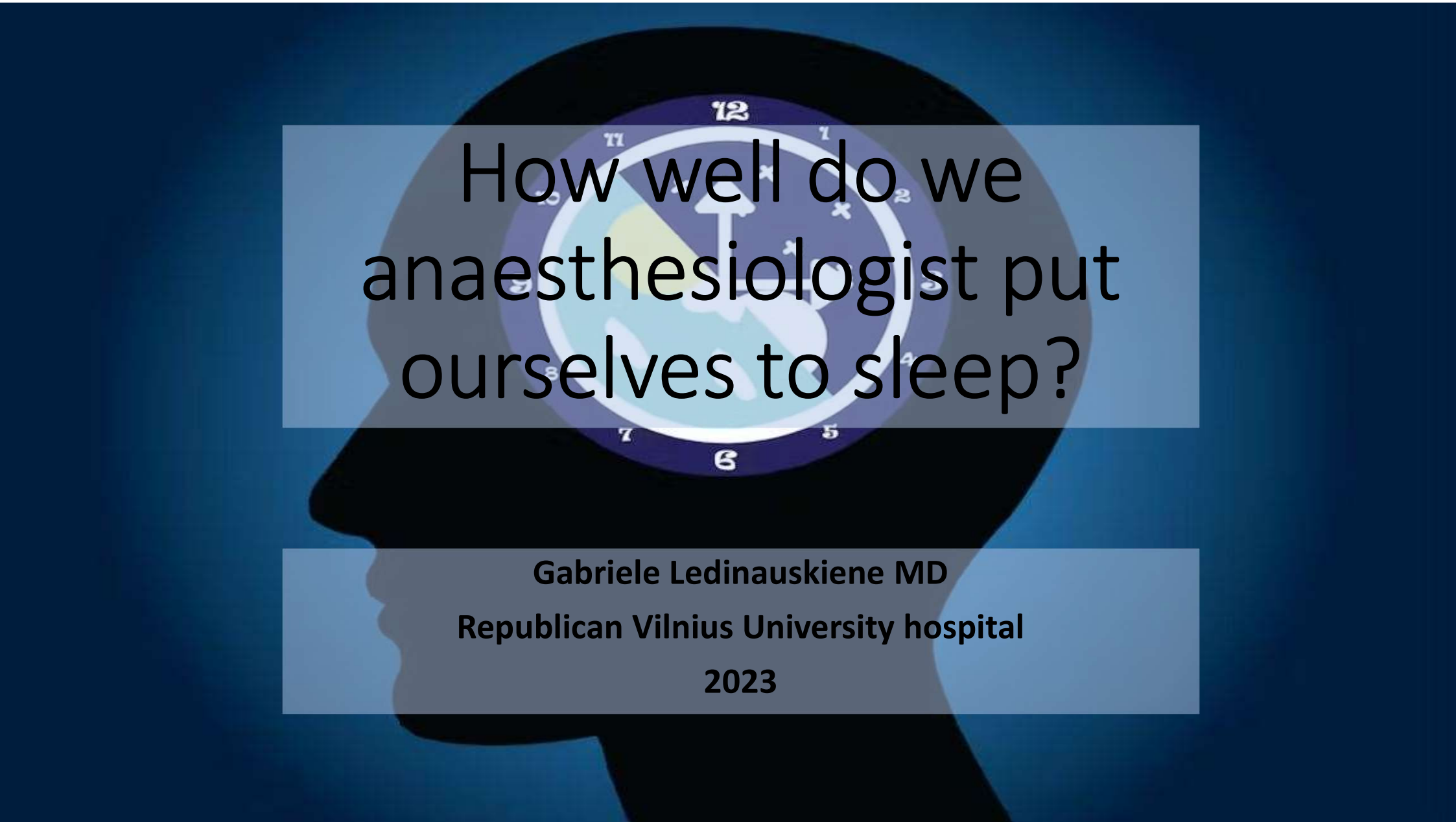


How well do we anaesthesiologist put ourselves to sleep?

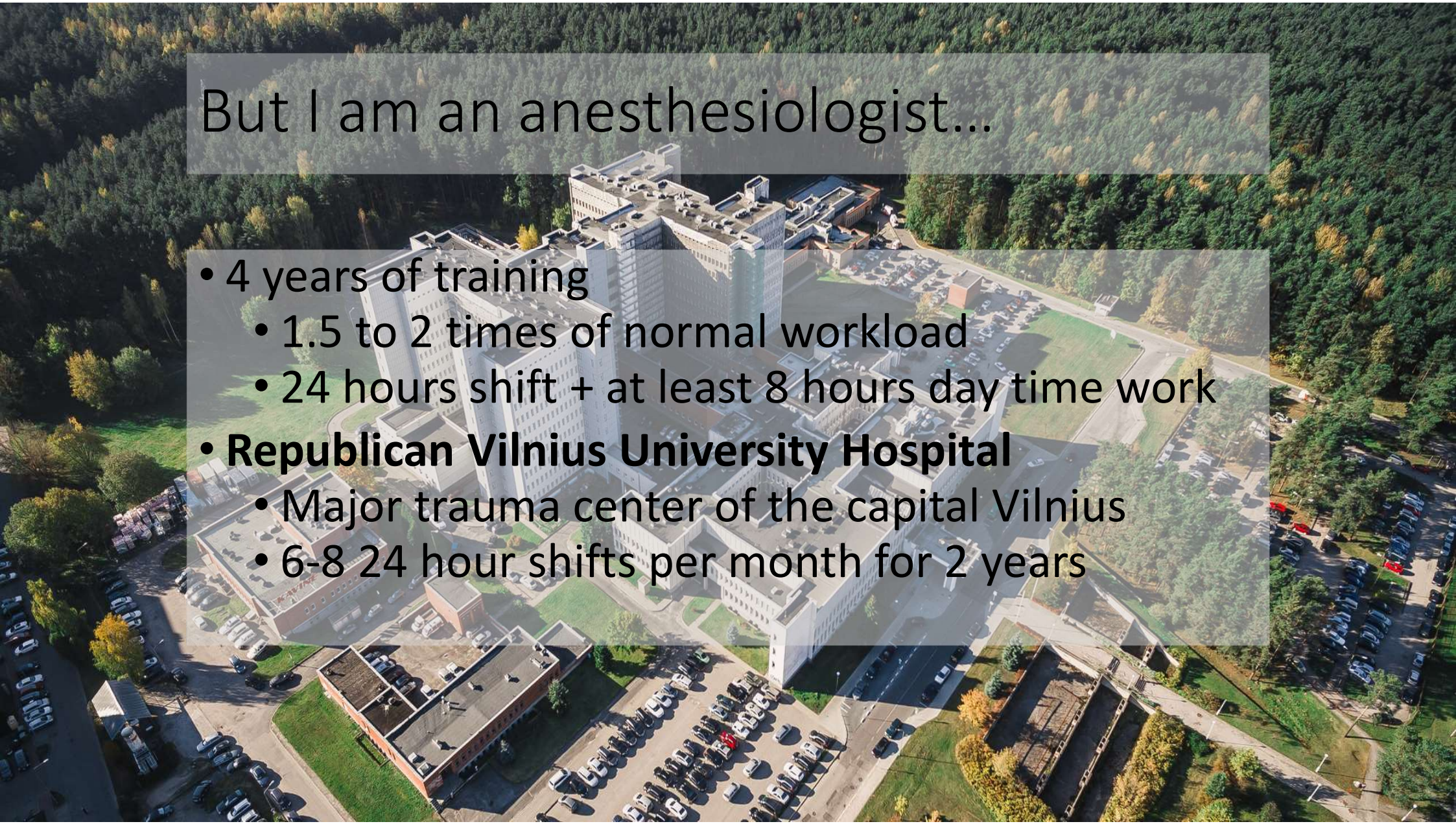
Gabriele Ledinauskiene MD

Republican Vilnius University hospital

2023

Disclaimer

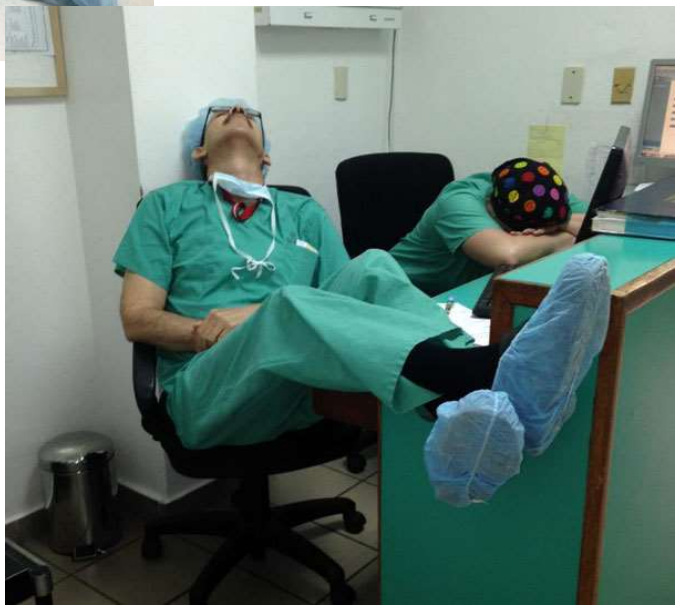
I am not a sleep physician …



But I am an anesthesiologist…

- 4 years of training
  - 1.5 to 2 times of normal workload
  - 24 hours shift + at least 8 hours day time work
- **Republican Vilnius University Hospital**
  - Major trauma center of the capital Vilnius
  - 6-8 24 hour shifts per month for 2 years


© Cover News



Life happened…

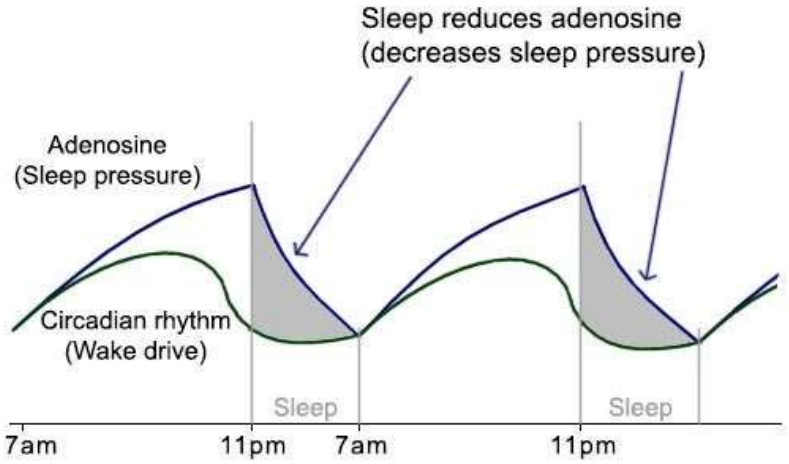
- Elective wrist arthroscopy
- Cast for almost 2 months
- 2 months physiotherapy

- NO WORK!!!
- Finally, normal sleep schedule

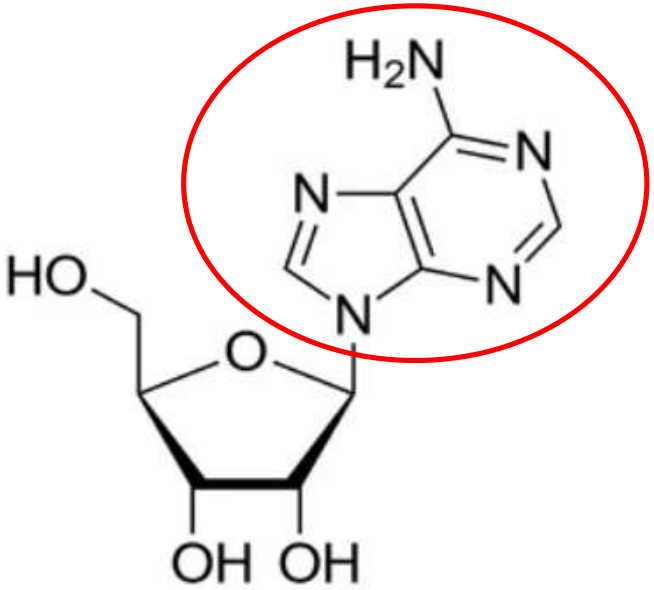
Sleep physiology: #1 chemical force

ADENOSINE

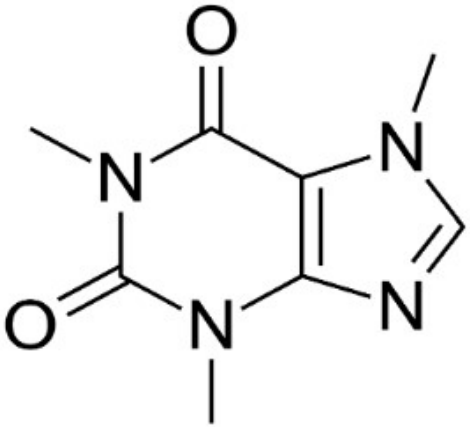
- Endogenous nucleoside found in every cell of the body
- In the brain acts as inhibitory neurotransmitter
- Basal forebrain uses energy (ATP) → byproduct adenosine →↑ sleep



Sleep physiology: adenosine



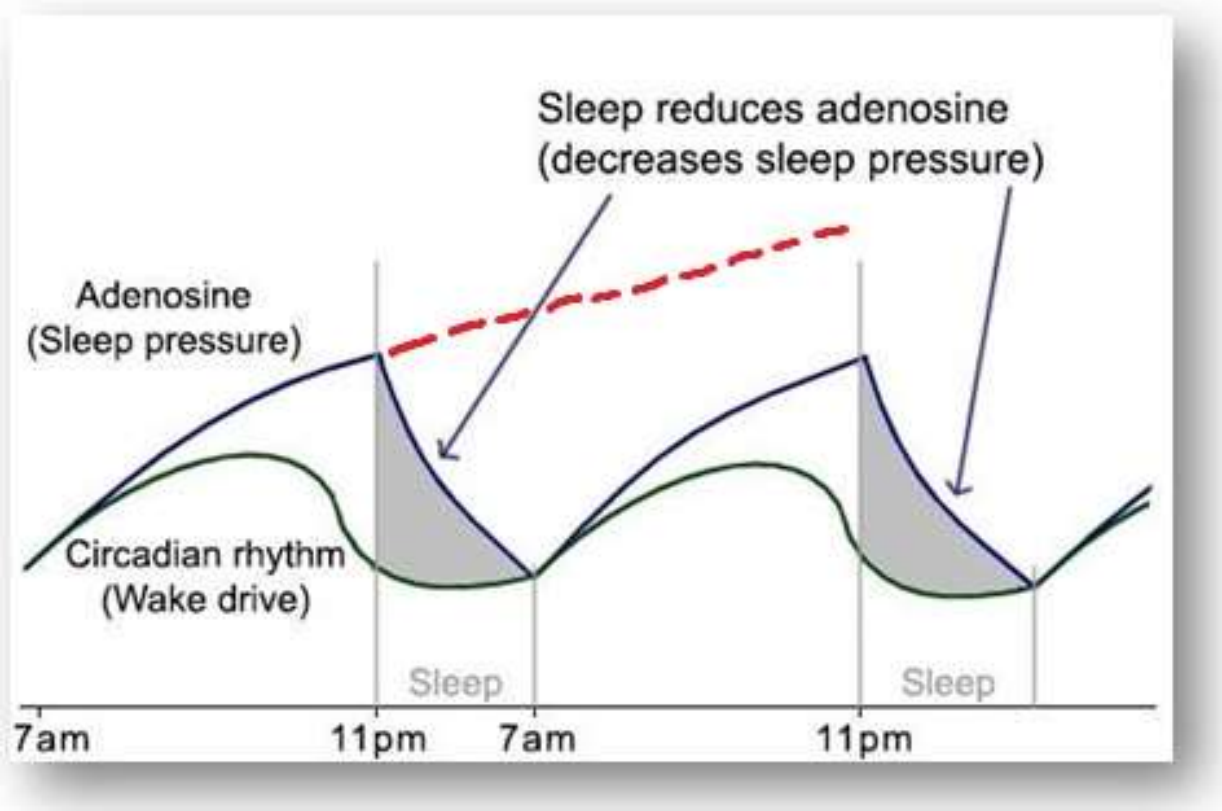
ADENOSINE



CAFFEINE

Caffeine primarily works by entering the brain and blocking adenosine receptors → **adenosine receptor antagonist**.

Sleep physiology: adenosine



Sleep physiology: #2 circadian force

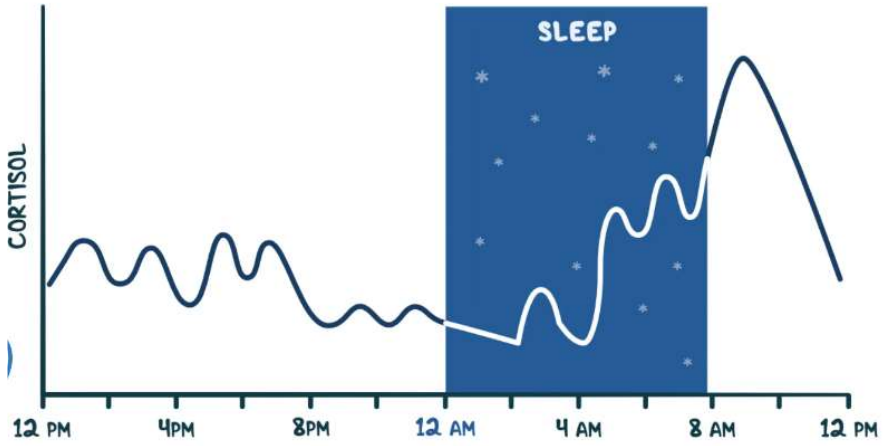
CIRCADIAN RHYTHM

- The body's internal clock that is naturally aligned with the cycle of day and night.
- Dictates multiple processes in the body, including alertness or sleepiness, appetite, and body temperature within 24-hour cycles.
- This internal clock is directly influenced by environmental cues, especially light, which is why circadian rhythms are tied to the cycle of day and night.
- Developed over hundreds of thousands of years to help us adapt and thrive under the selective pressures of food scarcity, seasonal changes in sunlight availability, and variable range of temperature exposure.

Sleep physiology: endogenous rhythm of cortisol and melatonin

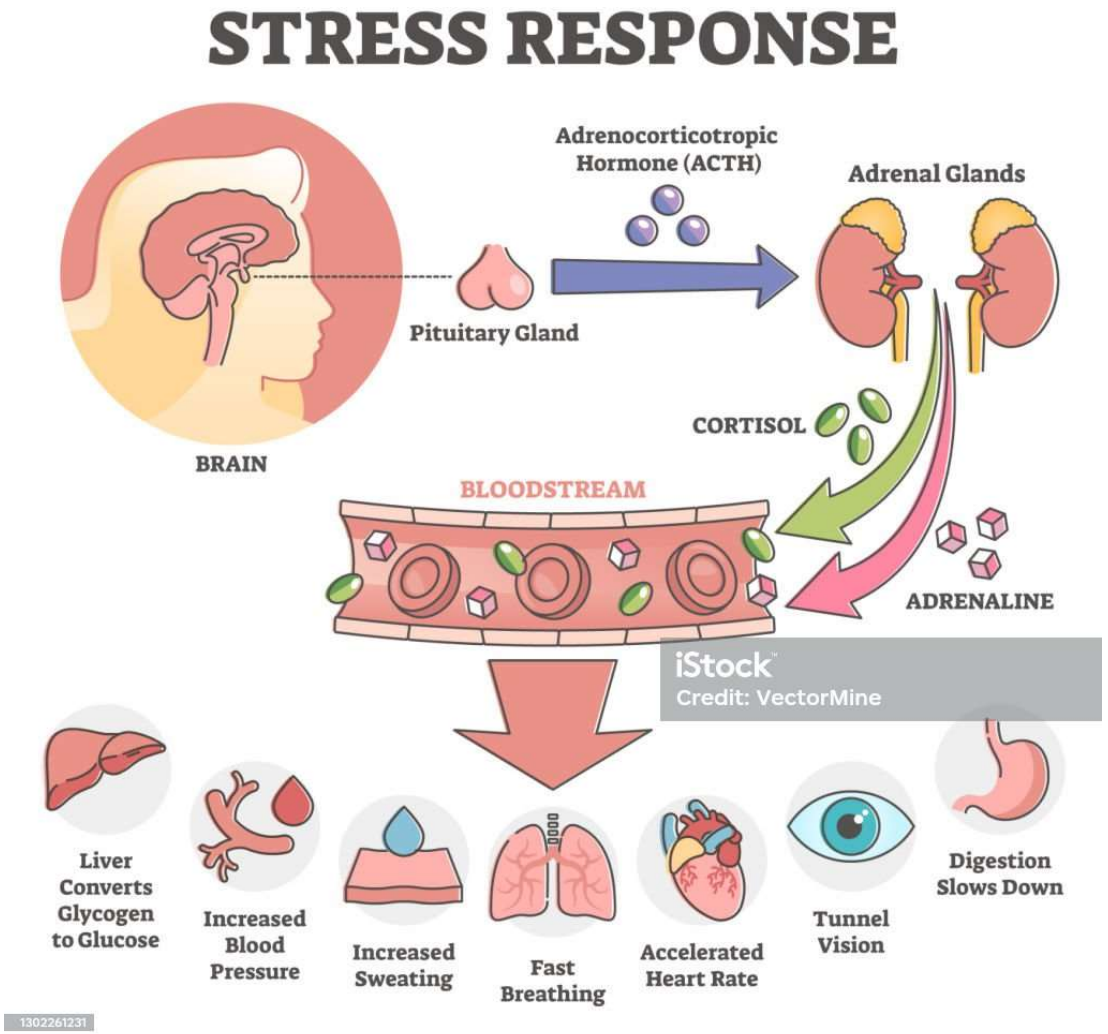
CORTISOL

- Lower levels of cortisol are present at the initial part of sleep
- There is an increase at the end of the sleep period
- Peaks just minutes before the individual wakes up



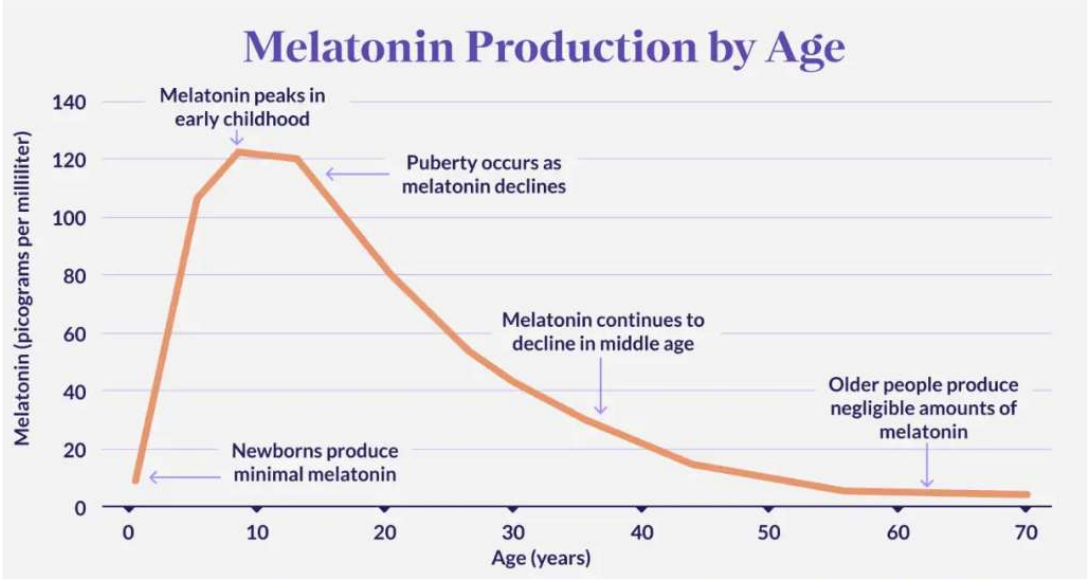
Sets “timer” for MELATONIN release after 12-14 hours

Cortisol:

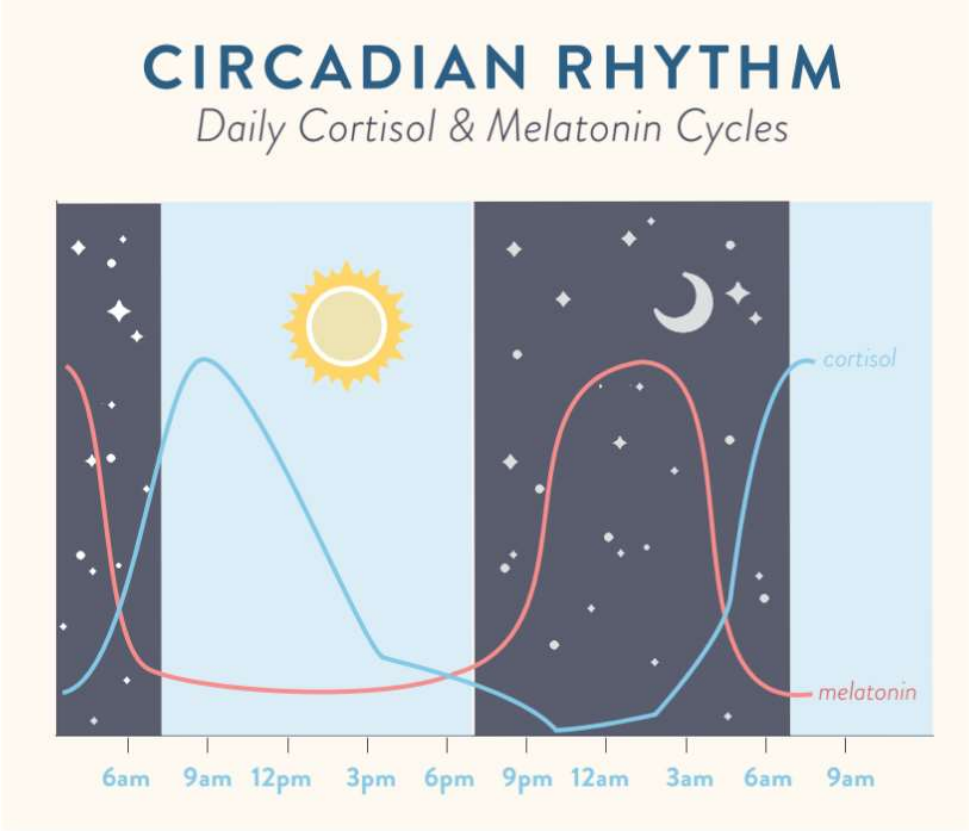

STRESS RESPONSE
Adrenocorticotropic Hormone (ACTH)
Adrenal Glands
Pituitary Gland
BRAIN
CORTISOL
BLOODSTREAM
ADRENALINE
iStock
Credit: VectorMine
Liver Converts Glycogen to Glucose
Increased Blood Pressure
Increased Sweating
Fast Breathing
Accelerated Heart Rate
Tunnel Vision
Digestion Slows Down
1302261231

Sleep physiology: melatonin

- Hormone released by pineal gland in response to cortisol and light
- Regulates sleep-wake cycle; production increases in the darkness
- Suppresses the onset of puberty



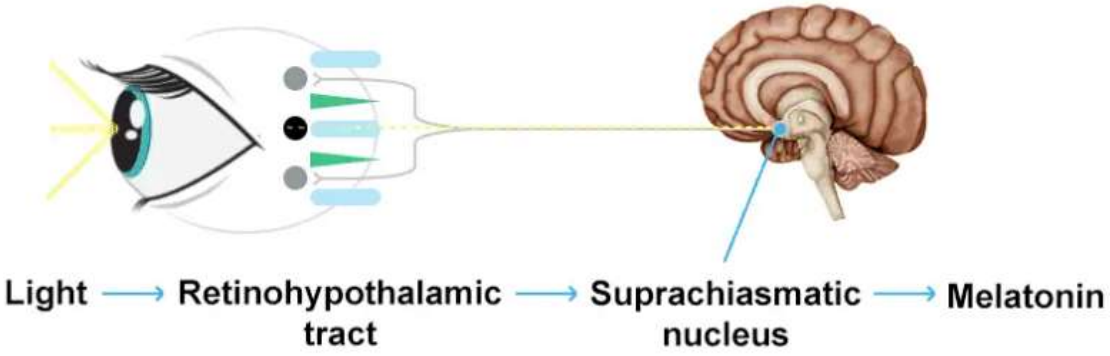
Sleep physiology: endogenous rhythm of cortisol and melatonin



If we lived in the cave, the cycle of cortisol-melatonin release would still occur once every 24-hour cycle, but it would be later and later each day

Sleep physiology: anchor - light

- Light plays a central role in regulating circadian rhythm
- Light comes into the eye → retinal ganglion cells send signal to the suprachiasmatic nucleus (SCN) → SCN governs every cell of our body
- This is how the release of cortisol and melatonin is timed properly



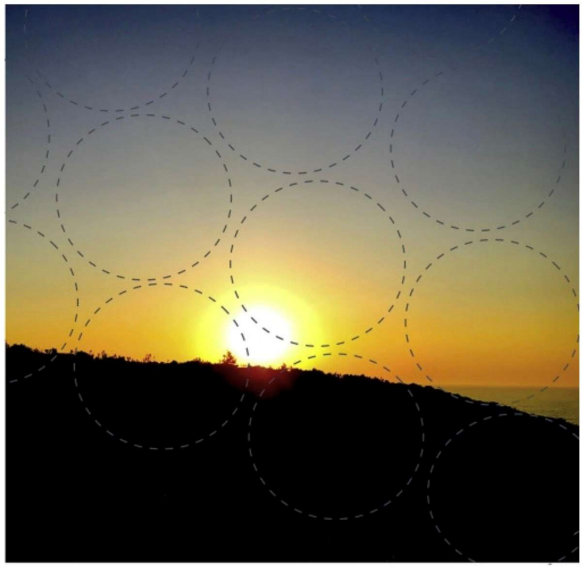
Quality and the amount of light matters!

Sleep physiology: light quality and quantity

- Cells in the retina are particular responsive to low solar angle as it is in the morning
- However, early in the morning retina is not very sensitive → lots of photons
- Best way to set internal clocks properly is to go outside till 9 a.m. for to 2 to 10 min
- If not possible – opt for artificial lights that is similar to low angle sun light (rich in blue light wavelengths!)
- It is not about seeing and perceiving sunlight! Theses neurons are triggered “subconsciously”.

Sleep physiology: light quality and quantity

- Discovery of **photopigment melanospin** in the retina (1998).
- The melanospin system mediates several non-imaging-forming visual functions, including light entrainment of circadian rhythms and pupillary responses to light.
- Are particular responsive to low solar angle as it is in the morning.
- It is not about seeing and perceiving sunlight! Theses neurons are triggered “subconsciously”.



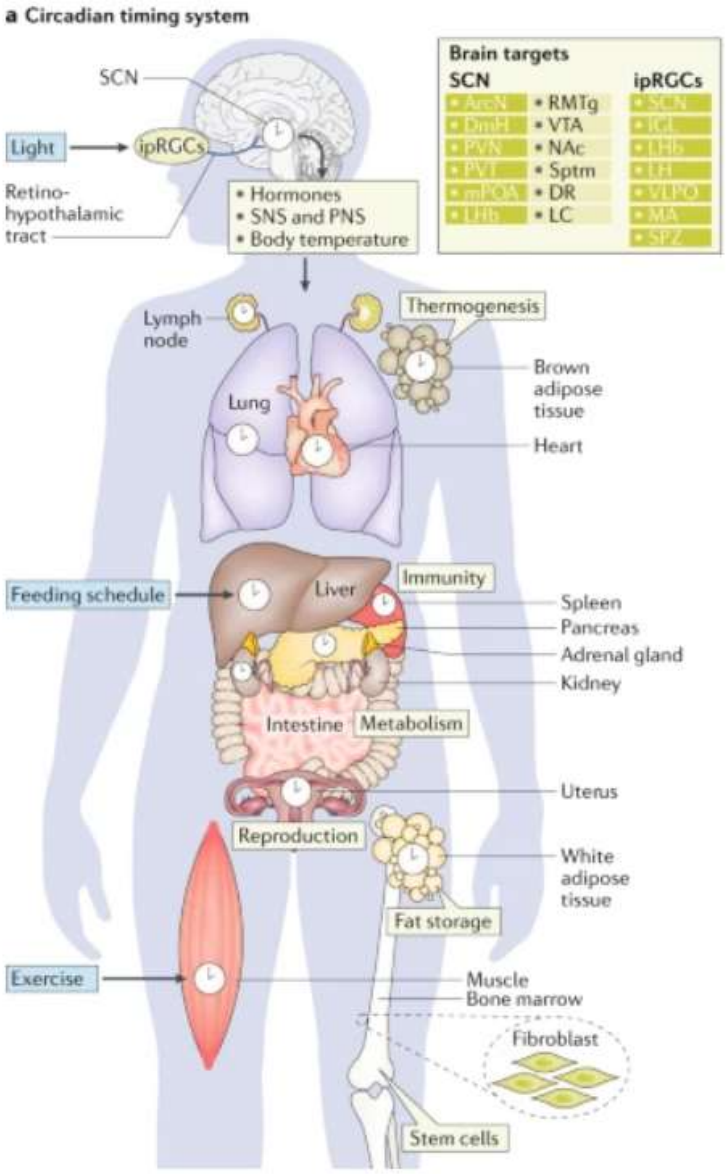
Sleep physiology: sunlight

- Viewing sunlight early in the morning is a key for establishing healthy sleep-wake rhythms
- It governs circadian rhythm that is responsible for many many many things in the body starting from metabolism, inflammatory response ending with learning, focus and mental health…
- Melanopsin ganglion cells in the retina are the main and the only DIRECT way to set the internal clocks
- Other things that contribute: timing of feeding and exercise

Circadian timing system

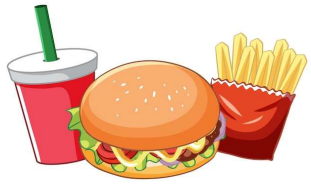
Circadian rhythms are key regulators of

- thermogenesis,
- immune function,
- metabolism,
- reproduction,
- stem cell development.



Logan, R.W., McClung, C.A. Rhythms of life: circadian disruption and brain disorders across the lifespan. *Nat Rev Neurosci* **20**, 49–65 (2019). https://doi.org/10.1038/s41583-018-00

Modern life



- Although this fine-tuned system was sufficient for many thousands of years, we have rapidly developed societal conditions, which seem to exceed the adaptive limitations of our circadian programming.
- Growing population of shift workers, more regular travel across time zones, **social** jet lag, nearly constant exposure to artificial light, sedentary lifestyle, availability of inexpensive, high-calorie foods…
- Insufficient sleep is associated with a broad range of health and safety risks including premature death, obesity, vehicle crashes, worker errors, and various chronic diseases such as heart disease, diabetes, and cancer.

Disrupted circadian rhythm: mood&cognition

Chronic bright light exposure between 10 PM & 4 AM suppresses dopamine

Fernandez DC, Fogerson PM, Lazzerini Ospri L, Thomsen MB, Layne RM, Severin D, Zhan J, Singer JH, Kirkwood A, Zhao H, Berson DM, Hattar S. Light Affects Mood and Learning through Distinct Retina-Brain Pathways. Cell. 2018 Sep 20;175(1):71-84.e18. doi: 10.1016/j.cell.2018.08.004. Epub 2018 Aug 30. PMID: 30173913; PMCID: PMC6190605.

Sleep loss-induced neurobehavioral impact extends from simple measures of cognition (i.e., attention and reaction time) to far more complex errors in judgment and decision making, such as medical errors.

Landrigan CP, Rothschild JM, Cronin JW, Kaushal R, Burdick E, Katz JT, Lilly CM, Stone PH, Lockley SW, Bates DW, Czeisler CA. Effect of reducing interns' work hours on serious medical errors in intensive care units. N Engl J Med. 2004 Oct 28;351(18):1838-48. doi: 10.1056/NEJMoa041406. PMID: 15509817.

The NEW ENGLAND JOURNAL of MEDICINE

Effect of Reducing Interns' Work Hours on Serious Medical Errors in Intensive Care Units

Christopher P. Landrigan, M.D., M.P.H., Jeffrey M. Rothschild, M.D., M.P.H., John W. Cronin, M.D., Rainu Kaushal, M.D., M.P.H., Elisabeth Burdick, M.S., Joel T. Katz, M.D., Craig M. Lilly, M.D., Peter H. Stone, M.D., Steven W. Lockley, Ph.D., David W. Bates, M.D., and Charles A. Czeisler, Ph.D., M.D. for the Harvard Work Hours, Health and Safety Group

- Prospective, randomized study
- **Rates of serious medical errors of interns working on tradional vs reduced working week**
  - traditional schedule: 77-81 hours per week with extended 24 hours shifts
  - reduced schedule: 63 hours per week and no extended shifts
- Two physicians who were unaware of the interns' schedule assignments independently rated each incidence

Table 3. Incidence of Serious Medical Errors.

Variable	Traditional Schedule	Intervention Schedule	P Value
	no. of errors (rate/1000 patient-days)		
Serious medical errors made by interns			
Serious medical errors	176 (136.0)	91 (100.1)	<0.001
Preventable adverse events	27 (20.9)	15 (16.5)	0.21
Intercepted serious errors	91 (70.3)	50 (55.0)	0.02
Nonintercepted serious errors	58 (44.8)	26 (28.6)	<0.001
Types of serious medical errors made by interns			
Medication	129 (99.7)	75 (82.5)	0.03
Procedural	11 (8.5)	6 (6.6)	0.34
Diagnostic	24 (18.6)	3 (3.3)	<0.001
Other	12 (9.3)	7 (7.7)	0.47
All serious medical errors, unit-wide			
Serious medical errors	250 (193.2)	144 (158.4)	<0.001
Preventable adverse events	50 (38.6)	35 (38.5)	0.91
Intercepted serious errors	123 (95.1)	63 (69.3)	<0.001
Nonintercepted serious errors	77 (59.5)	46 (50.6)	0.14
Types of serious medical errors, unit-wide			
Medication	175 (135.2)	105 (115.5)	0.03
Procedural	18 (13.9)	11 (12.1)	0.48
Diagnostic	28 (21.6)	10 (11.0)	<0.001
Other	29 (22.4)	18 (19.8)	0.45

Table 4. Examples of Serious Medical Errors and Nonpreventable Adverse Events.

Category and Type	Description
Intercepted serious error	
Procedural	As intern is preparing to perform a thoracentesis on the left side of the patient's chest, the senior resident enters the room and informs the intern that the pleural effusion is on right side of the patient's chest.
Diagnostic	Several days after a patient with a history of flash pulmonary edema is admitted for congestive heart failure, intern reports that patient is in clinically stable condition, having miscalculated that 24-hour input and output volumes are well matched (positive by 20 ml). The nurse is concerned that patient seemed overloaded with fluid and in mild respiratory distress and requests a reevaluation. A recalculation by the senior resident reveals an error by a factor of 100: the patient's input and output volume has, in fact, been positive by 2000 ml for the prior 24 hours. Furosemide is promptly administered and the patient's symptoms improve.
Medication	Intern orders an intravenous vasopressin drip at rate of 0.2 U/min (overdose by a factor of 10). Nurse intercepts the order, and the rate is changed to 0.02 U/min.
Nonintercepted serious error	
Procedural	Patient with defibrillator implanted on left side urgently needs central access for inotropic support. Intern inserts a central venous catheter in the left subclavian vein. Not recognizing that the vein contains the wire from the defibrillator, the intern is having repeated difficulty advancing the introducer. In the middle of the placement, the cardiology fellow enters and asks the intern to abort the procedure immediately. The catheter is removed before it can interfere with or dislodge the defibrillator wire.

Disrupted circadian rhythm: physical health

Sleep deprivation → ↑ cortisol levels →

- ↑ BP,
- ↓glucose tolerance,
- ↑ activity of fight-or-flight system

JOURNAL ARTICLE

Health disorders of shift workers FREE

Anders Knutsson

Occupational Medicine, Volume 53, Issue 2, March 2003, Pages 103–108,
https://doi.org/10.1093/occmed/kqg048

Published: 01 March 2003 **Article history**

Circadian Rhythm, Clock Genes, and Hypertension: Recent Advances in Hypertension

Hannah M. Costello and Michelle L. Gumz

Originally published 4 Oct 2021 | https://doi.org/10.1161/HYPERTENSIONAHA.121.14519 | Hypertension. 2021;78:1185–1196

Other version(s) of this article

Physical health: ↑ risk of
- Diabetes
- Myocardial infarction
- Stroke

Cognitive performance ↓
- More accidents
- 24 hours wakefulness = blood alcohol 0.10 %

People who sleep **less than four hours** dramatically **increase their risk of dying early**, possibly through heart disease, diabetes, high blood pressure, chronic stress, lower immunity, and overall more rapid aging.

Circadian rhythm disorders

A group of conditions tied to dysfunctions or misalignments with the body's internal clock.

Shift work disorder

- Affects people who work nontraditional hours outside the "regular" 9 a.m. to 5 p.m. workday.
- Causes difficulties adjusting to a different sleep/wake schedule, which results in significant issues with:
  - Sleeping when you want.
  - Staying asleep.
  - Unwanted sleepiness.

Reduced REM = association with increased mortality!

- A study published in JAMA Neurology looked at the relationship between REM sleep and earlier death in two large study groups.
  - One consisting of 2,675 older men
  - The other of 1,386 middle-aged men and women

- They followed both groups over time and looked at the relationship between sleep stages and causes of death.

Original Investigation

July 6, 2020

Association of Rapid Eye Movement Sleep With Mortality in Middle-aged and Older Adults

Eileen B. Leary, PhD, RPSGT[1]; Kathleen T. Watson, MS[1]; Sonia Ancoli-Israel, PhD[2]; et al

» Author Affiliations | Article Information

JAMA Neurol. 2020;77(10):1241-1251. doi:10.1001/jamaneurol.2020.2108

Both groups showed ↑ mortality rates related to a decrease in REM sleep, with a 13% higher mortality rate for every 5% reduction in REM sleep. REM sleep was the most important sleep stage for predicting survival.

Sleep is a basic need !!!

Sleep researchers warn that adequate sleep appears to be as important for living as **food and water**, and people should get the amount of sleep they need.

What can be done?

- **Optimal shift pattern:**
  - Forward rotating shifts – morning-afternoon-night
  - Limiting night shifts to 3 consecutive days
  - Limiting shift duration to 8 hours
  - Allowing 3 days of recuperation after night shifts

Burgess PA. Optimal shift duration and sequence: recommended approach for short-term emergency response activations for public health and emergency management. Am J Public Health. 2007 Apr;97 Suppl 1(Suppl 1):S88-92. doi: 10.2105/AJPH.2005.078782. Epub 2007 Apr 5. PMID: 17413074; PMCID: PMC1854972.

- **Light**
  - Avoid bright light into the eyes during the night when at home
- **Naps or non-sleep deep rest techniques, e.g. yoga nidra (guided meditation)**
  - replenish physical energy and increase cognitive function
  - can reset dopamine and other neuromodulators
- **Caffeine – refrain from caffeine use for 6 to 8 hours prior to bedtime.**
  - Affects sleep architecture – shortens deep sleep stages
  - Half life – from to 2 to 10 hours

Non-sleep deep rest (NSDR)

- **How to do NSDR?**
  - Simply lay down somewhere comfortable, or even sitting in a comfy desk chair.
  - Find a free NSDR script and follow the track.
  - Unlike meditation, they don't require a whole lot of focus.
- **The science behind**:

A study out of Denmark, using brain imaging, showed that a 30 minute NSDR/Yoga Nidra script, increased dopamine resting levels in the brain area called the striatum by 65%. Putting people into a state where they're ready for action when they come out.

Kjaer TW, Bertelsen C, Piccini P, Brooks D, Alving J, Lou HC. Increased dopamine tone during meditation-induced change of consciousness. Brain Res Cogn Brain Res. 2002 Apr;13(2):255-9. doi: 10.1016/s0926-6410(01)00106-9. PMID: 11958969.

Annals *of* Emergency Medicine
An International Journal

Improving Alertness and Performance in Emergency Department Physicians and Nurses: The Use of Planned Naps

Rebecca Smith-Coggins, MD • Steven K. Howard, MD • Dat T. Mac, MS • ... Raymond Balise, PhD • Joel Levis, MD, PhD • David M. Gaba, MD • Show all authors

Published: May 01, 2006 • DOI: https://doi.org/10.1016/j.annemergmed.2006.02.005

Study objective

We examine whether a 40-minute nap opportunity at 3 am can improve cognitive and psychomotor performance in physicians and nurses working 12-hour night shifts.

Results

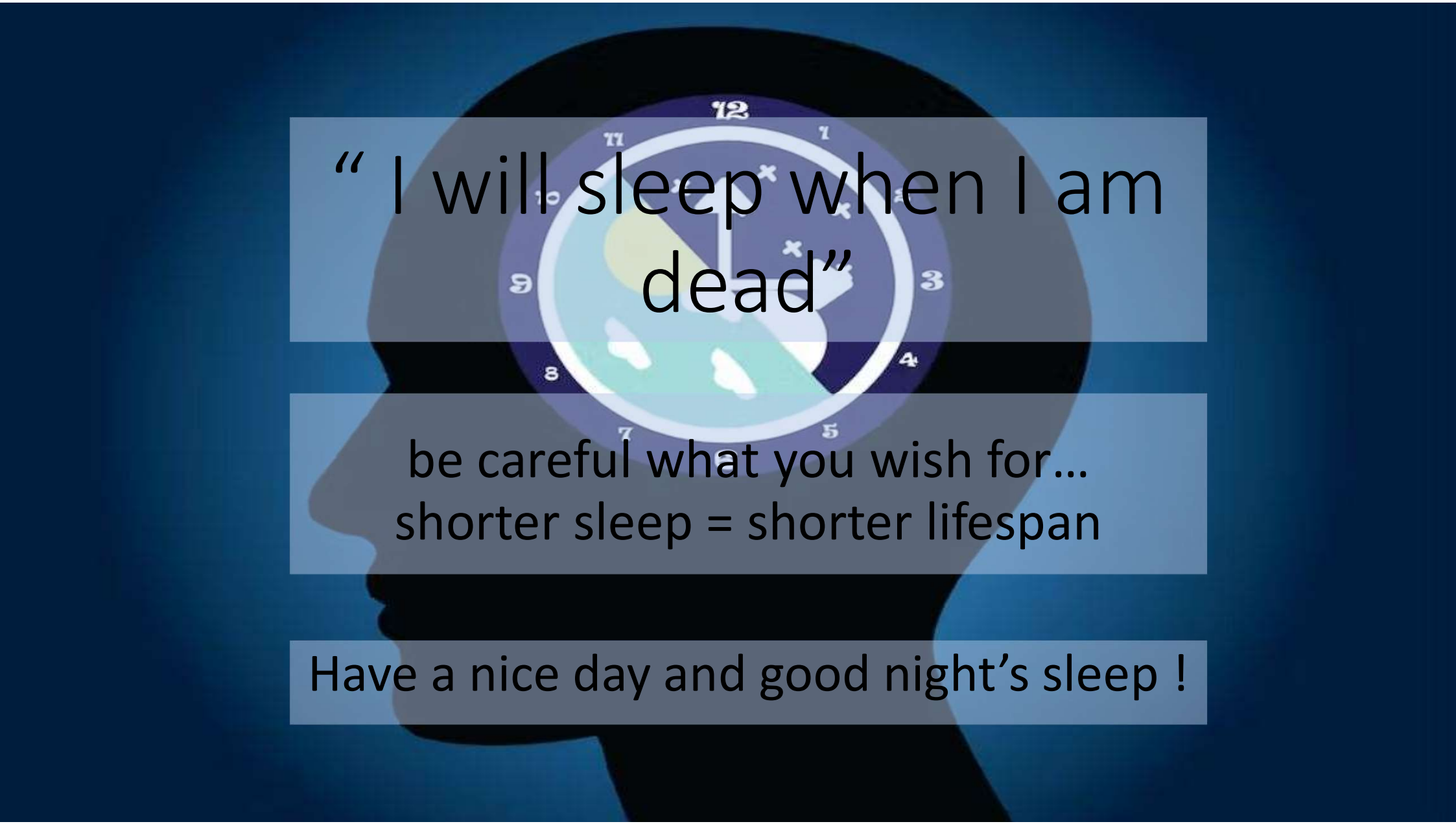
- Polysomnographic data revealed that 90% of nap subjects were able to sleep for an average of 24.8 minutes
- At 7:30 am, the **nap group had fewer performance lapses**, reported **more vigor**, **less fatigue** and **less sleepiness**.
- They tended to **more quickly complete the intravenous insertion**.
- Exhibit **less dangerous driving** and **display fewer behavioral signs of sleepiness** during the driving simulation.
- Immediately after the nap (4 am), the subjects scored **more poorly on Probed Recall Memory**.

My recipe for keeping circadian rhythm on track

- No phone or laptop in the bedroom
- Working schedule: daytime work + two 24 hours shifts
- NSDR from time to time when I feel tired (even after daytime work, before driving home)
- No caffeine after 2 p.m., opt for decaf coffee
- Home like a cave in the evening and a lot of light in the morning if possible – sunlight till 9 a.m.

Zemynos band of kankles

Spotify : ZEMYNA


“ I will sleep when I am dead”
be careful what you wish for…
shorter sleep = shorter lifespan
Have a nice day and good night’s sleep !