

Fatigue Management from a Pilot's Perspective



Capt. German Diaz-Barriga Martinez.

Charles A. Lindbergh

The nose is down, the wing low, the plane
wing and turning. I've been asleep with
shut eyes... I kick left rudder and pull the
stick back... My eyes jump to the
altimeter...I'm at 1600 feet. The turn-indicator
comes over the left - the airspeed drops - the
plane rolls quickly to the side...My plane is
getting out of control!"

Is Fatigue a Concern in Flight Operations?

Incidents

About 20 percent of reported incidents to NASA Aviation Safety Reporting System (ASRS) mention factors that are fatigue-related

Accidents

Hard to document, but NTSB cited fatigue as a factor in 1993 DC8 accident

American 1420 at Little Rock

Colgan Air

Research

Can we measure fatigue ?

Fatigue, per se, can not be measured.

Alertness and degradation to alertness, on the other hand, can be measured, by response time in visual search tasks, inattention, complex reactions and lost reactions

They can be compared to:

- Blood alcohol content

- Karolinska scale of sleep

- Samn-Perelli fatigue scale.

Program

Since 1980, research on fatigue, sleep, and circadian rhythms

evaluated over 500 pilot volunteers
line operations, simulations, laboratory

now providing feedback to the aviation industry

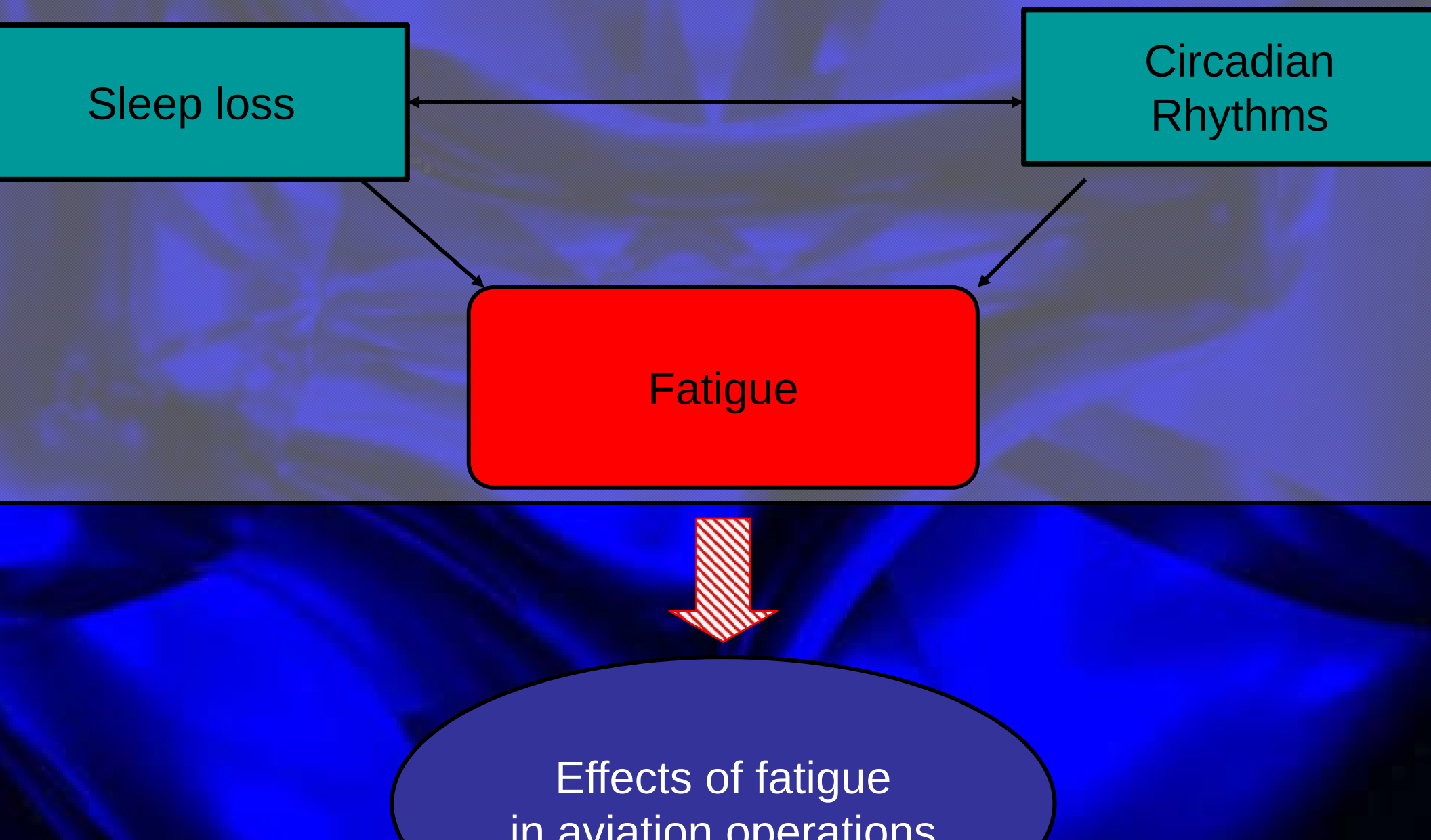
“Alertness Management in Flight Operations”

Primary Physiological Causes of Fatigue

Sleep loss

Circadian rhythm disruption

Fatigue's affect on operations





leep and Sleep Lo

Charles A. Lindbergh

My mind clicks on and off... I try letting one eyelid close at a time when I prop the other open with my will. But the effort's too much. Sleep is winning. My whole body argues that nothing, nothing life can attain is quite as desirable as sleep. My mind is losing resolution and control."

What Research Shows

Sleep is a vital physiological function

Sleep loss is cumulative

Sleep loss and sleepiness can degrade
essentially every aspect of human performance

Sleepiness should be taken seriously

Sleep loss can affect performance like alcohol

After being awake for 18 hours, mental and physical performance on many tasks can be like having a blood-alcohol content (BAC) of 0.05.

After being awake for 23 continuous hours, people perform as badly as people who have a BAC of 0.12.

Dawson and Reid, as reported in Reason's "Managing Maintenance Errors"
BAC = Blood Alcohol Content

BAC Chart

# Drinks in 1 Hour	Body Weight in US Pounds								Individual percentages may vary. Based on .08 legal Blood Alcohol limit
	100	120	140	160	180	200	220	240	
1	.03	.02	.02	.01	.01	.01	.01	.01	.00% - .03% Drive With Caution
2	.07	.06	.05	.04	.03	.03	.03	.02	
3	.12	.10	.08	.07	.06	.05	.05	.04	.04% - .07% Driving Impaired
4	.16	.13	.11	.10	.08	.07	.07	.06	
5	.20	.17	.14	.12	.11	.10	.09	.08	.08% and UP Intoxicated!
6	.25	.21	.17	.15	.13	.12	.11	.10	
7	.29	.24	.21	.18	.16	.14	.13	.11	

In Mexico

El Artículo 100 del Reglamento de Tránsito del Distrito Federal, establece que "ninguna persona podrá conducir vehículos por la vía pública si tiene una cantidad de alcohol en la sangre superior a 0.8 gramos por litro, o de alcohol en aire expirado superior a 0.4 miligramos por litro.

How Sleepy Are You?

It is difficult for most people to accurately estimate their own fatigue level and alertness

- It may actually be worse than you think

Sleep Changes with Age

Amount of sleep and structure of sleep change as a person gets older

Less deep sleep, and more disrupted sleep

Daily percentage sleep loss is 3.5 times greater in long-haul pilots aged 50-60, compared than pilots aged 20-30

Quality versus Quantity

8 hours of disrupted sleep can be like
getting very little sleep

The “Body Clock”



Programmed for two times of maximal sleepiness during a 24-hour period

3-5 AM and 3-5 PM

Performance and alertness can also be decreased

2 AM to 6 AM

According to NASA

- "Sleep loss and sleepiness can decrease physical, psychomotor, and mental performance, and negative mood can increase and positive mood can decrease"
- "It can lead to a reduced safety margin and increased potential for operational incidents and accidents."

Alertness Management Strategies

What crews can do to minimize the effects
of fatigue

Go to FSF AeroSafety World



Fatigue Countermeasures in Aviation

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CALDWELL JA, MALLIS MM, CALDWELL JL, PAUL MA, MILLER JC, NERI DF, AEROSPACE MEDICAL ASSOCIATION AEROSPACE FATIGUE COUNTERMEASURES SUBCOMMITTEE OF THE HUMAN FACTORS COMMITTEE. *Fatigue countermeasures in aviation*. *Aviat Space Environ Med* 2009; 80:29–59.

Pilot fatigue is a significant problem in modern aviation operations, largely because of the unpredictable work hours, long duty periods, circadian disruptions, and insufficient sleep that are commonplace in both civilian and military flight operations. The full impact of fatigue is often underappreciated, but many of its deleterious effects have long been known. Compared to people who are well-rested, people who are sleep deprived think and move more slowly, make more mistakes, and have memory difficulties. These negative effects may and do lead to aviation errors and accidents. In the 1930s, flight time limitations, suggested lay-over durations, and aircrew sleep recommendations were developed in an attempt to mitigate aircrew fatigue. Unfortunately, there have been few changes to aircrew scheduling provisions and flight time limitations since the time they were first introduced, despite evidence that updates are needed. Although the scientific understanding of fatigue, sleep, shift work, and circadian physiology has advanced significantly over the past several decades, current regulations and industry practices have in large part failed to adequately incorporate the new knowledge. Thus, the problem of pilot fatigue has steadily increased along with fatigue-related concerns over air safety. Accident statistics, reports from pilots themselves, and operational flight studies all show that fatigue is a growing concern within aviation operations. This position paper reviews the relevant scientific literature, summarizes applicable U.S. civilian and military flight regulations, evaluates various in-flight and pre-/postflight fatigue countermeasures, and describes emerging technologies for detecting and countering fatigue. Following the discussion of each major issue, position statements address ways to deal with fatigue in specific contexts with the goal of using current scientific knowledge to update policy and provide tools and techniques for improving air safety.

Keywords: alertness, sleep, hypnotics, stimulants, flight time regulations, duty time regulations, sustained operations.

FATIGUE COUNTERMEASURES IN AVIATION: OUTLINE OF CONTENTS

- I. Description of the Problem
- II. Current Regulations, Practices, and an Alternative Approach
 - a. Crew Rest Guidelines
 - b. Flight and Duty Time Guidelines
 - c. Fatigue Risk Management System (FRMS): An Alternative Regulatory Approach
 - d. Ultra-Long-Range Flights: A Nontraditional Approach

Position Statement on Crew Rest, Flight, and Duty Time Regulations

- d. In-Flight Rostering
- e. Cockpit Lighting

Position Statement on the Use of In-Flight Countermeasures

IV. Pre-/Postflight Countermeasures and Strategies

- a. Hypnotics
- b. Improving Sleep and Alertness
 - i. Healthy Sleep Practices
 - ii. Napping
 - iii. Circadian Adjustment
 - iv. Exercise
 - v. Nutrition

Position Statement on Improving Sleep and Alertness

- c. Non-FDA-Regulated Substances

Position Statement on Non-FDA-Regulated Substances

V. New Technologies

- a. On-Line, Real-Time Assessment
- b. Off-Line Fatigue Prediction Algorithms

Position Statement on New Technologies

VI. Military Aviation

- a. Relevant Regulations and Policies
- b. Crew Rest and Duty Limitations
- c. Stimulants/Wake Promoters

Position Statement on the Use of Stimulants to Sustain Flight Performance

- d. Sleep-Inducing Agents
- e. Nonpharmacological Countermeasures and Strategies

VII. Conclusions and Recommendations

I. DESCRIPTION OF THE PROBLEM

Pilot fatigue is a significant problem in modern aviation operations, largely because of the unpredictable work hours, long duty periods, circadian disruptions,

This Position Paper was adopted by the Aerospace Medical Association. It was prepared by a special subcommittee of the Aerospace Human Factors Committee chaired by Dr. David Neri and consisting of the authors. The paper is intended to review the relevant literature, describe fatigue-related issues and challenges, summarize applicable regulations, and present the Association's position with respect to fatigue countermeasures.

This manuscript was received and accepted for publication in September 2008.

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Alertness Management Strategies

Preventive strategies

Used before duty and on layovers to reduce adverse effects of fatigue, sleep loss, and circadian disruption

Operational strategies

Used in-flight to maintain alertness and performance

Preventive Strategies

Begin a trip as rested as possible
at home

Maximize sleep 1-2 days before departing on
trip

ayovers, too

strategic napping can be very effective
45 minutes or less, if just before duty

Preventive Strategies

Alcohol consumption can have “major disruptive effects” on sleep quality

Exercise regularly, but avoid just before bedtime

If you can't fall asleep in 30 minutes, get up and engage in some relaxing activity

Don't just lay in bed and be frustrated

Operational Strategies

Strategic caffeine consumption

Best not to constantly drink caffeine before, during and after duty

Use it to best increase alertness

Don't use it when already alert (start of duty or after a nap)

Avoid caffeine near bedtime

Sensible nutrition and stay hydrated

Know your Caffeine Content

1 Ounce Coffee Beverage

– Instant	25 – 102 milligrams
– Drip	115 – 250
– Brewed	80 – 135
– Espresso (4 ounce)	120 - 200
– Decaf	2 – 10

1 Ounce Tea Beverage

– Instant	15 – 30
– Brewed	25 - 83
– Iced Tea	10 – 50
– Decaf	1 - 5



How your Caffeine Content

Ounce Soft Drinks

Cola	35 - 47 milligrams
Orange Soda	40
Mountain Dew	55
Jolt	71

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Frozen Desserts	8 - 85
Chocolate	5 - 31
Yogurt	1 - 45



Stay Active In-flight

Engage in conversations with other crewmembers

Frequent stretching helps, too

NASA Recommends

Sleepiness can have severe consequences
take it seriously

People are different - tailor this information
to your own needs

There is no one single answer - find out
what works for you



Safety Regulation Group



CAA PAPER 2005/04

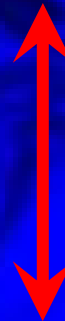
**Aircrew Fatigue: A Review of Research
Undertaken on Behalf of the UK Civil Aviation
Authority**

International Federation of Air Line Pilots' Associations



IFALPA

The Global Voice of Pilots



gue. A physiological state of reduced mental or physical performance capability resulting from sleep or extended wakefulness and/or physical activity that can impair a crew member's alertness and ability to safely operate an aircraft or perform safety related duties.

ga. Estado fisiológico de capacidad reducida de desempeño mental o físico resultado de la perdida de sueño o vigilia de sueño extendida y/o actividad física que puede deteriorar la vigilancia y habilidad de operar una aeronave o desempeñar trabajos

ICAO Annex 6 Operation of Aircraft

6 Flight time, flight duty periods, duty periods and rest periods for fatigue management

For the purpose of managing fatigue, the State of the Operator shall establish regulations specifying the limitations applicable to the flight time, flight duty periods, duty periods and rest periods for flight crew members. These regulations shall be based upon scientific principles and knowledge, where available, with the aim of ensuring that flight crew members are performing at an adequate level of alertness.



FAA's Airline Safety and Pilot Training Action Plan

24, 2009

Immediate and Short Term Action Items (June-July 2009)

Aviation Rulemaking: By July 15, FAA will charter an aviation rulemaking committee consisting of representatives from FAA, industry and labor organizations. The committee will have until September 1, 2009, to draft recommendations to the FAA which will inform a new, science-based notice of proposed rulemaking (NPRM) on flight instructor requirements.

Enhanced Inspection Initiative: Recognizing the urgency of proposals in the Call to Action, FAA has reordered priorities contained in a prior June 16 Notice to FAA Air Traffic Controllers and is directing that a focused program review of air carrier flight



Aviation Rulemaking Committee



Beyond ARC – EASA- CAP 371.....

RMS- should be implemented

ULR flights

Must develop a process for a “Basic” and “mature FR

Should develop a Central FRMS office

Advisory Circulars

FRMS

Flight Crew Rest Facilities

Fatigue Risk Management-en Español

Fatigue Risk Management: Un método de administración empresarial de la fatiga que incluya proceso de medición , mitigación y gestión del riesgo de la fatiga

Fatigue Risk Management System (FRMS): Un sistema de gestión basado en evidencia para el control del riesgo de fatiga

FRMS ¿Que hay de nuevo?

FATIGUE RISK MANAGEMENT SYSTEM (FRMS) IMPLEMENTATION GUIDE FOR OPERATORS



EXECUTIVE LETTER

Dear Colleagues,

Air travel continues to be the safest means of transportation, but that does not allow for us to become complacent. We continually strive for improvements in our industry safety record, which is a testament to our ongoing commitment to safety.

Fatigue Risk Management Systems (FRMS) continues the move from prescriptive to performance based regulatory oversight. As in Safety Management Systems (SMS), FRMS strives to find the realistic balance between safety, productivity and costs in an organization, through collection of data and a formal assessment of risk.

Traditionally, crewmember fatigue has been managed through prescribed limits on maximum flight and duty hours, based on a historical understanding of fatigue through simple work and rest period relationships. New knowledge related to the effects of sleep and circadian rhythms provides an additional dimension to the management of fatigue risks. An FRMS provides a means of adding this safety dimension, allowing operators to work both safer and more efficiently.

This FRMS Implementation Guide for Operators is a significant milestone. It marks the successful collaboration between IATA, IFALPA and ICAO to jointly lead and serve industry in the ongoing development of fatigue management, using the most current science. The input of these three organizations has ensured that this document presents a scientifically-based approach that is widely acceptable to the operators and the crew members who will be using it. It also offers this information in an accessible and practical way to assist implementation.

We are extremely proud to mutually introduce this FRMS Implementation Guide for Operators, which will contribute to the improved management of fatigue risk, and to ultimately achieve our common goal of improving aviation safety worldwide.

Three handwritten signatures are displayed at the bottom of the page. From left to right: the signature of J. E. Hobbie, the signature of J. A. Hobbie, and the signature of J. A. Hobbie.

FRMIS – Who is responsible?

STATE – INDUSTRY – AIRLINE - INDIVIDUAL

The Objective is always AN ACCEPTABLE
LEVEL OF SAFETY still

We should capitalize on everybody's experience

Work as a team

Gather and SHARE data

Norm on a Scientific base

Use of Technology

The New York Times

[/www.nytimes.com/](http://www.nytimes.com/)

GLOBAL EDITION

- Since 1

LACK OF FATIGUE REGULATION KILLS 300 IN RUNWAY EXCURSION



Even after aviation authorities were gathered in a safety seminar, early this year in **LIMA, PERU**, nothing was done. There is no fatigue Regulation and no one is even worried about the increased work hours for pilots and crewmembers. Market is dictating new labor rules everyday and authorities around the world are too startled to react, or

In efforts to cut costs, they are asked to be more productive, or they will be jobless.

Manufacturers are suggesting bizarre solutions too, they are offering harnesses for passengers to travel standing up, as far as proposing a pilot in the cockpit for long-range flights.



¿Preguntas?

MUCHAS GRACIAS