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Key FM scientific principles

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Fatigue Management Approaches Symposium

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Fatigue

'a physiological state of reduced mental or physical performance capability

resulting from sleep loss, extended wakefulness, circadian phase, and/or workload (mental and/or physical activity)

that can impair a person's alertness and ability to perform safety related operational duties'

- Scientific Principle 1: The Need for Sleep
- Scientific Principle 2: Sleep Loss and Recovery
- Scientific Principle 3: Circadian Effects on Sleep and Performance
- Scientific Principle 4: Effects of Workload on Fatigue

Scientific Principle 1

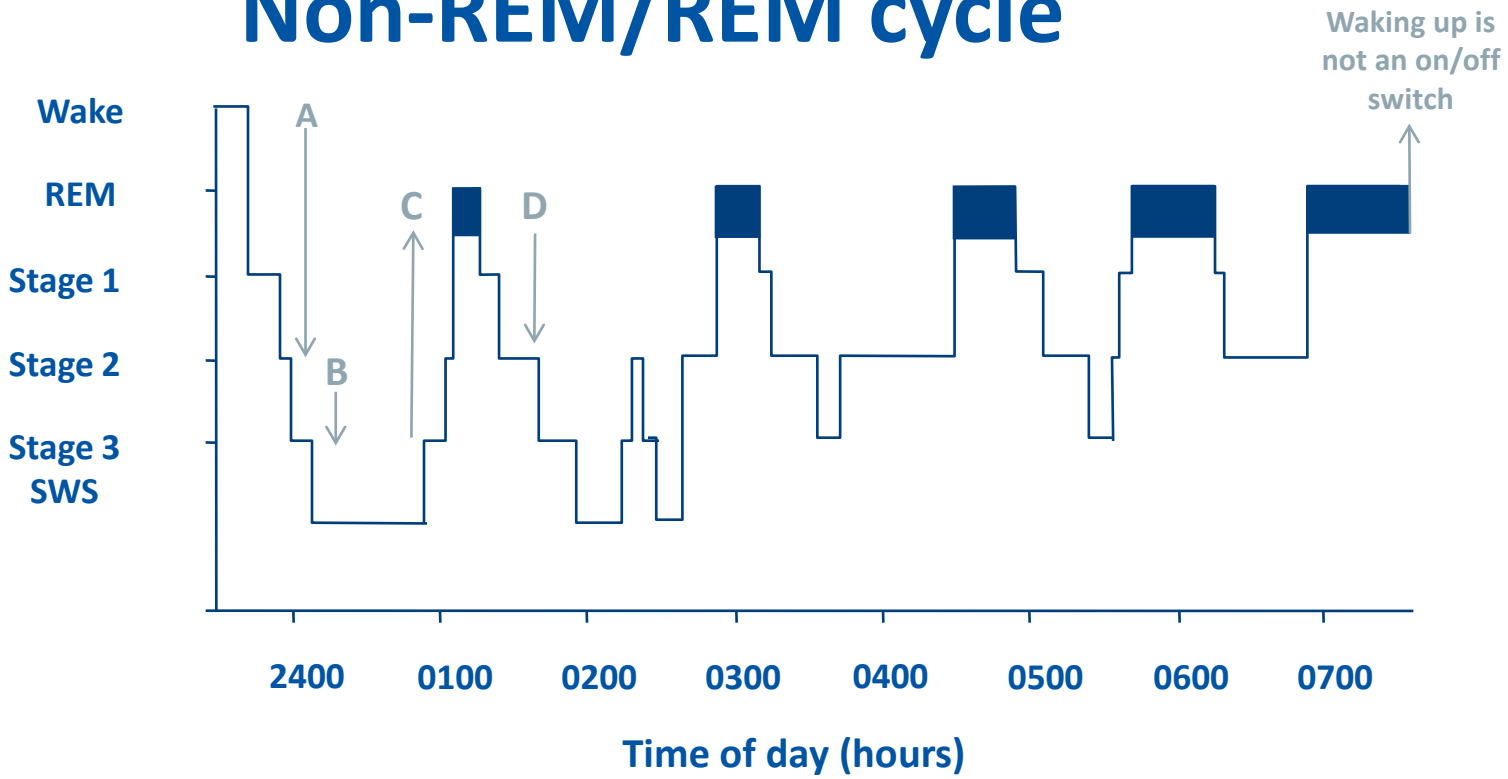
THE NEED FOR SLEEP

Why sleep?

Brain needs to go ‘off-line’ for essential recovery and maintenance

- reduced processing of inputs from the senses (light, sound, smell)
- complex series of processes
  - dreaming (REM) and non-dreaming (non-REM)
  - memory consolidation, learning
  - emotional regulation
  - repair of tissue wear-and-tear
  - growth
  - recharge immune system
  - regulate appetite, metabolism …
- wake up as an updated version of yourself

Non-REM/REM cycle



Good sleep - unbroken non-REM/REM cycles

Sleep quality

- Declines with normal aging
  - Less slow-wave, more sleep fragmentation
- Disrupted by sleep disorders
  - Insomnia, sleep apnoea …
- Disturbed by stimulants (caffeine, nicotine) and alcohol
- Affected by environmental factors
  - Light, heat, noise, comfort
  - Sleeping at work, being on standby (residual arousal)

Scientific Principle 2

SLEEP LOSS AND RECOVERY

Sleep loss and recovery

- Restricted sleep leads to:
  - feeling sleepier, irritability, degraded alertness, slower reaction times, poorer coordination, slower thinking, loss of situation awareness, less creative problem-solving
  - lack of awareness of your own performance
  - uncontrolled sleep
    - sleepiness → micro-sleeps → established sleep
- Effects of restricted sleep are cumulative and dose-dependent
- Recovery is not hour-for-hour:
  - deeper, more consolidated sleep on 1st recovery night
  - recovery usually takes at least 2 nights of unrestricted sleep
    - 1st night – recover deep non-REM (slow-wave sleep)
    - 2nd night – recover REM
    - **not 48 hours off**
    - waking function can take more than 2 full nights of sleep to recover
- Pressure for sleep builds up across time awake

Scientific Principle 3

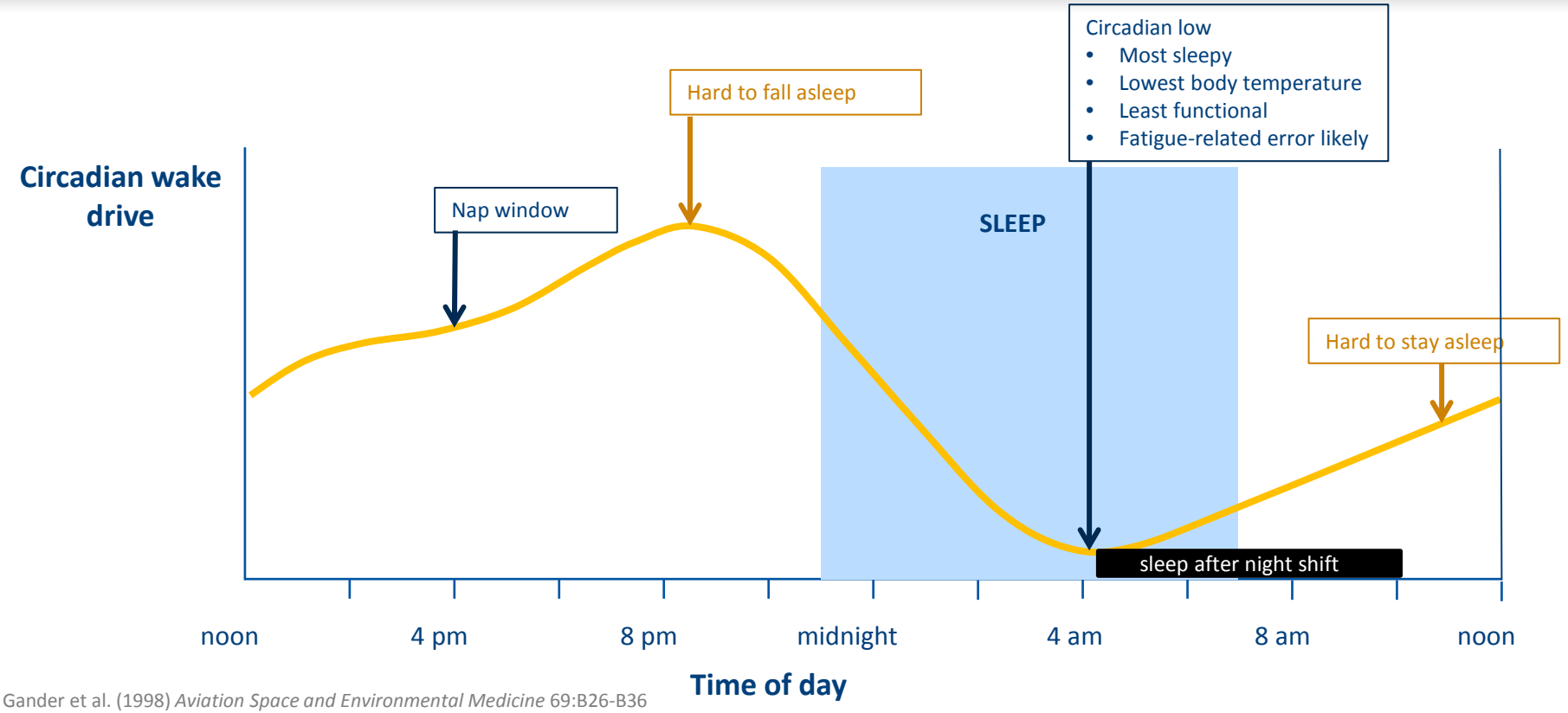
CIRCADIAN EFFECTS ON SLEEP AND PERFORMANCE

Why do we sleep at night?

Circadian body clock

- Pacemaker in the brain that drives daily cycles (circadian rhythms) in
  - How you function
    - body functions – hormones, heart rate, digestion …
    - ability to do physical and mental work
  - How you feel
    - mood, sleepiness, fatigue …
- Tracks light intensity even through closed eye lids
  - Designed to keep us in step with the day/night cycle
  - Connected to sleep-promoting centres and wake-promoting centres in the brain

A feature of life on earth



Gander et al. (1998) *Aviation Space and Environmental Medicine* 69:B26-B36

Shift work versus jet lag

Shift work

- Sleep/wake cycle displaced, day/night cycle unchanged
  - Circadian body clock does not adapt fully (tracks day/night cycle)
  - Working at sub-optimal times
  - Sleeping at suboptimal times

Jet lag

- Day/night cycle displaced
  - Full circadian adaptation after 1 flight, if stay long enough
  - Out-and-back with 1-2 day layover, minimal adaptation
  - Multiple transmeridan flights with 1-2 day layovers, circadian drift?

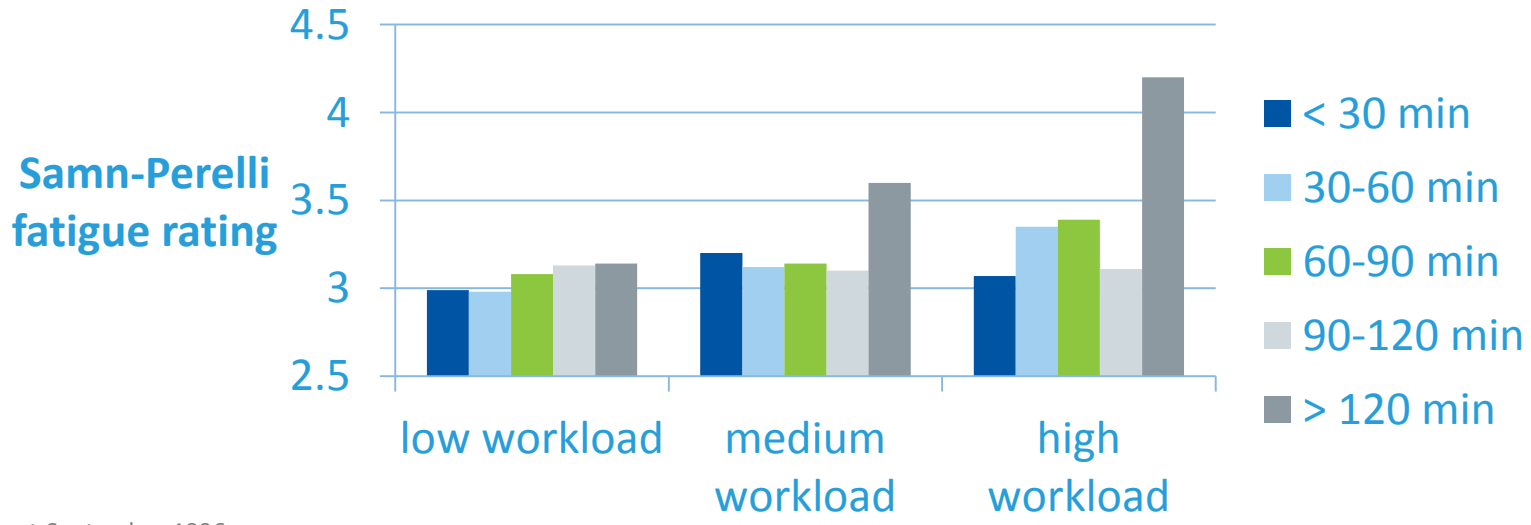
Scientific Principle 4

EFFECTS OF WORKLOAD ON FATIGUE

Workload

- Less research than other causes of fatigue, different measures
  - Flight crew, number of sectors in a duty period is considered a measure of workload
    - greater fatigue at the end of short haul duty periods with multiple sectors
  - Cabin crew, NASA Task Load Index at end of flights on a ULR trip
    - workload an independent predictor of sleepiness, fatigue and PVT lapses at TOD (after controlling for effects of total in-flight sleep, time awake at TOD, flight direction)
  - For ATCs, self rated (low, medium, high) workload
    - interacts with time-of-day and duration of time on operational duty

Effect of workload on fatigue at end of ATC operational duty periods



98 UK ATCs, August-September 1996
Spencer MB et al (1997) DERA Report PLSD/CHS5/CR/97/020

Key points

- Fatigue-related impairment results from physiological disruption
  - fatigued people are unable to perform at their optimum level, not unwilling
- Sleep is required to recover from the physical and mental exertion of all waking activities (not just work demands)
  - managing fatigue is primarily about managing sleep opportunities, not the length of rest breaks
  - fatigue risk management is a shared management/workforce responsibility
- The circadian body clock drives rhythms in
  - many aspects of waking function (physical and mental work capacity, mood …)
  - ability to fall sleep and stay asleep
  - the perfect roster is day work with unrestricted sleep at night
- In 24/7 operations fatigue is inevitable – the associated safety risk must be managed

THANK YOU

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