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# Fatigue Management Seminar

FAR 117 Fitness for Duty and Responsibilities  
January 22–23, 2020  
McLean, Va.



# Predictability and Sleep Planning

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Institutes for Behavior Resources

**DAY 1**

**January 22 at 1015-1115**

**“Fitness for Duty – What Does this Mean?”**



**Fatigue Management Seminar**  
FAR 117 Fitness for Duty and Responsibilities

# What is Event Predictability?

- Two major dimensions:
  - Advance warning time
  - Probability of occurrence
- Examples:
  - Train crossing warning
    - Advance warning is sufficient to stop before crossing (less than a minute) and
    - Probability of occurrence is nearly 100%
  - Flight duty predictability
    - Advance warning is sufficient to plan sleep and commute to terminal
    - Probability of occurrence depends on whether you are assigned or standby



# Predictability Alters Sleep Planning

- Sleep quality and quantity is reduced by unpredictable scheduling
- Reduced sleep impairs performance, especially at night



# Duties Factors that Impact Predictability

- On-call/reserve duties
- Duty extensions or changes within an FDP
- Delays of flight times that extend the duration of FDPs
- Additional duties between assigned FDPs



# Sleep Impacted by Low Predictability

- Pre-flight naps, especially prior to evening/night duties
- Sleep advancing (or delaying) prior to early (or delayed) starts
- Recovery sleep that occurs after one or more night duties
- Duration and timing of main sleep in preparation for duty



# Quality of Sleep Opportunity

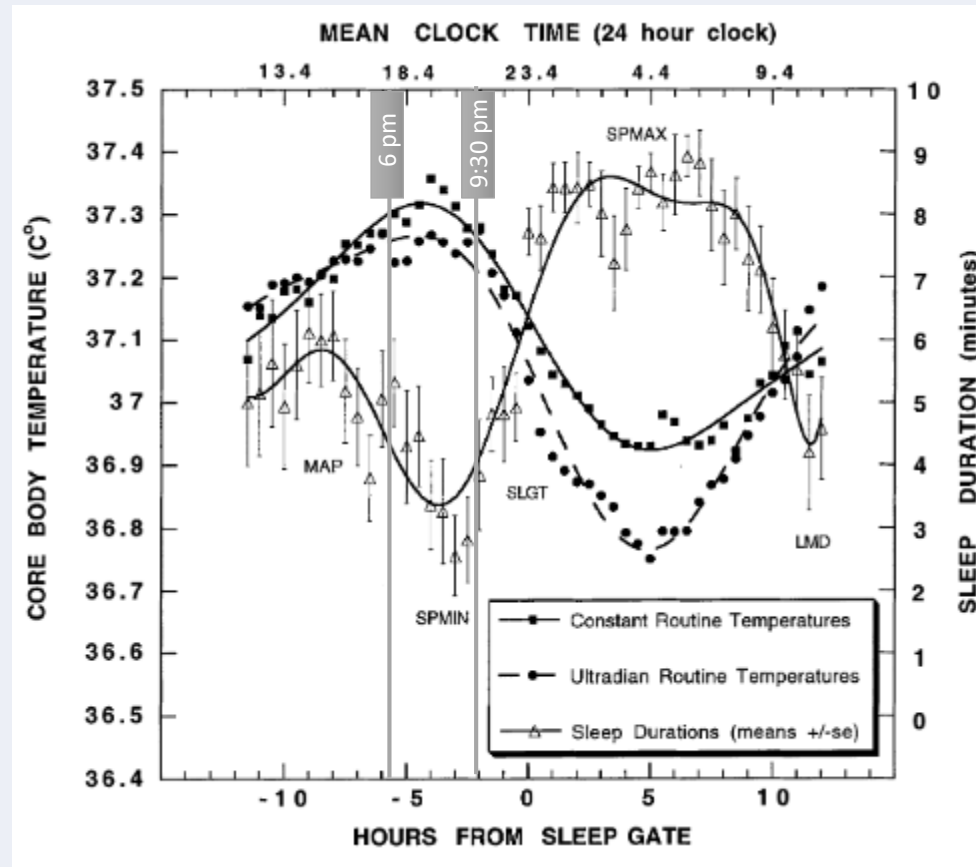
## *Sleep does not occur “on demand”*

- Physiological factors that impact sleep
  - Sleep pressure – time since last sleep and duration of prior sleep
- Zones of Wakefulness
  - The evening period after about 6 pm when the circadian activation function is near its peak makes falling to sleep difficult unless very tired.
  - The Awake Maintenance Zone is roughly from 6 pm to 9:30 pm but varies greatly between subjects
  - The afternoon period from 1 pm to 7 pm is often not used for sleep because the circadian rhythm is rising AND it is a good time to do other activities precluded by duty.
- Zone of Sleepiness
  - Depending on personal sleep habits, the major time of greatest sleepiness occur between 11 pm and 8 am.
  - Minor period of sleepiness occurs in the early afternoon between 1 pm and 3 pm





# The Awake Maintenance Zone



LACK, L. and LUSHINGTON, K. (1996), The rhythms of human sleep propensity and core body temperature. Journal of Sleep Research, 5: 1-11. doi:[10.1046/j.1365-2869.1996.00005.x](https://doi.org/10.1046/j.1365-2869.1996.00005.x)





# Lessons from Sleep Research

- Unpredictable schedule changes can impair the opportunities for preparatory sleep to improve fitness for duty.
- Missed sleep will ultimately impact performance and the impact will be greatest at night.
- Unpredictable opportunities for additional sleep may not be beneficial depending on when it occurs.
- For example, delaying a morning duty to the afternoon may not add more sleep because a full night of sleep has already occurred.
- Delaying an evening duty may not allow for a meaningful pre-duty nap because of the awake maintenance zone.



# Maximizing Predictability

- Minimize changes in scheduled duties in the first place.
- Maximizing lead time to prepare for a change increases predictability and ability to prepare.
- It is hard to provide a “rule of thumb” for the warning time because of the circadian rhythm and prior sleep events.
- A longer warning with a 70% chance of occurrence may be better than a short warning with a 100% chance of occurrence.

