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The 22th Annual Dental Sleep Conference:
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Leading Innovations from the Womb to the Tomb

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1

Understanding the Results of Sleep Studies From the Home to the Lab, and the Use of Remote Patient Monitoring

by

Jerald H. Simmons, M.D.

Director, Comprehensive Sleep Medicine Associates
Director, Sleep Education Consortium

www.CSMA.clinic

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Financial Relationship Disclosure

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Harmony Biosciences : Speaker Honorarium, Research funding for medication trial

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Avadel Pharmaceuticals: Research funding for medication trial, Speaker Honorarium

Takeda Pharmaceuticals : Research funding for medication trial

SleepArchiTx: Advisory Board

REST Technologies, Inc: Owner, NIH SBIR Grant

Merck Pharmaceuticals : Speaker Honorarium

3

The different types of sleep testing: From the lab to the home

What you see depends on how you look

Ancient Proverb (? Source)

4

What type of test to use?

Whats the difference between a Nocturnal Polysomnogram vs a Home Sleep Apnea Test?

5

Home Sleep Apnea Testing (HSAT) Devices

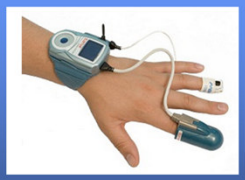
(These are NOT equivalent to in-lab sleep studies)

These are only able to reliably identify Moderate to Severe OSA

Apnea Link

Ares

WatchPAT



SleepImage

6

To confuse things further, both types of devices provide results with the same terms, such as Apnea Hypopnea Index **(AHI)** and Respiratory Index **(RDI)**, however, the only real parameter that is equivalent between these two devices would be the Oxygen Desaturation Index **(ODI)**.
HSATs that do not measure Sleep Time should report a Respiratory Event Index **(REI)**
The REI is the number of events / hour of recoding time, not per hour of sleep time.

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AASM clarifies hypopnea scoring criteria

These scoring rules were established based on in lab polysomnography

American Academy of Sleep Medicine
Monday, **September 23, 2013**

For NPSG studies

In August members were notified that the AASM has suspended indefinitely the requirement for accredited sleep centers to score hypopneas in adult patients according to the 3 percent oxygen desaturation criterion in the new AASM scoring manual.

The AASM continues to recommend scoring hypopneas in adults when there is a ≥ 3% oxygen desaturation from pre-event baseline and/or the event is associated with an arousal. However, it is acceptable for accredited sleep centers to score hypopneas in adults when there is a ≥ 4% oxygen desaturation from pre-event baseline.
AASM sleep centers must specify in the PSG report whether hypopneas were scored using the recommended rule 1A or the acceptable rule 1B:

Recommended!!!!!!!!
1A. Score a respiratory event as a hypopnea if ALL of the following criteria are met:
a. The peak signal excursions drop by ≥30% of pre-event baseline using nasal pressure (diagnostic study), PAP device flow (titration study), or an alternative hypopnea sensor (diagnostic study).
b. The duration of the ≥30% drop in signal excursion is ≥10 seconds.
c. There is a ≥3% oxygen desaturation from pre-event baseline and/**or the event is associated with an arousal.**

OR

Acceptable
1B. Score a respiratory event as a hypopnea if ALL of the following criteria are met:
a. The peak signal excursions drop by ≥30% of pre-event baseline using nasal pressure (diagnostic study), PAP device flow (titration study), or an alternative hypopnea sensor (diagnostic study).
b. The duration of the ≥30% drop in signal excursion is ≥10 seconds.
c. There is a ≥ 4% oxygen desaturation from pre-event baseline.

Please note that the criterion involving arousals is included in 1A and excluded from 1B.

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For HSAT studies

H. HSAT Respiratory Events Rules: Scoring Hypopnea Utilizing Respiratory Flow and/or Effort Sensors [N1]

1.A If sleep is NOT recorded, score a respiratory event as a hypopnea if ALL the following criteria are met: [N1]
RECOMMENDED

a. The peak signal excursions drop by ≥30% of pre-event baseline using a recommended or *alternative* airflow sensor.
b. The duration of the ≥30% drop in signal excursion is ≥10 seconds.
c. There is a ≥3% oxygen desaturation from pre-event baseline.

1.B If sleep is NOT recorded, score a respiratory event as a hypopnea if ALL the following criteria are met: [N1]
OPTIONAL

a. The peak signal excursions drop by ≥30% of pre-event baseline using a recommended or *alternative* airflow sensor.
b. The duration of the ≥30% drop in signal excursion is ≥10 seconds.
c. There is a ≥4% oxygen desaturation from pre-event baseline.

Nothing about arousals as is with the NPSG 1A Hypopnea rule

2.A If sleep IS recorded, score a respiratory event as a hypopnea if ALL the following criteria are met: [N1, N2]
RECOMMENDED

a. The peak signal excursions drop by ≥30% of pre-event baseline using a recommended or *alternative* airflow sensor.
b. The duration of the ≥30% drop in signal excursion is ≥10 seconds.
c. There is a ≥3% oxygen desaturation from pre-event baseline or the event is associated with an arousal. [N2]

2.B If sleep IS recorded, score a respiratory event as a hypopnea if ALL the following criteria are met: [N1, N2]
OPTIONAL

a. The peak signal excursions drop by ≥30% of pre-event baseline using a recommended or *alternative* airflow sensor.
b. The duration of the ≥30% drop in signal excursion is ≥10 seconds.
c. There is a ≥4% oxygen desaturation from pre-event baseline.

Note 1. The criteria used to score a respiratory event as a hypopnea should be specified in the report.

Note 2. Scoring a hypopnea based on arousals is only possible if sleep (using EEG) is recorded.

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The three parameters needed to identify and characterize the different stages of sleep include:

EEG – Electrical brain wave activity
EOG – Eye movement activity
EMG – Muscle tone activity

Types of Sleep Testing

Type I : Polysomnography (PSG) : Fully attended by a trained technologist, providing EEG (2 or more), EOG (2), EMG, ECG/heart rate, airflow, respiratory effort (typically 2 or more channels) and oxygen saturation

Type II : Home sleep study test (HST) with a portable monitor, unattended; minimum of 7 channels: EEG, EOG, EMG, ECG/heart rate, airflow, respiratory effort and oxygen saturation

Type III : Home sleep test (HST) with a portable monitor, unattended; minimum of 4 channels: 2 respiratory movement/airflow, 1 ECG/heart rate and 1 oxygen saturation BEST referred to as HSAT (A for Apnea).

Type IV : Home sleep test (HST) with type IV portable monitor, unattended; minimum of 3 channels , one of which is air flow. (ex – flow, SaO2, position) BEST referred to as HSAT (A for Apnea).

Note: Types III and IV testing devices DO NOT provide the three signals needed to identify and stage sleep. **They assume sleep based on indirect parameters.**

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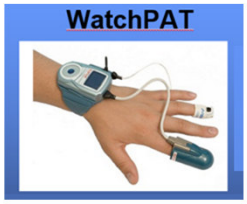
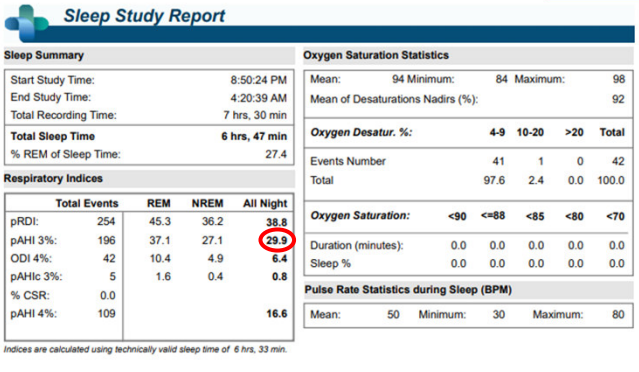
WatchPAT

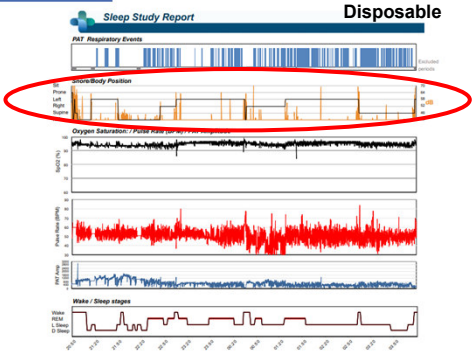
Developed by Itamar Medical, purchased and now sold by ZOLL Medical

Itamar Medical was founded in 1995, in Israel, as a developer of devices for assessing vascular defects. Its early products included technology for early detection of heart disease (EndoPAT) and detection of sleep disorders (WatchPAT). The company is named after Itamar Yaron (one of the founders' brothers), who was killed in the Yom Kippur War when trying to rescue an injured soldier.



WatchPAT One
Disposable





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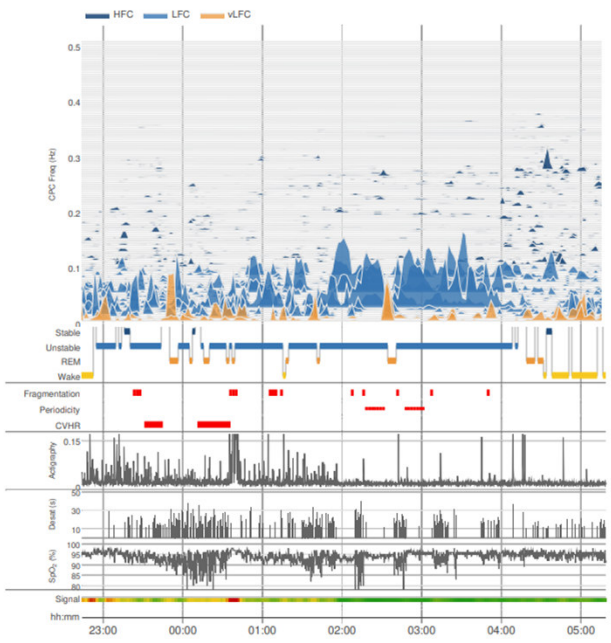

Another example of when a HSAT result is without question showing OSA

SleepImage Ring

- **Uses CardioPulmonary Coupling analysis**
- **Does not measure snoring**

	Desaturations 3%	4%
sAHI$_{TOTAL}$	51	38
ODI	38	26

Sleep Onset	10:54 PM
Sleep Conclusion	4:38 AM
TST	5h:13m
WASO	0h:38m
WAKE TRANSITIONS	#5

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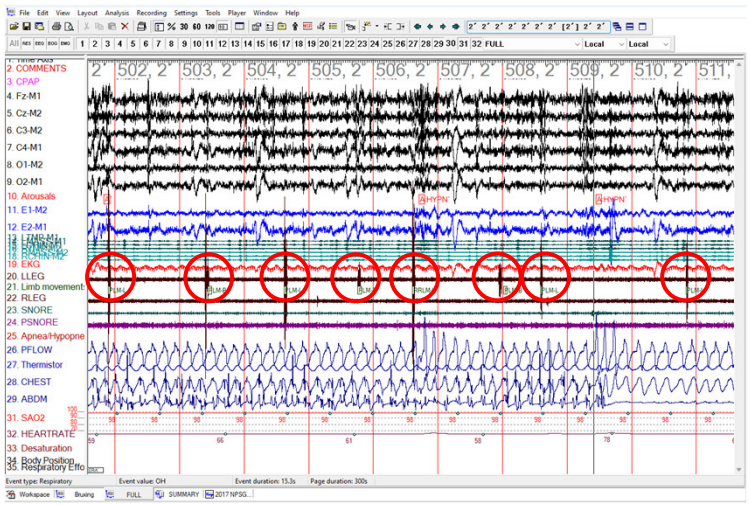
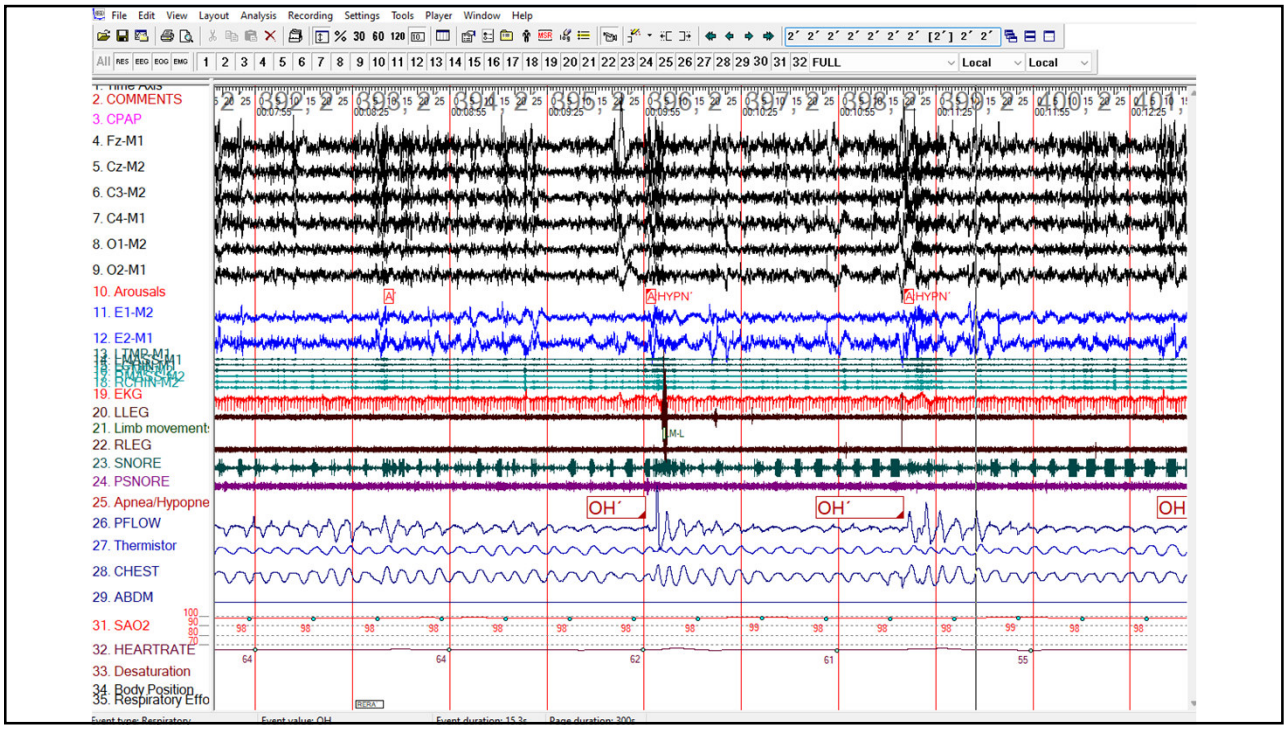
Example when these HSAT should not be used to definitively characterize the patients condition.

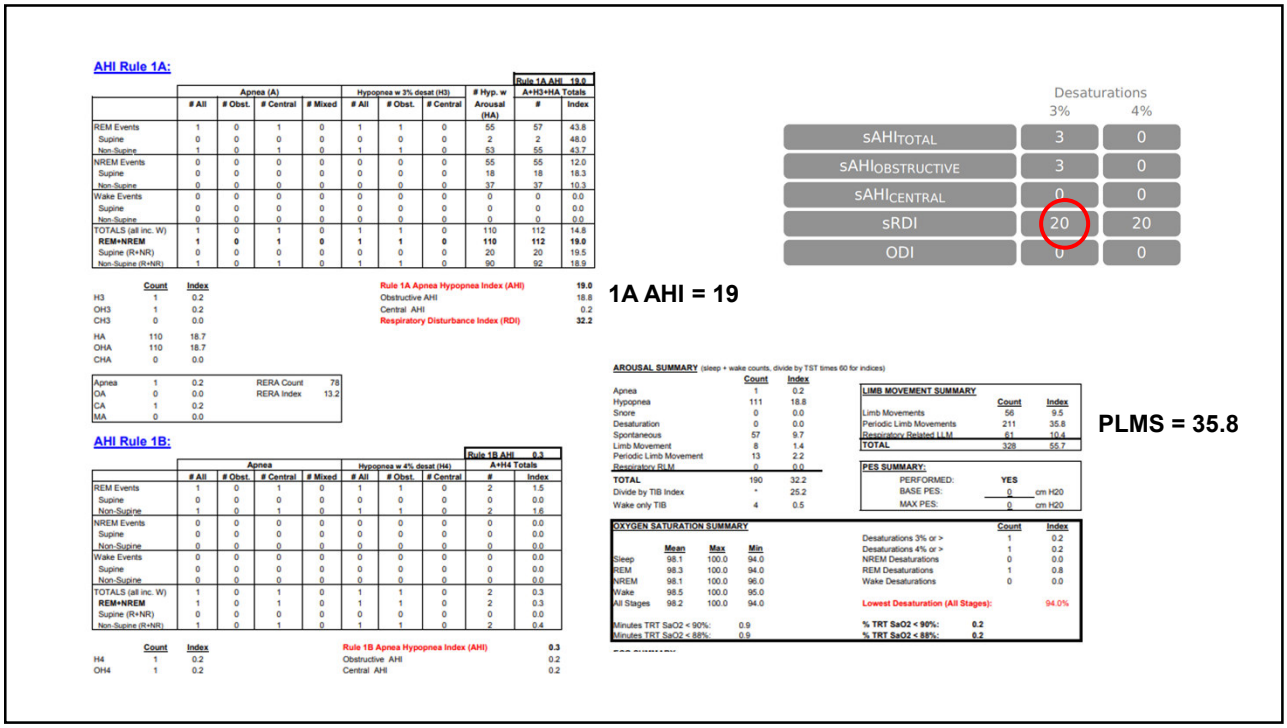
	Desaturations 3%	4%
sAHI$_{TOTAL}$	3	0
sAHI$_{OBSTRUCTIVE}$	3	0
sAHI$_{CENTRAL}$	0	0
sRDI	20	20
ODI	0	0



14


2. COMMENTS
3. CPAP
4. Fz-M1
5. Cz-M2
6. C3-M2
7. C4-M1
8. O1-M2
9. O2-M1
10. Arousals
11. E1-M2
12. E2-M1
19. EKG
20. LLEG
21. Limb movement
22. RLEG
23. SNORE
24. PSNORE
25. Apnea/Hypopne
26. PFLOW
27. Thermistor
28. CHEST
29. ABDM
31. SAO2
32. HEARTRATE
33. Desaturation
34. Body Position
35. Respiratory Effo
A
AHYPN
OH´
OH

15


AHI Rule 1A:
Rule 1A AHI 19.0
A+H3+HA Totals
Rule 1A Apnea Hypopnea Index (AHI) 19.0
Obstructive AHI 18.8
Central AHI 0.2
Respiratory Disturbance Index (RDI) 32.2
1A AHI = 19
Desaturations
3%
4%
sAHITOTAL 3 0
sAHIOBSTRUCTIVE 3 0
sAHICENTRAL 0 0
sRDI 20 20
ODI 0 0
AHI Rule 1B:
Rule 1B AHI 0.3
A+H4 Totals
Rule 1B Apnea Hypopnea Index (AHI) 0.3
Obstructive AHI 0.2
Central AHI 0.2
AROUSAL SUMMARY
LIMB MOVEMENT SUMMARY
PES SUMMARY:
OXYGEN SATURATION SUMMARY
PLMS = 35.8

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HSAT for 2 nights
AHI 2.2 & 3.6

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BUSINESS OFFICE: 15423 CREEK BEND DRIVE, SUGAR LAND TX 77478
JERALD H. SIMMONS, MD

OUT-OF-LABORATORY PORTABLE HOME SLEEP APNEA TEST (HSAT)

Patient Name: ___
Date of Birth: ___
ID Number: LH_ZM_04-25-2022
Device Type: Z-Machine

Ordering Provider: David Alfi, M.D.
Interp Provider: Jerald Simmons, M.D.
Night 1 Date: 04/25/2022
Night 2 Date: 04/26/2022

	Overall AHI	% time < 90% SpO2	Minimum SpO2	OSA Treatment Utilized	Sleep Aid
Night 1:	2.2	0.1 %	89%	No	None
Night 2:	3.6	0 %	90 %	No	None

CLINICAL HISTORY: ___ is a 50-year -old Female 67-inch, 180-lbs. (BMI 28.2) with an Epworth Sleepiness Scale of 5 out of 24. Signs and symptoms suggestive of sleep-disordered breathing include sleep initiation/maintenance insomnia, snoring, nocturnal bruxism, difficulty concentrating, and morning nasal congestion.

SLEEP STUDY FINDINGS (NIGHT 1): Based upon 4% hypopnea desaturation criteria, there was no clear evidence of sleep-disordered breathing (AHI=2.2 events/hour). The total valid recording time of the study was 7.46 hours. Analysis of oxygen desaturation during the night revealed a mean SpO2 of 94.6%, with an SpO2 < 90% for 0.1% of the total recording time and a minimum SpO2 of 89%.

SLEEP STUDY FINDINGS (NIGHT 2): Based upon 4% hypopnea desaturation criteria, there was no clear evidence of sleep-disordered breathing (AHI=3.6 events/hour). The total valid recording time of the study was 8.12 hours. Analysis of oxygen desaturation during the night revealed a mean SpO2 of 94.2%, with an SpO2 < 90% for 0% of the total recording time and a minimum SpO2 of 90%.

INTERPRETATION: The results of this unattended home sleep study were not diagnostic of obstructive sleep apnea. It is important to point out that HSAT's frequently under estimate the severity of obstructive respirations during sleep. Therefore, the patients condition may be worse than what this study suggests. Since this patient has clinical symptoms that would suggest a sleep disturbance and HSAT has known limitation in characterizing sleep physiology, it is necessary to perform an attended in-laboratory diagnostic polysomnogram.
The study will be performed with esophageal manometry (Pes), a tool that allows for the assessment of respiratory effort during sleep. This will provide more objective data characterizing disturbances in sleep respirations during the night.

Jerald H. Simmons, M.D., Diplomate
American Board of Sleep Medicine
American Board of Neurology and Psychiatry
American Board of Clinical Neurophysiology

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The significance in this patient was NOT in the oxygen levels

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JERALD H. SIMMONS, MD

OVERNIGHT POLYSOMNOGRAPHY (95810) REPORT
Recorded at Sugar Land Sleep Lab

Patient:		**Study #**	LH11-08-22_SL-SR-04
Date of birth:		**Study date:**	7/2022
Referring:	J Alfi, M.D.	**Consulting:**	Jerald H. Simmons, M.D.

INDICATIONS: This is a 50-year -old, 67-inch, 180-lbs. female with a history of with non-diagnostic HSAT complaining sleep initiation/maintenance insomnia, snoring, nocturnal bruxism, difficulty concentrating, and morning nasal congestion in whom there is a need to evaluate for the presence and severity of obstructive respirations during sleep.

PROCEDURE: An all-night comprehensive sleep study was performed in which the following medical parameters were recorded using a Compumedics computerized polygraph. The study was attended by a polysomnographic technologist (PSGT) and reviewed by Jerald H. Simmons, MD, Diplomate of the ABSM

Mid-Central(CZ), Left Central(C3), Frontal(FZ) & Occipital(OZ), Left & Right Electro Oculogram & Anterior Tibialis Electromyogram, Electrocardiogram, Nasal/Oral Airflow, Oxygen Saturation(SaO2), Sonogram(snoring), Body Position & Movement, Chest & Abdominal Respiratory Effort. Additionally, electromyogram monitoring was conducted on the external muscles of mastication to include temporalis, masseter, and submental locations bilaterally. In order to obtain more sensitive objective data relating to respiratory effort during sleep, esophageal manometry was utilized during this study.

IMPRESSION:
1. **This study demonstrated evidence of moderate obstructive sleep apnea (AHI 24.4, RDI 50.1).**

DISCUSSION:

1. SLEEP ARCHITECTURE:
While there is a known phenomenon of abnormal sleep architecture that is induced by the novelty of the laboratory experience ("the first night effect"), the overall sleep architecture was within normal limits.

2. SLEEP-RELATED MOVEMENTS:
There were no significant periodic limb movements of sleep noted during the study.

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JERALD H. SIMMONS, MD

PSG Technical Report

Respiratory Events Summary

	REM	NREM	SUPINE	NON-SUPINE	TOTAL
Sleep Time (minutes):	78	251	157	172	329
Respiratory Events					
Obstructive Apnea:	7	2	8	1	9
Mixed Apnea:	0	0	0	0	0
Central Apnea:	0	0	0	0	0
All Apneas:	7	2	8	1	9
Central Hypopnea:	12	0	10	2	12
Obstructive Hypopnea:	66	47	64	52	113
Hypopneas (1a):	78	47	74	51	125
Hypopneas (1b):	1	0	1	0	1
Apneas + Hypopneas:	85	49	82	52	87
Apnea Index:	5.4	0.5	3.1	0.3	1.6
Hypopnea Index:	61.5	11.2	28.7	18.1	22.8
RERAs:	38	101	71	68	[illegible]
AHI (Rule 1A)	65.4	11.7	31.3	18.1	24.4
AHI (Rule 1B)	6.2	0.5	3.4	0.3	1.8
RDI:	96.2	35.8	58.9	42.1	[illegible]

- **AHI-AASM (1a)** was **24.4** (includes hypopneas associated with at least 3% O2 desaturation or EEG arousal)
- **AHI-CMS (1b)** was **1.8** (includes hypopneas associated with at least 4% O2 desaturation)

% of Central Apneas (inclusive of Hypopneas scored with AASM Rule 1A): 0.0%
% of Central Apneas (inclusive of Hypopneas scored with AASM Rule 1B): 0.0%

Oxygen Saturation Summary (Report Time)

Total O2 Desaturations:	2
O2 Desaturation Index:	0.3
Average O2 Saturation (%)	96
Min O2 Saturation (%)	91
Time @ 90% - 100% (min.)	401.0
Time @ 80% - 89% (min.)	0.0
Time @ 70% - 79% (min.)	0.0
Time @ 60% - 69% (min.)	0.0
Time @ 50% - 59% (min.)	0.0
Time ≤ 88% (min.)	0.0

SaO2 <88% for 0.0 % of the Total Sleep Time.
SaO2 Nadir in sleep: 91%

1A AHI =24.4
1B AHI = 1.8

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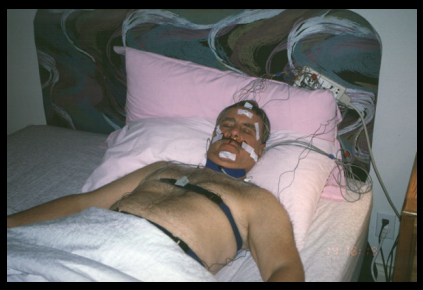

Nocturnal PolySomnoGraphy (NPSG) Type I sleep testing.

In-Lab Sleep testing. It is the most reliable method to evaluate sleep. The most common parameters used for nocturnal polysomnograph testing include the following:

- Electroencephalograph, two to twenty separate channels
- Right and left eye movements or electro-oculograph
- Chin muscle activity, known as electromyography
- Electrocardiograph
- Leg electromyography, usually right to left anterior tibialis muscles
- Snoring or tracheal sounds, measured with a microphone taped to the throat
- Air flow through the nose and mouth
- Movement of the chest
- Movement of the abdomen
- Oxygen level, measured with a finger oximeter
- Body position
- Esophageal manometry -- in some laboratories.

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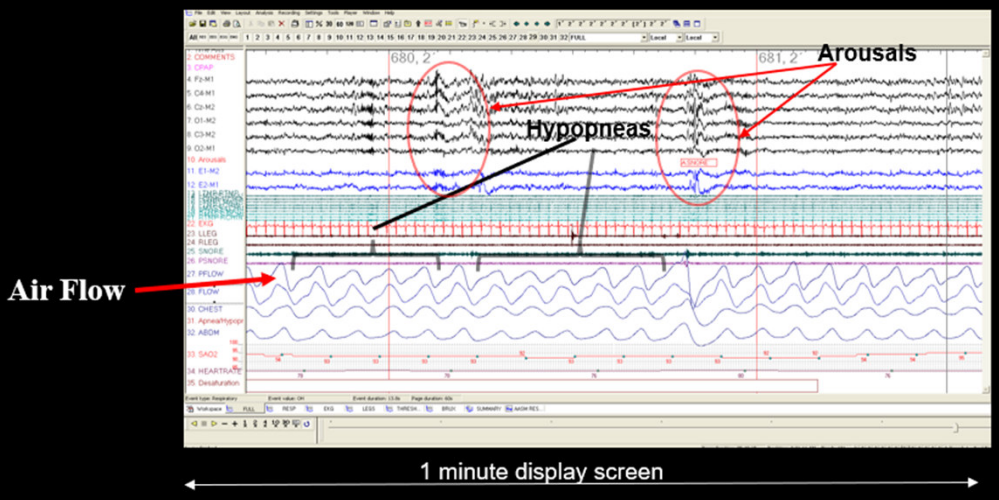
Hypopneas noted by a decrease in air flow for more than 10 seconds ending with an arousal with the SaO2 maintained between 92% to 94%



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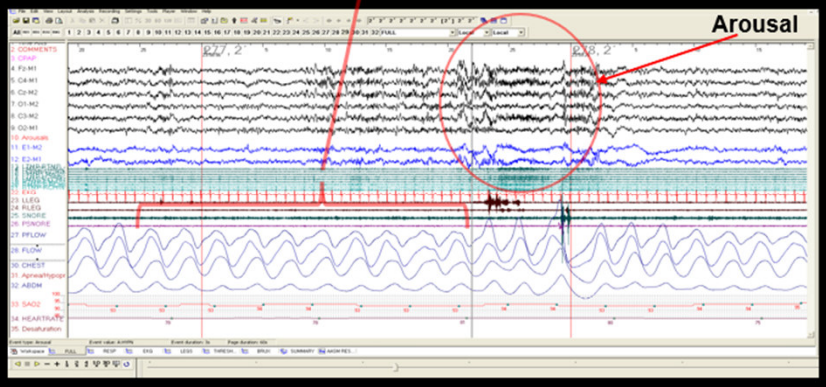
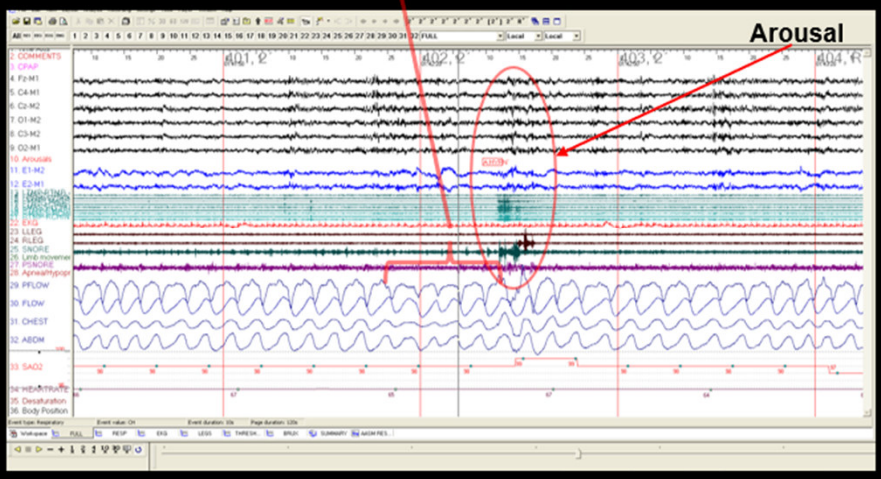
Hypopnea noted by >10 sec decrease in air flow leading to an arousal but SaO2 maintained at **93%-94%**



1 minute display screen

21

Hypopnea noted by a decrease in air flow for more than 10 sec ending with an arousal with the SaO2 maintained between **98% to 99%**



2 minute display screen

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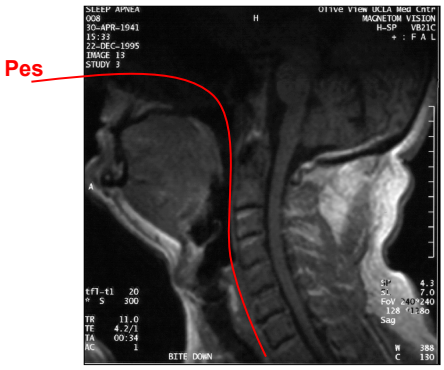
Measuring the negative pressure within the airway is the optimal method of identifying respiratory effort and upper airway obstruction. That is what is provided by the Pressure within the Esophagus (Pes).



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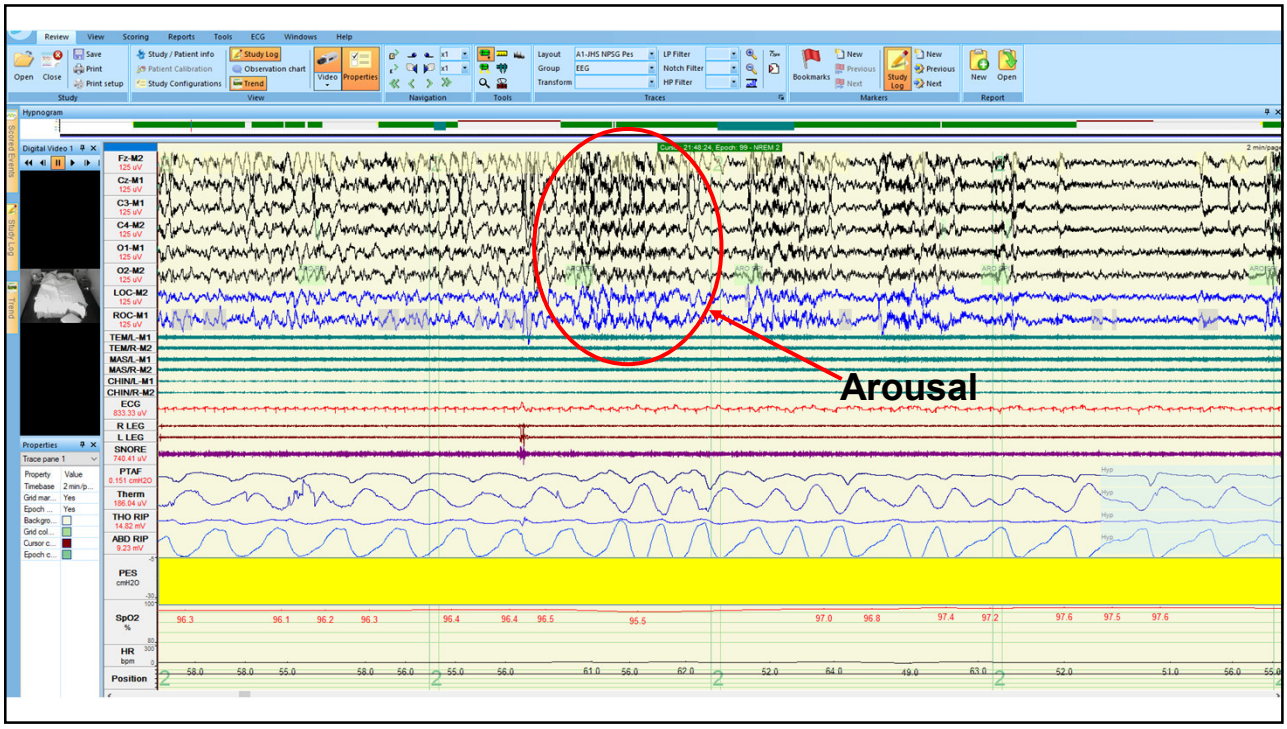

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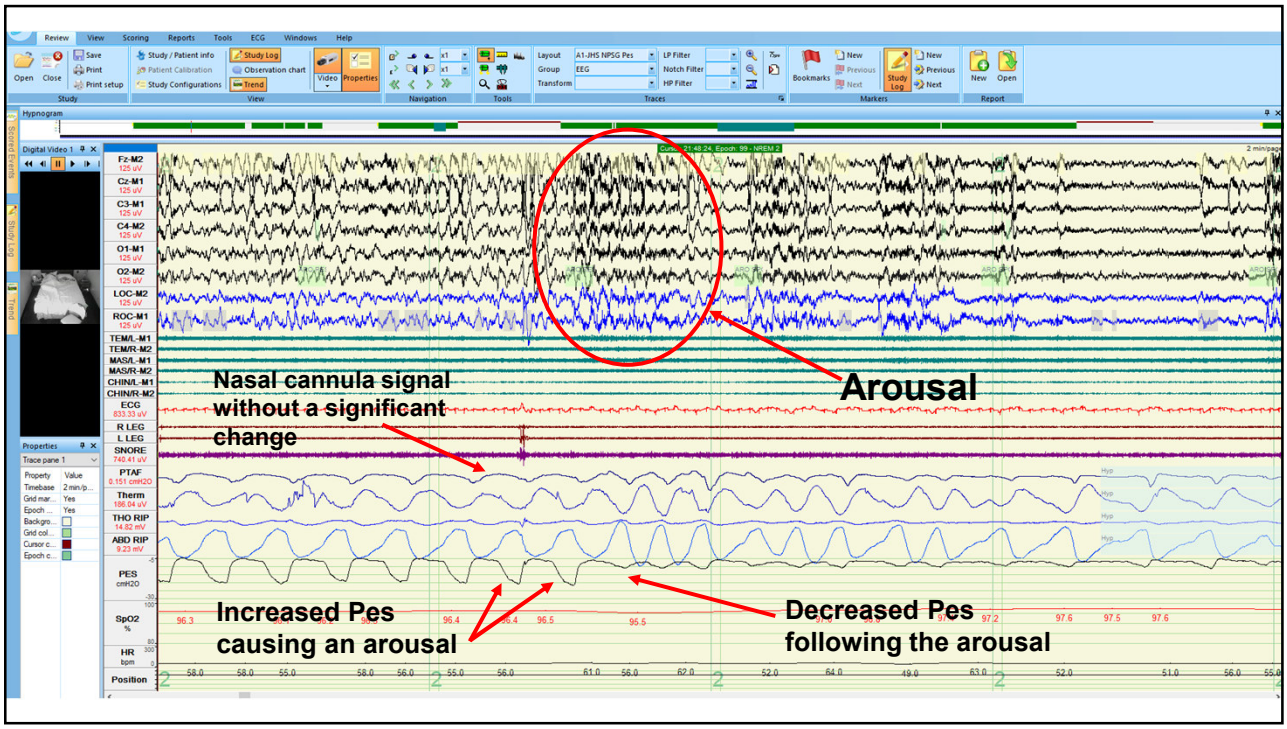
Nasal cannula signal without a significant change
Arousal
Increased Pes causing an arousal
Decreased Pes following the arousal

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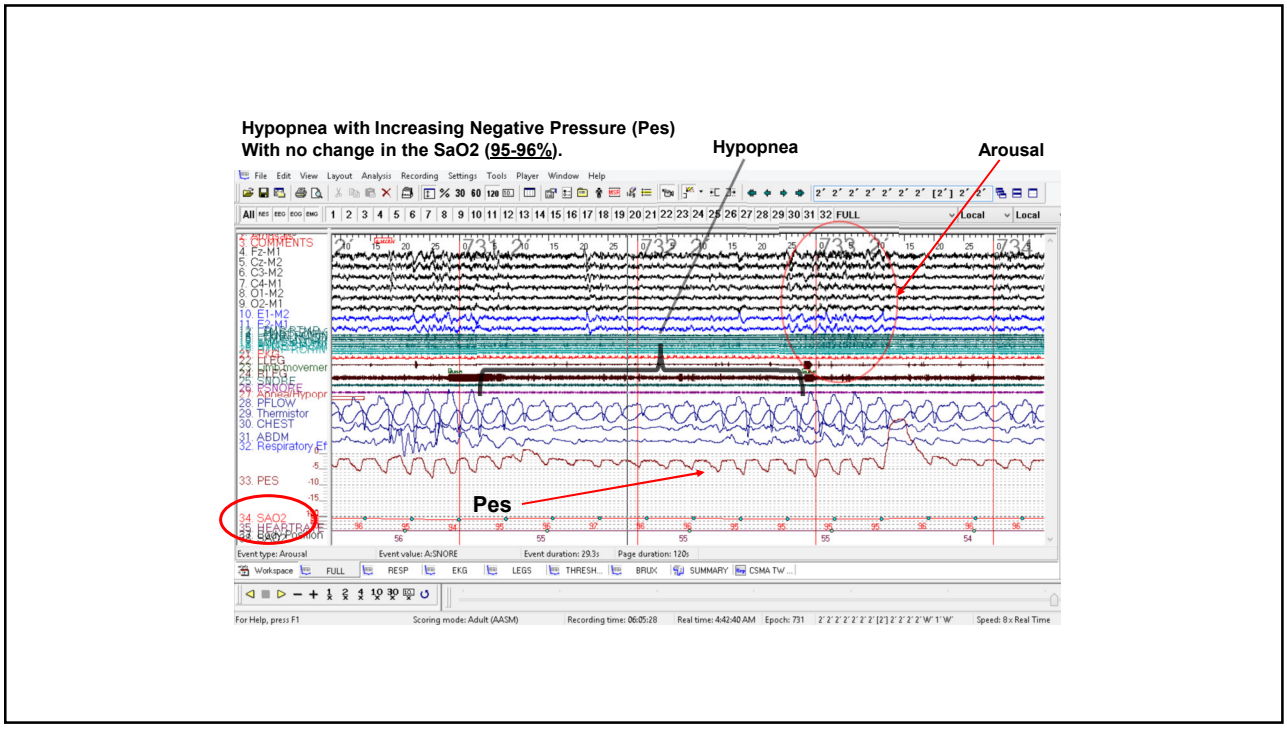
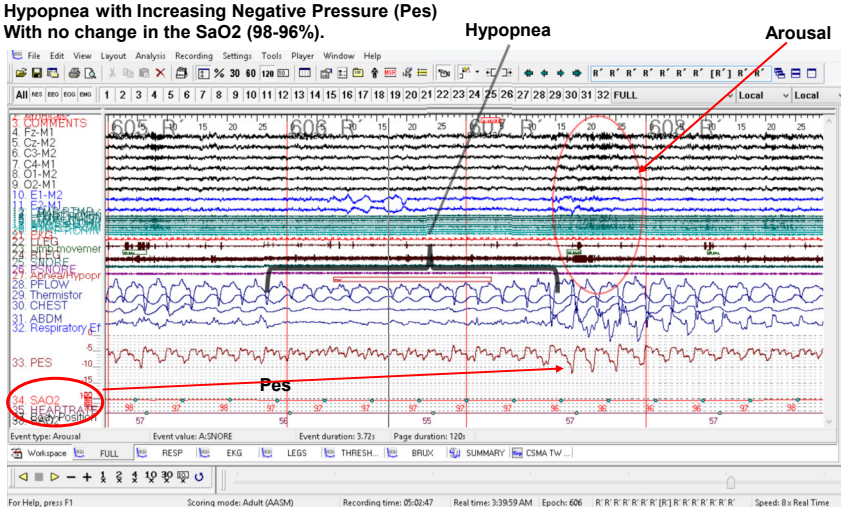

Hypopnea with Increasing Negative Pressure (Pes)
With no change in the SaO2 (95-96%).
Hypopnea
Arousal
Pes

26

Hypopnea with Increasing Negative Pressure (Pes)
With no change in the SaO2 (98-96%).



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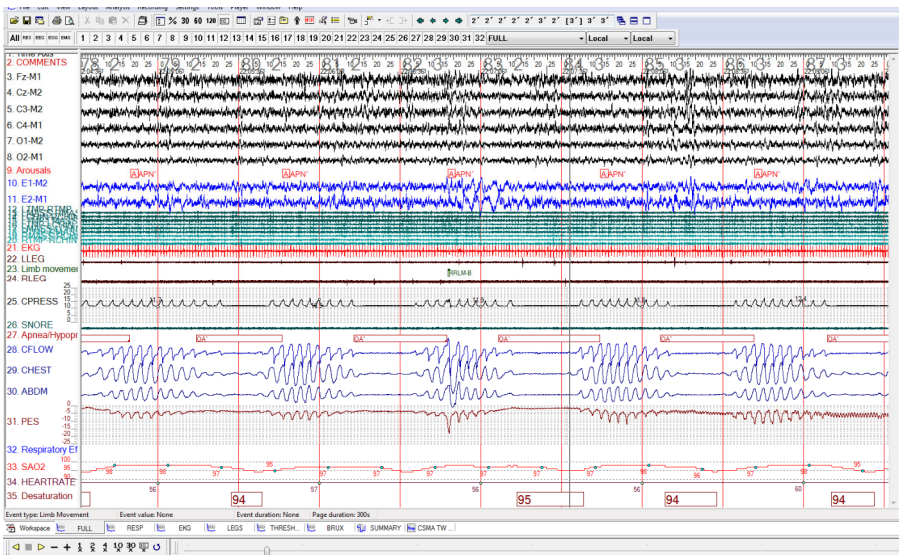
Central Sleep Apnea in the form of Cheyne Stokes Respirations



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Types of Respiratory Disturbances During Sleep

- Obstructive Apnea
- Central Apneas
- Obstructive Hypopneas
- Central Hypopneas
- Respiratory Effort Related Arousals (RERA)
- Mixed Apnea or Complex Apnea (both Central and Obstructive Apneas)

Apnea Hypopnea Index (AHI) = Apneas + Hypopneas per hour sleep

Respiratory Disturbance Index (RDI) = Apneas + Hypopneas + RERAs per hour sleep

Respiratory Event Index (REI) = number of respiratory events / hour of recording time
Only for HSAT

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Sleep Architecture values that can not be obtained from Type III and Type IV devices

COMPREHENSIVE SLEEP MEDICINE ASSOCIATES
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OFFICE PHONE #: 713-668-4100 FAX #: 713-668-4105

POLYSOMNOGRAPHY REPORT

Patient:		**Study Da**	3/10/2015	**MR#:**	
DOB:		**BMI:**	22.3	**Rec ID:**	
Height:	71.0 inches	**Age:**	35 Years	**Tech:**	
Weight:	160.0 lbs.	**Gender:**	Male	**Scorer:**	
				ESS:	11

Referring Physician:
Interpreting Physician:

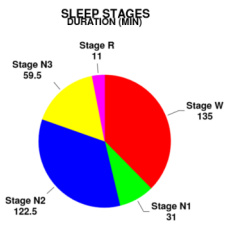
SLEEP SUMMARY

Lights Out: (Clock Time)	22:48:54
Lights On: (Clock Time)	4:47:54
Total Recording Time: (Lights Out to Lights On)	359.0 min
Total Sleep Time:	224.0 min
Sleep Period Time:	261.5 min
Percent Sleep Efficiency:	62.4 %
Sleep Latency: (Lights Out to first epoch of sleep)	88.0 min
Stage R Latency: (Sleep Onset to first epoch of R)	164.5 min
Number of Awakenings (NW):	6.0

PES DIAGNOSTIC STUDY

SLEEP STAGE SUMMARY

STAGE	Duration (min)	% SPT	%TST
Stage W	135.0	*	*
WASO	47.0	*	*
Wake During Sleep (WDS)	37.5	14.3	*
Stage N1	31.0	11.9	13.8
Stage N2	122.5	46.8	54.7
Stage N3	59.5	22.8	26.6
Stage R	11.0	4.2	4.9
Total NREM	213.0	81.5	95.1
Supine	144.0	55.1	64.3
Supine REM	11.0	4.2	4.9
Supine NREM	133.0	50.9	59.4
Non-Supine	80.0	30.6	35.7
Non-Supine REM	0.0	0.0	0.0
Non-Supine NREM	80.0	30.6	35.7



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You need to know what is behind the numbers

Patient: [redacted] MR#: Study Date: 3/10/2015

RESPIRATORY EVENTS SUMMARY

	Apnea # Obst.	Apnea # Central	Apnea # Mixed	Hypopnea #	Total #	Total Index
REM Events	1	7	0	1	9	49.1
Supine	1	7	0	1	9	49.1
Non-Supine	0	0	0	0	0	0.0
NREM Events	0	0	0	59	59	16.6
Supine	0	0	0	52	52	23.5
Non-Supine	0	0	0	7	7	5.3
Wake Events	0	0	0	0	0	0.0
Supine	0	0	0	0	0	0.0
Non-Supine	0	0	0	0	0	0.0
TOTAL EVENTS	1	7	0	60	68	11.4
REM+NREM Event Total	**1**	**7**	**0**	**60**	**68**	**18.2**
Supine Event Total (Sleep + Wake)	1	7	0	53	61	13.7
Non-Supine Event Total (Sleep + Wake)	0	0	0	7	7	4.6

AHI in REM 49 / hr)
BUT only in REM
for 11 minutes

PES SUMMARY:

BASE PES:	-7 cm H20
MAX PES:	-25 cm H20

APNEA + HYPOPNEA INDEX (AHI) 18.2

RESPIRATORY DISTURBANCE INDEX (RDI) 21.7

AHI (in this case 18/hr)

RDI (in this case 22/hr)

Apnea Index 2.1
OA Index 0.3
CA Index 1.9
Hypopnea Index 16.1

OXYGEN SATURATION SUMMARY

	Mean	Max	Min
Sleep	96.6	98.0	95.0
REM	96.6	98.0	95.0
NREM	96.6	98.0	95.0
Wake	97.2	100.0	95.0
All Stages	96.8	100.0	95.0

	Count	Index
Desaturations 3% or >	3	0.8
NREM Desaturations	0	0.0
REM Desaturations	3	16.4
Wake Desaturations	0	0.0

Lowest Desaturation (All Stages): 95.0%

ODI 0.8 / hr based on 3%

ODI 16.4 in REM
BUT only in REM
for 11 minutes

ECG SUMMARY

	Mean	Max	Min
Sleep	68.0	181.8	10.9
REM	70.0	89.6	22.6
NREM	67.9	181.8	10.9
Wake	71.4	193.5	0.2
All Stages	69.3	193.5	0.2

Bradycardia: NO
Tachycardia: NO
Atrial fib/flutter: NO
Other:

HEARTRATE DETAILS

Lowest HR 56
Highest HR 104

AROUSAL SUMMARY

	Count	Index
Apnea	8	2.1
Hypopnea	59	15.8
Snore	0	0.0
Desaturation	0	0.0
Spontaneous	16	4.3
Limb Movement	9	2.4
Periodic Limb Movement	0	0.0
Respiratory RLM	0	0.0
TOTAL	92	24.6

LIMB MOVEMENT SUMMARY

	Count	Index
Limb Movements	10	2.7
Periodic Limb Movements	9	2.4
Respiratory Related LLM	7	1.9
TOTAL	26	7.0

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Jerald H. Simmons, MD, Director — HoustonSleep.Net — Gerard J. Meskill, MD

OVERNIGHT POLYSOMNOGRAPHY REPORT

Recorded at The Woodlands Sleep Lab

Patient:	[redacted]	**Study #**	[redacted]
Date of birth:	[redacted]	**Study date:**	9/18/2017
Referring:	[redacted]	**Consulting:**	Jerald H. Simmons, M.D.

INDICATIONS: This is a 62 yrs. -old, 66-inch, 202-lbs. woman with a history of snoring, witnessed pauses in breathing during sleep, excessive daytime sleepiness, excessive fatigue, nocturnal bruxism, difficulty concentrating, TMJ pain, non-restorative sleep, headaches, frequent movements during sleep, nocturnal awakenings, morning nasal congestion, nocturnal GERD. Lapses in awareness, parasomnias consisting of violent kicking, and poor concentration.with an Epworth Sleepiness Scale of 20 in whom there is a need to evaluate for the presence and severity of obstructive respirations during sleep.

PROCEDURE: An all-night comprehensive sleep study was performed in which the following medical parameters were recorded using a Medcare Diagnostics computerized polygraph. The study was attended by a polysomnographic technologist (PSGT) and reviewed by Jerald H. Simmons, M.D., Diplomate of the American Board of Sleep Medicine.

Mid-Central(CZ), Left Central(C3), Frontal(FZ) & Occipital(OZ), Left & Right Electro Oculogram & Anterior Tibialis Electromyogram, Electrocardiogram, Nasal/Oral Airflow, Oxygen Saturation(SaO2), Sonogram(snoring), Body Position & Movement, Chest & Abdominal Respiratory Effort. Additionally, electromyogram monitoring was conducted on the external muscles of mastication to include temporalis, masseter, and submental locations bilaterally. In order to obtain more sensitive objective data relating to respiratory effort during sleep, esophageal manometry was utilized during this study.

IMPRESSION:

1. **The patient demonstrated a severe degree of obstructive respirations during sleep.**
2. **None**
3. **The patient's obstructive respirations resulted in fragmented sleep continuity and treatment is indicated.**
4. **Treatment with CPAP should be considered, and this would require a full night CPAP titration study to determine the optimal pressure setting for this patient.**
5. **There were no abnormalities detected on single-lead ECG.**

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Patient: Study Date: 9/18/2017

AHI Rule 1A:

Rule 1A AHI 36.7

	Apnea (A)				Hypopnea w 3% desat (H3)			# Hyp. w Arousal (HA)	A+H3+HA Totals	
	# All	# Obst.	# Central	# Mixed	# All	# Obst.	# Central		#	Index
REM Events	0	0	0	0	2	2	0	1	3	17.1
Supine	0	0	0	0	0	0	0	0	0	0.0
Non-Supine	0	0	0	0	2	2	0	1	3	17.1
NREM Events	2	0	2	0	18	18	0	73	93	38.1
Supine	0	0	0	0	12	12	0	49	61	46.9
Non-Supine	2	0	2	0	6	6	0	24	32	28.0
Wake Events	0	0	0	0	0	0	0	0	0	0.0
Supine	0	0	0	0	0	0	0	0	0	0.0
Non-Supine	0	0	0	0	0	0	0	0	0	0.0
TOTALS (all inc. W)	2	0	2	0	20	20	0	74	96	15.4
REM+NREM	**2**	**0**	**2**	**0**	**20**	**20**	**0**	**74**	**96**	**36.7**
Supine (R+NR)	0	0	0	0	12	12	0	49	61	46.9
Non-Supine (R+NR)	2	0	2	0	8	8	0	25	35	25.6

	Count	Index
H3	20	7.6
OH3	20	7.6
CH3	0	0.0
HA	74	28.3
OHA	74	28.3
CHA	0	0.0

Apnea	2	0.8	
OA	0	0.0	RERA Count 47
CA	2	0.8	RERA Index 18.0
MA	0	0.0	

Rule 1A Apnea Hypopnea Index (AHI) 36.7
Obstructive AHI 25.6
Central AHI 0.8
Respiratory Disturbance Index (RDI) 54.6

AHI Rule 1B:

Rule 1B AHI 3.4

	Apnea				Hypopnea w 4% desat (H4)			A+H4 Totals	
	# All	# Obst.	# Central	# Mixed	# All	# Obst.	# Central	#	Index
REM Events	0	0	0	0	1	1	0	1	5.7
Supine	0	0	0	0	0	0	0	0	0.0
Non-Supine	0	0	0	0	1	1	0	1	5.7
NREM Events	2	0	2	0	6	6	0	8	3.3
Supine	0	0	0	0	3	3	0	3	2.3
Non-Supine	2	0	2	0	3	3	0	5	4.4
Wake Events	0	0	0	0	0	0	0	0	0.0
Supine	0	0	0	0	0	0	0	0	0.0
Non-Supine	0	0	0	0	0	0	0	0	0.0
TOTALS (all inc. W)	2	0	2	0	7	7	0	9	1.4
REM+NREM	2	0	2	0	7	7	0	9	3.4
Supine (R+NR)	0	0	0	0	3	3	0	3	2.3
Non-Supine (R+NR)	2	0	2	0	4	4	0	6	4.6

	Count	Index
H4	7	2.7
OH4	7	2.7
CH4	0	0.0

Rule 1B Apnea Hypopnea Index (AHI) 3.4
Obstructive AHI 2.7
Central AHI 0.8
Respiratory Disturbance Index (RDI) 21.4

Page 2 of 3 Pages

Patient: Study Date: 9/18/2017

AROUSAL SUMMARY (sleep + wake counts, divide by TST times 60 for indices)

	Count	Index
Apnea	2	0.8
Hypopnea	94	35.9
Snore	0	0.0
Desaturation	7	2.7
Spontaneous	41	15.7
Limb Movement	1	0.4
Periodic Limb Movement	0	0.0
Respiratory RLM	0	0.0
TOTAL	145	55.4
Divide by TIB Index	*	29.2
Wake only TIB	1	0.2

LIMB MOVEMENT SUMMARY

	Count	Index
Limb Movements	7	2.7
Periodic Limb Movements	0	0.0
Respiratory Related LLM	5	1.9
TOTAL	12	4.6

PES SUMMARY:

PERFORMED: YES
BASE PES: 10 cm H20
MAX PES: 44 cm H20

OXYGEN SATURATION SUMMARY

	Mean	Max	Min
Sleep	94.7	98.0	87.0
REM	93.0	96.0	87.0
NREM	94.8	98.0	92.0
Wake	94.5	98.0	85.0
All Stages	94.6	98.0	85.0

	Count	Index
Desaturations 3% or >	22	8.4
Desaturations 4% or >	9	3.4
NREM Desaturations	20	8.2
REM Desaturations	4	22.9
Wake Desaturations	0	0.0

Minutes TRT SaO2 < 90%: 16.0
Minutes TRT SaO2 < 88%: 15.7
Lowest Desaturation (All Stages): 87.0%
% TRT SaO2 < 90%: 4.3
% TRT SaO2 < 88%: 4.2

ECG SUMMARY

	Mean	Max	Min
	74.3	193.5	9.9
REM	73.6	84.5	36.9
NREM	74.4	193.5	9.9
Wake	75.7	200.0	0.1
All Stages	75.1	200.0	0.1

HYPOPNEA CRITERIA:
RULE 1A: Recommended: Score a respiratory event as a hypopnea if ALL of the following criteria are met:
a. The peak signal excursions drop by =30% of pre-event baseline using nasal pressure (diagnostic study), PAP device flow (titration study), or an alternative hypopnea sensor (diagnostic study).
b. The duration of the >=30% drop in signal excursion is >=10 seconds.
c. There is a >= 3% oxygen desaturation from pre-event baseline and/or the event is associated with an arousal.
RULE 1B: Acceptable: Score a respiratory event as a hypopnea if ALL of the following criteria are met:
a. The peak signal excursions drop by =30% of pre-event baseline using nasal pressure (diagnostic study), PAP device flow (titration study), or an alternative hypopnea sensor (diagnostic study).
b. The duration of the >=30% drop in signal excursion is >=10 seconds.
c. There is a >= 4% oxygen desaturation from pre-event baseline.

PARAMETERS:
Channel name
Fp1, F3, C3, P3, F7, T3, T5, O1, Fp2, F4, C4, P4, F8, T4, T6, O2, Fpz, Fz, Cz
Pz, Oz, M1, M2, REF X1, E1, E2, EKG, LTMP, RTMP, LMASS, RMASS, LCHIN, RCHIN, L-R ARMS
LLEG, RLEG, LFOOT, RFOOT, CPRESS, Snoring Sensor, Thermistor, PSNORE, PFLOW, SNORE
CFLOW, FLOW, CHEST, ABDM, PES, SAO2, HEARTRATE, PLESMO, Gravity X, Gravity Y, CO2 WAVE
EtCO2, Phase, RMI, XFlow, XSum, ENURMON

This very symptomatic patient would have been considered NORMAL with a **1b AHI** of 3.4 but is severe when using the **1a** AHI.

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Ares

Nasal Flow
Oximtry
Pulse Rate
Snoring
Head position
EOG / EEG - ?

Level III device

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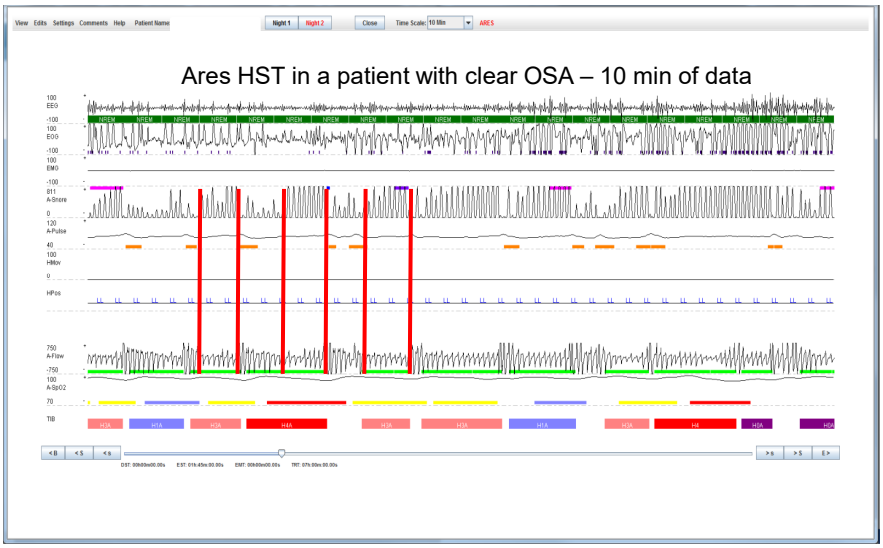
Ares HST in a patient with clear OSA – 10 min of data

35


Ares HST in a patient with clear OSA – 2 min of data

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PORTABLE UNATTENDED NOCTURNAL RESPIRATORY MONITORING STUDY

PATIENT: ----------
DOB: 03-21-1966
DATE OF STUDY: 10-22-13 / 10-23-13
LOCATION: HOUSTON
REFERRING:
INTERPRETING PHYSICIAN: Jerald Simmons, M.D.

INDICATIONS: This is a 47-year-old man with severe snoring, witnessed pauses in breathing while asleep, and excessive daytime sleepiness. This portable unattended nocturnal respiratory monitoring study is being performed in an attempt to characterize the patient's breathing during sleep.

PROCEDURE: A portable unattended nocturnal respiratory data acquisition recording was obtained using the Watermark ARES device which measures Nasal/Oral Airflow/PAP Flow, Oxygen Saturation (SpO2), Heart Rate, Sonogram (Snoring), Body Position and movement, and Thorax Respiratory Effort.
The data was reviewed by Jerald Simmons, MD, Diplomate of the American Board of Sleep Medicine.

SIGNAL INTEGRITY: The signal integrity of all signals acquired was adequate for review and assessment of the data recorded.

IMPRESSION:

With the unattended portable sleep study the patient demonstrated a severe degree of obstructive respirations during sleep. This was in the form of apneic and hypopneic episodes. This resulted in an overall Apnea Hypopnea Index of 31 based on a 4% hypopnea desaturation criteria, with indication of respiratory control instability. The patient slept supine for 49.5% of the night. Total sleep time was 13 hours. The patient's oxygen saturation dropped down as low as 76% in association with some of these obstructive respiratory events. The patient's obstructive respirations clearly indicated sleep fragmentation and treatment is clearly indicated. Treatment with CPAP should be considered and this would require a full night CPAP titration study to determine the optimal pressure setting for this patient. Please call with any questions regarding the interpretation of this study.

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PORTABLE UNATTENDED NOCTURNAL RESPIRATORY MONITORING STUDY

PATIENT:
DOB: 02-25-1987
DATE OF STUDY: 8-7-13 8-8-13
LOCATION: THE WOODLANDS
REFERRING: Jerald Simmons, MD
INTERPRETING PHYSICIAN: JERALD SIMMONS, MD

INDICATIONS: This is a 26y/o male with symptoms of excessive daytime sleepiness, fatigue, GERD and insomnia. An in laboratory overnight sleep study evaluation with the addition of the Pes (Pressure within the esophagus) was ordered to assess the patients sleep. However, this was denied by the insurance company and a directive to perform this unattended home respiratory study was given instead. This portable unattended nocturnal respiratory monitoring study is being performed in an attempt to characterize the patient's breathing during sleep.

PROCEDURE: A portable unattended nocturnal respiratory data acquisition recording was obtained using the Watermark Ares device which measures Nasal/Oral Airflow/PAP Flow, Oxygen Saturation (SpO2), Heart Rate, Sonogram (Snoring), Head Position.
The data was reviewed by Jerald Simmons, MD, Diplomat of the American Board of Sleep Medicine.

SIGNAL INTEGRITY: The signal integrity of all signals acquired was adequate for review and assessment of the data recorded.

Data Summarization: Data summarization is listed within the page(s) that follow which represent overnight parameters of those signals listed above.

IMPRESSION:

This unattended portable home respiratory "sleep" monitoring study did not demonstrate a significant degree of obstructive respiration during sleep. The AHI from this study was 2. Therefore this study was not successful in identifying a cause for the patients sleep pathology. It would be appropriate for this patient to have a full sleep study in a laboratory setting and possibly with additional parameters to increase the sensitivity of the test, such as the Pes, in order to characterize the patients sleep disturbance. Clinical follow up in our sleep center is scheduled for this patient to review these results and explore additional diagnostic pathways, such as those originally requested.

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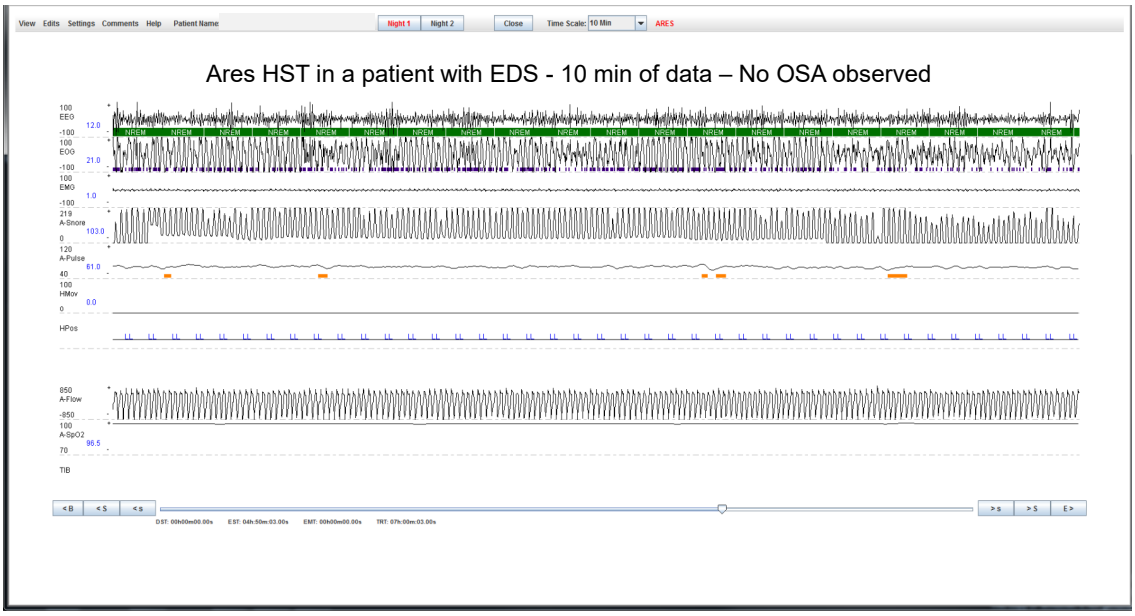
Ares HST in a patient with EDS - 10 min of data – No OSA observed



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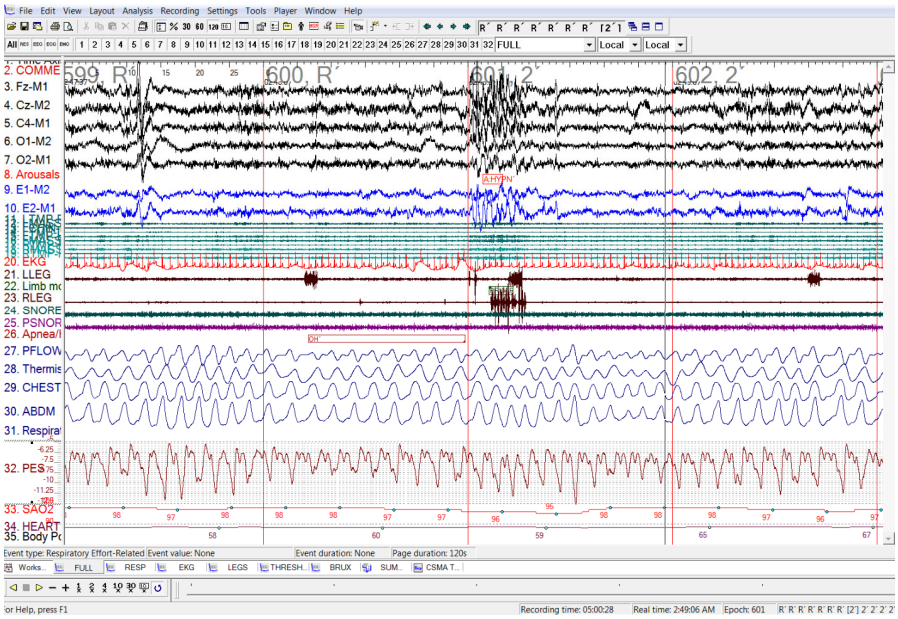
NPSG on the same patient – clear hypopneas and PLMS



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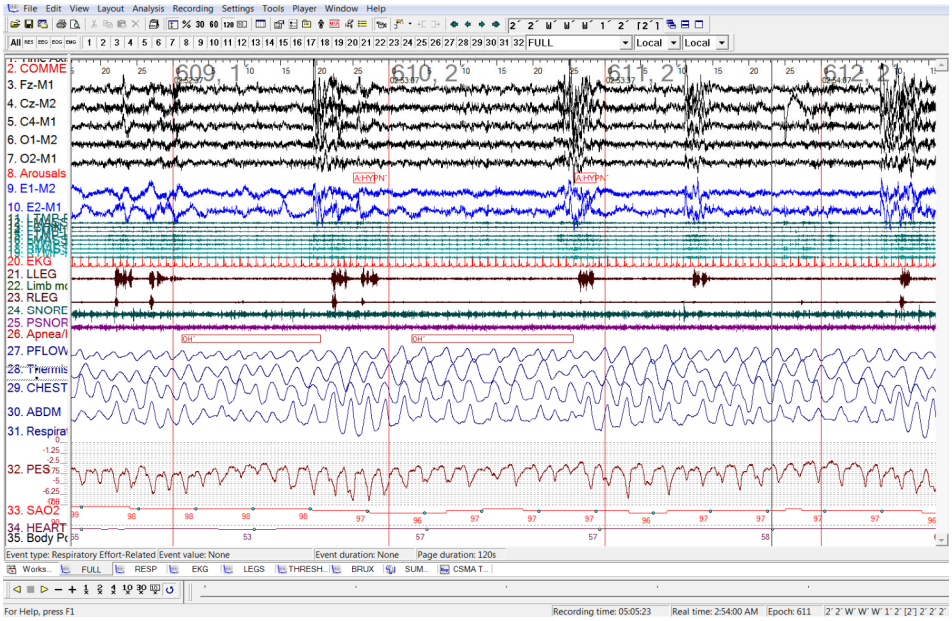
NPSG on the same patient – clear hypopneas and PLMS



AHI = 6

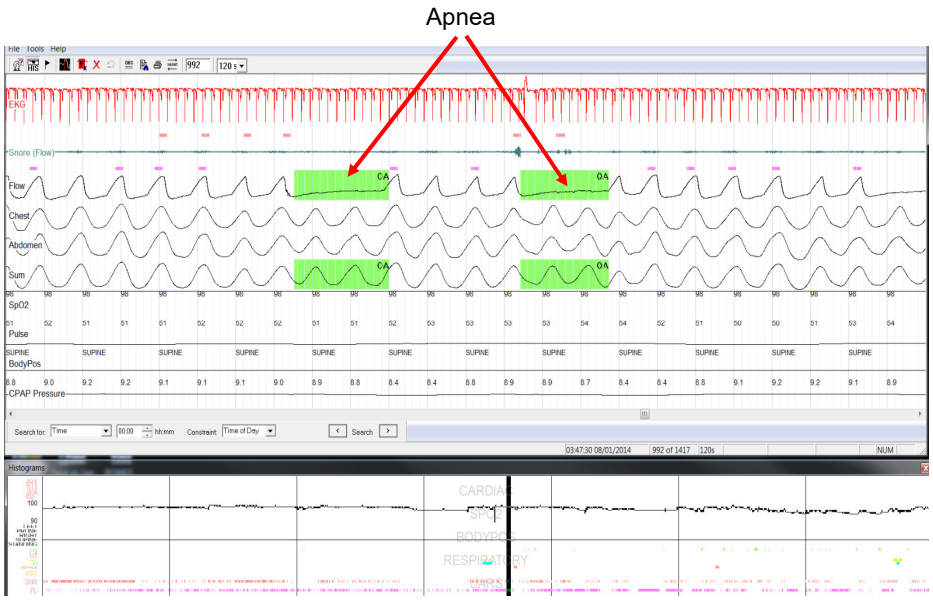
RDI = 16

SaO2 94%

41

Patient on CPAP using a TAP – PAP at 9 cm H2O

42



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PORTABLE UNATTENDED NOCTURNAL RESPIRATORY MONITORING STUDY

PATIENT: ---------- **DOB: 09-06-1933**
DATE OF STUDY: 01-07-14 & 01-08-14 **LOCATION: THE WOODLANDS**
REFERRING: Ronald Prehn, DDS
INTERPRETING PHYSICIAN: JERALD SIMMONS, MD

INDICATIONS: This is a 80y/o female with symptoms of OSA. This portable unattended nocturnal respiratory monitoring study is being performed in an attempt to characterize the patient's breathing during sleep while using her TAP-PAP appliance at a pressure of 9 cm H2O.

PROCEDURE: A portable unattended nocturnal respiratory data acquisition recording was obtained using the Medibyte Breabon device which measures PAP Flow, Oxygen Saturation (SpO2), Heart Rate, Sonogram (Snoring), Body Position and movement, and Thorax Respiratory Effort.
The data was reviewed by Jerald Simmons, MD, Diplomat of the American Board of Sleep Medicine.

SIGNAL INTEGRITY: The signal integrity of all signals acquired was adequate for review and assessment of the data recorded.

IMPRESSION:

With the unattended portable sleep study the patient demonstrated essentially normal respirations during sleep. The patient had less than 5 obstructive respirations per hour with an Apnea Hypopnea Index of 4.3 episodes per hour when using her TAP-PAP appliance. The patient's oxygen saturation dropped only to 94% in association with some of these obstructive respiratory events. The patient's TAP-PAP appliance is effective in treating the patient's obstructive respirations at night.

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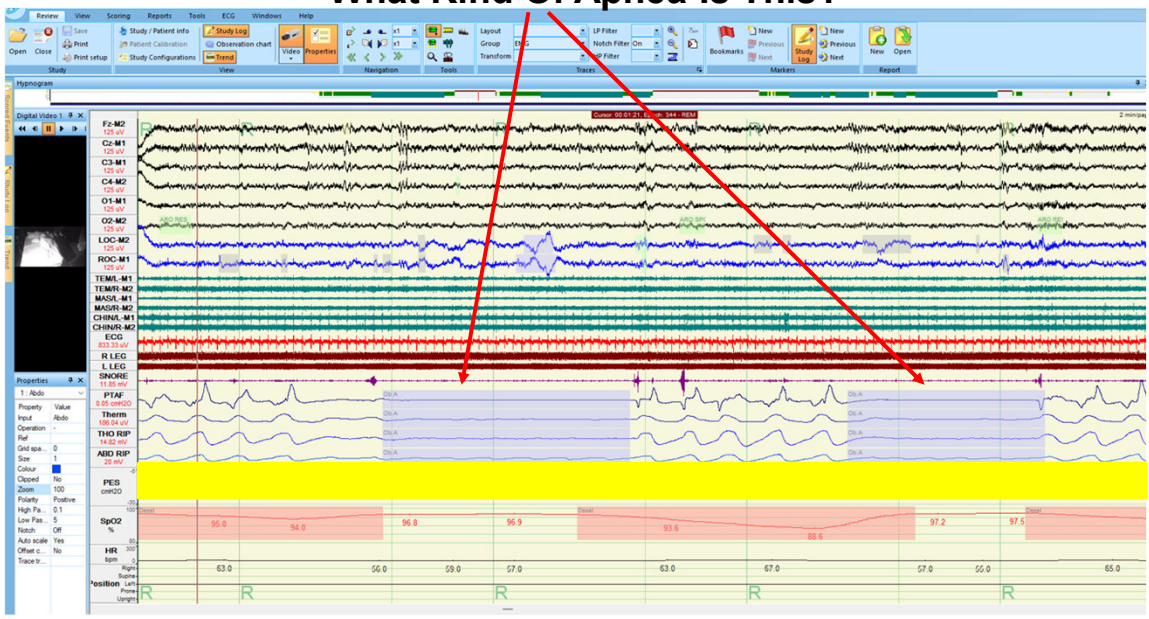
What Kind Of Apnea Is This?



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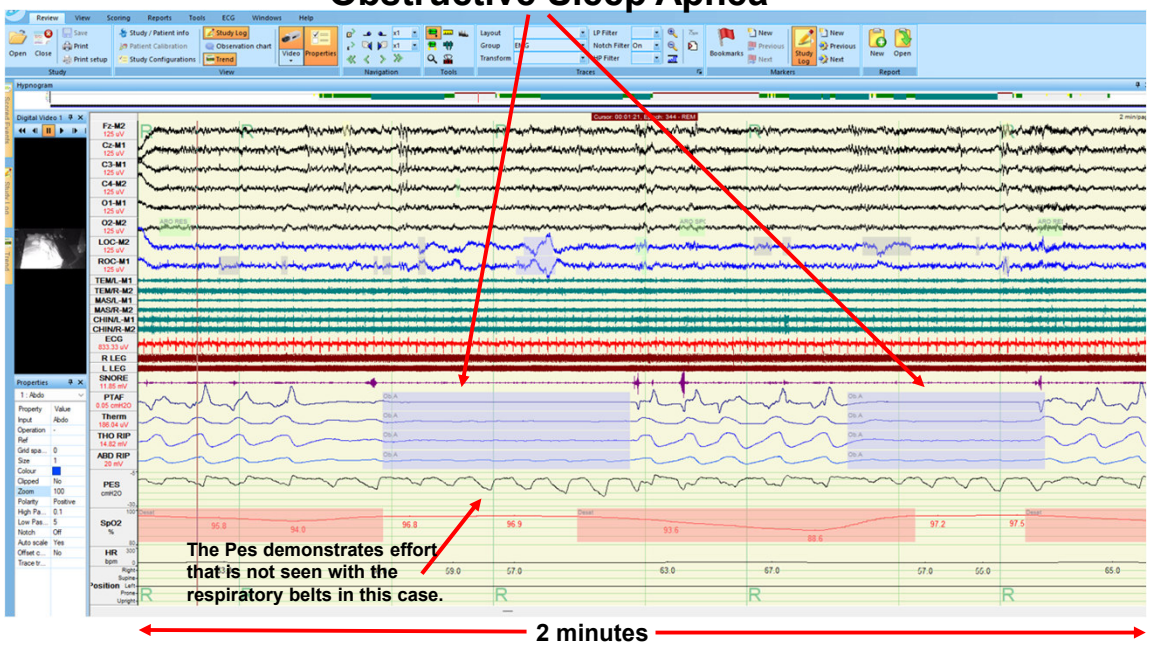
Obstructive Sleep Apnea



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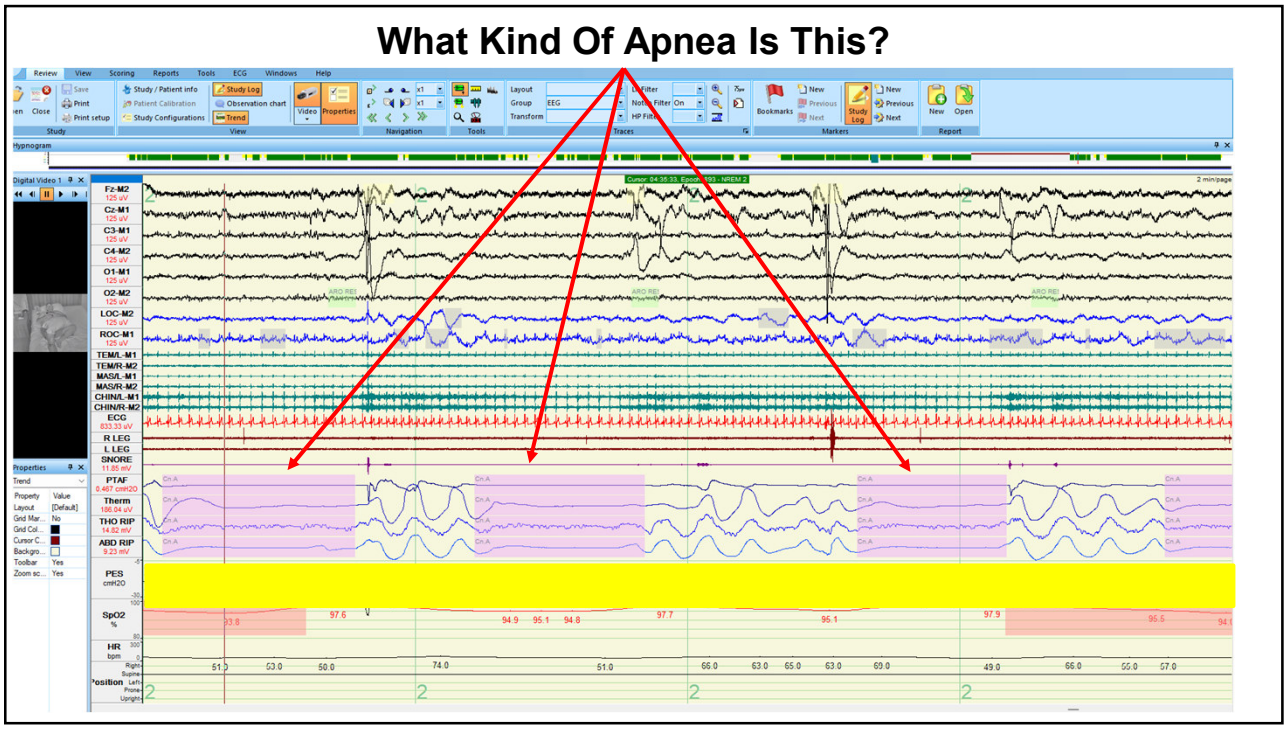
What Kind Of Apnea Is This?



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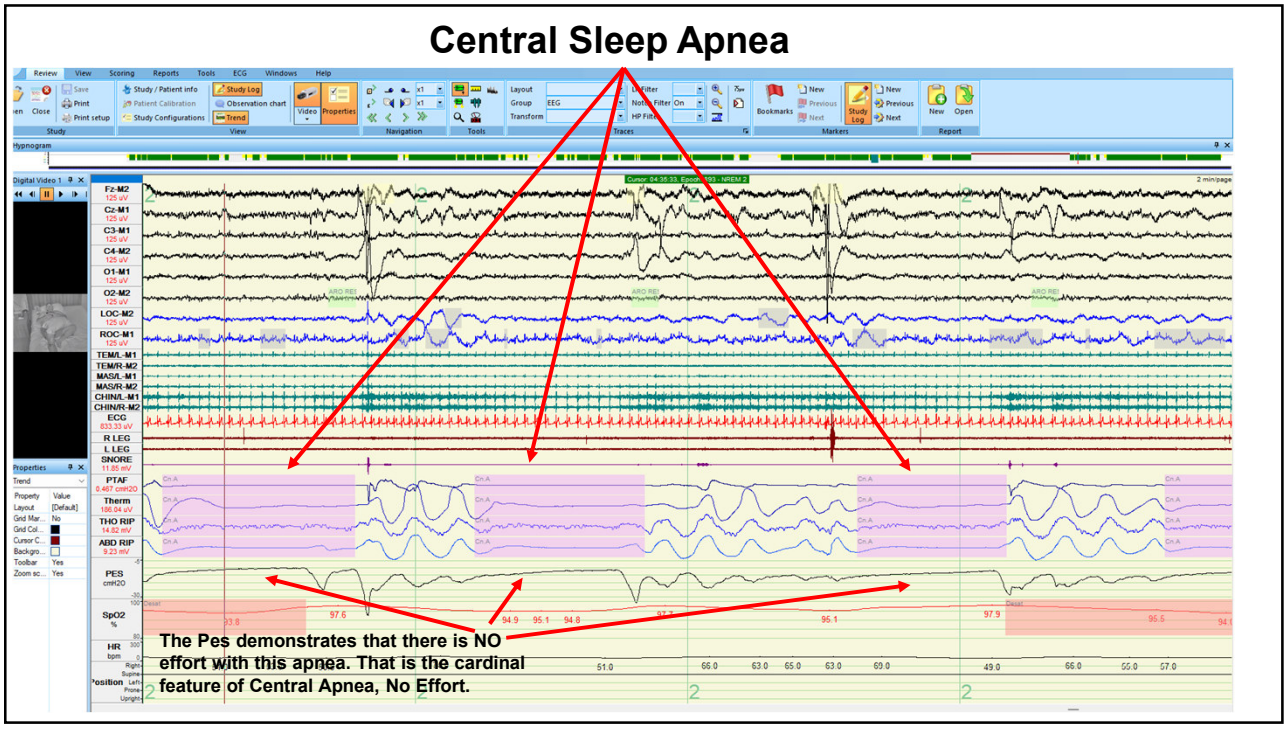
Central Sleep Apnea



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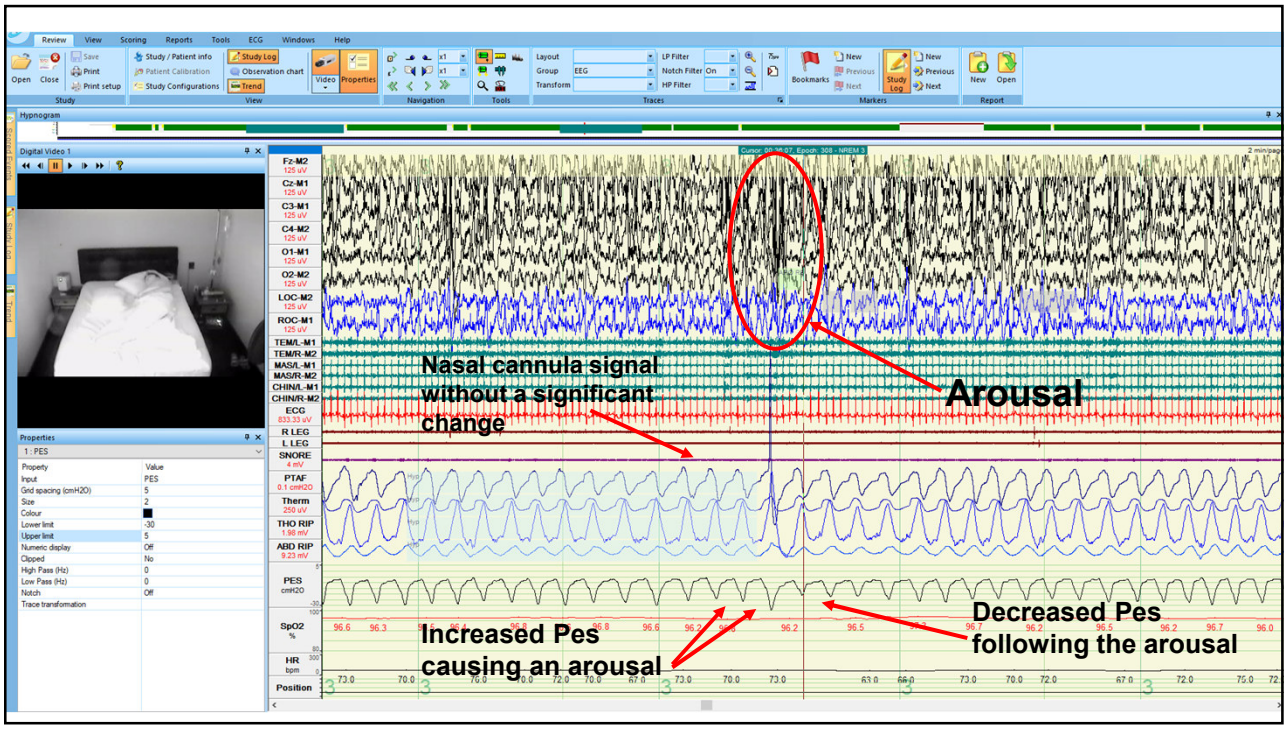
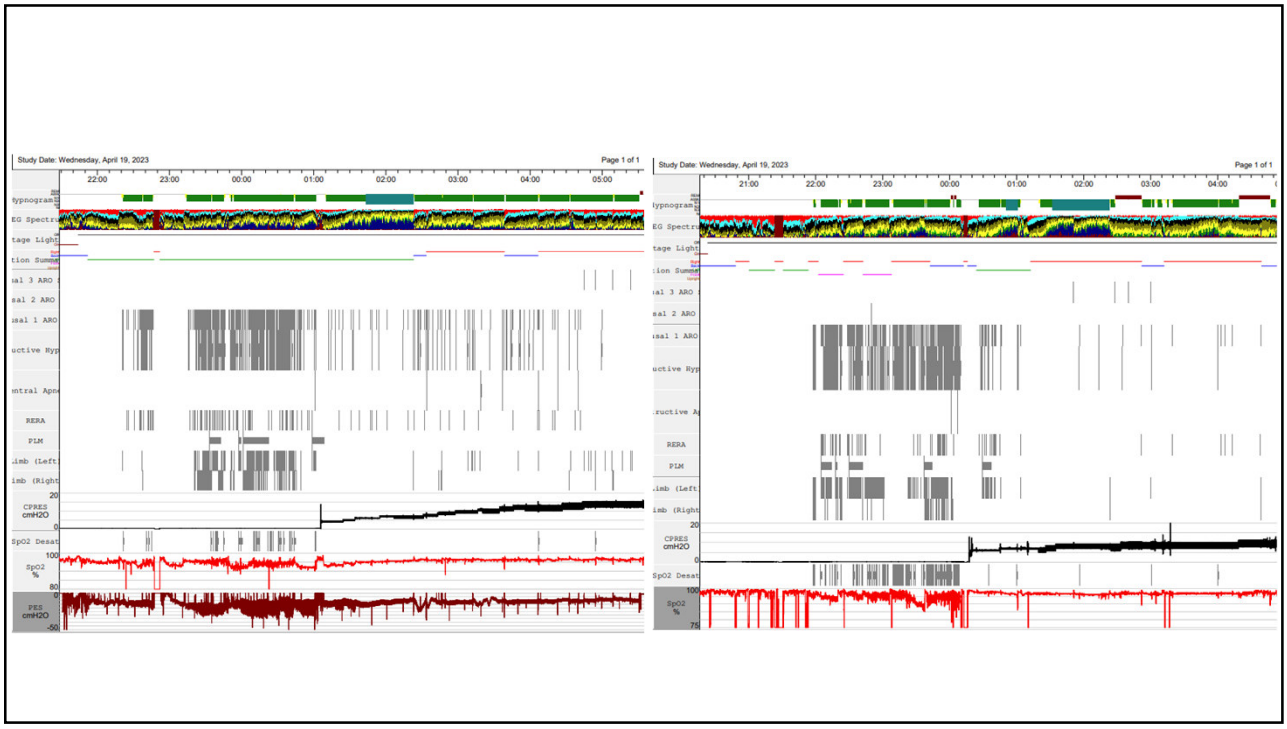

Nasal cannula signal without a significant change
Arousal
Increased Pes causing an arousal
Decreased Pes following the arousal

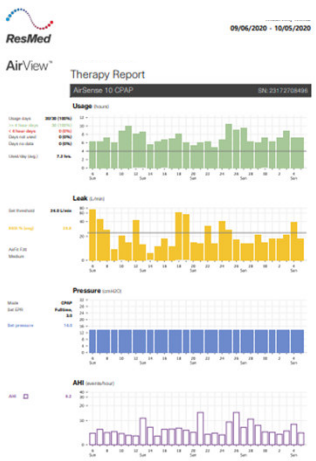
49



50

Remotely obtain patients CPAP data to augment the Telemedicine care.


ResMed
AirView™
09/06/2020 - 10/05/2020
Compliance Report
Compliance
Usage
Usage days 30/30 days (100%)
>= 4 hours 30 days (100%)
< 4 hours 0 days (0%)
Usage hours 216 hours 49 minutes
Average usage (total days) 7 hours 14 minutes
Average usage (days used) 7 hours 14 minutes
Median usage (days used) 7 hours 0 minutes
Total used hours (value since last reset - 10/05/2020) 6,200 hours
AirSense 10 CPAP
Serial number 23172708496
Mode CPAP
Set pressure 14 cmH2O
EPR Fulltime
EPR level 3
Therapy
Leaks - L/min 95th percentile: 24.8
Events per hour AHI: 6.2
Usage - hours


ResMed
AirView™
09/06/2020 - 10/05/2020
Therapy Report
AirSense 10 CPAP
Usage
Leak
Pressure
AHI

51


ResMed
AirView™

SUGAR LAND
15423 CREEK BEND DR
SUGAR LAND
Texas, 77478

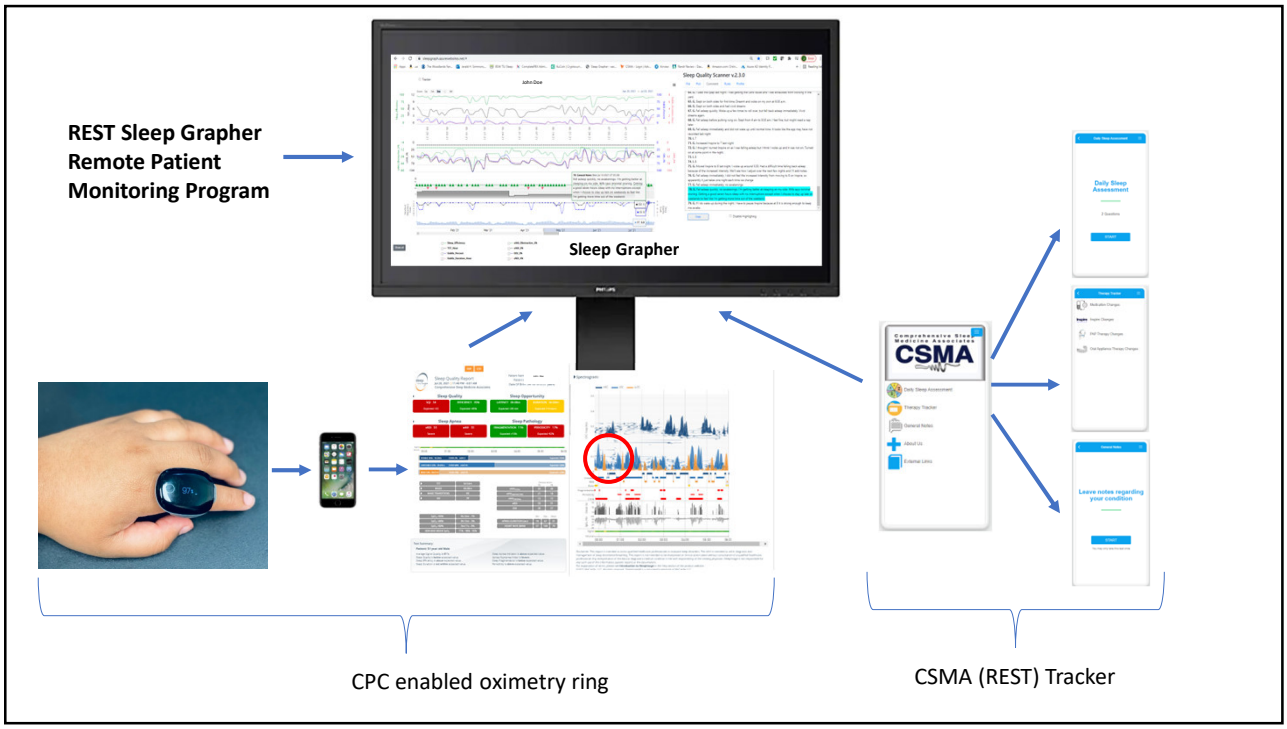
Phone: 281-269-7802
Email: mira.houstonrest@gmail.com

09/20/2021
DOB: 04/19/1970
Age: 51 years

Detailed report

AirSense 10 AutoSet						
Serial number						23183269170
Mode / set pressure						**CPAP / 14.0 cmH2O**
EPR / level						**Fulltime / 3.0 cmH2O**
Statistics						
Usage						**6 hr 26 min**
Leak - L/min			Median:	**3.6**	95th %:	**26.4**
Events per hour	AHI:	**0.9**	AI:	**0.7**	HI:	**0.2**
	Central:	**0.4**	Obstructive:	**0.3**	Unknown:	**0.0**
					RERA	**0.0**

52

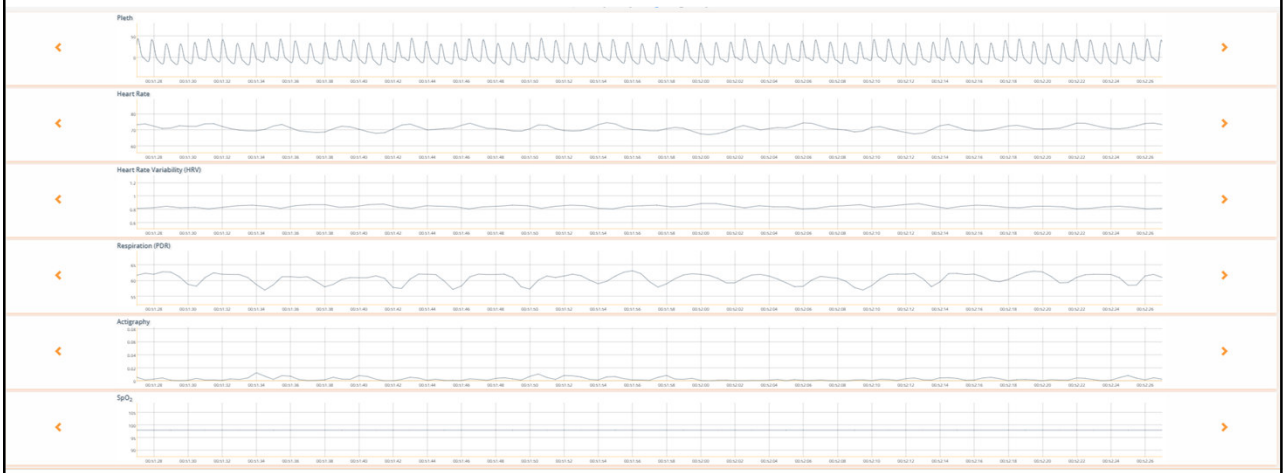

REST Sleep Grapher
Remote Patient
Monitoring Program
Sleep Grapher
CSMA
CPC enabled oximetry ring
CSMA (REST) Tracker

53


97%

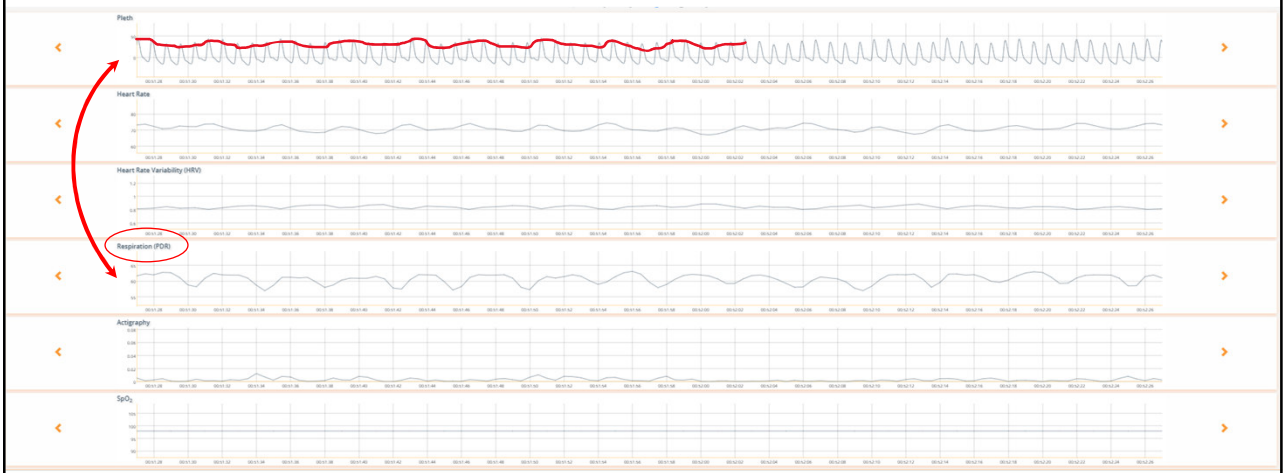
54

Cardioplumonary Coupling takes data from a ring oximeter, extracts a Plethysmographic Respiratory Signal and Heart Rate Variability data



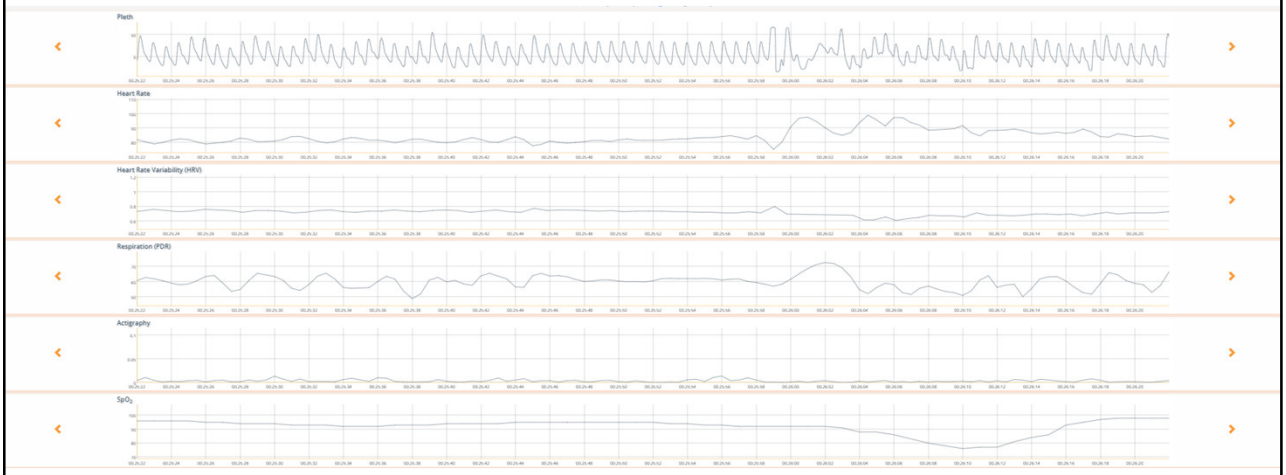
55

Cardioplumonary Coupling takes data from an oximeter, extracts a Plethysmographic Respiratory Signal and Heart Rate Variability data



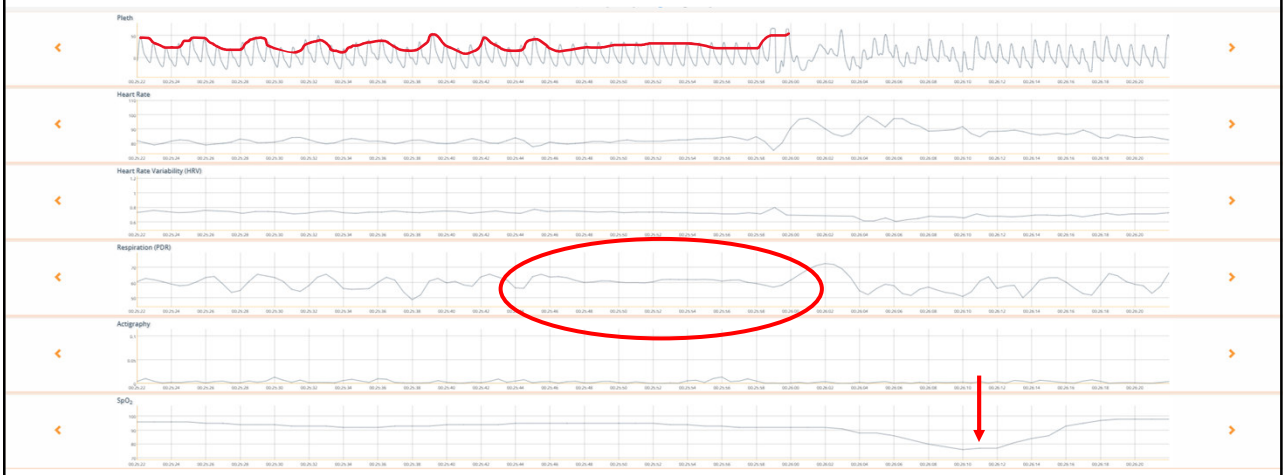
56

Cardioplumonary Coupling takes data from a ring oximeter, extracts a Plethysmographic Respiratory Signal and Heart Rate Variability data

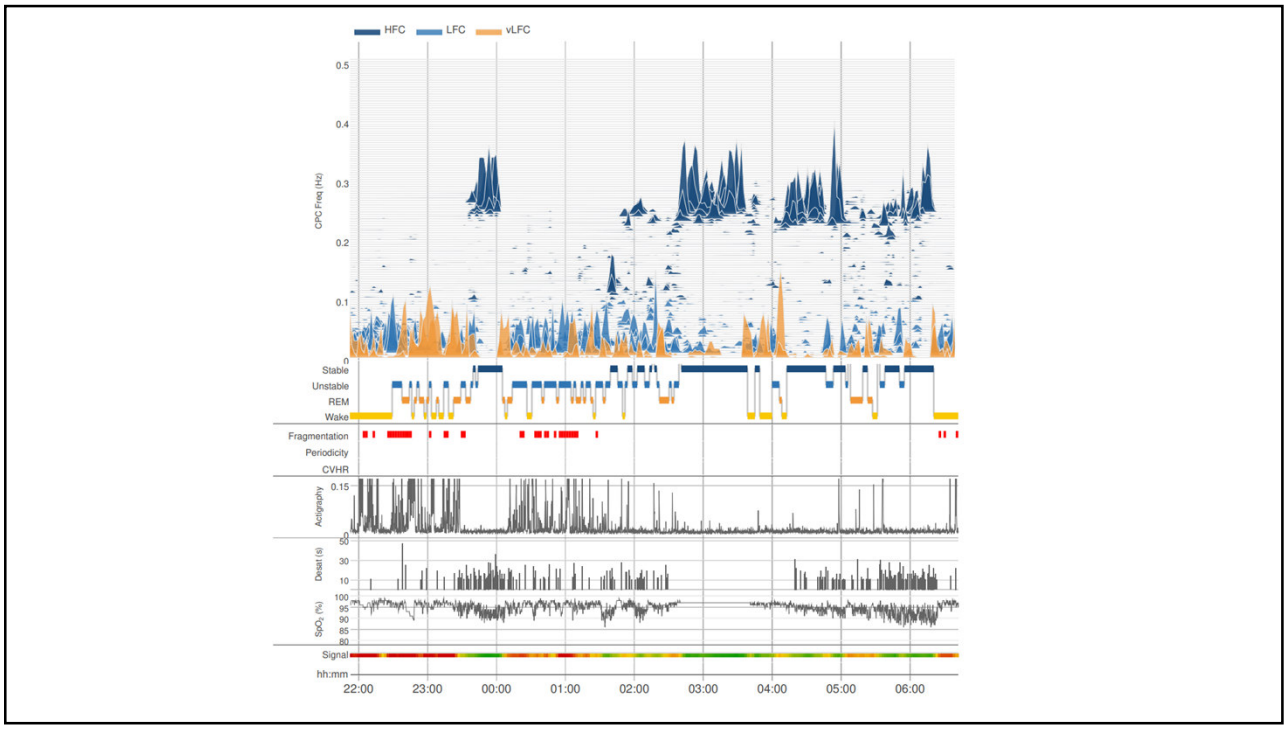


57

Cardioplumonary Coupling takes data from a ring oximeter, extracts a Plethysmographic Respiratory Signal and Heart Rate Variability data



58



59

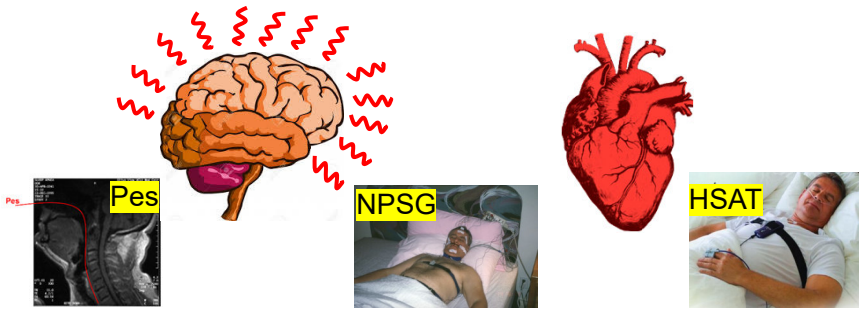
The Full Spectrum of Obstructive Breathing During Sleep

Different types of testing for different clinical situations

Snoring **Gasping** **Pauses in breathing**

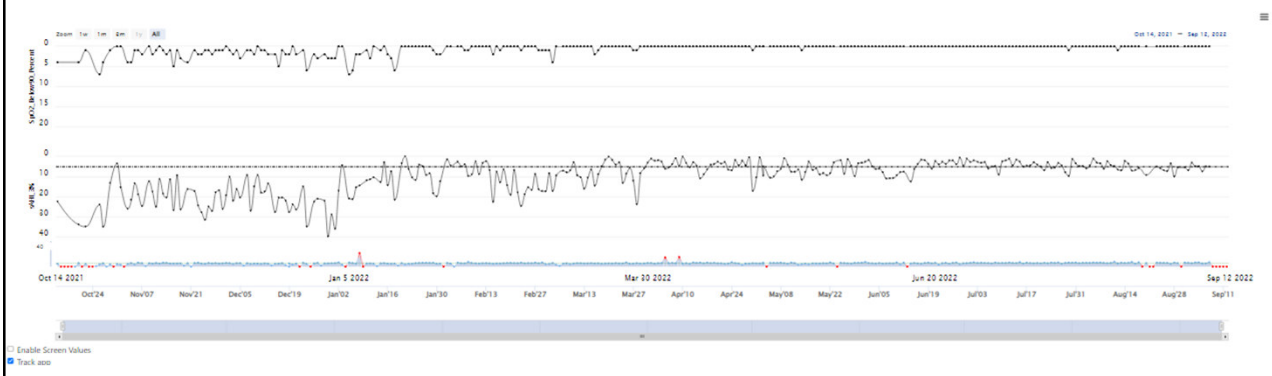
< - Bruxing / Clenching During Sleep - >

Normal Breathing → Respiratory Effort Related Arousals of Sleep (RERAS) → Hypopneas with normal SaO2 (Hypopnea Rule 1A) → Hypopneas with SaO2 desaturations (Hypopnea Rule 1B) → **Complete Obstructive Apnea**



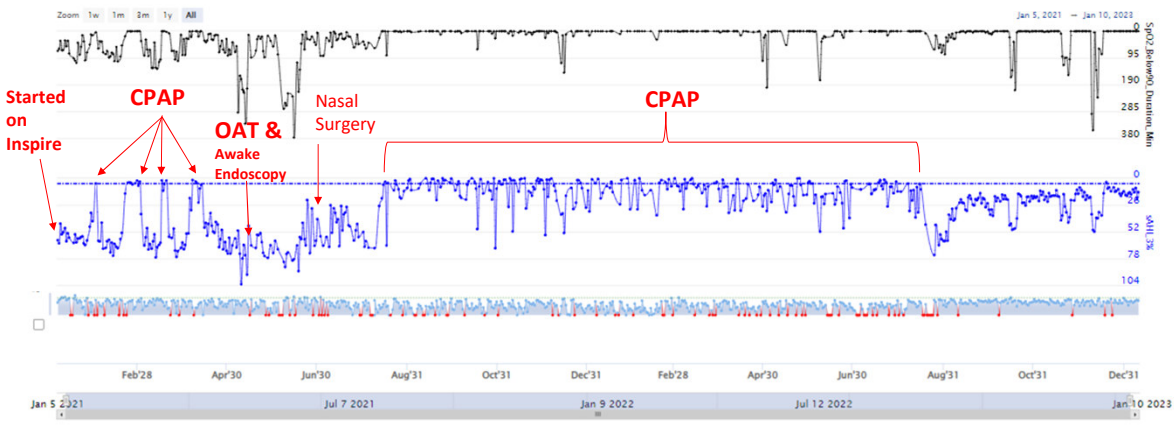
60

Patient with mixed OSA (Central and Obstrcutive) monitored since October 2021



61

Two years of nightly monitoring of a patient with OSA using our nightly tracking system

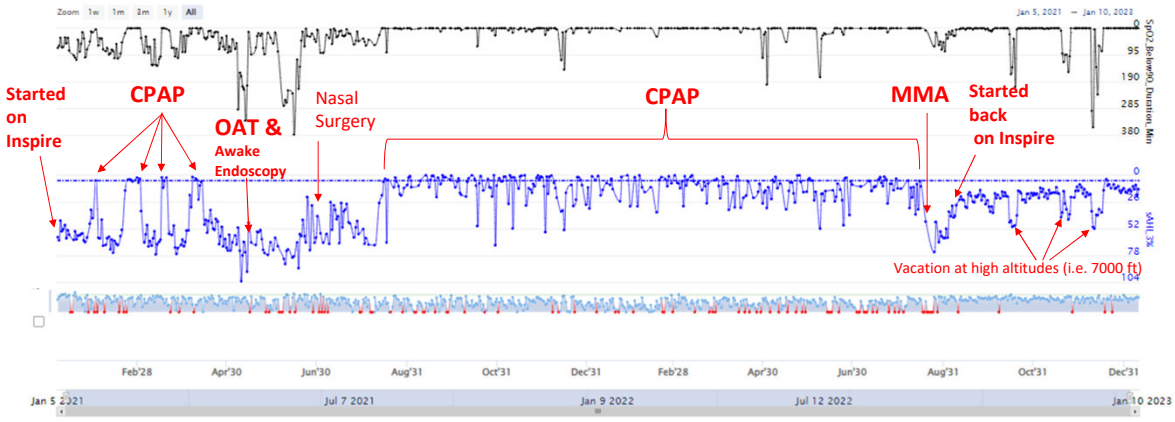


62

62

63

Two years of nightly monitoring of a patient with OSA using our nightly tracking system



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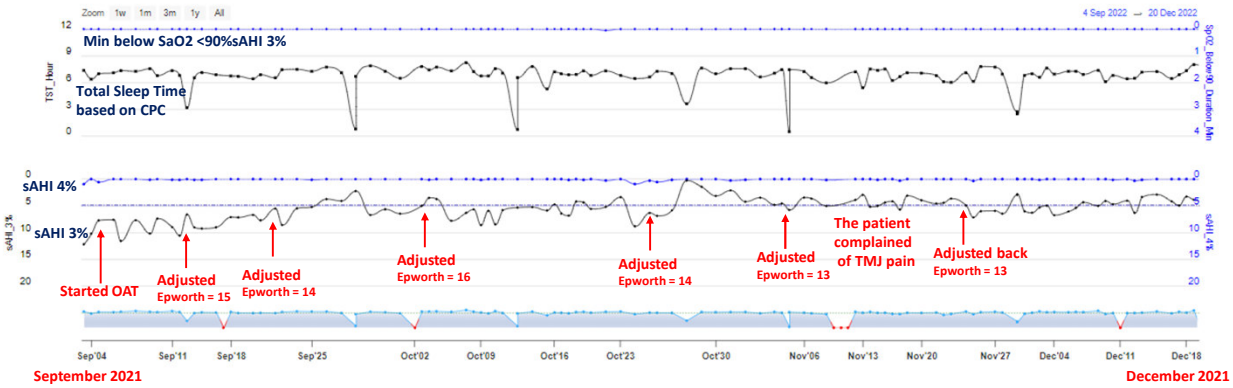
64

The patient was placed on nightly Remote Patient Monitoring (RPM), wearing a ring, and then he started wearing his OAT device which was adjusted based on the findings.

The patients daytime sleepiness never resolved with the improvement in his OSA as measured by the sAHI 3% parameter. So, he came into the lab for a NPSG with a Pes followed by a MSLT.



65

NPSG demonstrated

IMPRESSION:

1. **This study demonstrated evidence of mild / significant obstructive sleep apnea (AHI 8.5).**
2. **This study was followed by a Multiple Sleep Latency Test (MSLT).** **With the appliance**

Multiple Sleep Latency Test demonstrated

IMPRESSION:

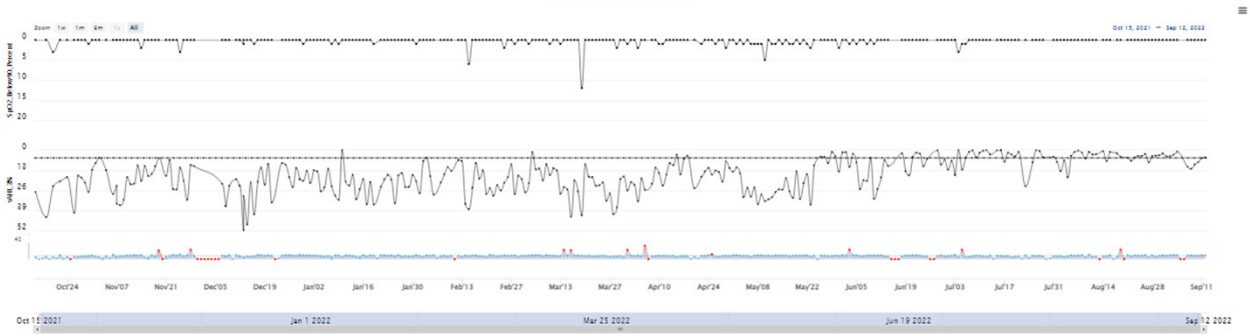
1. **The mean sleep latency was 9.6 minutes.**
2. **There was REM sleep in 2 of the sessions.**

Diagnosis: Narcolepsy Type 2 in addition to OSA
(with the oral applaince the AHI was 8.5 in the lab but with the HSAT it was under 5 /hr most nights.

This patient needed combination treatment of his OSA and medications to treat his narcolepsy.

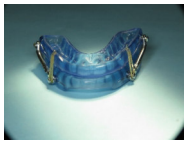
66

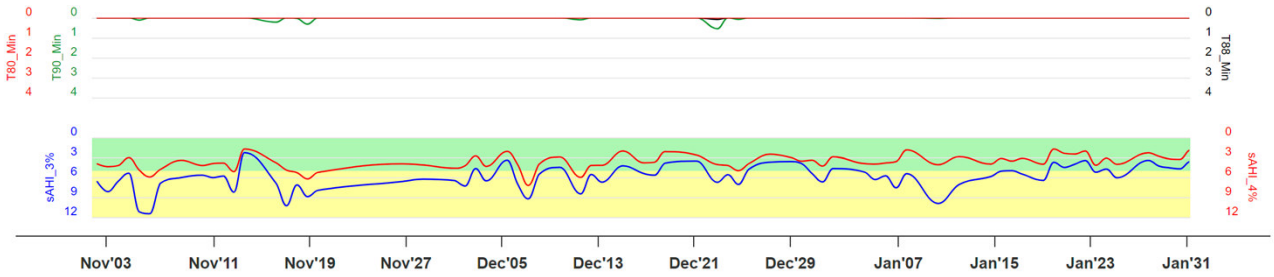
Patient on who failed Inspire alone and is on combination therapy with PAP with good results



67

CSMA is currently assisting dentist titration of OAT using the REST Tracker



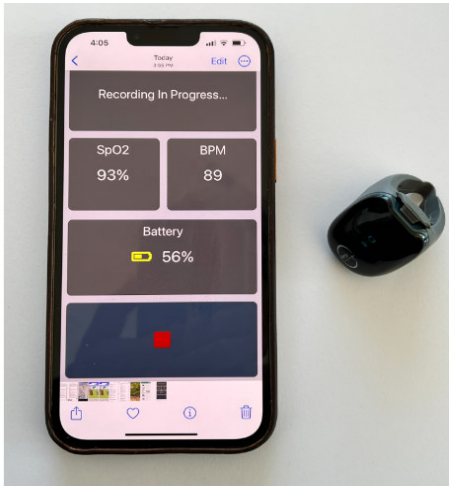


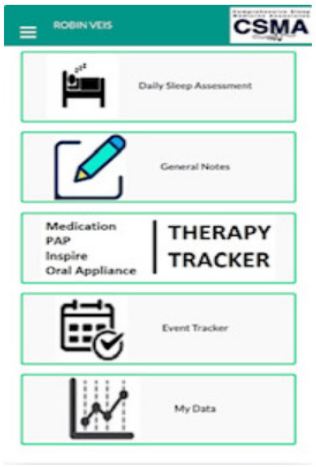
27 Oct 2023 → 7 Feb 2024

Adjustments made on the appliance during this period of time, guided by the data from the REST Tracking platform. Note the night-to –night variability

68

Rest Diagnostics





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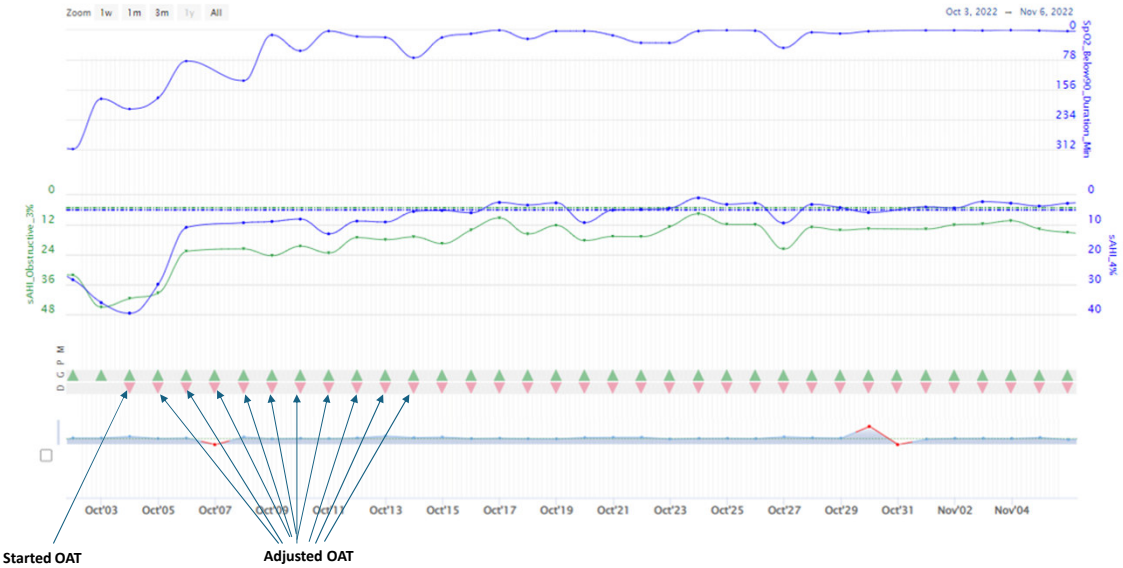
Dental Appliance Mono Therapy



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A Feasibility Study to Test the REST Tracker System for Use in Maternal Care to Improve Outcomes by Early Detection of Obstructive Sleep Apnea
Principle Investigator: Jerald H Simmons, MD

REST Technologies monitoring of pregnant women is supported by the National Heart, Lung, And Blood Institute of the National Institutes of Health under Award Number R43HL166038.

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Presented at SLEEP 2025

Feasibility of the REST Tracker Platform to Monitor Obese Pregnant Woman for the Onset of OSA Throughout Pregnancy

Jerald H. Simmons MD[1,2,6], Robert Thomas MD[4], Renee Ivins FNP[3], Brian Kirshon MD[3], Karolina Adam MD[3], George Saade MD[3], Sam Sadeghian[1,6], Ashley Paige MPH[1,2,6], Chris Mann PhD[5] Timothy Van Meter PhD[1],

1. Rest Technologies Inc 2. Comprehensive Sleep Medicine Associates, PA 3. Hermann Memorial Hospital 4. BIDMC/Harvard 5. Eastern Virginia Medical School 6. Sleep Education Consortium

Introduction

- Studies suggest the prevalence of OSA increases throughout the course of pregnancy and is associated with increased risk for gestational-diabetes, hypertension, preeclampsia, and eclampsia, contributing to maternal and neonatal morbidity and mortality.
- OSA increases risk of chronic cardiovascular disease, well beyond pregnancy.
- Continuous evaluation is necessary as the risk increases throughout the course of the pregnancy; however, this is not currently a standard practice.
- REST Technologies has developed the REST-Tracker, a Remote Patient Monitoring platform for the management of OSA patients and has been funded by the NIH to assess the feasibility of tracking an obese pregnant population at risk of developing OSA.
- The REST-Tracker system manages data obtained from a Ring-Oximeter / plethysmograph monitor worn nightly.
- Data is processed through the FDA cleared Sleepimage™ system that performs Cardiopulmonary Coupling analysis on plethysmographic / oximetry data providing sleep metrics include AASM 1a and 1b AHI surrogates labeled sAHI3% and sAHI4%.

Methods

- Subjects were recruited from a high-risk obstetrics clinic with inclusion-criteria: BMI >27, entry < 16 weeks gestational-age and no prior diagnosis of OSA.
- Target=30 subjects monitored nightly to the end of pregnancy.
- Only subjects who remained pregnant into the third trimester completed the study and included in the statistical analysis.
- Analysis consisted of paired t-test of the average of the sAHI3% from each subject prior to 16 weeks gestation compared to the sAHI3% from the average of the last 4 collection points prior to delivery.
- Subjective assessments (self report, Smartphone): Pittsburgh Sleep Quality Index (PSQI) and Insomnia Severity Index (ISI) scheduled monthly, and Epworth Sleepiness Scale (ESS) and a pregnancy related sleep questionnaire (PRSQ) scheduled weekly. Subjects were prompted by messages to complete the assessments.

Results

- 57 subjects: 15 screen failed for lack of compliance with instructions during screening, another 14 withdrawn prior to the third trimester, 2 from miscarriages, 1 from preterm delivery at 22 weeks, and 11 for ongoing lack of compliance wearing the ring, leaving 28 that recorded to delivery completing the study to the end of pregnancy.
- Of the 28 completers: Ave BMI = 36.8 (+/- 5.9), Gestational Age on monitoring initiation = 12.39 weeks (+-3.29), Average Gestational Age at Delivery = 36.8 (+/- 2.6).
- Initial sAHI3% = 5.01 (+/-2.79), Final sAHI3% = 9.35 (+/-5.74) with significant increase across pregnancy (p<0.001). Initial sAHI4%= 2.94 (+/- 1.56), Final sAHI4% = 5.48 (+/- 3.40) with significant increase across pregnancy (p<0.001).
- Initial High Frequency Coupling (Stable Sleep) Ave = 52.04 (+/- 17.60) and Final was 39.44 (+/- 18.18) with significant decrease in Stable Sleep p<0.001).
- Compliance of subjects inputting data according to the schedule: PSQI 91%, ISI 88%, ESS 49% and PRSQ <40% .
- None of the responses from subjective assessments provided statistically significant. correlation to the sAHI3% or sAHI4% using Pearson correlation coefficient. Similarly, there was no correlation of the sAHI3% or sAHI4% to BMI or weight.

The research reported here was supported by the National Heart, Lung, And Blood Institute of the National Institutes of Health under Award Number R43HL166038. The content is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

More Information:
For more information about Remote Patient Monitoring with The REST Technologies REST Tracker, go to the QR link

Conclusion

- The REST-Tracker provides a new approach, monitoring maternal patients at-risk of developing OSA.
- OSA in this obese maternal population, overall, tends to develop through the course of pregnancy.
- The REST Tracker system can be integrated into a prenatal care protocol to identify the onset of OSA in an at-risk population.
- The system is highly scalable and can aid in assessing the relationship between sleep pathology and poor pregnancy outcomes, e.g., gestational hypertension, gestational diabetes and eclampsia.
- None of the subjective assessment measure provided reliable results to function as a meaningful alternative adequate sensitivity.
- The REST Tracker allows for an expedited OSA management protocol.
- Longitudinal nightly assessment is necessary in an evolving medical scenario such as that presented in the third-trimester of pregnancy. We anticipate a phase II multi-center study to enhance the performance of this platform and cultivate protocols for its implementation on a large scale.

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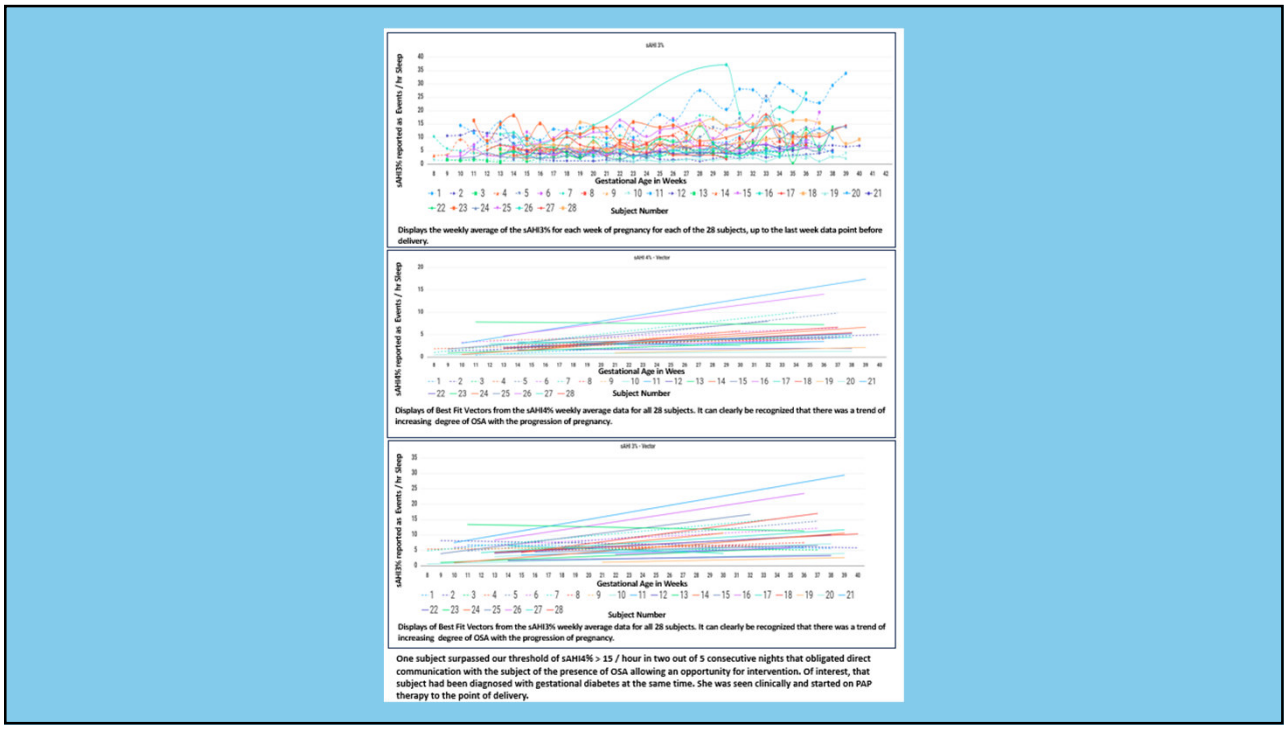
sAHI 3%
sAHI3%: reported as Events / hr Sleep
Gestational Age in Weeks
Subject Number
Displays the weekly average of the sAHI3% for each week of pregnancy for each of the 28 subjects, up to the last week data point before delivery.
sAHI 4% - Vector
sAHI4%: reported as Events / hr Sleep
Gestational Age in Weeks
Subject Number
Displays of Best Fit Vectors from the sAHI4% weekly average data for all 28 subjects. It can clearly be recognized that there was a trend of increasing degree of OSA with the progression of pregnancy.
sAHI 3% - Vector
sAHI3%: reported as Events / hr Sleep
Gestational Age in Weeks
Subject Number
Displays of Best Fit Vectors from the sAHI3% weekly average data for all 28 subjects. It can clearly be recognized that there was a trend of increasing degree of OSA with the progression of pregnancy.
One subject surpassed our threshold of sAHI4% > 15 / hour in two out of 5 consecutive nights that obligated direct communication with the subject of the presence of OSA allowing an opportunity for intervention. Of interest, that subject had been diagnosed with gestational diabetes at the same time. She was seen clinically and started on PAP therapy to the point of delivery.

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HSATs vs NPSGs
What inspired you to reflect?
Pick the context and a clinically relevant concept or phrase that inspired you to reflect.
Reflective Learning Moment
HSATs vs NPSGs
Step 1 of 4
Next

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