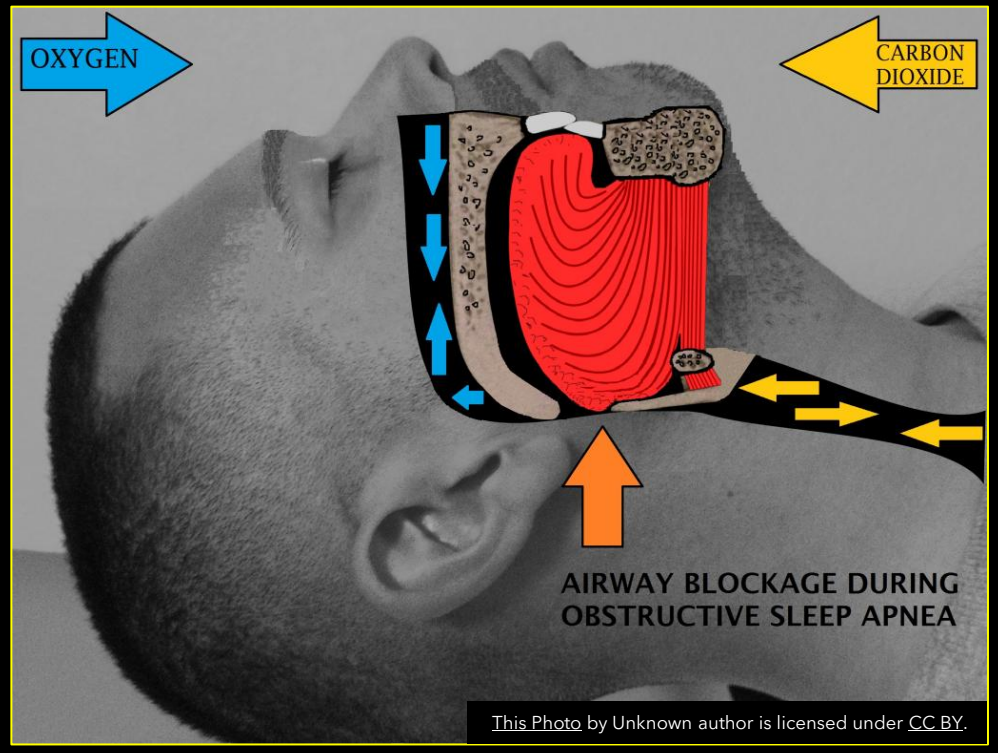
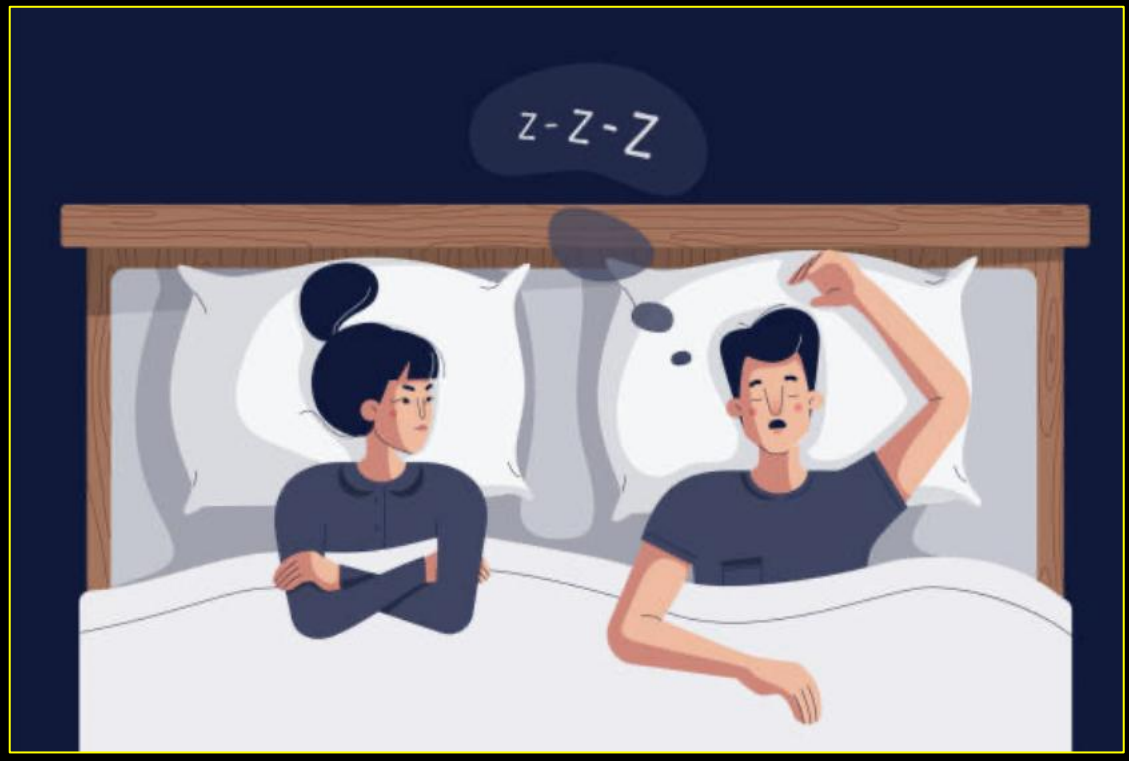
Positional Sleep Apnea 2025

FREDRIC JAFFE, DO, FCCP, FAASM





Disclosures

- I have no commercial disclosures
- I have been involved in positional device research

Objectives

- Prevalence of Sleep Apnea and causes
- Physiology of part of the upper airway
- Treatment options for Sleep Apnea related to the upper airway
- Positional Sleep Apnea
  - Physiology /Epidemiology
  - Treatment/Efficacy
  - Cost

Population-based OSA and OSAS prevalence studies

Study	# subjects	AHI>=5	AHI >=15	OSAS	Methods
WI, 1993	M=352 W=250 (age 30-60)	M=24% W=9%	M=9% W=4%	M=4% W=2%	PSG
PA, 1998, 2001	M=741 W=1000 (age 20-100)	M=17% W=5%	M=7% W=2%	M=3.3% W=1.2%	PSG
Spain, 2001	M=325 W=235 (age 30-70)	M=26% W=28%	M=14% W=7%	M=3.4% W=3%	PSG
Australia, 1995	M=294 (age 40-65)	M=25.9%	M=10% (AHI≥10)	M=3.1% W=n/a	HST
Hong Kong, 2001, 2004	M=153 W=106 (age 30-60)	M=8.8% W=3.7%	M=5.3% W=1.2%	M=4.1% W=2.1%	PSG
Korea, 2004	M=309, W=148 (age 40-69)	M=27% W=16%	M=10.1% W=4.7%	M=4.5% W=3.2%	PSG or HST
India, 2006	M=88 W=63 (age 30-60)	M=19.7% W=7.4%	n/a	M=4.9% W=2.1%	PSG

Adapted from Lee et al. Expert Rev Respir Med 2008;2:349-364

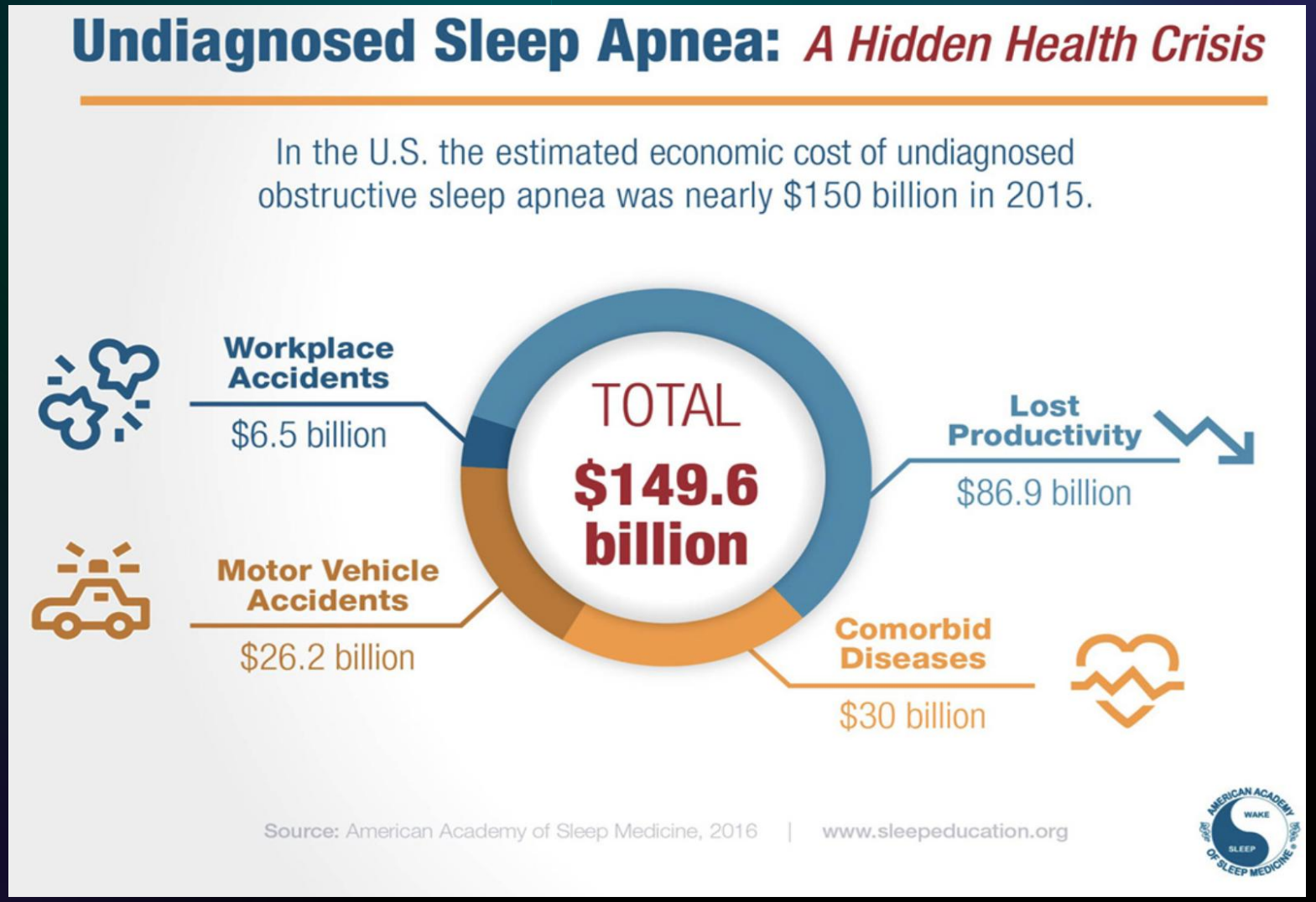
Obstructive Sleep Apnea (OSA)

- OSA
  - Moderate to Severe (AHI $\geq$ 15 events/hour)
    - Men 30-49 yrs old – 10%
    - Men 50-70 yrs old – 17%
    - Women 30-49 yrs old – 3%
    - Women 50-70 yrs old - 9%

Relative increase 14-55% in past 2 decades

Peppard et al. Am J Epidemiology 2013; 177(9):1006-1014

Obstructive Sleep Apnea



Treatment Criteria

Centers for Medicare and Medicaid Services

- **Treatment is reimbursed**
  - **AHI > 15 (Moderate to Severe OSA)**
  - **AHI = 5-15 (Mild OSA)**
    - **Other factors present that are attributed to AHI**
      - **Excessive Daytime Somnolence**
      - **Impaired Cognitive Function**
      - **Mood Disorders**
      - **Insomnia**
      - **HTN**
      - **Ischemic Heart Disease**
      - **History of Cerebrovascular Disease**

Epidemiology

- The propensity for developing SDB is influenced by
  - Ethnicity
  - Gender
  - Obesity
  - Age
  - Oropharyngeal anatomy

Worldwide Obesity

Worldwide obesity has more than doubled since 1980.

1.9 billion adults (18 years and older) were overweight

- Of these over 650 million were obese.

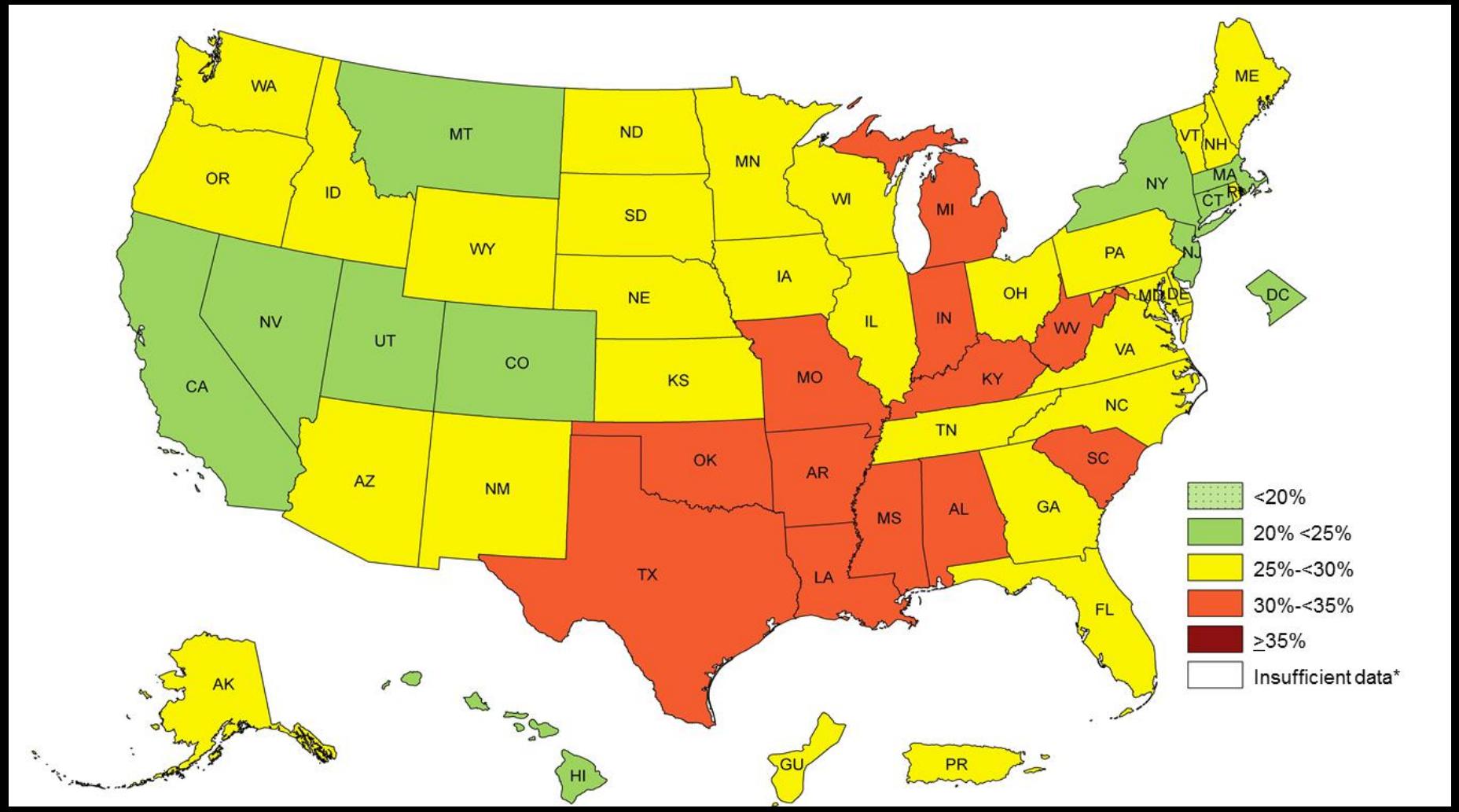
39% of adults aged 18 years and over were overweight in 2016, and 13% were obese.

38 million children under the age of 5 were overweight or obese in 2019

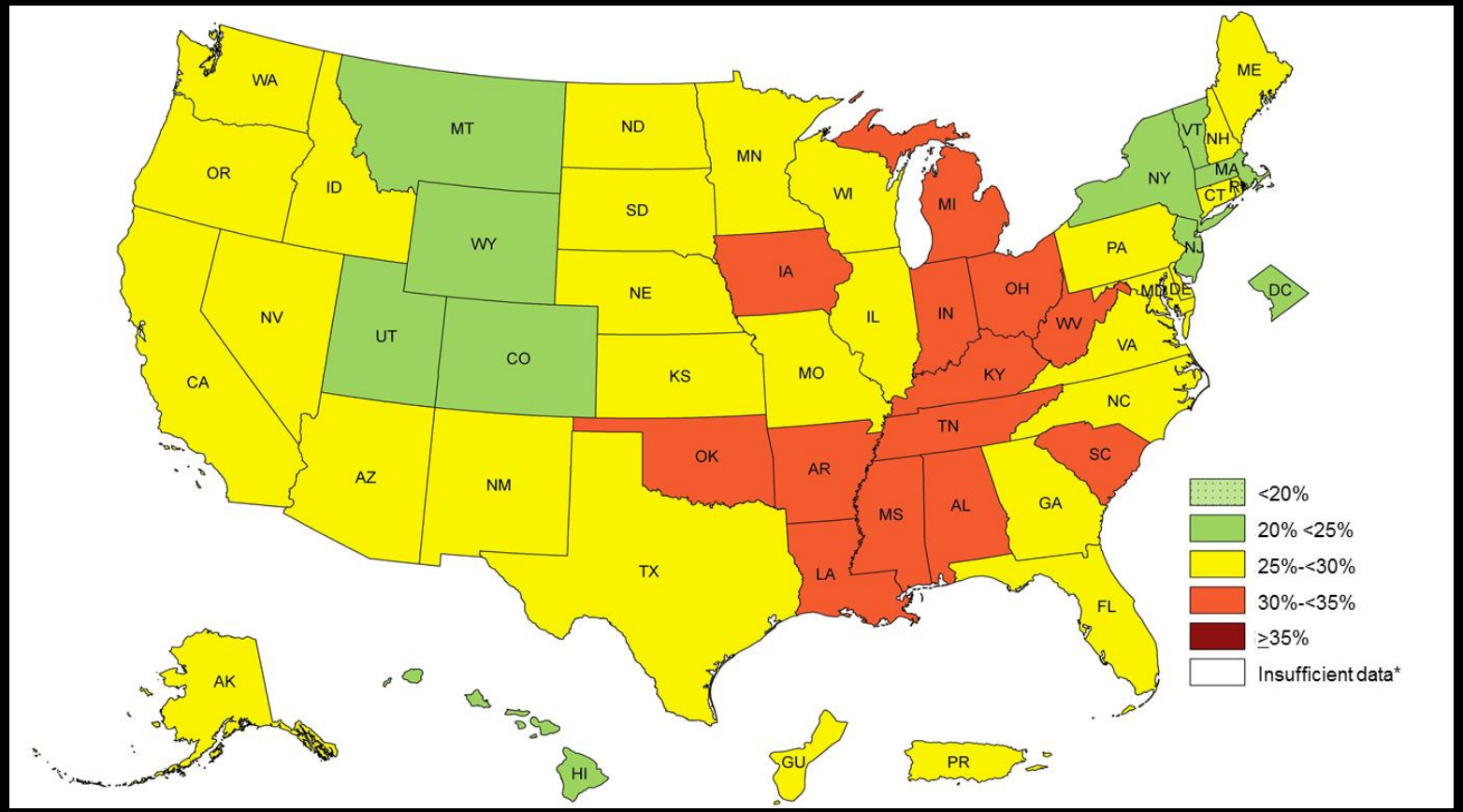
Over 340 million children and adolescents aged 5-19 were overweight or obese in 2016

WHO 2020

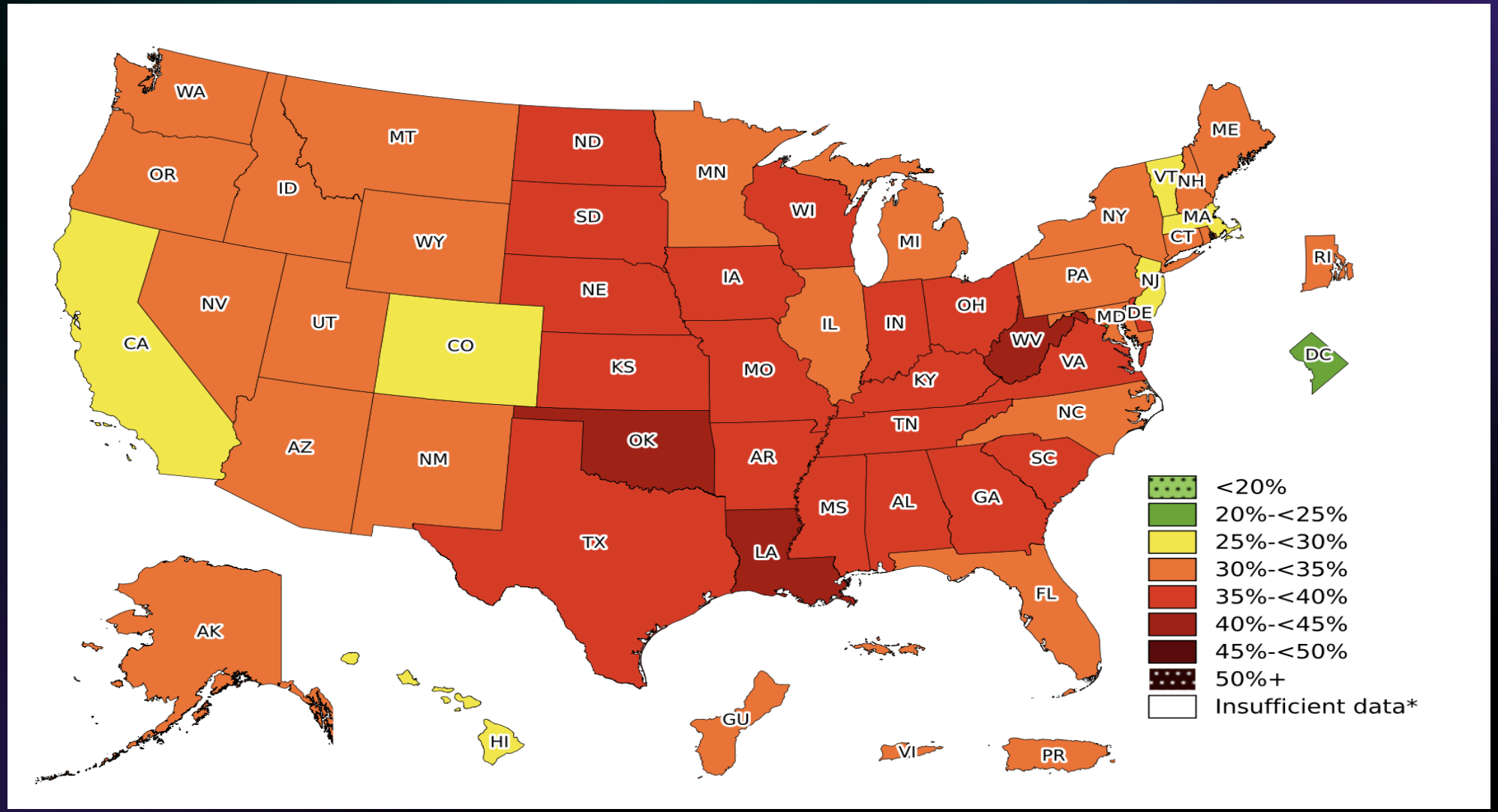
Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2011



Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2012

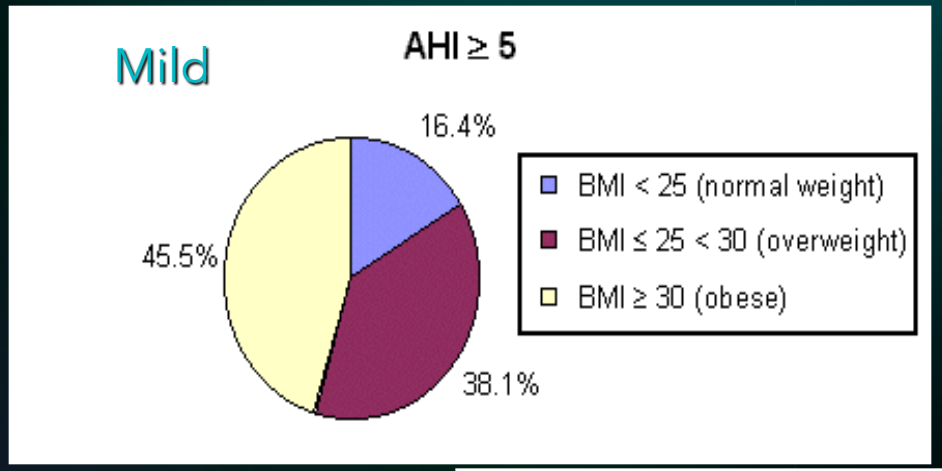


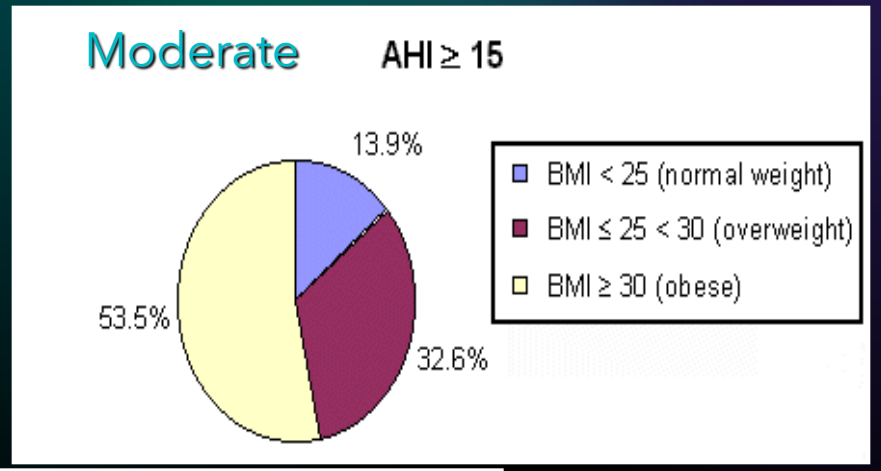
Self-Reported Obesity Among U.S. Adults by State and Territory, BRFSS, 2022

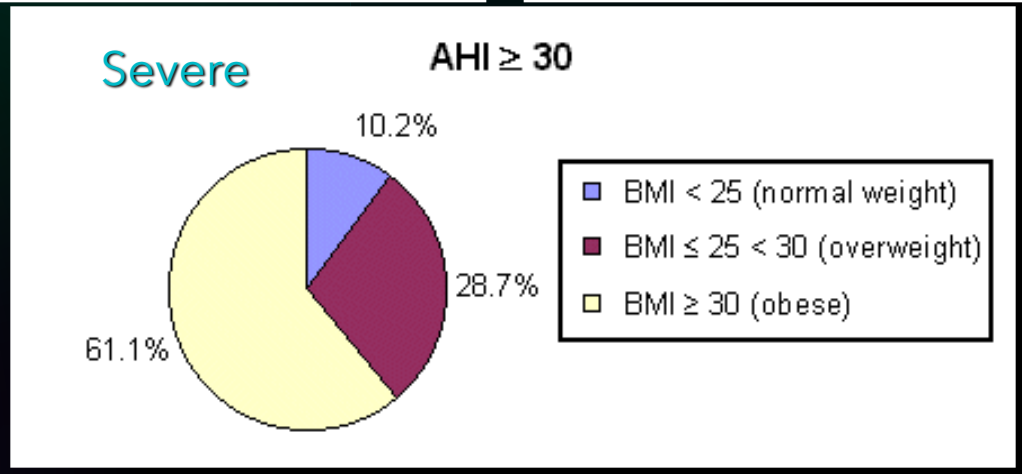


Obstructive Sleep Apnea

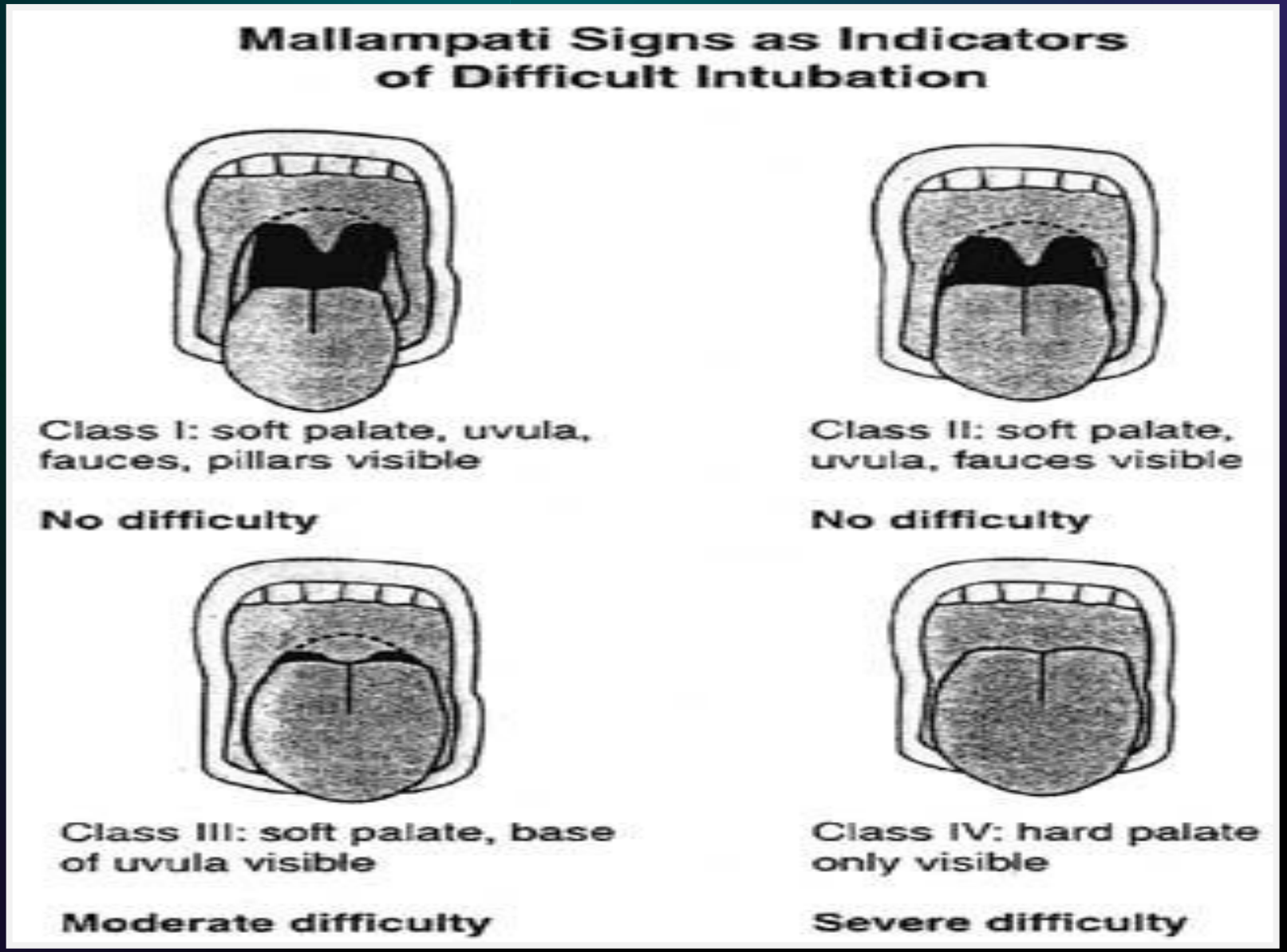
- Obesity is the predominant risk factor
  - Not Everyone







Oropharyngeal Airway Anatomy



The Whole System

Physical System (Anatomy)

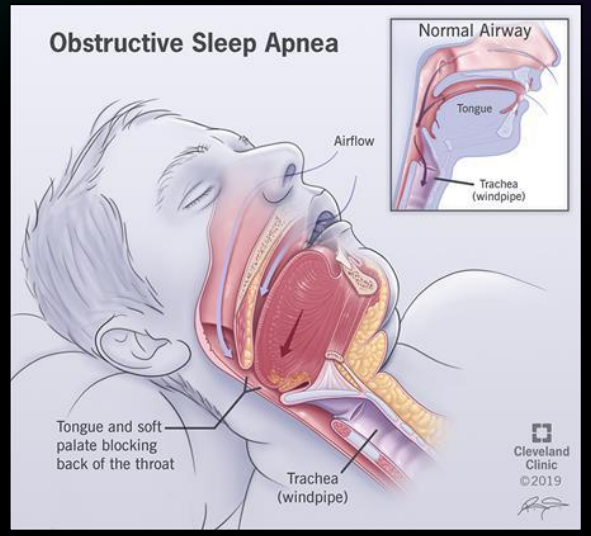
+

Loop Gain (Plant Gain + Controller Gain)

Pathophysiology

Related to collapsibility of the pharynx

1. Reduced upper airway tone
2. Diminished reflexes to protect pharyngeal collapse
3. Reduced load compensation



Loop Gain

- Measurement of how a system responds to a stimulus
  - *Plant Gain*
    - How the physical system responds
  - *Controller Gain*
    - How the chemoreceptor system responds

  - Derangements in these systems perpetuate the underlying pathology

Defining Phenotypic Causes of Obstructive Sleep Apnea

Identification of Novel Therapeutic Targets

Danny J. Eckert[1,2], David P. White[1], Amy S. Jordan[1,3], Atul Malhotra[1], and Andrew Wellman[1]

Anatomic Contribution to OSA

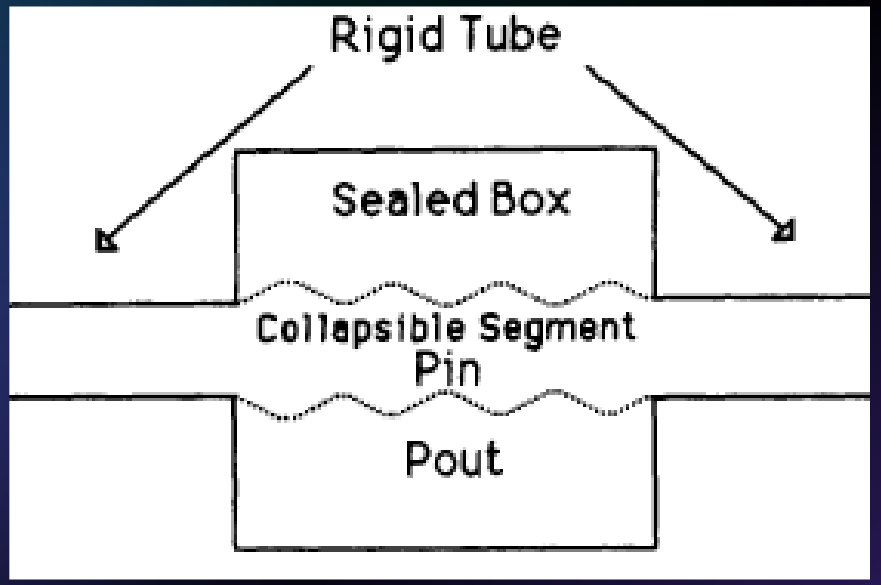
- P_{crit}
- Pharyngeal Pcrit is the pressure at which the airway can no longer stay open and collapses

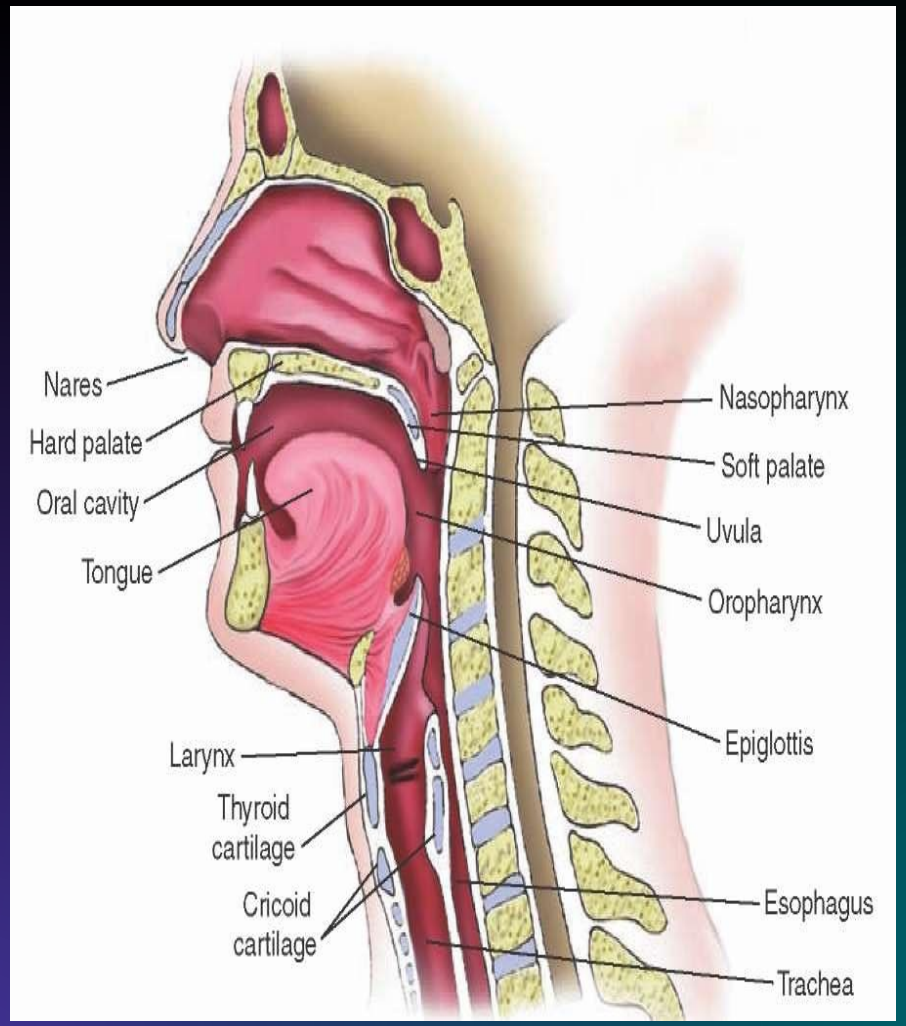
Non-anatomic Contribution to OSA

- Genioglossus Responsiveness
- Arousal Threshold
- Loop Gain

Am J Respir Crit Care Med Vol 188, Iss. 8, pp 996–1004, Oct 15, 2013

Control of Upper Airway Patency

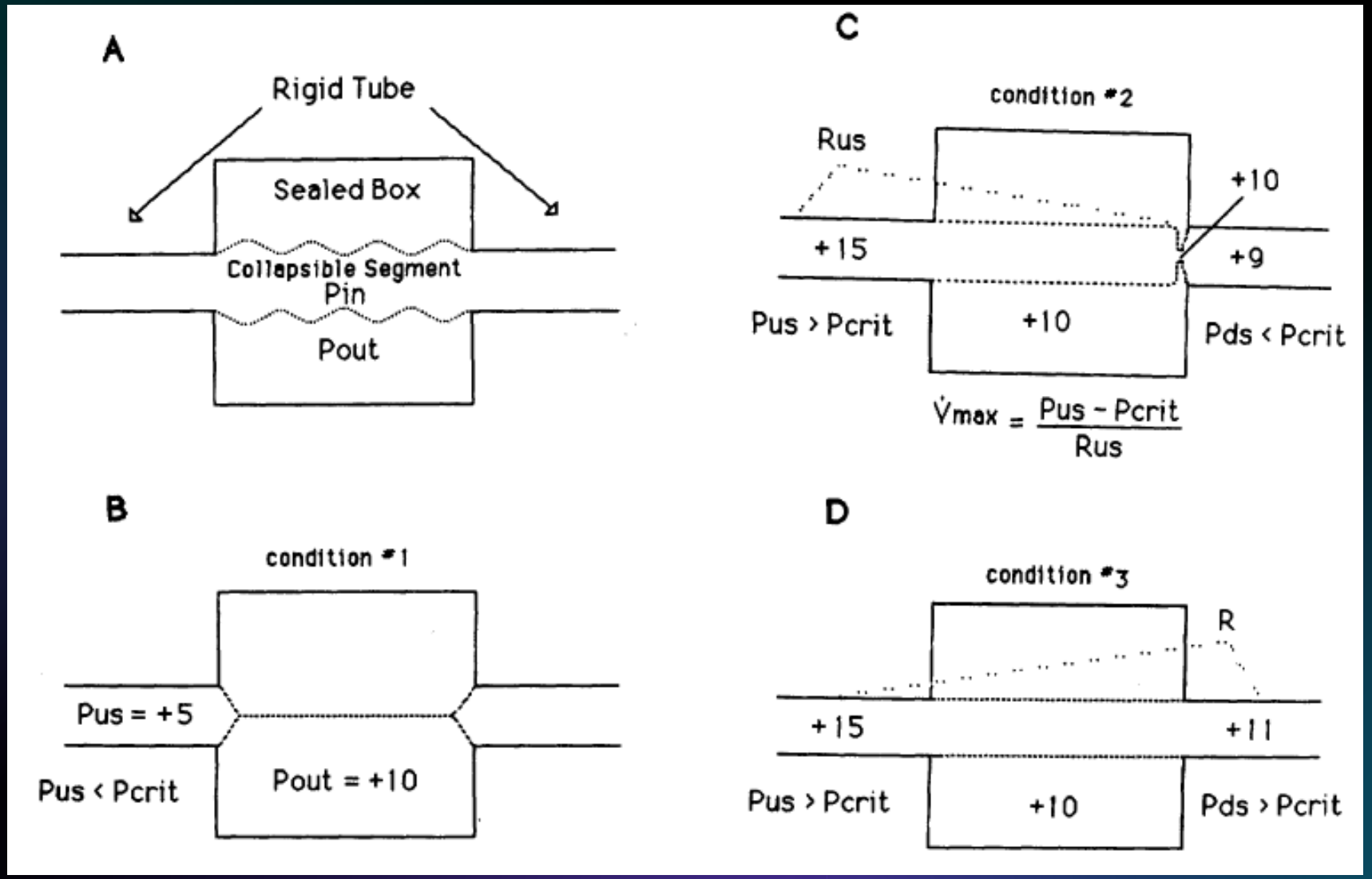




P_{crit}

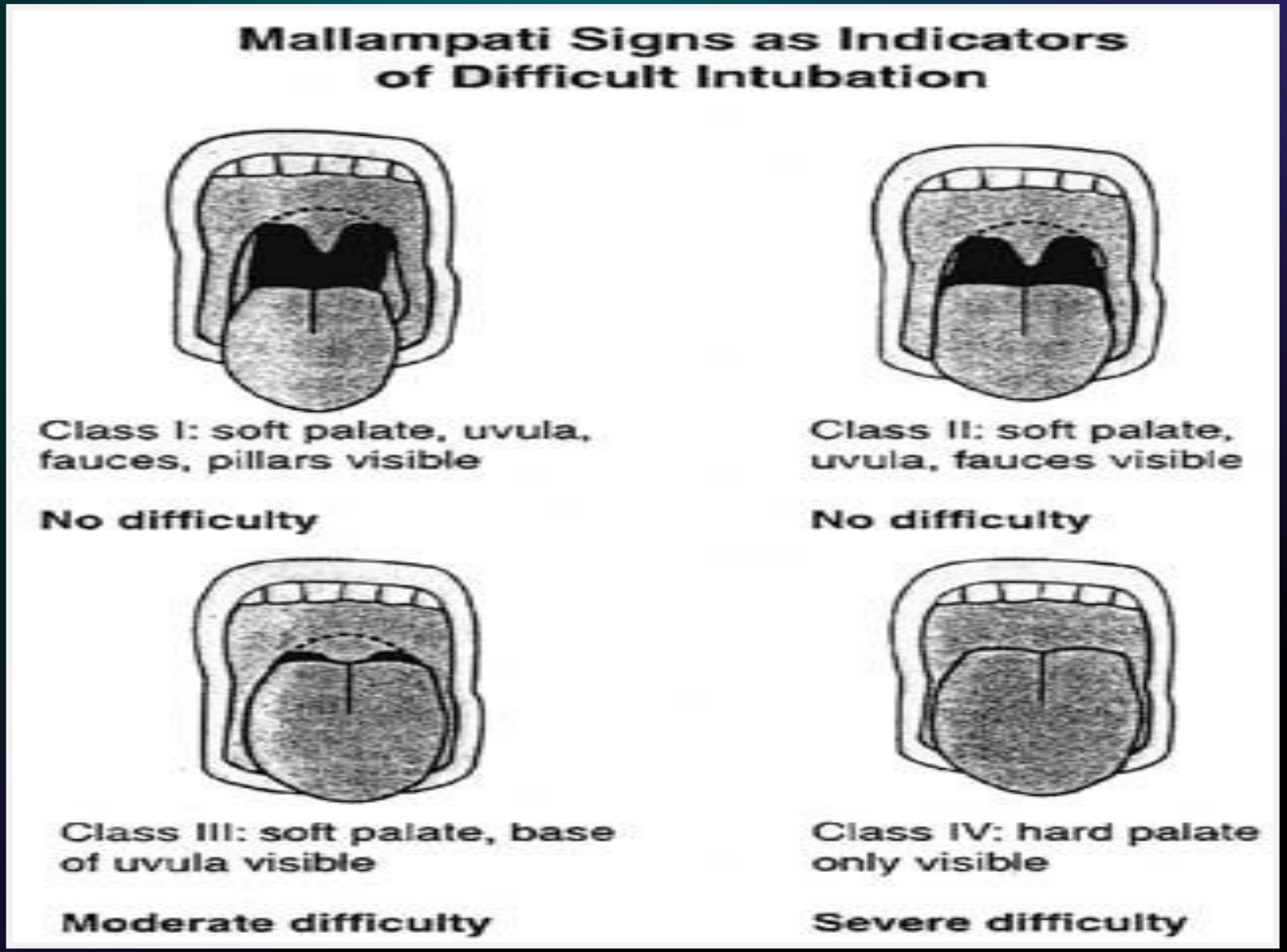
- Pharyngeal P_{crit} is the pressure at which the airway can no longer stay open and collapses
- It is a measure of the level of collapsibility of the pharyngeal airway
  - The surrounding pressure rises to a level above the pressure inside the tube and causes its collapse, the pressure within the tube is equal to the surrounding pressure.
    - The pressure at this specific moment is known as the Pcrit of that segment
  - The lower the P_{crit} is the less collapsible the airway
    - **More negative is better**
  - Higher P_{crit} the more collapsible the airway

Upper Airway Patency – Collapsible Tube Model



Gold and Swartz Chest 1996;110:1077-88

Oropharyngeal Airway Anatomy

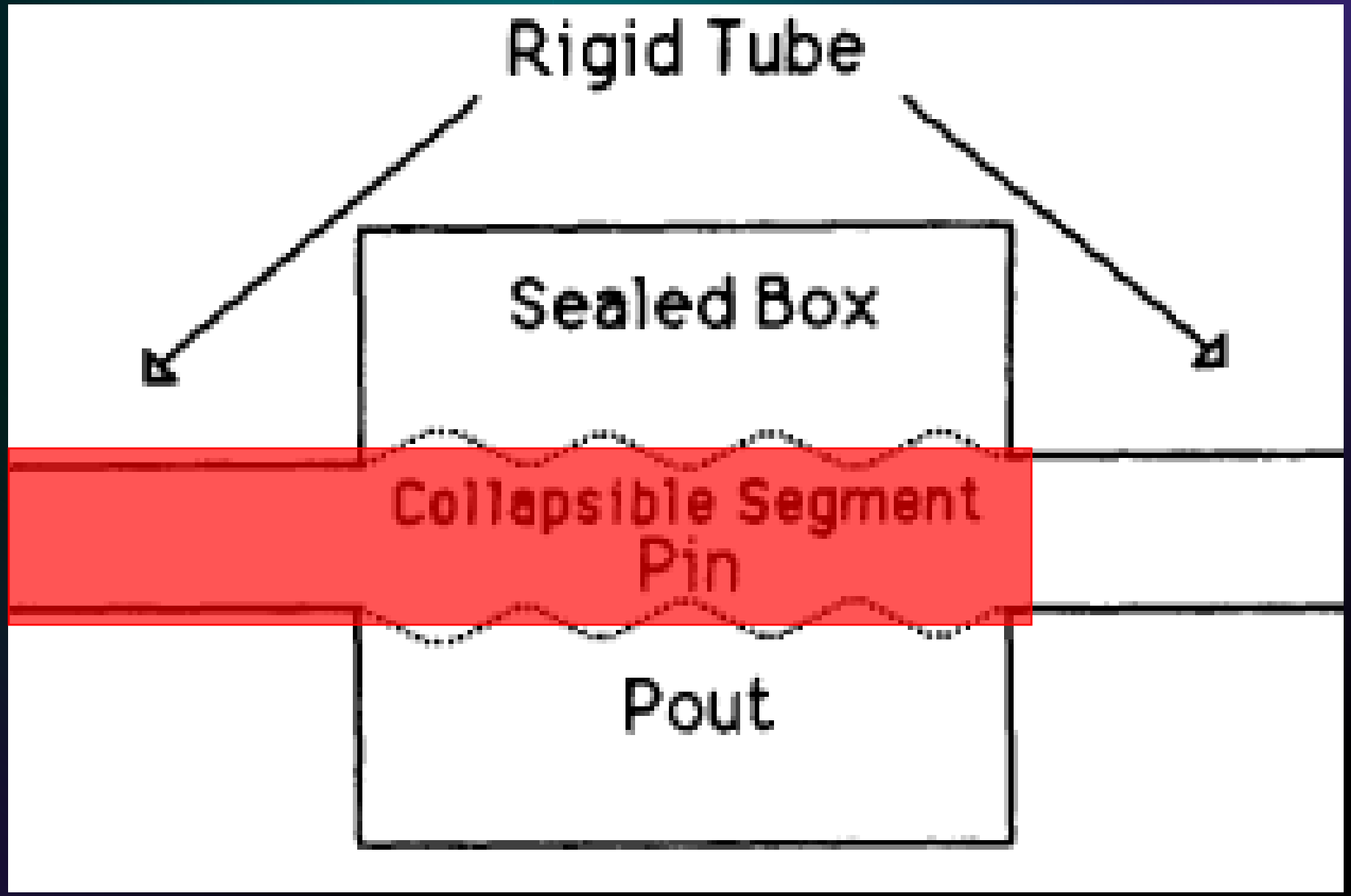


Medical Treatment Options

- **Non invasive Ventilation (PAP)**
  - CPAP/BLPAP
    - Autotitrating
  - ASV : VPAP
- Dental Devices
- Weight Loss
- Medications
- Positional Therapy

Treatment Options for OSAS

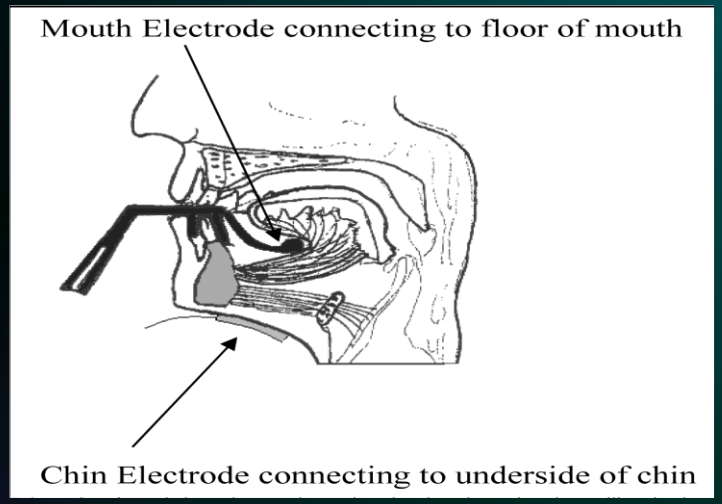
PAP THERAPY

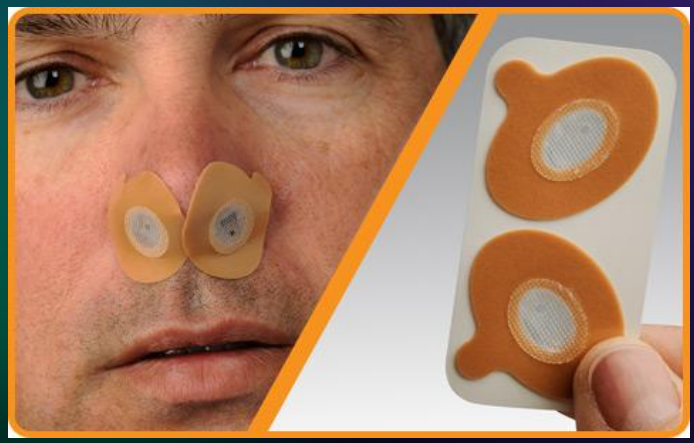

Rigid Tube
Sealed Box
Collapsible Segment
Pin
Pout

PAP Therapy

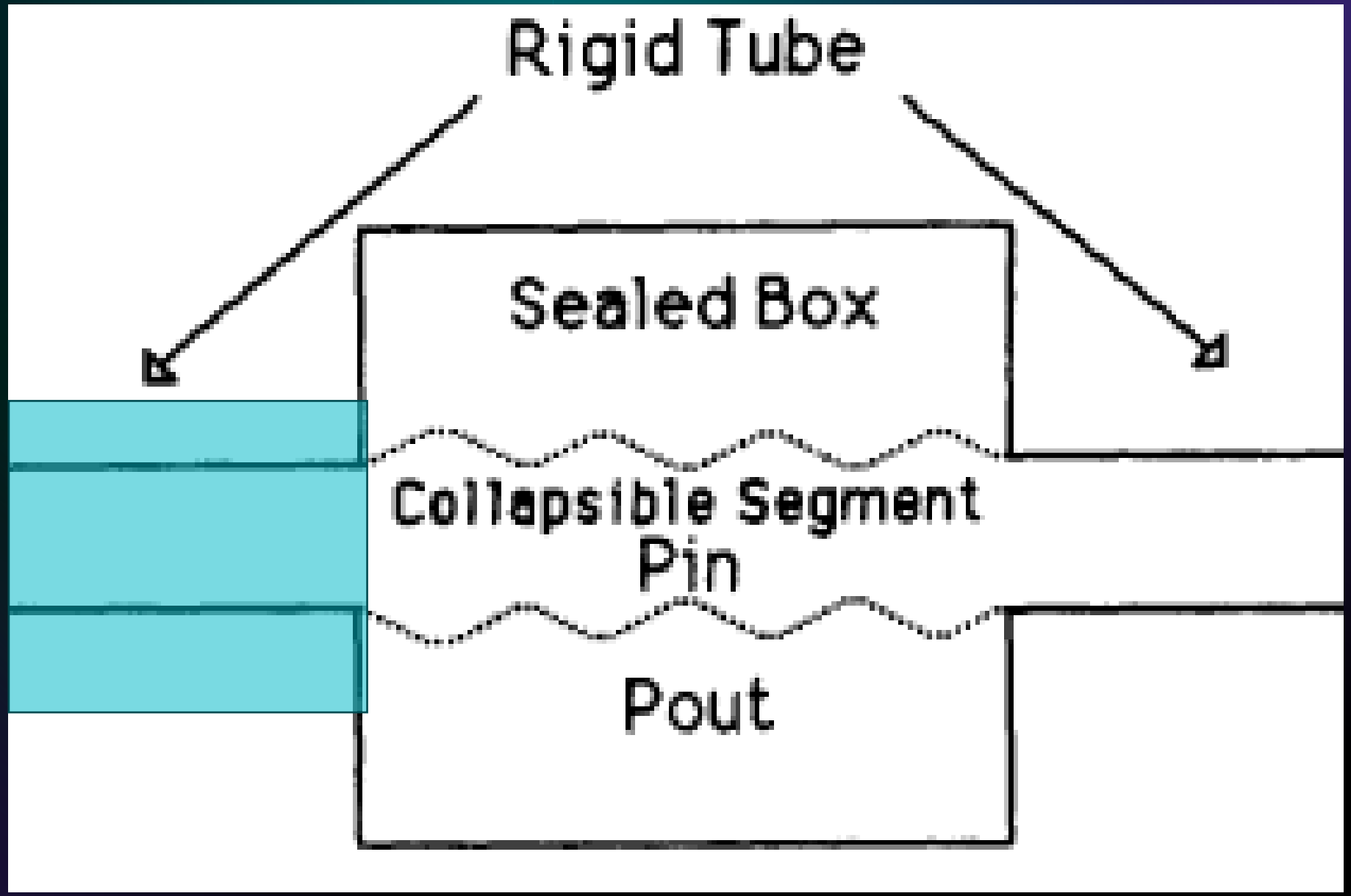
Effective vs Tolerated vs Compliant

Upstream Therapies

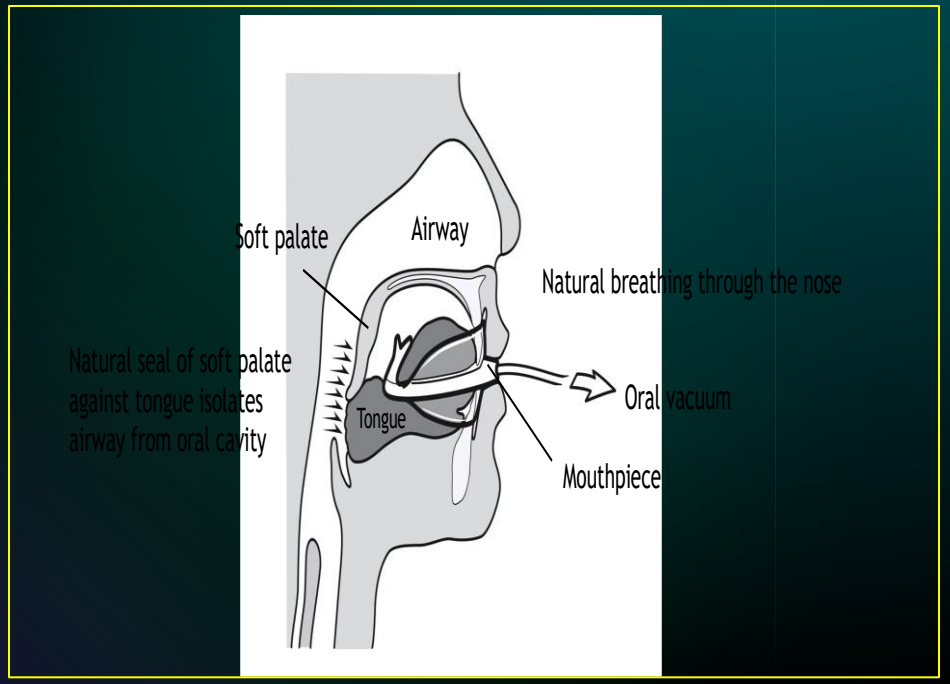




FDA Cleared

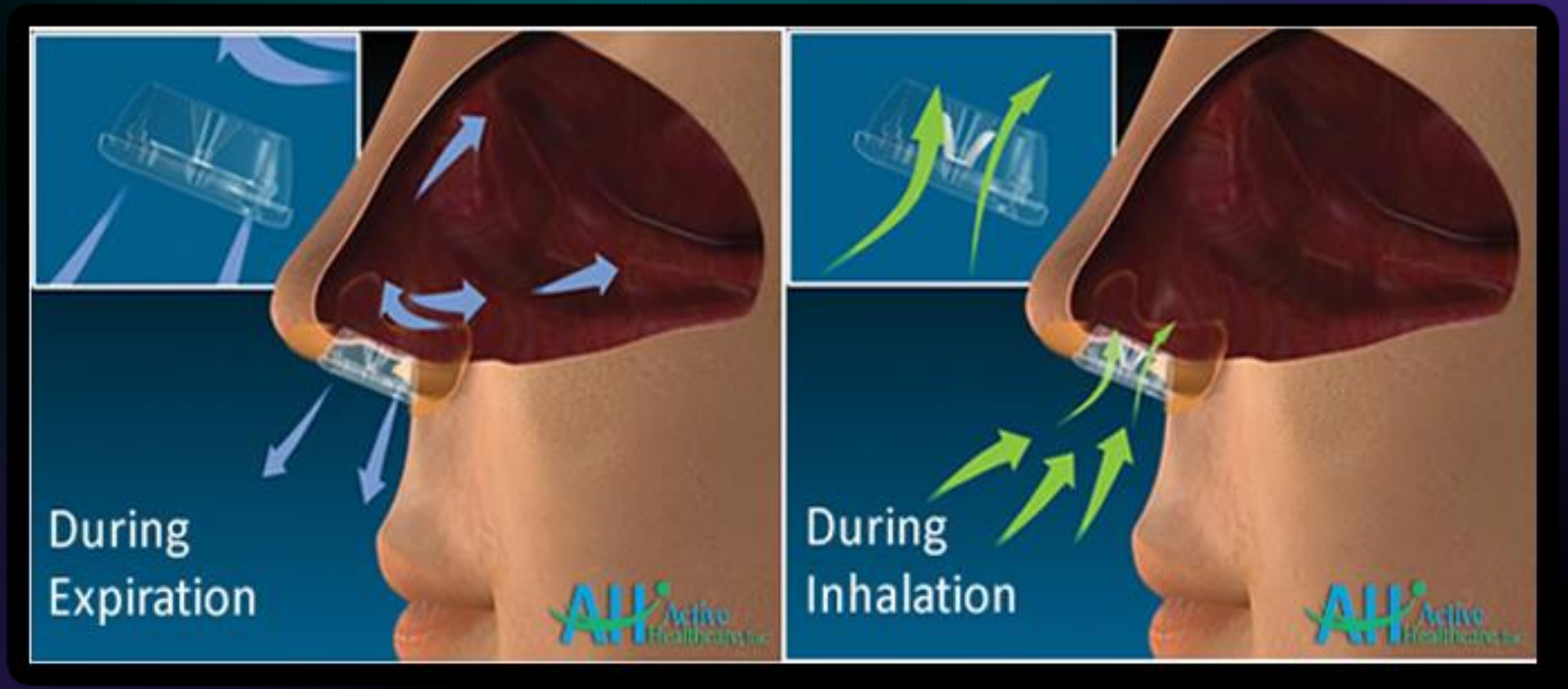

Rigid Tube
Sealed Box
Collapsible Segment
Pin
Pout

Apnic©

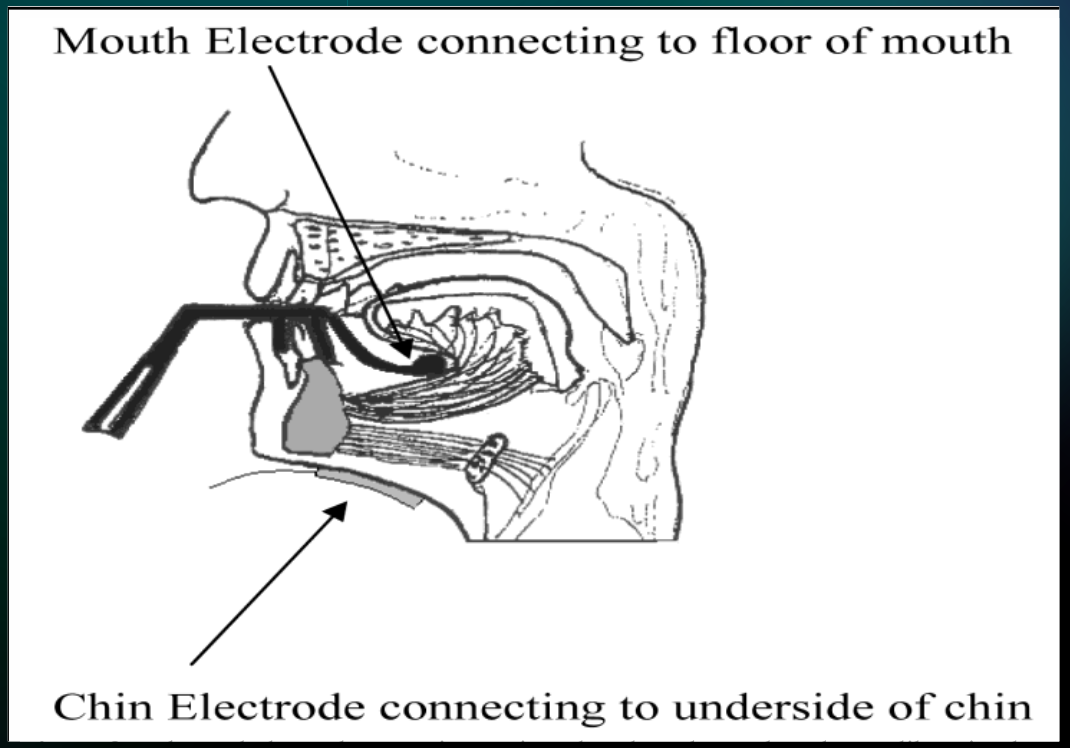

Soft palate
Airway
Natural breathing through the nose
Natural seal of soft palate against tongue isolates airway from oral cavity
Oral vacuum
Tongue
Mouthpiece

Provent

Provent



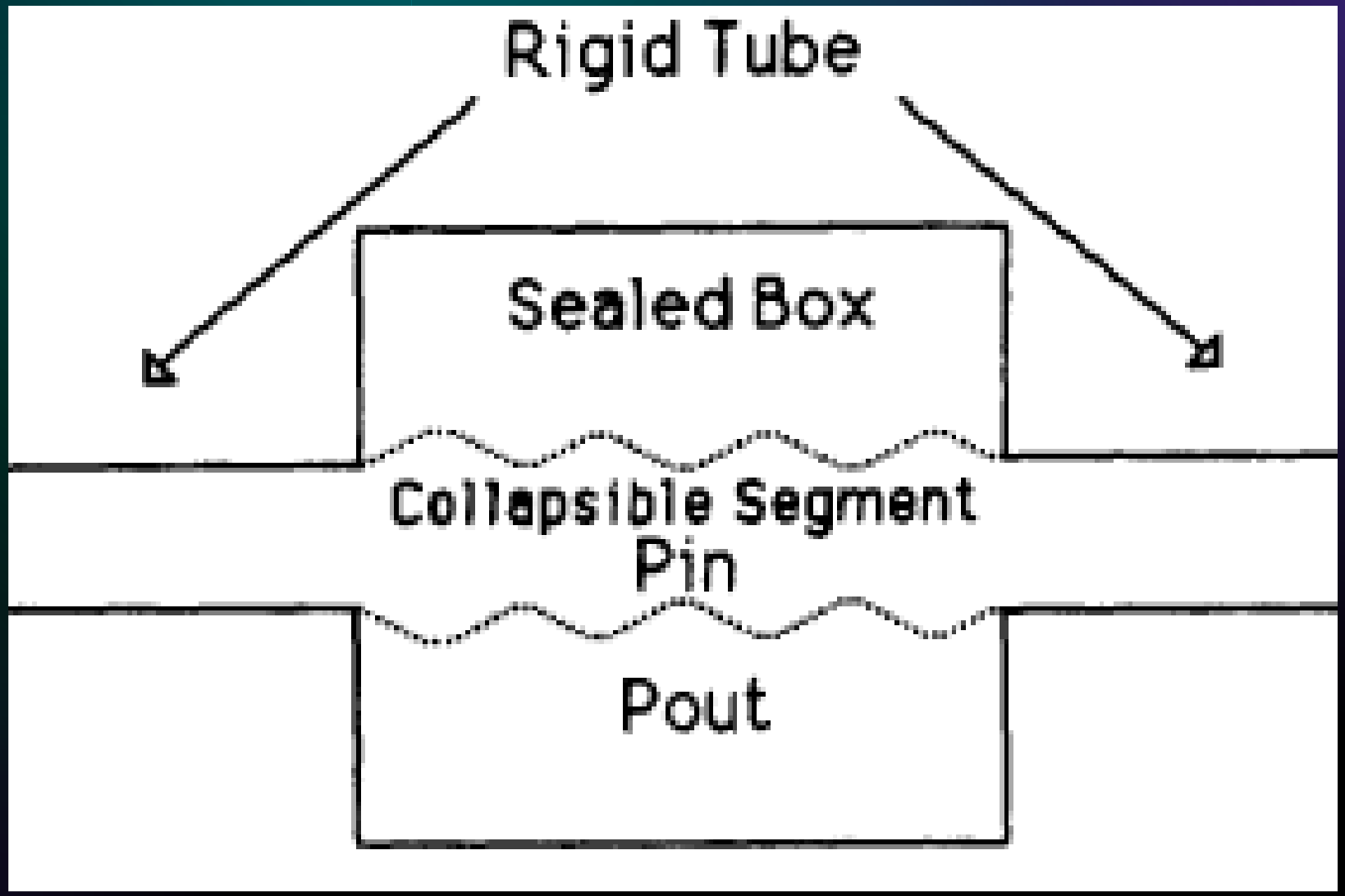
Tongue Muscle Training



- The genioglossus muscle has been implicated as a cause in some individuals with sleep apnea
- Only indicated for snoring

Tongue Retaining Device

The
Ultimate
Controller!!



Pharmacologic Treatment

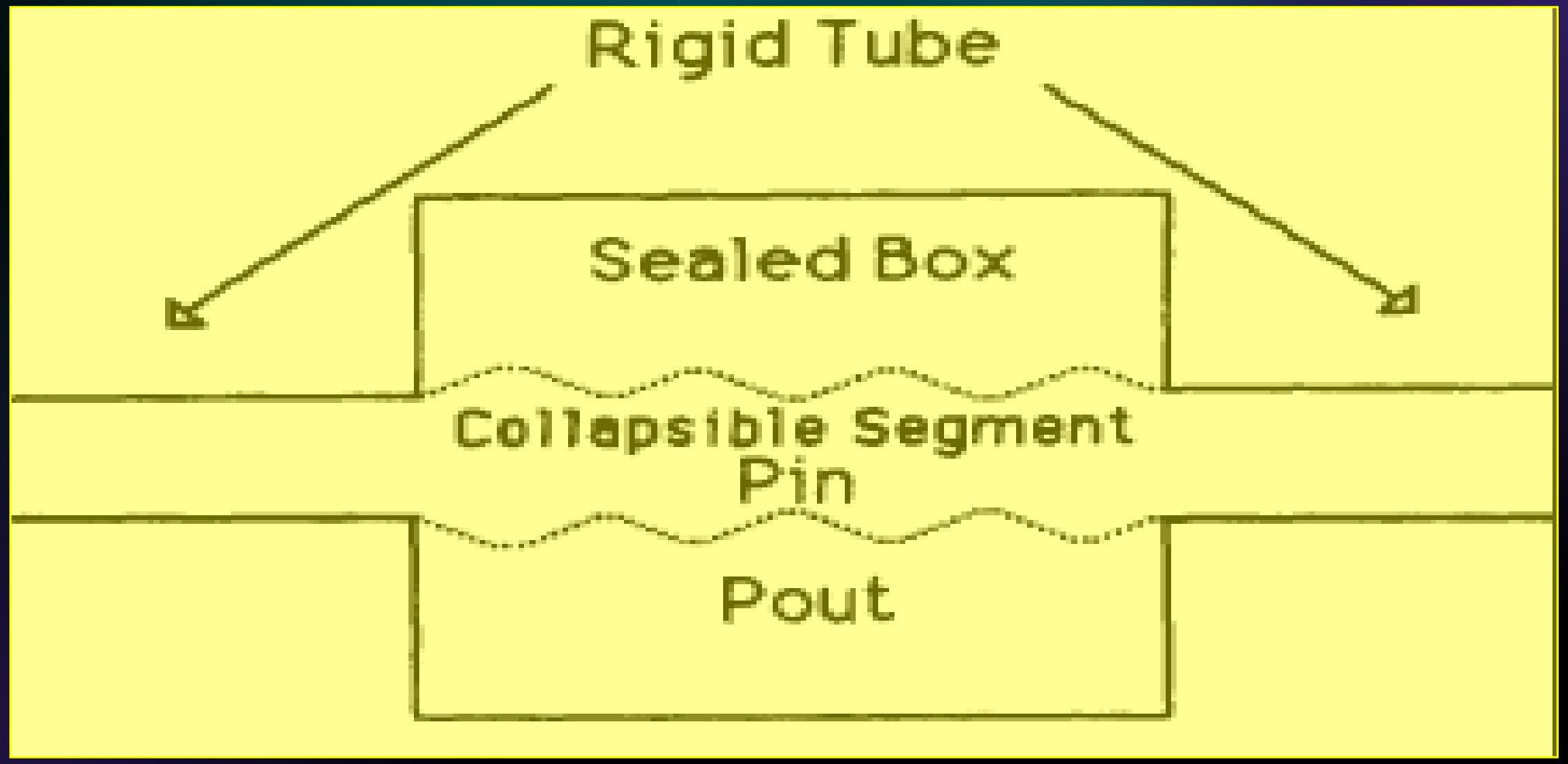
- Acetazolamide (250 mg PO QID)[1]
  - Produces a Metabolic Acidosis
    - Increases Respiratory Drive
      - Mixed results in obese patients
- Almitrine (200 mg PO QD)[2]
  - Respiratory stimulant
    - Sensitizes carotid body receptors
      - May decrease duration of apnea
- Medroxyprogesterone (60-120mg PO QD)[3]
  - Central Respiratory Stimulant
  - May need to be given with estrogen to improve SDB
  - Some success in postmenopausal women
- **GLP-1**
- Mariposa Trial
  - Stimulant+Anticholinergic

[1]Tojima, H.,et.al., Effects of Acetazolamide in patients with the sleep apnoea syndrome. Thorax 1988;43:113-119

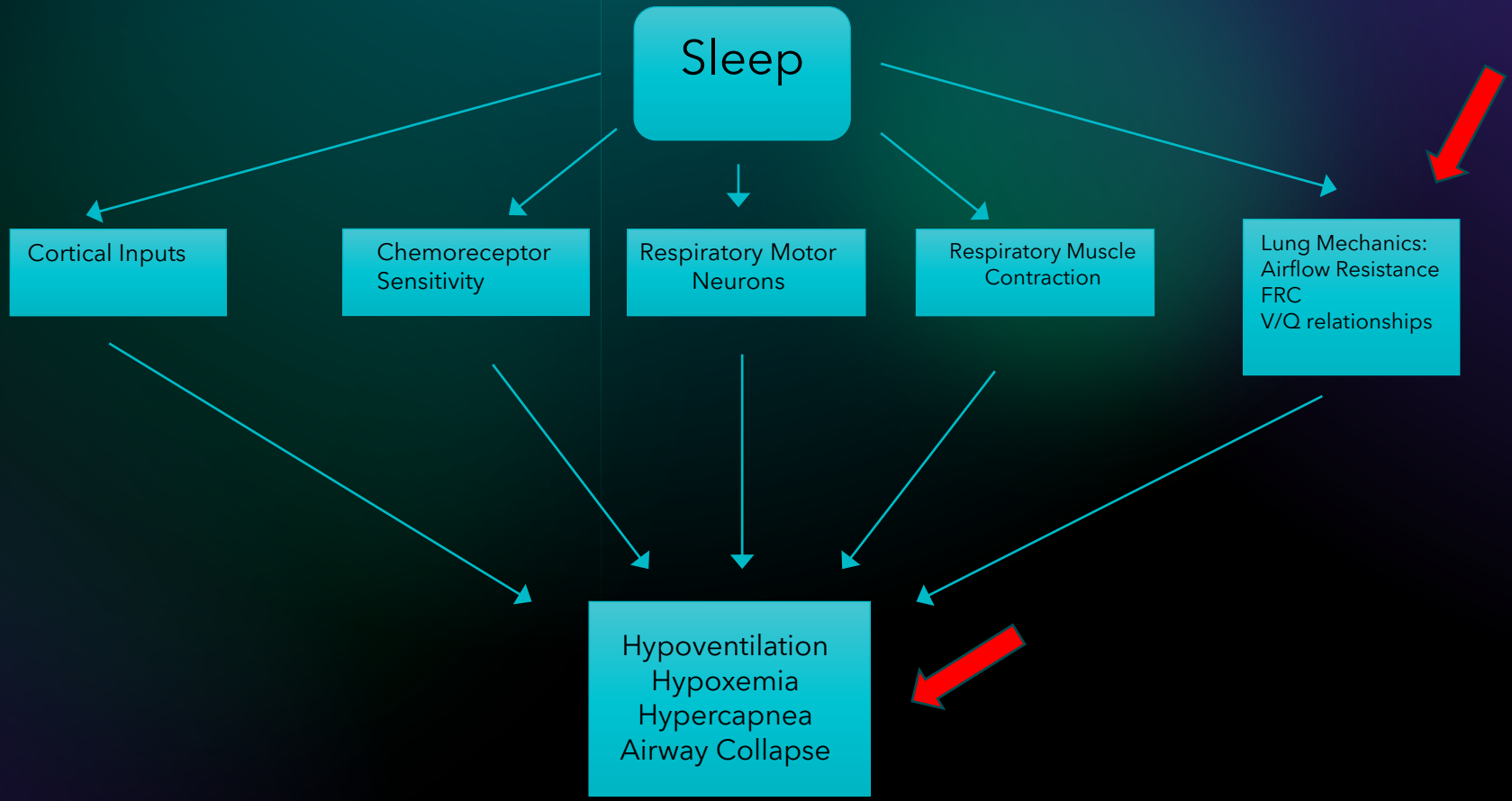
[2]Mangin, P., et.al., Effect of oral almitrine on sleep apnea syndrome. Rev Fr Mal Respir 1983;11:889-906.

[3]Pickett, CK, et. al., Progestin and estrogen reduce sleep disordered breathing in postmenopausal women. J Appl Physiol 1989;66:1656-1661

Obesity Influence

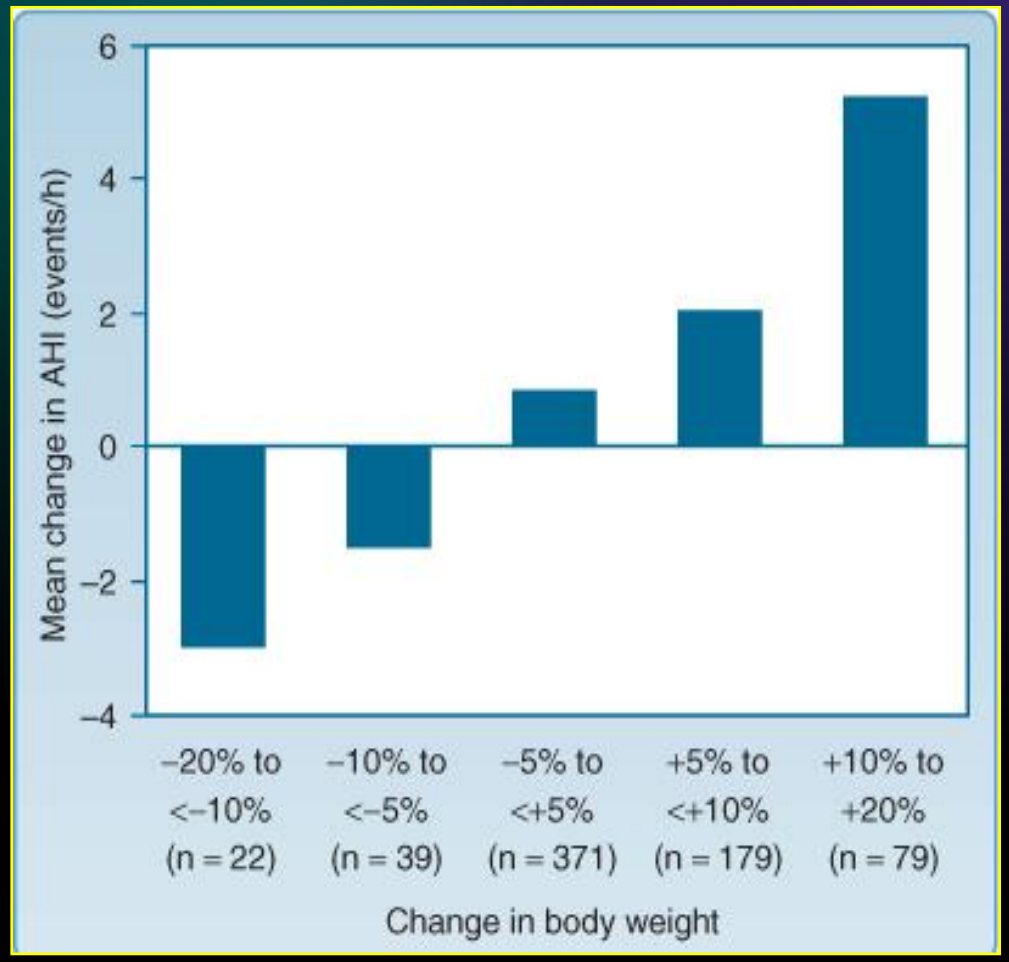


Sleep Effects on Respiration



Weight Loss

- Longitudinal Study by Peppard et. al. in 2000
  - Moderate to severe apnea
- Showed the mean AHI change over a 4 year period
- 10% reduction in weight lead to a 26% reduction in AHI
- Increase in weight of 10%
  - 6-fold increase of developing sleep disordered breathing
- Weight Loss Drugs now readily available



Positional OSAS

Definition

- Exclusive positional obstructive sleep apnea **(ePOSA)** defined as a supine apnea-hypopnea index (sAHI) ≥ 2 times the nonsupine AHI (nsAHI) and a nsAHI < 10 events/h. (Mild OSA)

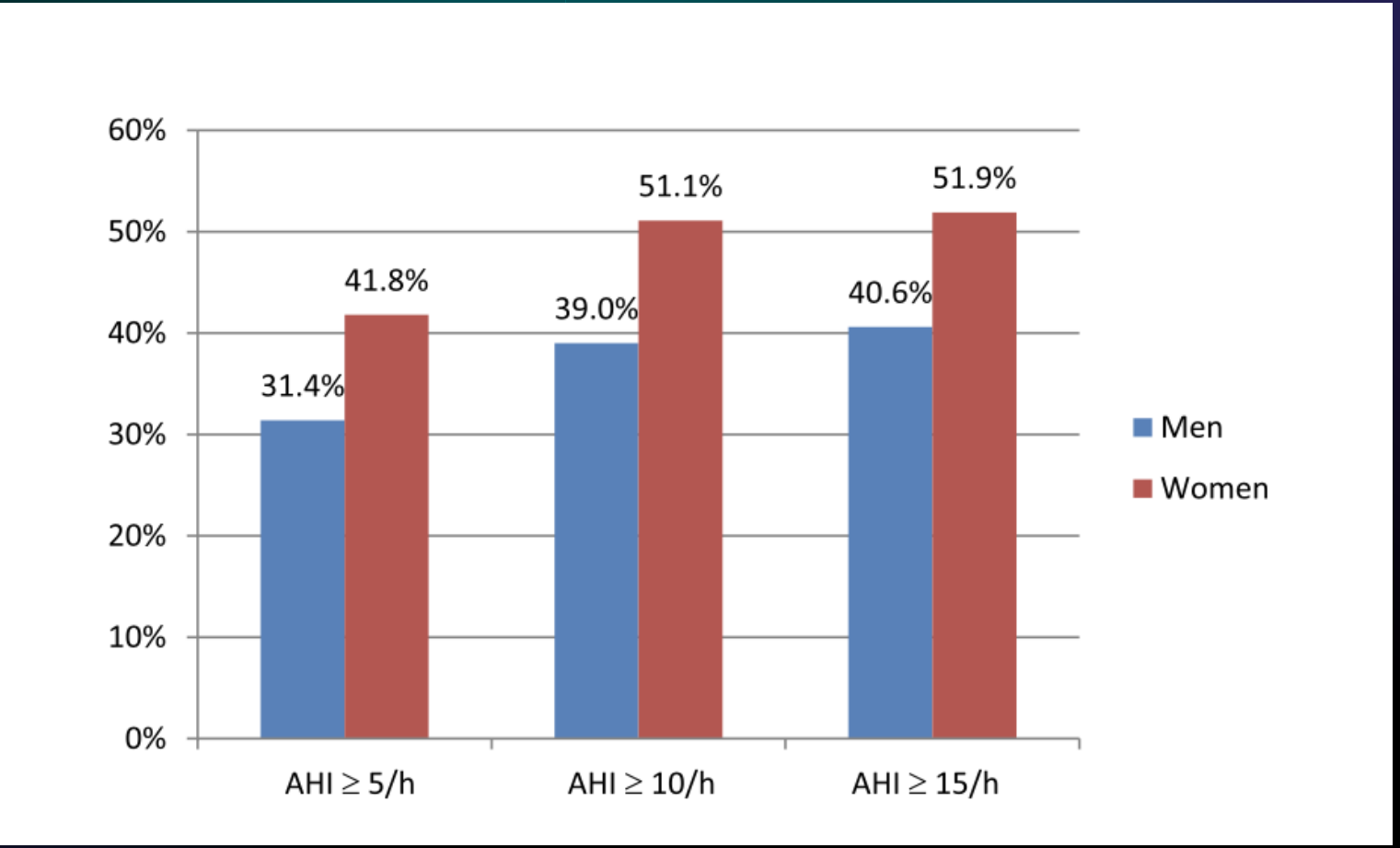
- pOSA is an sAHI twice the nsAHI with an nsAHI > 10

Prevalence of Positional Sleep Apnea

- 1719 subjects (40-85y.o. 46% men) with at least 30 min spent in both the supine and non-supine positions were included.
    - OSA was present in 1224 subjects ------ 71% AHI >5/H
- POSA was present in 53% of all subjects, and in ***75% of OSA subjects***.
    - ePOSA was present in 26% of all subjects and in 36% of OSA subjects.

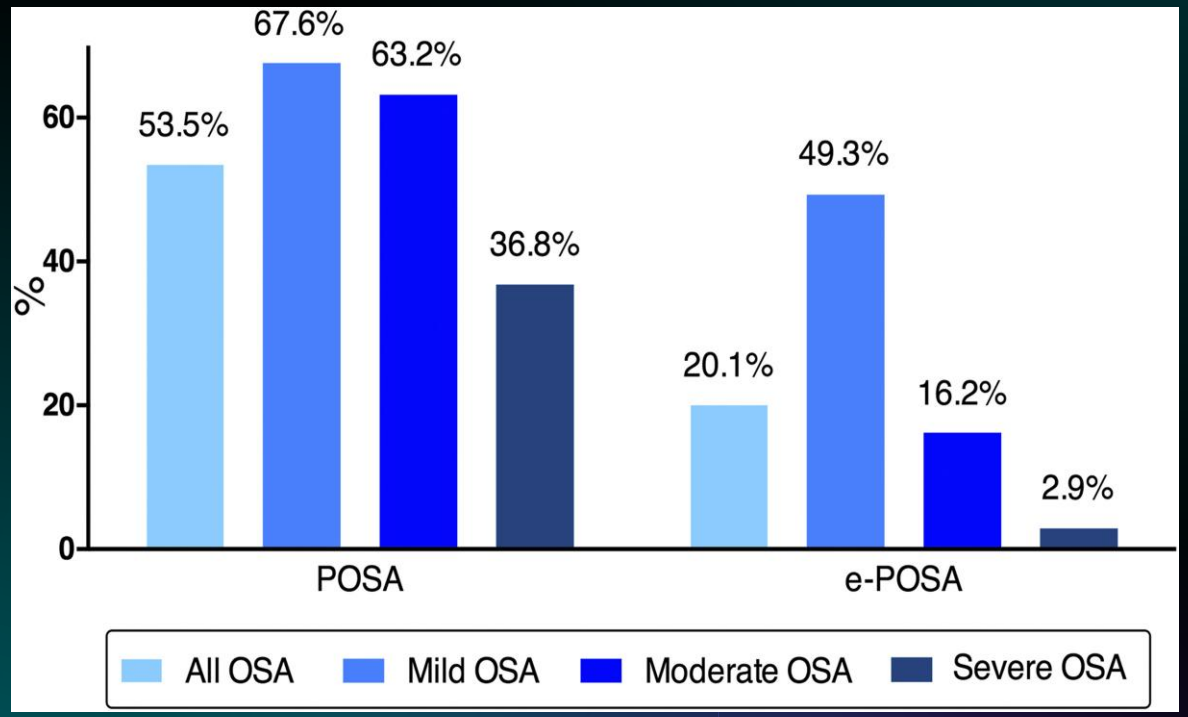
Heinzer R, Petitpierre NJ, Marti-Soler H, Haba-Rubio J. Prevalence and characteristics of positional sleep apnea in the HypnoLaus population-based cohort. Sleep Med. 2018 Aug;48:157-162. doi: 10.1016/j.sleep.2018.02.011. Epub 2018 Mar 9. PMID: 29957486.

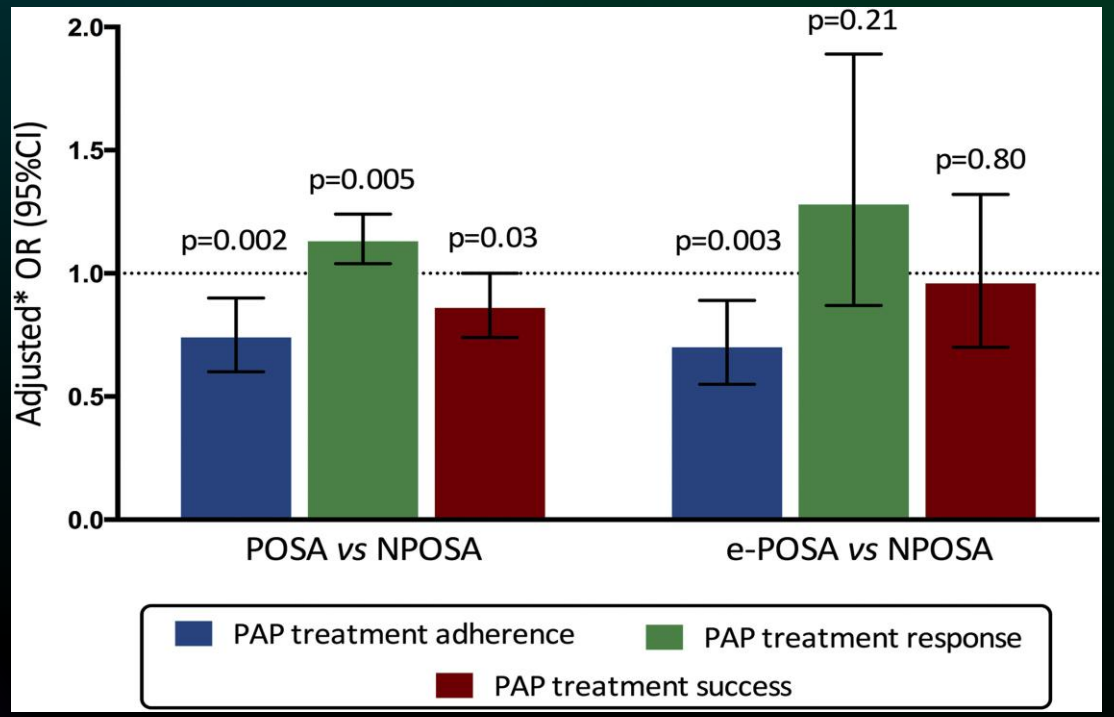
Positional OSAS and Severity



Raphael Heinzer, Nicolas J. Petitpierre, Helena Marti-Soler, José Haba-Rubio, Prevalence and characteristics of positional sleep apnea in the HypnoLaus population-based cohort, Sleep Medicine, Volume 48, 2018, Pages 157-162

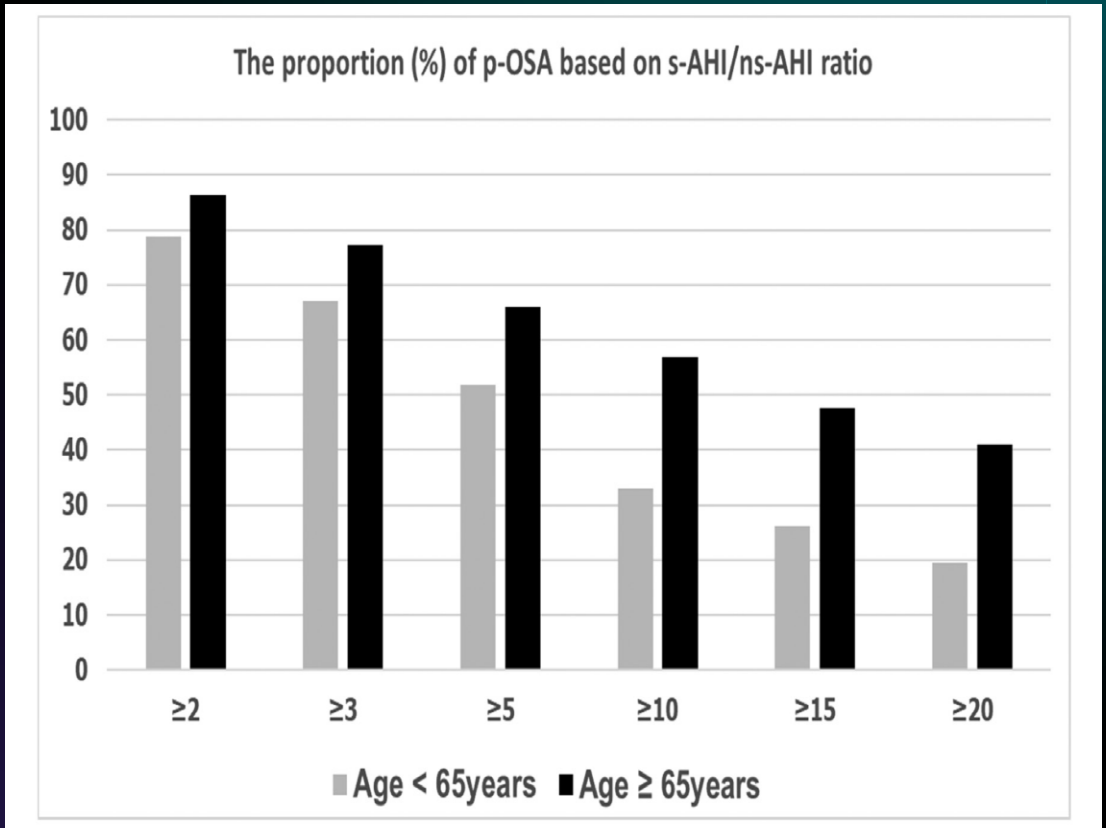
Prevalence of POSA + PAP efficacy

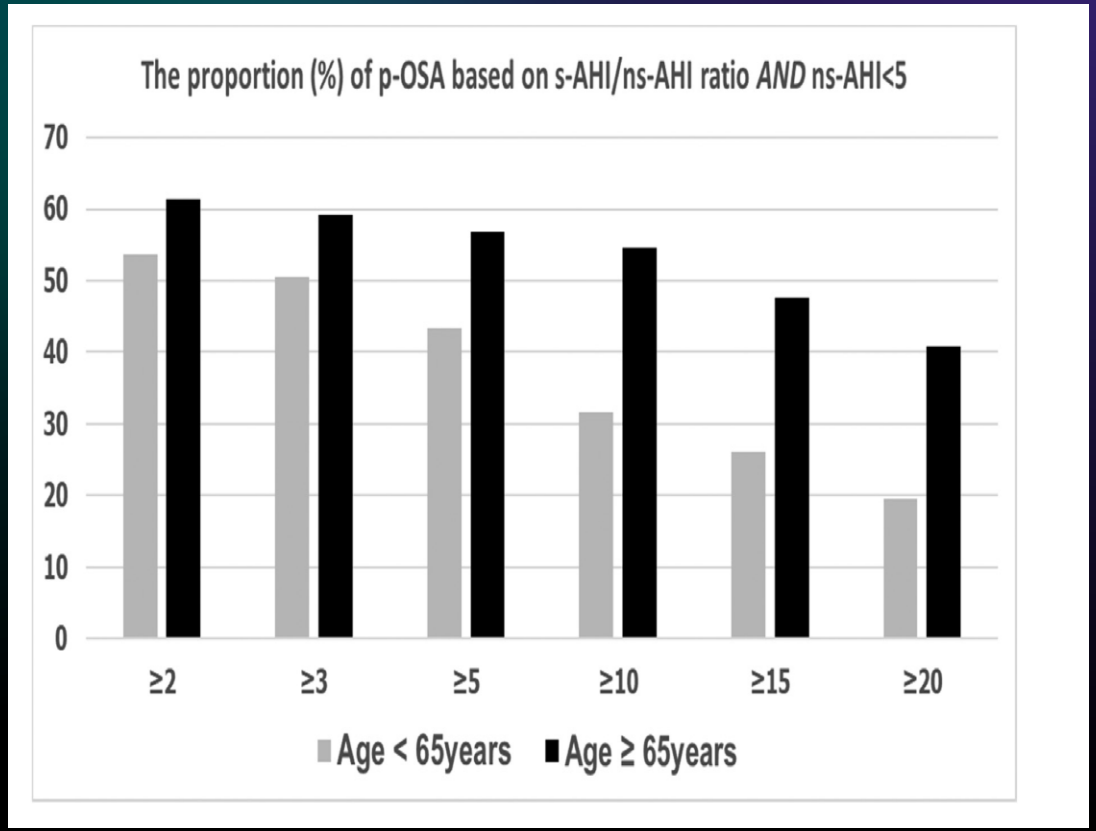




Sabil A, Blanchard M, Trzepizur W, et al. Positional obstructive sleep apnea within a large multicenter French cohort: prevalence, characteristics, and treatment outcomes. *J Clin Sleep Med*. 2020;16(12):2037–2046.

Age and pOSA





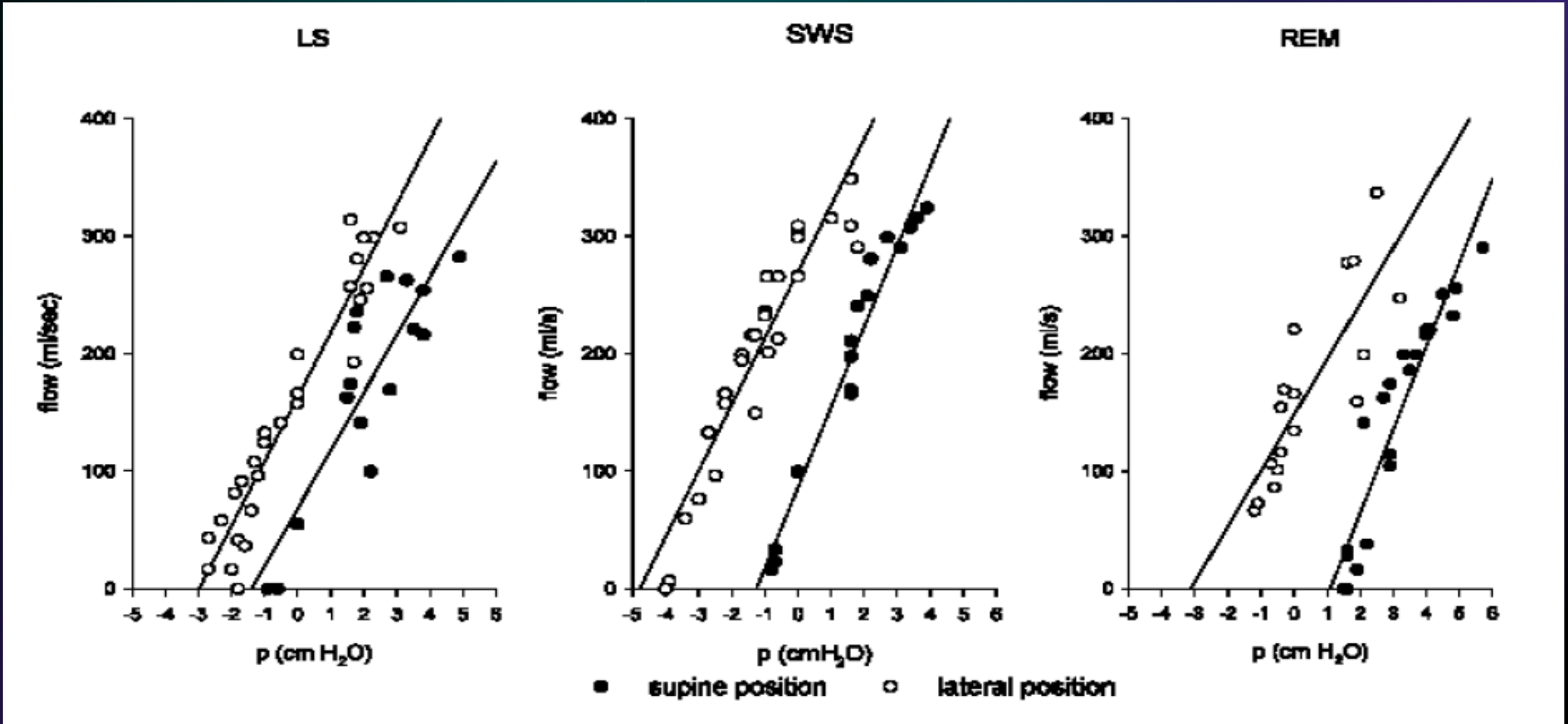
Lydia Ann, Chang-Hoon Lee, Rachel Immen, Mark Eric Dyken, KyoungBin Im, Older Age is Associated With Positional Obstructive Sleep Apnea,The American Journal of Geriatric Psychiatry, Volume 31, Issue 11,2023, Pages 943-952 ,ISSN10647481,https://doi.org/10.1016/j.jagp.2023.05.010.


dreamstime.

Drastic Positional Therapy

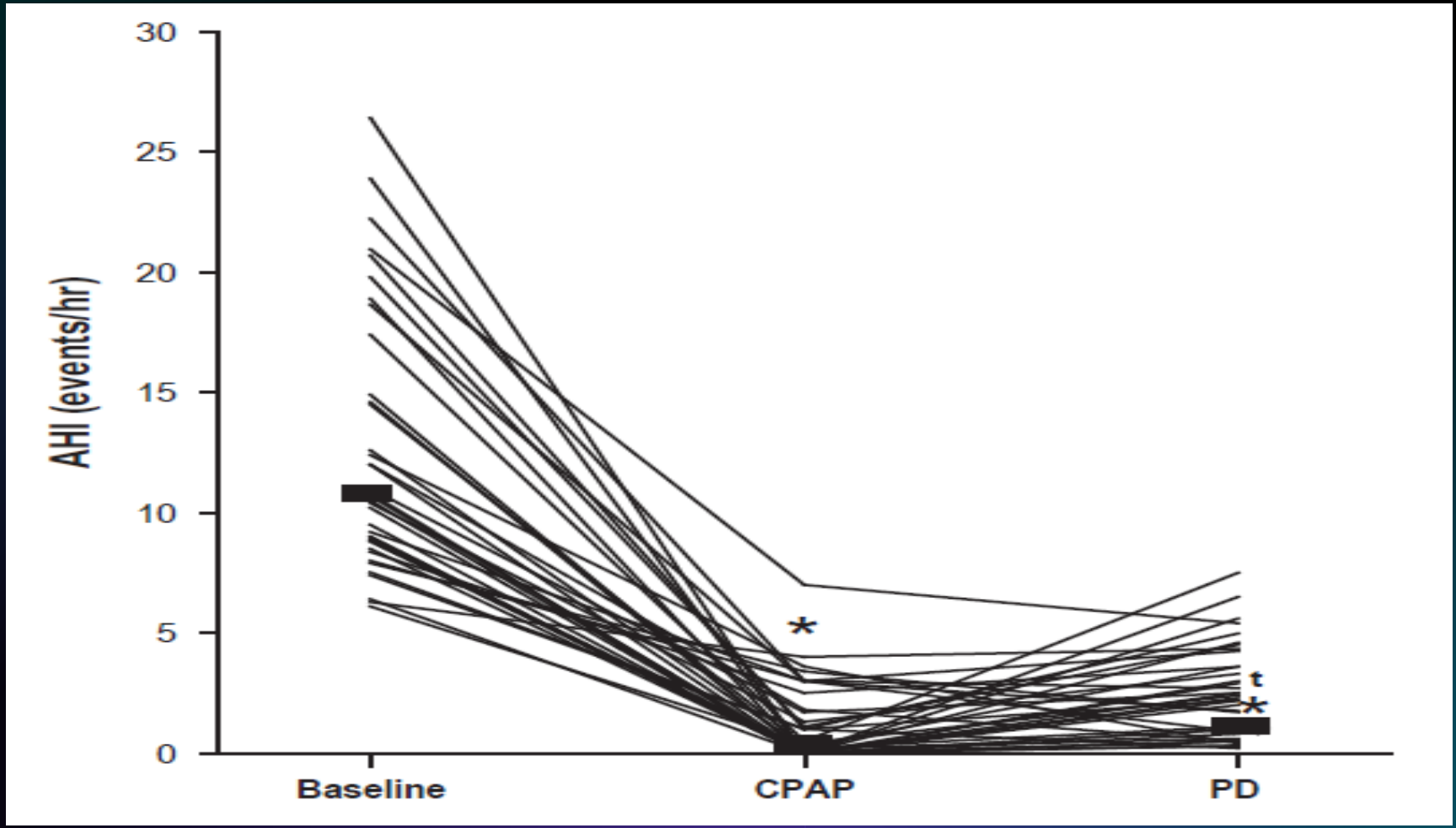
Positional Sleep Apnea Therapy

Airway Closure – Supine vs Lateral



Penzelt et al. Sleep 2001, 24: 90–95.

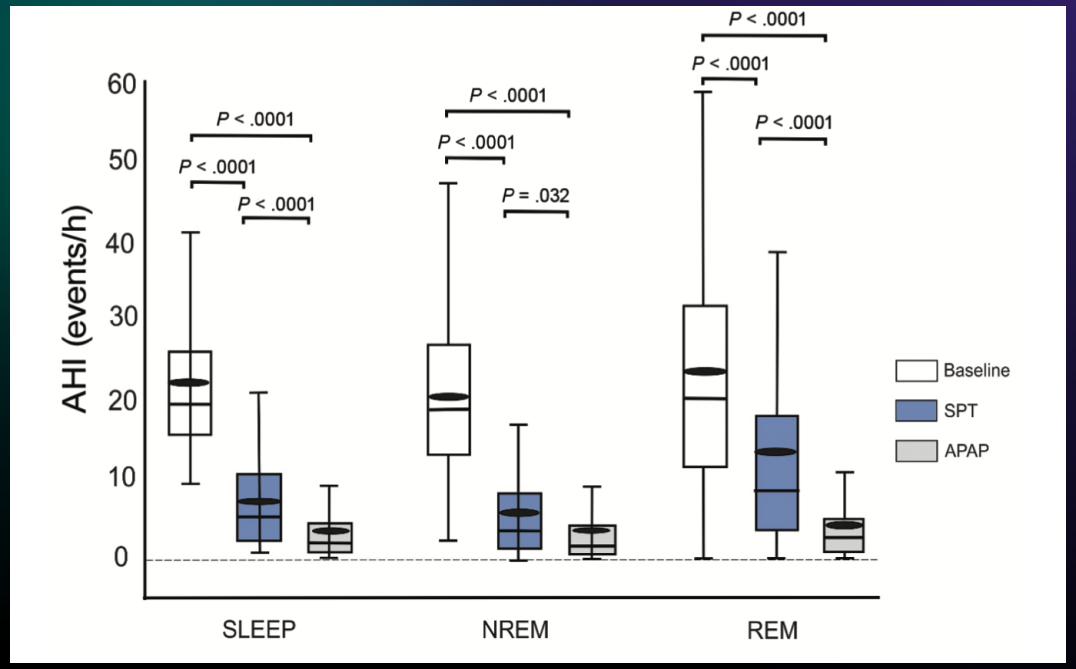
Positional Sleeper



Permut et al *J Clin Sleep Med* 2010;6(3):238-243

Night Balance

- Patients with positional obstructive sleep apnea and a nonsupine apnea-hypopnea index < 10 events/h could potentially be treated with a device preventing supine sleep.
- Non-inferior treatment efficacy and greater adherence compared to APAP in ePOSA suggesting that SPT is an effective treatment for this group.
- NightBalance sleep position treatment (SPT) device provides **a treatment option** that compares favorably with auto-adjusting positive airway pressure
  - reduction in the apnea-hypopnea index
  - treatment adherence is better
- Position treatment devices that are comfortable may be more acceptable to patients than positive airway pressure.



Berry, Richard B et al. “NightBalance Sleep Position Treatment Device Versus Auto-Adjusting Positive Airway Pressure for Treatment of Positional Obstructive Sleep Apnea. vol. 15,7 947-956. 15 Jul. 2019, doi:10.5664/jcsm.7868

Combination Therapy

- Can be combined with any therapy:
  - CPAP
  - Surgery
  - Dental Devices
  - Medications
  - Weight Loss

- One Study after upper airway surgery: (33 patients)
  - Therapeutic effectiveness by improving the median MDA (effectiveness+compliance) from 39.5 % (effect of surgery alone) to 65.6 % (effect of combining surgery and PT).

Benoist LBL, Verhagen M, Torensma B, van Maanen JP, de Vries N. Positional therapy in patients with residual positional obstructive sleep apnea after upper airway surgery. Sleep Breath. 2017 May;21(2):279-288. doi: 10.1007/s11325-016-1397-x. Epub 2016 Aug 17. PMID: 27535072.

Cost of Treatment

- AASM cost of ongoing CPAP therapy $2000 plus per year
  - Costs for initiating auto-titrating CPAP therapy ($962.49) in the home were based on IBC pricing for LEHB
  - Costs for the Zzoma Positional Device® ($189.95) were based on the suggested retail price at the time of the study

Vega, Maria Elena et al. “Use of positional therapy when incorporated into a diagnosis-treatment algorithm for obstructive sleep apnea.” vol. 12,1 (2019): 15-20. doi:10.5935/1984-0063.20190052

Just for fun

Happiness

- Treating Sleep Apnea is a little like trying to make people HAPPY
- It is not a one size fits all solution.
  - Obesity
  - Upper Airway Anatomy
  - Loop Gain
    - Plant – Upper airway devices, surgery ---Various
    - Controller - Medications

- Sleep Apnea Therapy needs to be individualized and tailored

Thank you for listening!

Questions?