Who Am I?

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USPHS officer 1990 - 2016, currently work as hospitalist in Tulsa and as a buprenorphine prescriber for Cherokee Nation and I read sleep studies for Cherokee Nation

Board Certified IM (1997 + recerts) and Sleep Medicine (2011+ recert)

I have no financial disclosures

Obstructive Sleep Apnea and Diabetes Mellitus

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Goals of Presentation

- What is OSA?
- What is the relationship between OSA and DM?
- Testing for OSA
- Treatment of OSA
- OHS

Obstructive Sleep Apnea (OSA)

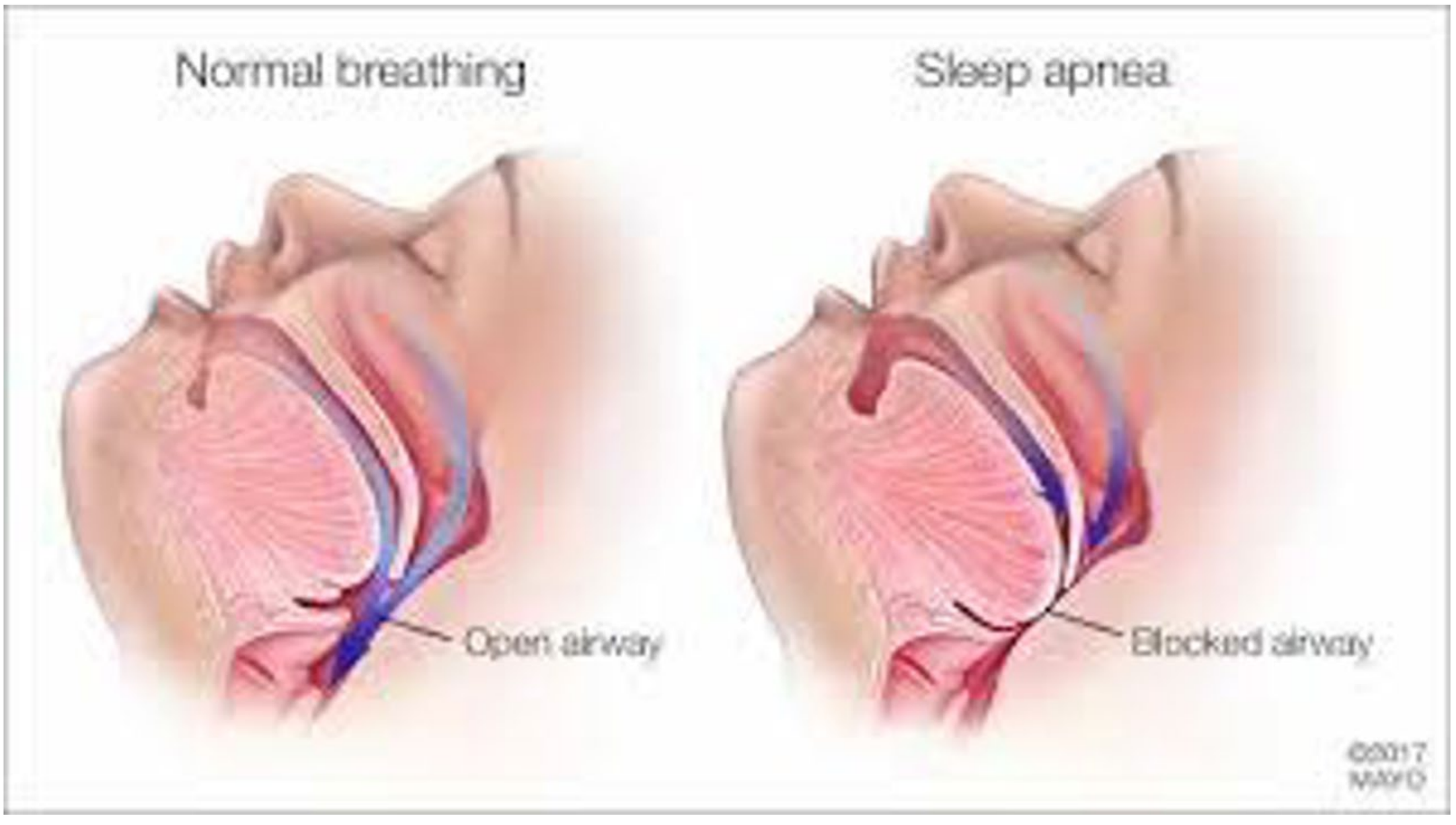
Due to Mechanical obstruction of the airway during sleep, patients stop breathing when asleep

- The Mechanical obstruction is most often loose tissue (from excess tissue i.e., adipose, also from loose tissue i.e., age) but can also be enlarged tissue like tonsils and adenoids in children or rarely masses and sometime morphologic abnormalities

DM

A disease in which the body’s ability to produce or respond to the hormone insulin is impaired, resulting in abnormal metabolism of carbohydrates and elevated levels of glucose in the blood and urine.

Sleep Apnea


Normal breathing
Sleep apnea
Open airway
Blocked airway
©2017
MAYO

Central Sleep Apnea

This is another sort of sleep apnea where the there is no effort to breath, less common than obstructive, but very common with heart failure patients and stroke and opiate use.

Cardiac Hospitalizations and Sleep Disorders

- 104 cardiac hospitalized patients with symptoms of sleep disordered breathing were studied with portable home sleep study in house and if study was positive were started on PAP therapy in the hospital
  - 81/104 had AHI > 5, 65/81 events were obstructive, 16/81 events were central
  - 19% of hospital patients were compliant with PAP therapy and 0% of them had readmissions

Kauta sr et al, “Diagnosis and treatment of sleep disordered breathing in hospitalized cardiac patients: a reduction in 30-day readmission rates”, *J Clini Sleep Med, (*2014) 10(10): 1051-1059

How Common is OSA

- Children 2-4%
- Adults 10% - 25% with men 2x as likely as women
- Hospitalized Adults OSA rates 2 out of 5
- Adult patients with cardiac disease have rate of OSA 2 - 3x greater than general population
- Heart failure patients have rates of OSA and CSA 50-80% (Katua reference)
- 90% of adults undiagnosed
- **In adult patients with DM - 71% have OSA** (ASMS The Link Between Sleep Apnea and Diabetes - 2018)

(Shear et al, "Risk of Sleep Apnea in Hospitalized Older Patients“, J Clinic Sleep Med, (2014),:10(10):1061-1066)

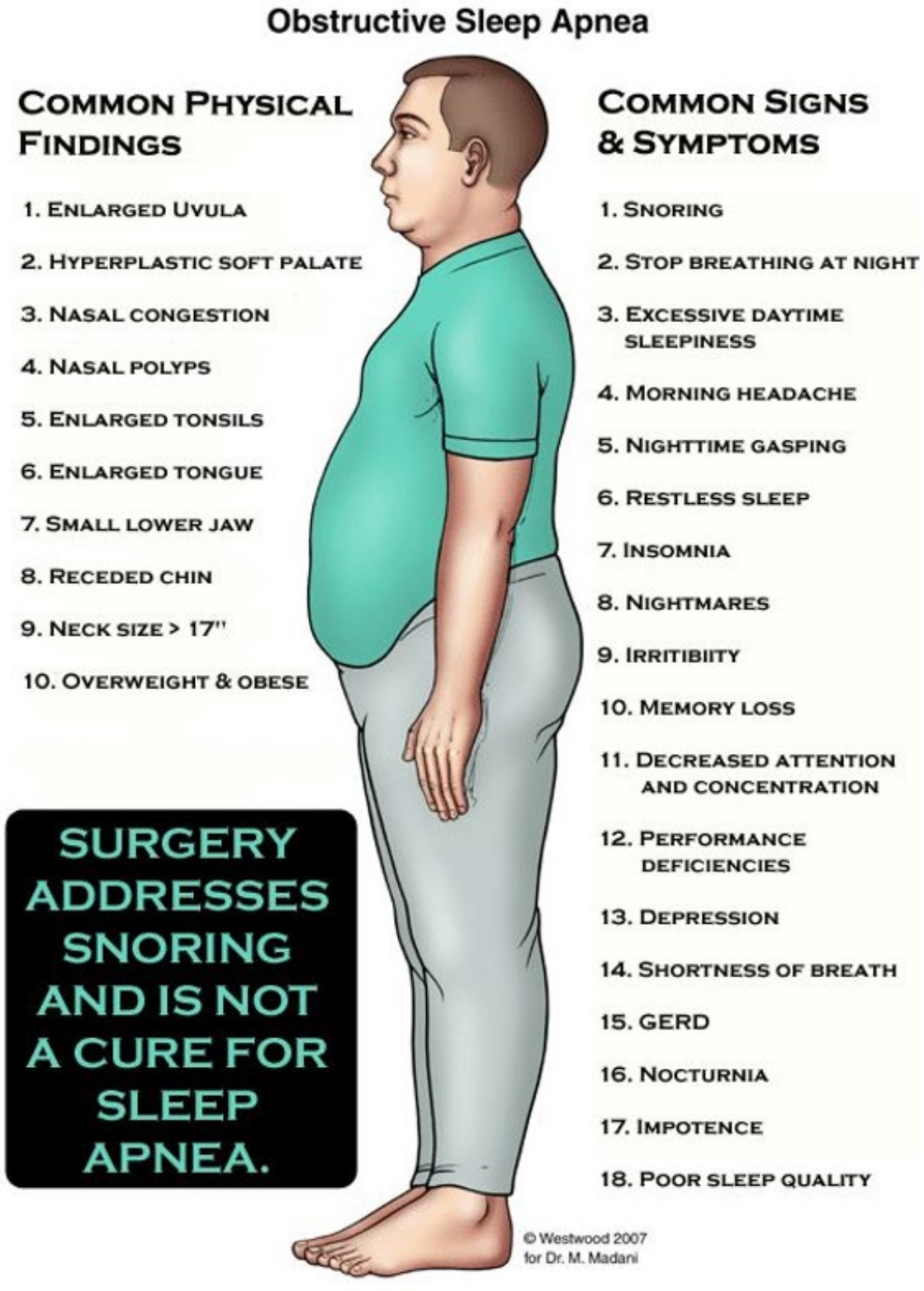
Ondrej et al, "Sleep Apnea, Cardiac Arrhythmias and Sudden Death“, Texas Heart Journal, (2011), 33(4): 340-343

How Common is DM

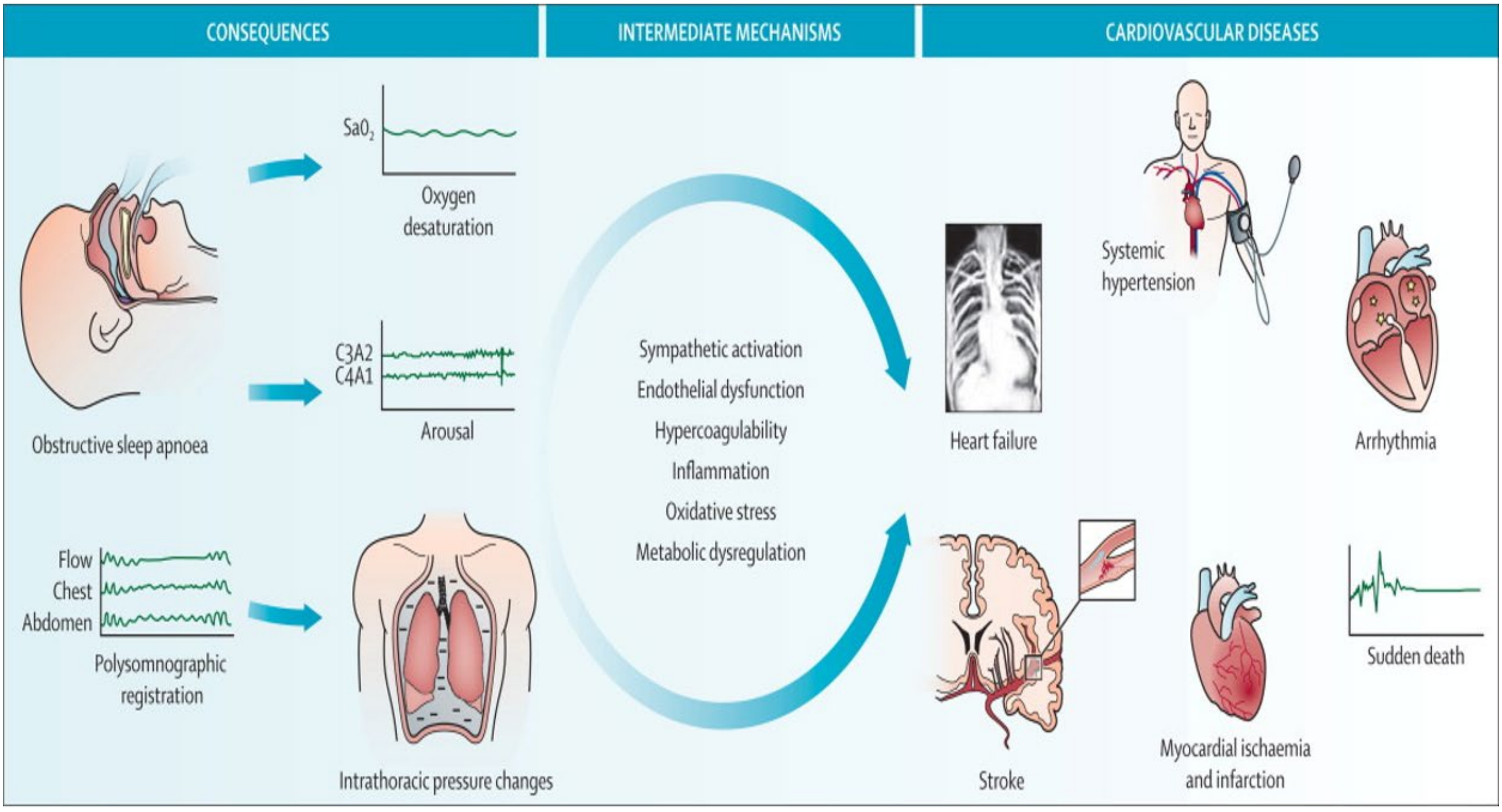
- Current estimates are 110 million people at risk or with the disease DM (30 million in active treatment for DM)
- Recall - the damage begins as fasting blood sugars rise above 80 - 90 which is before patients meet criteria for DM dx

OSA Risk Factors

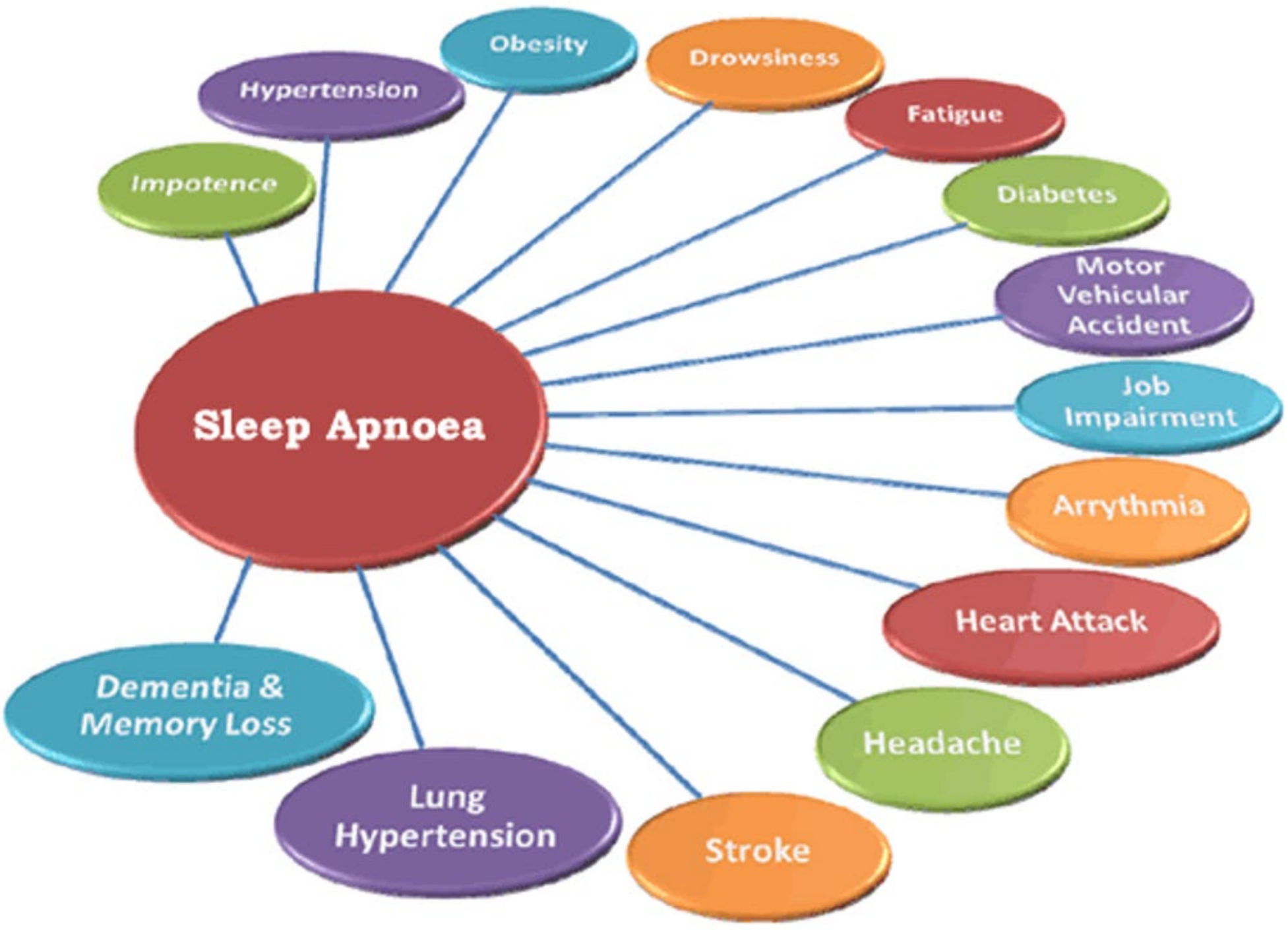
- AGE



Consequences of OSA

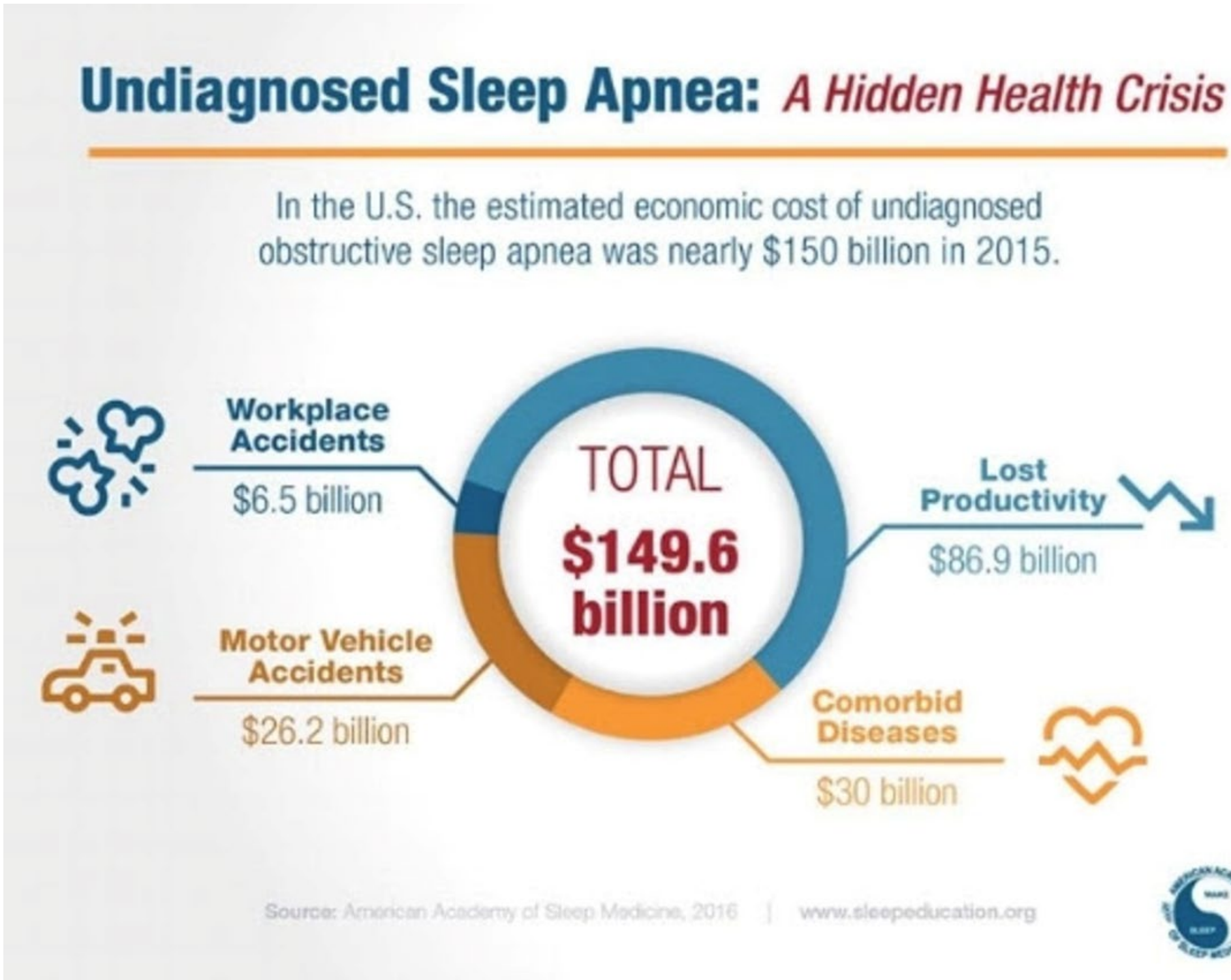


Sleep Apnea and Other Health Issues



Sleep Apnea and Cardiac Deaths

Cost of Undiagnosed Sleep Apnea



OSA and DM

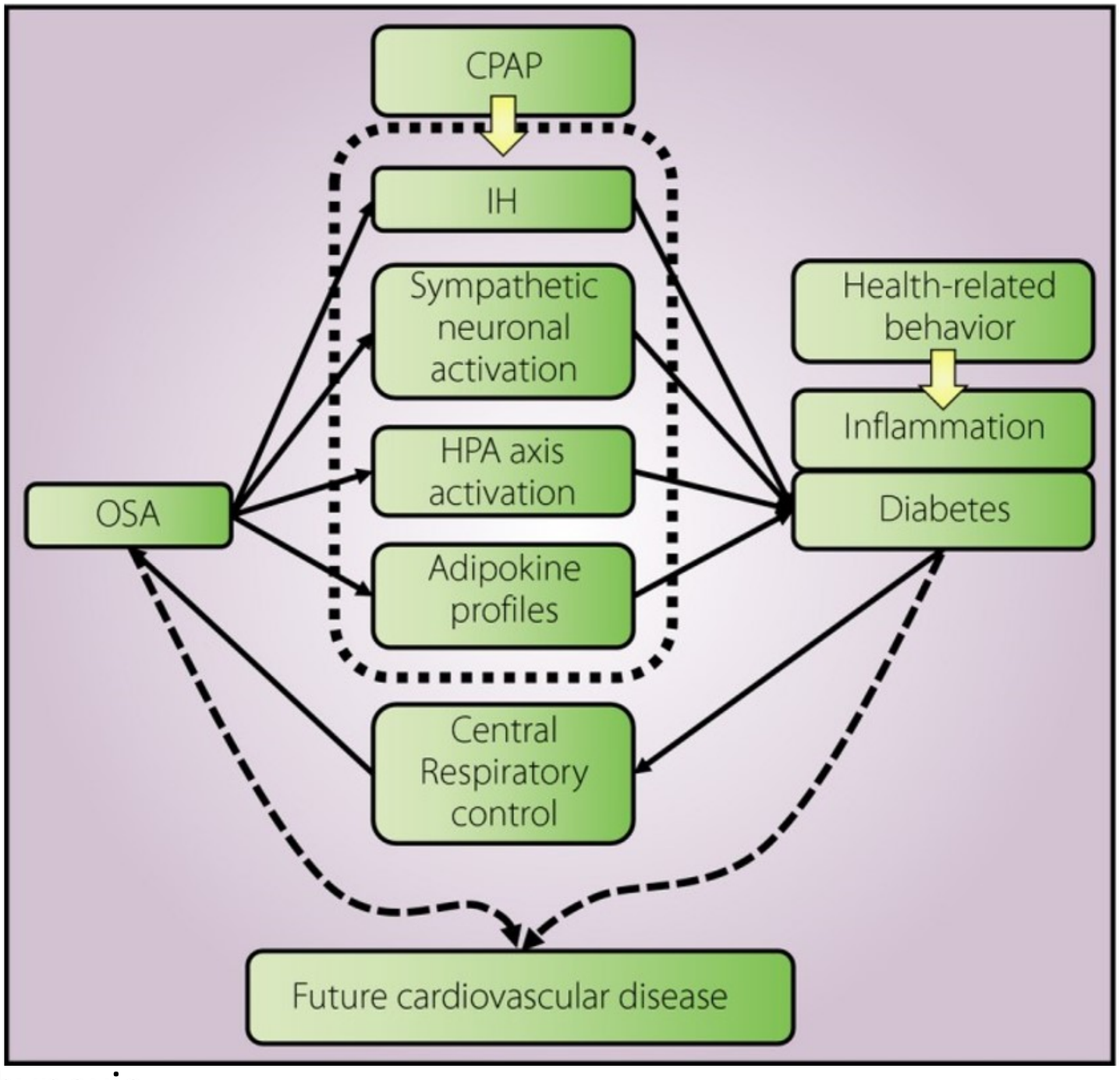
- OSA is more common with DM2 but is also more common than otherwise expected with DM1 (26%-70% depending on study)
- So, the relationship works both ways, patients with DM are more likely to have OSA (71%) and patients with OSA are more likely to have DM (1/3)
- The more severe the OSA the more likely the patient will have DM
- The higher the AHI (Apnea Hypopnea Index) the higher the A1c
- There is no correlation between patient perceived daytime sleepiness and presence of OSA in patients with DM - Lorenzi filho

Link Between OSA and DM

Why? It is not clear, possible explanations:

- Hypoxia
- Fragmented sleep
- "a cascade of events - increased negative thoracic pressure - arousals from sleep and intermittent hypoxia lead to increased sympathetic activity, oxidative stress, metabolic deregulation (insulin resistance and lipid dysfunction) and endothelial dysfunction and accelerated atherosclerosis " Lorenzi - filho
- DM may change the neuro reflex of the upper airway making OSA more likely

Treatment Effects



IH – intermittent hypoxia.

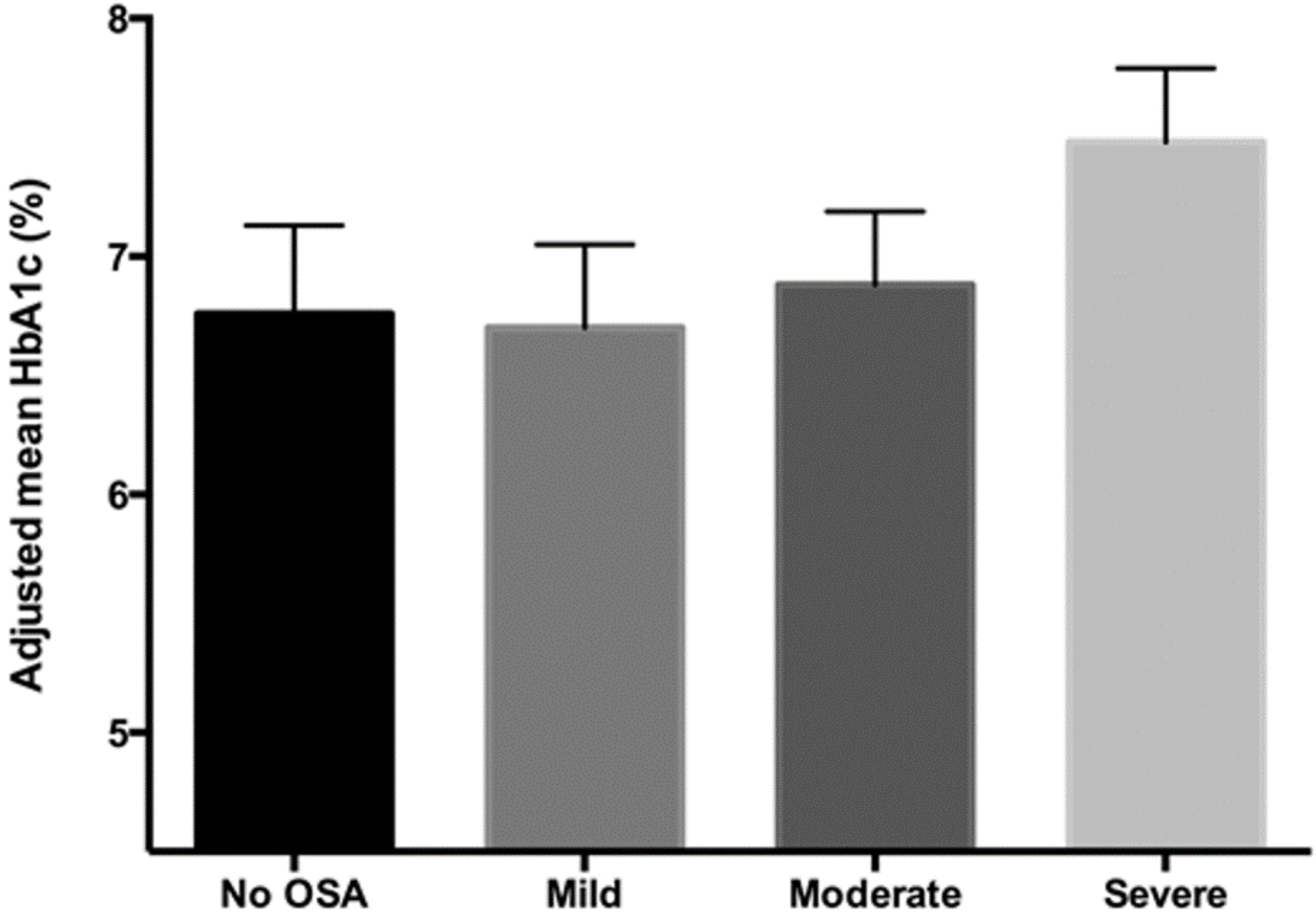
HPA – hypothalamic pituitary adrenal axis adipokine – cytokines secreted by adipose.

Muraki et al, "Sleep Apnea and type 2 diabetes", *Journal Diabetes Investig,*. (2018) September, ;9(5):991-997

Does OSA Treatment Improve DM?

- Studies are mixed
- PAP compliance is so poor that studies are difficult to interpret
- Some evidence that treatment of OSA before the onset of frank DM may improve DM

Sleep Apnea Severity and HbA1c



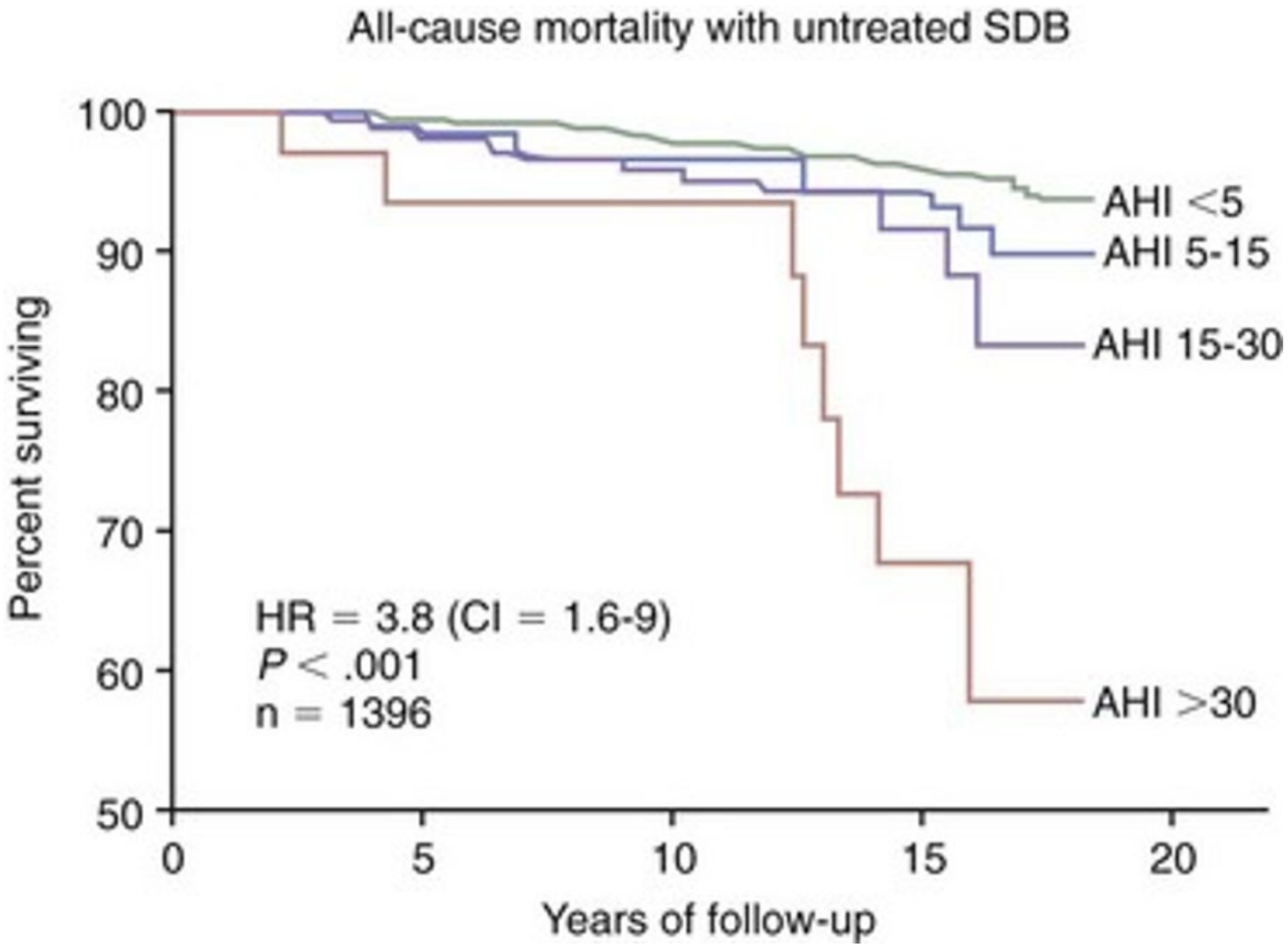
Kent, B.D. et al, “Diabetes mellitus prevalence an control in sleep-disordered breathing: the European Sleep Apnea Cohort (ESADA) Study.” Chest 146(4),982-990 2014

In Summary

1. OSA and Type 2 DM are highly prevalent and share common risk factors, with obesity being the most prominent. Complications related to OSA, Type 2 DM and obesity often overlap.
2. Intermittent hypoxia and sleep fragmentation in OSA may affect glucose metabolism and insulin sensitivity.
3. There is currently a lack of evidence to support the benefits of screening every DM patient for OSA.
4. DM patients with symptoms suggestive of OSA may be referred to a sleep specialist for further evaluation.
5. CPAP remains the standard treatment for OSA and should be offered to all symptomatic patients.
6. Limited evidence suggests that CPAP treatment may improve glycemic control.
7. Diabetic medications, together with lifestyle modifications and weight loss, remain the mainstay of treatment to achieve optimal DM control.
8. Further research is necessary to clarify the pathophysiological mechanisms and develop treatment strategies for patients with both DM and OSA.

Mok, Y et al, “Obstructive sleep apnea an type 2 diabetes mellitus: are they connected?” *Singapore Med J.,* (2017) Apr, ;58(4):179-183

Mortality of OSA



Modified from Young T, Finn L, Peppard PE, et al: “Sleep-disordered breathing and mortality: eighteen-year follow-up of the Wisconsin Sleep Cohort.”, *Sleep,* (2008);31:1071-1078.

Diagnose OSA

- Home sleep study
- In Lab sleep study
- The potential PAP payer will largely determine what test is best used and what therapy is available to the patient

OSA Treatment

- Mild OSA - weight loss and position therapy and dental implants are realistic therapies
- Moderate to Severe OSA requires PAP therapy to treat, CPAP (constant pressure) or BiPAP (bilevel pressure PAP)
  - CPAP is quite affordable
  - BiPAP is often quite pricey - and high pressure BiPAP machines (>25 mgH2O) are often hard to obtain for patient

OSA Treatment (con’t)

Auto PAP is a real treatment option for patients that do not have COPD or CHF or neuro - muscular based resp failure or other chronic resp failure with hypercapnia - BUT, I have not found that insurance will pay.

Obstacles to OSA Therapy

- Accessing sleep evaluation
- Accessing recommended PAP therapy and equipment
- Patient compliance with therapy
  - Patient compliance with PAP therapy is about 20 - 30% (similar to compliance with other chronic medical therapy, but insurance can interrogate machine and determine patient compliance and if used < 4 hours a night they will have supply company remove machine from home)
  - Trying different masks and head gear, humidified air, and treating nasal congestion will all improve compliance

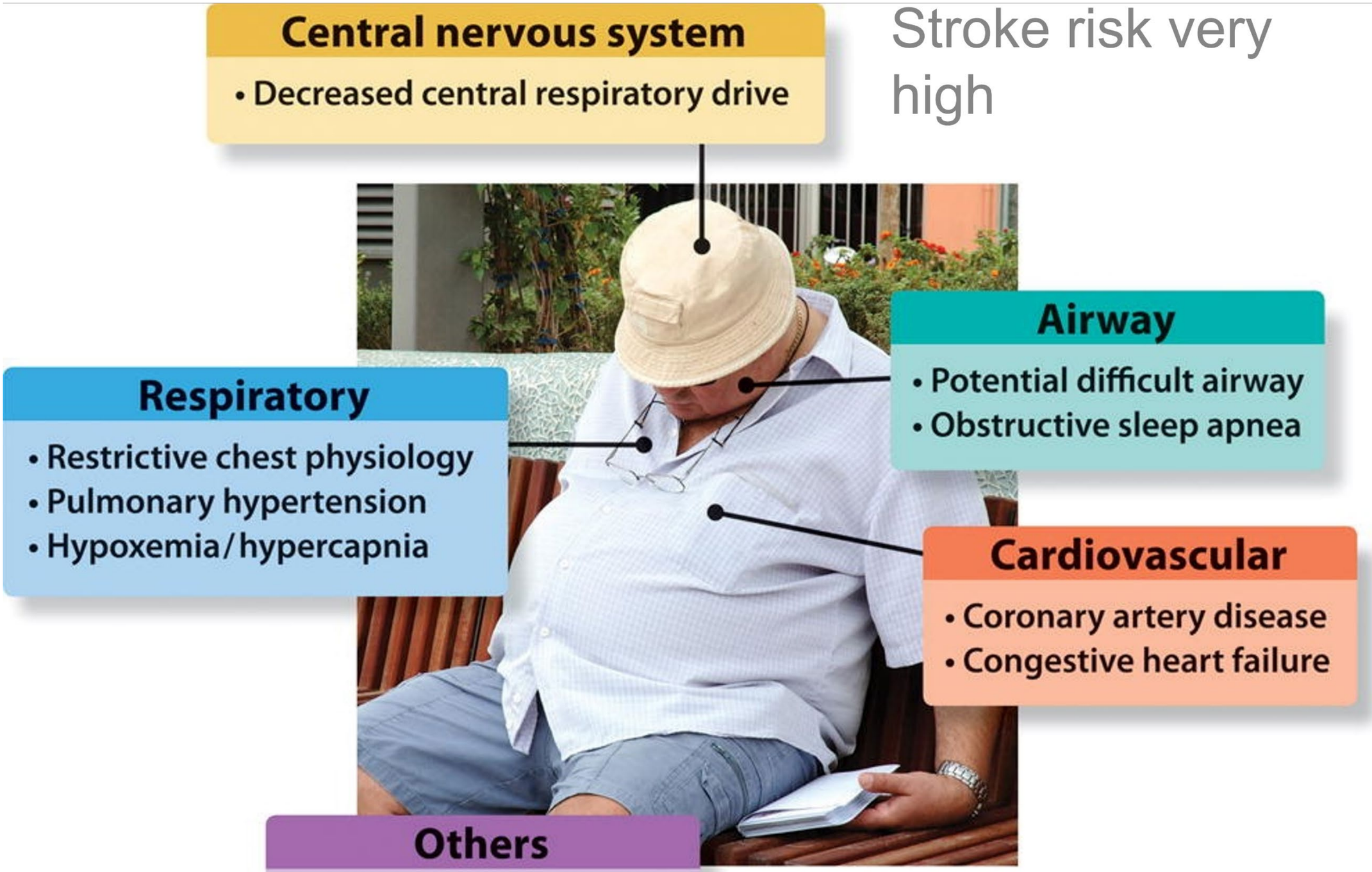
Obesity Hypoventilation Syndrome

OHS Definition

- BMI> 30
- PCO2> 45
- Chem Bicarb> 27 with OSA (50% will have OHS)
- OSA is present in 90% of people with OHS
- 10% have pure obesity hypoventilation

Effects of OSA

Stroke risk very high



Chau, E et al Anesthesiology 2012

Terminal Presentation

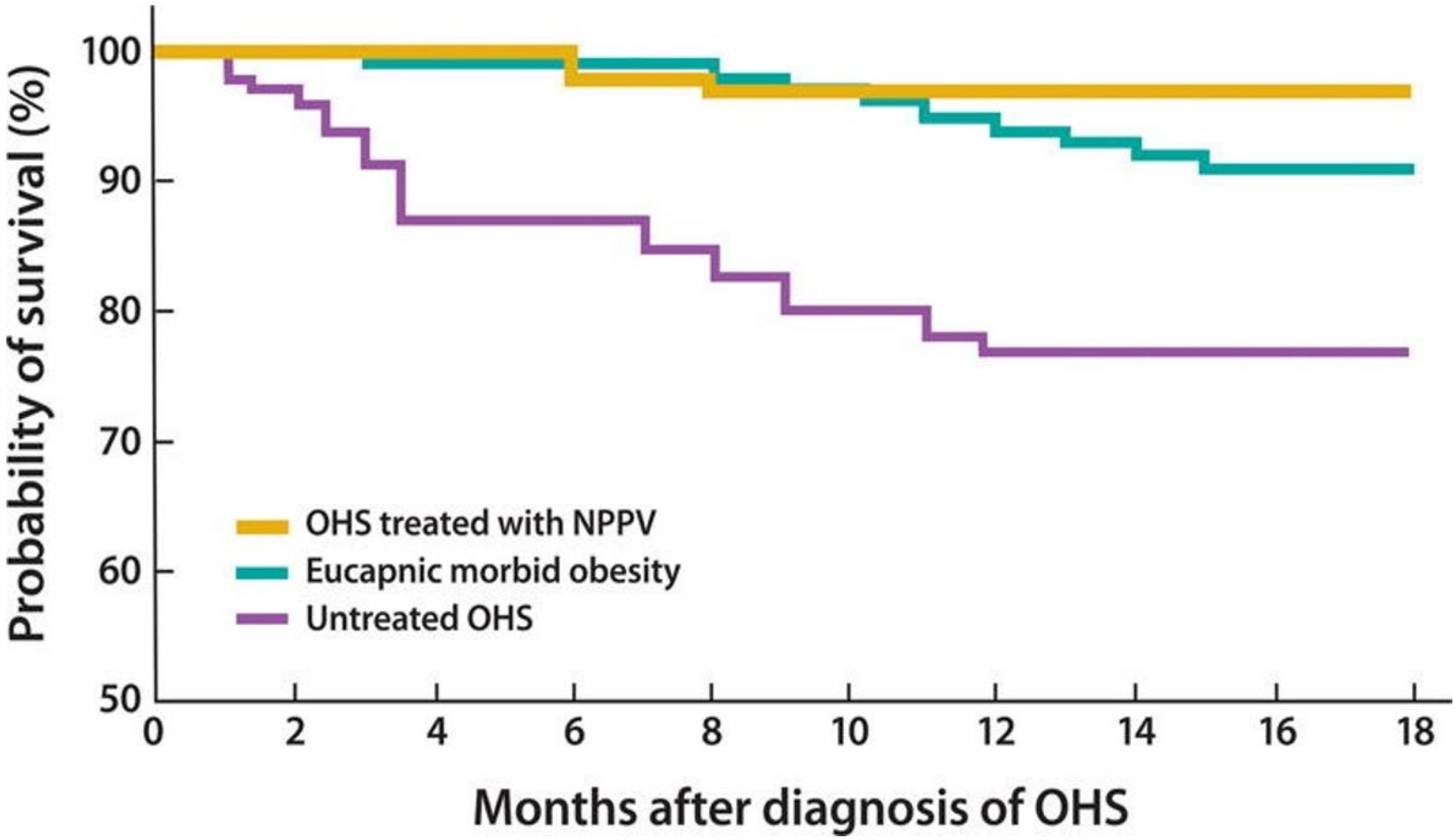
- Daytime hypoxia, worsening SOB symptoms
- Rapidly accelerating anasarca
- Unable to laydown, has to sit up to breath
- Bicarb on chem is increasing week to week then day to day
- Extreme somnolence ex. falling asleep in middle of talking
- Without intervention near death is certain

Mortality Rate of Treated OHS

With PAP (positive airway therapy) therapy 4-year mortality rates drop to 13%.

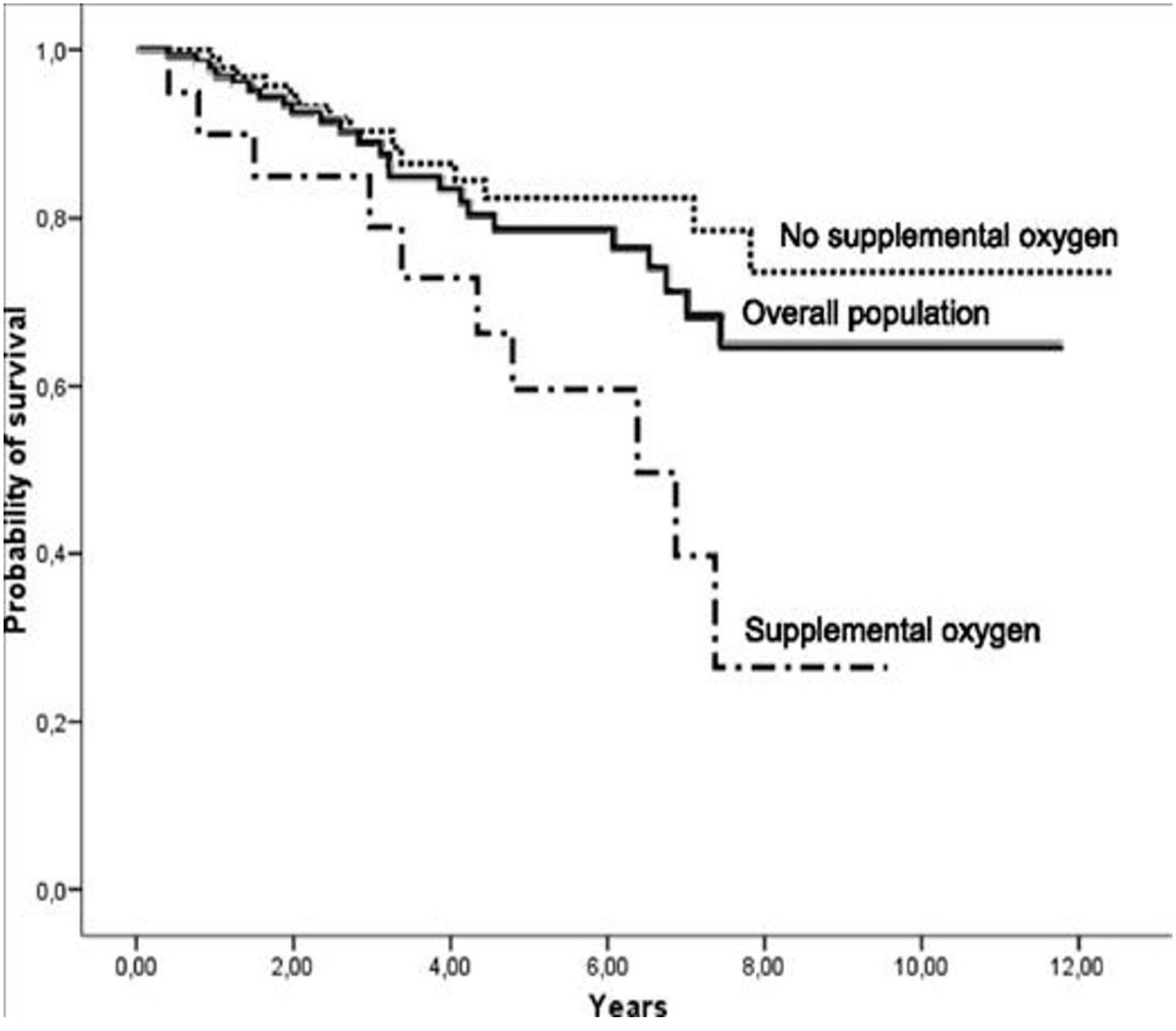
Priou P, Hamel JF, Person C, Meslier N, Racineux JL, Urban T, Gagnadoux F: “Long-term outcome of noninvasive positive pressure ventilation for obesity hypoventilation syndrome.”, Chest 2010

Mortality From Untreated OHS



Mokhlesi B, Kryger MH, Grunstein RR, "Assessment and Management of Patients with Obesity Hypoventilation Syndrome", *Proceedings of the American Thoracic Society*, (2008), 5:218–25

Probability of Survival Over Time



Priou et al (2010)