performance with the overwing exit. (In the first part of the study, using the Type I floor-level exit, passenger hesitation in using the slide was the most significant factor.)

After the trials, the infant-carriers completed an “Emergency Aircraft Evacuations With Infants Survey” to measure their degree of ease/difficulty on a scale of “very difficult” to “very easy” and their preferred carrying orientation/maneuver with regard to comfort, safety and the technique they would recommend to parents.

Vertical Carrying Positions Preferred

Findings included the following:

- Carrying the infant dummy through the exit, in either a horizontal position or a vertical position, was significantly faster than passing the infant through the exit to another person, especially with the smaller dummies;
- Infant-carriers chose to carry the dummy in the vertical position significantly more often than they chose to carry the dummy in the horizontal position or to pass the dummy through the exit, as the most comfortable method, the safest for the infant and the one that they would recommend to parents. Neither the infant-carrier’s parental status nor the size of the dummy was related to that choice; and,
- Eighteen of the 48 infant-carriers said that passing the dummy was time-consuming and required prior coordination with another passenger, and that typically a parent would not hand off a child to anyone other than a family member.

“Waiting for someone to help with the dummy proved to take more time than simply climbing through the exit, and there was no guarantee that someone would take the infant dummy, unless the maneuver had first been coordinated,” the report said. “This *planning* strategy would not be apparent to the average passenger who has not been informed of its benefit.”



An infant-carrier holds a dummy of an 18-month-old child in a horizontal position, using both hands to support its head and body, while evacuating the airplane. (Photo: U.S. Federal Aviation Administration Civil Aerospace Medical Institute)

Those who chose the passing maneuver for the 18-month to 24-month size dummy said that the dummy was too heavy to carry through the exit and that they were concerned that a child might be injured by striking the exit frame. More women than men recommended passing the infant.

During the first trial, when participants chose the method of carrying the dummies, 34 participants (71 percent) carried the dummies vertically and 14 participants (29 percent) carried them horizontally. On the last trial, 31 participants (65 percent) carried the dummies vertically, 14 participants (29 percent) carried them horizontally and three participants (6 percent) who had carried them vertically on the first trial passed them through the exit to another person. Thirteen percent who used the vertical carrying position in the first trial chose the horizontal position in the fifth trial; another 13 percent who used the horizontal position in the first trial chose the vertical position in the fifth trial.

The theatrical smoke in the cabin for the fifth trial did not affect the amount of time required for the infant-carriers to

approach or climb through the overwing exit — in fact, they were faster in the final trial with smoke than in the first trial without smoke, indicating that they had become familiar enough with the dummies that they were able to follow the line of passengers to the exit and climb out, without being slowed by the smoke, the report said. Also, they were allowed to choose their preferred method of carrying the infant and selected the one that suited them best, probably resulting in more efficient egress.

(In the first part of the study, researchers found that the infant-carriers took longer to get out of the Type I floor-level exit in smoke than in clear air.)

Researchers had expected egress to be significantly slower through the Type III overwing exit than egress through the Type I floor-level exit. That was observed on the first trial, but by the final trial, the infant-carriers performed almost identically on Type III exits and Type I exits.



An infant-carrier holds a dummy of a two-month-old child in a horizontal position in one arm as she climbs through the exit. (Photo: U.S. Federal Aviation Administration Civil Aerospace Medical Institute)

The study also found that egress time for passengers immediately following the infant-carriers was not significantly affected. Although individual egress times of the infant-carriers did not significantly influence the egress time of other individuals through the overwing exit, the report said that their presence could add critical seconds to the evacuation time of the group as a whole.

“In an actual emergency, a delay caused by a parent waiting for someone to take his or her child could very well mean that passengers still in the plane would not survive,” the report said.

In the first part of the study, the egress times showed that jumping onto the slide was the recommended maneuver, rather than sitting to board the slide.

In both parts of the study, the infant-carriers’ performance in the fifth trial “is a noteworthy demonstration of the beneficial effects of education and ‘hands-on’ experience in airplane evacuations,” the report said. Speed of egress through the Type III exit appeared to benefit the most from participants’



Two dummies of 18-month-old children are held in vertical positions during an evacuation. (Photo: U.S. Federal Aviation Administration Civil Aerospace Medical Institute)



A dummy of a 24-month-old child is passed through the exit to a study participant. (Photo: U.S. Federal Aviation Administration Civil Aerospace Medical Institute)

experience, “which is particularly significant, as this small exit is the closest means of escape for as many as two-thirds of the passengers on many airplanes.”

The report said that the study, along with related research, shows that “the best chance passengers have of surviving an airplane accident is to be fully knowledgeable of, and especially proficient at, appropriate emergency procedures and behaviors.”

The study resulted in the following conclusions:

- “To safely and efficiently evacuate with an infant from an airplane, it is necessary that the infant’s head, neck and limbs be protected,” the report said. “The size of the infant will likely dictate whether protection is best achieved by holding the child vertically or horizontally”; and,
- When evacuating through a Type III overwing exit, “the infant-carrier should climb quickly through the exit opening,” the report said. “If the size of the infant will inhibit

egress through this small exit, and passing the infant is preferred, a strategy to accomplish this maneuver ... should be planned well in advance of the need to evacuate. When evacuating by way of the Type I floor-level exit, jumping on the escape slide is the preferred boarding maneuver.”

The report said that the recommendations should be included in passenger education materials, training programs, safety cards and pre-evacuation briefings.

Nevertheless, the report said, “It is known that passengers are not well-informed about emergency evacuation procedures and do not try to become more aware [for example, by paying attention] to oral and written safety briefings. Therefore, future research should seek to identify the best methods for providing information about the techniques for ‘caring for precious cargo’ during emergency aircraft evacuations.”♦

Notes

1. The terms “infants,” “young children” and “small children” refer to children less than two years old. In this study, dummies were used to represent children between the ages of two months and 24 months.

The U.S. Federal Aviation Administration (FAA) said in May 1995 that infant enplanements are estimated to comprise about 1 percent of all airplane passengers. The U.S. Department of Transportation in 1998 projected that 80 million infants would fly during the 10 years from 2000 through 2009, and the American Academy of Pediatrics estimates that 4.6 million children younger than age two fly on U.S. domestic airlines each year. A review of accident/incident data collected by the FAA Civil Aerospace Medical Institute (CAMI) identified 29 transport airplane accidents between 1970 and 1995 that required the evacuation of 67 infants, 23 of whom were injured, eight fatally.

2. Corbett, Cynthia L. *Caring for Precious Cargo, Part II: Behavioral Techniques for Emergency Aircraft Evacuations With Infants Through the Type III Overwing Exit*, DOT/FAA/AM-05/2. CAMI. March 2005.
3. A Type III exit is defined by U.S. Federal Aviation Regulations 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].”
4. Corbett, Cynthia L. *Caring for Precious Cargo, Part I: Emergency Aircraft Evacuations with Infants Onto Inflatable Escape Slides*, DOT/FAA/AM-01/18. CAMI. November 2001.
5. A Type I exit is defined by 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].”
6. A preliminary study conducted by CAMI in 1998 involving both Type I floor-level exits with evacuation slides and Type III overwing exits found that participants preferred jumping onto the slide while holding

upright an infant dummy or climbing through an overwing exit while cradling the dummy. In that study, researchers observed that “the head and limbs of the larger infant dummies often struck the side of the ... exit frames as they passed through.” However, their observations and interviews with study participants did not adequately address risks of injuries to infants during emergency evacuations. That study also did not consider the effects of egress of adults with infants on the safe and efficient egress of other passengers. The two-part study conducted in 2001 and 2005 addressed both issues.

7. U.K. Air Accidents Investigation Branch (AAIB). Accident Report 4/2003 (EW/C2001/5/1). 2003.

An evacuation was conducted after the right main landing gear collapsed upon touchdown at Liverpool (England) Airport following a charter flight from Palma de Mallorca, Spain. The AAIB, in the final report on the accident, said that causal factors included the failure of the right main landing gear cylinder immediately upon touchdown because of “the application of spin-up drag loads on a section of the cylinder containing a major fatigue crack ... and several other associated smaller cracks.”

About the Author

Jean Christensen, formerly an editor and reporter with *The Associated Press*, *Knight Ridder Financial News* and other news organizations, is a freelance writer and editor in the Washington, D.C., U.S., area.

Further Reading From FSF Publications

Van Es, Gerard; Post, Hans. “Analysis of Evacuation-slide Problems Calls Attention to Recurrent Issues.” *Cabin Crew Safety* Volume 40 (May–June 2005).

FSF Editorial Staff. “Communication Problems Contribute to Misperceptions of Evacuation Urgency.” *Cabin Crew Safety* Volume 38 (March–April 2003).

FSF Editorial Staff. “Able-bodied Passengers Extend Crew Capabilities During In-flight Emergencies.” *Cabin Crew Safety* Volume 38 (January–February 2003).

FSF Editorial Staff. “Report Recommends Jumping Onto Evacuation Slide as Best Egress Method for Adults Carrying Infants and Young Children.” *Cabin Crew Safety* Volume 37 (May–June 2002).

FSF Editorial Staff. “Rapid Deplaning by Airbridge Requires Coordinated Procedures.” *Cabin Crew Safety* Volume 28 (March–April 2002).

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

Johnson, Daniel. “Studies Reveal Passenger Misconceptions About Brace Commands and Brace Positions.” *Cabin Crew Safety* Volume 33 (May–June 1998).

Koenig, Robert L. “U.S., Canadian and European Aviation Authorities Coordinate Cabin-safety Research.” *Cabin Crew Safety* Volume 31 (May–June 1996).

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