DM SEMINAR

DOMICILIARY SLEEP STUDY & TITRATION OF CPAP

By Dr. Pratibha Jha

Outline of presentation

- OSA, definition and Diagnostic criteria
- Diagnostic methods : PSG vs HSAT
- Basic HSAT sensors
- Various HSAT devices
- Diagnostic algorithm for OSA
- Modes of PAP for OSA
- Home CPAP titration
- Summary

Introduction

- Obstructive sleep apnea (OSA) is a sleep-related breathing disorder (SDB) characterized by **repetitive episodes of complete or partial upper airway obstruction** during sleep.
- It is associated with **several co-morbidities** such as insulin resistance, metabolic syndrome, diabetes mellitus, hypertension, stroke, coronary artery disease, increased risk of vehicular accidents and various psychiatric disorders.
- According to a survey in India, With Covid-19 pandemic, 72% physicians have closed their sleep labs , 24% shifted to home sleep apnea testing, 58.6% opined for usage of APAP for OSA without diagnostic PSG.

Kanchan S et al. JCSM. 2021;17(6):1229–1235

Diagnostic criteria for OSA

A PSG/OSCT determined obstructive respiratory disturbance index (RDI) ≥ 5 events/hr associated with the typical symptoms of OSA or an RDI ≥ 15 events/hr (even in the absence of symptoms) where RDI is sum of **Apnea + Hypopnea + RERA.** (ICSD3 definition)

Apnea: cessation of breathing or airflow for 10 s or longer

Hypopnea: decrease in amplitude of airflow by > 30% for longer than 10 secs and associated with either an oxygen desaturation of >3% or an arousal

RERA: defined as an arousal from sleep that follows a 10 s or longer sequence of increasing respiratory effort, but which does not meet criteria for apnea or hypopnea

Typical symptoms: excess sleepiness, fatigue, waking up with choking , gasping, breathholding, or habitual snoring, or comorbid illness HTN,T2DM,CAD,CHF,AF,Mood disorder and cognitive dysfunction

Diagnostic methods

- Polysomnography (PSG) is **gold standard** test for diagnosing TOSA
- However **limited availability** and **high cost** of PSG makes it difficult to use it on a wider scale plus need of an overnight stay in a lab is inconvenient to many.
- Home sleep apnea test (HSAT) is an alternative medical test for the diagnosis of OSA

Differences

PSG	HSAT
• Standardized technology • Includes EOG, EMG, EEG sensors to differentiate sleep vs awake • Estimates severity of SDB based on actual sleep time • Reports apnea-hypopnea index **(AHI)**	• sensor technology varied • Lacks these channels, can't differentiate sleep vs awake • Estimates severity based on monitoring/ recording time • Reports respiratory event index **(REI)**

PSG	HSAT
• Can detect hypopnea associated only with cortical arousal • Laboratory personnel available to avoid such incidence • Estimates true AHI and severity of OSA	• Can’t detect hypopneas with only cortical arousal • Sensor dislodgement & poor quality signal common • Underestimates “true” AHI and severity of OSA

Indication of HSAT

Home sleep apnea testing should be used for the diagnosis of OSA in uncomplicated adult patients presenting with signs and symptoms that indicate an increased risk of moderate to severe OSA

with a technically adequate device

What is a technically adequate device ?

HSAT device with **a minimum** of the following sensors:

Nasal pressure

Chest and Abdominal respiratory inductance plethysmography

Oximetry

else

PAT (peripheral arterial tonometry) with oximetry and actigraphy

Who are at Moderate to severe risk of OSA ?

Presence of excessive daytime sleepiness

+

At least two of the following three criteria

Habitual loud snoring

witnessed apnea or gasping or choking

Diagnosed hypertension

Who are uncomplicated patients ?

Patients without increased risk for **non-obstructive** SDB

Patient without risk for **non-respiratory SDB**

Patients without **environmental or personal factors** that preclude the adequate acquisition and interpretation of data from HSAT

Contraindications to HSAT

- **At risk for non-obstructive SDB** → Any form of neuromuscular disease
  Uncontrolled hypertension/ CHF
  COPD and an FEV1 or less than 65%
  Within 180 days of MI
  known or documented severe hypoxemia.
- **At risk for non-respiratory sleep disorder(s)** → Suspected OHS, CSA, parasomnia, narcolepsy, severe insomnia or taking opioids
- **Environmental / personal factors** → Alcohol abuse, psychiatric disorders, cognitive dysfunction, Pregnant patients, stroke within 180 days

Sleep study device classification

Type I : PSG (attended study) (≥ 7 channels)

Type II : Like PSG but unattended (≥ 7 channels)

Type III : Typically measure 4-7 physiologic variables including 2 respiratory variables (effort to breathe, airflow), a cardiac variable (e.g., heart rate or ECG) & oximetry

(usually 4–7 channels)

Type IV : Only 1 or 2 parameters, typically oxygen saturation, heart rate, or just air flow

(1 or 2 channels)

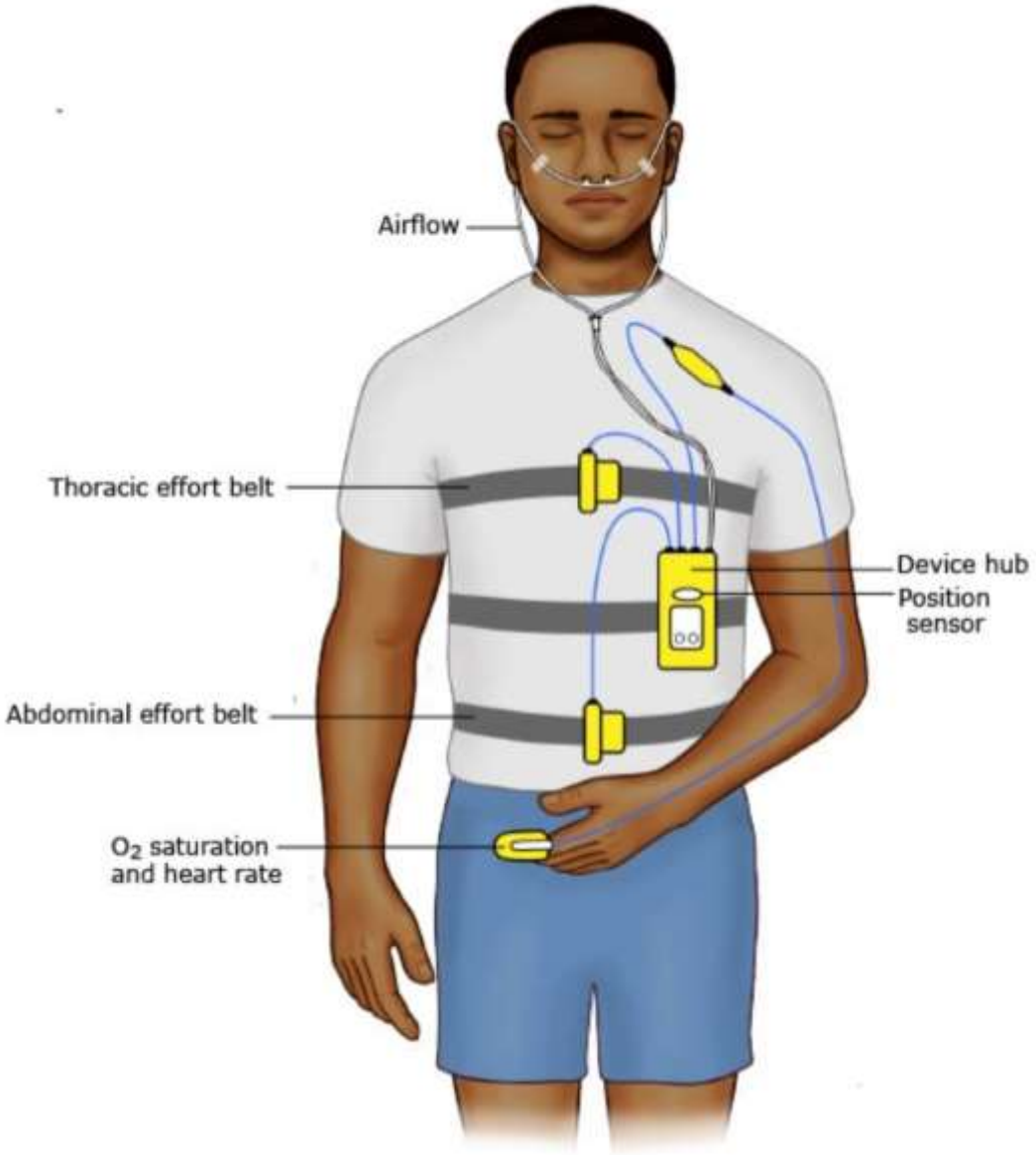
HSAT testing, Typically utilizes only type III devices.

Basic Sensors of HSAT Device

- **Nasal air pressure transducer**
- **oronasal thermal sensor (optional)**
- **Chest & abdominal respiratory inductance plethysmography**
- **Oximetry**
- **Peripheral arterial tonometry (PAT)**
- **Actigraphy**

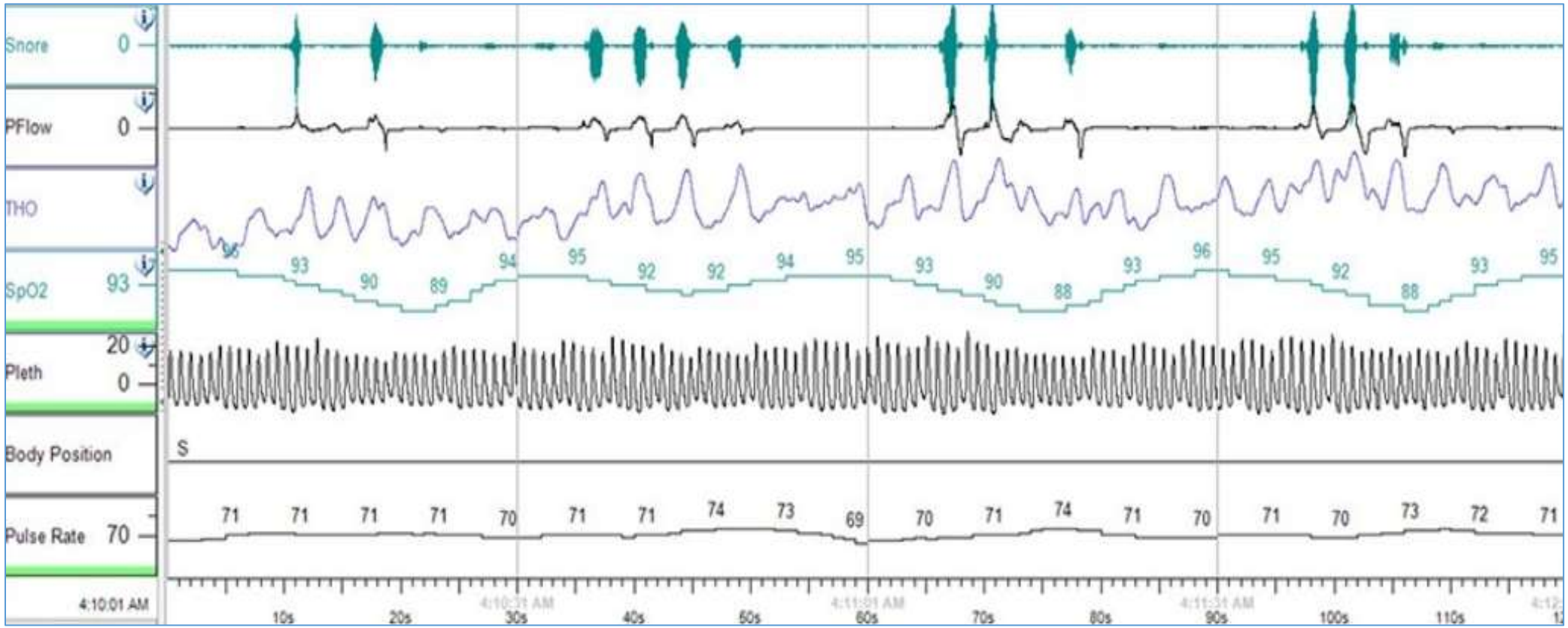
- Record airflow and snore signal
- Detects mouth breathing
- Evaluates ventilation by measuring movement of chest & abdomen.
- Measures saturation and heart rate.
- Assess episodic vasoconstriction associated with airway obstruction and hypoxia by a finger-mounted sensor
- Device worn on the wrist or ankle to record limb movement activity over time & estimates wakefulness and sleep

A typical set up of HSAT



Source of image:Uptodate

A sample report of Type 3 HSAT device



Source of image: Uptodate

Watch-PAT

- Unique wrist worn device that uses **PAT along with oximetry and actigraphy**
- Uses the principle of **variability of autonomic nervous system**. Airway obstruction induces transient elevation of sympathetic tone which leads to arousal and vasoconstriction in the distal vascular beds.
- WatchPAT detects apnea and hypopnea indirectly by measuring peripheral arterial volume changes by a finger mounted plethysmograph
- The PAT signal was included in the 2017 AASM guideline as clinically adequate

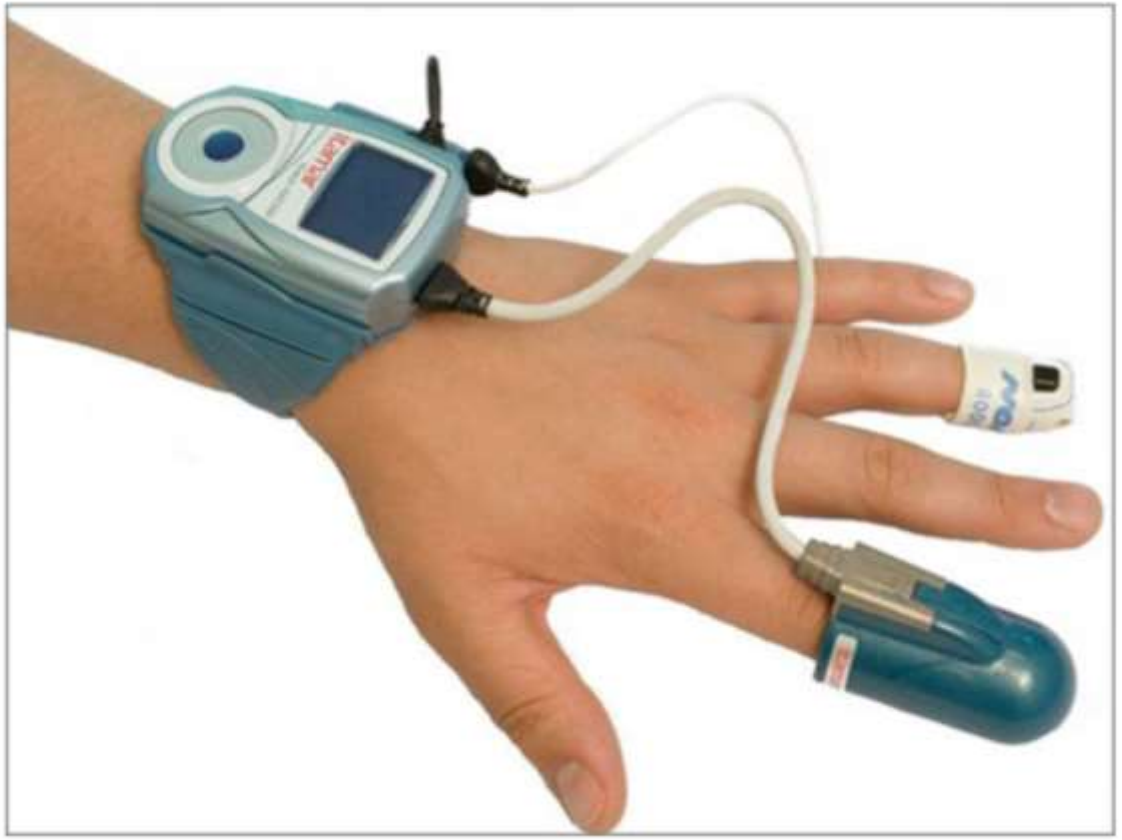


Image source : Itamar Website

Original Investigation

Diagnosis of Obstructive Sleep Apnea by Peripheral Arterial Tonometry Meta-analysis

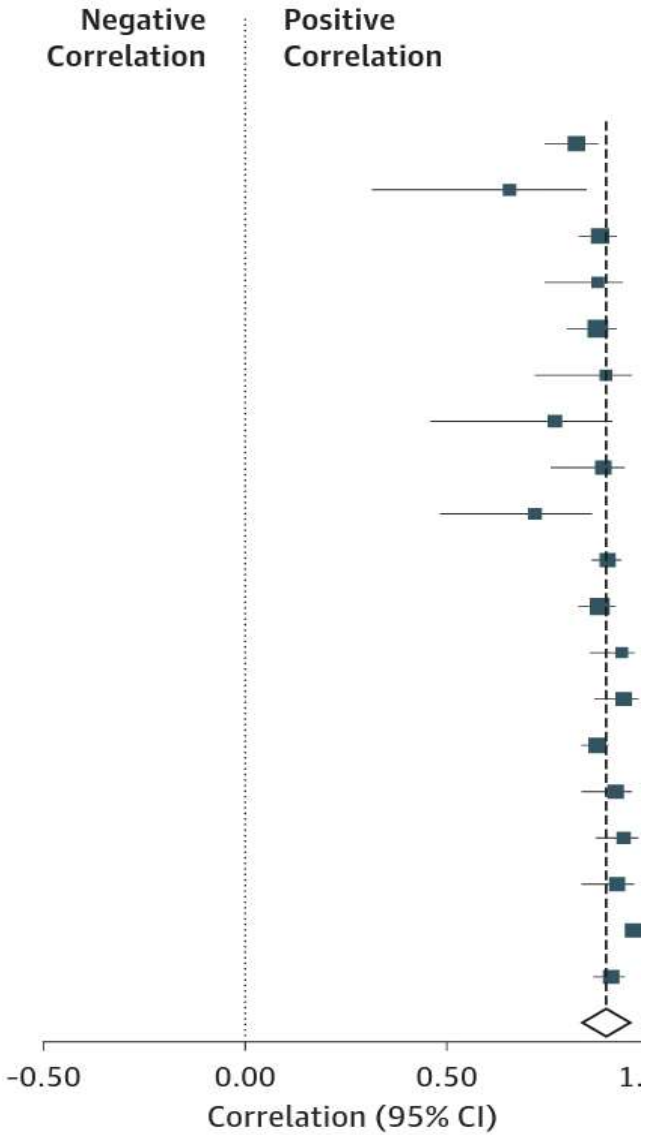
Sreeya Yalamanchali, MD; Viken Farajian, MS; Craig Hamilton, MBChB; Thomas R. Pott, MD; Christian G. Samuelson, MD; Michael Friedman, MD

JAMA Network

- 14 studies included in metaanalysis (most were blinded)
- Aim : to assess correlation between sleep indices measured by PSG vs PAT
- Included studies had patients with age >18yrs, and reported correlation between PSG and PAT for the AHI
- Respiratory indices calculated by PAT correlate strongly with PSG (r =0.85-0.9) however , patients with negative result should undergo in lab PSG if clinical suspicion remains
- Limitations: Cannot differentiate between different type of sleep apnea. Contraindicated in patients with CSA, periodic limb movement disorder, Mod-severe Pulmonary disease, CHF, Neuromuscular disorder. Most studies were performed in Laboratory setting rather than at home.
- Patients with T2DM, peripheral neuropathy , vasculopathy, hypertension , cardiac disease , taking betablockers were excluded from the study.

Yalamanchali S et al. JAMA Otolaryngol Head Neck Surg. 2013;139(12):1343-1350

Source (Study Setting), (Design)	Subgroup Within Study	Correlation, *r* Value	Statistics: Lower Limit (95% CI)	Statistics: Upper Limit (95% CI)	*Z* Value	*P* Value
Pillar et al,[17] 2000 (L), (B)	AHI[a]	0.820	(0.740-0.877)		11.035	<.001
Penzel et al,[18] 2002 (L), (B)	AHI	0.656	(0.313-0.848)		3.334	.001
Bar et al,[19] 2003 (L), (B)	AHI[a]	0.880	(0.826-0.918)		13.480	<.001
Ayas et al,[20] 2003 (L), (B)	AHI	0.870	(0.742-0.937)		6.927	<.001
Pillar et al,[21] 2003 (L), (B)	AHI[a]	0.870	(0.797-0.918)		10.748	<.001
Penzel et al,[22] 2004 (L), (B)	AHI	0.890	(0.715-0.960)		5.320	<.001
Penzel et al,[22] 2004 (L), (B)	RDI	0.770	(0.459-0.913)		3.818	<.001
Pittman et al,[23] 2004 (L), (B)	AHI[a]	0.880	(0.758-0.943)		7.015	<.001
Pittman et al,[23] 2004 (L), (B)	AHI[a]	0.720	(0.480-0.860)		4.628	<.001
Zou et al,[24] 2006 (H), (B)	AHI	0.900	(0.854-0.932)		14.349	<.001
Zou et al,[24] 2006 (H), (B)	RDI	0.880	(0.826-0.918)		13.409	<.001
Pang et al,[25] 2007 (L), (B)	AHI	0.929	(0.858-0.965)		8.883	<.001
Choi et al,[26] 2010 (L), (NB)	AHI	0.940	(0.867-0.974)		8.152	<.001
Hedner et al,[27] 2011 (L), (B)	RDI	0.870	(0.834-0.898)		19.962	<.001
Onder et al,[30] 2012 (L), (B group 1)	AHI	0.920	(0.835-0.962)		8.102	<.001
Onder et al,[30] 2012 (L), (B group 2)	AHI	0.940	(0.871-0.973)		8.515	<.001
Weimin et al,[32] 2013 (L), (B)	AHI	0.920	(0.833-0.963)		7.945	<.001
Yuceege et al,[31] 2013 (L), (B)	AHI	0.960	(0.939-0.974)		17.621	<.001
Yuceege et al,[31] 2013 (L), (B)	RDI	0.909	(0.863-0.940)		13.780	<.001
Overall		0.889	(0.862-0.911)		24.096	<.001



Yalamanchali S et al. JAMA Otolaryngol Head Neck Surg. 2013;139(12):1343-1350

JCSM | Journal of Clinical Sleep Medicine

SCIENTIFIC INVESTIGATIONS

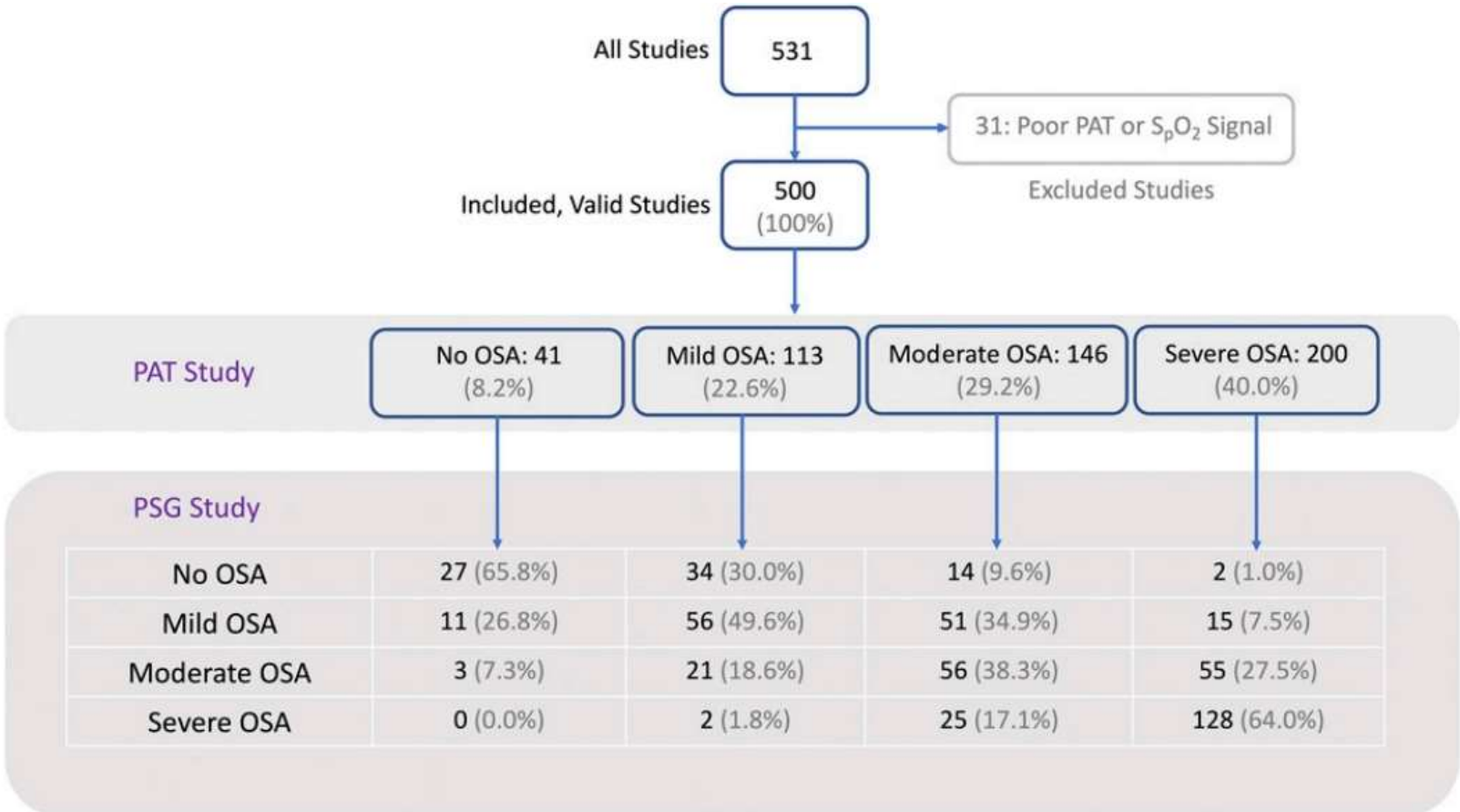
Performance of peripheral arterial tonometry–based testing for the diagnosis of obstructive sleep apnea in a large sleep clinic cohort

Octavian C. Ioachimescu, MD, PhD[1,2]; J. Shirine Allam, MD[1,2]; Arash Samarghandi, MD[1]; Neesha Anand, MD[1]; Barry G. Fields, MD, MSEd[1,2];

- 500 patients with suspected OSA underwent simultaneous PSG and PAT based testing
- Overall concordance with PSG was only 69%
- Diagnostic accuracy for mild OSA was only 49%
- Strengths: large sample size , blinded study
- Limitations: single centre, patients with CHF, AF, HF, on adrenergic blockers were not excluded.
- Higher prevalence of heart failure patients.
- Conclusion: A diagnosis of mild OSA/ no OSA in the setting of high pretest probability should warrant a PSG study.

Loachimescu OC et al. J Clin Sleep Med. 2020;16(10):1663-1674

Results: Five hundred concomitant PSG and WatchPat tests were analyzed. Median (interquartile range) PSG AHI was 18 (8–37) events/h and PAT $AHI_{3\%}$ was 25 (12–46) events/h. Average bias was + 4 events/h. Diagnostic concordance was found in 42%, 41%, and 83% of mild, moderate, and severe OSA, respectively (accuracy = 53%). Among patients with PAT diagnoses of moderate or severe OSA, 5% did not have OSA and 19% had mild OSA; in those with mild OSA, PSG showed moderate or severe disease in 20% and no OSA in 30% of patients (accuracy = 69%). On average, using a 3% desaturation threshold, WatchPat overestimated disease prevalence and severity (mean + 4 events/h) and the 4% threshold underestimated disease prevalence and severity by −6 events/h.



No OSA	27 (65.8%)	34 (30.0%)	14 (9.6%)	2 (1.0%)
Mild OSA	11 (26.8%)	56 (49.6%)	51 (34.9%)	15 (7.5%)
Moderate OSA	3 (7.3%)	21 (18.6%)	56 (38.3%)	55 (27.5%)
Severe OSA	0 (0.0%)	2 (1.8%)	25 (17.1%)	128 (64.0%)

Loachimescu OC et al. J Clin Sleep Med. 2020;16(10):1663-1674

JCSM | Journal of Clinical Sleep Medicine

SCIENTIFIC INVESTIGATIONS

Use of the WatchPAT to detect occult residual sleep-disordered breathing in patients on CPAP for obstructive sleep apnea

Matthew Epstein, MD[1,2,3]; Tariq Musa, MD[2]; Stephanie Chiu, MPH[2]; Jacquelyn Costanzo, RRT[2]; Christine Dunne, RRT[1,2]; Federico Cerrone, MD[1,2]; Robert Capone, MD[1,2]

Aim : To determine accuracy of AHI as measured by CPAP machines by HSAT device in patients with residual SDB

100 patients using CPAP with AHI <5 and adequate CPAP adherence

Patients were divided into 2 groups :

Group 1 : CPAP and WPAT AHI <5 : 52 patients

Group 2 : WPAT AHI > CPAP AHI (>5) : 48

Inclusion Criteria

Compliant with CPAP (usage of 4 or more hours per night on at least 70% of nights.

Clinical criteria for suspected residual SDB: significant weight gain (more than 10 pounds), persistent daytime sleepiness, worsening self-reported sleep quality or recurrent apneas, or new or worsening medical comorbidities

Epstein M et al. J Clin Sleep Med. 2020 Jul 15; 16(7): 1073–1080

Table 2—Comparison of WPAT and CPAP report data.

Variable	Group 1 (n = 52)	Group 2 (n = 48)	*P* Value
Sleep time	389.2 ± 83.7	403.8 ± 66.4	.335[a]
Record time	466.8 ± 74.8	475.4 ± 72.7	.562[a]
Sleep efficiency	.87 (.27–.95)	.86 (.69–.93)	.833[b]
CPAP AHI	1 (0–5)	1 (0–5)	.260[b]
Adjusted CPAP AHI	1 (0–11)	1 (0–7)	.358[b]
WPAT AHI	2.5 (0–5)	11 (6–45)	< .001[b]
AHI difference	1 (-4 to 4)	9.5 (1–44)	< .001[b]
WPAT REM AHI	4 (0–21)	17.5 (6–55)	< .001[b]
WPAT RDI	6.5 (1–22)	17 (8–45)	< .001[b]
WPAT ODI	1 (0 to –3)	4 (0–39)	< .001[b]
WPAT O_2 saturation	.91 (.78–.96)	.875 (.73–.93)	< .001[b]

Conclusion: WPAT could **detect elevated AHI in 50% of patients** with OSA already on CPAP with residual SDB symptoms

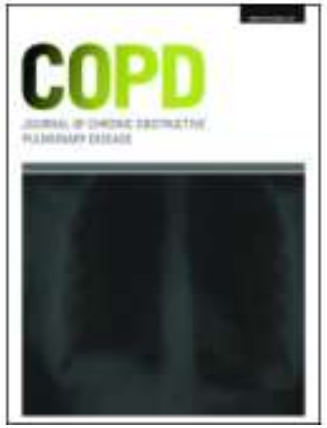
WPAT may represent a valuable tool to **ensure adequate treatment in high risk patients** in general.

Epstein M et al. J Clin Sleep Med. 2020 Jul 15; 16(7): 1073–1080

Accuracy of WatchPAT for the Diagnosis of Obstructive Sleep Apnea in Patients with Chronic Obstructive Pulmonary Disease

R. Jen[a,b], J. E. Orr[b], Y. Li[b,c], P. DeYoung[b], E. Smales[b], A. Malhotra[b], and R. L. Owens[b]

[a]Division of Respiratory Medicine, University of British Columbia, Vancouver, British Columbia, Canada; [b]Division of Pulmonary, Critical Care, and Sleep Medicine, University of California San Diego, La Jolla, California, USA; [c]Department of Otolaryngology Head and Neck Surgery, Beijing Tongren Hospital, Capital Medical University, Key Laboratory of Otolaryngology, Head and Neck Surgery (Ministry of Education of China), Beijing, China



Jen R et al. evaluated accuracy of WatchPAT for diagnosis of OSA in 33 COPD subjects

Subjects underwent PSG and simultaneous recording with WatchPAT

Adult patients (18 years of age) with known COPD (GOLD stage 2 or higher and 10 pack-years of smoking history) were included

Unstable COPD or active cardiovascular disease (recent hospitalization within 3 months) ,peripheral vascular disease, peripheral neuropathy, non-sinus cardiac rhythm, permanent pacemaker, finger deformity that precluded adequate sensor application were excluded

Jen R et al. COPD. 2020;17(1):34-39

The **sensitivity** of WatchPAT at an AHI cut-off of 5, 15, and 30 events/h for corresponding PSG AHI cut-offs was 95.8, 92.3, and 88.9, respectively; **specificity** was 55, 65.0, and 95.8, respectively.

There was **no significant difference in the apnea–hypopnea index (AHI) between PSG and WatchPAT** (19 ± 20 versus 20 ± 15 events/h; mean difference 2(–2, 5) events/h; p =0.381).

WatchPAT and PSG results comparison ($N = 33$).

	PSG (Mean ± SD)	WatchPAT (Mean ± SD)	Beta co-efficient (95% CI)	Intra-individual difference [Mean (95% CI)]	*p* value
Overall AHI (events/h)	19 ± 20	20 ± 15	1 (1, 1)*	2 (–2, 5)	0.381
REM AHI (events/h)	22 ± 21	26 ± 14	1 (1, 2)*	4 (–2, 10)	0.217
NREM AHI (events/h)	17 ± 20	17 ± 16	1 (1, 1)*	0 (–5, 4)	0.915
Total sleep time (min)	283 ± 78	313 ± 68	1 (0, 1)*	29 (7, 52)	0.011
Sleep efficiency (%)	71 ± 17	76 ± 14	1 (0, 1)†	5 (0, 11)	0.081
REM duration (min)	41 ± 29	52 ± 33	1 (0, 1)*	11 (1, 21)	0.033
% REM sleep (%)	13 ± 9	16 ± 8	1 (0, 1)†	2 (–1, 5)	0.117
Mean SpO_2 (%)	92 ± 2	94 ± 2	1 (1, 1)*	2 (2, 3)	<0.001
SpO_2 nadir (%)	82 ± 6	86 ± 6	0 (0, 1)	4 (1, 6)	0.004
ODI 3% (events/h)	11 ± 11	10 ± 10	1 (1,1)*	1 (–3, 2)	0.502

Jen R et al. COPD. 2020;17(1):34-39

Alice PDX

- Portable monitor with sensors for oxygen saturation, pulse rate, airflow nasal cannula and thermister, thoracic and abdominal effort belt and body position
- PDX was in diagnostic agreement with PSG in 96.4% of the evaluation
- Compared with in lab PSG, high sensitivity and specificity in quantifying AHI especially in moderate to severe OSA
- Very few cases of Apnea under/over estimation (<3%)
- In 10% false negative finding could occur

Nilius G et al. Nat Sci Sleep. 2017 Jun 6;9:171-180

ApneaLink

Image source: Resmed.com

- Level 4 sleep portable monitor
- Measures airflow through nasal cannula , Saturation and heart rate
- Battery powered
- Upto 10 hr of data collection
- >80% sensitivity at all AHI levels
- Highest sensitivity and specificity at AHI >15
- At lower AHI, good sensitivity but low specificity, increased number of false positives.

Erman MK et al. J Clin Sleep Med. 2007; 3(4)387–392

Meta-analysis of diagnostic accuracy of type IV PM apnea link

PSG, and PM AHI/RDI cut off	Studies	Sensitivity	Specificity	Area under ROC curve
≥ 5 events/hr	Bahammam et al 2011 Crowley et al 2013 Nigro et al. 2010 Nigro et al. 2011 Octay et al. 2011 Ragette et al. 2010	0.88 (0.82,0.92)	0.64 (0.52, 0.75)	0.84
≥ 15 events /hr	same as above	0.82 (0.69,0.90)	0.88 (0.83, 0.91)	0.88

Abrahamyan L et al. Sleep Breath. 2018;22(3):593-611

ALICE Nightone

image source: Phillips.co.in

Type 4 HSAT device
Has 3 sensors :
Saturation probe
Nasal transducer
Effort sensor

CMAJ RESEARCH

Diagnostic accuracy of level 3 portable sleep tests versus level 1 polysomnography for sleep-disordered breathing: a systematic review and meta-analysis

Mohamed El Shayeb MD MSc, Leigh-Ann Topfer MLS, Tania Stafinski PhD, Lawrence Pawluk MD, Devidas Menon PhD

19 studies comparing level III with Level I included in the metaanalysis

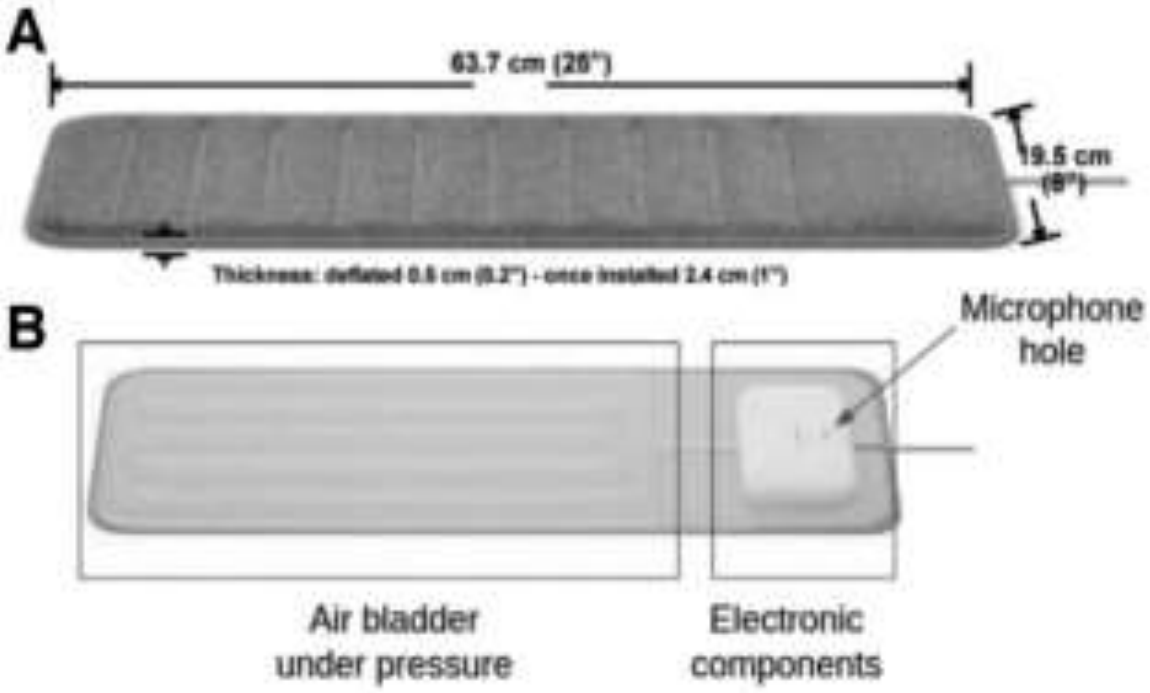
4 channels measured in all the studies were nasal airflow, thoracoabdominal movement, oxygen saturation and body position

Location, apnea–hypopnea cut-off	Sensitivity (95% CI)	Specificity (95% CI)	Area under the ROC curve (95% CI)	Positive LR (95% CI)	Negative LR (95% CI)
Home, ≥ 5 events/h	0.93 (0.90–0.95)	0.60 (0.51–0.68)	0.89 (0.86–0.92)	2.3 (1.9–2.9)	0.11 (0.07–0.16)
Laboratory, ≥ 5 events/h	0.96 (0.90–0.98)	0.76 (0.63–0.85)	0.92 (0.90–0.94)	3.9 (2.6–6.1)	0.05 (0.02–0.13)
Home, ≥ 10 events/h	0.83 (0.73–0.89)	0.81 (0.70–0.89)	0.89 (0.86–0.91)	4.3 (2.7–7.0)	0.22 (0.14–0.33)
Laboratory, ≥ 10 events/h	0.92 (0.87–0.95)	0.85 (0.77–0.90)	0.93 (0.91–0.95)	6.0 (4.0–8.9)	0.09 (0.05–0.15)
Home, ≥ 15 events/h	0.79 (0.71–0.86)	0.79 (0.63–0.89)	0.85 (0.82–0.88)	3.7 (2.1–6.7)	0.26 (0.19–0.37)
Laborator, ≥15 events/h	0.92 (0.86–0.96)	0.91 (0.85–0.95)	0.97 (0.95–0.98)	10.6 (6.1–18.2)	0.08 (0.04–0.15)
Home, ≥ 30 events/h	0.79 (0.72–0.85)	0.90 (0.84–0.95)	0.86 (0.83–0.89)	8.2 (4.7–14.6)	0.23 (0.16–0.32)
Laboratory, ≥ 30 events/h	0.97 (0.92–0.99)	0.93 (0.89–0.96)	0.99 (0.98–1.00)	14.9 (8.6–25.8)	0.03 (0.01–0.08)

El Shayeb M et al. CMAJ. 2014 ;186(1):E25-51

Validation of the **Withings Sleep Analyzer**, an under-the-mattress device for the detection of moderate-severe sleep apnea syndrome

- New concept of non wearable devices that can be placed under mattress.
- Consists of a hardware piece, the Withings Sleepmat, and software that estimates AHI.
- The WSA is powered by a deep-learning algorithm that uses body movement, breathing patterns, cardiac activity, and snoring to estimate an apnea-hypopnea index (AHI).



Dimensions (**A**) and components (**B**). WSA = Withings Sleep Analyzer.

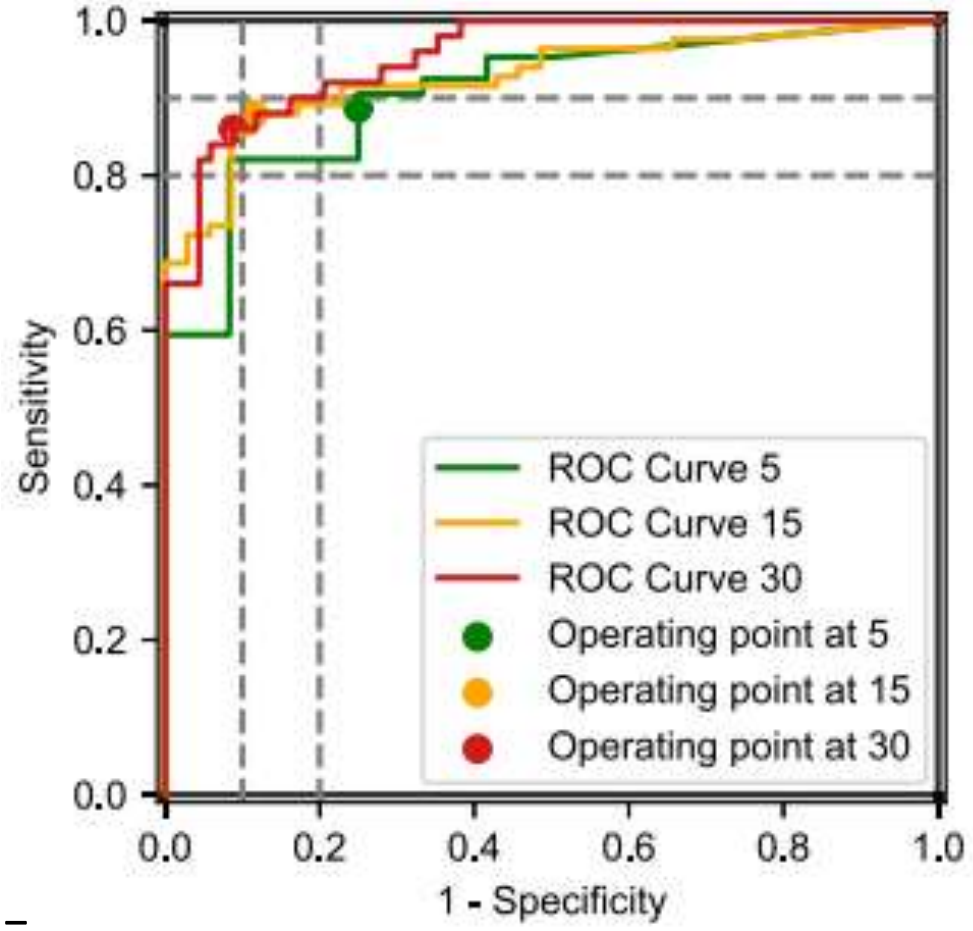
Edouard P et al. J Clin Sleep Med. 2021;17(6):1217-1227

- Edouard P et al. evaluated the diagnostic performance of the WSA compared to the gold-standard PSG in a population of **118 patients** with suspected OSAS
- Primary endpoints of this study were the sensitivity and specificity in detecting an AHI ≥ 15 events/h and an AHI ≥ 30 events/h

RESULTS :

The sensitivity, specificity, and area under the ROC curve at **thresholds of AHI ≥ 15 events/h** were, respectively, 88.0%, 88.6%, (AUROC) 15 = 0.926

At the **threshold of AHI ≥ 30 events/h**, results included Se30 = 86.0%, Sp30 = 91.2%, AUROC30 = 0.954.



Edouard P et al. J Clin Sleep Med. 2021;17(6):1217-1227

Belun Ring Platform

Gu W et al. J Clin Sleep Med. 2020;16(9):1611-1617

- Captures oxygen saturation, photoplethysmography and accelerometer signals and runs on proprietary cloud based neural network algorithms
- Correlated well with PSG AHI (r=0.8) with sensitivity 0.85 and specificity 0.75 in categorizing AHI > 15 and PPV 0.88 and NPV 0.83
- Limitation : Overestimate AHI in individuals with AHI under 15/h and underestimate AHI in those over 15/h
- Participants did not have cardiorespiratory/neuromuscular disorders, B blockers/CCB's and test was conducted in sleep lab rather than home setting

Gu W et al. J Clin Sleep Med. 2020;16(9):1611-1617

Nightowl HSAT system

- Miniature HSAT device
- consists of sensor placed on finger tip and a cloud based analytic software
- sensors acquire accelerometer which gives actigraphy and photoplethysmographic data which provides PAT data.
-

Massie F et al. J Clin Sleep Med. 2018;14(10):1791-1796

SIESTA STUDY : BRESODx

- TYPE IV Single channel acoustic device
- consist of open face frame with embedded microphone in front of nose and mouth
- **breath sound capturing single microphone** and accelerometer microchip into faceframe
- compared to PSG sensitivity 0.86-0.89 and specificity 0.38-0.44
- To be used at referral centers in patients with very high pre-test probability to rule in a diagnosis of OSA
- Limitation : does not measure sao2

Fitzpatrick M et al. Sleep Med. 2020;65:45-53

Rooti Rx

- Screening of OSA in patients who snore using

  a patch type device using ECG & 3 axis accelerometer

- Uses the principle of chest wall motion Excursion (chest effort index) and cyclic variation of heart rate (CVHR) in detecting OSA. Tested in 119 patients

- CVHR detected moderate-to-severe OSA with 52.9% sensitivity and 94.1% specificity

  whereas CEI identified moderate-to-severe OSA with 80% sensitivity and 79.4% specificity

- The discrimination ability was greater (AUC = 0.90, 95% confidence interval: 0.85–0.95) when combining these two signals.

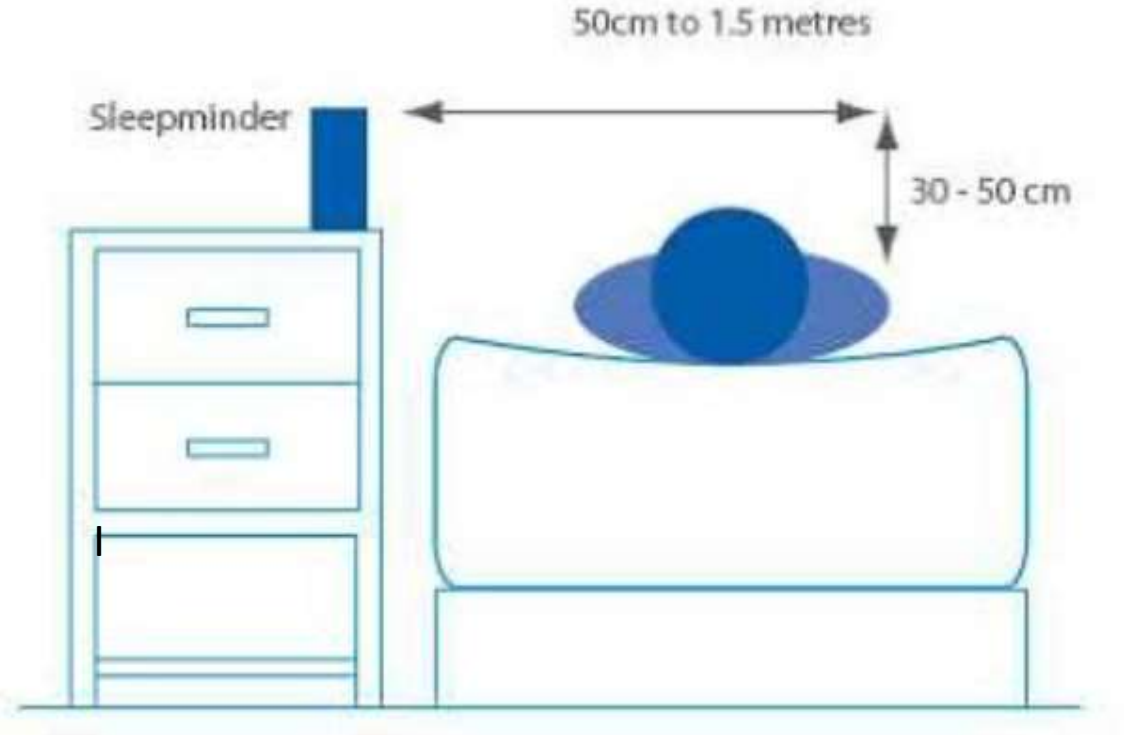
Hsu Y S et al. J Clin Sleep Med. 2020; 16(7): 1149–1160

Smart phone screening for OSA : FIREFLY

- Subtle breathing patterns of a person in bed can be measured via smartphone using ‘Firefly’ app
- Utilizes advanced digital signal processing and artificial technology algorithm to detect sleep stage, respiration rate , snoring.
- Hybrid technology : Passive breath sound detection and active sonar technology
- System has been trained over 128 overnight PSG recording.
- Can screen for AHI > 15events/hr
- Performance compared to ambulatory OSA screeners (sensitivity 88%, specificity 80%)

Tiron R et al. J Thorac Dis. 2020;12(8):4476-4495

SLEEP MINDER



- Novel non contact bedside sensor
- uses radiowaves to measure respiration and movement
- Correlated strongly with PSG (r=0.9)
- Sensitivity and specificity of 90% & 92% in diagnosing Moderate to severe OSA >15 AHI

Zaffaroni A et al. J Sleep Res. 2013;22(2):231-6

Digital Health and Sleep-Disordered Breathing: A Systematic Review and Meta-Analysis

Talita Rosa, MD, MS[1]; Kersti Bellardi, MS[2]; Alonço Viana Jr, MD, MS[3]; Yifei Ma, MS[4]; Robson Capasso, MD[5]

- Inclusion Criteria
- Studies that reported on adults with SDB symptoms by measuring physiological parameters through the use of mobile phones or other novel technologies like portable devices, handheld technologies and wearable devices
- 18 articles were included in final metaanalysis
- 6 studied bed/mattress based devices (eg. sonomat, SD-101, Emfit)
- 6 studied contact less devices (sleep minder, smartphone sensor, Early sense)
- 5 studied contact devices with fewer than 3 sensors
- 3 studied contact devices with 3 more sensors

Rosa T et al. J Clin Sleep Med. 2018;14(9):1605-1620

Bed/Mattress-Based Sensors							
Agatsuma et al. (2009)	Cross-sectional	Japan, 2004–2007	Adults suspected of OSA and CA	201	Sheet type device (SD-101); sensors: (1) pressure (n = 162)	Alice 3	RDI versus AHI-PSG
Beattie et al. (2013)	Cross-sectional	United States	Adults suspected of OSA and CA	45	Sheet type device; sensors: (1) pressure sensors	Routine 16-channel	RDI versus RDI-PSG
Norman et al. (2014)	Case-control randomized	Australia	Adults suspected of OSA and CA	60	Sonomat device, pressure sensors measures: (1) movement (2) acoustic (4 total in mattress)	Compumedics	AHI versus AHI-PSG
Takasaki et al. (2008)	Cross-sectional	Japan, 2006	Adults suspected of OSA	52	Sheet type device (SD-101); sensors: (1) pressure (n = 162)	Not specified	AHI versus AHI-PSG
Tenhunem et al. (2013)	Retrospective	Finland, 2005–2006	Adults suspected of OSA	157	Emfit; Pressure device; Body (1) and respiratory movement (2), Heart and (3) Respiratory rate	Embla N7000	Emfit OPT time versus AHI- PSG
Tsukahara et al. (2014)	Cross-sectional	Japan, 2010–2012	Adults suspected of OSA	101	Sheet type device (SD-101); sensors: (1) pressure (n = 162)	Compumedics	RDI versus AHI-PSG

AHI Threshold Subgroup	Summary Accuracy (95% CI)		No. of Participants (Studies Included)
	Sensitivity	False Positive Rate	
Overall	0.921 (0.870, 0.953)	0.203 (0.124, 0.314)	515 (5)
Cutoff 5 events/h	0.951 (0.789, 0.990)	0.395 (0.189, 0.647)	515 (5)
Cutoff 15 events/h	0.944 (0.886, 0.973)	0.155 (0.055, 0.366)	515 (5)
Cutoff 30 events/h	0.917 (0.833, 0.961)	0.113 (0.065, 0.191)	515 (5)

Rosa T et al. J Clin Sleep Med. 2018;14(9):1605-1620

Contactless Devices (Other Than Bed/Mattress-Based Sensors)							
Abad et al. (2016)	Cross-sectional	Spain, 2013–2014	Adults suspected of OSA	50	SleepWise image processing: video measures: (1) respiratory and (2) body movement	32-channel E series	AHI versus AHI-PSG
Davidovich et al. (2016)	Cross-sectional	United States	Adults suspected of OSA	96	EarlySense Ltd; estimates: (1) respiratory movement (2) heart rate (3) body movement	Alice 5, Respironics	AHI versus AHI-PSG
Espinoza-Cuadros et al. (2015)	Cross-sectional	Spain, 2010	Patients suspected of OSA	285	Speech (laptop) and facial image (digital camera)	Not specified	AHI versus AHI- PSG
Nandakumar et al. (2015)	Cross-sectional	United States	Adults suspected of OSA and CA	37	Smartphone sensors; emits sonar waves and captures with (1) microphone	EEG, EOG, EMG, ECG, thoraco-abdominal belts, plethysmography, oximetry, thermistor, nasal cannula	AHI versus AHI-PSG
Zaffaroni et al. (2013)	Cross-sectional	Ireland, 2010	Adults suspected of OSA	74	SleepMinder; emits radio-frequency energy: (1) body and respiratory movement	Jaeger-Toennies 1000e System	AHI versus AHI-PSG
Weinreich et al. (2014)	Cross-sectional	Germany, 2011–2013	Adults suspected of OSA	52	SleepMinder; emits radio-frequency energy: (1) body and respiratory movement	Embla, USA	AHI versus AHI-PSG

AHI Threshold Subgroup	**Summary Accuracy (95% CI)**		**No. of Participants (Studies Included)**
	Sensitivity	**False Positive Rate**	
Overall	0.905 (0.839, 0.946)	0.217 (0.110, 0.383)	594 (6)
Cutoff 5 events/h	0.976 (0.899, 0.995)	0.487 (0.137, 0.851)	498 (5)
Cutoff 15 events/h	0.876 (0.760, 0.941)	0.136 (0.075, 0.235)	594 (6)
Cutoff 30 events/h	0.806 (0.695, 0.883)	0.066 (0.043, 0.101)	456 (4)

Rosa T et al. J Clin Sleep Med. 2018;14(9):1605-1620

Contact Devices With Three or More Sensors							
Al-Mardini et al. (2014)	Case-control	Not specified	Adults suspected of OSA	15	Smartphone and sensors: external (1) oximeter and (2) microphone, and (3) built-in accelerometer	Not specified	Average AHI and ODI versus AHI-PSG
Benistant (2016)	Cross-sectional	The Netherlands, 2015	Adults suspected of OSA	9	External sensors: (1) pulse oximeter (2) nasal cannula pressure (3) accelerometers	Not specified	AHI versus AHI-PSG
Rofouei et al. (2011)	Case study	Not specified	Patients in whom moderate OSA was diagnosed	1	Neck-cuff at home; built-in (1) pulse oximeter (2) microphone (3) accelerometer	Not specified	AHI versus AHI-PSG

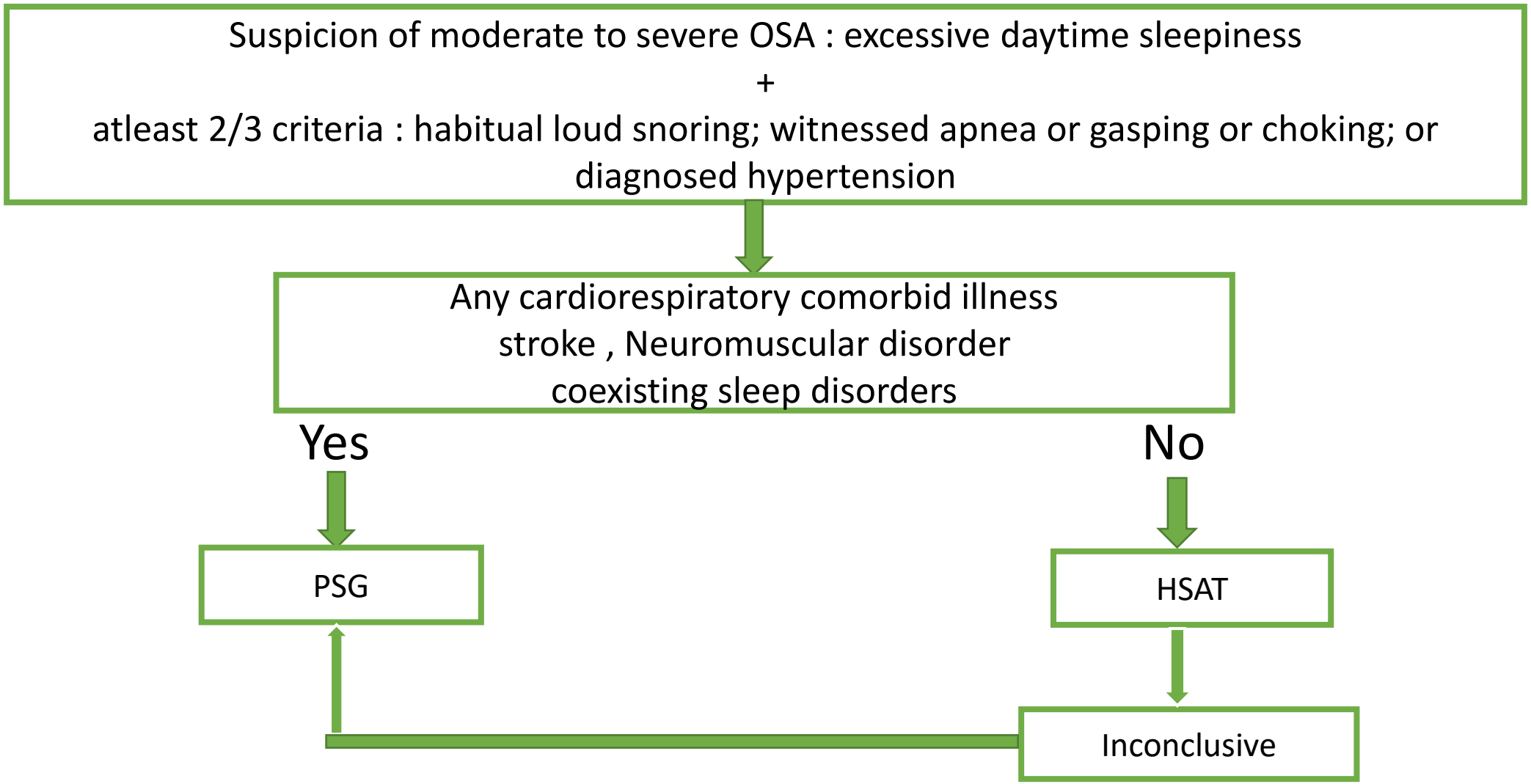
AHI Threshold Subgroup	Summary Accuracy (95% CI)		No. of Participants (Studies Included)
	Sensitivity	False Positive Rate	
Overall	0.771 (0.466, 0.929)	0.094 (0.029, 0.269)	24 (2)
Cutoff 5 events/h	0.770 (0.171, 0.982)	0.134 (0.028, 0.459)	24 (2)

Rosa T et al. J Clin Sleep Med. 2018;14(9):1605-1620

Contact Devices With Fewer Than Three Sensors						
Dinç et al. (2014)	Cross-sectional	Turkey	Adult snorers	31	SleepStrip at home; sensors: (1) 3 flow sensors	EOG, EEG, EMG, ECG, thermistor, oronasal airflow, respiratory effort, abdominal and thoracic belts, oximetry
Levendowski et al. (2015) Arm A	Cross-sectional	United States	Adults suspected of OSA	20	Wearable device (neck); sensors: (1) built-in microphone and (2) accelerometer	Alice 3 or 4
Ozmen et al. (2011)	Cross-sectional	Turkey, 2008–2009	Adults suspected of OSA	64	SleepStrip at home; sensors: (1) 3 flow sensors	Compumedics
Selvaraj et al. (2014)	Case-control	Not specified	Adult volunteers.	53	HealthPatch; sensors: (1) accelerometer (built-in) (2) heart signal (ECG built in)	22-channel PSG (Sapphire, CleveMed, Inc)
Nakano et al. (2014)	Case-control	Japan	Adults suspected of OSA	40	Smartphone sensor: (1) built-in microphone	EEG 7414, Nihon Kohden

AHI Threshold Subgroup	Summary Accuracy (95% CI)		No. of Participants (Studies Included)
	Sensitivity	False Positive Rate	
Overall	0.713 (0.594, 0.808)	0.099 (0.058, 0.166)	169 (4)
Cutoff 5 events/h	0.637 (0.392, 0.827)	0.077 (0.011, 0.392)	51 (2)
Cutoff 15 events/h	0.716 (0.500, 0.865)	0.122 (0.049, 0.273)	169 (4)
Cutoff 30 events/h	0.450 (0.191, 0.740)	0.022 (0.001, 0.268)	31 (1)

Rosa T et al. J Clin Sleep Med. 2018;14(9):1605-1620



A technically adequate diagnostic HSAT recording must include a minimum of four hours of technically adequate oximetry and flow data

Therapy in OSA

- Positive airway pressure (PAP) has become the primary therapy to treat adult OSA
- AASM recommends PAP therapy for all patients diagnosed with OSA having excessive daytime sleepiness, impaired sleep related quality of life or comorbid conditions
- Patients with certain occupation (pilots, drivers) can be given PAP at AHI>5 even in absence of symptoms
- The initiation of PAP therapy requires selection of a mode of PAP (eg, continuous or bilevel PAP) and titration of pressure to determine the optimal settings to reduce obstructive events
- Several modes of PAP are available.

Modes of administration

- Three basic modes of giving PAP to patient with OSA include **CPAP**, auto-titrating CPAP **(APAP)** and rarely, bilevel PAP **(BPAP)** in select patients.
- CPAP (Fixed-level) is the first-choice therapy. It delivers PAP at a level that remains relatively constant throughout the respiratory cycle.
- APAP increases or decreases the PAP in response to change in airflow, circuit pressure, a vibratory snore.
- BPAP delivers PAP at different levels during inspiration (IPAP) and expiration (EPAP)

Auto-adjusting PAP (APAP) Devices

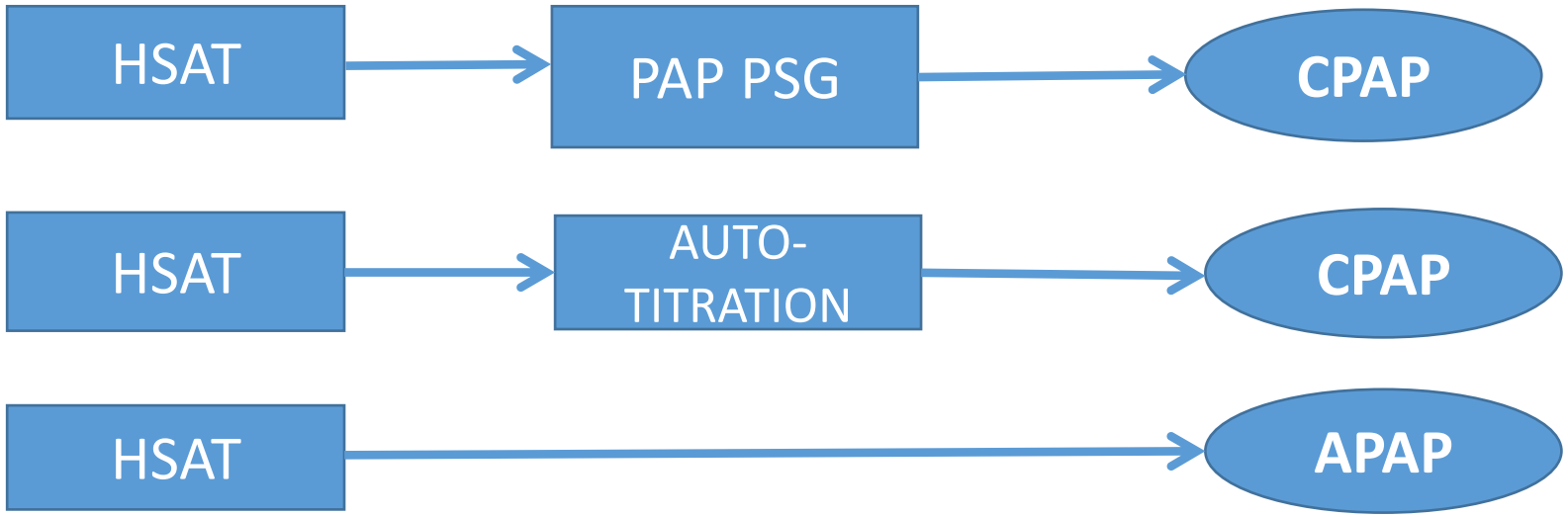
- Flow sensors were integrated into PAP devices to assess the presence of obstructive breathing events using proprietary algorithms
- These devices can dynamically increase CPAP when obstructive breathing events are detected, and to periodically reduce the delivered pressure when no events were detected for some period of time, hence deliver the lowest pressure needed to maintain airway patency
- APAP in the ambulatory setting is increasingly being utilized as an alternative to traditional in-laboratory PAP titrations for the initiation and continued treatment of OSA.
- Recent increase in the use of APAP in the covid pandemic

Titration with APAP

- APAP device typically gather downloaded data from a 7- to 14-day period of in-home APAP titration and set a minimum and maximum pressure range of 5 to 20 cm H_2O, respectively.
- The **optimal fixed-level CPAP** setting is typically the level of pressure at or below which obstructive events measured by the APAP device are eliminated for more than 90 or 95 percent of the time **("90th and 95th percentile pressure"** or "P90 and P95 pressure")
- **Successful APAP trial,** which consists of a combination of mean nightly use of at least 4 hours per night, a device-calculated REI ≤10 events per hour, and an acceptable leak profile (which is dependent on the individual device manufacturer, mask type, and proprietary algorithms).

Options for starting PAP therapy

- Pathway 1
- Pathway 2
- Pathway 3



WHICH OPTION IS BETTER?

NEW RESEARCH

JCSM
Journal of Clinical Sleep Medicine

pii: jc-00284-14
http://dx.doi.org/10.5664/jcsm.4272

Auto-adjusting Positive Airway Pressure Treatment for Sleep Apnea Diagnosed by Home Sleep Testing

Richard B. Berry, M.D., F.A.A.S.M.; Peruvemba Sriram, M.D.
Malcom Randall VA Medical Center, University of Florida, Gainesville, FL

- 156 patients diagnosed by HSAT were included in the study
- 78 each were randomized into APAP and PSG-CPAP group
- Patient received training for the use of APAP and CPAP devices in each arm
- CPAP was titrated in PSG to target AHI < 10
- APAP was provided with a pressure limit between 4-18 cmH20

- **Inclusion** :
- AHI>10, ESS >8
- Age >18, able to understand directions
- house within 200 miles
- **Exclusion**
- prior CPAP treatment , depression , psychosis
- severe COPD, CHF, uncontrolled HTN , Hypoventilation, neuromuscular disorder, baseline sao2 <88%, sleep < 4 hrs/night, central apnea index >5/hour, narcolepsy, use of narcotics.

Berry R et al. J Clin Sleep Med. 2014;10(12):1269-75

Result

	APAP	CPAP	APAP versus CPAP
PAP setups (#.)	78	70	
Using CPAP at clinic visit	66	59	
% Using CPAP (of those started on PAP)	84.6	84.3	p = NS
90% pressure/CPAP pressure (cm H_2O)	10.8 ± 3.1	11.7 ± 2.5	p = 0.07
Average nightly use (h)	4.45 ± 2.3	4.0 ± 2.3	p = 0.26
Residual AHI (#/h)	5.5 ± 4.7	4.9 ± 4.9	p = 0.49
Post treatment ESS	11.0 ± 5.1*	10.8 ± 3.5*	
Change ESS	−4.2 ± 4.7	−3.7 ± 4.8	p = 0.15
Post treatment FOSQ	15.2 ± 3.2*	15.5 ± 3.4*	
Change FOSQ	2.6 ± 3.5	2.2 ± 3.7	p = 0.33
PAP satisfaction	11.8 ± 2.3	10.7 ± 3.1	p = 0.03

Conclusion : Treatment with APAP results in equivalent PAP adherence and improvement in sleepiness as compared to PSG titration and CPAP titration

Berry R et al. J Clin Sleep Med. 2014;10(12):1269-75

The Clinical Respiratory Journal
Open Access

ORIGINAL ARTICLE

Comparison of 3-months treatment adherence and estimating residual apnea hypopnea index between home versus in-laboratory auto-titrating positive airway pressure titration

Ozge Aydin Guclu, Ahmet Ursavas, Fikret Kasapoglu, Gokhan Ocakoglu, Mehmet Karadag

First published: 27 February 2020

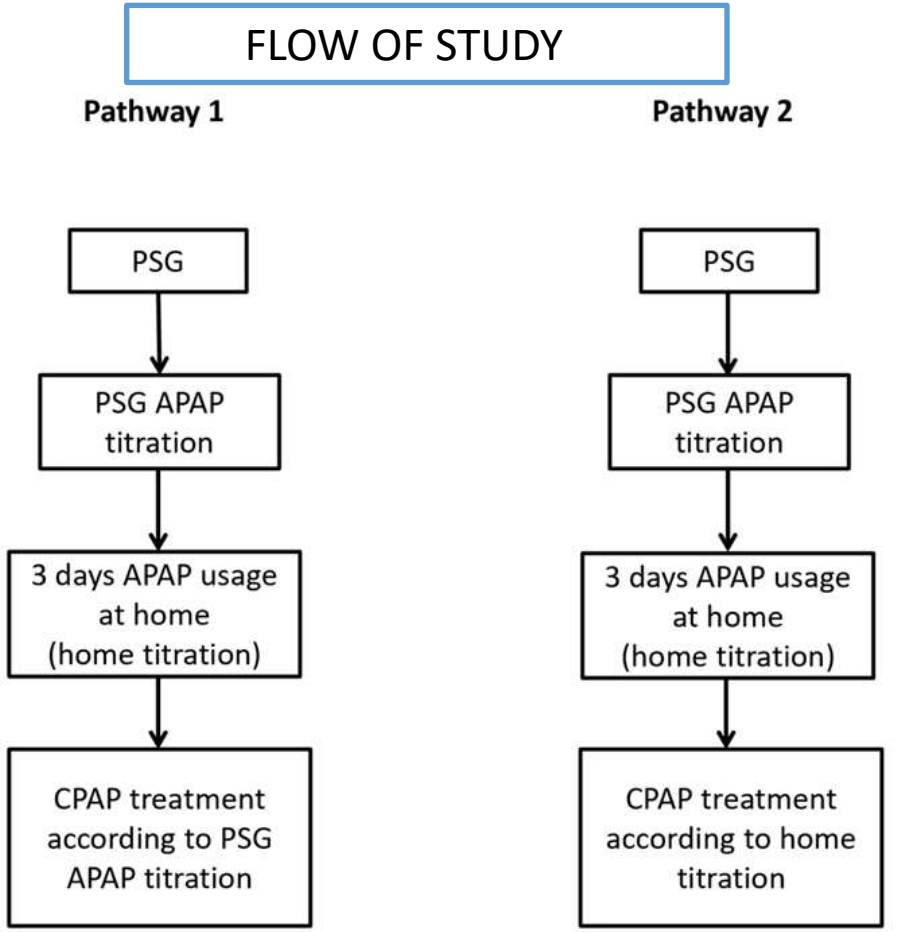
Aim: to assess accuracy of home titration for estimating AHI and optimal pressure values with PSG and to compare 3 month treatment adherence and residual AHI between the two group

Study design : Randomized , prospective

Sample size : 53

Inclusion: Age >18 yrs, AHI > 15 without symptoms or 5-15 with symptoms, ability to understand directions

Exclusion : CHF, Mod-sev COPD, hypoventilation, neuromuscular disorder, baseline sao2 < 88%, sleep duration < 4hr



Glucu OA et al. Clin Respir J. 2020; 14: 622– 630

Results: Fifty-three patients with newly diagnosed OSAS were enrolled. There was a significant positive correlation between PSG AHI and APAP AHI (r_s=0.43, p=0.003) and the fixed pressure for the APAP arm was positively correlated with the APAP PSG arm of the study (rs=0.71, p<0.001). When the Bland-Altman graphs were compared, it was seen that the measurements obtained by the APAP AHI method were 0.3 units higher than the PSG AHI measurements, and that the mean of the measurement differences between the two methods was not different than 0 (P (H0: Mean=0)=0.551). After 3 months of treatment, average nightly use was slightly higher in the APAP arm (p=0.387).

Table-2. Comparison of data at the 3rd month clinic visit after treatment

	APAP arm	PSG-APAP arm	p
Using CPAP at clinic visit	25	20	
% Using CPAP	92%	76%	
ESS			
Pre	11.24 ± 5.04	8.25 ± 5.35	0.057[a]
Post	8.24 ± 5.18	6.30 ± 3.44	-
%Percent change (Post→Pre)	-20 (-75.53)	-8.33 (-133.25)	0.226[c]
PSQI			
Pre	6.96 ± 3.21	6.25 ± 3.51	0.413[a]
Post	5 (1-11)	5 (3-11)	-
%Percent change (Post→Pre)	-28.57 (-61.66)	-14.17 (-97.16)	0.084[c]
FOSQ			
Pre	41.28 ± 22.32	37.75 ± 19.29	0.715[a]
Post	19 (0-88)	24 (0-64)	-
%Percent change (Post→Pre)	-49.65 (-64.62)	-35.48 (-101.04)	0.426[c]
3 month CPAP Use (hour)	309.27±167.98	267.70±146.05	0.387[a]

Data were presented as mean ± st.deviation , n (%) and median (Interquartile range: IQR)

Glucu OA et al. Clin Respir J. 2020; 14: 622– 630

Treatment of Adult Obstructive Sleep Apnea with Positive Airway Pressure: An American Academy of Sleep Medicine Clinical Practice Guideline

Recommendation 4: We recommend positive airway pressure therapy be initiated using either APAP at home or in-laboratory PAP titration in adults with OSA and no significant comorbidities. (STRONG)

This recommendation is based on studies that excluded patients with the following comorbidities or conditions: congestive heart failure, chronic opiate use, significant lung disease such as chronic obstructive pulmonary disease, neuromuscular disease, history of uvulopalatopharyngoplasty, sleep-related oxygen requirements, or expectation for nocturnal arterial oxyhemoglobin desaturation due to conditions other than OSA, including hypoventilation syndromes and central sleep apnea syndromes.

This recommendation is based on the clinical trials reviewed, in which mask fittings and education on PAP use at a sleep center and/or close follow-up by trained staff during the treatment period were provided to the home APAP group. In some studies, daytime acclimatization to PAP was included.

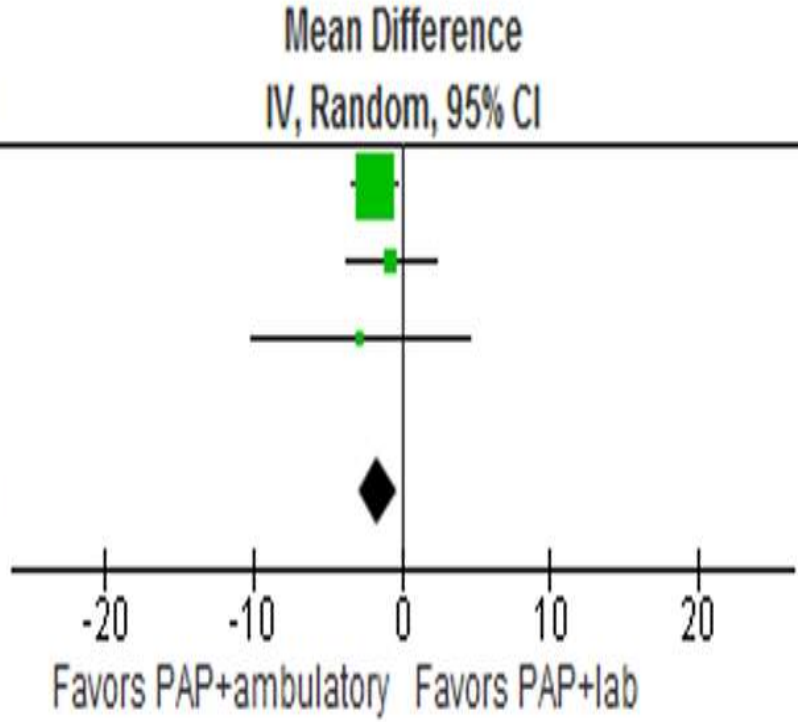
Patil SP et al. J Clin Sleep Med. 2019;15(2):335-343

Figure S58. APAP-intiated PAP vs. In-lab-intiated PAP (AHI, events/hr)

Study or Subgroup	PAP+ambulatory Mean	SD	Total	PAP+lab Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Berry 2008	3.5	1.9	40	5.3	4.4	39	77.3%	-1.80 [-3.30, -0.30]
Mulgrew 2007	2.5	6.8	31	3.2	5	30	19.5%	-0.70 [-3.69, 2.29]
Planes 2003	7.6	6.9	16	10.4	12.5	14	3.2%	-2.80 [-10.17, 4.57]
Total (95% CI)			87			83	100.0%	-1.62 [-2.94, -0.30]

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 0.52$, df = 2 (P = 0.77); $I^2 = 0\%$

Test for overall effect: Z = 2.40 (P = 0.02)



Patil SP et al. J Clin Sleep Med. 2019;15(2):335-343

Figure S60. APAP-intiated PAP vs. In-lab-intiated PAP (ESS)

Study or Subgroup	PAP+ambulatory Mean	SD	Total	PAP+lab Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Antic 2009	9.7	4.4	90	9.2	3.8	84	17.1%	0.50 [-0.72, 1.72]
Berry 2008	9.9	6.3	40	9.6	5.6	39	3.7%	0.30 [-2.33, 2.93]
Cross 2006	8.5	5	100	9.5	4.9	98	13.4%	-1.00 [-2.38, 0.38]
Hui 2017	8.5	5.5	86	7.7	5	86	10.3%	0.80 [-0.77, 2.37]
Kuna 2011	9.4	2.2	95	10	4.8	84	20.3%	-0.60 [-1.72, 0.52]
McArdle 2010	8.3	4.5	62	7.4	3.7	63	12.2%	0.90 [-0.55, 2.35]
Mulgrew 2007	5	4.4	31	5	4.4	30	5.2%	0.00 [-2.21, 2.21]
Planes 2003	7.5	3.4	16	7.6	3.4	14	4.3%	-0.10 [-2.54, 2.34]
Rosen 2012	7.2	4.2	77	7.1	4.1	65	13.6%	0.10 [-1.27, 1.47]
Total (95% CI)			**597**			**563**	**100.0%**	**0.04 [-0.46, 0.55]**

Heterogeneity: Tau² = 0.00; Chi² = 6.31, df = 8 (P = 0.61); I² = 0%
Test for overall effect: Z = 0.16 (P = 0.87)

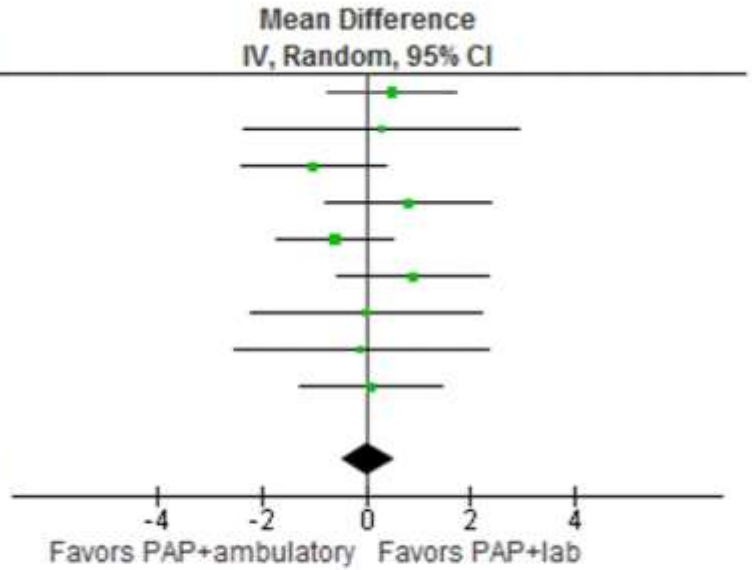


Figure S61. APAP-intiated PAP vs. In-lab-intiated PAP (FOSQ & SAQLI)

Study or Subgroup	PAP+ambulatory Mean	SD	Total	PAP+lab Mean	SD	Total	Weight	Std. Mean Difference IV, Random, 95% CI
Cross 2006	13.8	2	100	13.4	3	98	25.6%	0.16 [-0.12, 0.44]
Hui 2017	4.7	1	86	4.6	1	86	22.3%	0.10 [-0.20, 0.40]

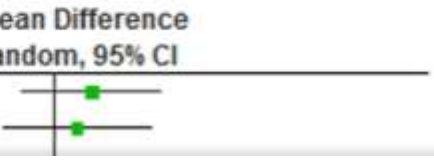
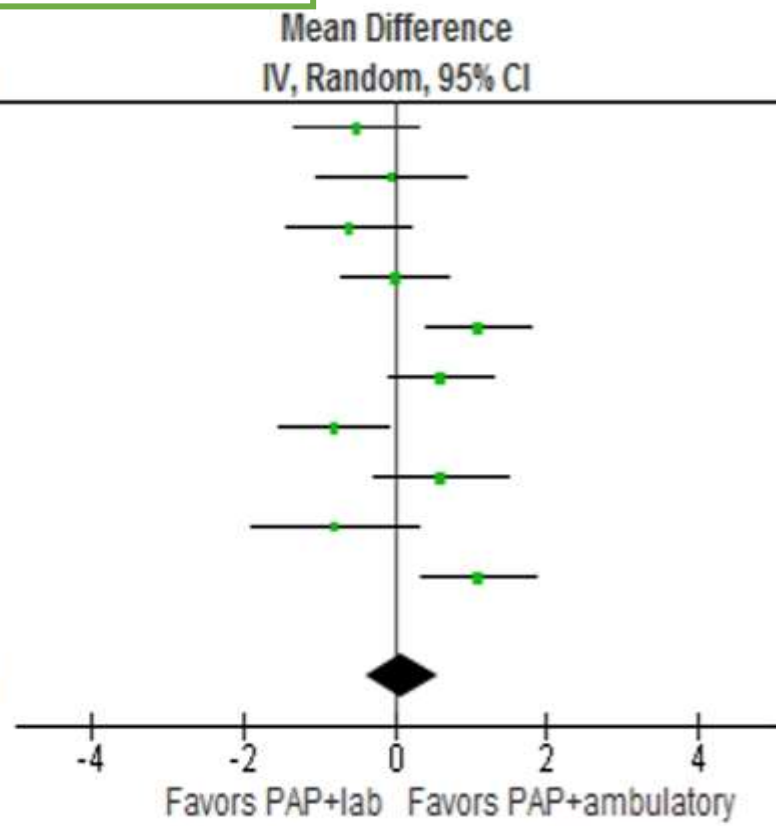


Figure S59. APAP-intiated PAP vs. In-lab-intiated PAP (Adherence, hrs/night)

	PAP+ambulatory			PAP+lab				Mean Difference
Study or Subgroup	Mean	SD	Total	Mean	SD	Total	Weight	IV, Random, 95% CI
Antic 2009	4.1	2.9	94	4.6	2.7	83	9.9%	-0.50 [-1.33, 0.33]
Berry 2008	5.2	1.9	40	5.25	2.5	39	8.8%	-0.05 [-1.03, 0.93]
Chai-Coetzer 2013	4.8	2.1	51	5.4	2	44	9.9%	-0.60 [-1.43, 0.23]
Cross 2006	4.4	2.5	100	4.4	2.5	98	10.9%	0.00 [-0.70, 0.70]
Hui 2017	5	2	62	3.9	2.1	69	10.9%	1.10 [0.40, 1.80]
Kuna 2011	3.5	2.4	95	2.9	2.3	84	11.0%	0.60 [-0.09, 1.29]
McArdle 2010	4.4	2.2	61	5.2	1.9	65	10.7%	-0.80 [-1.52, -0.08]
Mulgrew 2007	6	1.5	31	5.4	2	30	9.5%	0.60 [-0.29, 1.49]
Planes 2003	4.5	1.7	16	5.3	1.4	14	8.0%	-0.80 [-1.91, 0.31]
Rosen 2012	4.7	2.1	74	3.6	2.4	61	10.4%	1.10 [0.33, 1.87]
Total (95% CI)			**624**			**587**	**100.0%**	**0.09 [-0.38, 0.56]**

Heterogeneity: $Tau^2 = 0.40$; $Chi^2 = 30.90$, df = 9 (P = 0.0003); $I^2 = 71\%$

Test for overall effect: Z = 0.39 (P = 0.70)



Patil SP et al. J Clin Sleep Med. 2019;15(2):335-343

APAP Versus CPAP

- Meta-analysis of 26 RCT's by the AASM found **no differences in the residual apnea hypopnea index (AHI)** between APAP and CPAP titration strategies
- No clinically significant differences in residual AHI, adherence, daytime sleepiness, general QOL and attention between APAP and CPAP
- The **AASM clinical practice guideline** states that the final decision on which strategy**(APAP Vs CPAP)** to implement in an individual patient should be **based upon "patient preferences and abilities, the sleep clinician's judgment, anticipated or known previous difficulty with PAP treatment, and availability of resources** and cost of each strategy in a particular region

Patil SP et al. J Clin Sleep Med. 2019;15(2):335-343

Benefits of APAP

- Reduced time to initiation
- Can be used in areas with limited laboratory resources, lower overall cost.
- Can be used to determine pressure limit for fixed level CPAP without PSG
- Potential benefit of APAP over CPAP is the ability to automatically adjust therapeutic pressures as OSA severity changes
- Better tolerated than CPAP

Disadvantages of APAP

- Problems related to mask fit or leak cannot be addressed that may reduce adherence to therapy.
- Patients with prior uvulopalatopharyngoplasty [UPPP] are not good candidates
- Sleep disruption from pressure fluctuations
- Return of sleep disordered breathing events when the PAP level is lowered
- Inadvertent increases in pressure may result in the development of treatment-emergent central sleep apnea or periodic breathing

Indication for PSG based PAP titration

- Patients with suspected or known central apneas
- Patients with Complicated OSA
- Patients with **uncomplicated OSA who have previously failed in-home APAP titration**
- Patients who need additional PAP education, and patients who may have medical problems (eg, severe arthritis) or cognitive difficulties (eg, dementia) that may limit in-home titration success should undergo fixed in-laboratory CPAP titration

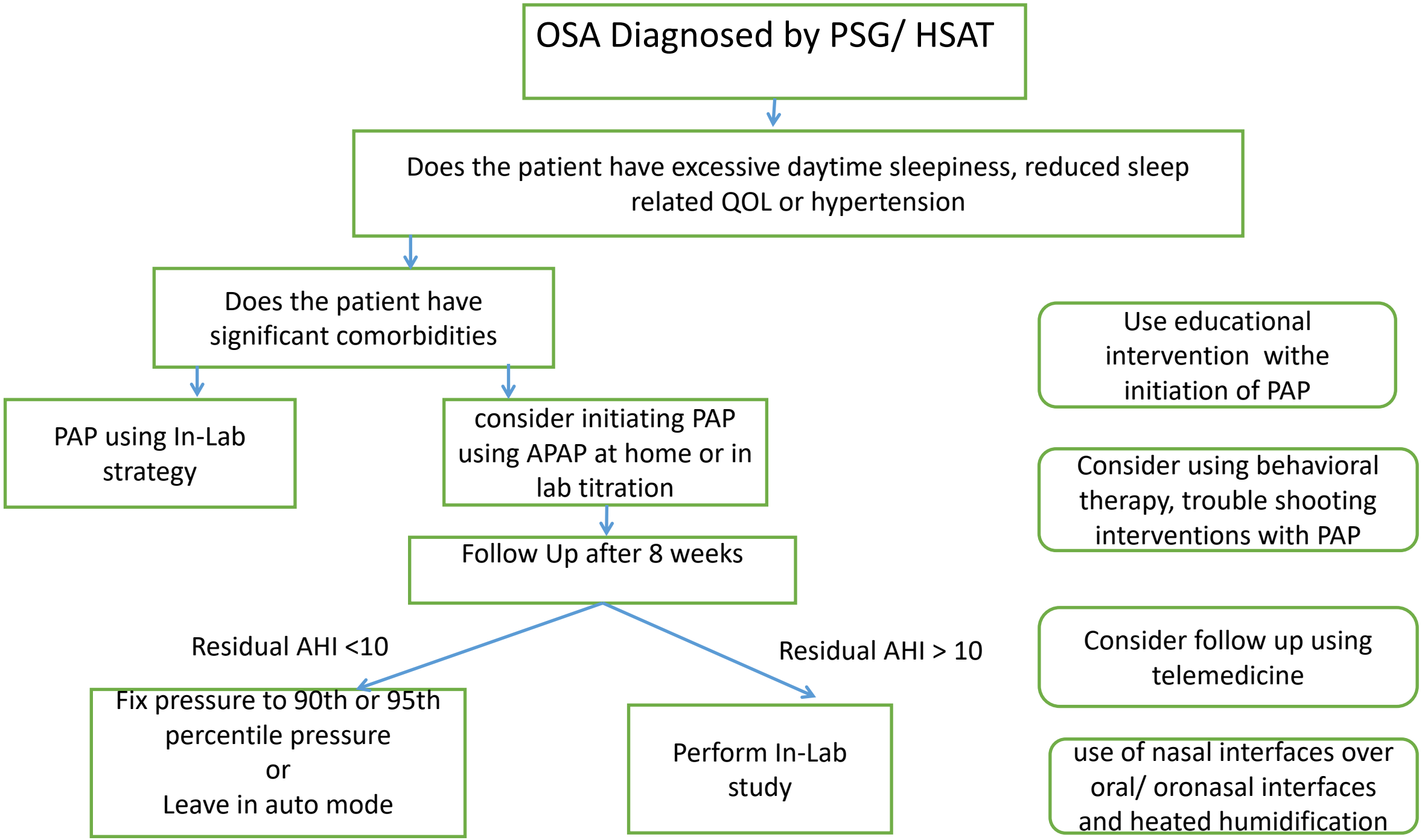
Follow up after Titration

- To maximize clinical benefit, most clinicians recommend utilization of PAP therapy for the entire sleeping period
- Minimal acceptable levels of adherence: PAP **use for at least 4hrs for ≥70 percent of nights**
- American Thoracic Society (ATS) recommends a **period between 7 and 90 days** for the adequate assessment of adherence
- After initial PAP titration, assess the adequacy of titration.

Assessment of Titration

- Optimal PAP : pressure that eliminates SDB events in **all sleep positions** and **stages,** particularly REM sleep, improving sleep quality **without creating any untoward pressure related side effects** for patients.
- **Optimal titration:** AHI <5/h and includes supine REMsleep
- **Good titration:** AHI <10/h or reduced by 50% if the baseline <15/h and includes supine REM
- **Adequate titration:** AHI cannot be reduced to less than 10/h, but is reduced by 75% from baseline or criterion for optimal or good titration is attained, but without supine REM sleep
- **Unacceptable titration**: Any one of the above grades is not met, which requires a repeat titration.

- Symptoms must also be considered in assessment of titration adequacy
- If residual symptoms of daytime sleepiness and/or snoring persist despite adequate nightly APAP use, the clinician should **assess for adequate mask fit, excessive leak, and proper pressure range** settings
- Patients with **persistent symptoms** and/or snoring, **an REI >10 events per hour** and/or high levels of leak **despite empiric changes in pressure and attention to mask fit**, a formal attended in-laboratory titration with CPAP or, if indicated, bilevel PAP in spontaneous mode (BPAP-S) therapy is recommended with PSG monitoring.


OSA Diagnosed by PSG/ HSAT
Does the patient have excessive daytime sleepiness, reduced sleep related QOL or hypertension
Does the patient have significant comorbidities
PAP using In-Lab strategy
consider initiating PAP using APAP at home or in lab titration
Follow Up after 8 weeks
Residual AHI <10
Residual AHI > 10
Fix pressure to 90th or 95th percentile pressure
or
Leave in auto mode
Perform In-Lab study
Use educational intervention withe initiation of PAP
Consider using behavioral therapy, trouble shooting interventions with PAP
Consider follow up using telemedicine
use of nasal interfaces over oral/ oronasal interfaces and heated humidification

Thankyou