Keeping an eye - and ear - out for Sleep apnea

Timothy J. Barreiro, DO, MPH, FCCP, FACOI, FACP
Section Chair, Professor of Medicine
Mercy Health Science, St. Elizabeth Hospital. Youngstown, Ohio
NIH Health Minority & Harvard Macy Scholar
Ohio University Heritage College of Osteopathic Medicine
Northeast Ohio Medical University
Director Pulmonary Health & Research Center
tbarreir@neomed.edu

Course Disclosures

I have no disclosures - conflicts of interest related to this subject or talk.

Full Disclosures

I’m not as old as I look &

I also payed too much for my child to get into a community college

Learning Objectives

- Define the risk, diagnosis and consequences of known and unknown sleep related diseases for patients in the hospital.
- Define the risks, diagnosis and consequences of sleep apnea (OSA) in pre-operative and post-operative patients.
- Review potential treatment options for sleep related disorders for the above patients.
- Describe the physiologic effects of being a nocturnist and ways to protect yourself from errors.

The Importance of Sleep

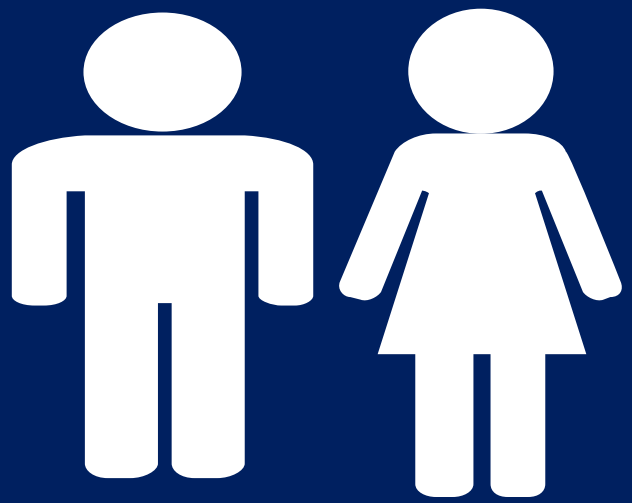
- Sleep is important to health perhaps no more so than when people become sick.
- Sleep disturbance is a leading cause of hospital complications, such as falls and delirium.[1]
- Poor sleep also has been linked to:[2]
  - reduced immune function
  - worsening blood pressure control
  - mood disorders
- All of these problems potentially impair the ability of patients to recover from the acute illnesses that caused them to be hospitalized.

1. Sleep Disorders and Sleep Deprivation: An Unmet Public Health Problem. Institute of Medicine, 2006; Gerontology. 2009;55(2):162-8.
2. Arch Intern Med. 2006;166:1756-62.
Sleep. 2003;26(8):986-9.
Sleep Med. 2009;8(3):215-21.

Profile of Sleep Patients

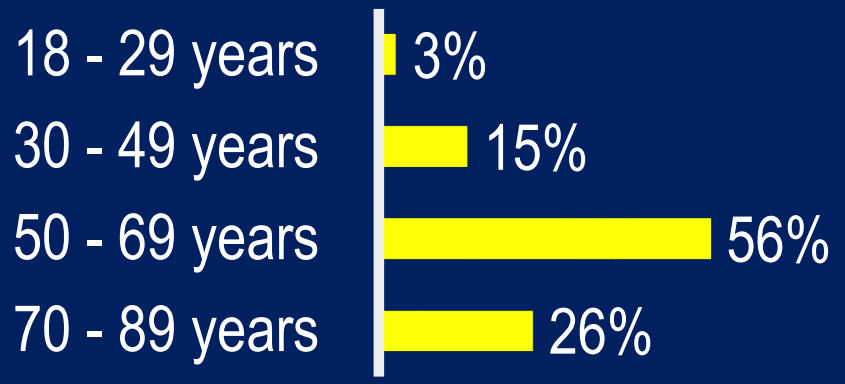
506 U.S. adults (18+ yrs old) being treated for OSA responded to an online survey

Gender



49.7% 23.4%

Age



Age Diagnosed with Sleep Apnea

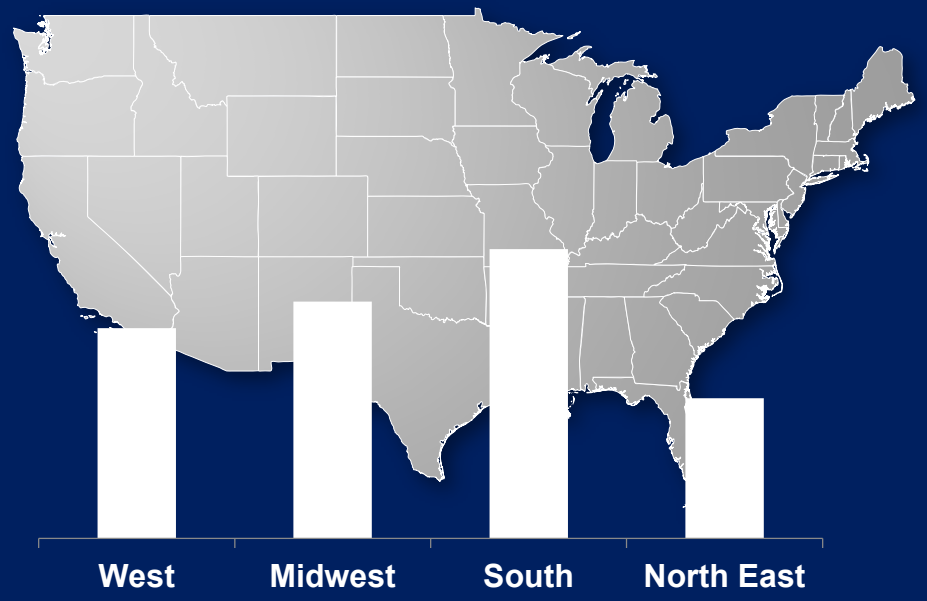
53 years old

(Mean)

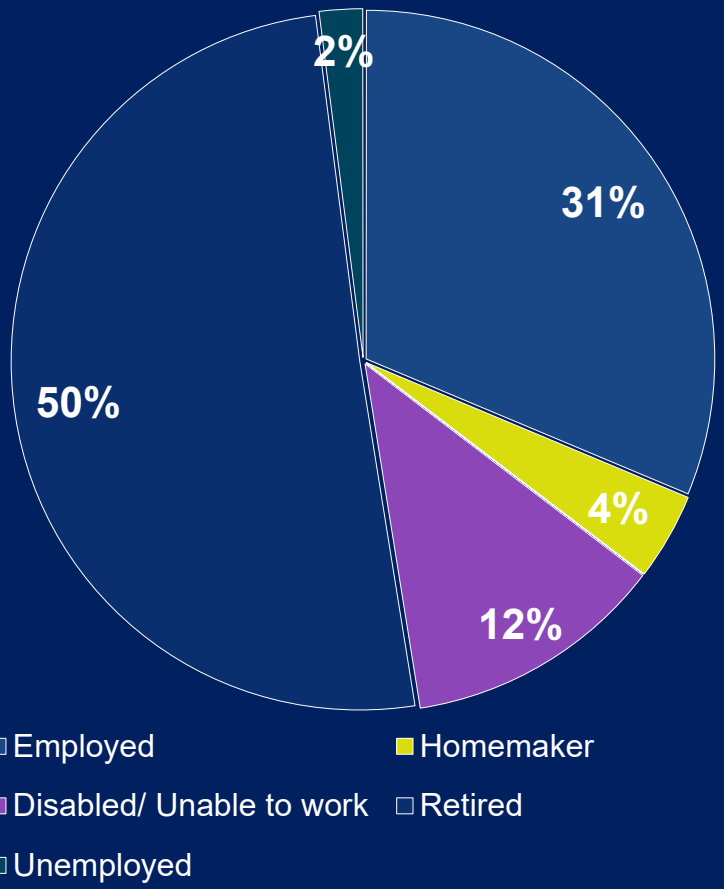
Punjabi NM. The epidemiology of adult obstructive sleep apnea. Proc Am Thorac Soc 2008;5(2):136–43. 2. Lyons PG, Mokhlesi B. Diagnosis and management of obstructive sleep apnea in the perioperative setting. Semin Respir Crit Care Med 2014;35(5):571–81.

Profile of Respondents

Geographic Location

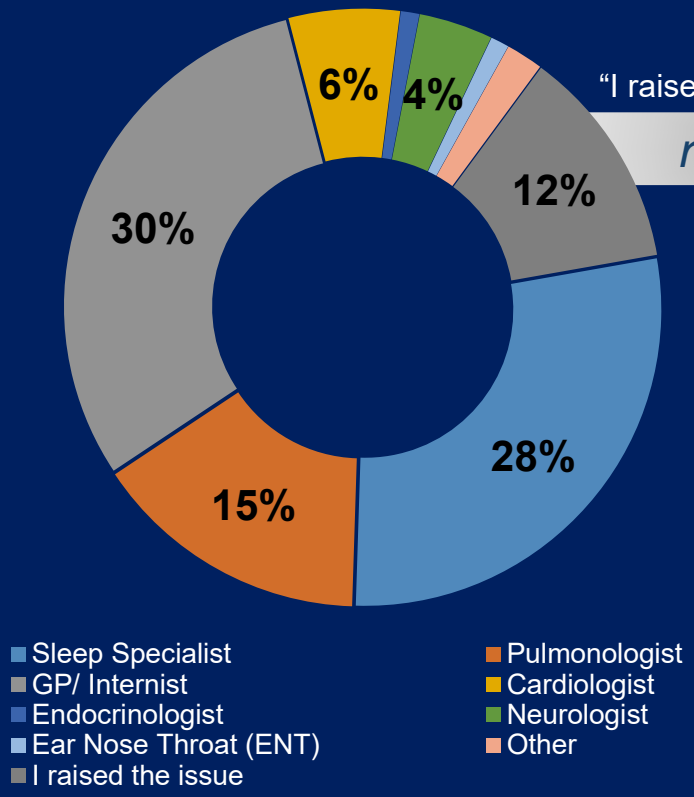


Occupational Status



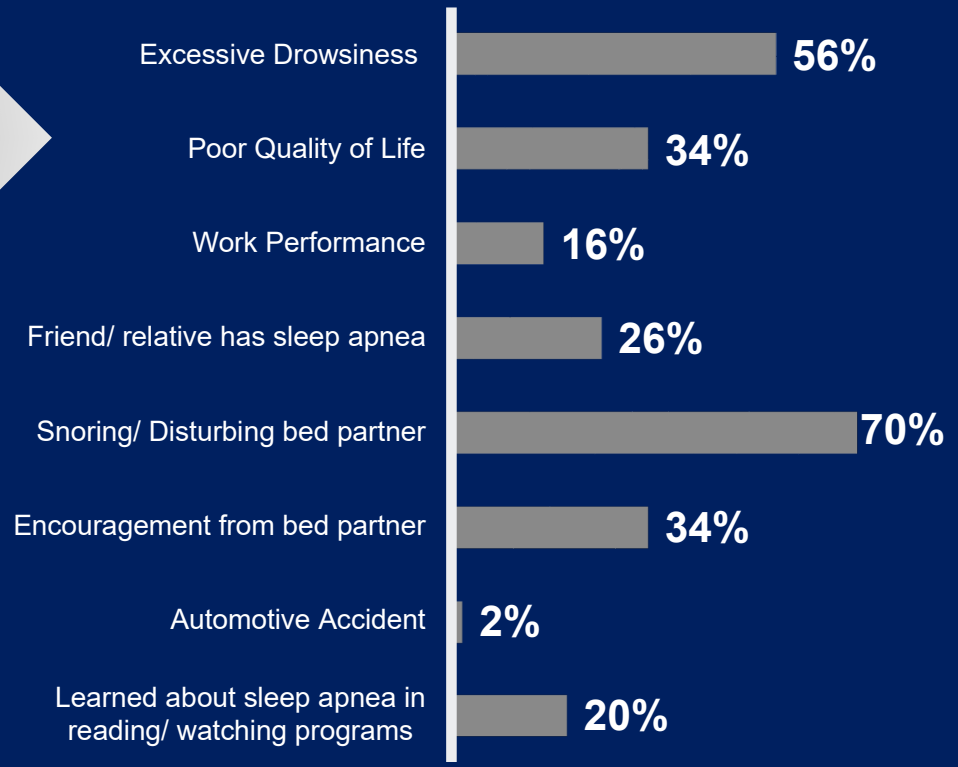
Diagnosis and Treatment

What type of healthcare provider initially warned you about the risk of sleep apnea? ***(n=506)***



(Percentages under 3% not shown for transparency).

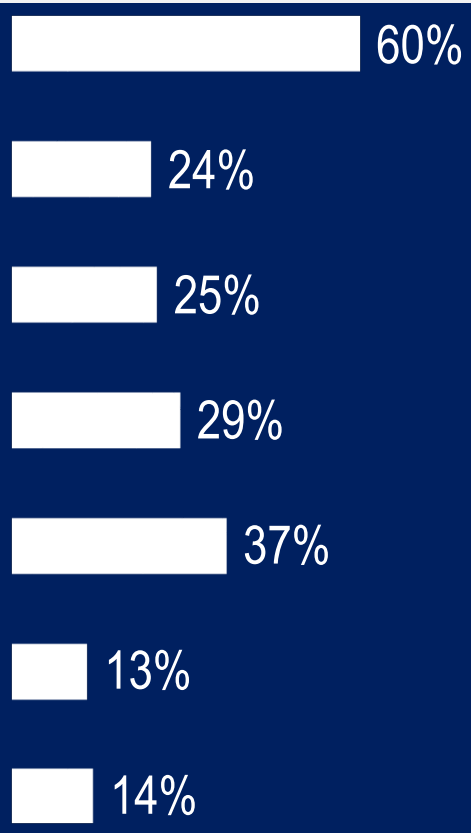
What caused you to raise the issue of your risk of sleep apnea with your healthcare provider? ***(n=61)***



Kapur VK, Auckley DH, Chowdhuri S, Kuhlmann DC, Mehra R, Ramar K, et al. Clinical practice guideline for diagnostic testing for adult obstructive sleep apnea: an American Academy of Sleep Medicine clinical practice guideline. J Clin Sleep Med. 2017;13:479-504.

Sleep Apnea Existing Medical Conditions

Medical Condition	% of respondents
Hypertension *(n=288)*	60%
Diabetes *(n=111)*	24%
Asthma and Other Breathing Problems (COPD, Emphysema, etc.) *(n=122)*	25%
Insomnia *(n=134)*	29%
Depression, Anxiety or Other Mental Health Problems *(n=176)*	37%
Heart Disease *(n=54)*	13%
None of the above *(n=70)*	14%



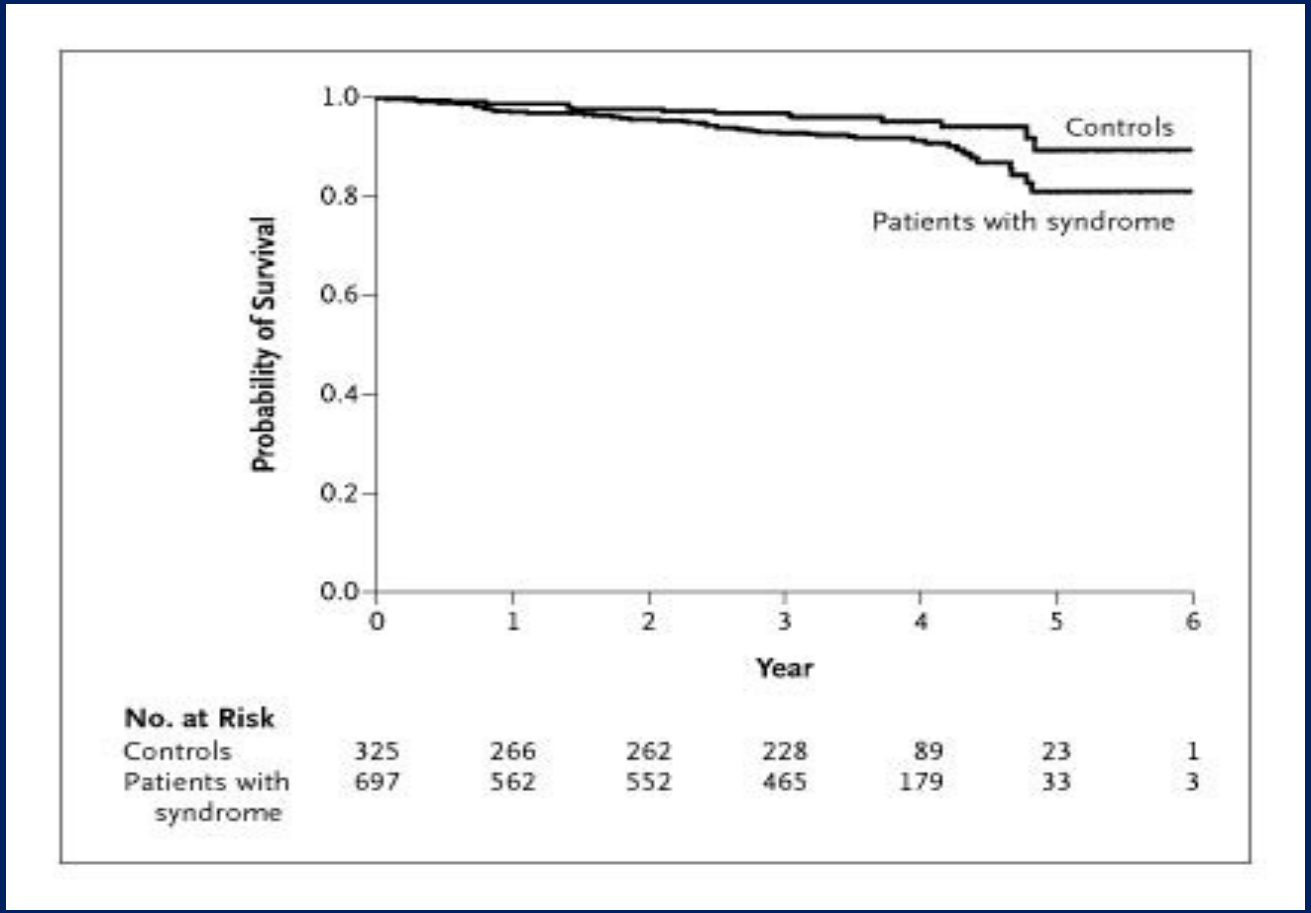
Epstein LJ et al; Adult Obstructive Sleep Apnea Task Force of the American Academy of Sleep Medicine. Clinical guideline for the evaluation, management and long-term care of obstructive sleep apnea in adults. J Clin Sleep Med. 2009;5:263-76. [PMID: 19960649]

OSA Increases Co-Morbid Health Risk

N =1022

Study mean AHI = 35
Control AHI = 2

Results: Stroke or Death from any cause (hazard ratio, 2.24; 95 percent confidence interval, 1.30 to 3.86; P=0.004).



OSA syndrome significantly increases the risk of stroke or death (HR ratio, 2.24) from any cause, and the increase is independent of other risk factors.

H. Klar Yaggi, M.D., M.P.H., John Concato, M.D., M.P.H., et al. N Engl J Med 2005; 353:2034-2041.

Case Question

A 52-year-old is evaluated in follow-up after undergoing surgery weeks ago. The surgical procedure was uncomplicated, but he requires reintubation in the recovery room following to persistent hypoxemia. He was extubated 24 hours later without difficulty.

He is on three medications for high blood pressure. Examination reveals normal temperature and blood pressure of 128/84 mmHg; his heart rate is 78 bpm; respiratory rate is 14; BMI is 38. Oxygen saturation is 97% on room air. The examination is notable for a low-lying soft palate and thick neck. Lungs & cardiac examinations are normal. The surgical incision is healing, and the remainder of the examination is unremarkable.

Which are the following is most appropriate next step in management?

A. Overnight pulse oximetry
B. Polysomnography
C. StopBANG questionnaire
D. No additional testing

Practice guidelines for perioperative management of patients with obstructive sleep apnea: An updated report by the American Society of Anesthesiologist Task Force on Perioperative Management of patients with obstructive sleep apnea. Anesthesiology 2000; 14 (2): 268-286.

Untreated Sleep Patient

- Surgical patients with untreated OSA are more likely to:
  - Develop respiratory complications (hypoxemia, acute respiratory failure, failure to extubate)
  - Be more adversely affected by sedative, hypnotics, muscle relaxants, and sleep aids
  - Develop cardiac arrhythmias, shock and cardiac arrest,
  - Develop neurologic complications (delirium, agitation, confusion, and drowsiness)
  - Have unplanned ICU transfers
  - Longer hospital stays

Gaddam S, Gunukula SK, Mador MJ. Post-operative outcomes in adult obstructive sleep apnea patients undergoing non-upper airway surgery: a systematic review and meta-analysis. Sleep Breath 2014;18(3):615–33.
Kaw R, Pasupuleti V, Walker E, et al. Postoperative complications in patients with obstructive sleep apnea. Chest 2012;141(2):436–41.

Obstructive Sleep Apnea Testing/Diagnosis

- Many patients won't have symptoms
  - > 50% don't have sleepiness
  - Key : the absence of daytime sympotms does not rule out the disease
  - Sleep partners history
    - Snoring & Witness Apnea (PPV 64%)

Epstein LJ et al; Adult Obstructive Sleep Apnea Task Force of the American Academy of Sleep Medicine. Clinical guideline for the evaluation, management and long-term care of obstructive sleep apnea in adults. J Clin Sleep Med. 2009;5:263-76. [PMID: 19960649]

Obstructive Sleep Apnea Testing/Diagnosis

- **Dissatisfied with sleep then…**

- **Screening Tests**

  (All have low quality of evidence)

  - **Epworth Sleepiness Scale**
  - **Berlin Questionnaire (PCP)**
  - **STOP-BANG (Pre-Op)**
  - **Sleep Quality Index**

http://epworthsleepinessscale.com

Screening tool for OSA: STOP-Bang

S	Does the patient **snore** loudly (louder than talking or loud enough to be heard through closed doors)?	Y/N
T	Does the patient often feel **tired**, fatigued, or sleepy during the day?	Y/N
O	Has anyone **observed** the patient stop breathing during their sleep?	Y/N
P	Does the patient have, or is the patient being treated for, high blood **pressure**?	Y/N
B	Does the patient have a **BMI** of more than 35?	Y/N
a	**Age.** Is the patient older than 50?	Y/N
n	Is the patient's **neck** circumference greater than 40cm?	Y/N
g	**Gender.** Is the patient male?	Y/N

Scoring: **Y ≥ 3 = high risk** of OSA
Y < 3 = low risk of OSA

Abrishami A, A systematic review of screening questionnaires. Can J Anaesth. 2010;57:423-38. & Anesthesiology 2008; 108: 812 – 21.
Qaseem A. Clinical Guidelines of OSA. Ann Intern Med 2014; 161: 210 - 220.

Obstructive sleep apnea in general surgery patients: is it more common than we think?

- Three hundred seventy-one (n = 371) patients presenting to the general surgical clinics administered the STOP-Bang questionnaire.
  - Two hundred thirty-seven (64.6%) patients were classified as high risk of OSA in the STOP-Bang questionnaire.
- ONLY, Forty-six (19.4%) SB+ patients had PSG study data with AHI values available for analysis.
  - Severe OSA in 17 (37%)
  - Moderate in 5 (10.9%)
  - Mild in 14 (30.4%)
  - No OSA in 10 (21.7%)
- The positive predictive value and sensitivity of the STOP-Bang questionnaire in detecting OSA of any severity were 76% and 92%, respectively.

Kulkarni GV, Horst A, Eberhardt JM, et al. Obstructive sleep apnea in general surgery patients: is it more common than we think? Am J Surg 2014;207(3):436–40.

Proportion of surgical patients with undiagnosed obstructive sleep apnea

- Patients visiting preoperative clinics were recruited over 4 years and screened with the STOP-BANG questionnaire. N = 1085 patients.
- Those + underwent polysomnography (PSG) (laboratory or portable) before operation.
- Chart review was conducted in this historical cohort to ascertain the clinical diagnosis of OSA by surgeons and anesthesia, blinded to the PSG results.
- The PSG study-identified OSA patients were further classified based on severity using the apnea – hypopnea index (AHI).

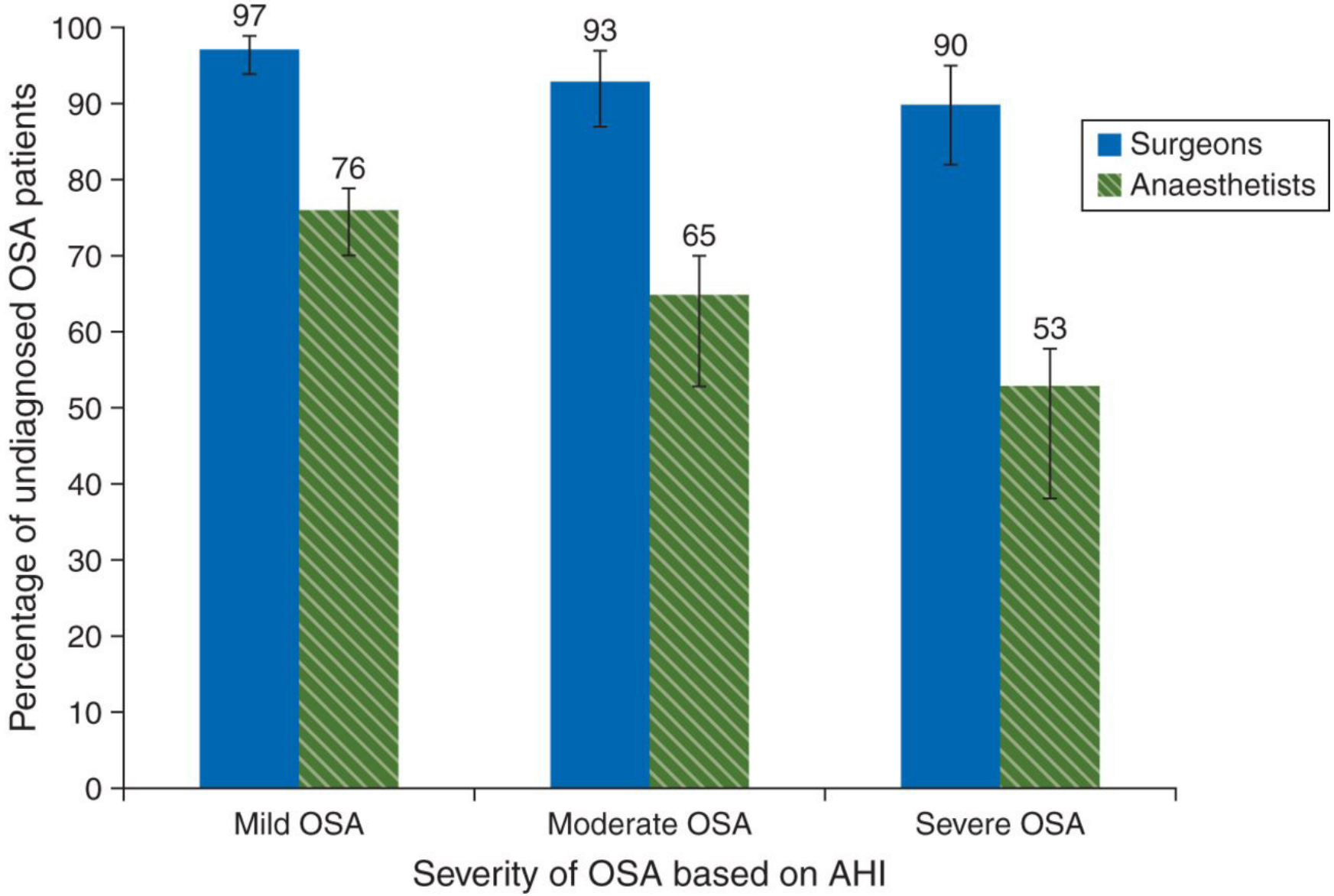
Singh M, Liao P, Kobah S, et al. Proportion of surgical patients with undiagnosed obstructive sleep apnoea. Br J Anaesth 2013;110(4):629–36.

Proportion of surgical patients with undiagnosed obstructive sleep apnea

- Of 819 patients, 111 patients had pre-existing OSA and 58% (64/111) were not diagnosed by the surgeons and 15% (17/111) were not diagnosed by the anesthetists.
- Among the 708 study patients, PSG showed that:
  - 233 (31%) had no OSA,
  - 218 (31%) patients had mild OSA (AHI: 5–15);
  - 148 (21%) had moderate OSA (AHI: 15–30),
  - 119 (17%) had severe OSA (AHI>30).
  - Before operation, of the 267 patients with moderate-to-severe OSA, 92% (*n*=245) and 60% (*n*=159) were not diagnosed by the surgeons and the anesthetists, respectively.

Singh M, Liao P, Kobah S, et al. Proportion of surgical patients with undiagnosed obstructive sleep apnoea. Br J Anaesth 2013;110(4):629–36.

The percentage of undiagnosed OSA cases among the PSG study-identified OSA subjects, according to the severity of OSA (*n*=485). The severity of OSA based on AHI, with mild (AHI >5–15), moderate (AHI >15–30), or severe OSA (AHI >30). The error bars represent the 95% CIs. OSA, obstructive sleep apnea; PSG: polysomnography



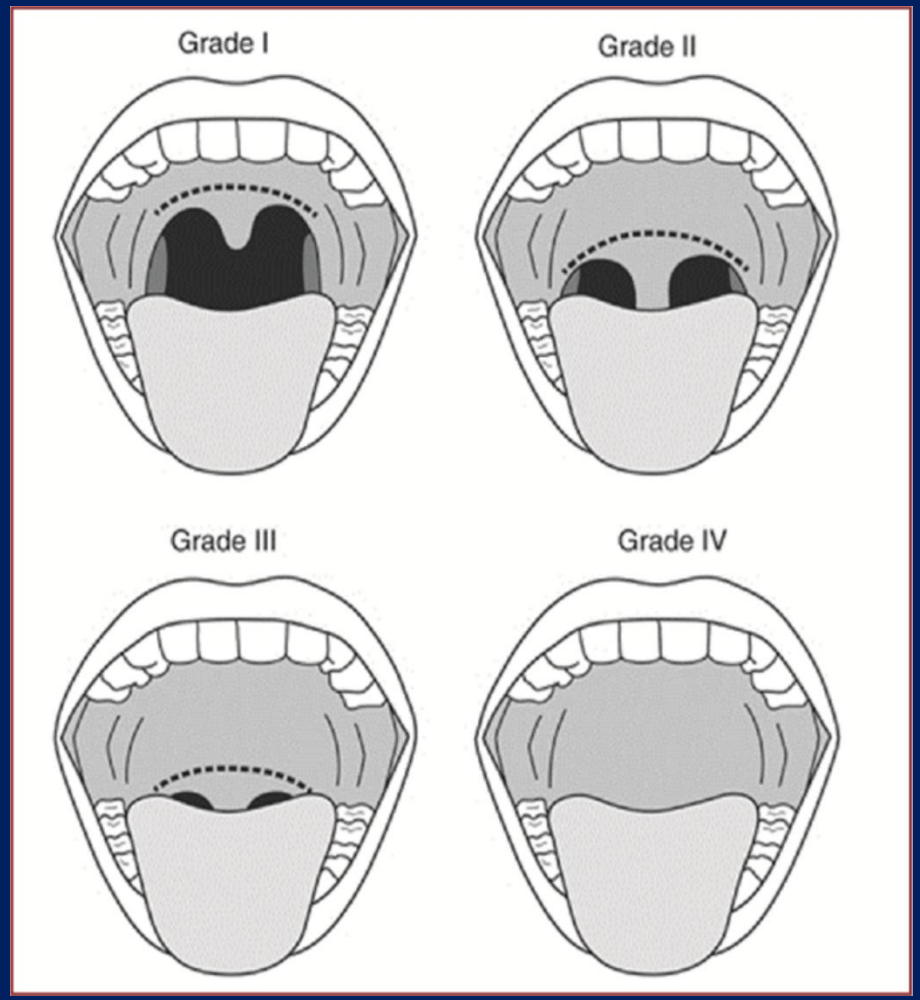
Obstructive Sleep Apnea
Risk Factors

- Age (≥ with age = 50% at 65 years old)
- Gender (♂ 2 -3x ≥♀)
- Post menopausal state (3x risk)
- Family history of sleep apnea
- Overweight & Obesity (neck size, >BMI)
- Upper airway anatomic changes
  - (micrognathia, retrognathia, TMJ, macroglossia)
- Medical Conditions
  - Atrial fibrillation
  - Heart failure (diastolic & systolic)
  - Down's syndrome, thyroid, polycystic ovarian syndrome

Strohl KP, et al; An official American Thoracic Society Clinical Practice Guideline: sleep apnea, sleepiness, and driving risk in noncommercial drivers. Am J Respir Crit Care Med. 2013;187:1259-66. [PMID: 23725615]

Obstructive Sleep Apnea- Risk Factors

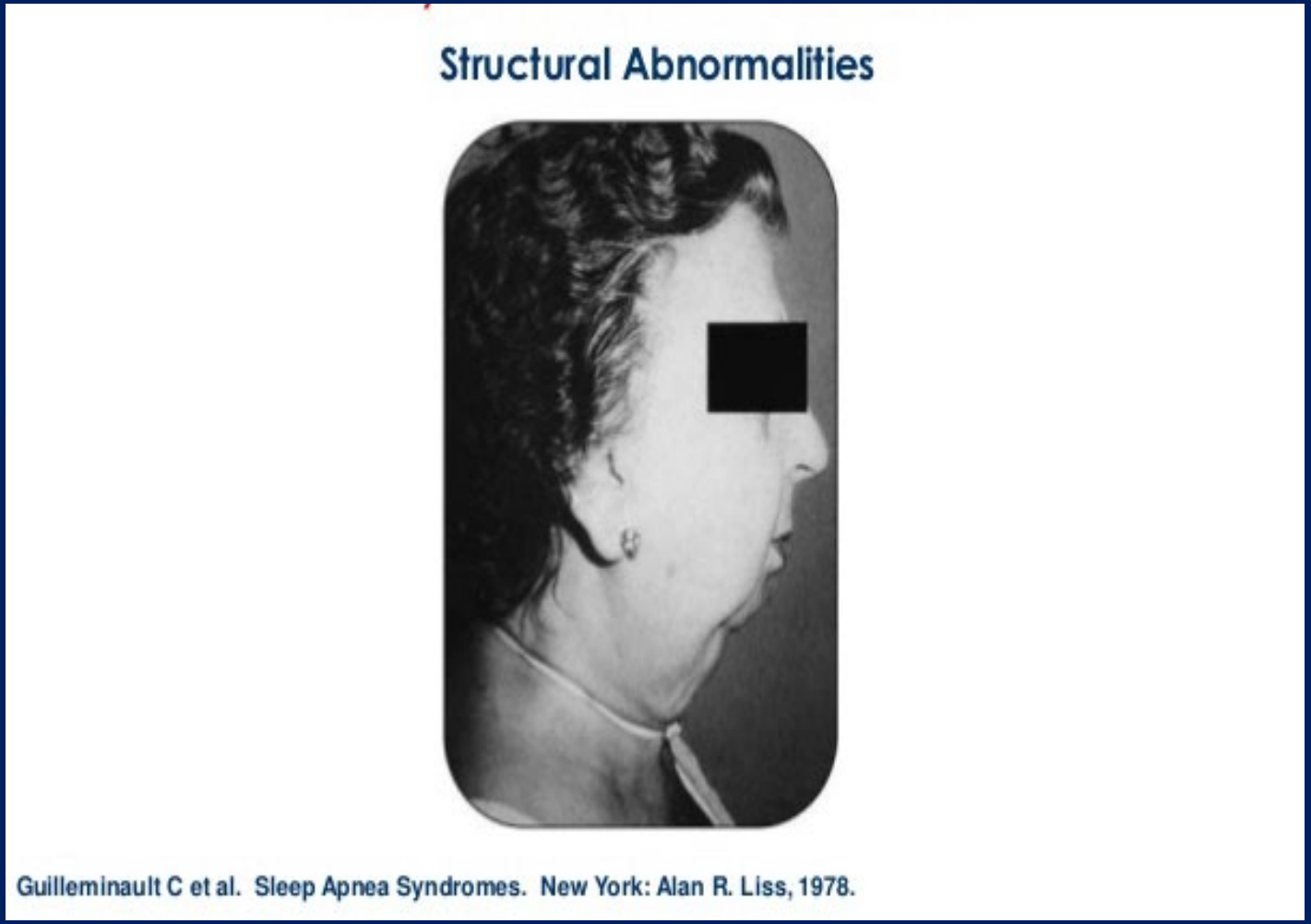
- Airway anatomic changes:
  - Micrognathia,
  - Retrognathia,
  - TMJ,
  - Macroglossia,
  - Neck circumference;
    - ♀ > 17 inches
    - ♂ >16 inches



Modified Mallampati Classification

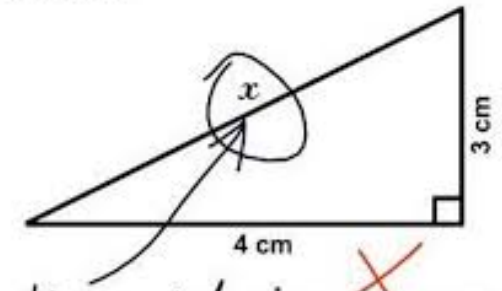
The mouth is evaluated with the patient in a sitting position with higher risk for OSA. Grade I = soft palate, uvula, tonsillar fauces, and pillars visible; grade II = soft palate, uvular, and tonsillar fauces visible; grade III = only soft palate and base of uvula visible; grade IV = only hard palate visible.

Obstructive Sleep Apnea
Physical Examination



Guilleminault C et al. Sleep Apnea Syndromes. New York: Alan R. Liss, 1978.

3. Find x.



Here it is X O

There are 300 students in Year 10. Mary and Mark want to find out Year 10's favourite colour.
Mary asks 30 people.
Mark asks 150 people.
Mark says 'My conclusions are more likely to be reliable than Mary's'.
Why does Mark think he is right?

Because Mark is a man

8. The first cells were probably...?

lonely.

What ended in 1896?

1895

2p 1)Brian has 50 slices of cake. He eats 48. What he has now?

Diabetes. Brian has [illegible] diabetes X

Type I

Obstructive Sleep Apnea Testing/Diagnosis

- Sleep partners history
- Snoring & witness apnea (PPV 64%)

Sleep Case Question

A 30-year-old is evaluated for daytime fatigue for 9 months. He denies falling asleep while driving but falls asleep at other times during the day. He reports no leg symptoms. He has no significant medical history and takes no medications.

On exam: the vital signs are normal, BMI is calculated at 33. Neck circumference is 43 cm (17 inches). Pharynx is normal. The lungs, cardiovascular, & neurologic examinations are unremarkable.

In addition to counseling regarding sleep hygiene & weight loss, which of the following is the most appropriate management in this patient?

A. Advise alcohol abstinence
B. Initiate therapy with zolpidem (Ambien)
C. Order iron studies
D. Referred for polysomnography

Sleep Case Question

A 73 year old man is evaluated for sleep difficulties. He notes unrefreshing sleep that is interrupted by nocturia. He also experiences episodes of dyspnea that awakened him. His normal sleep schedule is 10:30 p.m. to 6:20 a.m. During the week, he feels sleepy during the day and naps for 45 minutes. His medication are Lisinopril, atorvastatin, warfarin, and metoprolol. On physical examination and vital signs are unremarkable.

Which of the following is the most appropriate next step in management?

A. Auto-titrating positive airway pressure (APAP)
B. In-laboratory polysomnography
C. Out-of-center sleep testing
D. Overnight pulse oximetry

Sleep Apnea Syndrome
Diagnostic Testing

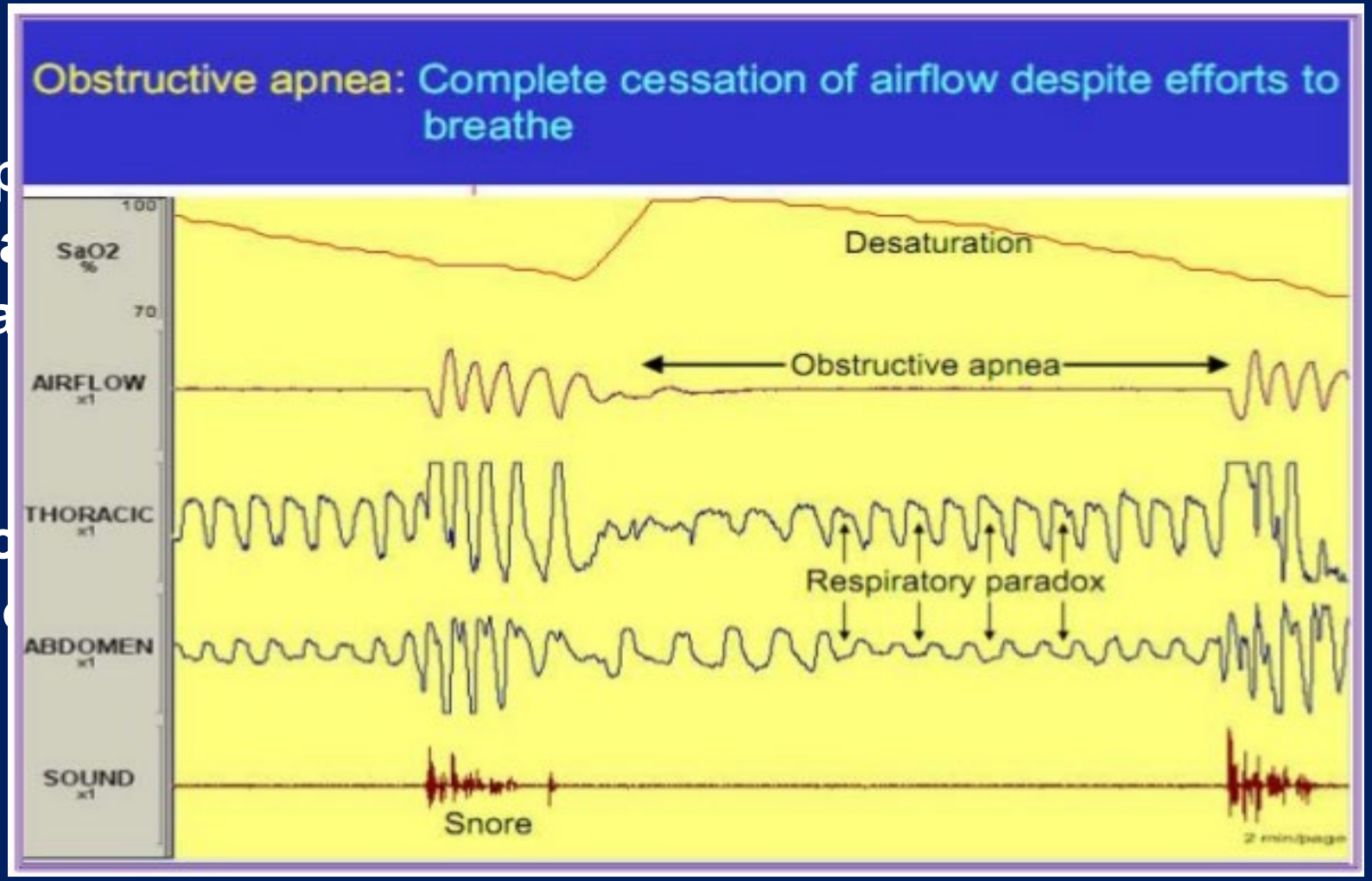
- **Polysomnography / Overnight Sleep Study**
  - Considered the gold standard
  - > 5 events / hour with symptoms
  - > 15 events / hour with or without symptoms

- **Home testing**
  - Becoming more common (economics)
  - Indicated for high clinical suspicion without associate comorbidities (HF, hypoventilation, COPD, stroke)
  - Not for patients with insomnia, RLS, narcolepsy

Kapur VK, Auckley DH, Chowdhuri S, Kuhlmann DC, Mehra R, Ramar K, et al. Clinical practice guideline for diagnostic testing for adult obstructive sleep apnea: an American Academy of Sleep Medicine clinical practice guideline. J Clin Sleep Med. 2017;13:479-504. PMID: 28162150 doi:10.5664/jcsm.6506

Types of Sleep Apnea
Obstructive apnea

- **Obstructive**
  - Prevalence is ap
  - As common as a
  - Increases with a
- **Central**
  - Is the absence o
  - Strong correlati
- **Mixed**



Sleep Case Question

A 60-year-old is evaluated for 3 month history of loud snoring and "gasping" during sleep. He frequently falls asleep in a chair while reading. Examination reveals a blood pressure of 135/90 mmHg. BMI is 38, neck circumference is 45.7 cm (18 inches), he has a low-lying soft palate.

Polysomnography discloses severe obstructive sleep apnea with an apnea index of 44 per hour. (normal <5 per hour) ***Which of the following is the most appropriate treatment?***

A. Continuous positive airway pressure
B. Nocturnal oxygen therapy
C. Oral dental appliance
D. Upper airway surgery

Gottlieb DJ, et al. CPAP versus oxygen in obstructive sleep apnea. N Engl J Med 2014; 370: 2276-2285.
Chirinos JA, et al. CPAP, weight loss, or both for obstructive sleep apnea. N Engl J Med 2014; 370 2265-2275.

Sleep Apnea
Treatment Options

- Avoidance of alcohol, sedatives & narcotics
- Position therapy
  - Works only in combination
- Weight loss (watch this answer)
- Continuous Positive Airway Pressure (CPAP)
- Oral Appliance
  - PAP more effective
  - Best for obstructive & mild disease
- Surgery (UPPP, Maxillary Advancement)
- Hypoglossal nerve stimulator

Morgenthaler TI, et al; Standards of Practice Committee. Practice parameters for the medical therapy of obstructive sleep apnea. Sleep. 2006;29:1031-5.
Sommer JU, Kraus M, Birk R, Schultz JD, Hörmann K, Stuck BA. Functional short- and long-term effects of nasal CPAP with and without humidification on the ciliary function of the nasal respiratory epithelium. Sleep Breath. 2014;18:85-93.

Post Operative Management

- The effects of sedative, analgesic (specifically opioids), and anesthetic agents can worsen OSA.

  - Mechanisms associated with this are:
    - worsening or reduced pharyngeal tone
    - worsening or reduced arousal response to hypoxemia
    - worsening or reduced arousal response to hypercarbia
    - worsening airway obstruction
    - increased upper airway resistance

Boushra NN. Anaesthetic management of patients with sleep apnea syndrome. Can J Anaesth 1996;43(6):599–616. 47.
Loadsman JA, Hillman DR. Anesthesia and sleep apnea. Br J Anaesth 2001; 86(2):254–66.

Post Operative Recommendations

- Use of pre/post operative opioids must be balanced.
  - Expert opinion regarding risk of basal opioid infusion is equivocal.*
  - Epidural and intrathecal techniques using MSO_4 can be used safely with monitoring.**
  - Alternative medications
    - NSAIDs and acetaminophen to minimized use of narcotics
    - Use of α-agonist
    - Non pharmacological use of transcutaneous nerve stimulations (TENS)

*Gross JB, Bachenberg KL, Benumof JL, et al. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: a report by the American Society of Anesthesiologists Task Force on Perioperative Management of patients with obstructive sleep apnea. Anesthesiology 2006;104(5):1081–93.

**Zotou A, Siampalioti A, Tagari P, et al. Does epidural morphine loading in addition to thoracic epidural analgesia benefit the postoperative management of morbidly obese patients undergoing open bariatric surgery? A pilot study. Obes Surg 2014;24(12):2099–108.

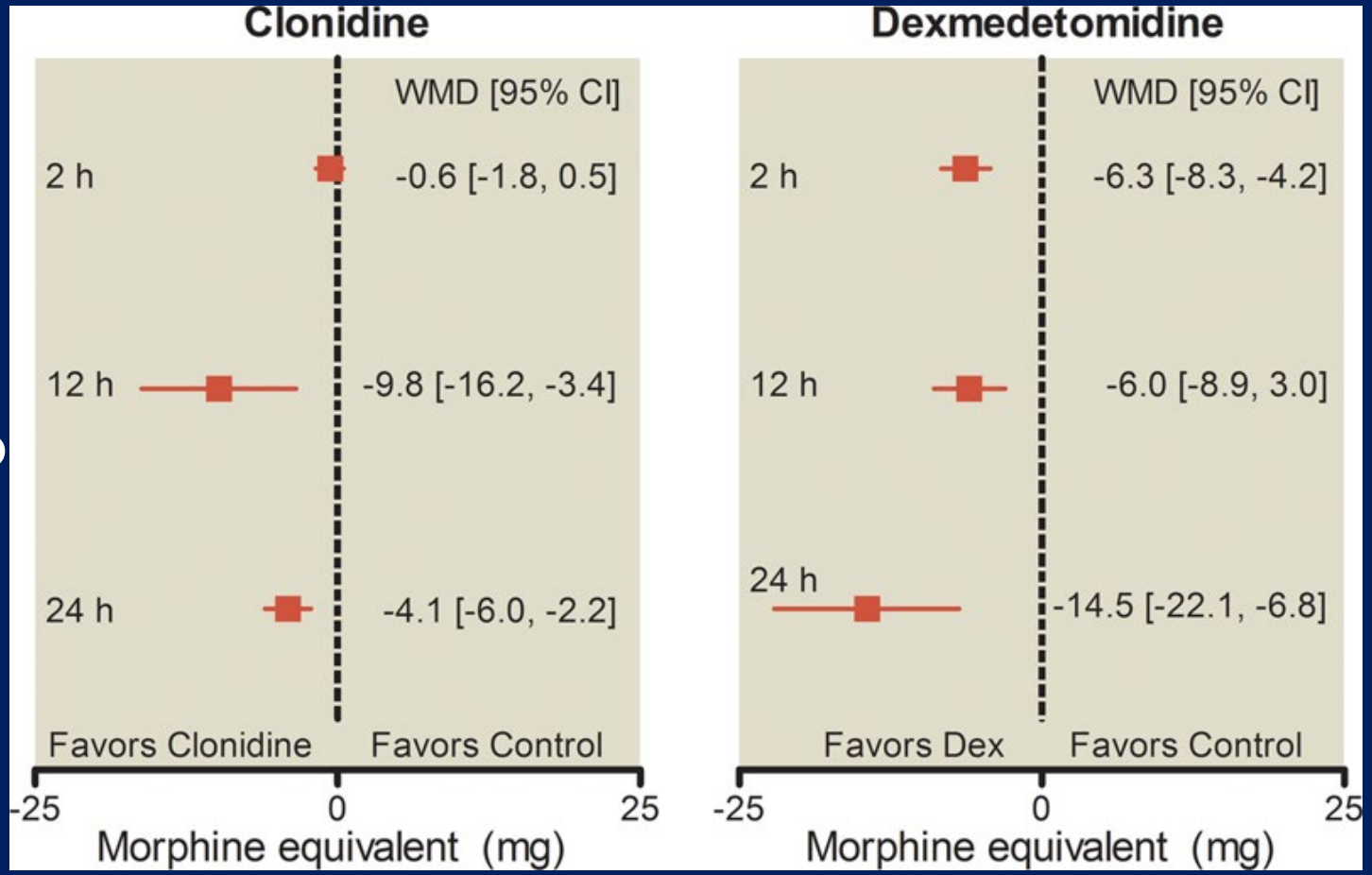
Effect of Perioperative Systemic α2 Agonists on Postoperative Morphine Consumption and Pain Intensity: Systematic Review and Meta-analysis of Randomized Controlled Trials

- Alpha (α2) agonists were tested, clonidine (19 studies) and Dexmedetomidine (11 studies).
- None tested these two drugs in a head-to-head comparison.
- Routes of administration were intravenous as boluses or continuous infusions (20 studies) or oral (10); in two studies, a transdermal therapeutic system also was used.
  - α2 Agonists were given before (10 studies), during (6), or after surgery (4) or throughout the perioperative period (10).
  - Because of multiple administration regimens, cumulative doses of clonidine or dexmedetomidine could not be estimated; thus, we were unable to test for dose responsiveness.

Tan M, Law LS, Gan TJ. Optimizing pain management to facilitate enhanced recovery after surgery pathways. Can J Anaesth 2014;62(2):203–18. 51. Blaudszun G, Lysakowski C, Elia N, et al. Effect of perioperative systemic alpha2 agonists on postoperative morphine consumption and pain intensity: systematic review and meta-analysis of randomized controlled trials. Anesthesiology 2012; 116(6):1312–22.

Effect of Perioperative Systemic α2 Agonists on Postoperative Morphine Consumption and Pain Intensity: Systematic Review and Meta-analysis of Randomized Controlled Trials

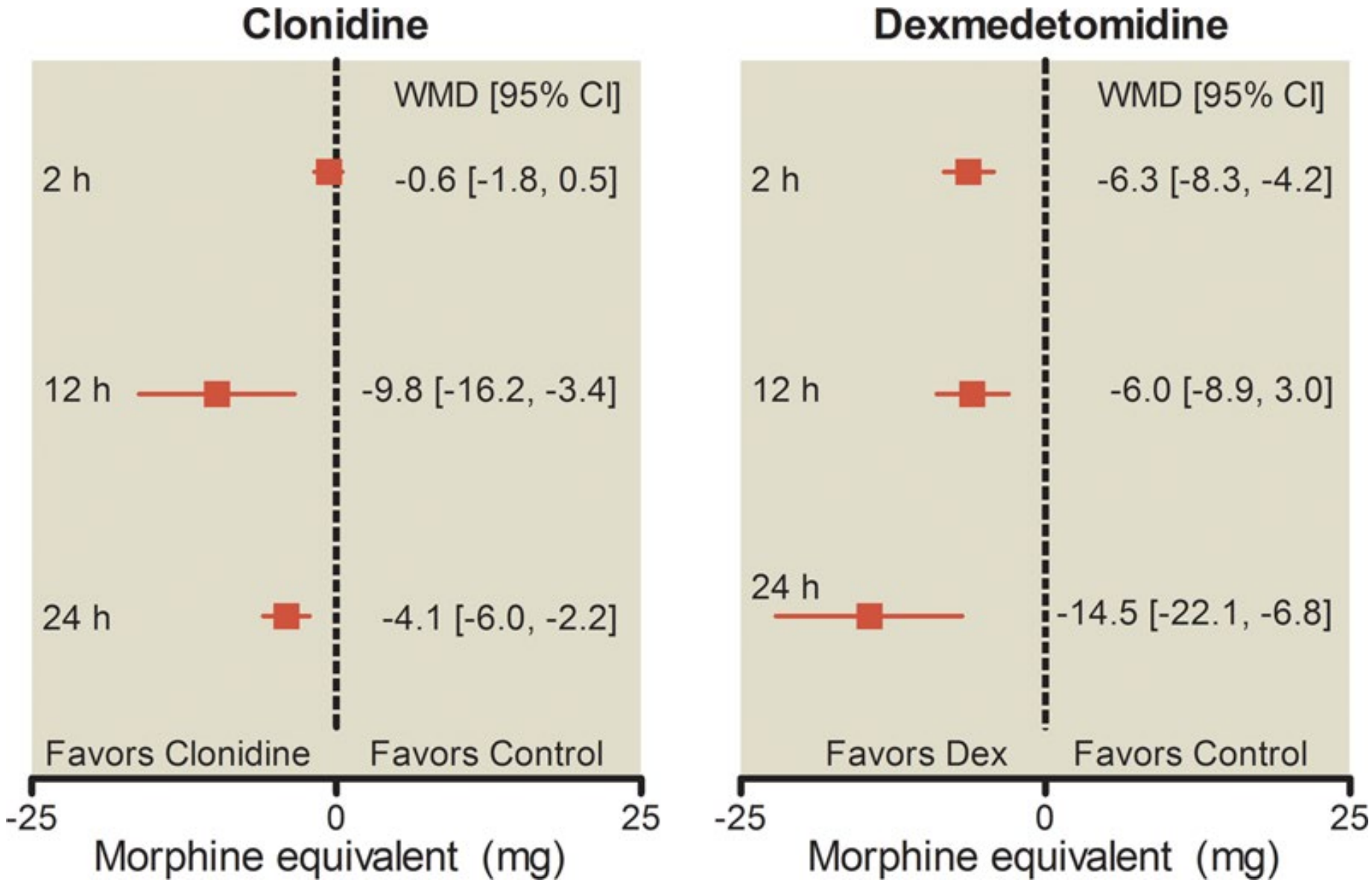
- Postoperative morphine-sparing.
- Doses of opioids other than morphine were converted to morphine equivalents



Dex = dexmedetomidine;
WMD = weighted mean difference.

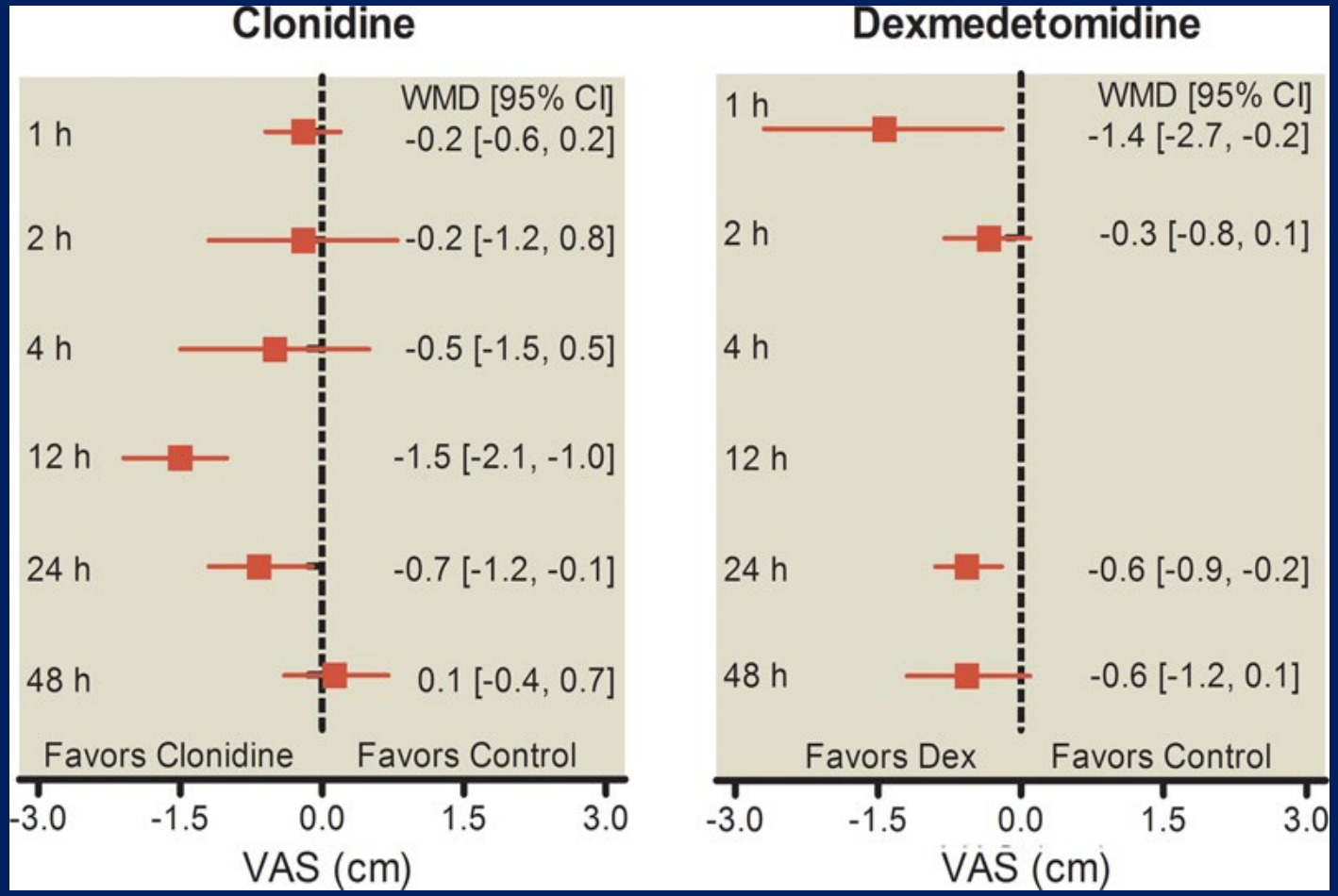
Tan M, Law LS, Gan TJ. Optimizing pain management to facilitate Enhanced Recovery After Surgery pathways. Can J Anaesth 2014;62(2):203–18. 51. Blaudszun G, Lysakowski C, Elia N, et al. Effect of perioperative systemic alpha2 agonists on postoperative morphine consumption and pain intensity: systematic review and meta-analysis of randomized controlled trials. Anesthesiology 2012; 116(6):1312–22.

Postoperative morphine-sparing. Doses of opioids other than morphine were converted to morphine equivalents. Dex = dexmedetomidine; WMD = weighted mean difference.



Effect of Perioperative Systemic α2 Agonists on Postoperative Morphine Consumption and Pain Intensity: Systematic Review and Meta-analysis of Randomized Controlled Trials

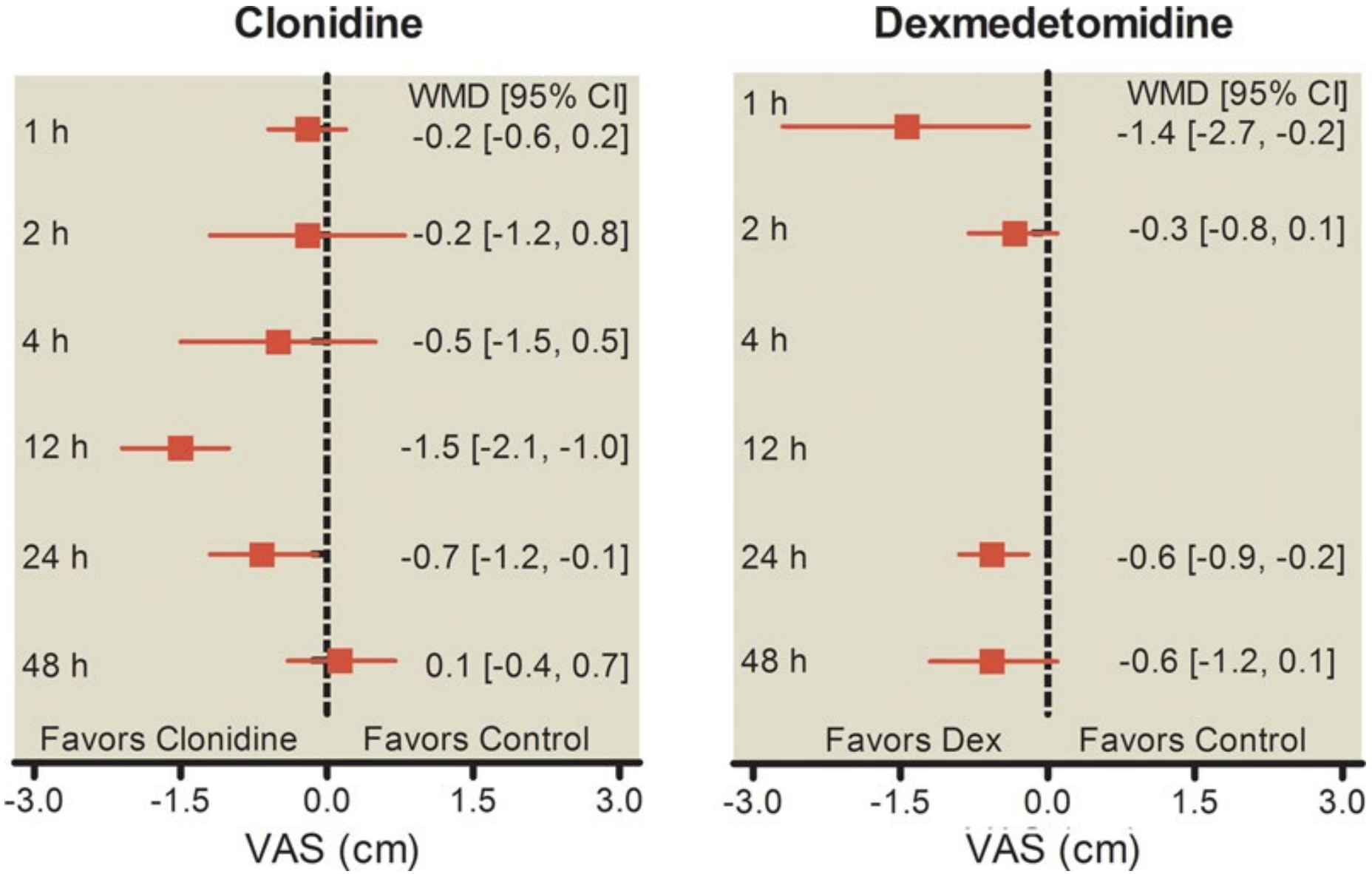
- Postoperative pain intensity.
- VAS = 0 –10 cm visual analog scale;
- WMD = weighted mean difference.



Dex = dexmedetomidine;
WMD = weighted mean difference.

Tan M, Law LS, Gan TJ. Optimizing pain management to facilitate enhanced recovery after surgery pathways. Can J Anaesth 2014;62(2):203–18. 51. Blaudszun G, Lysakowski C, Elia N, et al. Effect of perioperative systemic alpha2 agonists on postoperative morphine consumption and pain intensity: systematic review and meta-analysis of randomized controlled trials. Anesthesiology 2012; 116(6):1312–22.

Postoperative pain intensity.
Dex = dexmedetomidine; VAS = 0–10 cm visual analog scale; WMD = weighted mean difference.



Post Op Management of Suspected or Confirmed Obstructive Sleep Apnea

- Admission to monitor cardiopulmonary status
- Titrate oxygen to maintain saturations >90% but < 95%
- Minimize use of systemic opioid analgesics and sedatives
- Use alternative pharmacology. (NSAIDs, Tramadol)
- Non pharmacological. (i.e., Ice TENS, regional analgesics)
- NIPPV in the post-op period using patients own mask/equipment
- Avoid supine position, elevated HOV > 30 degrees
- Consider continuous capnography monitoring to identify hypoventilation

Qaseem A, Holty JE, Owens DK, et al. Management of obstructive sleep apnea in adults: a clinical practice guideline from the American College of Physicians. Ann Intern Med. 2014; 161:210-220.
Gross JB, Bachenberg KL, Benumof JL, et al. Practice guidelines for the perioperative management of patients with obstructive sleep apnea: a report by the American Society of Anesthesiologists Task Force on Perioperative Management of patients with obstructive sleep apnea. Anesthesiology 2006;104(5):1081–93.
Gammon BT, Ricker KF. An evidence-based checklist for the postoperative management of obstructive sleep apnea. J Perianesth Nurs 2012;27(5):316–22.
Boushra NN. Anesthetic management of patients with sleep apnea syndrome. Can J Anaesth 1996;43(6):599–616.

Application of Positive Pressure Devices

- Fewer than 20% of patients with a diagnosis of OSA received CPAP therapy.*
- The efficacy of CPAP in patients without a diagnoses of OSA is well-established. **
  - The results of this meta-analysis support that CPAP should be used immediately after development of postoperative hypoxemia, applied for at least 6 hours, and interrupted only when a normal oxygenation (i.e., an arterial oxygen tension-to inspiratory oxygen fraction ratio < 300) is established.

* Memtsoudis S.G., Besculides M.C., Mazumdar M. A rude awakening the perioperative sleep apnea epidemic. N Engl J Med. 2013;368(25):2352–2353.

** Ferreyra G.P., Baussano I., Squadrone V. Continuous positive airway pressure for treatment of respiratory complications after abdominal surgery: a systematic review and meta-analysis. Ann Surg. 2008;247(4):617–626.

Elective surgery
General anesthesia
Viscera exposure > 90 minutes.
Evaluated 1 hour post op if Pa/FiO_2 < 300 :

N= 1322

Exclusion

< 18 yr /old > 8o yr/old
NYHC II,III, IV / Valvular disease
Pacer in situ
MI/USA or CABG within 3 months
COPD / Asthma
Sleep disorder /OSA
BMI > 40
Facial, Neck or Chest wall deformity
pH < 7.30 or $PaCO_2$ > 50 mmHg
BP < 90 after surgery
Hb < 7 g/dL
Cr > 3.5 mg/dL
GCS < 12

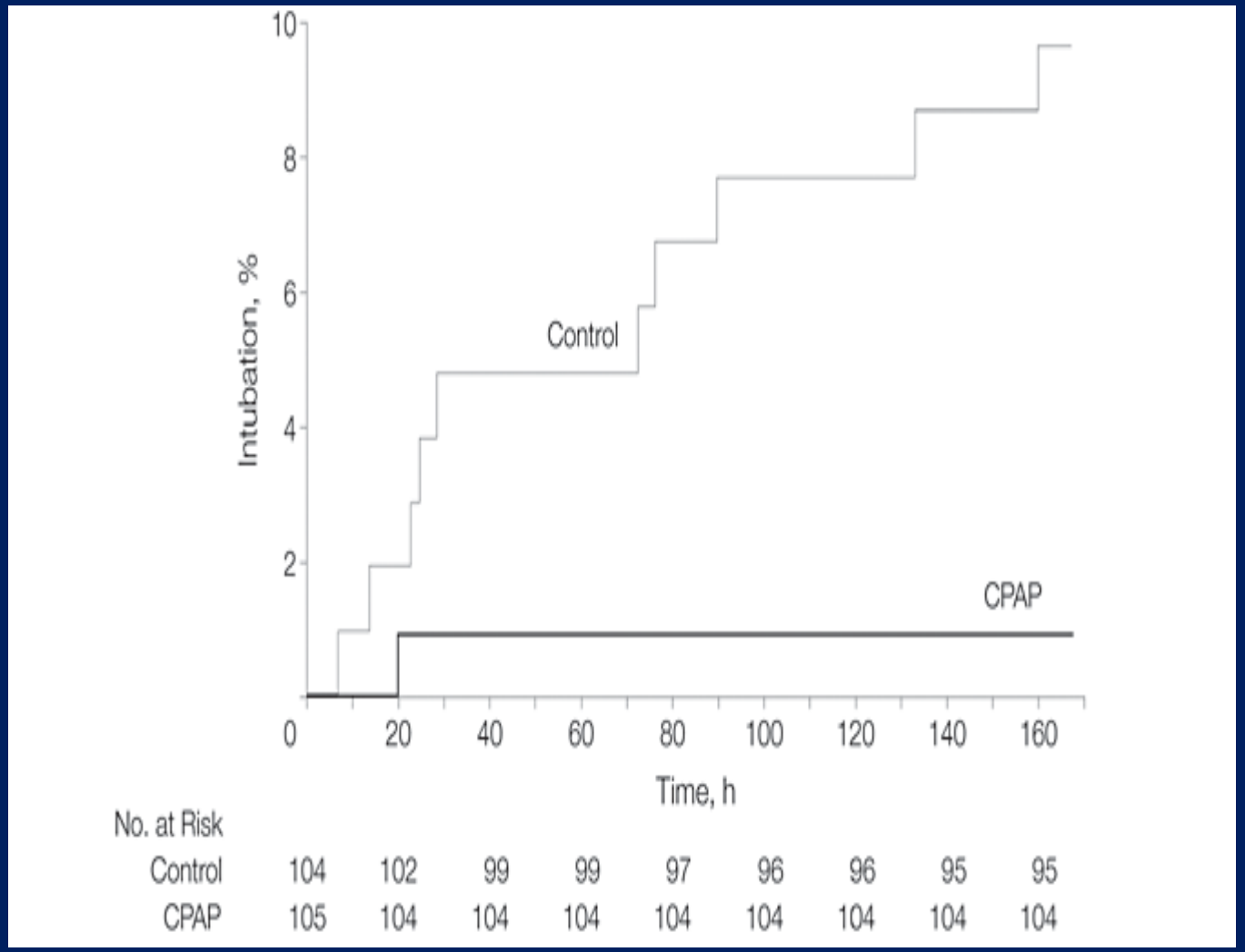
209 Randomized
Post op Criteria

N= 104
Oxygen (Control)
Venturi Mask

N =105
CPAP 7.5 cmH_20

Rx = 6 hours post op

O_2 + Continuous positive airway pressure had a lower intubation rate (1% vs 10%; *P* = .005; relative risk [RR], 0.099; 95% confidence interval [CI], 0.01-0.76)



Squadrone V., Coha M., Cerutti E. Continuous positive airway pressure for treatment of postoperative hypoxemia: a randomized controlled trial. JAMA. 2005;293(5):589–595.

CPAP for Postoperative Hypoxemia without OSA

- Patients who received oxygen plus continuous positive airway pressure (CPAP) had:
  - A lower intubation rate (1% vs 10%; *P* = .005)
  - A lower occurrence rate of pneumonia (2% vs 10%; *P* = .02)
  - A lower infection rate (3% vs 10%; *P* = .03)
  - A lower rate of sepsis. (2% vs 9%; *P* = .03)

Squadrone V., Coha M., Cerutti E. Continuous positive airway pressure for treatment of postoperative hypoxemia: a randomized controlled trial. JAMA. 2005;293(5):589–595.

Application of Positive Pressure Devices

- **Fewer than 20% of patients with a diagnosis of OSA received CPAP therapy.***
- **The efficacy of CPAP in patients with a diagnoses of OSA is ALSO well-established. ****

* Memtsoudis S.G., Besculides M.C., Mazumdar M. A rude awakening the perioperative sleep apnea epidemic. N Engl J Med. 2013;368(25):2352–2353.

**Chung F, Nagappa M, Singh M, Mokhlesi B. CPAP in the Perioperative Setting: Evidence of Support. *Chest*. 2016;149(2):586-597.

Effect of CPAP on Postoperative Outcomes in Surgical Patients With OSA

Author	Study Type	No.	Results
Rennotte et al, 1995	Case series report No-CPAP vs CPAP	N=16	No-CPAP vs CPAP: 2 vs 14 First patient died; second patient: serious postop Cx. 14 patients nasal CPAP Rx, no Cx
Liao et al, 2013	RCT	N=177	No-APAP vs APAP: 90 vs 87 Postoperative Cx: 48.3% vs 48.3% (*P* = .939) Preoperative AHI vs postoperative AHI (NS) APAP: 30.1 to 3.0 (*P* < .001) No-APAP: 30.4 to 31.9 (*P* = .302) Hospital stay: 4.3 ± 5.5 vs 3.5 ± 6.2 days (*P* = .36)
O'Gorman et al, 2013	RCT	N=137	No-APAP vs APAP Any Cx: 20.9% vs 23.3% (*P* = 1.0) No significant difference between LOS (*P* = .65)

AHI = apnea hypopnea index; aOR = adjusted odds ratio; APAP = autotitrated positive airway pressure; BiPAP = bilevel positive airway pressure; Cx = complications; LOS = length of hospital stay; NS = not significant; RCT = randomized controlled trial; Rx = treated; S_PO_2 = oxygen saturation; STOP-Bang = snoring, tired, observed, pressure, BMI, age > 50 years, neck size large, gender

Additional Studies That Supported the Use of CPAP in Surgical Patients With OSA

Author(s)	Study Type & Surgical Procedure	No.	Result
Ramirez et al, 2009	Retrospective review Roux-en-Y gastric bypass	310	Postoperative CPAP vs no-CPAP: 91 vs 219 Basal atelectasis: 3.3% vs 1.8% ($P > .05$) Wound infection: 4.4% vs 0.4% ($P > .05$) GI bleeding: 0% vs 0.4% (NS) Overall morbidity: 4.5% vs 3.6% ($P > .05$)
Hallowell et al, 2007	Retrospective review Bariatric surgery	890	Selective OSA testing (1998-2003) vs mandatory OSA testing and perioperative CPAP Rx (2004-2005) Respiratory-related ICU stay 34% vs 9% ($P < .001$)

Prospective Clinical Trials of PAP Therapy in Surgical Patients With Undiagnosed OSA or Untreated OSA

- Starting treatment with auto-titrating positive airway pressure (APAP) can be as effective as CPAP treatment with PSG titration.
- Because of possible fluid shifts, supine body position, and sedative effects of residual anesthetics and narcotics, a single fixed CPAP pressure setting may not be equally effective in the perioperative environment.

Masa J.F., Jiménez A., Durán J. Alternative methods of titrating continuous positive airway pressure: a large multicenter study. Am J Respir Crit Care Med. 2004;170(11):1218–1224.

Mulgrew A.T., Fox N., Ayas N.T., Ryan C.F. Diagnosis and initial management of obstructive sleep apnea without polysomnography: a randomized validation study. Ann Intern Med. 2007;146(3):157–166.

Kushida C.A., Berry R.B., Blau A. Positive airway pressure initiation: a randomized controlled trial to assess the impact of therapy mode and titration process on efficacy, adherence, and outcomes. Sleep. 2011;34(8):1083–1092.

Prospective Clinical Trials of Auto-PAP Therapy in Surgical Patients With Undiagnosed OSA or Untreated OSA

Feature	Guralnick et al, 2012 (n = 211)	Liao et al, 2013 (n = 177)	O'Gorman et al, 2013 (n = 138)
Study type	Retrospective observational study	RCT	RCT
Study objective	CPAP adherence during perioperative period	Effect of APAP on AHI and oxygenation	Effect of APAP on hospital stay and postoperative Cx
Timing of APAP	CPAP started preoperatively, followed for adherence postoperatively	3 days preoperatively and 5 days postoperatively	APAP started in PACU and during night and whenever patient sleeps
Study outcome	Median CPAP adherence 2.5 h/night Optimal pressure 9 ± 2 cm H_2O	APAP adherence 45% Preoperative AHI vs postoperative AHI (NS) APAP: 30.1 to 3.0 (*P* < .001) No-APAP: 30.4 to 31.9 (*P* = .302)	Any complications: 20.9 vs 23.3% (*P* = 1.0) LOS median, 5 vs 4 days; *P* = .02
Duration of APAP during first night after surgery	NA	4.1 ± 5.3 h	6.2 h (1.3-9.3 h)
PAP adherence (per night)	Median 2.5 h/night (0.7-4.5)	0-3.8 h/night, mean 2.4-4.6 h/night	3.0 h (1.0-7.5 h/night)

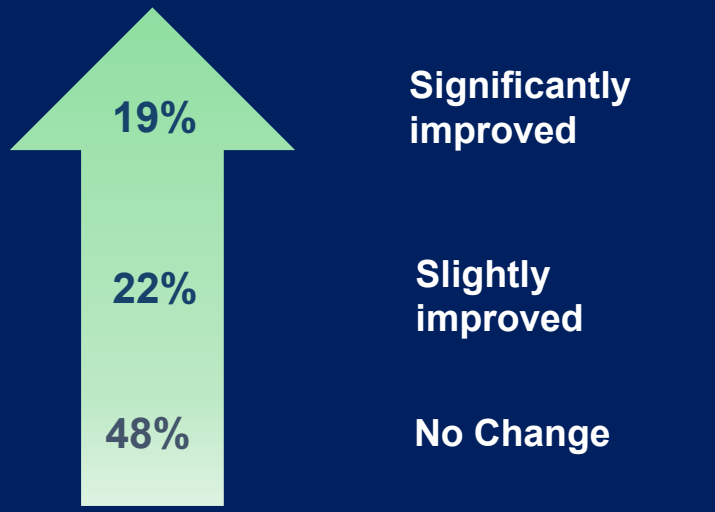
Sleep Apnea: The Bottom Line

- OSA is common, yet underdiagnosed & undertreated.
- Know the risk factors. > 50 % don't have symptoms "I sleep fine."
- Overnight Polysomnography remains the standard, with portable (home) testing = no comorbidities.
- Most patient with continued sleepiness on CPAP are noncompliant, gained weight or are sleep deprived.
- Pre Op STOPBANG questionnaire is useful.
  - Post op treatment needs to be:
    - Immediate,
    - Consider Auto PAP,
    - Treatment should continued for about 6 hours or till $Pa/FiO_2 > 300$
    - Consider use of clonidine, Precedex or non-pharmacological treatments.

Impact of Treatment on Patients with Comorbidities

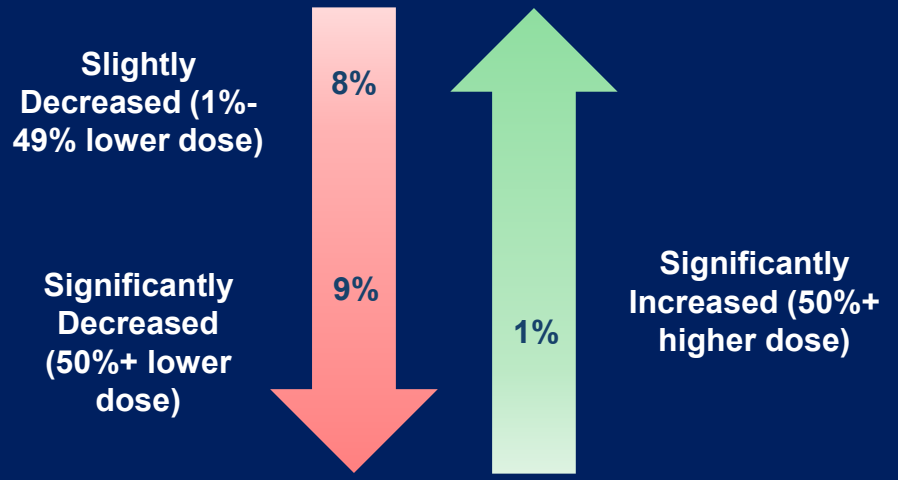
Blood Pressure Improvement and Medication Usage Before and after sleep apnea treatment

Change in Blood Pressure following OSA treatment



Do not remember	11%

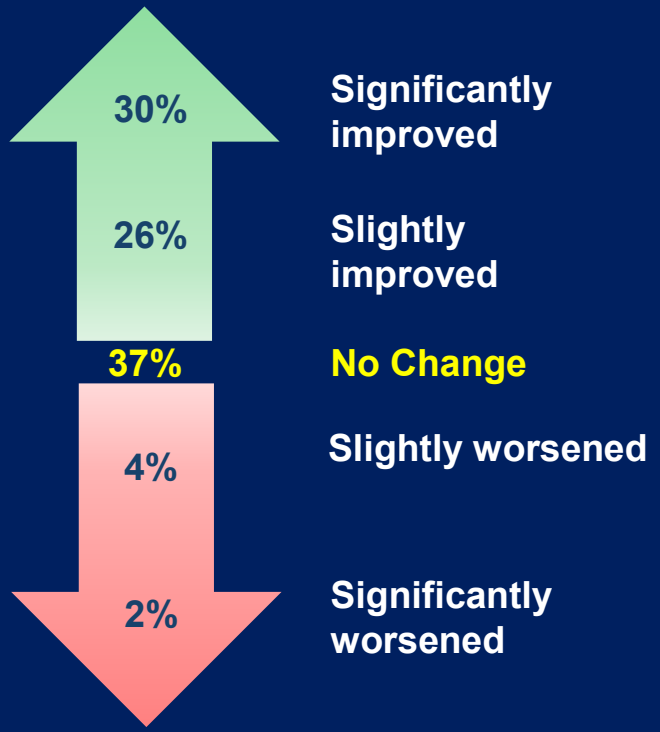
Change in Blood Pressure Medication following 1 year of OSA treatment



Began medication after treatment started	4%
Have never taken medication	3%
No Change	65%
Stopped taking medication after change	3%

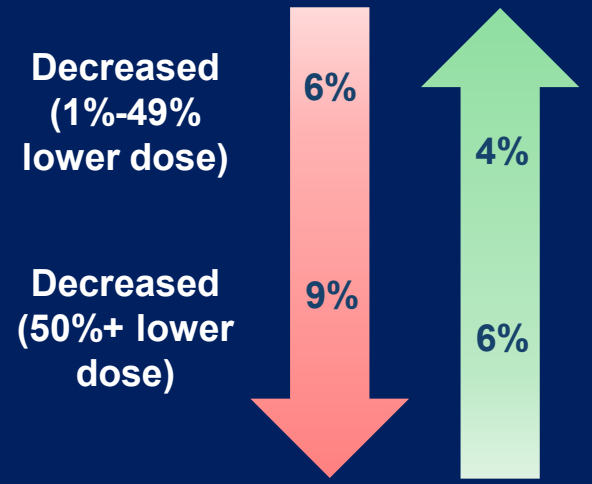
Heart Disease Improvement and Medication Usage Before and after sleep apnea treatment

Change in Heart Disease Following OSA Treatment



Do not remember	2%

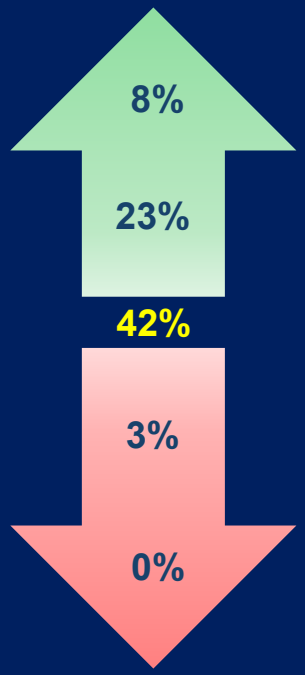
Change in Heart Disease Medication Usage After 1 year of OSA Treatment



Began medication after treatment started	4%
Have never taken medication	17%
No Change	54%
Stopped taking medication after change	2%

Diabetes Improvement and Medication Usage
Before and after sleep apnea treatment

Change in hemoglobin A1C test score following OSA treatment



Significantly improved

Slightly improved

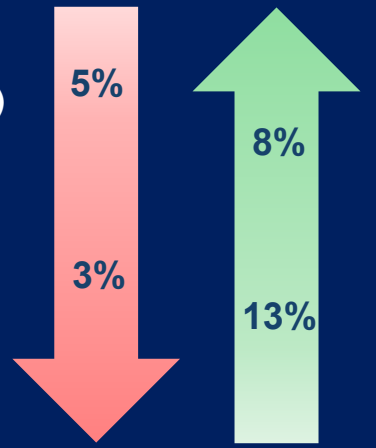
No Change

Slightly worsened

Significantly worsened

Do not remember	23%

Change in diabetes medication usage 1 year after OSA treatment



Decreased (1%-49% lower dose)

Decreased (50%+ lower dose)

Increased (50%+ higher dose)

Increased (1%-49% higher dose)

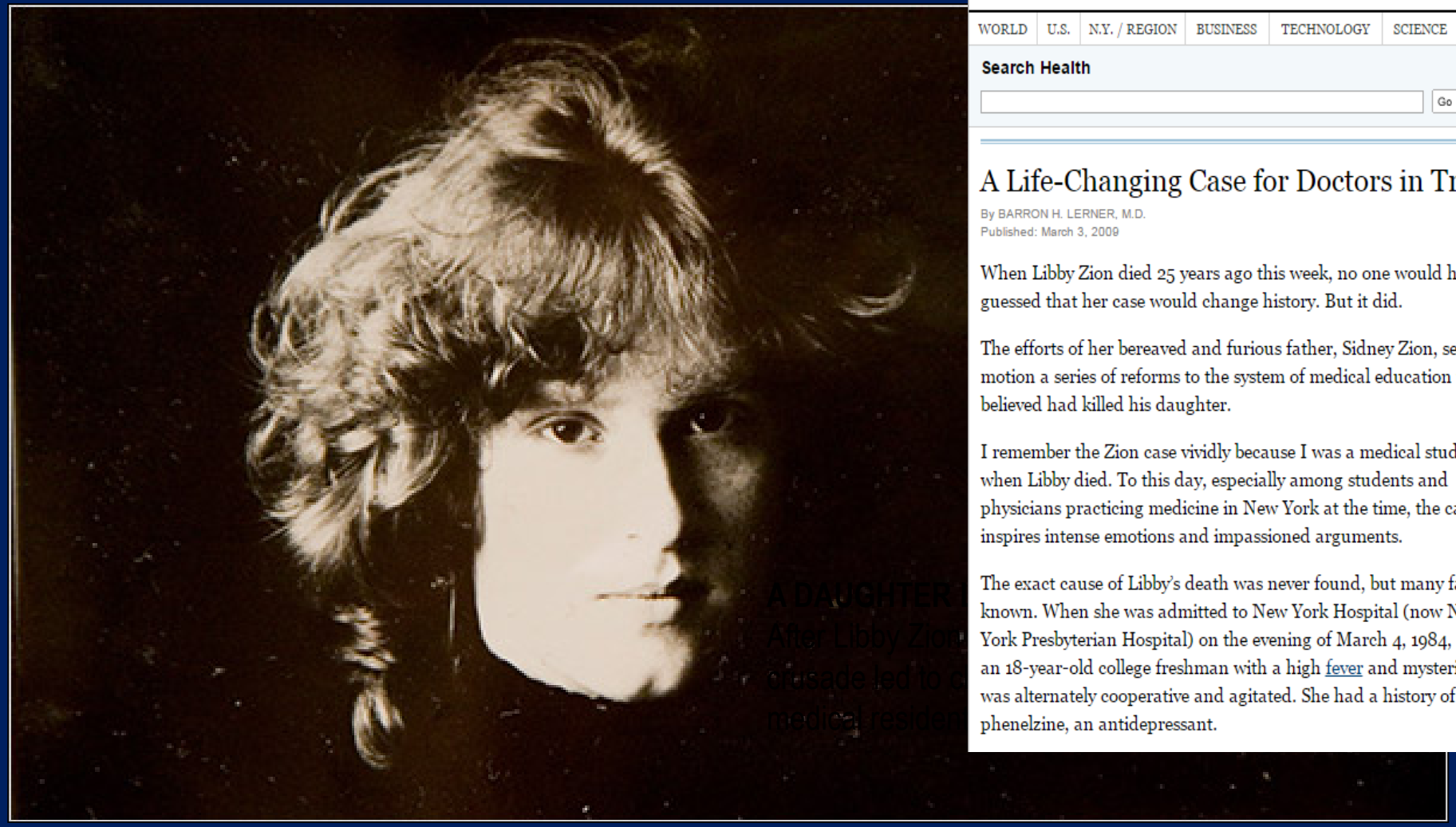
Began medication after treatment started	5%
Have never taken medication	5%
No Change	60%
Stopped taking medication after change	3%

Sleep and Circadian Misalignment for the hospitalist: The Nocturnist

Sleep and Circadian Misalignment

- Shift work is necessary to provide on-site 24 hours care.
- Hospitalist working beyond daylight hours are subject to a misalignment between work obligations and the endogenous circadian system (which regulates sleep and alertness patterns).
- Chronic misalignment can lead to medical conditions and increased medical errors.

The Woman Who Died Twice



The New York Times

Health

WORLD | U.S. | N.Y. / REGION | BUSINESS | TECHNOLOGY | SCIENCE | HEALTH | SPORTS | OPINION

Search Health

Go

Inside Health

Research | Fitness & Nutritio

A Life-Changing Case for Doctors in Training

By BARRON H. LERNER, M.D.
Published: March 3, 2009

When Libby Zion died 25 years ago this week, no one would have guessed that her case would change history. But it did.

The efforts of her bereaved and furious father, Sidney Zion, set into a motion a series of reforms to the system of medical education that he believed had killed his daughter.

I remember the Zion case vividly because I was a medical student when Libby died. To this day, especially among students and physicians practicing medicine in New York at the time, the case inspires intense emotions and impassioned arguments.

The exact cause of Libby's death was never found, but many facts are known. When she was admitted to New York Hospital (now New York Presbyterian Hospital) on the evening of March 4, 1984, she was an 18-year-old college freshman with a high fever and mysterious jerking movements. She was alternately cooperative and agitated. She had a history of depression and was taking phenelzine, an antidepressant.

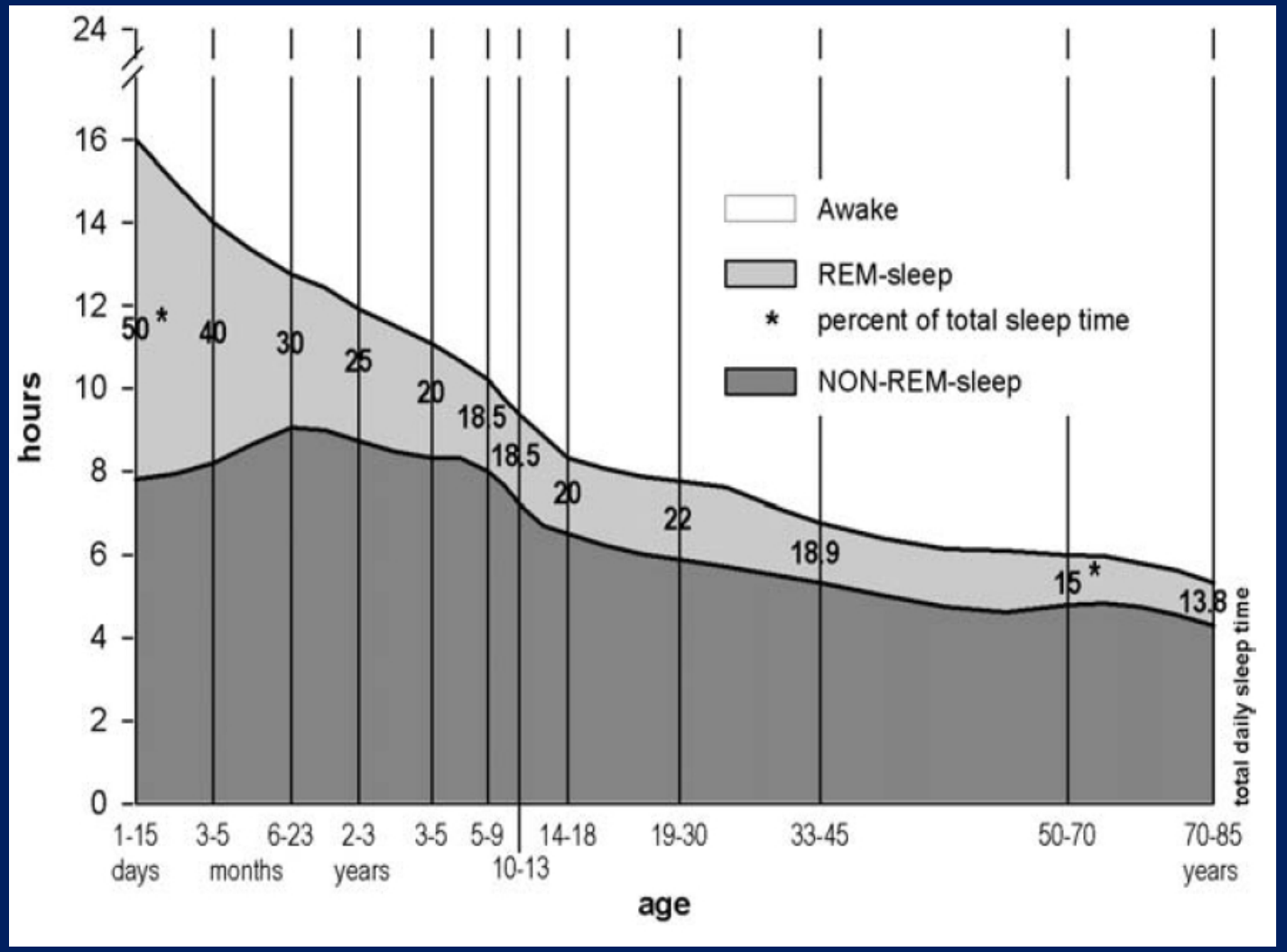
Normal Adult Sleep
Overview

- **Non REM** [Stages I – 3]
  - Stage 1 light sleep (10 minutes long)
  - Stage 2
  - Stage 3 deep sleep
  - 80% of total sleep time (TST)
  - Majority of sleep is in Stage 2 (50%)
- **REM** (Rapid Eye Movement)/Dream Sleep
  - 20% of total sleep
  - Cycles every 90 - 120 minutes
  - Duration (time) prolongs during the night

Sources: ATS Core Curriculum 2014: Part III. Adult Sleep Medicine. Ann Am Thorac Soc Vol 11, No 9, pp 1480.

Physiologic Changes in Sleep

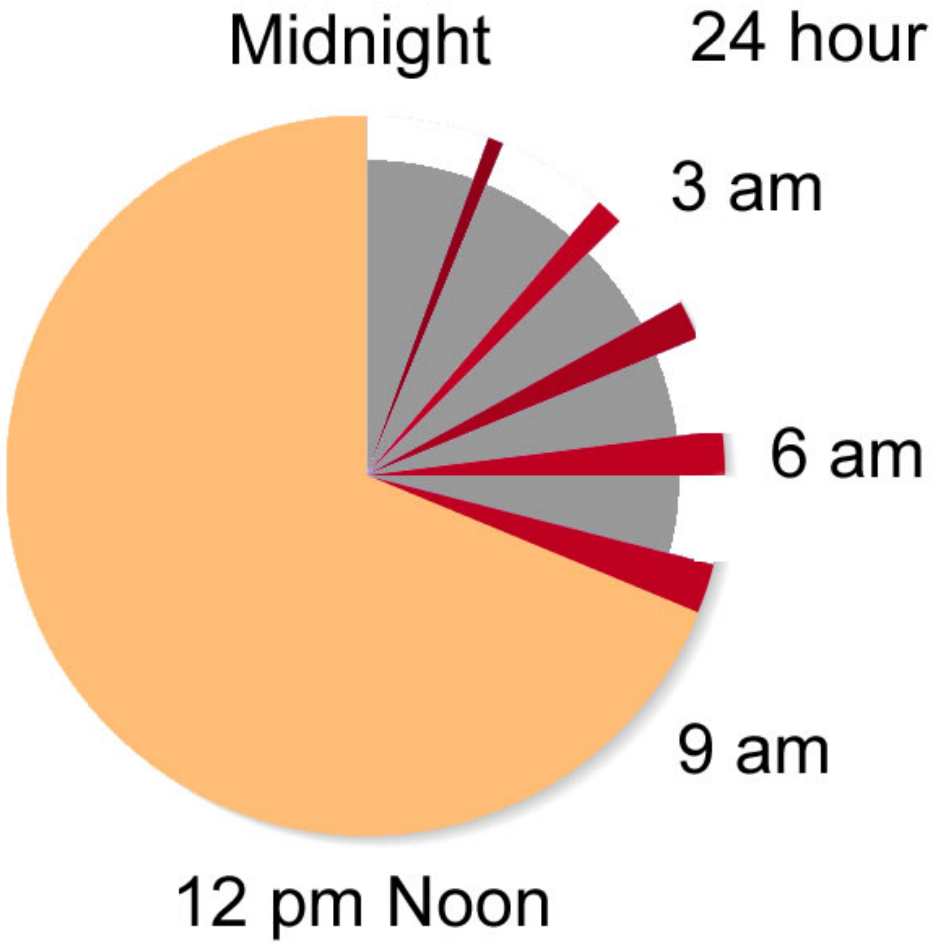
- **Body clock shifts earlier with age.**



Sources: Hobson. Sleep and Dreaming. In: Fundamental Neuroscience. 1999; Roffwarg et al. Science, 1996; 152:604

Circadian Rhythm:

24 hour - sleep / dream cycle

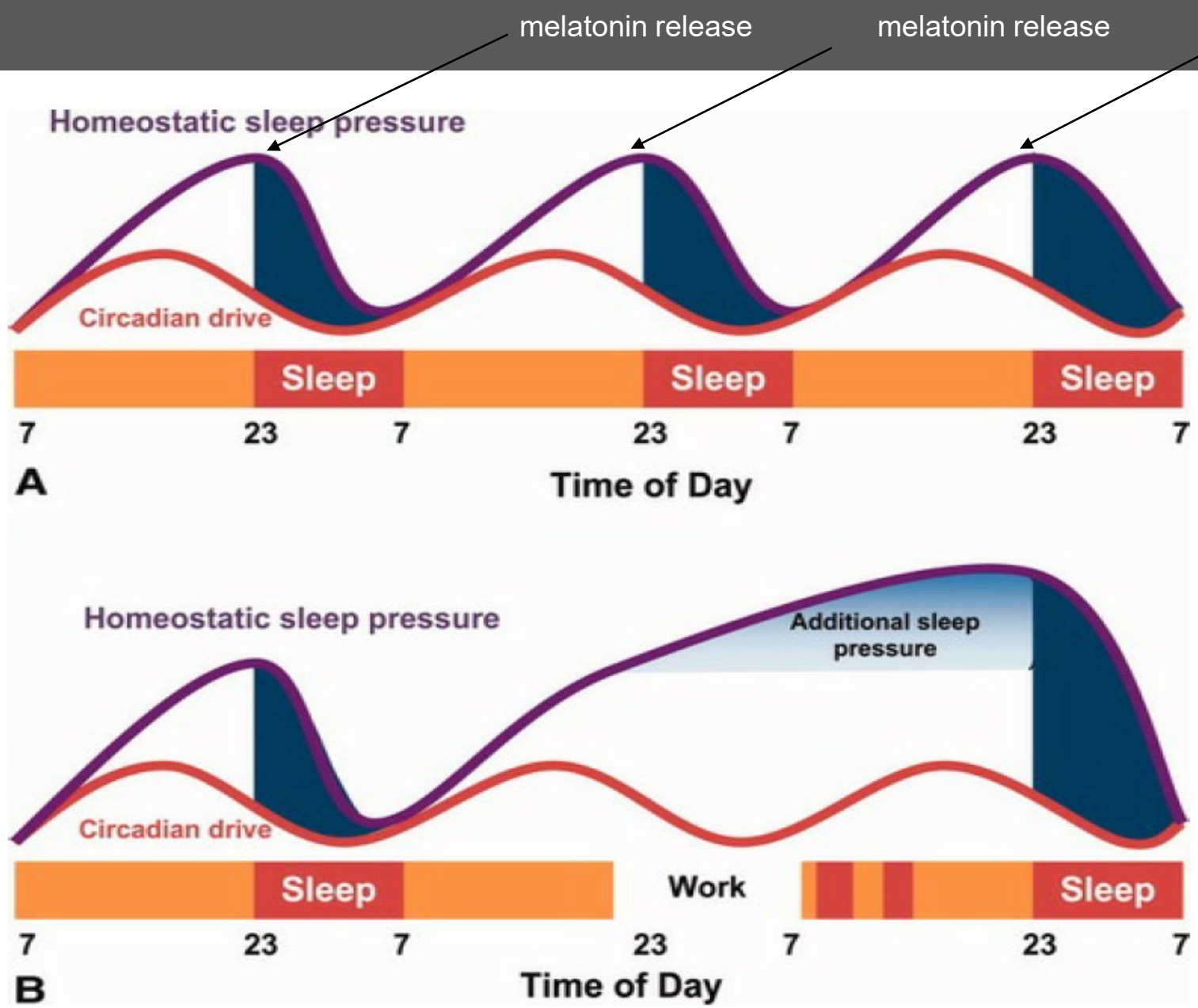


REM Dreaming Sleep

Deep Sleep

Awake

Note: Image based on 8 hour sleep cycle.



The circadian clock must be resynchronized daily to a 24 hour day this is called **entrainment**

Entrainment occurs primary by light-dark cycle. **The intensity, duration, and wave length of light all influence the circadian system.**

Adapted from Borbely, used with permission from Springer Science and Business Media.

Deleterious effects of Circadian Misalignment

https://www.youtube.com/watch?v=8vkyFgFQw90

Deleterious effects of Circadian Misalignment

Deleterious effects of Circadian Misalignment

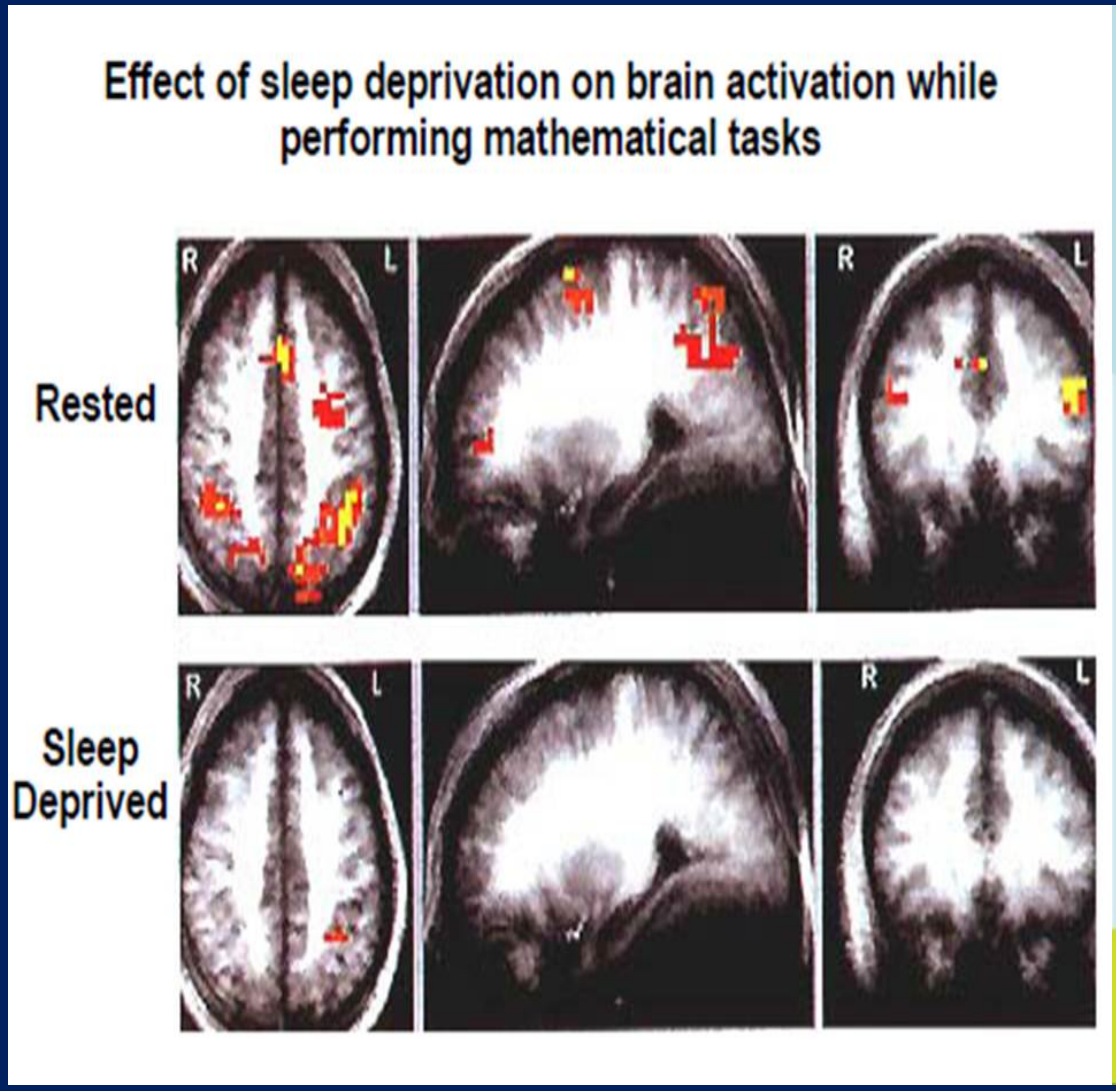
Deleterious effects of Circadian Misalignment

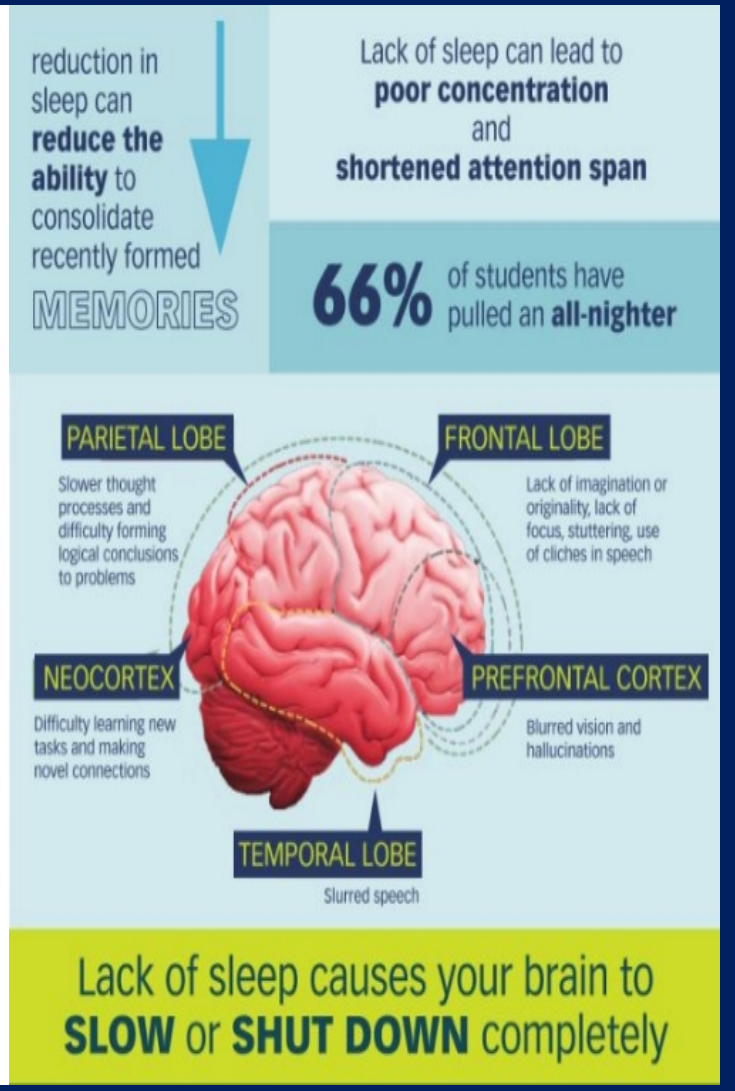
- Increase in hypertension
- Reduced sex drive
- Sympathetic nervous system activation leading to skin changes, perspiration, hair loss
- Reduced glucose tolerance & leptin levels (appetite) = weight gain
- Increased inflammatory markers (IL_6, TNFα, cRP) reducing overall immune function

Banks S, Dinges DF. J Clin Sleep Med 2007;3:519.

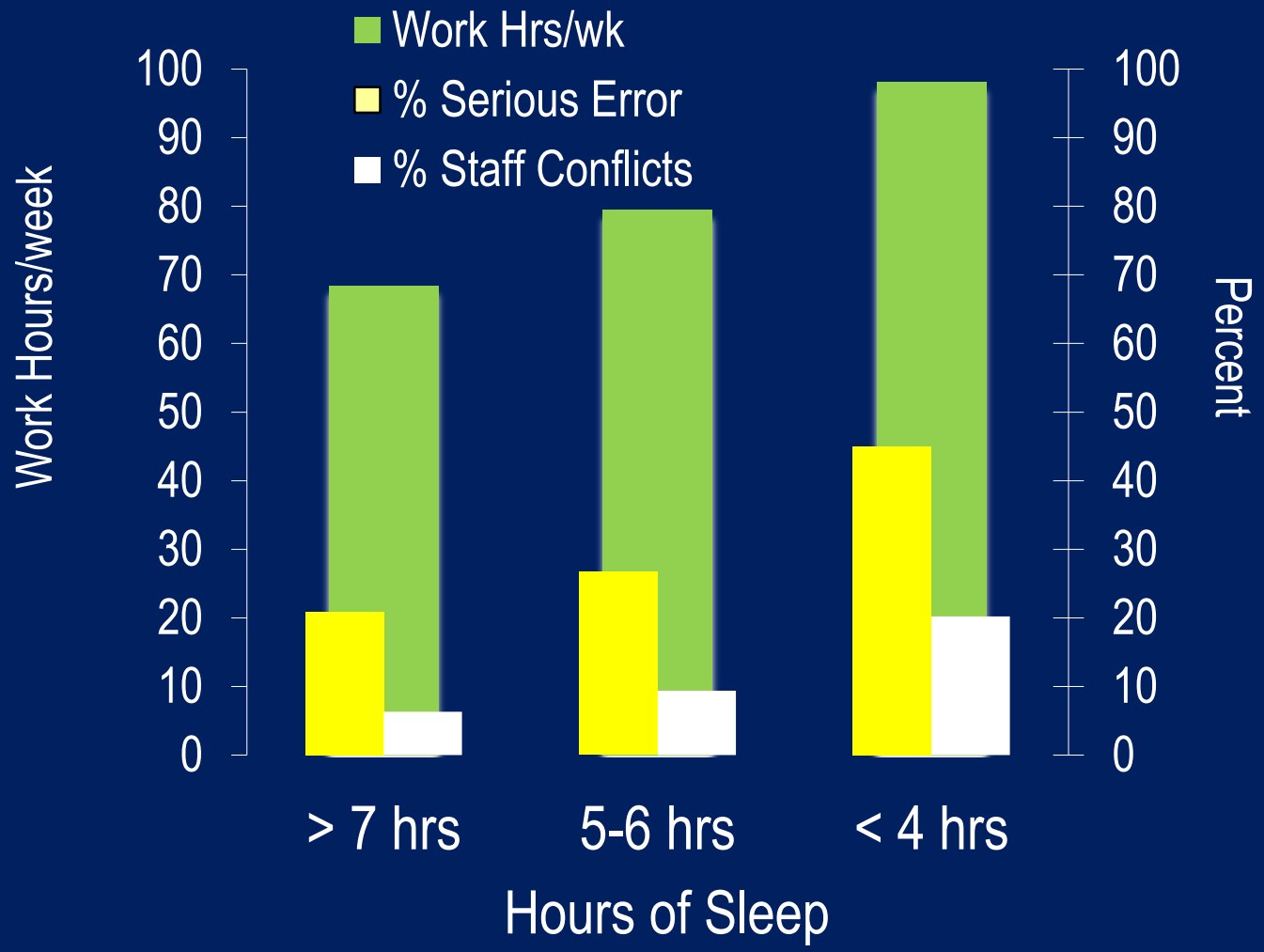
Ann Intern Med. 2004 Dec 7;141(11):846-50.

Deleterious effects of Circadian Misalignment

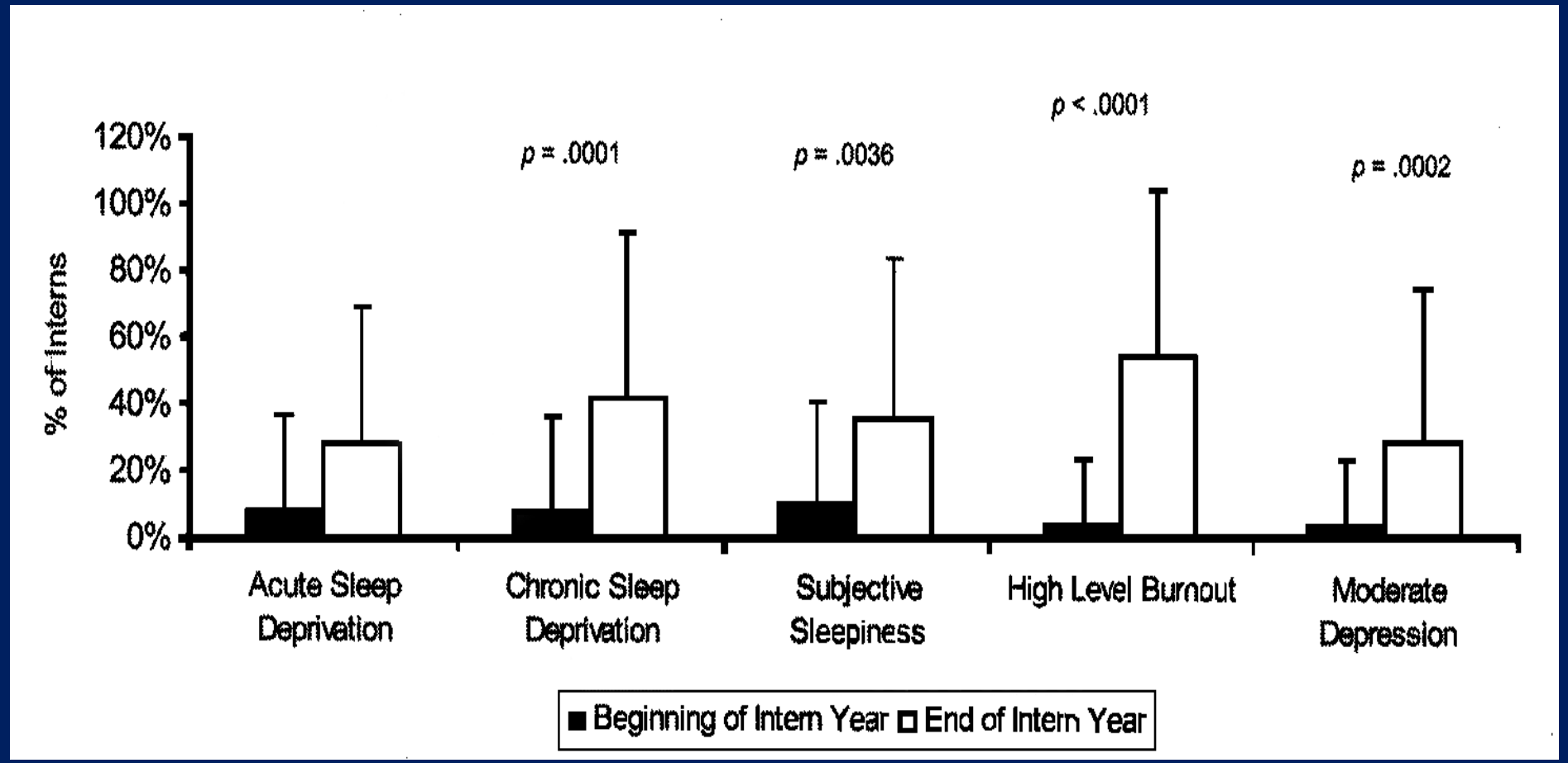




Deleterious effects of Circadian Misalignment



Evolution of Sleep Deprivation & Mood during Internship



Rosen et al. Acad Med 2006;81(1):82-5.

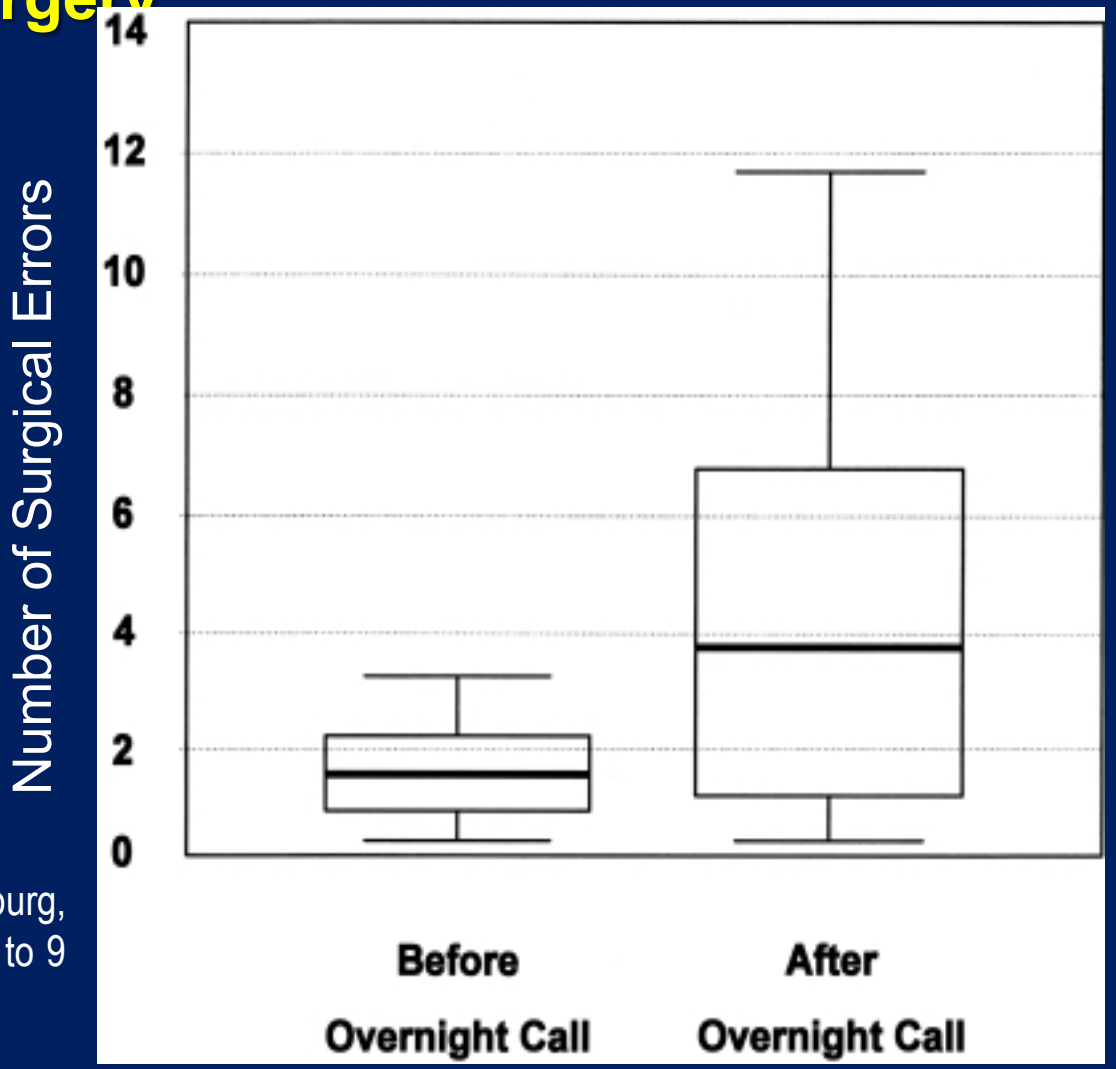
Correlates of Reduced Sleep Duration

Physicians averaging ≤ 5 hrs. sleep/night were more likely to report:

Serious accidents or injuries	OR = 1.84 (1.23 – 2.74)
Conflict with other professional staff	OR = 1.41 (1.08 – 1.84)
Use of medications to stay awake	OR = 1.91 (1.39 – 2.62)
Working in an "impaired condition"	OR = 2.19 (1.79 – 2.68)
Making significant medical errors	OR = 1.74 (1.47 – 2.06)
Being named in malpractice suit	OR = 2.02 (1.17 – 3.47)

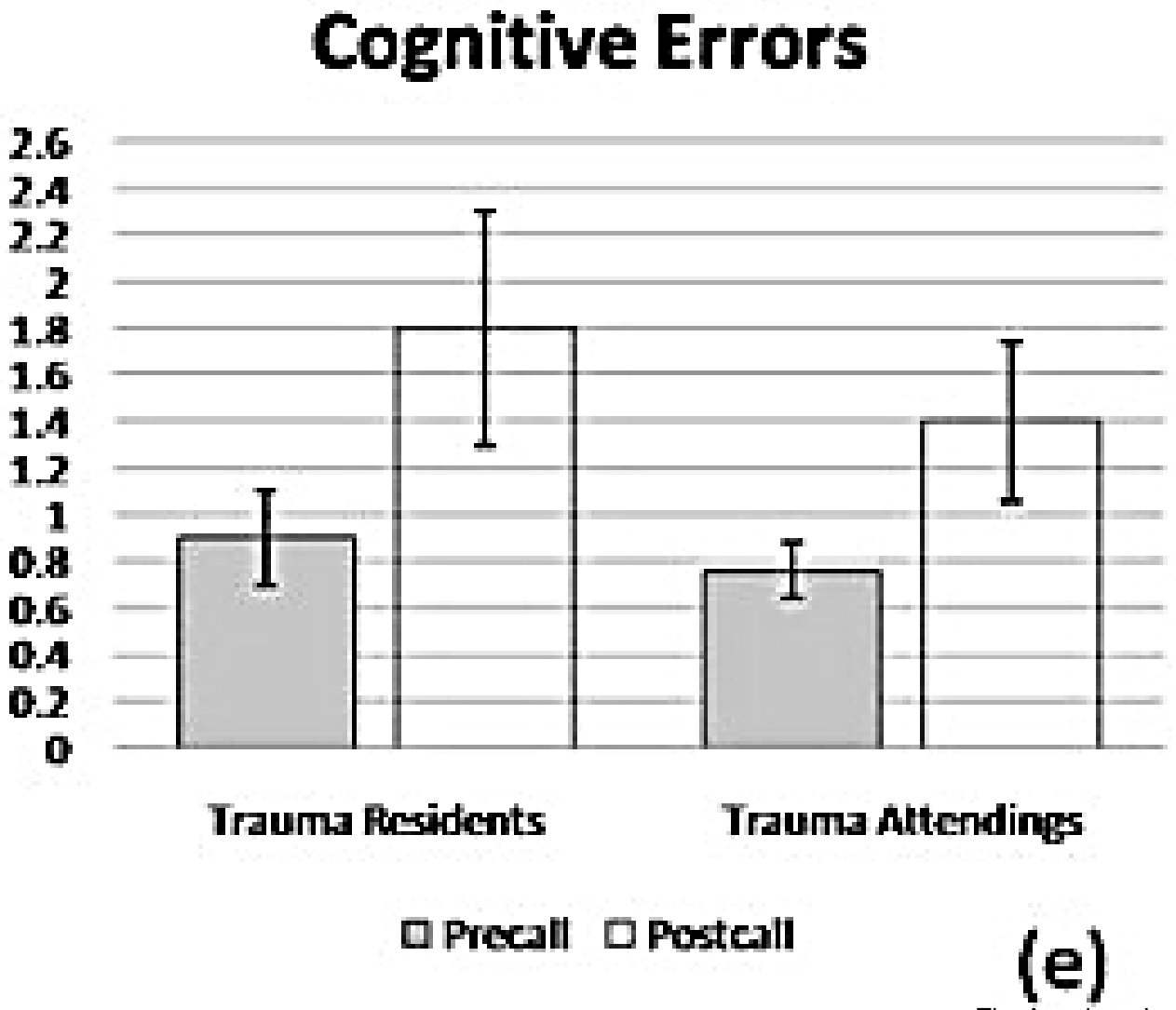
Baldwin & Daugherty. Sleep 2004;27(2):217-23.

Effect of Partial Sleep Loss during Hospital Call on Errors Committed by Surgeons During Simulated Surgery



Simulator (task 6 of the MIST-VR, Medical Simulation, Gothenburg, Sweden) before and after a night on call (17.5 hours from 3:30 pm to 9 am; median reported sleep time 1.5 h; range 0–3 h).

Grantcharov TP, Bardram L, Funch-Jensen P, Rosenberg J. BMJ 2001;323:1222–1223.

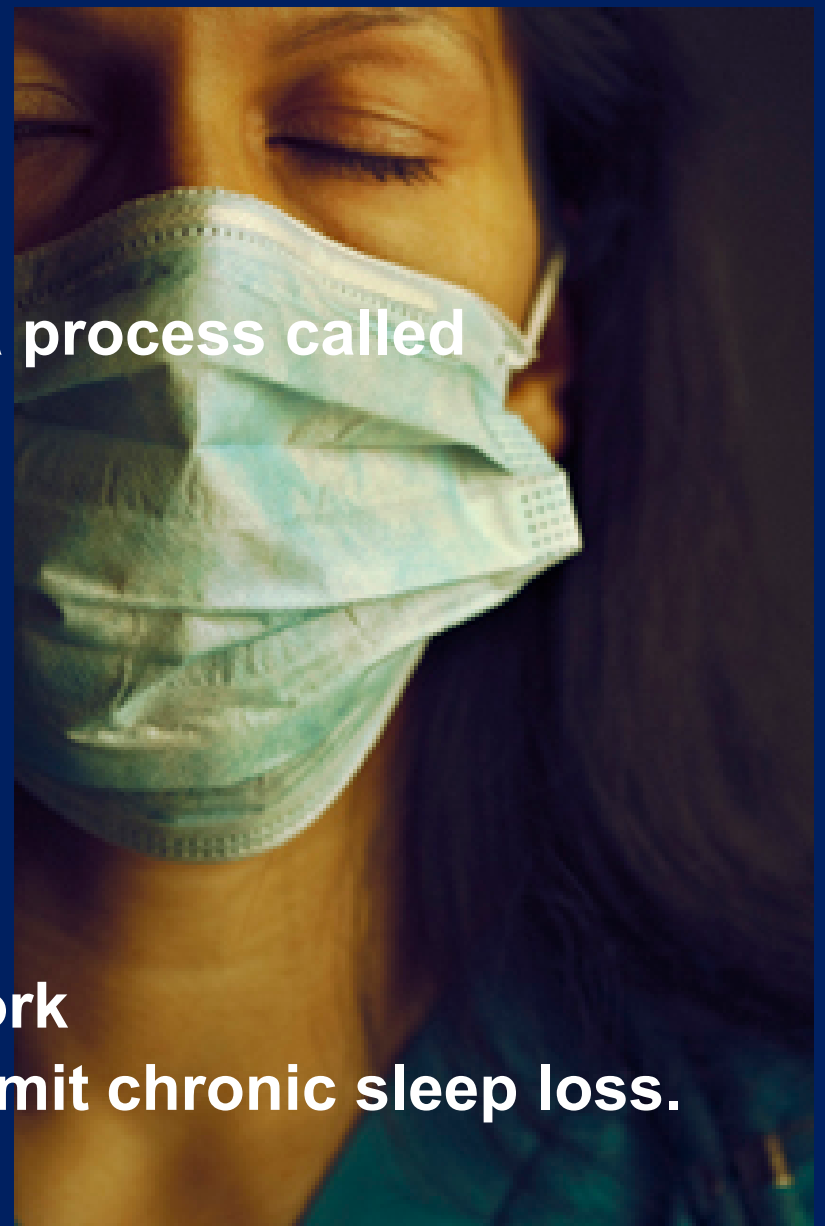


The American Journal of Surgery, Volume 196, Issue 6, 2008, 813–820

Jack Barney award: The effect of fatigue on cognitive and psychomotor skills of trauma residents and attending surgeons

Circadian adaptation

- Realigning work and circadian schedules is a process called circadian adaption.
- This can limit fatigue and improve safety.
- Strategies include:
  - Improving sleep hygiene before work
  - Caffeine use a the start of night shift
  - Bright light exposure
  - Planned naps during the shift
  - Short –term use of hypnotic after night work
  - Night float scheduling strategies help to limit chronic sleep loss.



Schaefer EW, Williams MV, Zee PC, Sleep and Circadian Misalignment. *J. Hosp. Med* 2012;6;489-496. doi:10.1002/jhm.1903