



## EMERGING TREATMENTS FOR SLEEP APNEA

**Dr. Mary Talley Bowden**

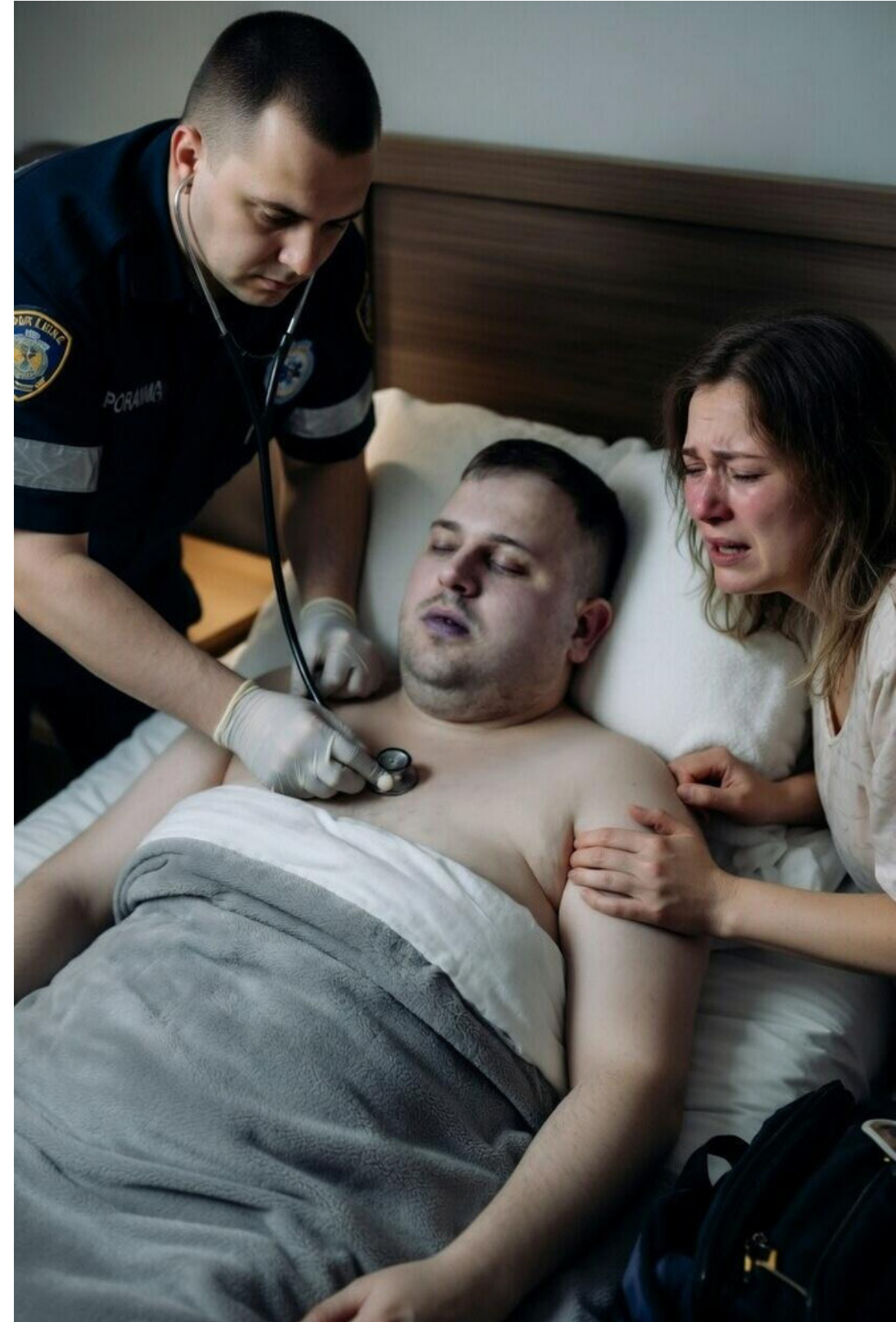
IMA Senior Fellow, Otolaryngology & Sleep Medicine



# Practical Approaches to Obstructive Sleep Apnea

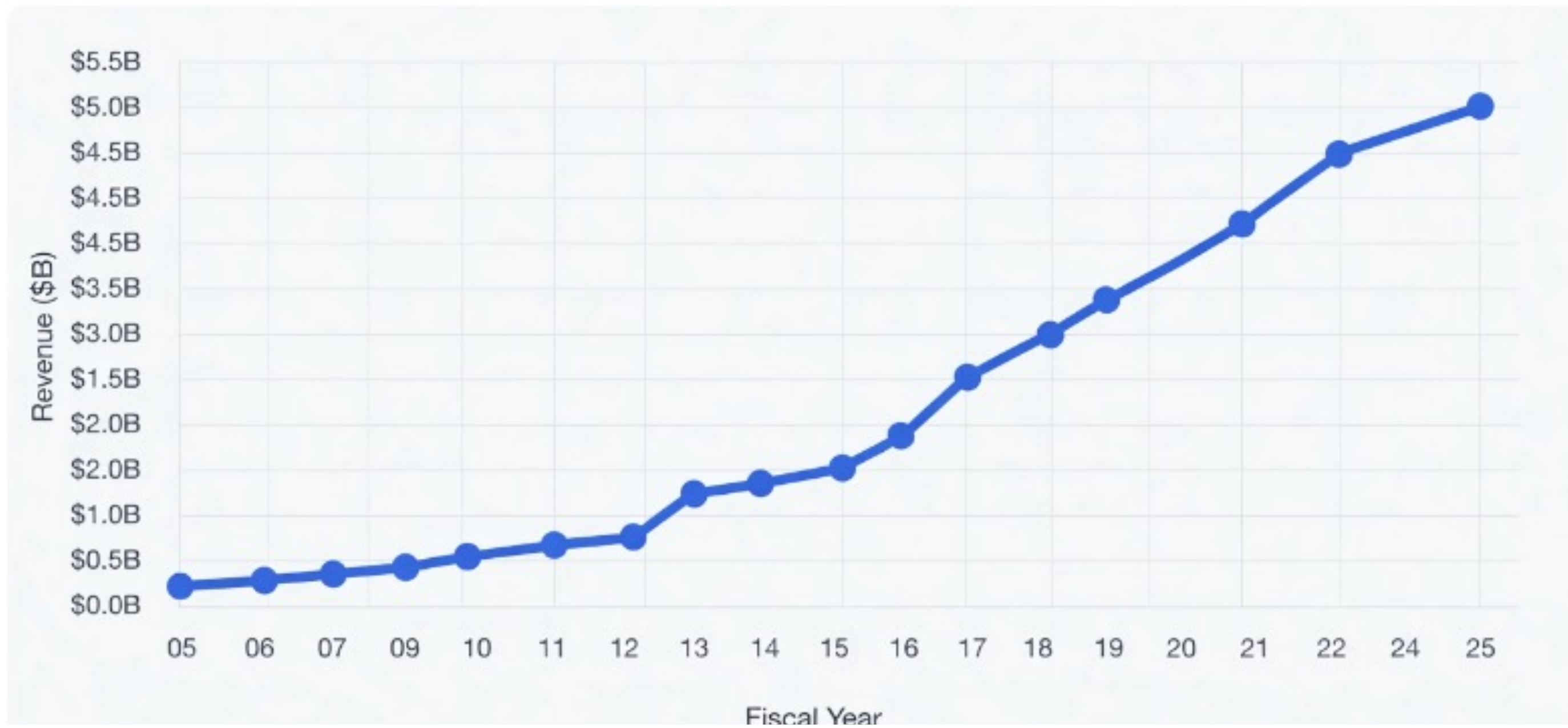
*With*

**Mary Talley Bowden, MD**



# Example of Revenue Increase of Commercial CPAP Provider

Annual Revenue (Fiscal Years 2005–2025)



Case Reports

> Rev Neurol (Paris). 1965 Jun;112(6):568-79.

# [Polygraphic study of diurnal and nocturnal (hypnic and respiratory) episodal manifestations of Pickwick syndrome]

[Article in French]

H Gastaut, C A Tassinari, B Duron





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Hc Polysomnography Cpap 6/>Yrs4/>Param

	A	B	C
8283	Hc Polysomnography 6/>Yrs 4/>Param	\$8,110.00	\$4,055.00
8284	Hc Polysomnography Cpap 6/>Yrs4/>Param	\$9,815.00	\$4,907.50





# Wrist Sleep Oxygen Monitor

Track oxygen levels and pulse rates overnight

- ✓ Patented Ring Sensor: allows your finger to move freely while staying securely in place
- ✓ Smart vibration when oxygen level drops below preset threshold
- ✓ The unit can store 4 sessions data (up to 10 hrs for each)
- ✓ Print & share free 4s interval oximetry reports

# Record Your Snoring

app for recording and tracking snoring to discover solutions.

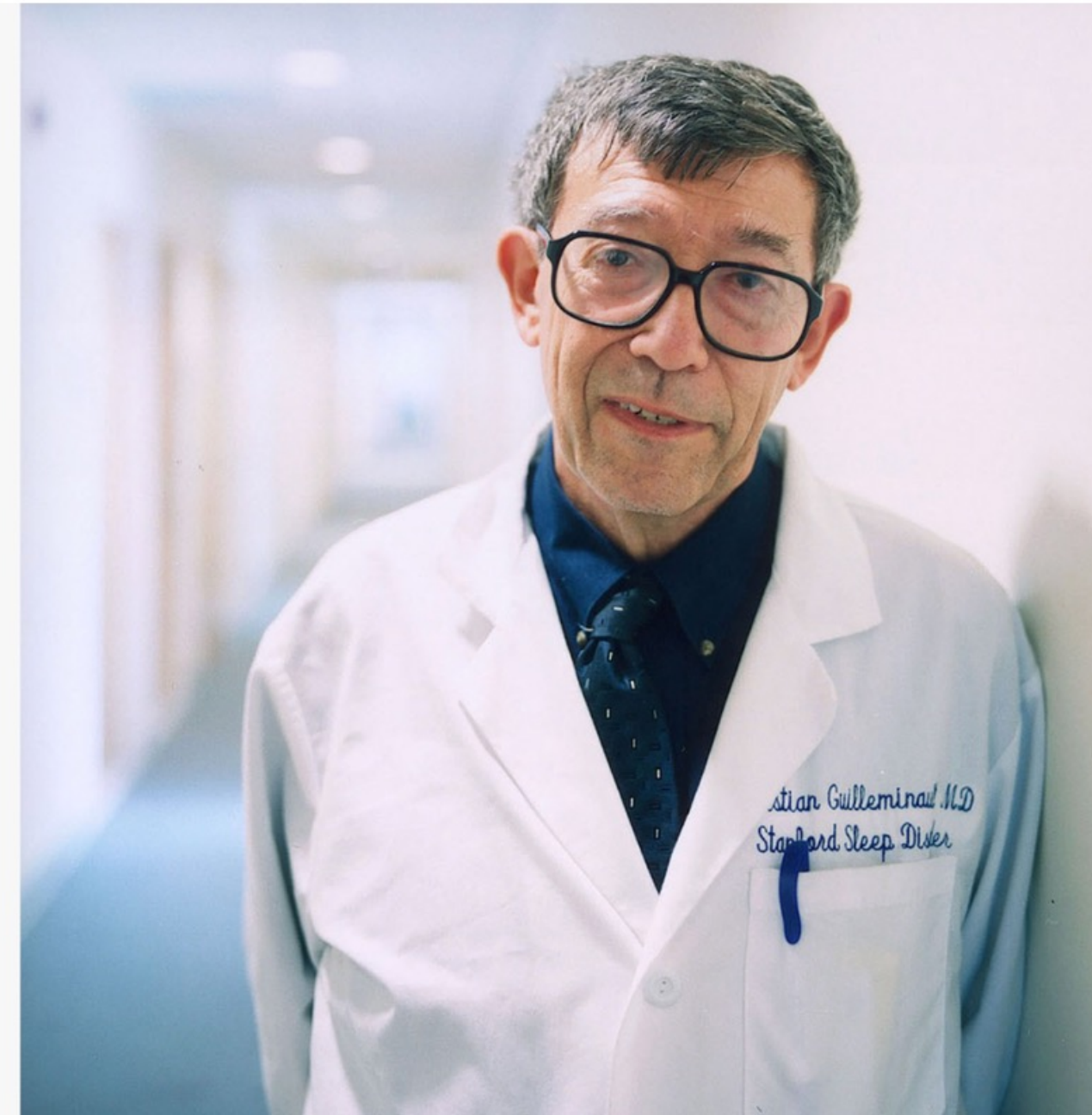




# Christian Guilleminault, researcher who coined 'obstructive sleep apnea syndrome,' dies at 80

By [Mandy Erickson](#)

Christian Guilleminault, a prolific researcher who helped build Stanford's sleep disorders clinic into an influential, full-service sleep center, died July 9 of cancer.



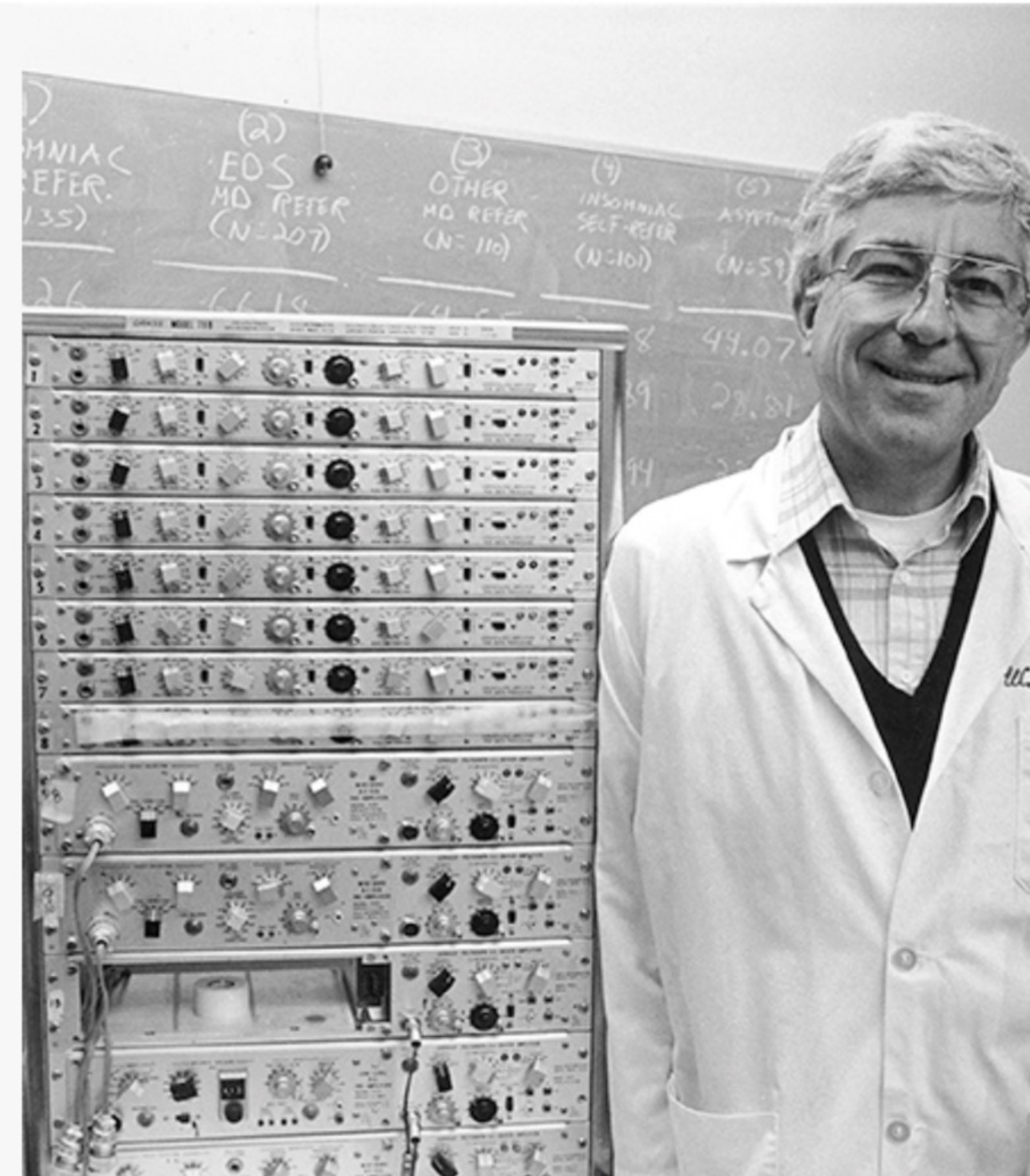


# William Dement, giant in sleep medicine, dies at 91

By [Rosanne Spector](#)

A founder of the field of sleep medicine, ardent campaigner against the dangers of drowsiness, and teacher of Stanford's hugely popular Sleep and Dreams course, William Dement has died.

**Sleep** | June 18, 2020





Otolaryngology—Head and Neck Surgery

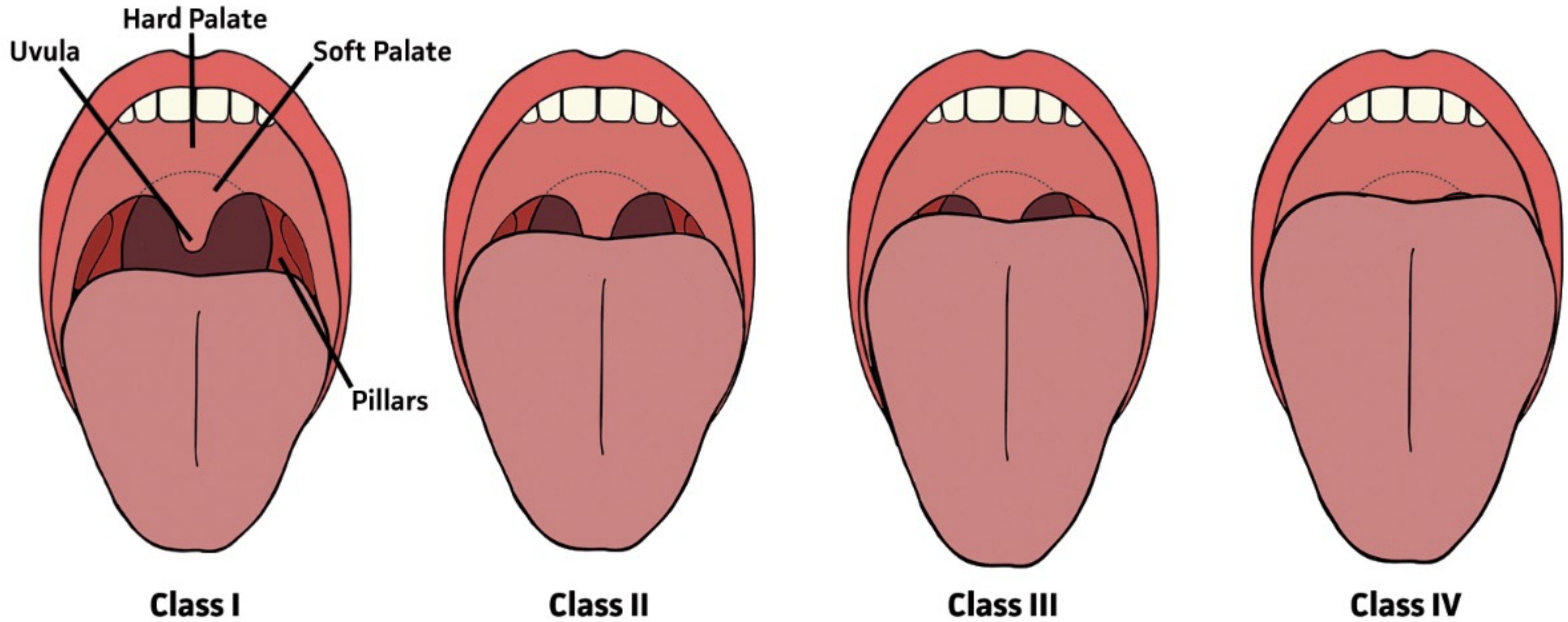


Restricted access | Research article | First published November-December 1981

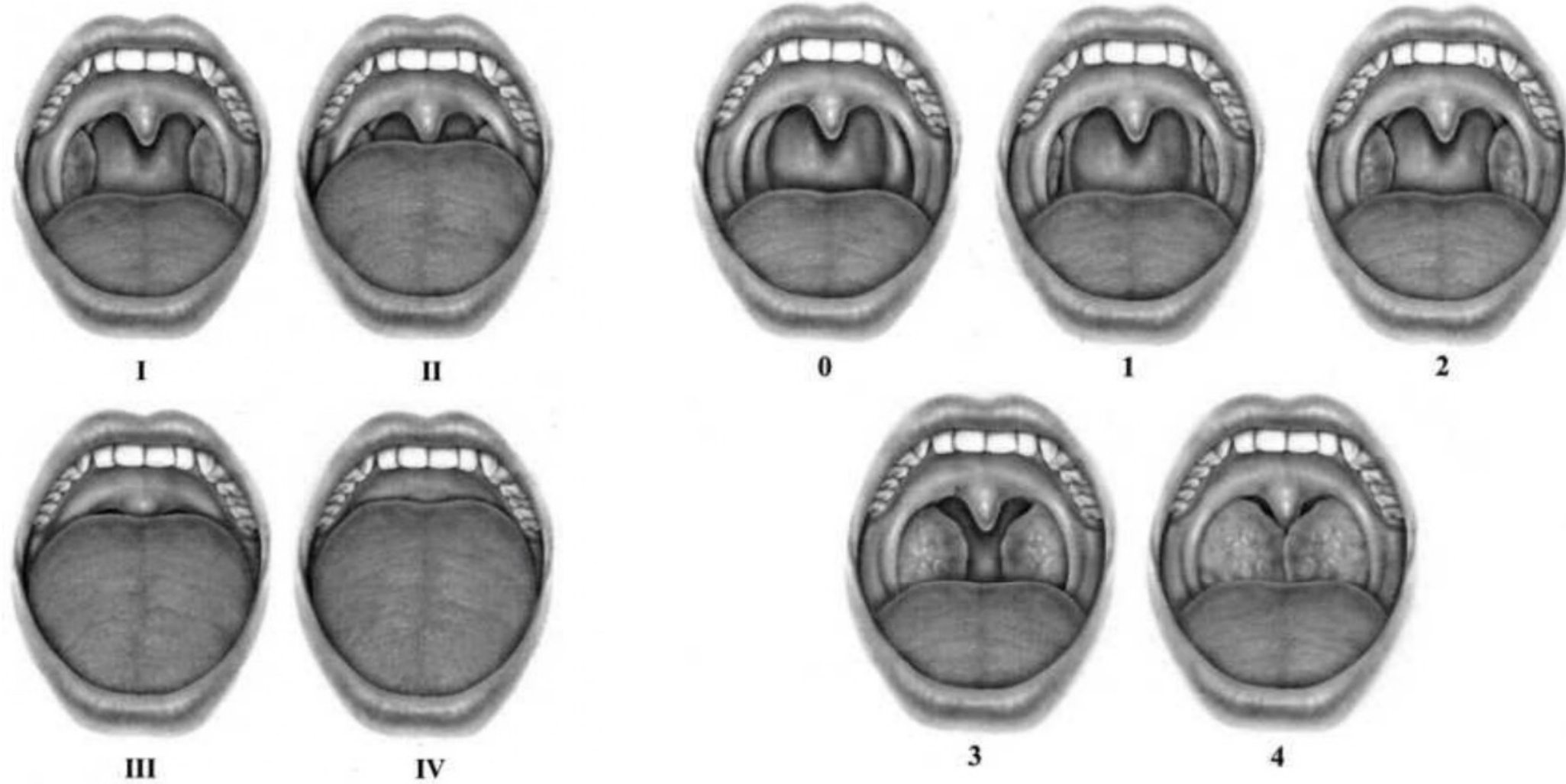
**Surgical Correction of Anatomic Abnormalities in Obstructive Sleep Apnea Syndrome: Uvulopalatopharyngoplasty**

[Shiro Fujita, MD](#), [William Conway, MD](#), [...], and [Thomas Roth, PhD](#) [View all authors and affiliations](#)



[Volume 89, Issue 6](#) | <https://doi.org/10.1177/019459988108900609>



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**TABLE I.**  
Modified Friedman Staging System for Patients with Obstructive Sleep Apnea/Hypopnea Syndrome.

	Friedman Palate Position	Tonsil Size	BMI
Stage I	1	3, 4	<40
	2	3, 4	<40
Stage II	1, 2	1, 2	<40
	3, 4	3, 4	<40
Stage III	3	0, 1, 2	<40
	4	0, 1, 2	<40
Stage IV	1, 2, 3, 4	0, 1, 2, 3, 4	>40

All patients with significant craniofacial or other anatomic deformities.

BMI = Body Mass Index.





## Journal of Cranio-Maxillofacial Surgery

Volume 43, Issue 7, September 2015, Pages 1113-1118



# Large maxillomandibular advancements for obstructive sleep apnea: An operative technique evolved over 30 years

Macario Camacho<sup>a b</sup>  , Stanley Yung Liu<sup>c</sup>, Victor Certal<sup>d e</sup>, Robson Capasso<sup>c</sup>, Nelson B. Powell<sup>c</sup>, Robert W. Riley<sup>c</sup>

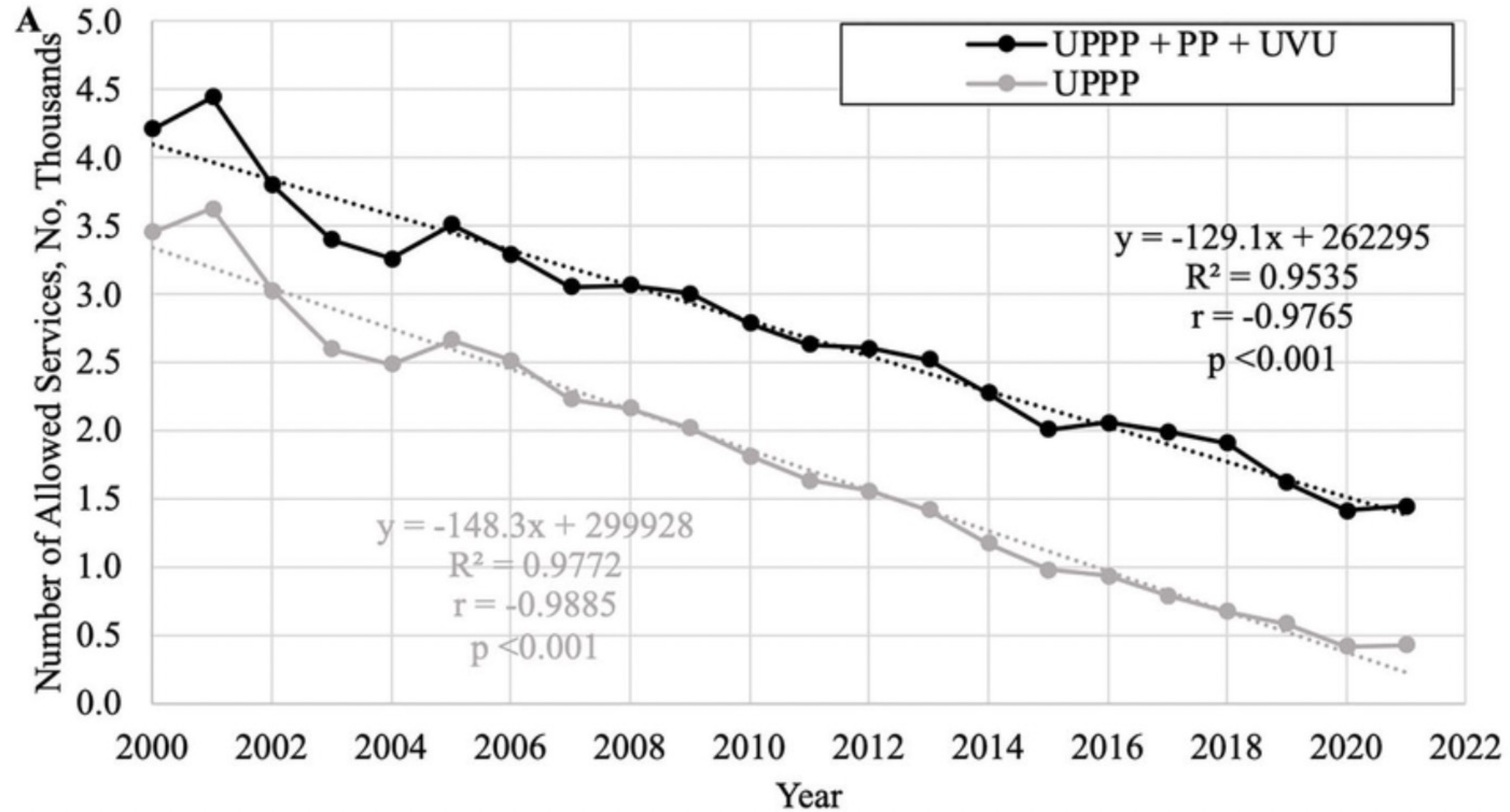
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<https://doi.org/10.1016/j.jcms.2015.05.015> 

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# UPPER AIRWAY STIMULATION



## Key Component of [REDACTED] Therapy for Sleep Apnea Recalled

Jul 8, 2024 | Recalls & Advisories, Sleep Apnea, Therapy Devices | ★★★★★



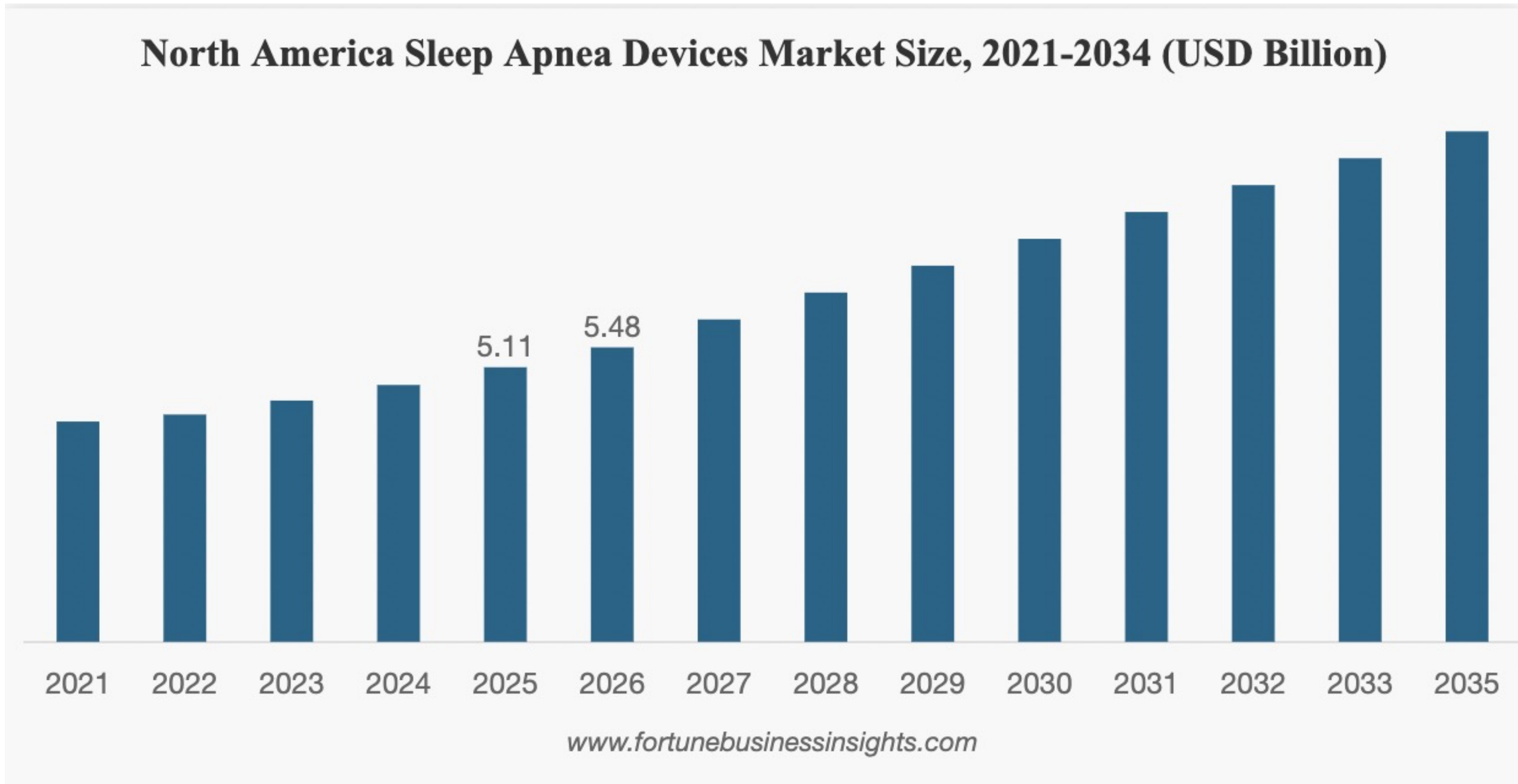
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15:15 | fx Hc Insj/Rplc Nstim Sleep Apnea Compl

	A	B	C
1	Description	Gross_Charge	Cash_Price
2	Hc Heart Acquisition Wo Eval	\$380,000.00	\$190,000.00
3	Hc Liver Acquisition Wo Eval	\$370,000.00	\$185,000.00
4	Hc Lung Acquisition Wo Eval	\$335,000.00	\$167,500.00
5	Hc Pancreas Acquisition Wo Eval	\$250,000.00	\$125,000.00
6	Hc Kidney Acquisition Cad W Eval	\$225,797.00	\$112,898.50
7	Hc Kidney Acquisition Cad Wo Eval	\$210,000.00	\$105,000.00
8	Hc Pancreas Acquisition W Eval	\$209,000.00	\$104,500.00
9	Hc Kidney Acquisition Lrd W Eval	\$171,747.00	\$85,873.50
10	Hc Cannula Protekduo #117832	\$162,179.71	\$81,089.86
11	Hc Kidney Acquisition Lrd Wo Eval	\$128,000.00	\$64,000.00
12	Noncdm Charge Record Medical Supplies	\$126,810.36	\$63,405.18
13	Hc Radiation Delivery Stereotactic Cranial Cobalt	\$126,764.00	\$63,382.00
14	Noncdm Charge Record Medical Supplies	\$124,993.49	\$62,496.74
15	Hc Insj/Rplc Nstim Sleep Apnea Compl	\$123,704.00	\$61,852.00
16	EPCORITAMAB-BYSP 48 MG/0.8 ML SUBCUTANEOUS SO	\$122,794.50	\$61,397.25



## CPAP for Prevention of Cardiovascular Events in Obstructive Sleep Apnea

R Doug McEvoy <sup>1</sup>, Nick A Antic <sup>1</sup>, Emma Heeley <sup>1</sup>, Yuanming Luo <sup>1</sup>, Qiong Ou <sup>1</sup>, Xilong Zhang <sup>1</sup>, Olga Mediano <sup>1</sup>, Rui Chen <sup>1</sup>, Luciano F Drager <sup>1</sup>, Zhihong Liu <sup>1</sup>, Guofang Chen <sup>1</sup>, Baoliang Du <sup>1</sup>, Nigel McArdle <sup>1</sup>, Sutapa Mukherjee <sup>1</sup>, Manjari Tripathi <sup>1</sup>, Laurent Billot <sup>1</sup>, Qiang Li <sup>1</sup>, Geraldo Lorenzi-Filho <sup>1</sup>, Ferran Barbe <sup>1</sup>, Susan Redline <sup>1</sup>, Jiguang Wang <sup>1</sup>, Hisatomi Arima <sup>1</sup>, Bruce Neal <sup>1</sup>, David P White <sup>1</sup>, Ron R Grunstein <sup>1</sup>, Nanshan Zhong <sup>1</sup>, Craig S Anderson <sup>1</sup>; SAVE Investigators and Coordinators

Collaborators, Affiliations + expand

PMID: 27571048 DOI: 10.1056/NEJMoa1606599

Free article

### Abstract

**Background:** Obstructive sleep apnea is associated with an increased risk of cardiovascular events; whether treatment with continuous positive airway pressure (CPAP) prevents major cardiovascular events is uncertain.

**Methods:** After a 1-week run-in period during which the participants used sham CPAP, we randomly assigned 2717 eligible adults between 45 and 75 years of age who had moderate-to-severe obstructive sleep apnea and coronary or cerebrovascular disease to receive CPAP treatment plus usual care (CPAP group) or usual care alone (usual-care group). The primary composite end point was death from cardiovascular causes, myocardial infarction, stroke, or hospitalization for unstable angina, heart failure, or transient ischemic attack. Secondary end points included other cardiovascular outcomes, health-related quality of life, snoring symptoms, daytime sleepiness, and mood.

**Results:** Most of the participants were men who had moderate-to-severe obstructive sleep apnea and minimal sleepiness. In the CPAP group, the mean duration of adherence to CPAP therapy was 3.3 hours per night, and the mean apnea-hypopnea index (the number of apnea or hypopnea events per hour of recording) decreased from 29.0 events per hour at baseline to 3.7 events per hour during follow-up. After a mean follow-up of 3.7 years, a primary end-point event had occurred in 229 participants in the CPAP group (17.0%) and in 207 participants in the usual-care group (15.4%) (hazard ratio with CPAP, 1.10; 95% confidence interval, 0.91 to 1.32; P=0.34). No significant effect on any individual or other composite cardiovascular end point was observed. CPAP significantly reduced snoring and daytime sleepiness and improved health-related quality of life and mood.

**Conclusions:** Therapy with CPAP plus usual care, as compared with usual care alone, did not prevent cardiovascular events in patients with moderate-to-severe obstructive sleep apnea and established cardiovascular disease. (Funded by the National Health and Medical Research Council of Australia and others; SAVE ClinicalTrials.gov number, NCT00738179 ; Australian New Zealand Clinical Trials Registry number, ACTRN12608000409370 .).

ARTICLES · Volume 13, Issue 5, P403-413, May 2025

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Positive airway pressure therapy and all-cause and cardiovascular mortality in people with obstructive sleep apnoea: a systematic review and meta-analysis of randomised controlled trials and confounder-adjusted, non-randomised controlled studies

Adam V Benjafield, PhD <sup>a</sup> · Prof Jean-Louis Pepin, MD <sup>b</sup> · Prof Peter A Cistulli, MD <sup>c,d</sup> · Alison Wimms, PhD <sup>a</sup> · Florent Lavergne, MSc <sup>e</sup> · Fatima H Sert Kunijoshi, PhD <sup>f</sup> · et al. Show more

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### Summary

Show Outline

#### Background

Data regarding the effect of positive airway pressure (PAP) therapy for obstructive sleep apnoea (OSA) on all-cause mortality are inconsistent. We aimed to conduct a systematic review and meta-analysis to test the hypothesis that PAP therapy is associated with reduced all-cause and cardiovascular mortality in people with OSA.

#### Methods

For this systematic review and meta-analysis, we searched PubMed, Embase, and the Cochrane Central Register of Controlled Trials, from database inception to Aug 22, 2023 (updated Sept 9, 2024), with no language or geographical restrictions. Reference lists of eligible studies and recent conference abstracts (2022–23) were also reviewed. We included outpatient studies (randomised controlled trials [RCTs] or confounder-adjusted, non-randomised controlled studies [NRCSS]) assessing the incidence of all-cause mortality, cardiovascular mortality, or both in adults (aged ≥18 years) with OSA who were treated versus not treated with PAP; other study types and studies that evaluated only PAP adherence were excluded. Abstracts of all retrieved publications were independently screened by two of three researchers (BS, SRB, and KCW), with disagreements resolved by adjudication from another researcher (SHM). The AutoLit feature of the Nested Knowledge platform was used for the review and data-extraction phases. We analysed each log-transformed hazard ratio (HR) and SE using a linear random-effects model to estimate overall HRs and 95% CIs. To evaluate the risk of bias, we used the Cochrane Risk of Bias tool for RCTs and the Newcastle–Ottawa Scale for NRCSS. This study was registered with PROSPERO, CRD42023456627.

#### Findings

Of 5484 records identified by our search, 435 were assessed for eligibility and 30 studies were included in the systematic review and meta-analysis (ten RCTs and 20 NRCSS). These studies included 1 175 615 participants, of whom 905 224 (77%) were male and 270 391 (23%) were female (SE 1.9), with a mean age of 59.5 (SE 1.4) years and a mean follow-up of 5.1 (0.5) years. The risk of bias was low to moderate. The risk of all-cause mortality (HR 0.63, 95% CI 0.56–0.72; p<0.0001) and cardiovascular mortality (0.45, 0.29–0.72; p<0.0001) was significantly lower in the PAP group than in the no-PAP group, and the clinically relevant benefit of PAP therapy increased with use.

#### Interpretation

Our results are consistent with a potentially beneficial effect of PAP therapy on all-cause and cardiovascular mortality in patients with OSA. Patients should be made aware of this effect of their treatment, which could result in greater acceptance of treatment initiation and greater adherence, leading to a higher likelihood of improved outcomes.

#### Funding

ResMed.

# Hypoxic burden

Hypoxic burden is a clinical term used to quantify the overall severity and duration of low oxygen levels (hypoxemia) in the body during sleep.



### Definition

Hypoxic Burden refers to a measure that quantifies the total impact of oxygen deprivation during sleep. Hypoxic burden is the cumulative area under the curve (AUC) of oxygen desaturation events.

It is based on:

- How low the oxygen drops (desaturation depth)
- How long it stays low (desaturation duration)
- All desaturations during sleep

This metric provides a composite measure that reflects both the intensity and the degree of hypoxemia during sleep.

### Why it matters

Hypoxic burden is a strong predictor of all-cause and cardiovascular disease-related mortality, sometimes more predictive than the commonly used apnea-hypopnea index (AHI)<sup>1</sup>.

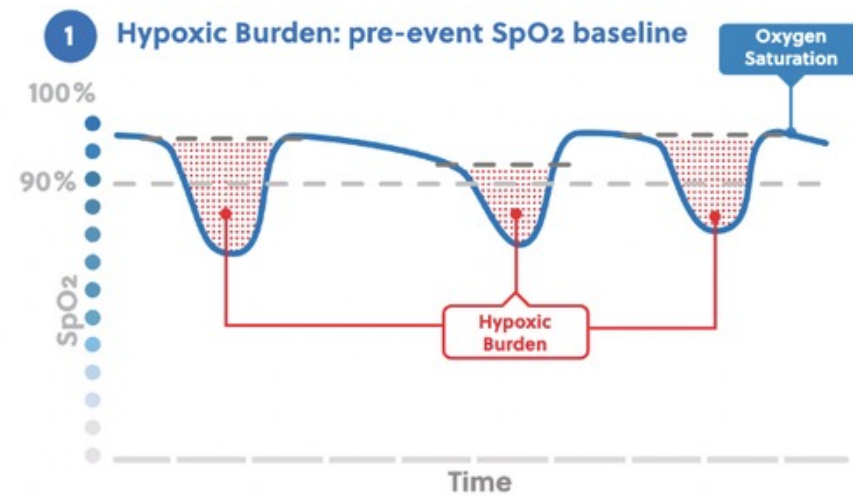
In addition to the AHI, which provides a frequency of events, hypoxic burden allows the clinician to assess the physiological harm from sleep disordered breathing events.

### How does the WatchPAT calculate Hypoxic burden?

There are various methods to calculate hypoxic burden, the WatchPAT implements two such methods.

Hypoxic burden is calculated on a second-by-second basis using two methods: (1) a pre-event oxygen saturation as a local threshold and (2) a 90% oxygen saturation threshold.

### Example 1: Patient with SpO2 baseline above 90%



Hypoxic Burden	Total [% • min]	Per hour [% • min/hour]
Desaturation area under SpO2 baseline	36*	7.1*

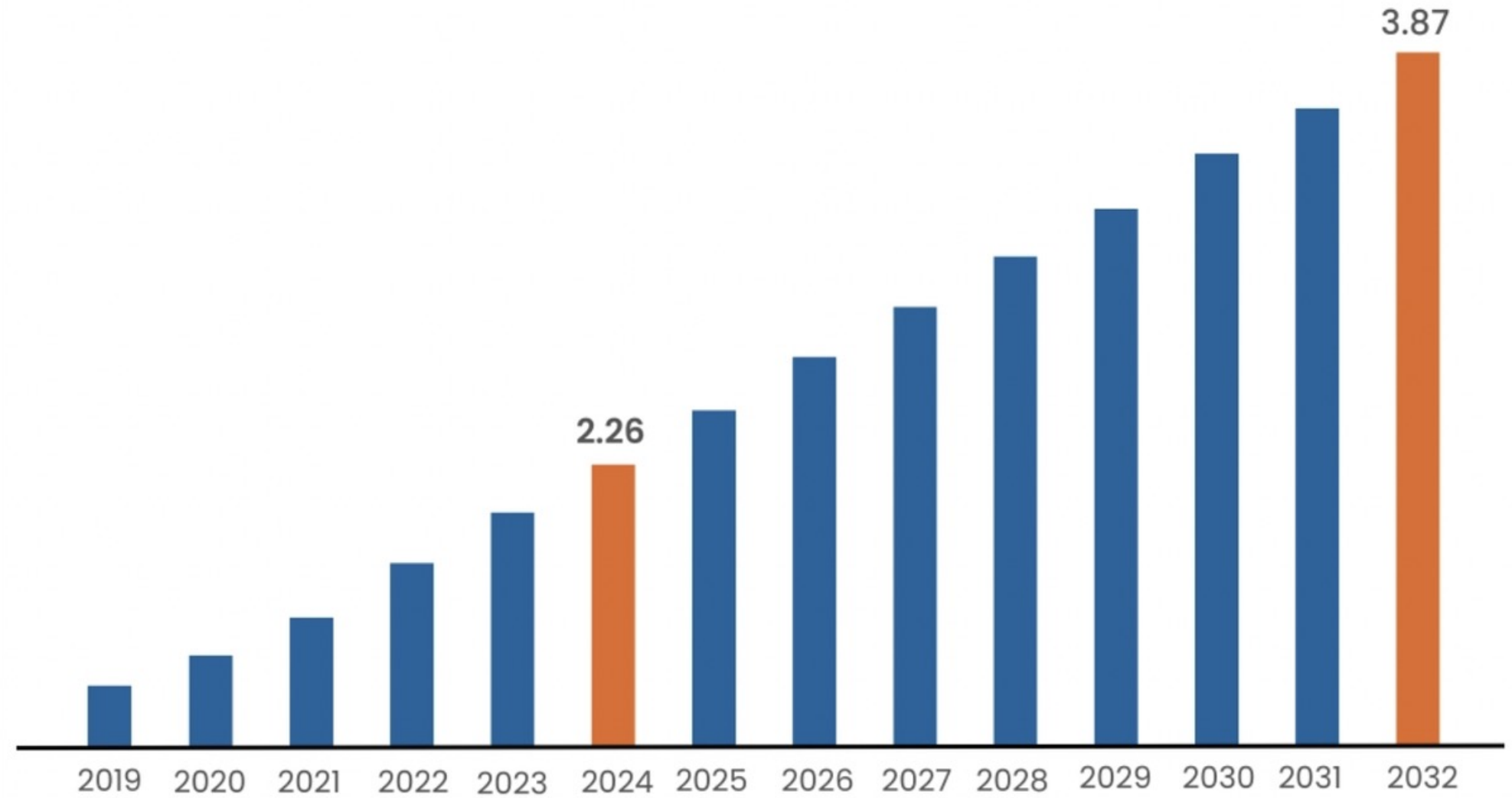
\* numbers are for reference only



# Evaluating Profitability and Growth in the United States Dental Sleep Medicine Market: Insights and Projected CAGR of 14.3% until 2033

...

North America Dental Sleep Medicine Market Size 2024 (USD Billion)



<https://www.consegicbusinessintelligence.com>



targeted-therapy



# Effect of Weight Loss on Upper Airway Anatomy and the Apnea-Hypopnea Index. The Importance of Tongue Fat

Stephen H. Wang <sup>1,2\*</sup>, Brendan T. Keenan <sup>2\*</sup>, Andrew Wiemken <sup>2</sup>, Yinyin Zang <sup>2</sup>, Bethany Staley <sup>2</sup>, David B. Sarwer <sup>3</sup>, Drew A. Torigian <sup>4</sup>, Noel Williams <sup>5</sup>, Allan I. Pack <sup>2,6</sup>, and Richard J. Schwab <sup>2,6</sup>

+ Author Affiliations

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**ALLERGY**

**FULL PRESCRIPTION STRENGTH**

**UP TO 24 HOUR RELIEF OF**

- ◀ Nasal congestion
- ◀ Runny nose
- ◀ Sneezing
- ◀ Itchy nose

**STEROID FREE**

**60** METERED SPRAYS  
0.37 fl oz (11 mL)





## Sleep Study Report

### Sleep Summary

Start Study Time:	7:21:20 AM
End Study Time:	1:35:34 PM
Total Recording Time:	6 hrs, 14 min
<b>Total Sleep Time</b>	<b>5 hrs, 44 min</b>
Indices are calculated using technically valid sleep time of	5 hrs, 33 min
% REM of Sleep Time:	5.2

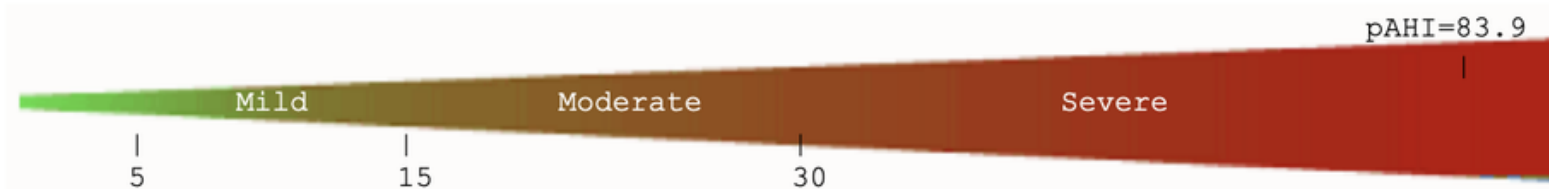
### Respiratory Indices

	Total Events	REM	NREM	All Night
pAHI 3%:	466	N/A	N/A	<b>83.9</b>
pAHI 4%:	458	N/A	N/A	<b>82.4</b>
ODI 4%:	466	N/A	N/A	<b>83.9</b>
pRDI:	466	N/A	N/A	<b>83.9</b>
pAHIc 3%:	73	N/A	N/A	<b>13.1</b>
pAHIc 4%:	72	N/A	N/A	<b>13.0</b>
% CSR:	0.0			

pRDI is calculated using oxi desaturation ≥ 3%

Indices are calculated using technically valid sleep time of 5 hrs, 33 min.

REM/NREM indices appear only if REM time



\* Reference values are given by physician

### Oxygen Saturation Statistics

Mean:	90	Minimum:	61	Maximum:	
Mean of Desaturations Nadirs (%):					
<b>Oxygen Desatur. %:</b>	<b>4-9</b>	<b>10-20</b>	<b>&gt;20</b>		
Events Number	70	273	123		
Total	15.0	58.6	26.4		
<b>Oxygen Saturation:</b>	<b>&lt;90</b>	<b>&lt;=88</b>	<b>&lt;85</b>	<b>&lt;80</b>	
Duration (minutes):	113.4	99.5	58.0	27.8	
Sleep %	32.9	28.9	16.8	8.1	

### Hypoxic Burden (% x min) TST Pe

Desaturation area under SpO2 baseline	2283
Area under 90% SpO2	808

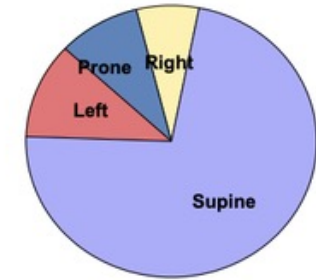
### Pulse Rate Statistics during Sleep (BPM)

Mean:	77	Minimum:	40	Maximum:	
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## Sleep Study Report

### Body Position Statistics

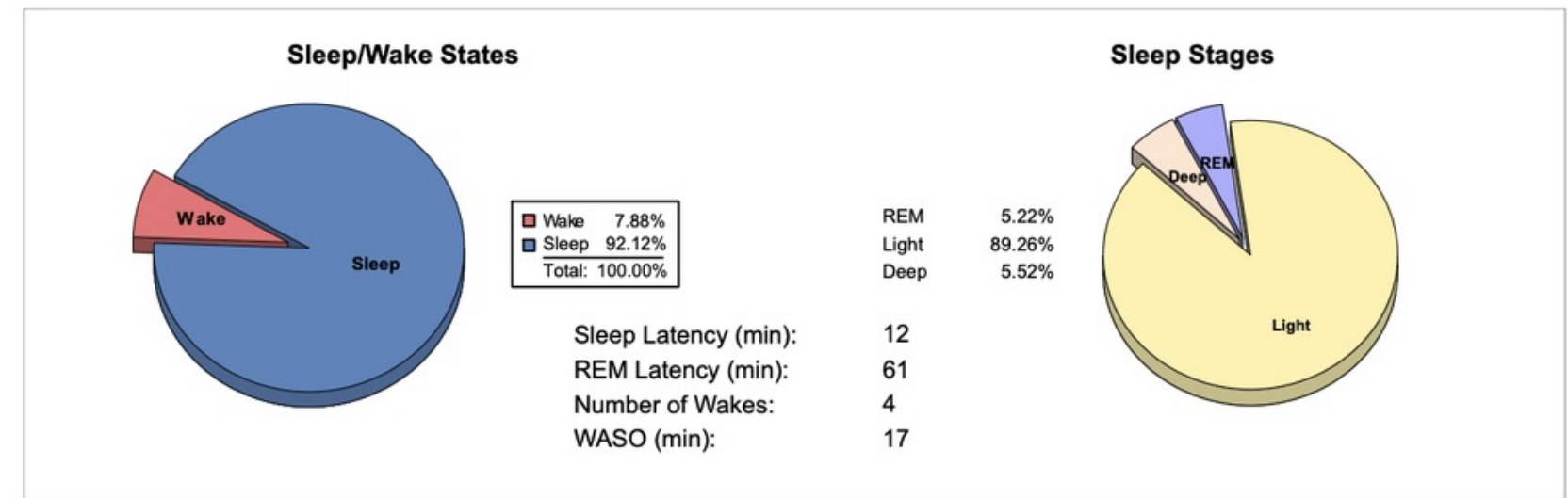
Position	Supine	Prone	Right	Left	Non-Supine
Sleep (min)	250.0	31.0	24.0	39.7	94.7
Sleep %	72.5	9.0	7.0	11.5	27.5
pAHI 3%:	87.9	66.7	45.0	95.1	73.4
pAHI 4%:	87.1	66.7	37.1	92.1	70.2
ODI 4%:	88.6	68.7	39.7	92.1	71.5
pRDI	87.9	66.7	45.0	95.1	73.4



### Snoring Statistics

Snoring Level (dB)	>40	>50	>60	>Threshold (45)	Mean:
Sleep (min)	251.9	73.4	21.8	118.4	46 dB
Sleep %	73.1	21.3	6.3	34.3	

### Sleep Stages Chart



## Sleep Study Report

### Sleep Summary

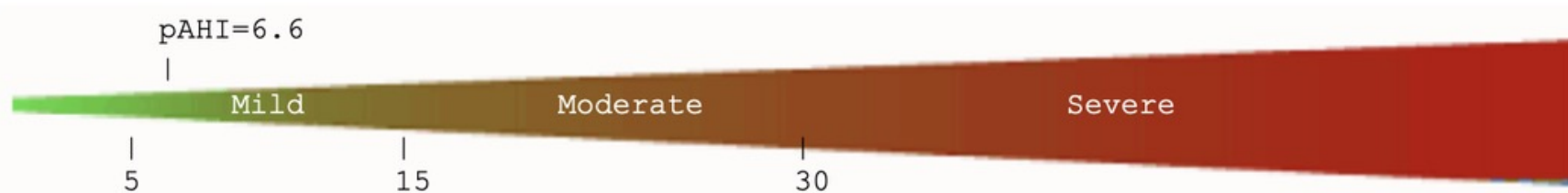
Start Study Time:	10:24:25 PM
End Study Time:	7:44:36 AM
Total Recording Time:	9 hrs, 20 min
<b>Total Sleep Time</b>	<b>8 hrs, 35 min</b>
Indices are calculated using technically valid sleep time of	8 hrs, 32 min
% REM of Sleep Time:	27.5

### Respiratory Indices

	Total Events	REM	NREM	All Night
pAHI 3%:	56	15.0	3.4	<b>6.6</b>
pAHI 4%:	17	6.0	0.5	<b>2.0</b>
ODI 4%:	15	6.0	0.2	<b>1.8</b>
pRDI:	101	21.8	8.1	<b>11.8</b>
pAHIc 3%:	0	0.0	0.0	<b>0.0</b>
pAHIc 4%:	0	0.0	0.0	<b>0.0</b>
% CSR:	0.0			

pRDI is calculated using oximetry desaturation  $\geq 3\%$

Indices are calculated using technically valid sleep time of 8 hrs, 32 min. Central-Indices are calculated using technically valid sleep time of 8 hrs, 13 min.



\* Reference values are given by physician

### Oxygen Saturation Statistics

Mean:	95	Minimum:	88	Maximum:	99
Mean of Desaturations Nadirs (%):	92				
<b>Oxygen Desatur. %:</b>	<b>4-9</b>	<b>10-20</b>	<b>&gt;20</b>	<b>Total</b>	
Events Number	15	0	0	15	
Total	100.0	0.0	0.0	100.0	
<b>Oxygen Saturation:</b>	<b>&lt;90</b>	<b>&lt;=88</b>	<b>&lt;85</b>	<b>&lt;80</b>	<b>&lt;70</b>
Duration (minutes):	0.0	0.0	0.0	0.0	0.0
Sleep %	0.0	0.0	0.0	0.0	0.0

Hypoxic Burden (% x min)	TST	Per hour
Desaturation area under SpO2 baseline	43	5
Area under 90% SpO2	0	0

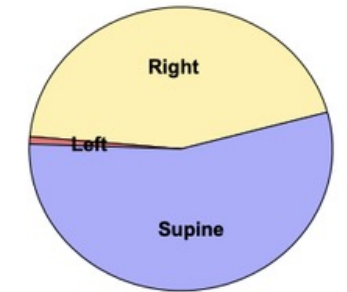
### Pulse Rate Statistics during Sleep (BPM)

Mean:	54	Minimum:	41	Maximum:	104
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## Sleep Study Report

### Body Position Statistics

Position	Supine	Prone	Right	Left	Non-Supine
Sleep (min)	281.2	0.0	230.0	4.0	234.0
Sleep %	54.6	0.0	44.6	0.8	45.4
pAHI 3%:	11.4	N/A	0.3	N/A	0.8
pAHI 4%:	3.4	N/A	0.0	N/A	0.3
ODI 4%:	3.0	N/A	0.0	N/A	0.3
pRDI	15.4	N/A	6.9	N/A	7.5

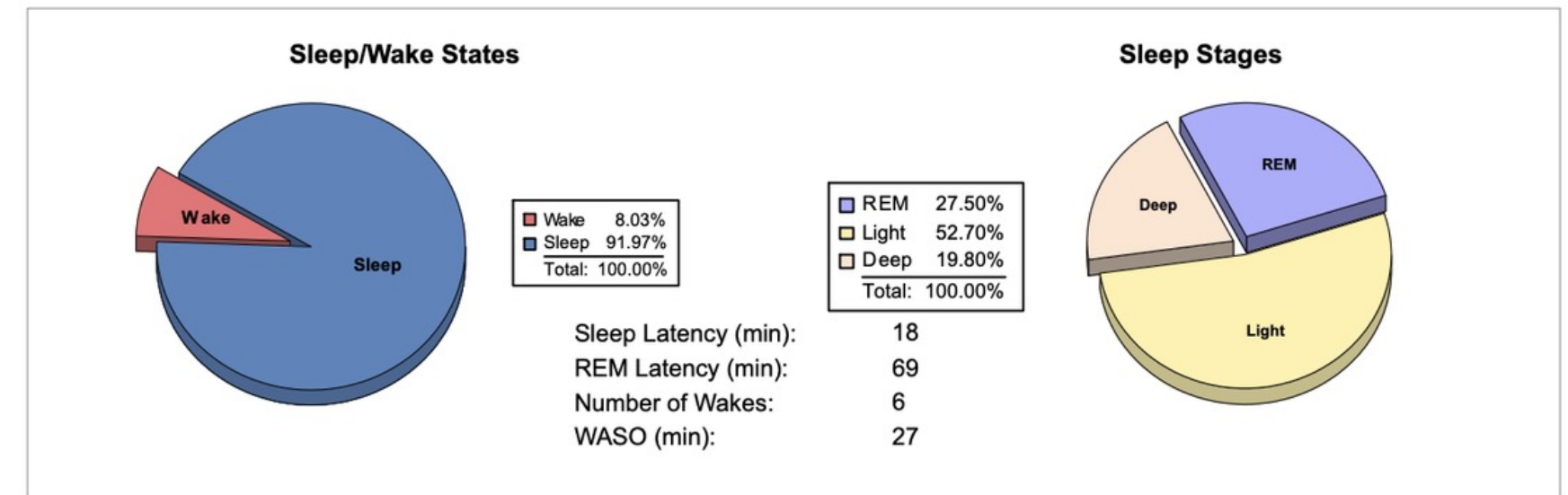


### Snoring Statistics

Snoring Level (dB)	>40	>50	>60	>Threshold (45)
Sleep (min)	66.4	2.7	0.8	6.8
Sleep %	12.9	0.5	0.2	1.3

Mean: 40 dB

### Sleep Stages Chart



# Thank you

For more medical education visit  
[www.IMAhealth.org](http://www.IMAhealth.org)

