ASSESSING FATIGUE RISK IN FAA AIR TRAFFIC OPERATIONS

FRMS Forum – March 18, 2025

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Project Objectives

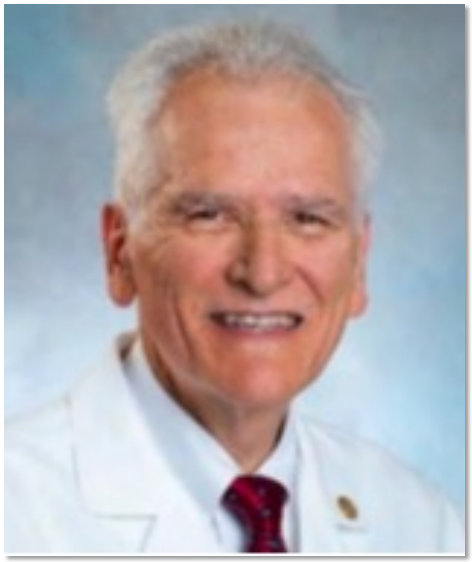
- FAA Administrator requested that: “a small group of independent, objective experts evaluate the **latest science on human sleep needs and fatigue** considerations **as applied to FAA’s current air traffic controller workforce, work requirements, and scheduling practices.**
- The purpose of this evaluation is to inform FAA’s ongoing efforts to enhance the safety and well-being of the agency’s controller workforce and the safety of the aviation system.”

Scientific Expert Panel on Air Traffic Controller Safety, Work Hours, and Health

Mark Rosekind, PhD

Chair

Erin Flynn-Evans, PhD, MPH



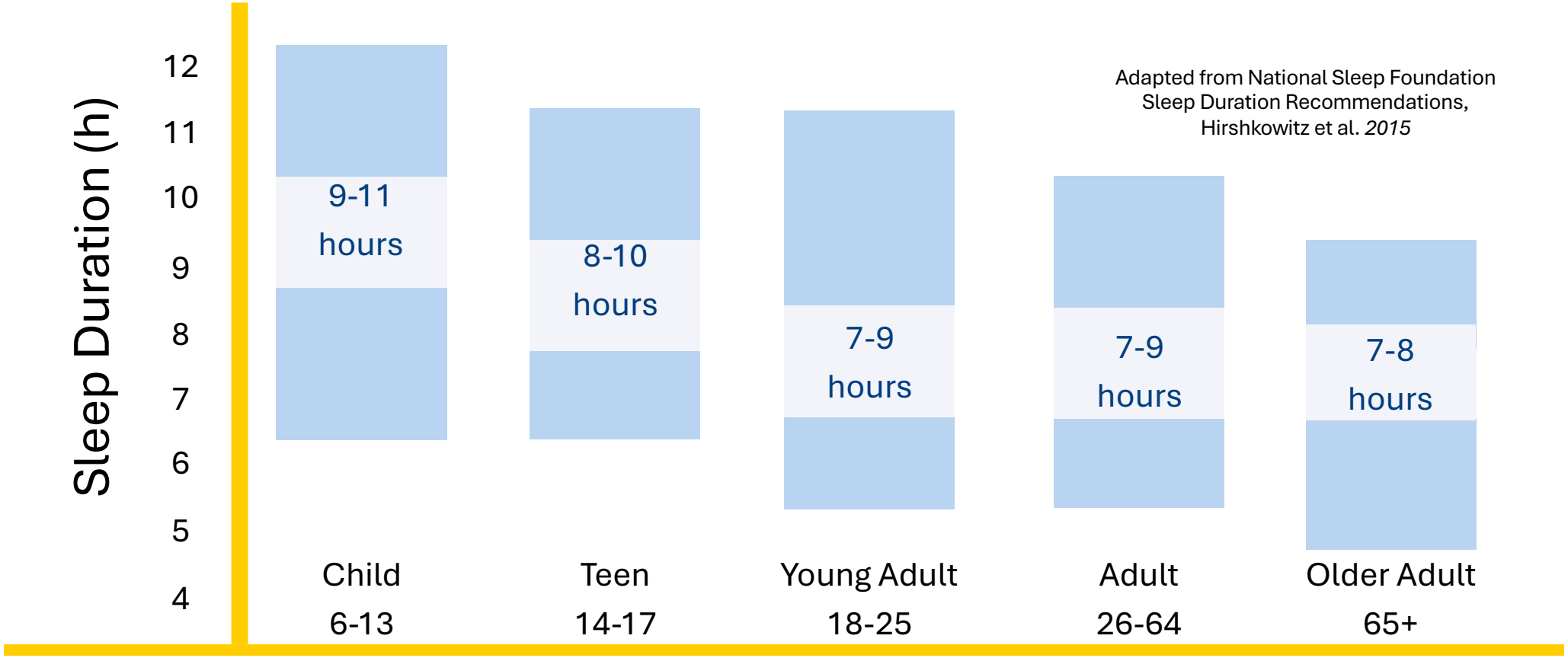
Charles Czeisler, MD, PhD

Photo Credits: Rosekind and Czeisler

Defining Fatigue

“A physiological state of reduced mental or physical performance capability resulting from **sleep loss** or **extended wakefulness, circadian phase**, or workload (mental and/or physical activity) that can impair a crew member’s alertness and ability to safely operate an aircraft or perform safety-related duties." **-ICAO**

How Much Sleep Do We Need?



Adapted from National Sleep Foundation Sleep Duration Recommendations, Hirshkowitz et al. *2015*

Types of Sleep Loss

ACUTE SLEEP LOSS

Staying awake too long

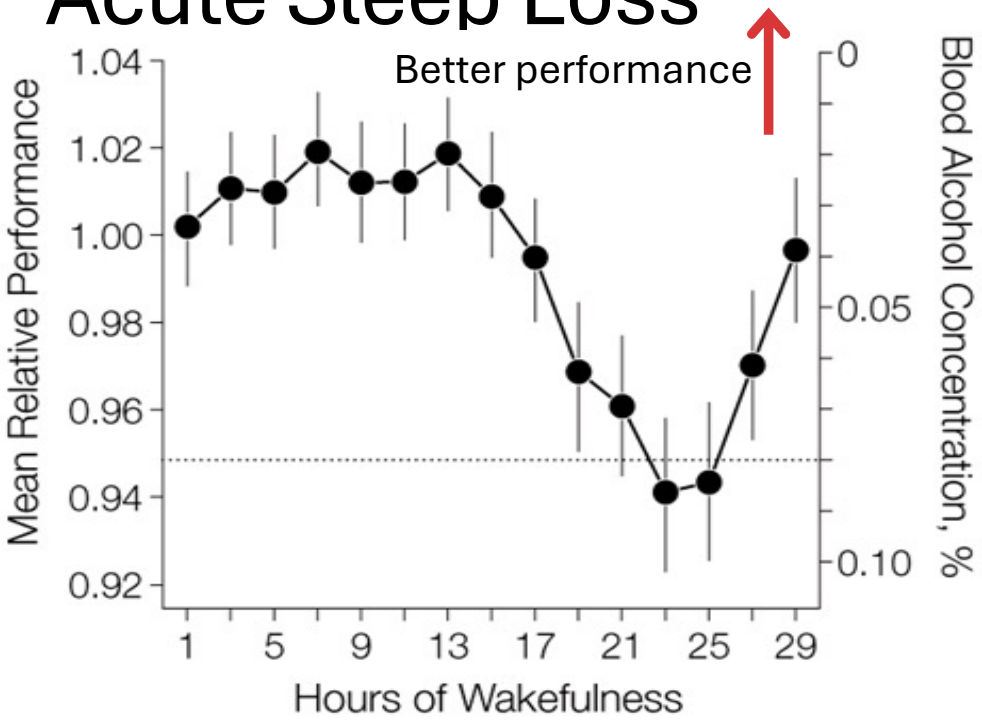
CHRONIC SLEEP LOSS

Sleep debt from not getting enough sleep

POOR SLEEP QUALITY

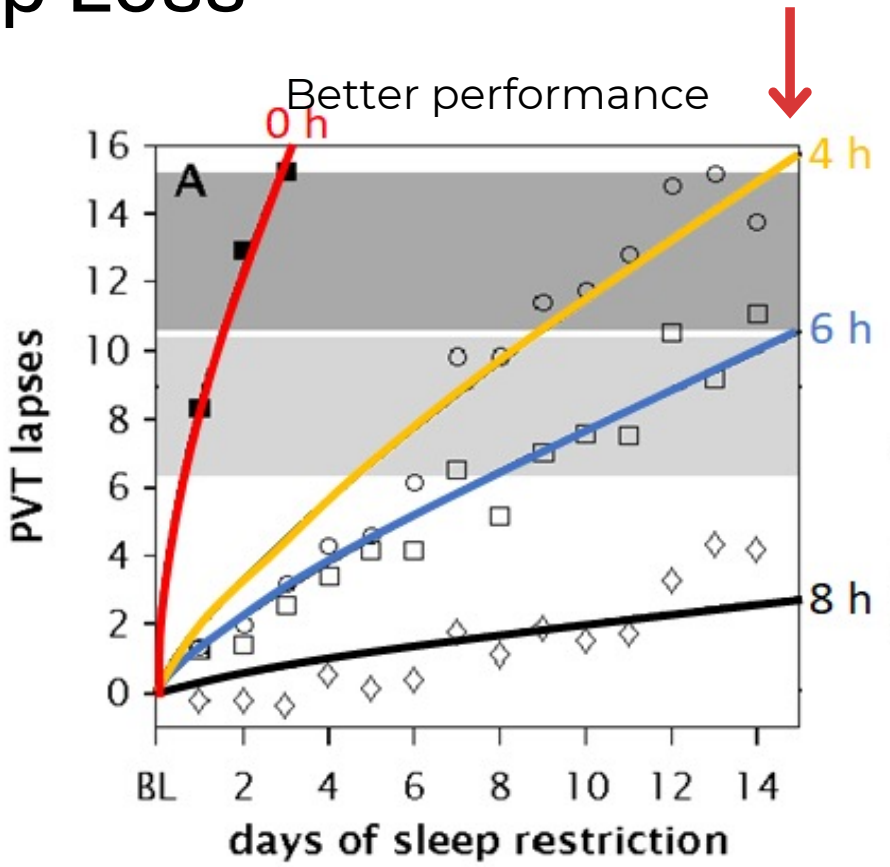
Poor sleep environment, sleep disorders, etc.

Acute Sleep Loss



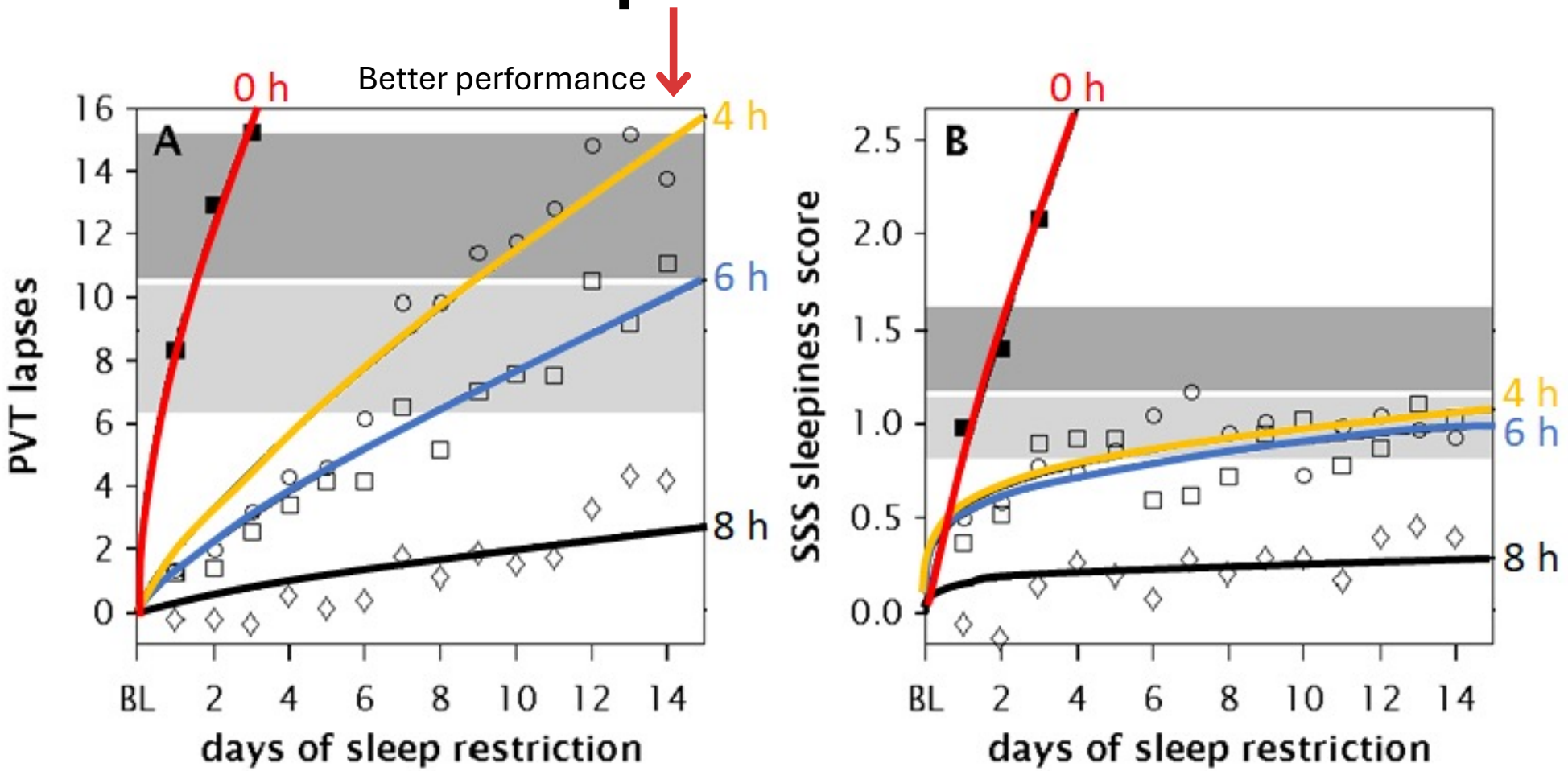
Dawson & Reid, 1997

Chronic Sleep Loss



Van Dongen et al., 2003

Chronic Sleep Loss



Van Dongen et al., 2003

Short-term Consequences of Sleep Loss

Increased safety risks

- Poorer driving performance (Flynn-Evans et al. 2018)
- Increased risk of workplace accidents (Folkard et al., 2005)

Burnout and poor behavioral health

- Increased depersonalization (Peterson et al., 2019)
- Increased anxiety & depression (d'Oliveira et al. 2021)

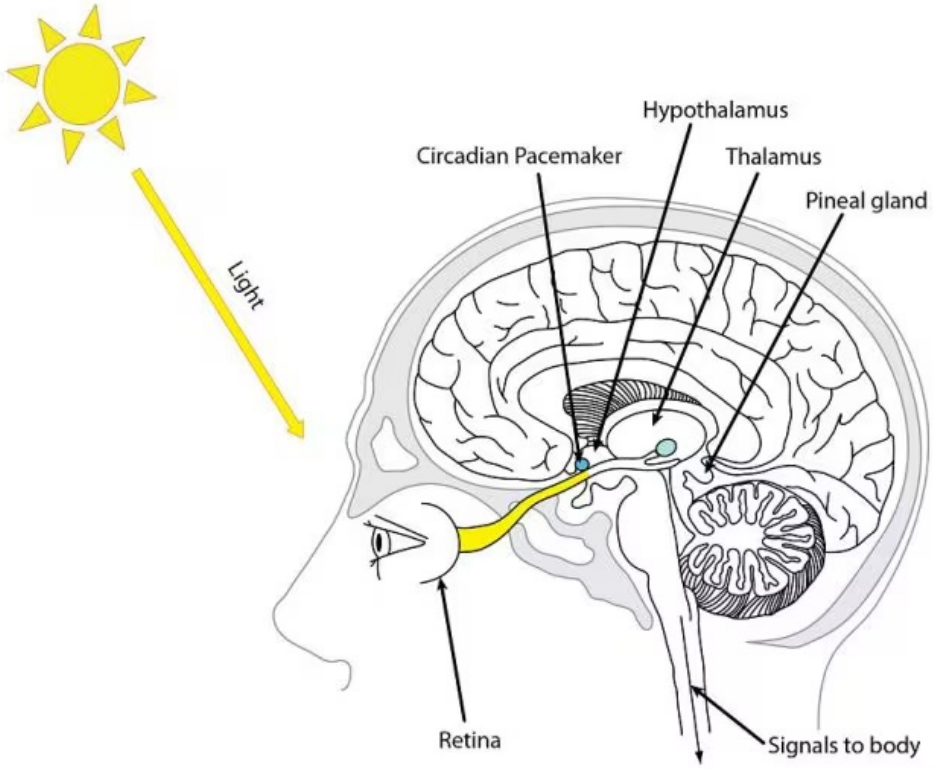
Increase in subclinical conditions

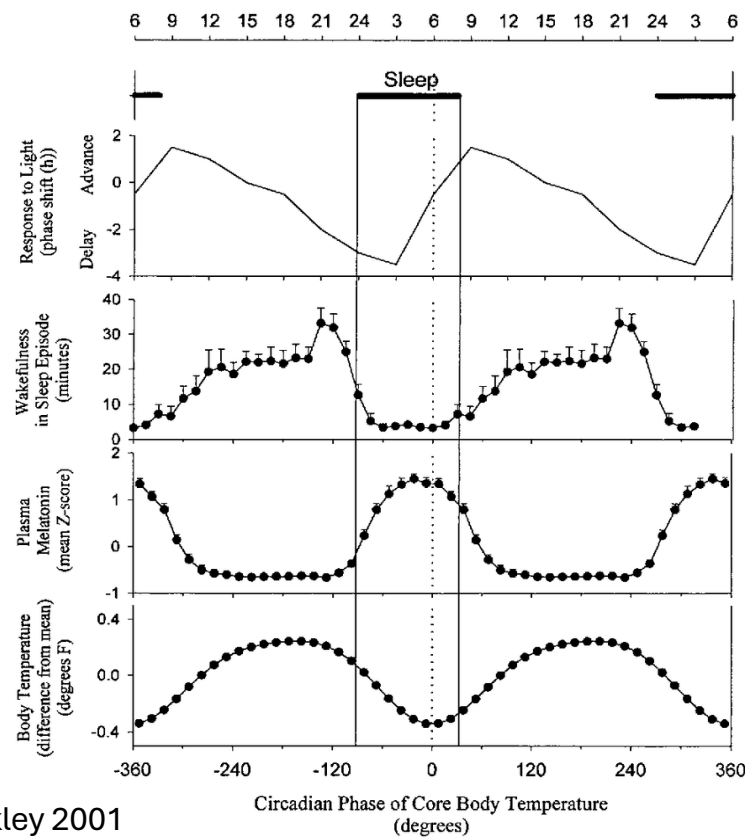
- GI distress (Hwang et al. 2022)
- Headache (Appel et al. 2020)
- Reduced immune function (Cuesta et al., 2016)

Numerous other short-term consequences

Circadian Rhythm

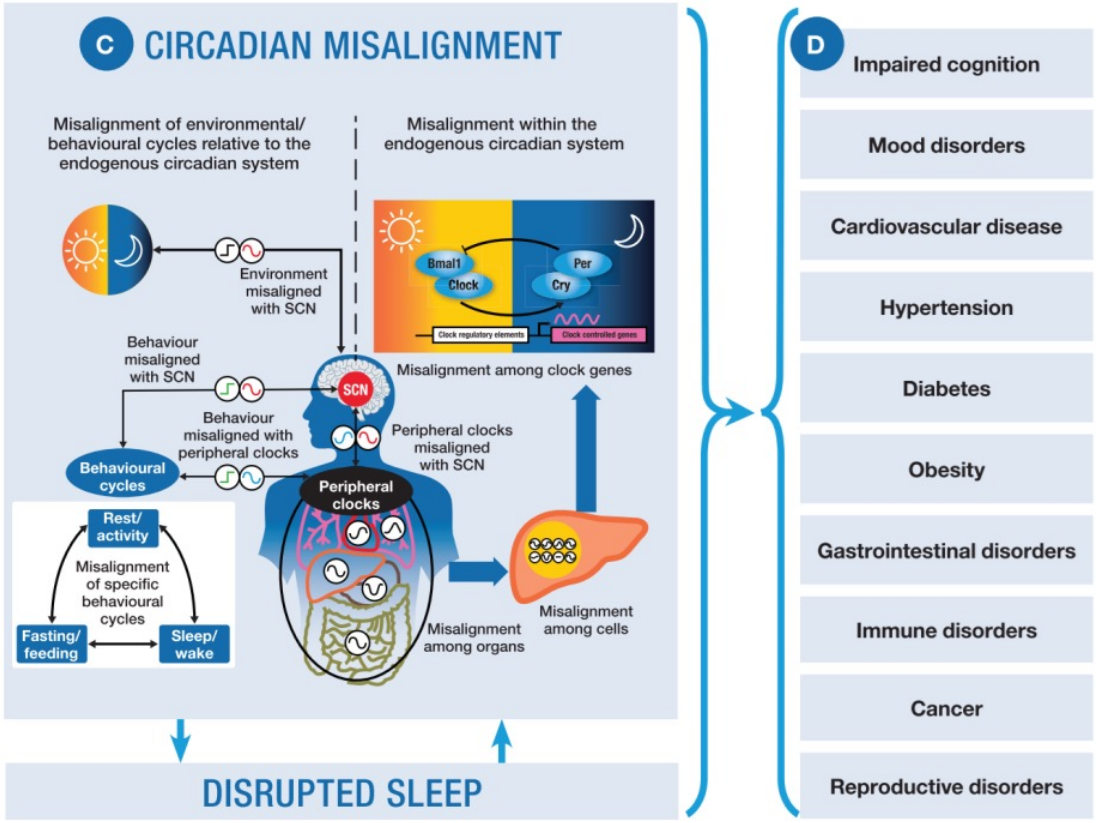
Circadian Control of Biological Function





CDC Shiftwork Training Module, Dijk and Lockley 2001

Circadian Rhythm

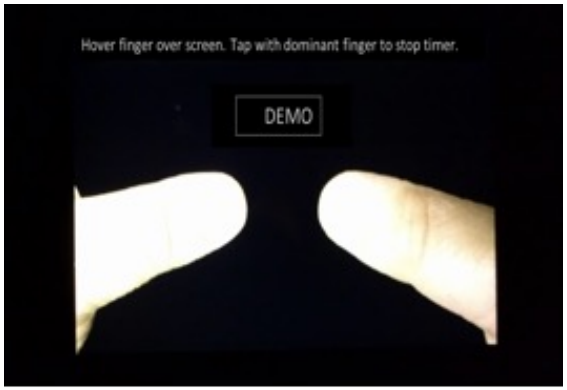


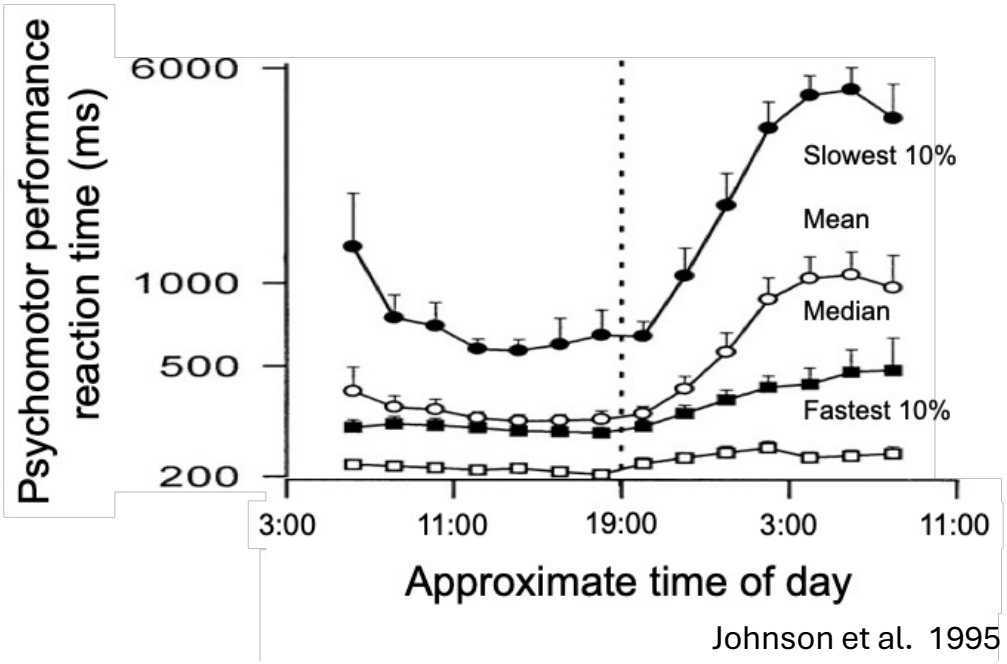
Circadian Control of Biological Function

Sletten et al., Sleep 2020

Circadian Misalignment

Performance Impairment

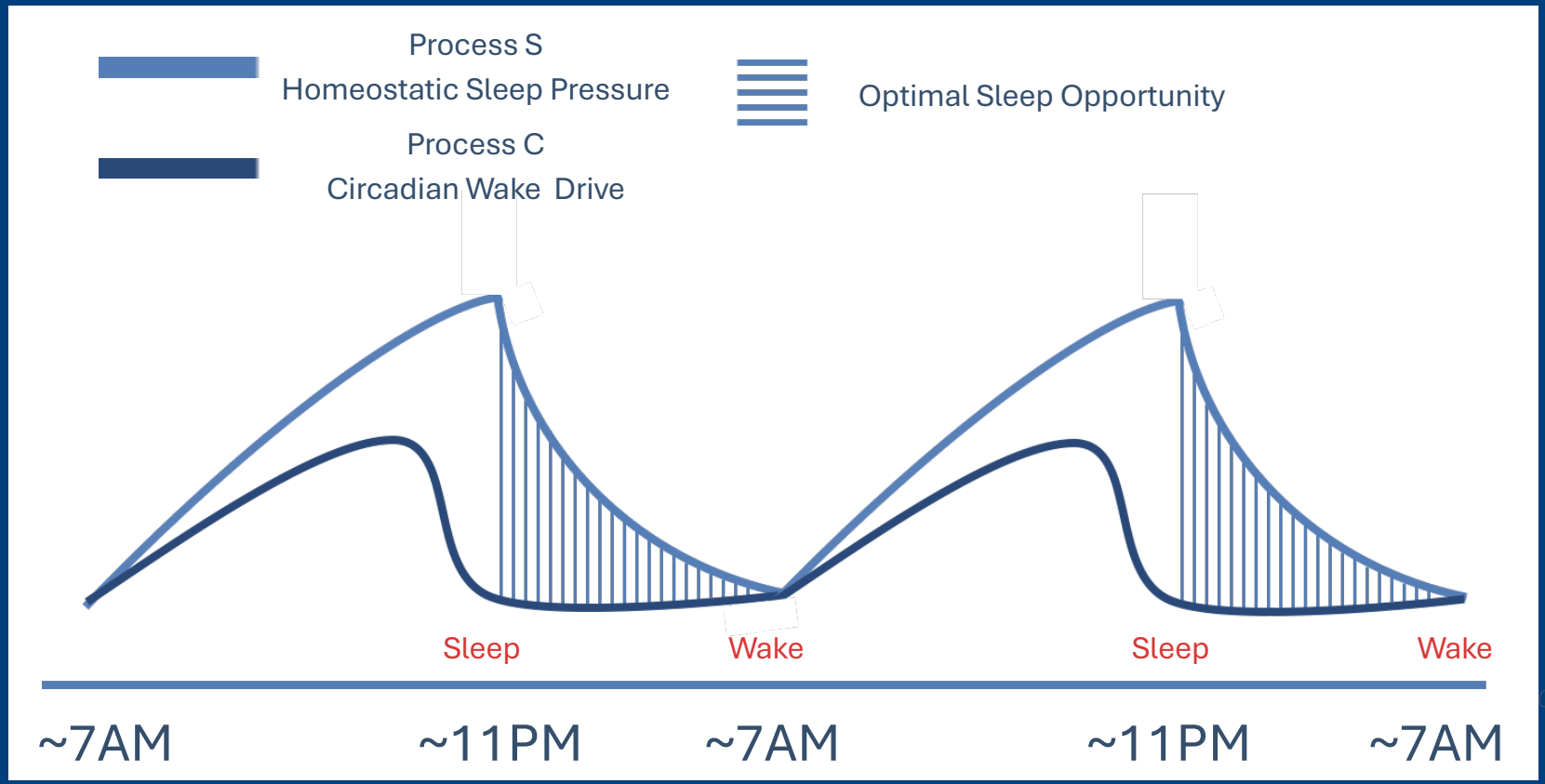




Johnson et al. 1995

Sleep-Wake Regulation

Two-Process Model of Sleep Regulation



adapted from Borbely *Hum Neurobiol* 1982

Sleep loss and circadian disruption create safety, performance, health, and mood decrements.

Methods

Workforce
Work Requirements
Scheduling Practices

Meetings with subject matter experts

Visits to ATO facilities

Review of 120 documents including:

- Prior air traffic control reports/studies
- Collective bargaining agreement
- FAA Order JO 7210.3DD
- FAA workforce plan

Evaluation of:

- Air traffic controller schedules for ~ 6 weeks (~700,000 work periods)

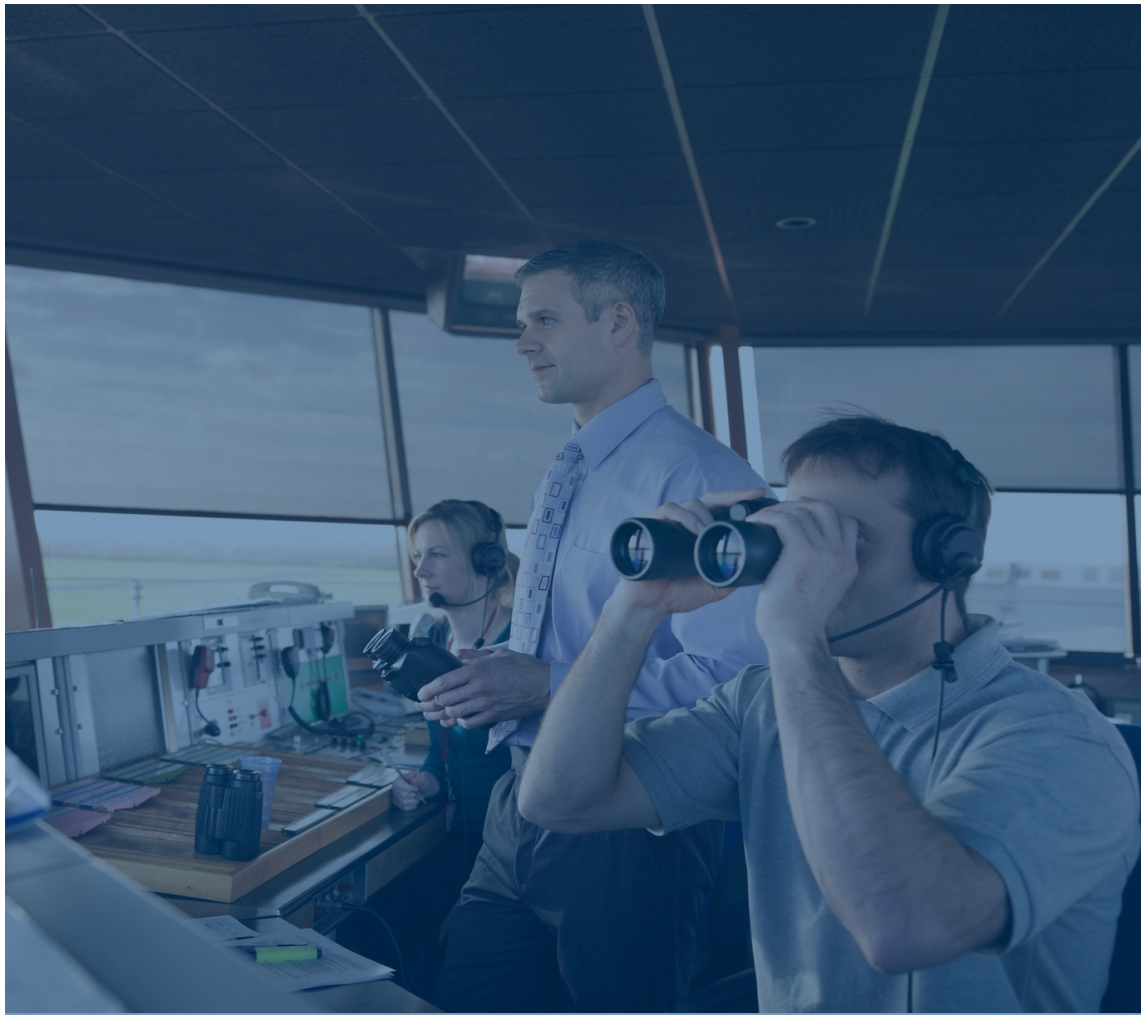


Photo Credit: Canva

Workforce

Staffing

Policies/Regulations/FRM

Health

Other Factors

Photo Credit: Canva

Work Requirements

Cognitive Demands

Workload

Staffing Utilization

Work Environment

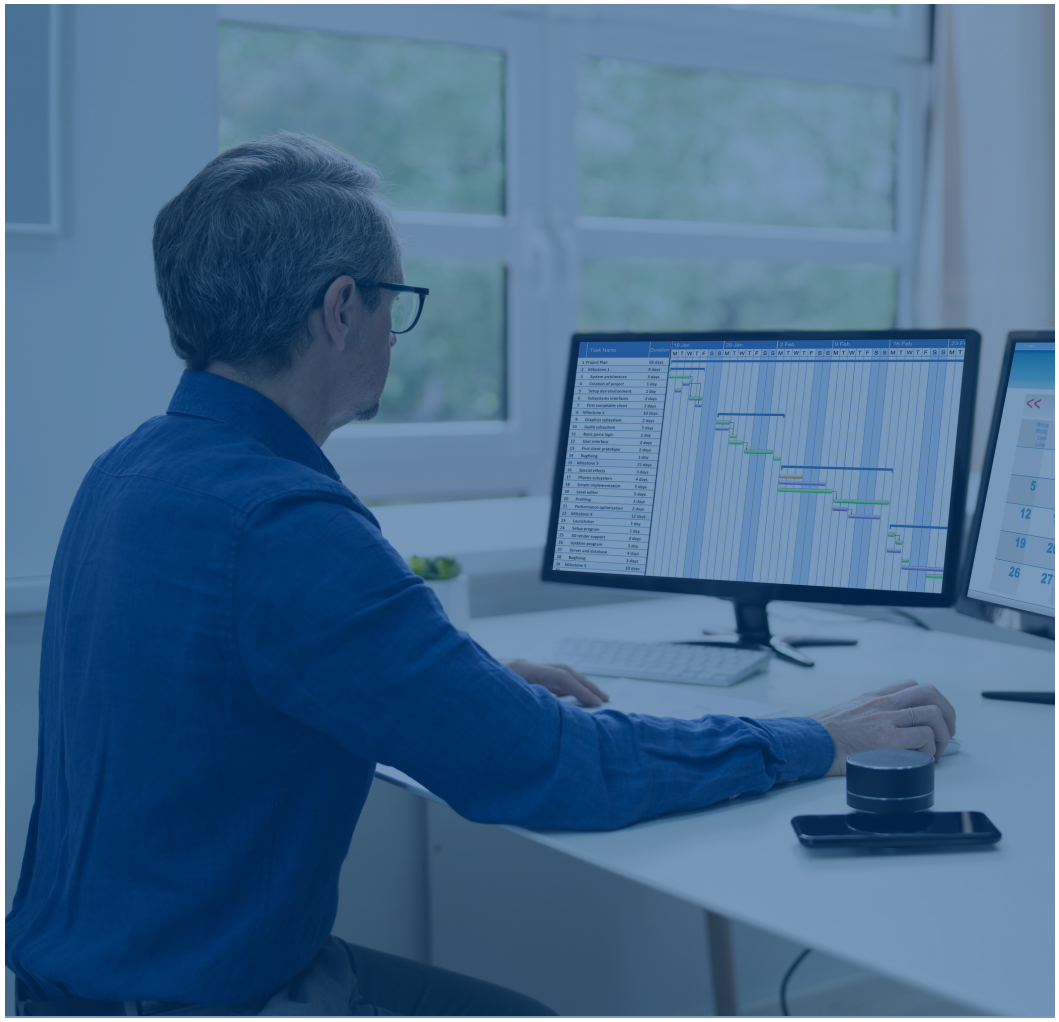


Photo Credit: Canva

Scheduling Practices

Operational Requirements

Employee Needs and Preferences

Biological vs. Schedule Demands

Scheduling Practices: Biological vs. Schedule Demands

SHIFT NAME	TOTAL SHIFTS WORKED	AVERAGE SHIFTS PER DAY
Early Morning	844	28.1
Morning	101,709	3,390.3
Mid-Day	11,200	373.3
Evening	73,252	2,441.7
Late Evening	594	19.8
Midnight Shift	21,118	703.9
Grand Total	208,717	6,957.2

Table SP- 3

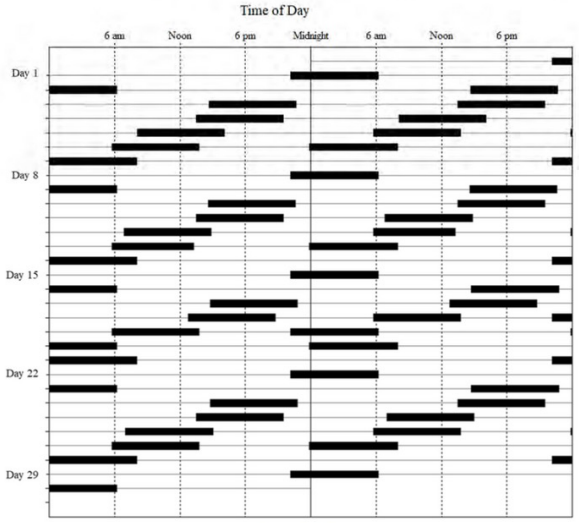
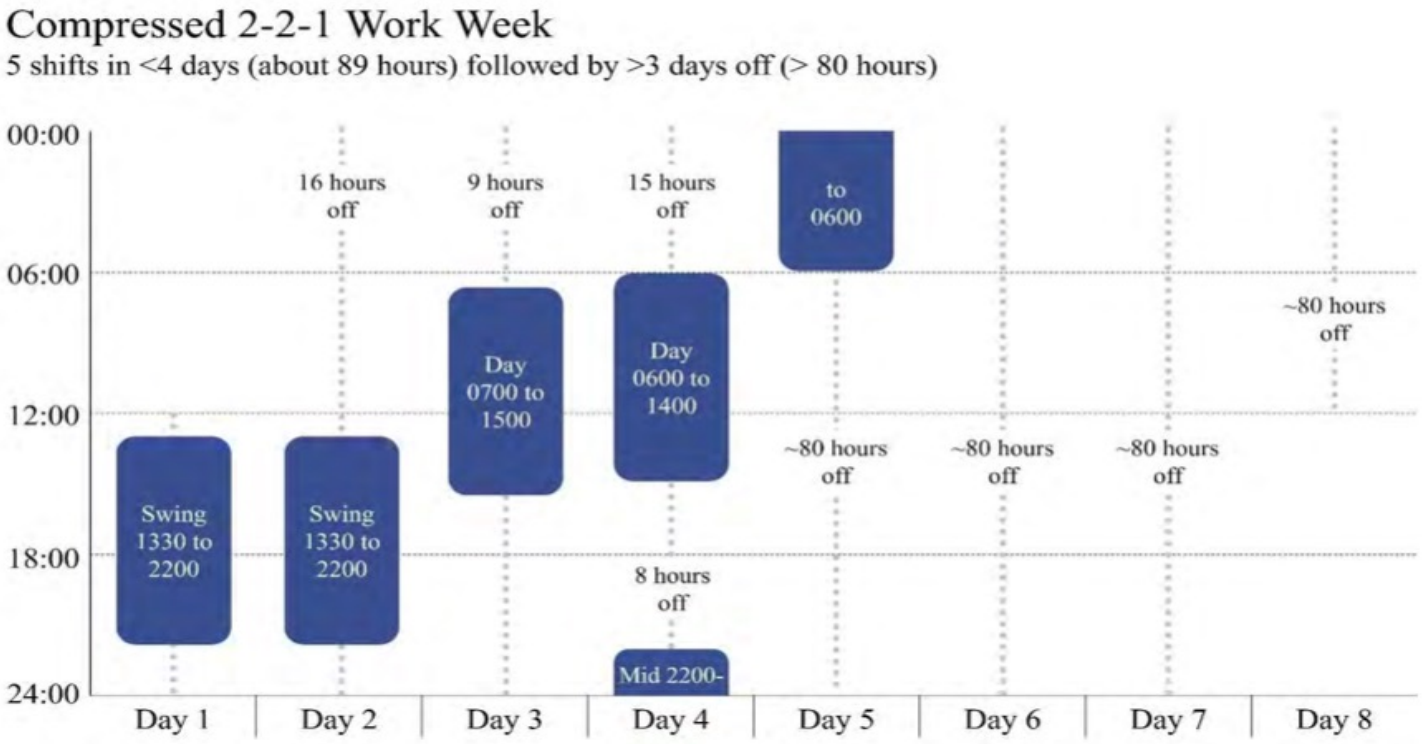


Figure SP- 10

Scheduling Practices: Employee Needs & Preferences



Top 4 Opportunity

PPR/FRMO1. Integrate prescriptive policies/regulations and FRMS into an appropriately structured single system that provides one source for FAA ATO FRM activities. This should include a single source repository of all relevant materials, ensuring consistency across elements, and emphasizing the integrated and complementary elements of the system.

Top 4 Opportunity

BNO2. Identify and determine specific circumstances around a subset of representative scheduling policy and agreement exceedances then implement mechanisms to monitor and eliminate such exceedances. This effort should be focused on developing and implementing these mechanisms and not involve punitive actions for past circumstances.

Top 4 Opportunity

BNO3. Develop and implement a strategy to eliminate the counterclockwise rotating 2-2-1 schedule and replace it with a schedule design that meets operational requirements and that incorporates sleep and circadian principles.

Top 4 Opportunity

BNO4. Develop and implement a strategy to update the current prescriptive policies to address identified fatigue factors, especially to avoid known schedule practices that induce fatigue. Specifically, require sufficient time off-duty (e.g., 10-12 hours) before all shifts, whether controllers are performing operational or non-operational tasks. Also, this off-duty time should account for the circadian timing of the shift, where increased off-duty time may be required before midnight shifts.

Thank you!

Scheduling Practices: Biological vs. Schedule Demands

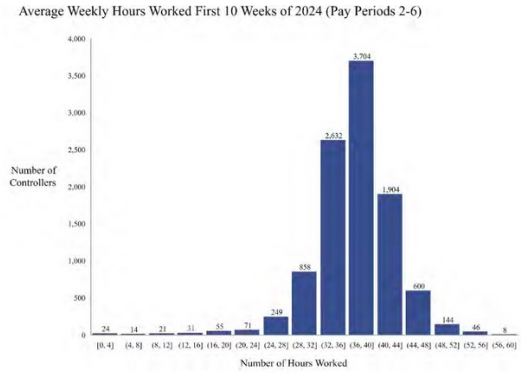
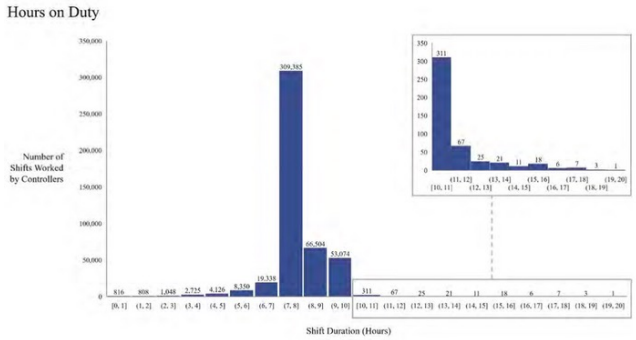


Figure SP- 3



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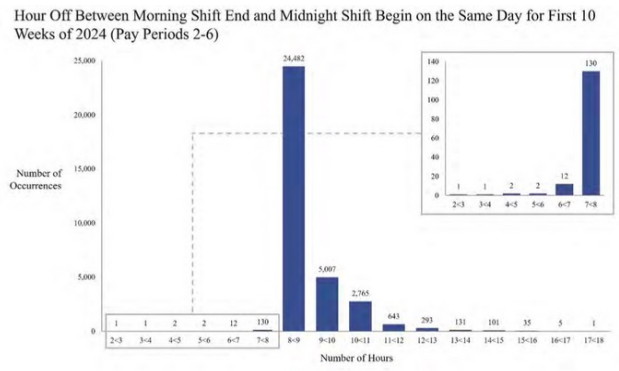

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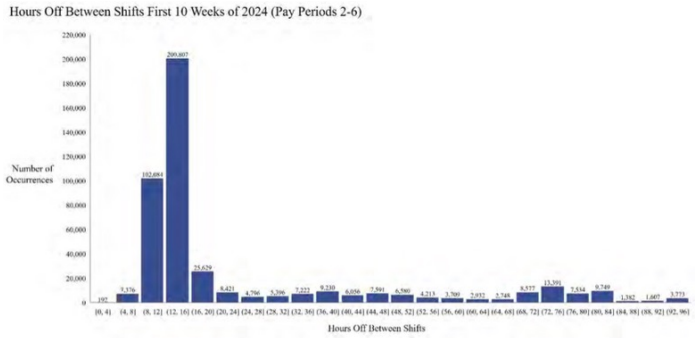

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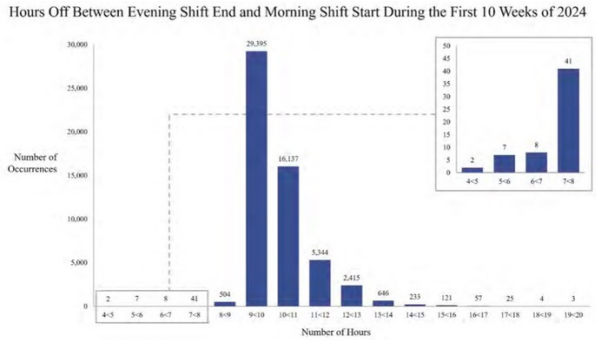

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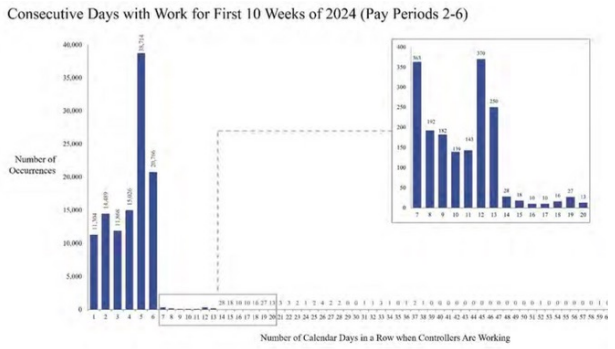

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