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Flight Attendant Fatigue, Part VI: Fatigue Countermeasure Training and Potential Benefits

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16. Abstract

Today's aviation industry is a 24/7 operation that produces a variety of challenges for cabin crew members, including extended duty periods, highly variable schedules, and frequent time zone changes. While these operational requirements may be necessary, they are far from ideal with respect to the human body's biological rhythms for managing sleep and alertness. In fact, acute sleep loss, sustained periods of wakefulness, and circadian factors resulting from this form of misalignment are all contributors to fatigue and fatigue-related mishaps (Caldwell, 2005; Rosekind et al., 1996). The strategic management of fatigue is necessary for safety improvement throughout the industry. Employee educational programs regarding the dangers of fatigue, the causes of sleepiness, and the importance of proper sleep hygiene to improve sleep quality may be critical for effective fatigue management (Caldwell, 2005). This report outlines specific recommendations regarding fatigue countermeasures training and its potential benefits to flight attendant operations.

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BACKGROUND

While a great deal of research has been conducted on human circadian processes as applied to the scheduling and training of flight crews, relatively little research has been accomplished in cabin crew operations. Cabin crew members work in an environment that requires multiple flight legs, extended duty days, limited time off, early departures, late arrivals, and less-than-optimal sleeping conditions (Caldwell, 2005; Nesthus, Schroeder, Connors, Rentmeister-Bryant, & DeRoshia, 2007). Performance of cabin duties is critical to the safety and security of the flying general public. Sleep researchers have found that all human performance is vulnerable to sleep loss and daily variations in physiological processes tied to underlying body-clock mechanisms (Caldwell, 2005). The extent of sleep loss, fatigue, and their impact on performance of duties among the cabin crew population and within the current duty regulations is currently unknown.

In 2005, a Congressional directive to the Civil Aerospace Medical Institute (CAMI) was given to address issues regarding flight attendant fatigue. CAMI contracted with the National Aeronautics and Space Administration (NASA) Ames Research Center's Fatigue Countermeasures Group to conduct literature and incident report reviews and examine a range of typical flight attendant schedules to assess potential vulnerability to fatigue. Two reports were delivered by NASA and were integrated into a published Federal Aviation Administration (FAA) Office of Aerospace Medicine Technical Report (Nesthus et al., 2007). In this report, NASA concluded that some degree of fatigue-related performance decrements were likely under the current regulations and suggested six areas of research that would facilitate understanding and government-industry decision making. The six recommendations included: 1) a survey of field operations; 2) field research on the effects of fatigue; 3) a validation of models for assessing flight attendant fatigue; 4) a focused study of incident reports, 5) a review of international policies and practices, and 6) a review of the potential benefits of training with corresponding recommendations for a training program.

In 2008, Congress provided another directive for CAMI to conduct follow-up studies in each of the six recommendation areas noted in the 2007 report. To accomplish this directive, CAMI researchers developed a project plan for completing each recommendation. To facilitate support for these projects and ensure participation, CAMI researchers coordinated with representatives of vested organizations (e.g., Air Transport Association, Regional Airline Association, Coalition of Flight Attendants) and provided them with the opportunity to review and comment on aspects of the project plan prior to its commencement.

The current report provides specific details regarding fatigue countermeasure training and the potential benefits it could provide to flight attendant operations and outlines suggested topics for a flight attendant fatigue countermeasures training program (recommendation #6). This report will be incorporated into our consolidated report to Congress.

INTRODUCTION

Technological advances in the last 20 years have produced a 24/7 aviation industry. As a result, cabin crew members are constantly challenged by multiple flight legs, extended duty days, limited time off, early departures, late arrivals, less-than-optimal sleeping conditions, jet lag, and non-standard work hours such as night duty and rotating schedules (Caldwell, 2005). Herein lies the problem. Despite operational requirements, the body's biological need for sleep to maintain alertness does not change. In other words, individuals are not physiologically prepared to operate effectively on the 24/7 schedules that define today's flight operations. Consequently, a well-planned, science-based fatigue management strategy is crucial for combating acute and cumulative sleep loss, sustained periods of wakefulness, and circadian factors that have been shown to contribute to fatigue-related flight mishaps (Caldwell, 2005; Rosekind et al., 1996).

Fatigue management

Fatigue management generally refers to the identification of fatigue risk and the implementation of strategic controls. In the aviation industry, the FAA has traditionally sought to manage fatigue through hours of service (HOS) regulations (see Table 1). The increasing number of fatigue-related Aviation Safety Reporting System reports (Holcomb et al., under review), however, suggests that HOS regulations are insufficient for systematically managing fatigue for flight attendants. In other words, effective fatigue management requires more than just scheduled rest and duty time regulations and might benefit from a

Table 1. *Summarized Flight Attendant (FA) Rest Periods According to CFRs*

Scheduled Duty Period	Normal Minimum Rest Period	Reduced Rest Period	Subsequent Rest Period	Number of FAs Required
14 hours or less	9 hours	8 hours	10 hours	Minimum
14-16 hours	12 hours	10 hours	14 hours	Minimum + 1
16-18 hours	12 hours	10 hours	14 hours	Minimum + 2
*18-20 hours	12 hours	10 hours	14 hours	Minimum + 3

*Applies only to duty periods with one or more flights that land or take off outside the 48 contiguous States and the District of Columbia

Note: Generally, rest periods begin no less than 15 minutes after the aircraft pulls into the gate and continues until one hour prior to a flight attendant's next departure.

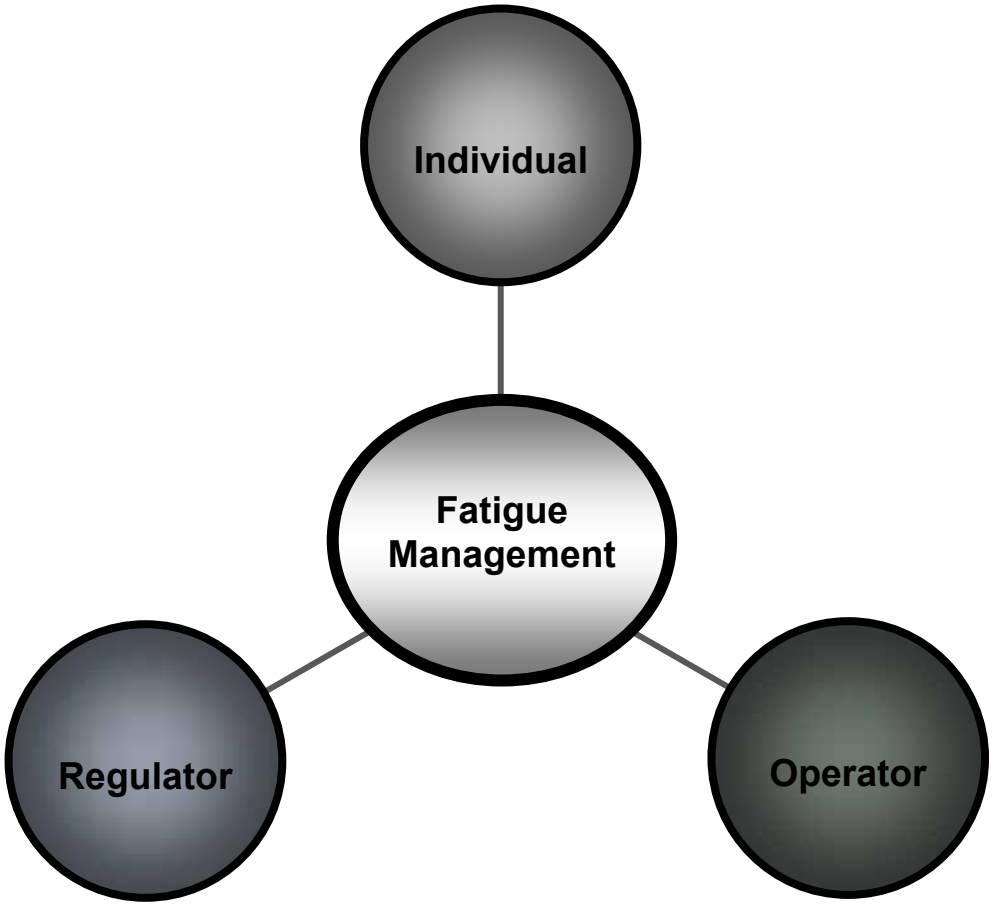

Figure 1. *Shared responsibility for fatigue management.*

multi-level, science-based approach. Systematic fatigue management requires everyone to take responsibility – the regulator, the operators, and the cabin crew members (see Figure 1). For example, the FAA is responsible for fatigue management regulations, while the operators have a responsibility for work schedule design, workload distribution, working conditions, and training (Rosa & Colligan, 1997). The cabin crew members are responsible for optimizing their rest opportunities to get the sleep they need to be fit for work and for implementing personal fatigue countermeasures as needed to mitigate fatigue and maintain alertness. Thus, an important part of fatigue management is to raise awareness of employees and managers regarding the causes and consequences of fatigue and provide training on scientifically-based countermeasures designed to better manage on and off-duty fatigue (Caldwell, 2005; Dawson & McCullough, 2005; Rosekind, Co, Neri, Oyung, & Mallis, 2002; Rosekind, Gander, Connell, & Co, 2001).

Fatigue countermeasure training

Education about the dangers of fatigue, the causes of sleepiness on the flight deck, and the importance of sleep and proper sleep hygiene is one key to addressing fatigue in operational aviation contexts (Caldwell, 2005; Dawson & McCullough, 2005; Rosekind et al., 2001a; Rosekind et al., 2002). Ultimately, cabin crew members and those responsible for scheduling trips must understand that sleep and circadian rhythms are important issues for consideration and that quality off-duty sleep is the best possible protection against fatigue prior to beginning their duty period. Recent studies have made it clear that as little as two hours of sleep loss can result in almost immediate performance decrements and an increased likelihood of error or accidents (Carskadon & Roth, 1991; Mitler et al., 1988). In fact, continuous wakefulness beyond 17 hours can result in performance decrements comparable to an individual considered legally drunk (i.e., Blood Alcohol Content [BAC] = 0.05–0.10; Arnedt, Wilde, Munt, & MacLean, 2001; Lamond & Dawson, 1999; Maruff, Falleti, Collie, Darby, & McStephen, 2005). Given the safety hazards associated with fatigue, it seems clear that fatigue countermeasure training is a necessary component of systematic fatigue management. Thus, the purpose of this report is to: 1) identify the essential components of a fatigue countermeasure training program and 2) examine the benefits a fatigue countermeasure training program can have for reducing fatigue.

REVIEW OF FATIGUE COUNTERMEASURE TRAINING PROGRAMS

Fatigue countermeasure training is not a new approach to fatigue management. In fact, fatigue countermeasure training has been utilized across a number of industries with 24/7 operations (e.g., railroad, trucking, water transport) for more than 20 years (e.g., Nicholson & Stone, 1987). In flight attendant responses to questions regarding fatigue training in a recent CAMI Flight Attendant Fatigue Survey, 35% of cabin crewmembers revealed that their carrier did provide some type of training or information regarding fatigue; however, 79% indicated that the training airlines were providing did not help reduce or minimize fatigue (Avers, Nesthus, King, Thomas, & Banks, under review). This is possibly a result of the content of the training, the method of training, lack of personal responsibility, or lack of integration of training with other fatigue risk management tools (i.e., scheduling).

We conducted an extensive review of the fatigue training literature to identify the critical components of an effective fatigue countermeasures training program. Existing fatigue countermeasure training programs were collected from diverse workforces and content analyzed to develop a basic outline of critical fatigue training topics. We then computed a frequency index to determine how often each topic occurred across training programs. This index was then used to identify the topics that were deemed most critical for inclusion in a fatigue countermeasures training program. When available, general information regarding the benefits and effectiveness of fatigue countermeasure training programs was also collected and reviewed.

Acquisition of training programs

Acquiring information on fatigue countermeasure training programs began with a three-pronged approach: 1) a search of scientific literature databases, 2) a general search of public and private educational materials, and 3) a series of inquiries to prominent fatigue researchers. Initially, an extensive literature search was conducted using seven academic computer databases (Academic Search Premier, Business Source Premier, ERIC, E-Journals, Military & Government Collection, PsycARTICLES, and PsycINFO) and the CAMI Online Library. Separate searches were also run on the FAA and NASA Websites to identify aviation-specific technical reports. General search terms included phrases like *alertness management*, *fatigue countermeasures, fatigue management*, *fatigue education,* and *shiftwork training*. To expand the search beyond scientifically published training programs, a general Internet search was conducted to locate public and private training programs. In particular, this Internet search attempted to locate programs available online and to identify companies that may have developed or implemented fatigue management training programs. Using the Google™ search engine, key phrases such as *fatigue training* and *fatigue risk management* were entered to locate fatigue training programs. The identified companies were then contacted to request a copy of their complete training program materials or an outline of the topic-areas covered in their training program. The third approach was to contact a number of prominent fatigue researchers requesting information regarding training program materials they had used or helped to develop. Responses from the companies and researchers that were contacted were very positive (73% response rate) and ultimately resulted in the collection of 50 training programs.

Inclusion criteria. After collecting the training program materials, each was reviewed and evaluated using three inclusion criteria: 1) the materials provided education and training on fatigue, shiftwork, or alertness management, 2) the materials were created or published after 1985, and 3) the materials included, at a minimum, at least an outline and summary of the topic areas included in the training program. If a program did not meet all three of these requirements, we dismissed it from further content analysis. Using these criteria, two doctoral students

reviewed each of the programs, and 49 programs were retained for further analysis (100% agreement). See Appendix A for the complete list of fatigue training programs.

Characteristics of training programs. The training programs included in this study covered a broad spectrum of educational materials that were developed for various workforces, instructed or disseminated to employees using multiple methods, and designed for different purposes according to organizational or work task requirement. Specifically, six programs were developed for the general driving population; 17 programs were developed for unspecified populations or general shiftworkers; 22 were developed for the transportation industry, and four were developed for an "others" category. Of the 22 programs developed for the transportation industry, 13 were developed for aviation-specific operations: pilots (n=4), maintenance workers (n=2), air traffic controllers (n=2), and general or unspecified (n=5). Dissemination of the educational materials to employees also utilized a number of different approaches and media venues, including: video (n=2), Web-based courses (n=2), printed materials (n=30), classroom instruction (n=6), combination of the above methods (n=7), and two with undocumented approaches. Some of the educational materials were developed by businesses, considered proprietary information, marketed, and sold for profit. As such, some training programs were only available for review in summary outline form (n=10). However, full training materials were obtained for the remaining programs (n=39).

Content analysis of training programs

Each program was reviewed to develop a comprehensive outline of the topic-areas that appeared to be critical to a fatigue education and countermeasures training program. Once the outline was established, the programs were content-analyzed by the two raters to identify the presence of each topic area; inter-rater agreement was sufficient (κ=.85). Each topic area was only to be considered present in the training program if at least three sentences were devoted to it or one specific, prescriptive recommendation was described. The purpose of this content analysis was to quantify the topics included in the training programs by creating a frequency index of how often each topic area had occurred across the various training sources. The frequency index thus provided the basis for identifying a hierarchical listing of critical topics for the fatigue countermeasures training program (see Table 2).

Identified topics areas. The content analysis revealed that each of the topic areas included in the initial outline should be included in the recommended fatigue countermeasures training program. In general, the fatigue experts consistently agreed on the most important topic areas that are necessary for an effective fatigue countermeasures training program. Topics were consistent across the overall training programs reviewed and even more consistent among the aviation-specific training programs. Any variations noted were mostly a function of the degree of detailed information provided and the specific focus of the training program (e.g., on-duty countermeasures vs. off-duty countermeasures). As expected, fatigue was a focal topic in all of the training programs (100%). However, not all fatigue-related factors were included with the same degree of frequency across programs. To break this down, topic areas such as sleep, circadian rhythms, nutrition, work hours, and substance use (e.g., caffeine, alcohol) were cited more frequently, while commuting, workload, and hydration topics were cited less frequently. All topic areas were cited in at least eight of the 49 training programs reviewed and could arguably be included in a *comprehensive* fatigue training program.

Organization of training topics. To organize the training topic areas for this report, the raters reviewed the educational materials and used a q-sort procedure that identified three broad content areas: introductory fatigue information, off-duty rest and activities, and on-duty or operationally specific issues. Within each of the three content areas, topics were broken into multiple sub-levels to ensure that all relevant information would be included. For instance, under the off-duty rest and activities section, there are two secondary headings: sleep fundamentals and lifestyle. Each secondary topic was further delineated to provide in-depth guidelines regarding content development. See Appendix B for the final proposed training outline.

REVIEW OF FATIGUE TRAINING EFFECTIVENESS

Although a number of focused and detailed fatigue training programs exist, relatively few organizations have evaluated and reported the effectiveness or recurrence recommendations of their fatigue training programs. The preliminary evidence, however, does suggest that training provides a number of physiological and psychological benefits to the individual, as well as the organization and should be considered one aspect of a company's overall fatigue mitigation strategy.

Individual benefits

In 2005, Gander and colleagues adapted a NASA Ames Fatigue Countermeasures Program and administered it to both heavy- and light-vehicle drivers. Heavy-vehicle drivers were tested on key concepts using a test administered before and after each training session and also by a follow-up survey sent out within 26 months of the

Table 2. *Frequency of Fatigue Topics Across Training Programs*

	Overall				*Aviation Specific*		
Topics	*# T*[a]	*Total T*[b]	*% T*[c]	*Programs*[d]	*# T*[a]	*Total T*[b]	*% T*[c]
Fatigue	49	49	100%	1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24, 25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45, 46,47,48,49	13	13	100%
Definition	21	49	43%	2,9,10,11,16,18,20,22,23,24,25,26,27,29,30,42,44,45,46,47,48	10	13	77%
Symptoms	33	49	67%	1,2,3,4,5,8,9,11,15,16,18,19,20,22,23,24,25,26,27,28,29,30,31,35, 36,42,43,44,45,46, 47,48,49	12	13	92%
Causes	36	49	73%	2,5,6,7,8,9,10,11,15,16,18,19,20,21,22,23,24,25,26,27,28,29,30, 32,33,35,36,38,40,41,42,45,46,47,48,49	13	13	100%
Consequences	45	49	92%	1,2,3,5,6,7,8,9,10,11,13,14,15,16,17,18,19,20,21,22,23,24,25,26, 27,28,29,30,31,32,33,34,35,36,37,39,40,41,42,44,45,46,47,48,49	13	13	100%
Mental	40	45	90%	2,3,5,6,9,10,11,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28, 29,30,33,34,35,36,37,39,40,41,42,44,45,46,47,48,49	13	13	100%
Physical	41	45	91%	1,2,3,5,6,9,10,11,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27, 28,29,30,31,33,34,35,36,37,39,40,41,42,44,45,47,48,49	13	13	100%
Health/Well-being	34	45	76%	1,2,3,5,6,9,10,11,13,14,15,16,17,18,20,21,22,23,24,25,26,27,28, 29,30,36,37,40,42,44, 45,47,48,49	12	13	92%
Digestive	16	34	47%	1,3,6,9,10,11,14,15,17,18,22,27,30,42,45,48	4	12	33%
Cardiovascular	16	34	47%	1,3,6,9,10,11,14,15,17,18,22,27,30,42,45,48	4	12	33%
Mood	24	34	71%	2,3,6,9,10,11,13,16,20,21,22,23,24,25,26,27,28,29,30,36,42,45, 48,49	11	12	92%
Circadian Rhythm	40	49	82%	1,3,4,5,6,7,9,11,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28, 29,30,31,32,33,35,36,38,39,43,44,45,46,47,48,49	13	13	100%
Sleep	44	49	90%	1,3,4,5,6,7,9,10,11,12,13,14,15,17,18,19,20,21,22,23,24,25,26,27, 28,29,30,31,32,33,35,36,37,38,39,40,41,43,44,45,46,47,48,49	13	13	100%
Cycle	22	44	50%	1,3,5,6,9,18,19,22,23,24,25,26,27,29,30,35,37,39,44,46,48,49	10	13	77%
Debt	26	44	59%	1,4,9,11,18,19,20,21,22,23,24,25,26,28,29,30,32,33,35,36,38,40, 44,47,48,49	12	13	92%
Quantity	39	44	89%	1,3,4,5,6,9,10,11,13,14,15,17,18,19,20,21,22,23,24,25,26,27,28, 29,30,32,33,35,36,37,39,40,41,44,45,46,47,48,49	13	13	100%
Quality	35	44	80%	1,3,4,9,12,13,14,15,17,18,19,20,21,22,23,24,25,26,27,28,29,30, 35,36,37,39,40,41,43,44,45,46,47,48,49	13	13	100%

Notes

[a] Number of training programs that included information on the topic area.

[b] Total number of training programs included in the percentage calculations based on category breakdowns.

[c] Percentage of training programs that included information on the topic area.

[d] Training programs that included information on the topic area (see Appendix A for the list of training programs)

Table 2 (cont.). *Frequency of Fatigue Topics Across Training Programs*

	Overall				*Aviation Specific*		
Topics	*# T*[a]	*Total T*[b]	*% T*[c]	*Programs*[d]	*# T*[a]	*Total T*[b]	*% T*[c]
Napping	30	49	61%	1,3,6,11,12,13,15,18,19,21,22,23,24,25,26,27,28,29,30,31,32,33, 35,36,43,44,45,47,48,49	12	13	92%
Work Hours	35	49	71%	1,3,4,5,6,9,11,13,14,15,17,18,20,21,22,23,24,25,26,27,30,33,35, 36,37,39,40,41,42,44, 45,46,47,48,49	10	13	77%
Shiftwork	28	34	82%	1,3,4,5,6,9,11,13,14,15,17,18,20,21,22,23,24,25,26,27,33,35,37, 44,45,46,48,49	9	10	90%
Overtime/Extended Hours	19	34	56%	9,11,13,14,15,18,23,24,25,26,35,36,40,41,42,45,46,48,49	5	10	50%
Shift Scheduling	25	34	74%	3,6,9,11,13,14,15,17,18,21,22,23,24,25,26,27,35,36,37,44,45,46, 47,48,49	8	10	80%
Nutrition	34	49	69%	1,3,5,6,7,9,10,12,13,14,15,17,18,19,21,22,23,24,25,26,27,29,30, 32,35,36,37,39,43,44, 45,47,48,49	11	13	85%
Hydration	15	49	31%	1,17,18,23,24,25,26,27,29,36,40,41,43,47,49	7	13	54%
Exercise	30	49	61%	1,3,4,5,7,9,13,14,15,17,18,19,21,22,23,24,25,26,27,29,30,35,36, 37,39,43,44,45,48,49	11	13	85%
Substances	35	49	71%	1,3,4,5,6,7,9,10,11,13,14,15,18,19,21,22,23,24,25,26,27,28,29,30, 31,32,35,36,43,44, 45,46,47,48,49	12	13	92%
Alcohol	30	34	88%	1,3,4,5,6,9,10,11,13,14,15,18,19,21,22,23,24,25,26,27,28,29,30, 31,35,36,45,47,48,49	12	12	100%
Caffeine	33	34	97%	1,3,4,5,6,9,10,11,13,14,15,18,19,21,22,23,24,25,26,27,28,29,30, 31,32,35,36,43,44,45, 47,48,49	12	12	100%
Nicotine	14	34	41%	1,3,5,13,14,18,19,21,26,27,30,36,47,48	6	12	50%
Other Drugs	26	34	76%	1,3,4,5,6,7,9,13,14,15,18,21,23,24,25,27,29,30,32,35,36,43,45,46, 48,49	8	12	67%
Sleeping Disorders	26	49	53%	1,4,9,13,14,18,19,21,23,24,25,27,28,29,30,32,33,35,36,40,41,44, 45,46,48,49	10	13	77%
Workload	8	49	16%	11,15,16,24,25,29,40,46	3	13	23%
Family & Social Life	26	49	53%	1,3,4,5,6,7,11,12,13,14,15,16,17,18,20,21,22,27,31,35,36,39,43, 45,47,48	5	13	38%
Work Environment	22	49	45%	1,3,5,9,13,14,15,16,17,20,22,23,24,25,29,33,35,40,41,45,47, 48	6	13	46%
Commuting	17	49	35%	1,3,4,6,9,10,11,13,18,21,22,27,30,39,40,41,48	5	13	38%
Jet Lag (if applicable)	10	10	100%	18,19,20,23,24,25,28,29,46,49	8	8	100%
Other Countermeasures	40	49	82%	1,3,4,5,6,7,8,9,10,11,12,13,15,16,17,19,22,23,24,25,26,27,29,30, 31,32,33,34,35,36,37,38,39,40,43,44,45,47,48,49	10	13	77%

Notes:

[a] Number of training programs that included information on the topic area.

[b] Total number of training programs included in the percentage calculations based on category breakdowns.

[c] Percentage of training programs that included information on the topic area.

[d] Training programs that included information on the topic area (see Appendix A for the list of training programs)

initial training. The survey inquired about the usefulness of the training course and about knowledge retention and use of fatigue countermeasures. The results indicated a significant change between the pre- and post-measures of knowledge. The median ratio of correct responses for the pre-measure was 9/16 items and 14/16 items for the post-measure. The follow-up survey revealed a median ratio of 13/14 items correct, with 82% answering at least 12/14 correctly. Seventy-five percent of drivers thought that the fatigue training was at least "moderately useful," with 47% changing the fatigue management strategies that they used at home and 49% changing the strategies they used at work. Sixty-one percent of drivers indicated that they would benefit from recurrent fatigue management training to refresh and update their knowledge on countermeasure strategies.

For light-vehicle drivers, a more informal follow-up questionnaire assessing the usefulness of training was administered within 2 years of the initial training. Results of these assessments indicated that 70% answered at least 11/13 questions correctly, and 91% found the training at least "moderately useful." A total of 50% reported having changed their fatigue management strategies at home, while 43% had changed their strategies at work. A handful of drivers in this study also reported that they thought that management had made positive changes, including improved roster designs and increasingly open communication with drivers regarding fatigue.

Using a similar pre- and post-test design, Kerin and Aguirre (2005) administered a training program to mining company employees and their spouses or domestic partners in a single, 4-hour group session that included 10-50 people. It's been suggested that training may have the greatest impact when partners are included because shiftwork schedules affect the entire family. The training course itself was meant to "provide factual information on solutions to the special challenges of shiftwork" (p. 202). Before completing the training course, workers filled out sleep/wake logs for a 28-day shift cycle, including a questionnaire regarding their sleep habits, lifestyle, family/home life, fatigue, alertness, health, and safety to provide a baseline measure of behavior. Six weeks after attending the training session, workers completed the sleep/wake log and the questionnaire again. The differences between the pre- and post-measures were used to assess the effectiveness of training. Results from the study indicated that six weeks following the training, there was a reduction in the number of workers reporting that it was difficult to fulfill their domestic responsibilities (41% vs. 23%), find time for entertainment and recreational activities (46% vs. 23%), or believing that their health would improve with a different schedule (77% vs. 50%). The miner's average scores on the gastrointestinal index declined considerably (17.9 to 13.6), as did their excessive use of caffeine (32% vs. 8%). The amount of sleep obtained during daytime hours increased by nearly an entire hour (from 4.8 to 5.8 hr), and more workers reported getting at least 5 hours of sleep each night (45% vs. 67%). Additionally, over half of the workers that completed the training with their partners reported making changes in their physical environment to make it more conducive to sleep. Overall, the feedback from both managers and workers was very positive and indicated that fatigue training was beneficial.

Organizational benefits

Additional research suggests that organizations benefit from fatigue-related countermeasure training. Large scale surveys of shiftwork facilities have linked fatigue and shiftwork training to reduced turnover, reduced absenteeism, fewer fatigue problems, and fewer morale issues for organizations (Kerin & Aguirre, 2005). Fatigue countermeasure training has also been predictive of worker perceptions of safety (Arboleda, Morrow, Crum, & Shelley, 2003) and fewer accidents and injuries (Moore-Ede, Heitman, Dawson, & Guttkuhn, 2005). A follow-up survey for one training program indicated that over half of the respondents surveyed reported that the educational materials were the basis for positive change as related to fatigue in their organizations (Rosekind et al., 2001b). Even seasoned long-haul truck drivers had very positive responses to fatigue training, with as high as 96% reporting that they have applied the course lessons presented during training and intend to continue using them (Dinges, Maislin, Brewster, Krueger, & Carroll, 2005). Clearly, the evidence suggests that fatigue countermeasure training programs can be beneficial to both the individual and the organization.

CONCLUSIONS

Mitigating fatigue in complex aviation operations is a challenging proposition. Results of this report, nonetheless, suggest that fatigue can be managed to some extent with a well-developed fatigue countermeasure training program. The content analysis conducted with the fatigue training programs reviewed for this report revealed the topic areas that should be included in an effective fatigue countermeasure training program. Despite the scarcity of research regarding fatigue training effectiveness, the available evidence suggests that training provides a number of benefits to both the individual and the organization. These benefits can only be realized, however, when individuals take personal responsibility and are committed to change. Additionally, some evidence suggests the need to integrate training with a broader focus on fatigue risk management, including scheduling relative to circadian

variations in alertness (e.g., Gander et al., 2005). Taken together, the training content analysis and review of countermeasure training benefits indicate that a flight attendant fatigue countermeasure training program is a viable and potentially beneficial method for managing and mitigating the effects of fatigue.

Consequently, we make two recommendations: 1) Airlines should implement training as outlined in Appendix B (tailored to the flight attendant population); and 2) Training should be integrated into broader fatigue risk management strategies.

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APPENDIX A
List of Fatigue Countermeasure Training Materials by Industry

General

1. Moore-Ede, M. (2006). *Working nights: Health and safety guide*. Circadian Information.
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APPENDIX B
Recommended Training Course Topics

I. INTRODUCTORY FATIGUE INFORMATION

1. Goals of Training
   a. Education about the causes and consequences of fatigue
   b. Provide strategies for fatigue management on and off the job

2. Topic Areas
   a. Fatigue basics
      i. Definition
      ii. Signs & symptoms
      iii. Misconceptions
   b. Causes of fatigue
      i. Circadian rhythm
      ii. Homeostatic sleep process
         1. Sleep quality
         2. Sleep quantity
         3. Total amount of continuous wakefulness
      iii. Shiftwork
      iv. Workload
      v. Previous hours and days worked
      vi. Time zone changes
      vii. Illness / Stress
      viii. Off-duty activities & responsibilities
      ix. Nutrition, hydration, substance use
   c. Introduction to the FAA regulations & NTSB recommendations on fatigue management
      i. Code of Federal Regulations
      ii. NTSB recommendations
   d. Consequences of fatigue
      i. Fatigue research
         1. Prevalence of fatigue
         2. Implications
            a. Mental
            b. Physical
            c. Health / Well-being
               i. Digestive
               ii. Cardiovascular
               iii. Mood
               iv. Cancer risk
            d. Accidents & job performance
            e. Post-duty
               i. Dead-heading
               ii. Driving concerns
      ii. Evidence of fatigue management training effectiveness

II. OFF-DUTY FATIGUE ISSUES: PREVENTATIVE STRATEGIES

1. Topic Areas
   a. Sleep fundamentals
      i. Stages of sleep
      ii. Sleep quality & quantity
      iii. Sleep debt
   b. Alertness and the circadian rhythm
   c. Common sleep disorders
   d. Physiological v. subjective assessments
      i. Countermeasures
         1. Napping
         2. Sleep environment
         3. Good sleep habits
         4. Scheduling sleep
   e. Lifestyle
   f. Nutrition
      i. Hydration
   g. Exercise
   h. Substance use
      i. Caffeine
      ii. Alcohol
      iii. Nicotine
      iv. Sleep aids
   i. Domestic situation / Family / Social life
      i. Women-specific issues
      ii. Partners, children, elder family care
   j. Commuting
      i. Recovery and preparatory rest strategies
   k. Countermeasures
      i. General health strategies
      ii. Appropriate substance use
      iii. Scheduling and management of non-work life

III. ON-DUTY FATIGUE ISSUES: OPERATIONAL STRATEGIES

1. Topic Areas
    a. Work environment
        i. High ambient temperature
        ii. Noise
        iii. Cabin pressure
    b. Dehydrating effects of aircraft
    c. Workload
        i. Physical
        ii. Mental / Emotional
    d. Scheduling
        i. Extended duty time
        ii. Rest periods
            1. Continuous wakefulness
        iii. Multiple flights
        iv. Night flying
        v. Reserve duty
    e. Transmeridian / Time zone changes
        i. Eastbound v westbound
        ii. Recovery time
        iii. Seasonal effects
    f. Ultra long range, long-haul, and short-haul flights
    g. International v domestic
    h. Countermeasures
        i. Strategic naps
            1. Sleep inertia
        ii. Breaks
        iii. Strategic nutrition (sensitive to circadian digestive issues)
            1. Nutritious food and snacks
            2. Strategic caffeine use
        iv. Social interaction
        v. Physical activity