Managing the Physiological and Safety Challenges of Night Flying: A Shared Responsibility

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Sleep/Circadian Interaction

- At any given moment, the ability to maintain wakefulness, alertness, and performance will be an interaction of the sleep homeostat and the circadian clock
- At any given moment, the ability to obtain an optimal quantity and quality of sleep will be an interaction of the sleep homeostat and the circadian clock

Commercial Airline Pilots NASA Study Results

- Long Haul: 7.3 hrs home vs. 5.3 hrs trip (6.5 hrs total)
- Short Haul: 6.7 hrs sleep in 12.5 hr layover
- Overnight Cargo: 7.5 hrs home vs. 4.6 hrs trip (6.3 hrs total)
- 85% accumulated a sleep debt on trip (8 hrs to 16 hrs)
- 71% corporate pilots reported "nodding off" in cockpit
- 80% regional pilots reported "nodding off" in cockpit

Circadian Clock

- Internal rhythm: ~24.2 hrs
- Measures time/allows anticipation
- Normal environmental stimuli (light/dark cycle) can entrain rhythm to 24 hrs
- When free of light/dark cycle, own internal period determines behavior (free-running)
- Zeitgebers or time-givers (cues for the clock)

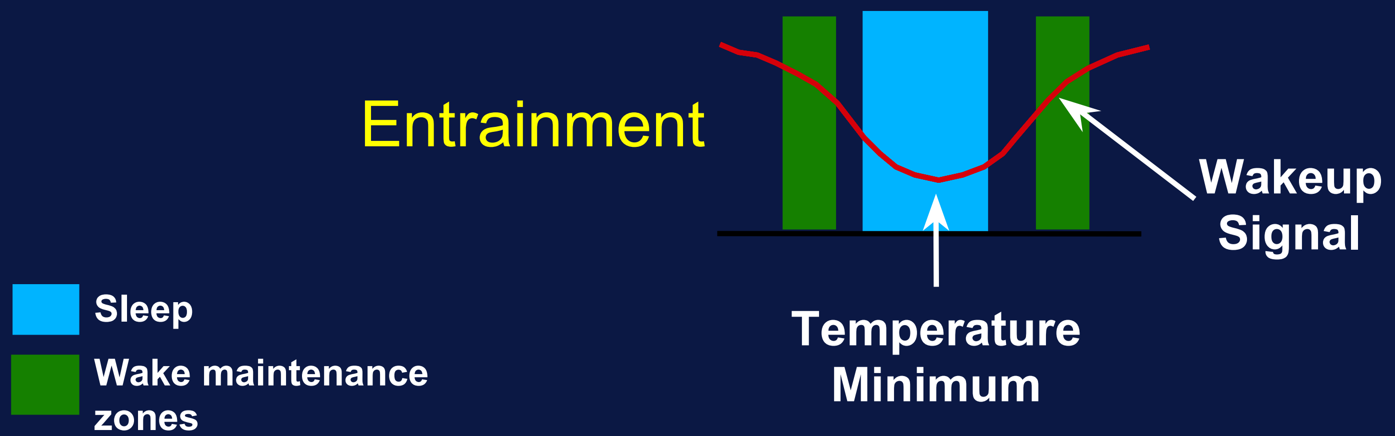
Circadian Clock

- Periods of increased sleepiness
  - 0300-0500 (near body temp. minimum)
  - 1500-1700 (less severe)

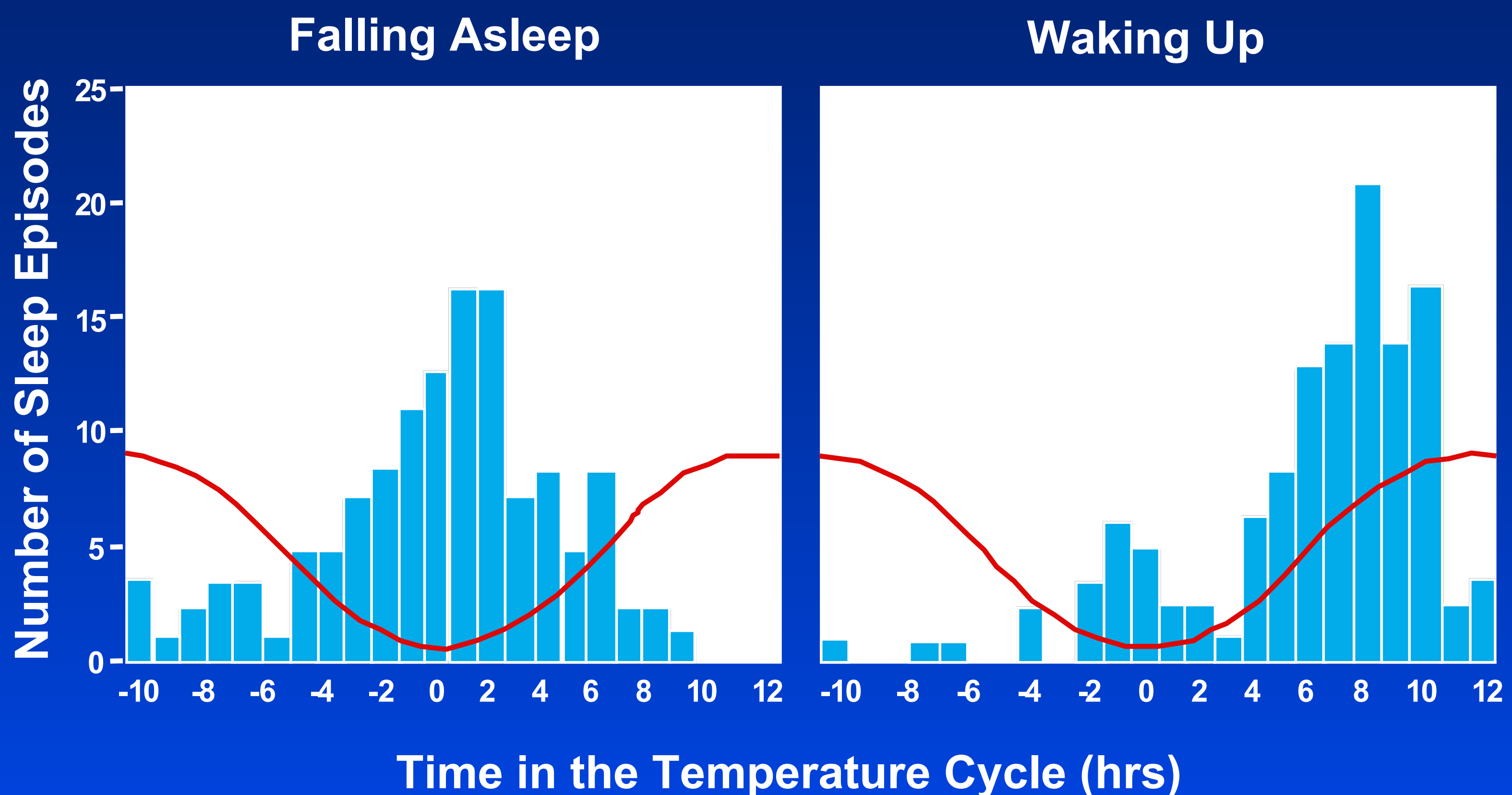
- Operational Implication
  – known times of increased risk; inadvertent sleep

Circadian Clock

- Periods of increased wakefulness ("wake maintenance zones")
  - 2-3 hrs before usual bedtime
  - late morning
  - 2-3 hr wide
- Wake-up signal
  - occurs with rise in body temperature
- Operational Implication
  - difficulty going to sleep earlier to compensate for earlier report time



Long-Haul Layover Sleep Timing



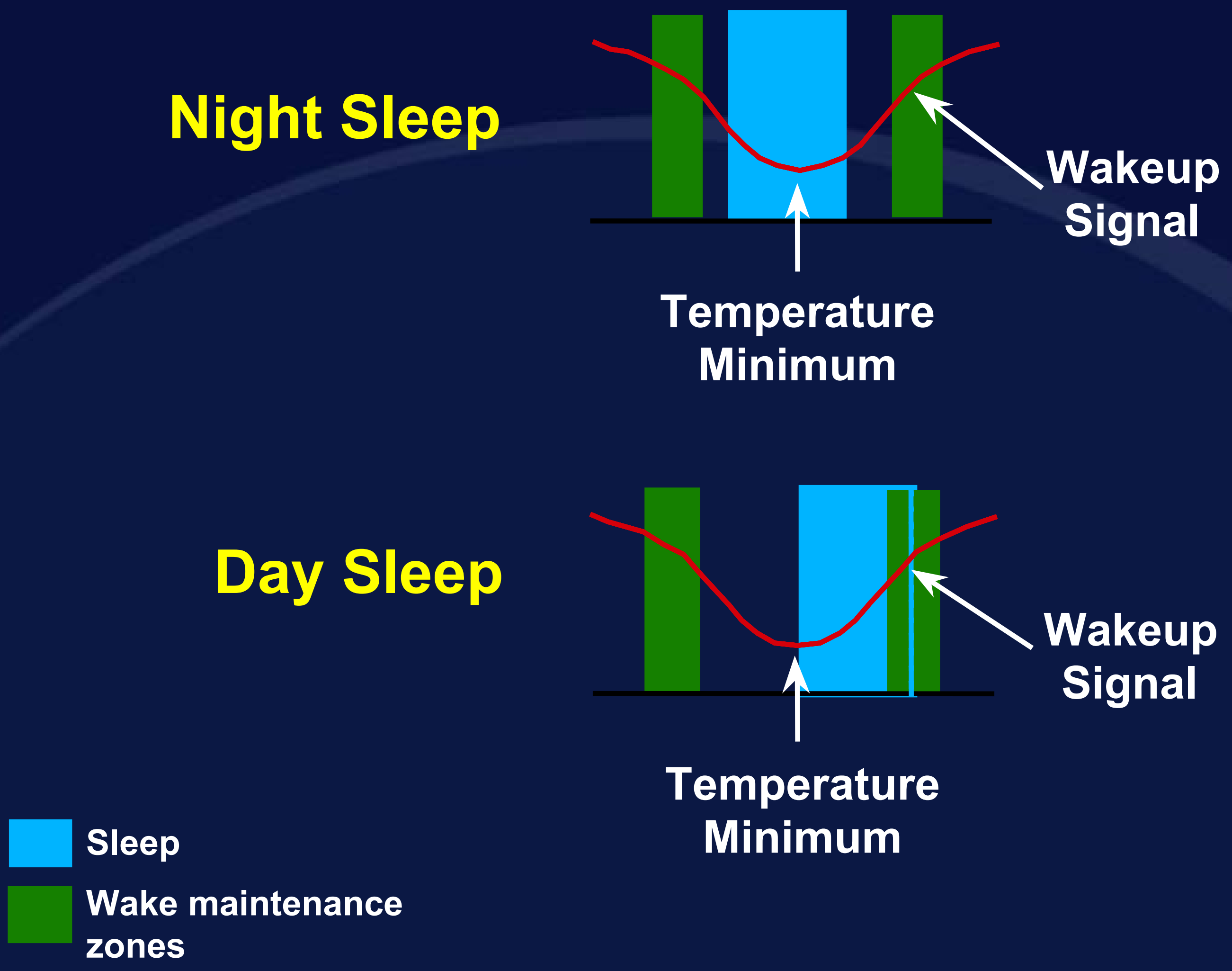
Fatigue Countermeasures Group

Circadian Regulation of Sleep

Circadian Wakeup Signal

- On 24 hr routine with sleep at night
  - 1-3 hr after temperature minimum
- Operational Implication
  - when latter half of sleep episode coincides with rising temperature, as with daytime sleep after night work, sleep is disturbed and/or shortened

Circadian Regulation of Sleep: Night Work



NASA Overnight Cargo Study

- Primary sleep periods shorter (pre = 7.5 hr vs. trip = 4.6 hr)
- Less total sleep per 24 hr (pre = 7.5 hr vs. trip = 6.3 hr)
- Rated as lighter, less restful, poorer overall (pre = 14.6 vs. trip = 13.4)
- Frequency of reported multiple sleeps
  - 53% on duty days
  - 17% on non-duty days

NASA Overnight Cargo Study

- 53% averaged > 1 hr of daily sleep loss across trip
- 29% averaged > 2 hr of daily sleep loss across trip
- Those who lost sleep
  - averaged 12.6 hr of sleep loss by trip end
  - maximum sleep loss = 32 hr
- 15% averaged more sleep on trip than pretrip

NASA Overnight Cargo Study

- Fatigue higher on trip
  (pre = 33.5 vs. trip = 51.0)
- Negative affect higher on trip
  (pre = 0.5 vs. trip = 0.7)
- Positive affect lower on trip
  (pre = 2.4 vs. trip = 2.0)
- Activation lower on trip
  (pre = 2.3 vs. trip = 1.9)

NASA Overnight Cargo Study

- Headaches increased 9x
- Congested nose increased 2x
- Burning eyes increased 9x

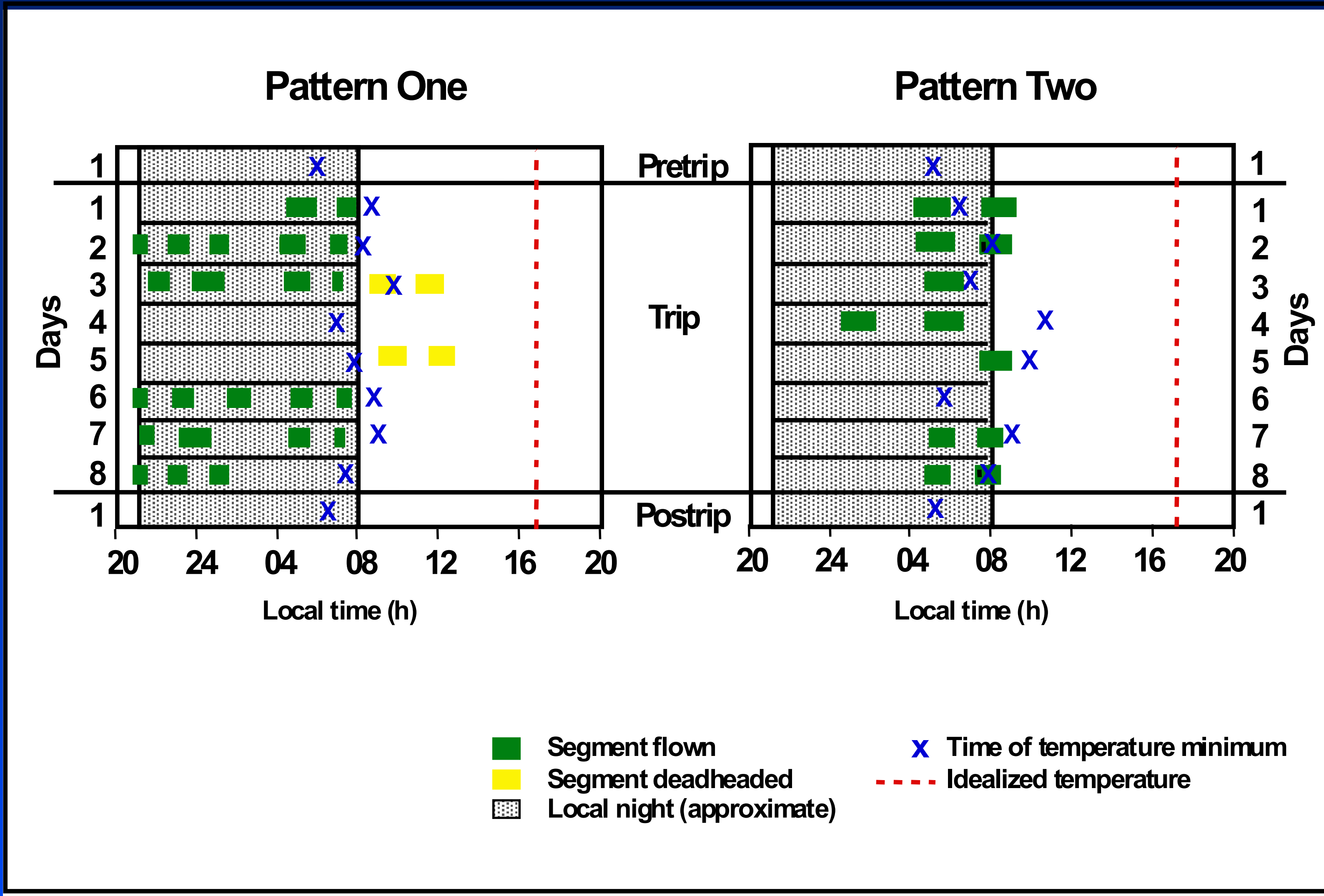
“Adapting” to Night Work

- In most instances complete circadian adaptation to night work never occurs

  - early morning light prevents adaptation

  - reversion to day-active schedule on days off

Incomplete Adaptation: Overnight Cargo



Why Air Cargo is Not Like Typical Night Shift Work

- Instability
  - consecutive “days” may not begin/end at the same time
  - flight schedules usually are not organized as:
    - sequences of identical work days
    - rotation to another stable work/rest pattern
- Unpredictability
  - scheduled work and rest periods may be altered in the event of unforeseen circumstances (weather, etc.)
  - call out from planned activities

Individual Differences

Aging

- Flight crews become more morning type with increasing age (NASA aging study: 205 flight crew members aged 20-60)
- The amplitude of the temperature rhythm decreases with age (NASA aging study: 91 flight crew members aged 20-60)
- During long haul operations, flight crew members aged 50-60 lost 3.5 times more sleep than crew members aged 20-30 (NASA aging study: 67 flight crew members aged 20-60)

Sleep Apnea: Occupational Perspective

- Health and safety risk
- Undiagnosed and untreated
- Exacerbated by sleep loss, ETOH, etc.
- Safety vs. confidentiality vs. work protection

The Challenges . . .

Diverse operational requirements

Individual differences

Complex physiology

History (“that’s how its always been”)

Economics (“it’s the economy, stupid”)

Managing Fatigue in Ops Settings

- Education and training
- Hours of service
- Scheduling
- Countermeasures
- Design and technology
- Policies / operational flexibility

Success requires . . .

A culture change that supports different attitudes and behavior

Change can occur through . . .

- Proactive, constructive, controlled
- Legislative, policy, regulatory
- Legal system, liability, risk assessment
- Personal experience, motivation, opportunity

No accident ≠

Safe operation