Manual of Procedures

Influence of Apnea versus Hypopnea Predominance in Predicting Mean Therapeutic Positive Airway Pressures Among Obstructive Sleep Apnea Patients

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All files are located on the Otorhinolaryngology shared drive ("I" drive). User access to the I Drive is provided by the Department IT (Chris Binder, Systems Administrator, as of 3/20/2020).

Throughout the MOP, "Shared Drive" refers to the following file pathway: \\UphsFP15\SHAREDATA3\HUP\Otorhinolaryngology\Dedhia Research\AHAPAP

Section 1: Accessing EncoreAnywhere

1. Access EncoreAnywhere.
    a. username: xxxxxxx
    b. password: xxxxxxx
2. Access the "My Patients" tab. This is the second tab from the left, located between the "My Day" & "My Profile" tabs.
    a. "Setup Date": enter the date range of interest (i.e., From 1/1/2019; To 1/1/2020)
        i. *Note:* Press the "Tab" key on your computer/laptop keyboard. This will prompt a green loading bar, as the EncoreAnywhere database filters for patients that meet the date range of interest.
    b. "Device Mode": enter "autoCPAP"
        i. *Note*: Press the "Tab" key on your computer/laptop keyboard. This will prompt a green loading bar, as the EncoreAnywhere database filters for patients using an autoCPAP device.
    c. *Note*: The numeric code listed under the "Patient ID" column for each patient corresponds to their MRN. The numeric code/MRN can be inputted into PennChart EMR to access the patient's medical record.

Section 2: Accessing Information in PennChart EMR

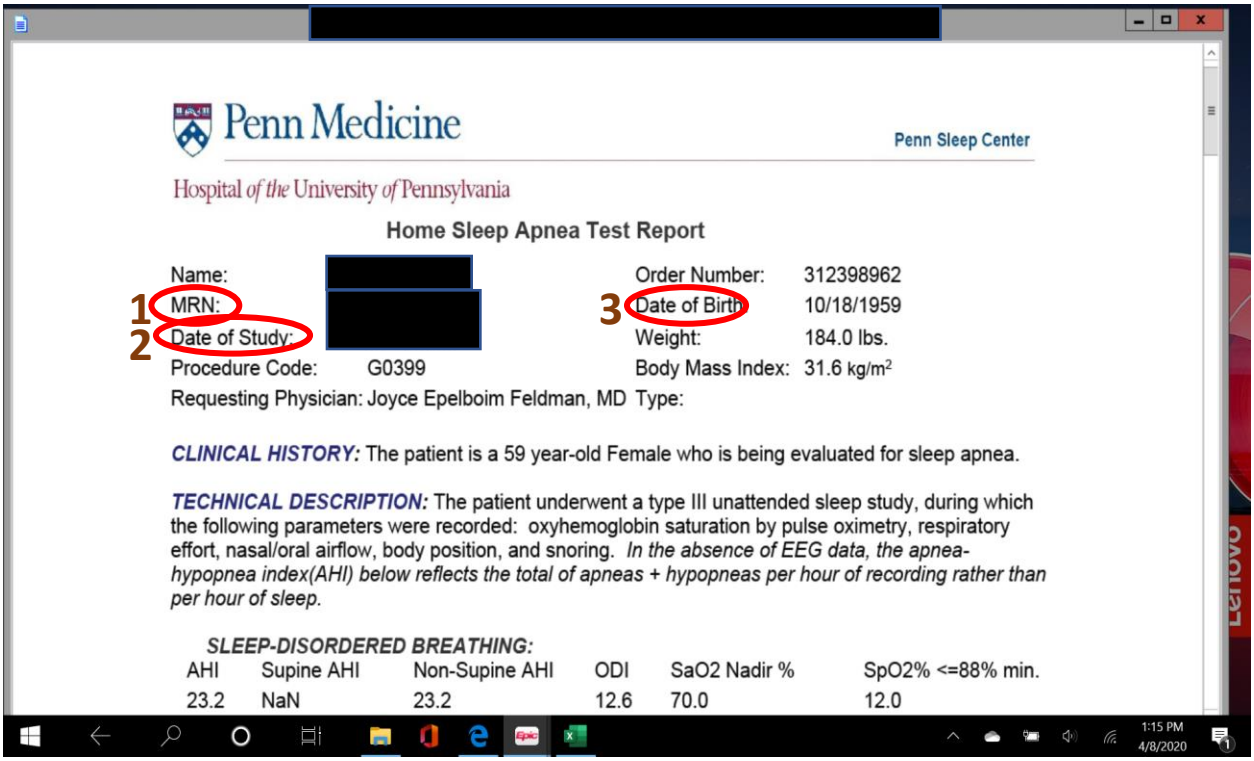
1. Access PennChart EMR, utilizing Penn Medicine credentials.
2. Access the "Review" Tab.
    a. Input the patient's MRN, per *Note* in Section 1, 2.c.
    b. Click "Accept", which will populate the patient's medical record.
3. Access the "Encounters" Tab.
    a. Click "Filters", and filter by "Specialty".
    b. Select "Sleep Medicine". This will populate all encounters associated with Sleep Medicine within the patient's chart.
4. Identify the patient's encounter initial evaluation for sleep apnea, which resulted in a diagnosis of obstructive sleep apnea (OSA).
    a. *Note:* This is typically the earliest or one of the earliest visits.
5. Determine patient's eligibility, based on study's Inclusion & Exclusion Criteria:
    a. Inclusion Criteria:
        i. Males & Females
        ii. 18 years of age or older
        iii. Diagnosis of obstructive sleep apnea (OSA)
        iv. Initially treated with auto-PAP (with follow-up compliance data in EncoreAnywhere)
    b. Exclusion Criteria:
        i. AHI < 10 events/hour
        ii. Central and/or mixed apneic events/hour > 25%
        iii. Prescribed any PAP device other than auto-PAP
        iv. No follow-up auto-PAP compliance data (at least 90 days)
    c. *Note*: If the patient was being re-evaluated at UPenn or was transferring their care to UPenn with a pre-existing diagnosis of OSA, the patient is NOT eligible.
    d. *Note*: If the patient was not initially treated with auto-PAP or received a form of combination therapy (i.e., auto-PAP with mandibular advancement device), the patient is NOT eligible.
6. Access the "Media Tab".
    a. The patient's sleep study will be located in the "Media" Tab. There are several different types of sleep studies including: Home Sleep Apnea Test (HSAT), Polysomnography Sleep Study (PSG), or Split Night Sleep Study (SPLIT).
    b. *Note*: If you cannot locate the "Media" Tab, it may be hidden in a small downwards-facing triangle on the right side of your PennChart window.
    c. *Note*: Within the "Media" Tab, click on "Document Type" to sort the media. Scroll to the documents categorized as "Procedure Results". Sleep studies are often uploaded under the category of "Procedure Results".
7. Evaluate the patient's sleep study to confirm eligibility, based on Inclusion & Exclusion Criteria in Section, 5.a & 5.b.
    a. *Note*: If the AHI < 10 events/hour, the patient is NOT eligible.
    b. *Note*: If central and/or mixed apneic events/hour > 25%, the patient is NOT eligible.
8. If the patient has met all eligibility criteria from review of their initial Sleep Medicine evaluation & review of their sleep study, proceed to data entry into REDCap.

Section 3: Data Entry into REDCap

1. Access REDCap, utilizing PMACS credentials.
    a. In the "My Projects" section, select the project titled "Apnea-Predominant OSA vs. Hypopnea Predominant OSA"
2. Click "Add/Edit Records".
    a. *Note*: This is located on the left-hand side of the page, underneath the header "Data Collection".
3. Click "Add New Record".
    a. *Note*: If you need to edit a previously-entered record, use the drop-down menu for "Choose an Existing Record ID".
4. Input Data.
    a. PennChart Variables: MRN, Date of Birth, Gender, Race.
        i. These variables are located under the "Demographics" Tab. If you click "Clinical Information", you can determine the patient's race.
    b. PennChart Variables: Height, BMI, Neck Circumference, SBP, DBP, Medical Comorbidities, # of anti-hypertensive medications, ESS, FOSQ
        i. These variables are located throughout the progress note for the patient's initial evaluation with Sleep Medicine.
        ii. *Note*: The height, weight, BMI, and blood pressure are typically located in the Physical Exam or Examination section of the progress note.
            1. *Note*: Height should be inputted in "meters".
            2. *Note*: Although BMI is also listed on the patient's sleep study, data entry of BMI will come from the PennChart progress note for consistency. If BMI is not found in PennChart, it can be entered from the sleep study
        iii. *Note*: The neck circumference may be located in the Physical Exam section of the progress note. If not, scroll to the bottom of the progress note to a section titled "Additional Documentation". Locate "Flowsheets", which may contain a link to Neck Circumference.
            1. *Note*: Neck circumference should be inputted in "centimeters". A conversion from inches to cm may be necessary.
        iv. *Note*: The medical comorbidities can be located by clicking "Problem List" on the left-hand column within the patient's chart.
        v. *Note*: The # of antihypertensive medications can be accessed by clicking the "Medications" Tab, which is located at the same level as the "Encounters" and "Media" Tabs.
        vi. *Note*: The Epworth Sleepiness Scale (ESS) and Functional Outcomes of Sleep Questionnaire (FOSQ) scores can be accessed from the progress note for the patient's initial evaluation with Sleep Medicine.
        vii. *Note*: The "mask type" can be identified in PennChart. It will require some searching after the initial evaluation, as the physician or a clinical team member may make mention of the type of mask the patient was initially started on.
    c. Sleep Study Variables: These variables will be accessed directly from the sleep study report. See the following sections for each type of sleep study.

i. *Note:* Depending on the type of sleep study, some data may be missing from what is available to enter into REDCap – this is OK. See below.
ii. **HSAT** will be missing the following variables in REDCap: REM AHI, nonREM AHI, REM AI, nonREM AI, REM HI, nonREM HI, Time Awake, Time in N1, Time in N2, Time in N3, Time in REM, Periodic Limb Movements
iii. **PSG** will be missing the following variables in REDCap: Supine Apnea Index, Supine Hypopnea Index, Average Apnea Length, Average Hypopnea Length, Time with Oxygen Saturation < 90% while Supine.
iv. **SPLIT** will be missing the following variables in REDCap: REM AHI, REM AI, REM HI, Average Apnea Length, Average Hypopnea Length.

Section 4: HSAT



Penn Medicine

Penn Sleep Center

Hospital of the University of Pennsylvania

Home Sleep Apnea Test Report

Name: [redacted]
1 MRN: [redacted]
2 Date of Study:
Procedure Code: G0399
Requesting Physician: Joyce Epelboim Feldman, MD

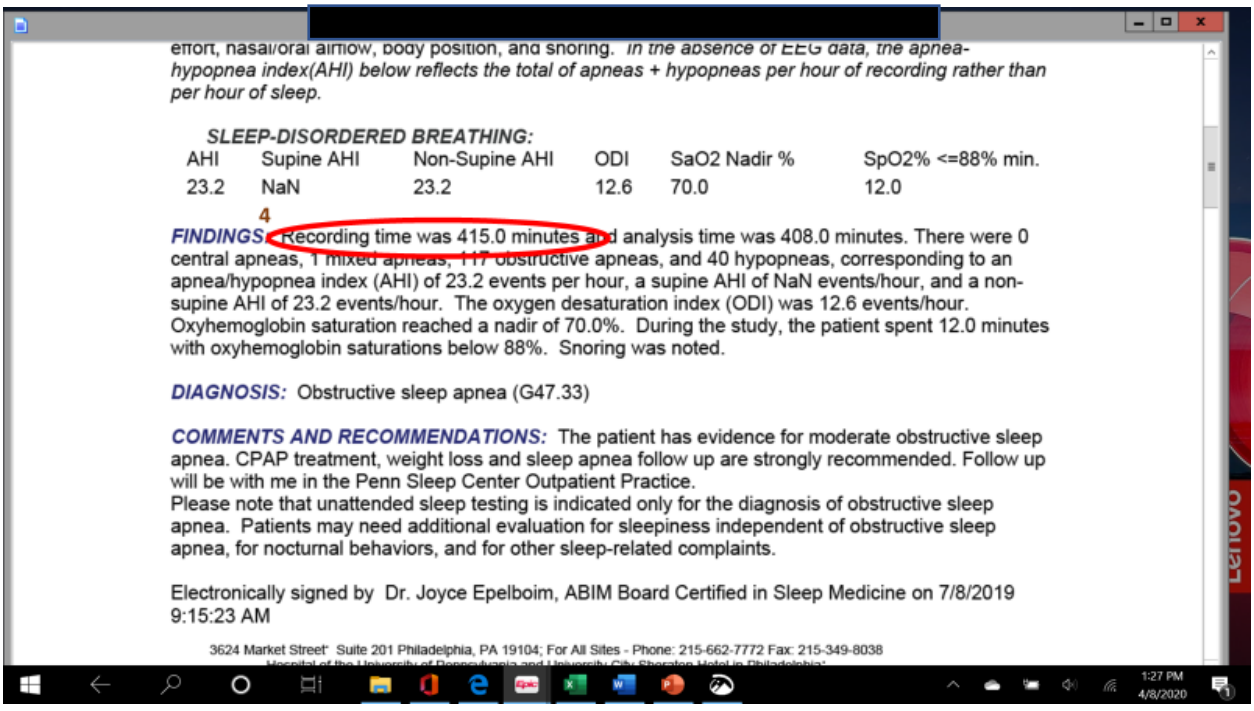
Order Number: 312398962
3 Date of Birth: 10/18/1959
Weight: 184.0 lbs.
Body Mass Index: 31.6 kg/m²
Type:

CLINICAL HISTORY: The patient is a 59 year-old Female who is being evaluated for sleep apnea.

TECHNICAL DESCRIPTION: The patient underwent a type III unattended sleep study, during which the following parameters were recorded: oxyhemoglobin saturation by pulse oximetry, respiratory effort, nasal/oral airflow, body position, and snoring. *In the absence of EEG data, the apnea-hypopnea index(AHI) below reflects the total of apneas + hypopneas per hour of recording rather than per hour of sleep.*

SLEEP-DISORDERED BREATHING:

AHI	Supine AHI	Non-Supine AHI	ODI	SaO2 Nadir %	SpO2% <=88% min.
23.2	NaN	23.2	12.6	70.0	12.0



effort, nasal/oral airflow, body position, and snoring. *In the absence of EEG data, the apnea-hypopnea index(AHI) below reflects the total of apneas + hypopneas per hour of recording rather than per hour of sleep.*

SLEEP-DISORDERED BREATHING:

AHI	Supine AHI	Non-Supine AHI	ODI	SaO2 Nadir %	SpO2% <=88% min.
23.2	NaN	23.2	12.6	70.0	12.0

4 ***FINDINGS:*** Recording time was 415.0 minutes and analysis time was 408.0 minutes. There were 0 central apneas, 1 mixed apneas, 117 obstructive apneas, and 40 hypopneas, corresponding to an apnea/hypopnea index (AHI) of 23.2 events per hour, a supine AHI of NaN events/hour, and a non-supine AHI of 23.2 events/hour. The oxygen desaturation index (ODI) was 12.6 events/hour. Oxyhemoglobin saturation reached a nadir of 70.0%. During the study, the patient spent 12.0 minutes with oxyhemoglobin saturations below 88%. Snoring was noted.

DIAGNOSIS: Obstructive sleep apnea (G47.33)

COMMENTS AND RECOMMENDATIONS: The patient has evidence for moderate obstructive sleep apnea. CPAP treatment, weight loss and sleep apnea follow up are strongly recommended. Follow up will be with me in the Penn Sleep Center Outpatient Practice.
Please note that unattended sleep testing is indicated only for the diagnosis of obstructive sleep apnea. Patients may need additional evaluation for sleepiness independent of obstructive sleep apnea, for nocturnal behaviors, and for other sleep-related complaints.

Electronically signed by Dr. Joyce Epelboim, ABIM Board Certified in Sleep Medicine on 7/8/2019 9:15:23 AM

3624 Market Street Suite 201 Philadelphia, PA 19104; For All Sites - Phone: 215-662-7772 Fax: 215-349-8038

Hospital *of the* University *of* Pennsylvania

Unattended In-Home Sleep Study Report

Apnea Hypopnea Index (AHI) events/hr	Saturation below 88% (minutes)	Total Desaturation Index (ODI) events/hr	Snore Index (% recording)
19.5	10.9	19.3	68.7

Central (Mixed) index= Apnea index * Central (Mixed) /apneas count

Respiratory Indices	total	supine
Apnea/Hypopnea Index	19.5 /h	25.3 /h
Apnea Index	4.6 /h	6.5 /h
Hypopnea Index	14.9 /h	18.8 /h
Snore Index	68.7 %	62.7 %
Flow Limitation Index	14.0 %	16.9 %
Longest Apnea	42 s	42 s
Longest Hypopnea	114 s	114 s

Respiratory Count	total	supine
Apneas	30	30
Obstructive	30	30
Mixed	0	0
Central	0	0
Hypopneas	98	87
Average Apnea	27 s	27 s
Average Hypopnea	26 s	26 s

	Duration	Apnea Count				Apnea Index (#/h)				Desat	
Position	(minutes)	A+H	OA	MA+CA	Hyp	A+H	OA	MA+CA	Hyp	Count	Index
All	394.4	128	30	0	98	19.5	4.6	0.0	14.9	127	19.3
Supine	276.9	117	30	0	87	25.3	6.5	0.0	18.8	115	24.9
Prone	-	-	-	-	-	-	-	-	-	-	-
Left	51.3	9	0	0	9	10.5	0.0	0.0	10.5	10	11.7
Right	66.3	2	0	0	2	1.8	0.0	0.0	1.8	2	1.8

Supine time
Non-supine time

* Hypopneas are scored on the basis of a 30% decrement in airflow or nasal pressure associated with a 4% oxyhemoglobin desaturation.

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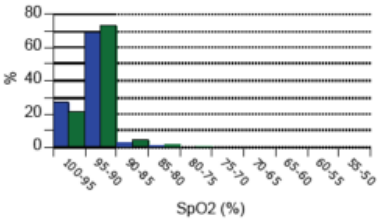
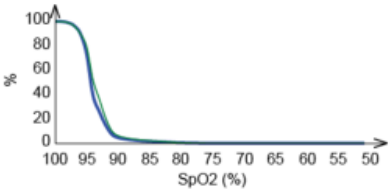
	All	Supine
Average SpO2 (%)	93.3	92.9
Minimum SpO2 (%)	74.0	74.0
SpO2 below 95% (m, %)	266 (73.0)	218 (78.9)
SpO2 below 90% (m, %)	18 (4.5)	17 (6.1)
SpO2 below 85% (m, %)	6 (1.6)	6 (2.1)
SpO2 below 80% (m, %)	2 (0.4)	1 (0.4)
SpO2 below 75% (m, %)	0 (0.0)	0 (0.0)
SpO2 below 70% (m, %)	0 (0.0)	0 (0.0)
Desaturation Count	127	115
Desaturation Index (#/h)	19.3	24.9
Average Desat (%)	7.4	7.7
Largest Desat (%)	20	20
Longest Desat (s)	116.0	116.0
Desat < 90% (#, #/h)	7.9 (52)	11.3 (52)
Desat < 85% (#, #/h)	3.5 (23)	5.0 (23)
Desat < 80% (#, #/h)	1.2 (8)	1.7 (8)
Desat < 75% (#, #/h)	0.2 (1)	0.2 (1)
Desat < 70% (#, #/h)	0.0 (0)	0.0 (0)

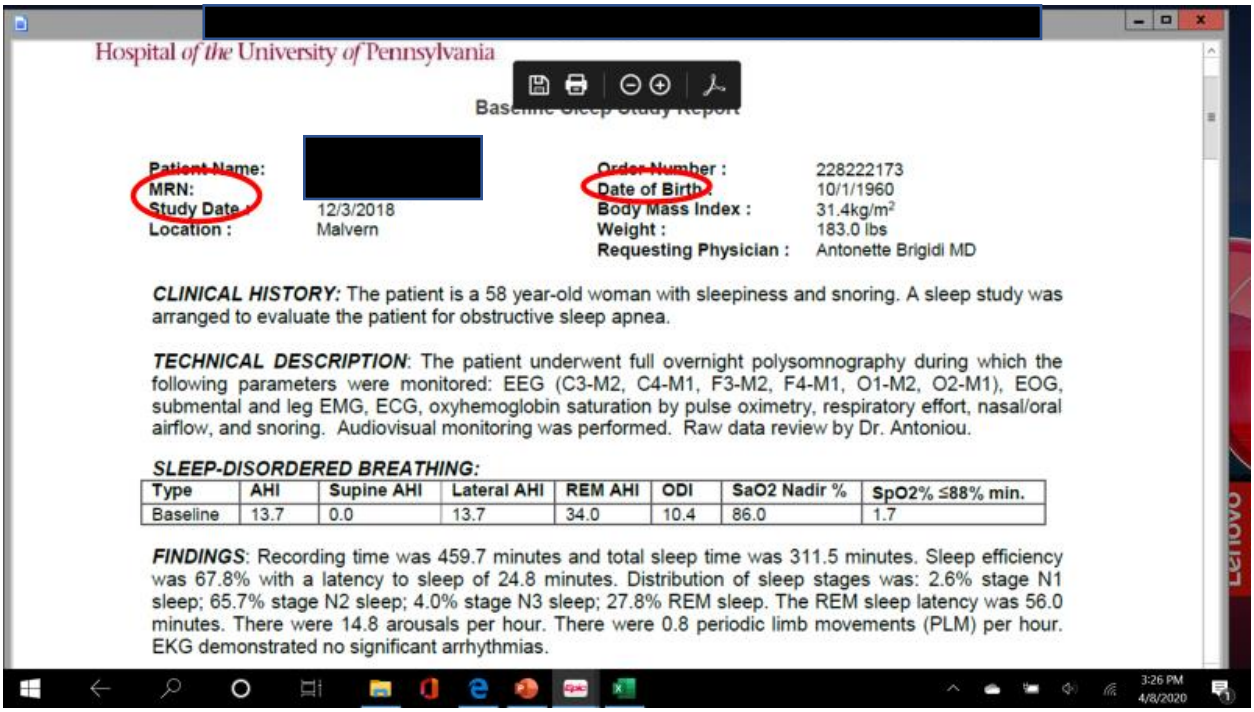
Cumulative SpO2 Histogram



SpO2 Histogram



Section 5: PSG



Hospital of the University of Pennsylvania

Baseline Sleep Study Report

[redacted]

Patient Name:
MRN:
Study Date :
Location :

12/3/2018
Malvern

Order Number : 228222173
Date of Birth : 10/1/1960
Body Mass Index : 31.4kg/m²
Weight : 183.0 lbs
Requesting Physician : Antonette Brigidi MD

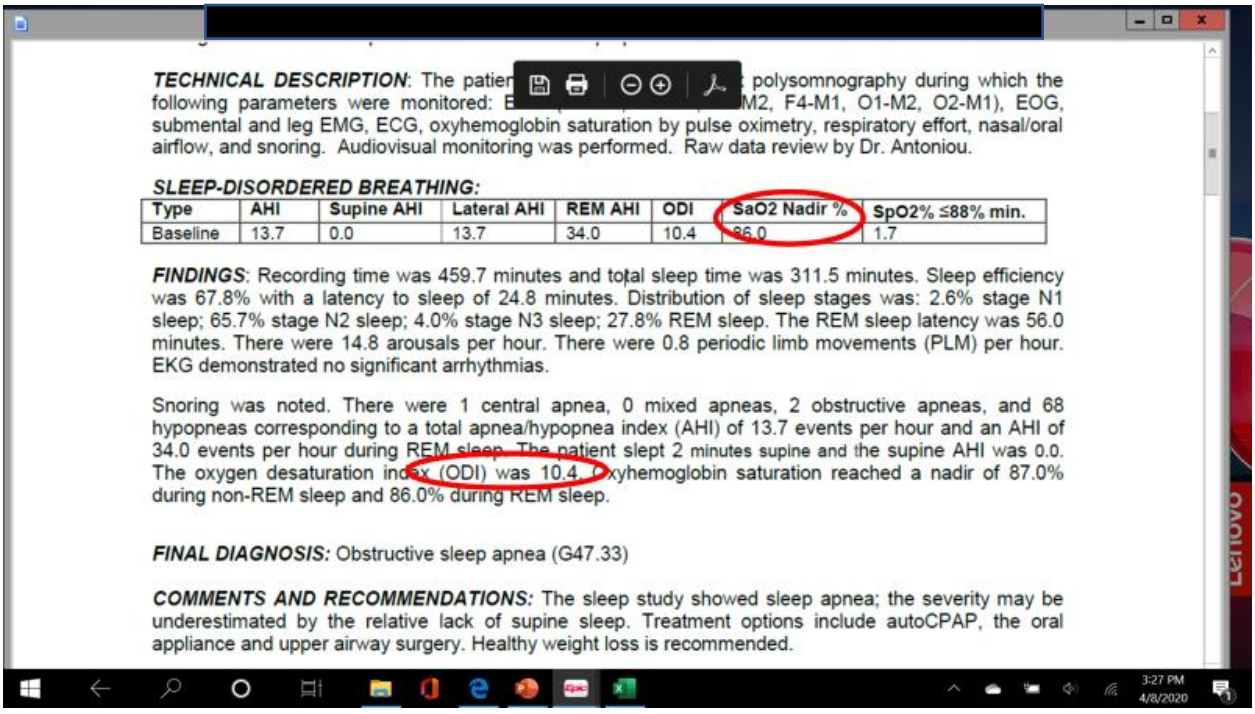
CLINICAL HISTORY: The patient is a 58 year-old woman with sleepiness and snoring. A sleep study was arranged to evaluate the patient for obstructive sleep apnea.

TECHNICAL DESCRIPTION: The patient underwent full overnight polysomnography during which the following parameters were monitored: EEG (C3-M2, C4-M1, F3-M2, F4-M1, O1-M2, O2-M1), EOG, submental and leg EMG, ECG, oxyhemoglobin saturation by pulse oximetry, respiratory effort, nasal/oral airflow, and snoring. Audiovisual monitoring was performed. Raw data review by Dr. Antoniou.

SLEEP-DISORDERED BREATHING:

Type	AHI	Supine AHI	Lateral AHI	REM AHI	ODI	SaO2 Nadir %	SpO2% ≤88% min.
Baseline	13.7	0.0	13.7	34.0	10.4	86.0	1.7

FINDINGS: Recording time was 459.7 minutes and total sleep time was 311.5 minutes. Sleep efficiency was 67.8% with a latency to sleep of 24.8 minutes. Distribution of sleep stages was: 2.6% stage N1 sleep; 65.7% stage N2 sleep; 4.0% stage N3 sleep; 27.8% REM sleep. The REM sleep latency was 56.0 minutes. There were 14.8 arousals per hour. There were 0.8 periodic limb movements (PLM) per hour. EKG demonstrated no significant arrhythmias.



TECHNICAL DESCRIPTION: The patien[redacted] polysomnography during which the following parameters were monitored: E[redacted]M2, F4-M1, O1-M2, O2-M1), EOG, submental and leg EMG, ECG, oxyhemoglobin saturation by pulse oximetry, respiratory effort, nasal/oral airflow, and snoring. Audiovisual monitoring was performed. Raw data review by Dr. Antoniou.

SLEEP-DISORDERED BREATHING:

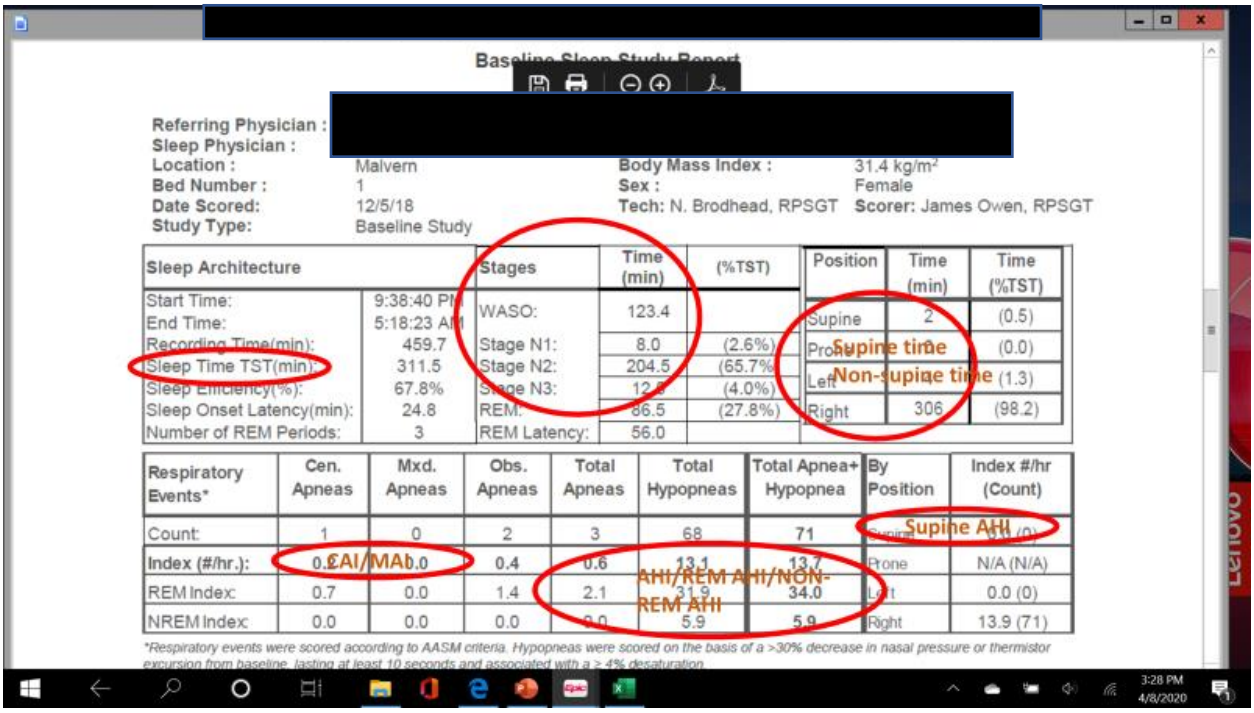
Type	AHI	Supine AHI	Lateral AHI	REM AHI	ODI	SaO2 Nadir %	SpO2% ≤88% min.
Baseline	13.7	0.0	13.7	34.0	10.4	86.0	1.7

FINDINGS: Recording time was 459.7 minutes and total sleep time was 311.5 minutes. Sleep efficiency was 67.8% with a latency to sleep of 24.8 minutes. Distribution of sleep stages was: 2.6% stage N1 sleep; 65.7% stage N2 sleep; 4.0% stage N3 sleep; 27.8% REM sleep. The REM sleep latency was 56.0 minutes. There were 14.8 arousals per hour. There were 0.8 periodic limb movements (PLM) per hour. EKG demonstrated no significant arrhythmias.

Snoring was noted. There were 1 central apnea, 0 mixed apneas, 2 obstructive apneas, and 68 hypopneas corresponding to a total apnea/hypopnea index (AHI) of 13.7 events per hour and an AHI of 34.0 events per hour during REM sleep. The patient slept 2 minutes supine and the supine AHI was 0.0. The oxygen desaturation index (ODI) was 10.4. Oxyhemoglobin saturation reached a nadir of 87.0% during non-REM sleep and 86.0% during REM sleep.

FINAL DIAGNOSIS: Obstructive sleep apnea (G47.33)

COMMENTS AND RECOMMENDATIONS: The sleep study showed sleep apnea; the severity may be underestimated by the relative lack of supine sleep. Treatment options include autoCPAP, the oral appliance and upper airway surgery. Healthy weight loss is recommended.



Baseline Sleep Study Report

[redacted]

Referring Physician : [redacted]
Sleep Physician :
Location : Malvern
Bed Number : 1
Date Scored: 12/5/18
Study Type: Baseline Study
Body Mass Index : 31.4 kg/m²
Sex : Female
Tech: N. Brodhead, RPSGT **Scorer:** James Owen, RPSGT

Sleep Architecture		Stages	Time (min)	(%TST)
Start Time:	9:38:40 PM	WASO:	123.4	
End Time:	5:18:23 AM	Stage N1:	8.0	(2.6%)
Recording Time(min):	459.7	Stage N2:	204.5	(65.7%)
Sleep Time TST(min):	311.5	Stage N3:	12.5	(4.0%)
Sleep Efficiency(%):	67.8%	REM:	86.5	(27.8%)
Sleep Onset Latency(min):	24.8	REM Latency:	56.0	
Number of REM Periods:	3			

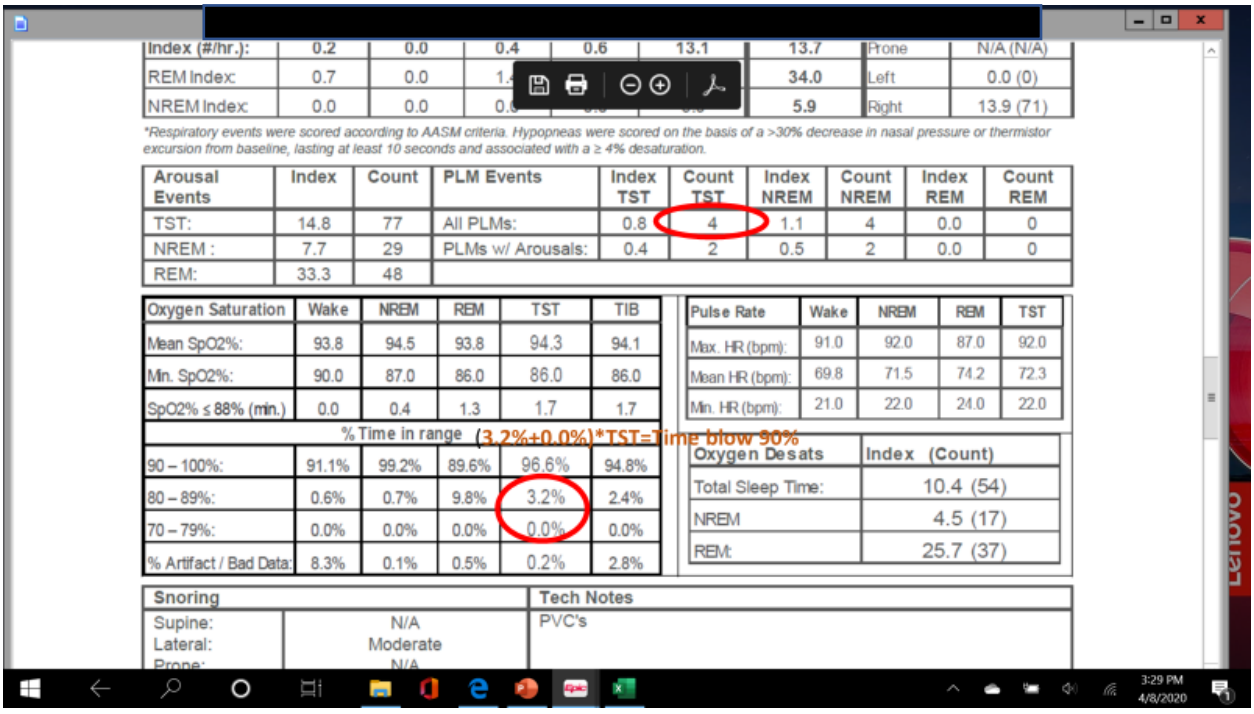
Position	Time (min)	Time (%TST)
Supine	2	(0.5)
Prone	0	(0.0)
Left	4	(1.3)
Right	306	(98.2)

Supine time
Non-supine time

Respiratory Events*	Cen. Apneas	Mxd. Apneas	Obs. Apneas	Total Apneas	Total Hypopneas	Total Apnea+ Hypopnea	By Position	Index #/hr (Count)
Count:	1	0	2	3	68	71	Supine	0.6 (2)
Index (#/hr.):	0.2	0.0	0.4	0.6	13.1	13.7	Prone	N/A (N/A)
REM Index:	0.7	0.0	1.4	2.1	31.9	34.0	Left	0.0 (0)
NREM Index:	0.0	0.0	0.0	0.0	5.9	5.9	Right	13.9 (71)

CAI/MAI
AHI/REM AHI/NON-REM AHI
Supine AHI

*Respiratory events were scored according to AASM criteria. Hypopneas were scored on the basis of a >30% decrease in nasal pressure or thermistor excursion from baseline, lasting at least 10 seconds and associated with a ≥ 4% desaturation.



Index (#/hr.):	0.2	0.0	0.4	0.6	13.1	13.7	Prone	N/A (N/A)
REM Index:	0.7	0.0	1.4			34.0	Left	0.0 (0)
NREM Index:	0.0	0.0	0.0			5.9	Right	13.9 (71)

*Respiratory events were scored according to AASM criteria. Hypopneas were scored on the basis of a >30% decrease in nasal pressure or thermistor excursion from baseline, lasting at least 10 seconds and associated with a ≥ 4% desaturation.

Arousal Events	Index	Count	PLM Events	Index TST	Count TST	Index NREM	Count NREM	Index REM	Count REM
TST:	14.8	77	All PLMs:	0.8	4	1.1	4	0.0	0
NREM :	7.7	29	PLMs w/ Arousals:	0.4	2	0.5	2	0.0	0
REM:	33.3	48							

Oxygen Saturation	Wake	NREM	REM	TST	TIB
Mean SpO2%:	93.8	94.5	93.8	94.3	94.1
Min. SpO2%:	90.0	87.0	86.0	86.0	86.0
SpO2% ≤ 88% (min.)	0.0	0.4	1.3	1.7	1.7
% Time in range					
90 – 100%:	91.1%	99.2%	89.6%	96.6%	94.8%
80 – 89%:	0.6%	0.7%	9.8%	3.2%	2.4%
70 – 79%:	0.0%	0.0%	0.0%	0.0%	0.0%
% Artifact / Bad Data:	8.3%	0.1%	0.5%	0.2%	2.8%

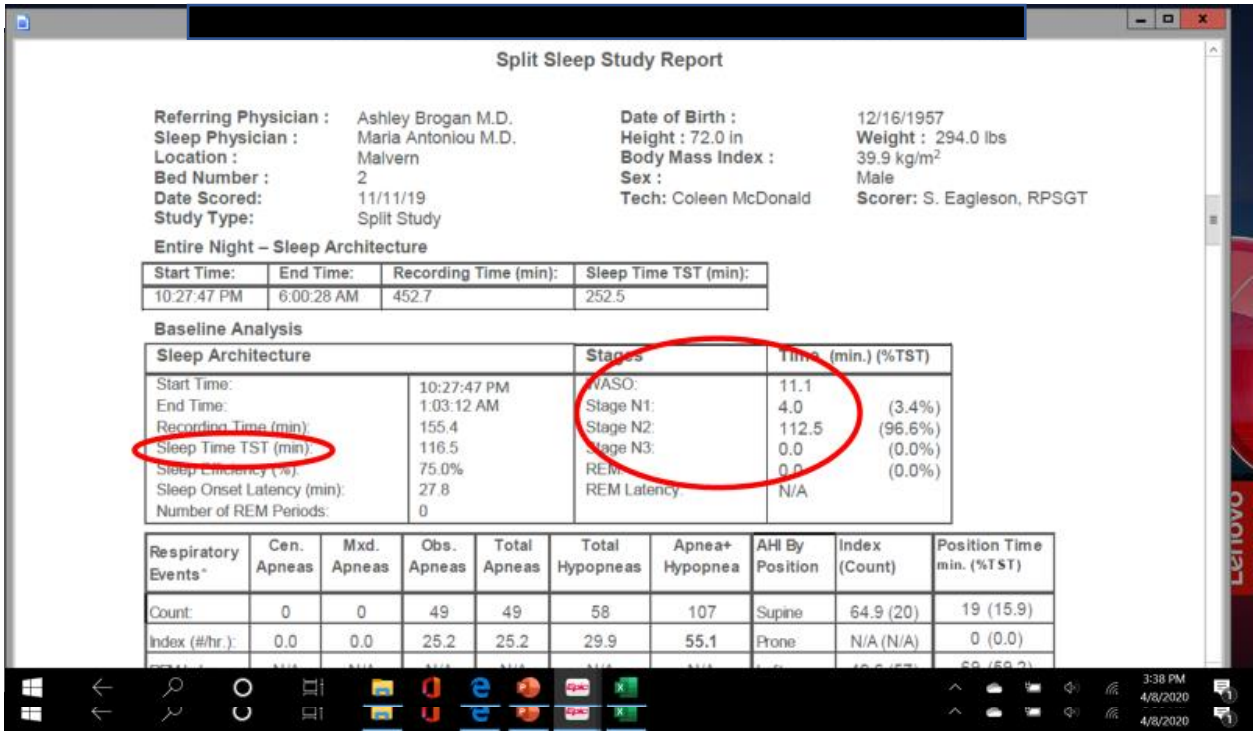
(3.2%+0.0%)*TST=Time blow 90%

Pulse Rate	Wake	NREM	REM	TST
Max. HR (bpm):	91.0	92.0	87.0	92.0
Mean HR (bpm):	69.8	71.5	74.2	72.3
Min. HR (bpm):	21.0	22.0	24.0	22.0

Oxygen Desats	Index (Count)
Total Sleep Time:	10.4 (54)
NREM	4.5 (17)
REM:	25.7 (37)

Snoring		Tech Notes
Supine:	N/A	PVC's
Lateral:	Moderate	
Prone:	N/A	

Section 6: Split Sleep Study



Split Sleep Study Report

[redacted]

Referring Physician :	Ashley Brogan M.D.	**Date of Birth :**	12/16/1957
Sleep Physician :	Maria Antoniou M.D.	**Height :** 72.0 in	**Weight :** 294.0 lbs
Location :	Malvern	**Body Mass Index :**	39.9 kg/m^2
Bed Number :	2	**Sex :**	Male
Date Scored:	11/11/19	**Tech:** Coleen McDonald	**Scorer:** S. Eagleson, RPSGT
Study Type:	Split Study		

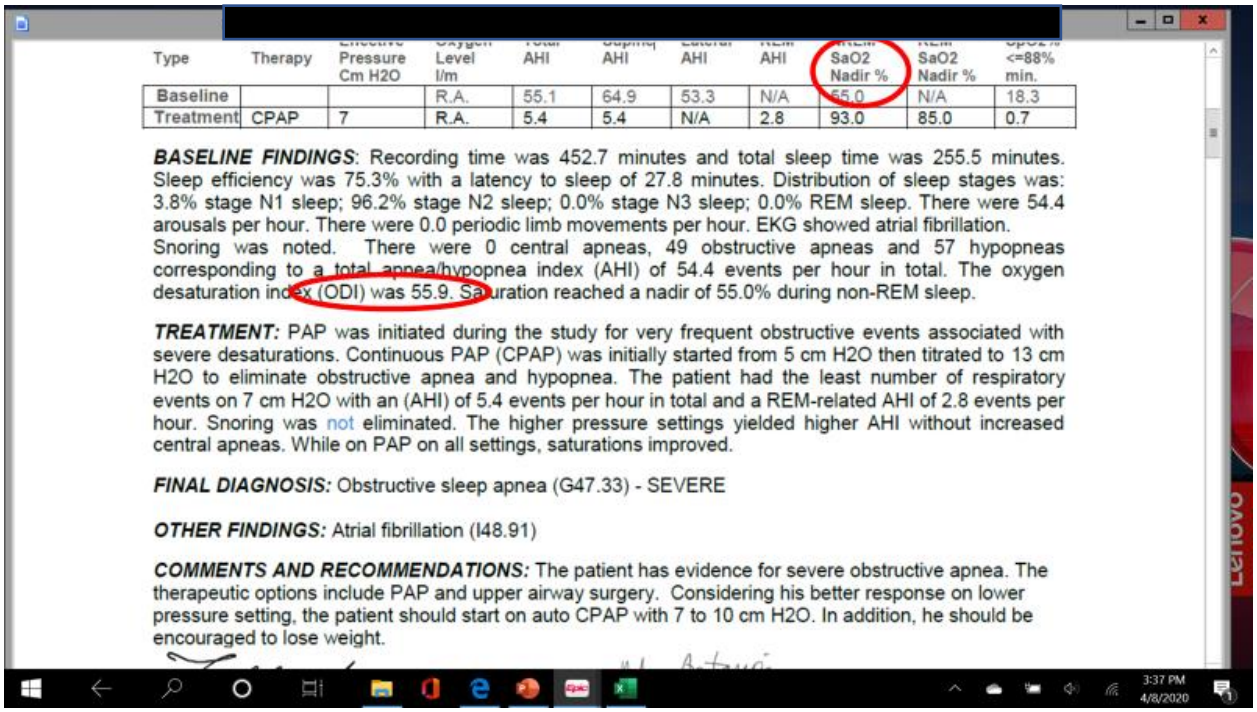
Entire Night – Sleep Architecture

Start Time:	End Time:	Recording Time (min):	Sleep Time TST (min):
10:27:47 PM	6:00:28 AM	452.7	252.5

Baseline Analysis

Sleep Architecture		Stages	Time (min.) (%TST)
Start Time:	10:27:47 PM	WASO:	11.1
End Time:	1:03:12 AM	Stage N1:	4.0 (3.4%)
Recording Time (min):	155.4	Stage N2:	112.5 (96.6%)
Sleep Time TST (min):	116.5	Stage N3:	0.0 (0.0%)
Sleep Efficiency (%):	75.0%	REM:	0.0 (0.0%)
Sleep Onset Latency (min):	27.8	REM Latency:	N/A
Number of REM Periods:	0		

Respiratory Events*	Cen. Apneas	Mxd. Apneas	Obs. Apneas	Total Apneas	Total Hypopneas	Apnea+ Hypopnea	AHI By Position	Index (Count)	Position Time min. (%TST)
Count:	0	0	49	49	58	107	Supine	64.9 (20)	19 (15.9)
Index (#/hr.):	0.0	0.0	25.2	25.2	29.9	55.1	Prone	N/A (N/A)	0 (0.0)



[redacted]

Type	Therapy	Effective Pressure Cm H2O	Oxygen Level l/m	Total AHI	Supine AHI	Lateral AHI	REM AHI	REM SaO2 Nadir %	REM SaO2 Nadir %	SpO2 <=88% min.
Baseline			R.A.	55.1	64.9	53.3	N/A	55.0	N/A	18.3
Treatment	CPAP	7	R.A.	5.4	5.4	N/A	2.8	93.0	85.0	0.7

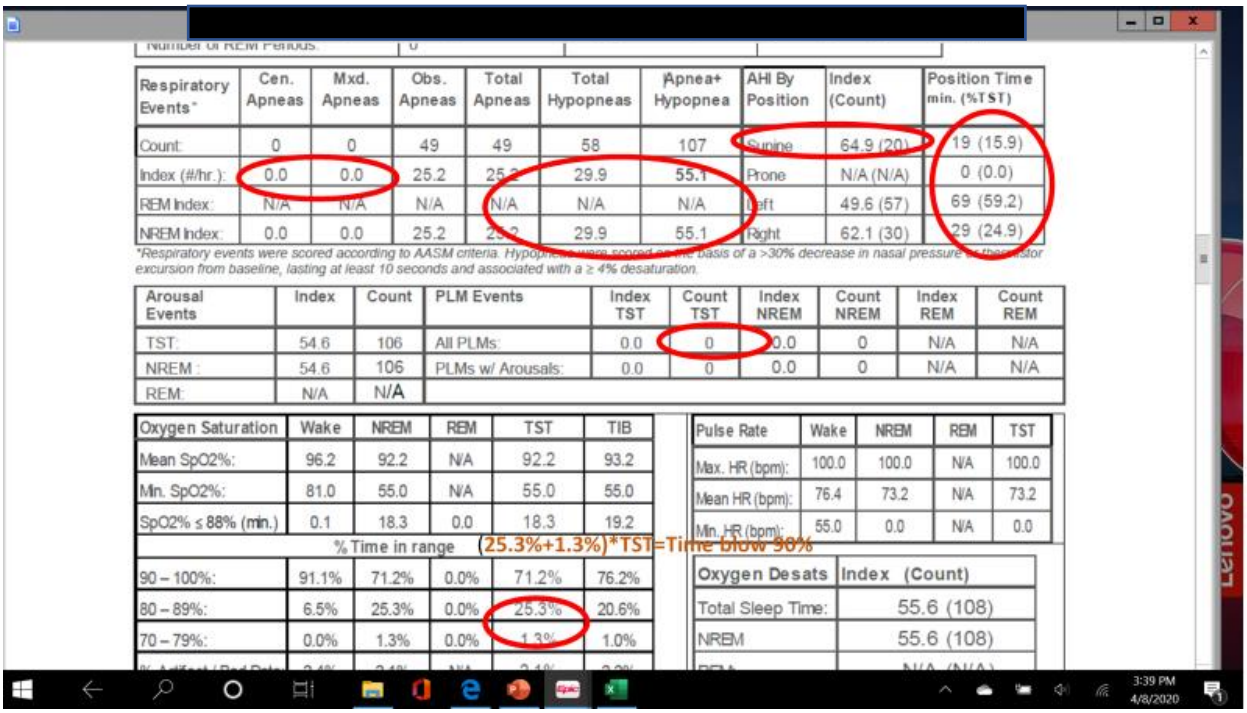
BASELINE FINDINGS: Recording time was 452.7 minutes and total sleep time was 255.5 minutes. Sleep efficiency was 75.3% with a latency to sleep of 27.8 minutes. Distribution of sleep stages was: 3.8% stage N1 sleep; 96.2% stage N2 sleep; 0.0% stage N3 sleep; 0.0% REM sleep. There were 54.4 arousals per hour. There were 0.0 periodic limb movements per hour. EKG showed atrial fibrillation. Snoring was noted. There were 0 central apneas, 49 obstructive apneas and 57 hypopneas corresponding to a total apnea/hypopnea index (AHI) of 54.4 events per hour in total. The oxygen desaturation index (ODI) was 55.9. Saturation reached a nadir of 55.0% during non-REM sleep.

TREATMENT: PAP was initiated during the study for very frequent obstructive events associated with severe desaturations. Continuous PAP (CPAP) was initially started from 5 cm H2O then titrated to 13 cm H2O to eliminate obstructive apnea and hypopnea. The patient had the least number of respiratory events on 7 cm H2O with an (AHI) of 5.4 events per hour in total and a REM-related AHI of 2.8 events per hour. Snoring was not eliminated. The higher pressure settings yielded higher AHI without increased central apneas. While on PAP on all settings, saturations improved.

FINAL DIAGNOSIS: Obstructive sleep apnea (G47.33) - SEVERE

OTHER FINDINGS: Atrial fibrillation (I48.91)

COMMENTS AND RECOMMENDATIONS: The patient has evidence for severe obstructive apnea. The therapeutic options include PAP and upper airway surgery. Considering his better response on lower pressure setting, the patient should start on auto CPAP with 7 to 10 cm H2O. In addition, he should be encouraged to lose weight.



Respiratory Events*	Cen. Apneas	Mxd. Apneas	Obs. Apneas	Total Apneas	Total Hypopneas	Apnea+ Hypopnea	AHI By Position	Index (Count)	Position Time min. (%TST)
Count:	0	0	49	49	58	107	Supine	64.9 (20)	19 (15.9)
Index (#/hr.):	0.0	0.0	25.2	25.2	29.9	55.1	Prone	N/A (N/A)	0 (0.0)
REM Index:	N/A	N/A	N/A	N/A	N/A	N/A	Left	49.6 (57)	69 (59.2)
NREM Index:	0.0	0.0	25.2	25.2	29.9	55.1	Right	62.1 (30)	29 (24.9)

*Respiratory events were scored according to AASM criteria. Hypopneas were scored on the basis of a >30% decrease in nasal pressure or thoracic excursion from baseline, lasting at least 10 seconds and associated with a ≥ 4% desaturation.

Arousal Events	Index	Count	PLM Events	Index TST	Count TST	Index NREM	Count NREM	Index REM	Count REM
TST:	54.6	106	All PLMs:	0.0	0	0.0	0	N/A	N/A
NREM:	54.6	106	PLMs w/ Arousals:	0.0	0	0.0	0	N/A	N/A
REM:	N/A	N/A							

Oxygen Saturation	Wake	NREM	REM	TST	TIB
Mean SpO2%:	96.2	92.2	N/A	92.2	93.2
Min. SpO2%:	81.0	55.0	N/A	55.0	55.0
SpO2% ≤ 88% (min.)	0.1	18.3	0.0	18.3	19.2
% Time in range					
90 – 100%:	91.1%	71.2%	0.0%	71.2%	76.2%
80 – 89%:	6.5%	25.3%	0.0%	25.3%	20.6%
70 – 79%:	0.0%	1.3%	0.0%	1.3%	1.0%

(25.3%+1.3%)*TST=Time blow 90%

Pulse Rate	Wake	NREM	REM	TST
Max. HR (bpm):	100.0	100.0	N/A	100.0
Mean HR (bpm):	76.4	73.2	N/A	73.2
Min. HR (bpm):	55.0	0.0	N/A	0.0

Oxygen Desats	Index (Count)
Total Sleep Time:	55.6 (108)
NREM	55.6 (108)

Section 7: autoPAP Compliance Data

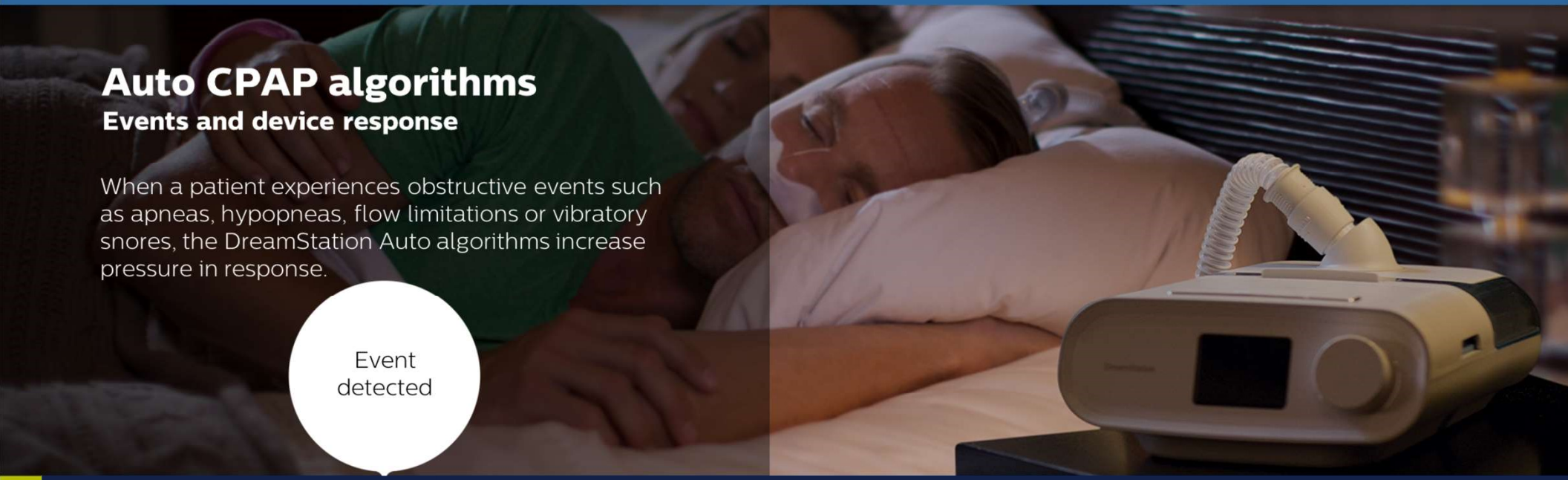
1. Access EncoreAnywhere.
2. Click on the patient's name (i.e., John Smith)
3. Click the third tab labelled "Therapy Data".
    a. Select the radio button "Best 30 Days of Compliance", which is located underneath the header "Select Data for Report"
    b. Select "Summary Report" and click "Create Report"
    c. *Note*: It may take a few minutes for the report to generate, and the report will populate in a new window.
4. Input Data.
    a. *Note*: For variables "Average Hours used on Days Used" & "Leak Duration", input data in the format HH:MM
        i. For example, if the average hours used on the report states 5 hours, 30 minutes, it would be inputted into REDCap as 05:30. Alternatively, if the leak duration was only 20 minutes, it would be inputted into REDCap as 00:20.
    b. *Note*: The "machine type" can be identified at the top of the summary report page. It is located underneath the patient's name, and it will state "Device" followed by the machine type (i.e., DreamStation AutoCPAP).
5. Once the REDCap record is complete, click "Complete" and "Save & Exit" within the REDCap software. This will save the data you inputted for that patient within the REDCap database.

DreamStation

Auto CPAP algorithms

The Auto algorithms are designed to keep the upper airways open and provide optimal therapy pressure. Not only do they respond to obstructive events, they also proactively search for the lowest possible pressure needed by the patient.

Auto CPAP algorithm – events and device response



Auto CPAP algorithms

Events and device response

When a patient experiences obstructive events such as apneas, hypopneas, flow limitations or vibratory snores, the DreamStation Auto algorithms increase pressure in response.

Event detected

Patient flow

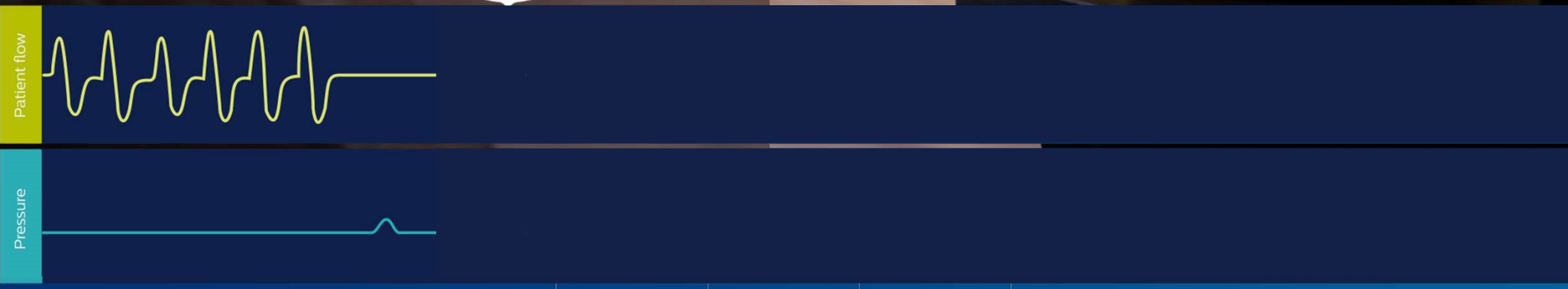
Pressure

Auto CPAP algorithms

Events and device response

Analysis of the flow will lead to the event being classified as obstructive or central and will generate the appropriate response.

Event classified as obstructive

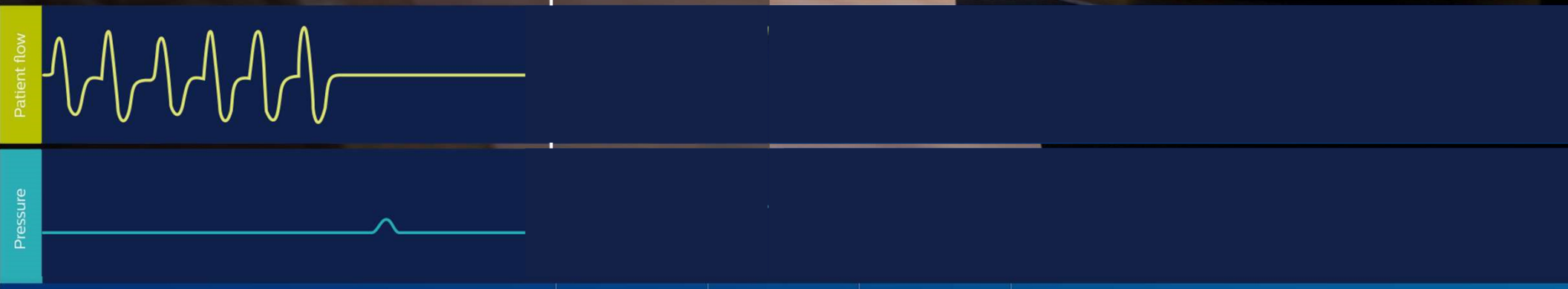


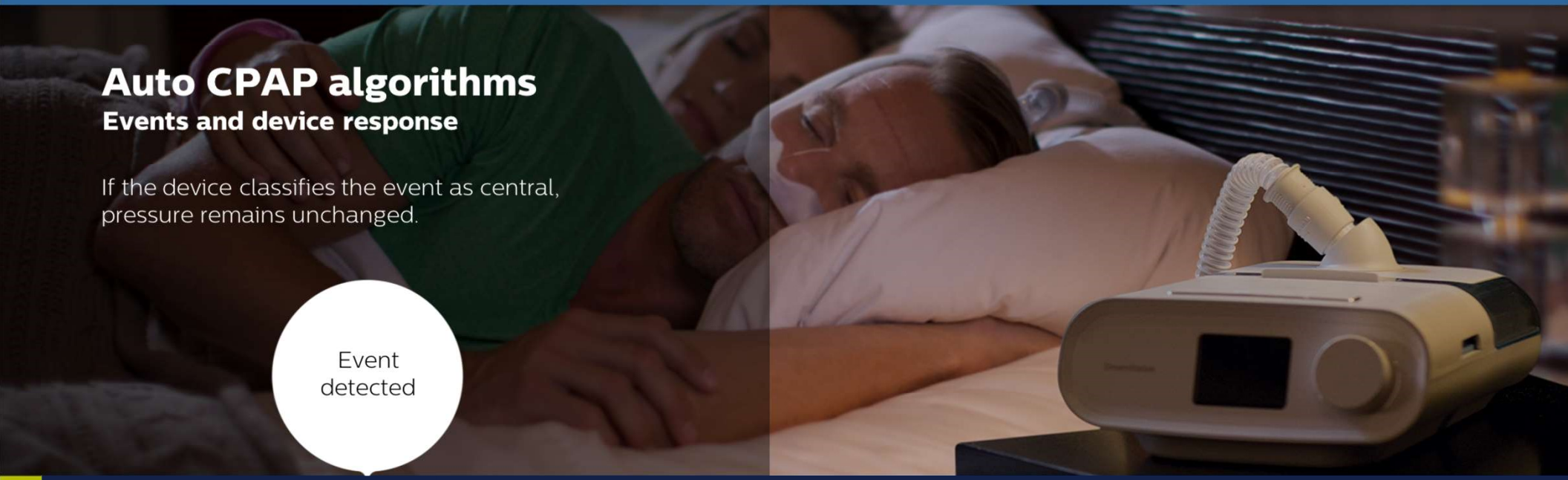
Auto CPAP algorithms

Events and device response

When a pattern of obstructive events occur, pressure increases to achieve airway patency.

Pressure **increases**





Auto CPAP algorithms

Events and device response

If the device classifies the event as central, pressure remains unchanged.

Event detected

Patient flow

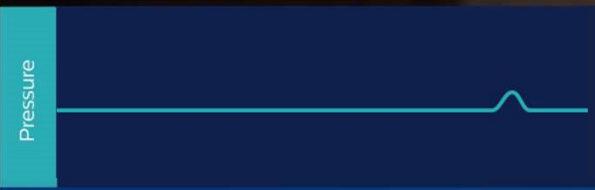
Pressure

Auto CPAP algorithms

Events and device response

If the device classifies the event as central, pressure remains unchanged.

Event classified as central

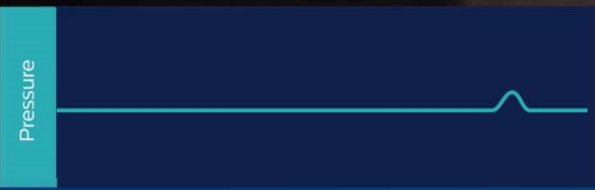


Auto CPAP algorithms

Events and device response

If the device classifies the event as central, pressure remains unchanged.

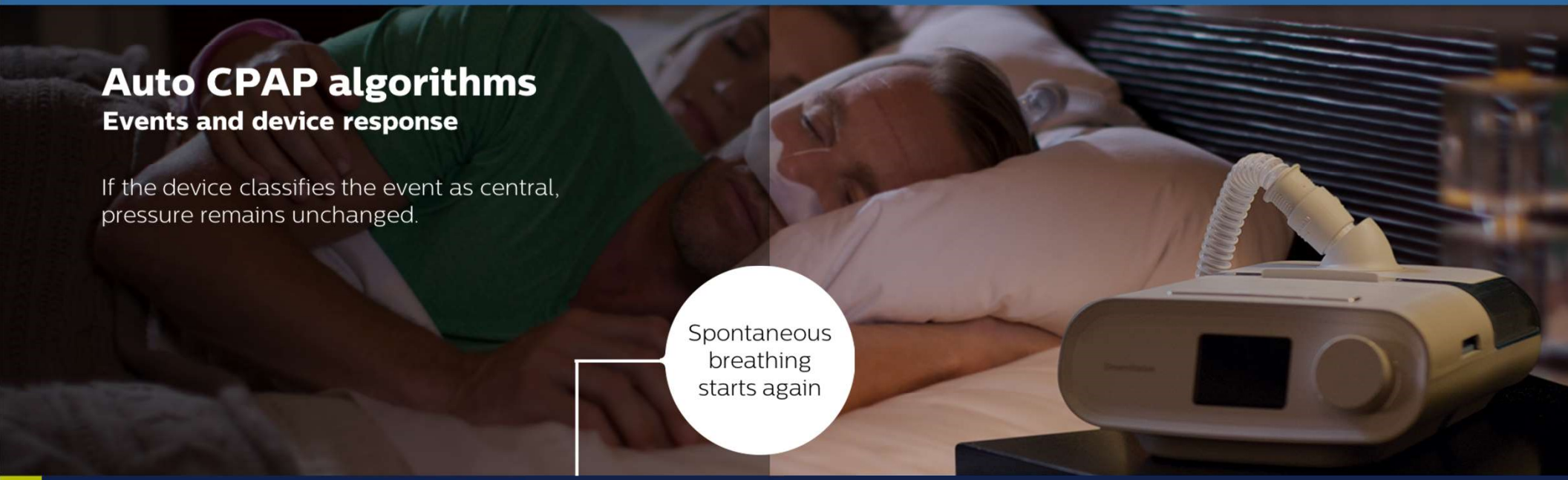
Pressure remains unchanged

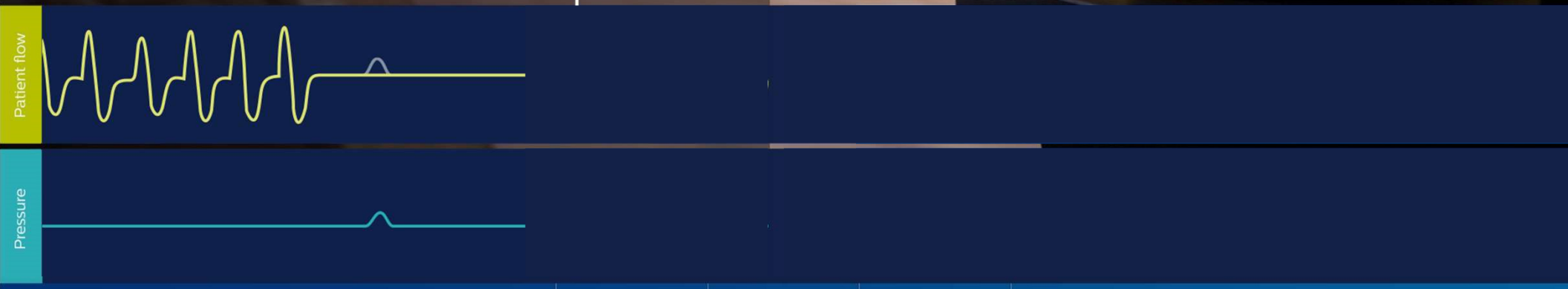


Auto CPAP algorithms

Events and device response

If the device classifies the event as central, pressure remains unchanged.





Auto CPAP algorithms

Events and device response

Flow limitation

Flow limitation is determined by evaluating 4 parameters of the patient's breathing – roundness, flatness, peak and shape. If two of the four parameters fall out of trend, it is considered a flow limitation. If a flow limitation is detected, a high pressure search is initiated in which pressure is gradually increased.

Note: BiPAP devices respond with IPAP.

Patient flow

Pressure

Auto CPAP algorithms

Events and device response

Flow limitation

Flow limitation is determined by evaluating 4 parameters of the patient's breathing – roundness, flatness, peak and shape. If two of the four parameters fall out of trend, it is considered a flow limitation. If a flow limitation is detected, a high pressure search is initiated in which pressure is gradually increased.

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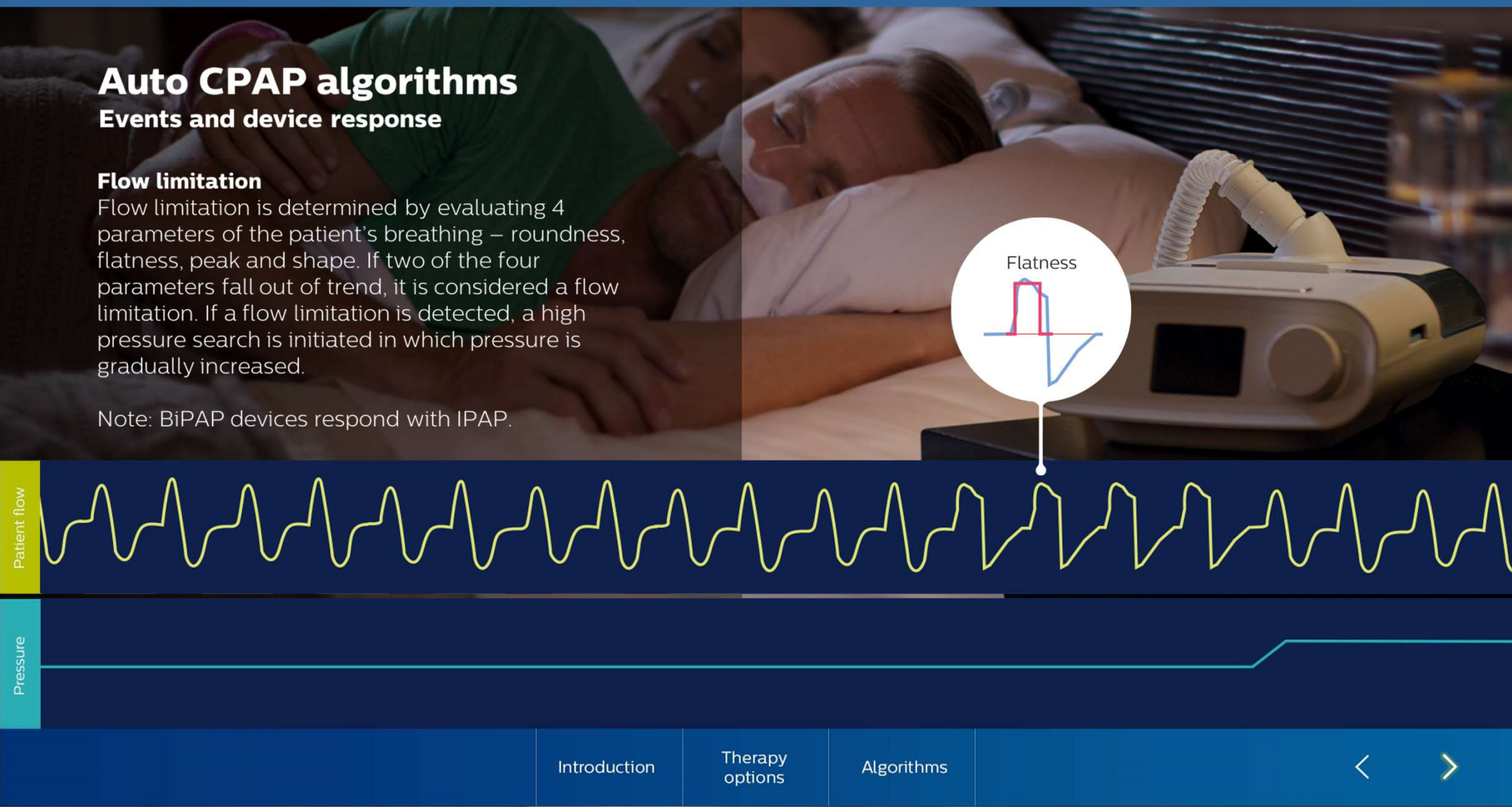

Auto CPAP algorithms

Events and device response

Flow limitation

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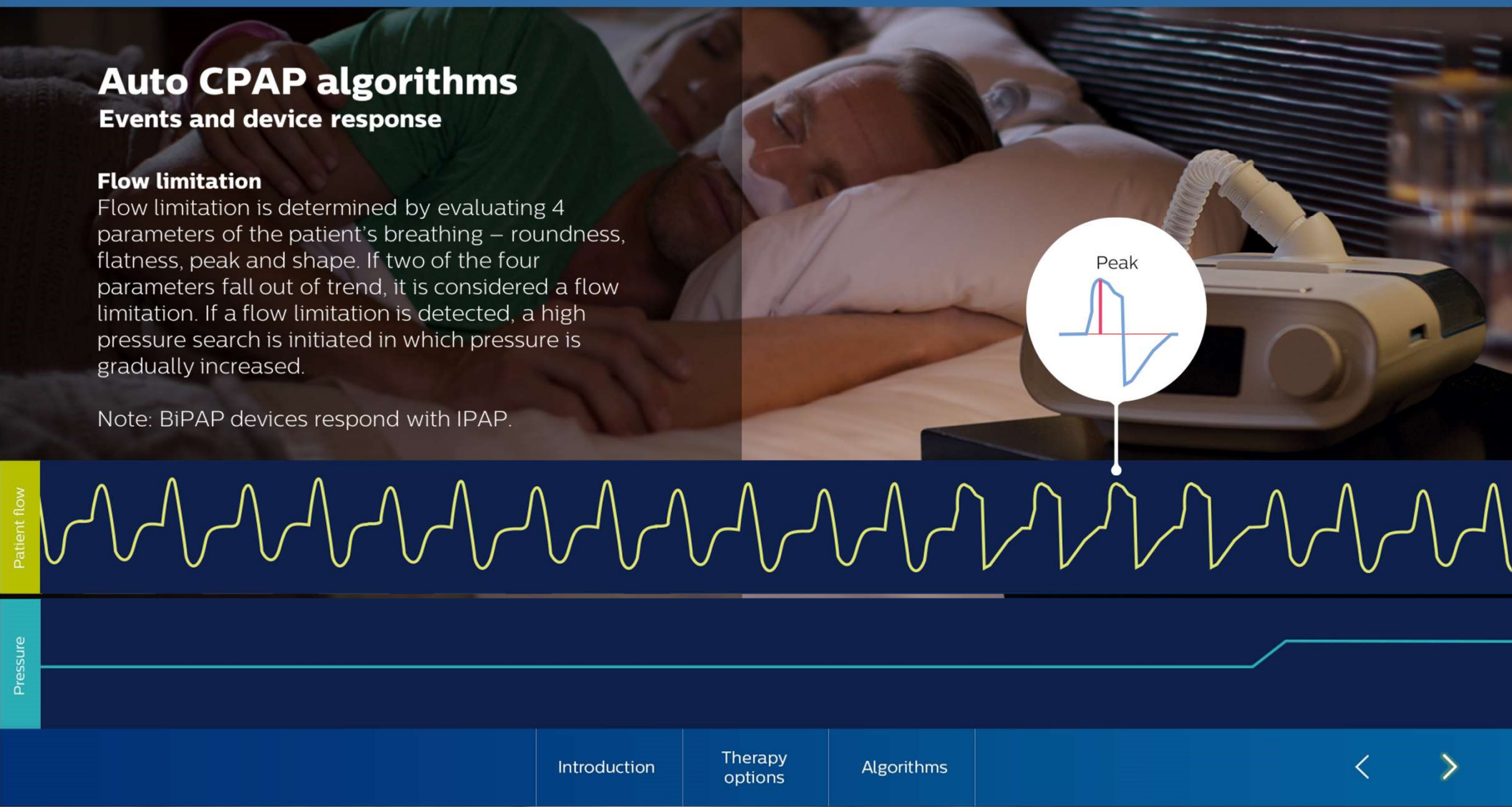


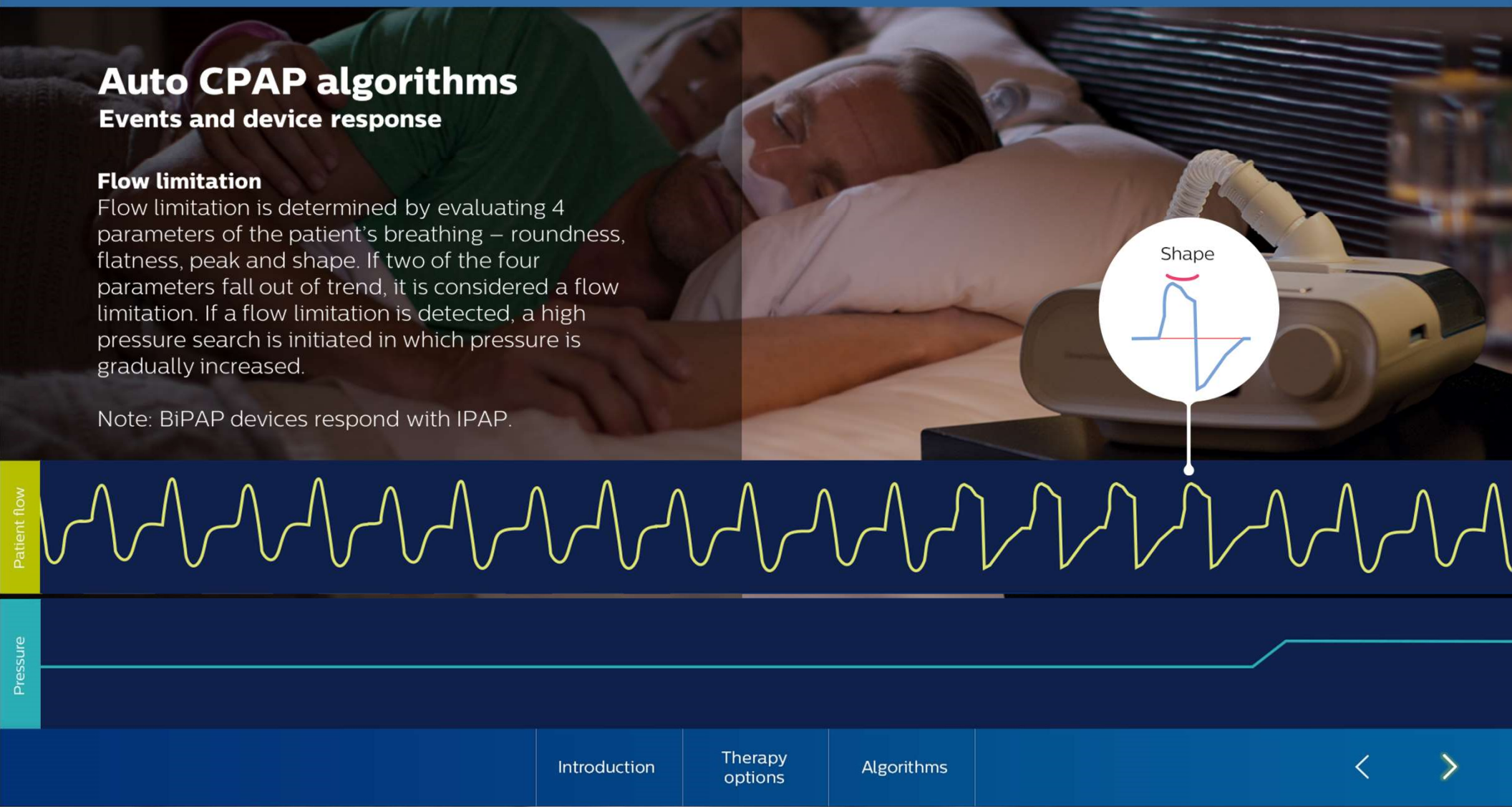
Auto CPAP algorithms

Events and device response

Flow limitation

Flow limitation is determined by evaluating 4 parameters of the patient's breathing – roundness, flatness, peak and shape. If two of the four parameters fall out of trend, it is considered a flow limitation. If a flow limitation is detected, a high pressure search is initiated in which pressure is gradually increased.

Note: BiPAP devices respond with IPAP.



Auto CPAP algorithms

Events and device response

Vibratory Snore (VS)
During a vibratory snore, pressure vibrations are detected.

If 3 vibratory snores are detected within 1 minute, with less than 30 seconds between snores, the algorithm increases pressure by 1cm over 15 seconds.

Note that for BiPAP devices these events will create a response for EPAP.

Patient flow

Pressure

Auto CPAP algorithms

Events and device response

Apnea (obstructive or central)
An apnea is the absence or reduction of patient air flow by at least 80% for 10 seconds or more.

If 2 obstructive airway apneas/hypopneas are detected within 3 minutes, the algorithm increases pressure by 1cm.

Note, BiPAP devices will create a response to obstructive apneas with EPAP. CPAP and BiPAP devices do not respond to central apneas.

Patient flow

Pressure

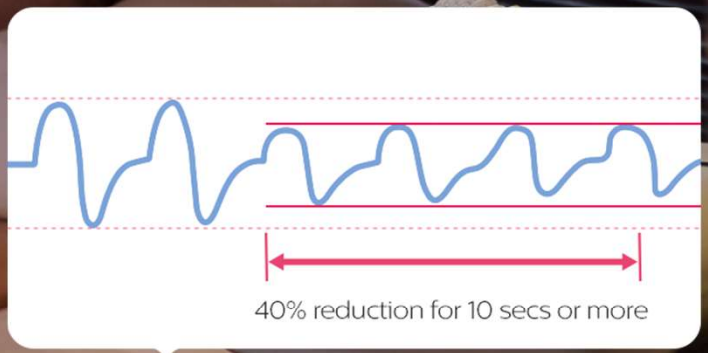
Auto CPAP algorithms

Events and device response

Hypopnea (H)
A hypopnea is the reduction of patient air flow by at least 40% for 10 seconds or more.

If 2 obstructive airway apneas/hypopneas are detected within 3 minutes, the algorithm increases pressure by 1cm.

Note, BiPAP devices will create a response with IPAP.



Patient flow

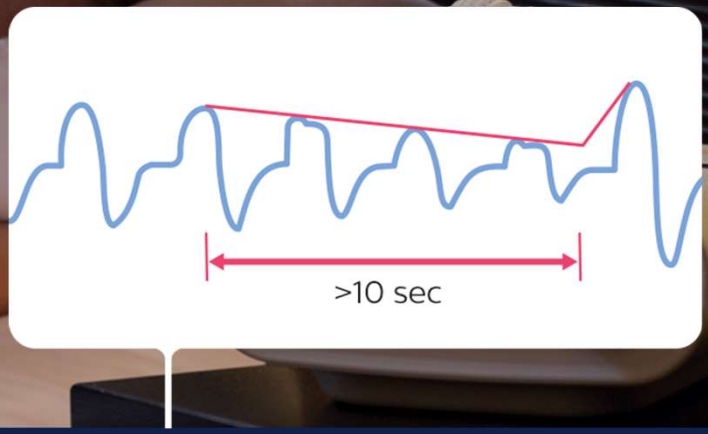
Pressure

Auto CPAP algorithms

Events and device response

Respiratory Effort Related Arousal (RERA)
A RERA is a sequence of breaths that exhibit both a subtle reduction in airflow during a 10 second period and a progressive increase in flow limitation. If a breath sequence is terminated by a sudden increase in air flow (along with elimination of flow limitation), a RERA is indicated.

If 2 RERA events are detected within 3 minutes, pressure increased by 0.5cm.



Patient flow

Pressure

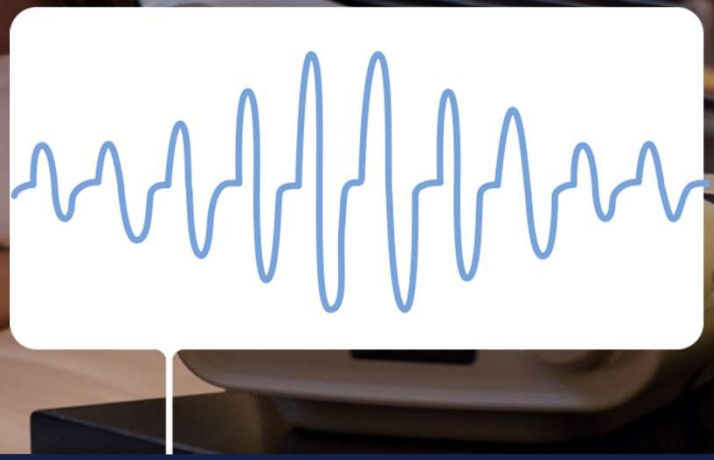
Auto CPAP algorithms

Events and device response

Periodic breathing

Periodic breathing such as Cheyne-Stokes Respiration is defined as alternating periods of hyperventilation with waxing and waning tidal volume and periods of central hypopneas or apneas.

No therapy adjustments are made in response to periodic breathing.



Patient flow

Pressure

Table S1: Multicollinearity testing of the multivariate linear regression model

Variables	Tolerance	VIF
AHI	0.68	1.48
Apnea%	0.77	1.30
O_2 Nadir	0.84	1.19
Age	0.84	1.19
Sex::Male	0.87	1.145
BMI	0.68	1.47
Mask Type::Nasal	0.97	1.03

Variance inflation factors were calculated as a metric of interaction among the 7 variables in the model. All values were less than 5 suggesting minimal collinearity among the variables.

Table S2: Addition of study type to multivariable regression analysis showing no significant contribution to the model (p = 0.9).

	Beta	95% CI[1]	Standardized Beta*	p-value
Age, y	-0.02	-0.03, 0.00	-0.09	0.028
Sex: Male	0.33	-0.03, 0.70	0.07	0.073
BMI, kg/m^2	0.04	0.02, 0.06	0.15	<0.001
AHI, events/h	0.04	0.03, 0.04	0.39	<0.001
O_2 Nadir, %	-0.05	-0.07, -0.03	-0.19	<0.001
OA%	0.00	0.00, 0.00	-0.09	0.035
Mask Type: Nasal	-0.87	-1.2, -0.53	-0.18	<0.001
Study Type: In-lab	**-0.03**	**-0.39, 0.33**	**-0.01**	**0.9**

[1]CI = Confidence Interval

BMI = Body mass index, AHI = Apnea-hypopnea index, ODI=Oxygen desaturation index, OA% = obstructive apnea percent

Table S3: Non-adherent subjects defined by <4 hours of nightly use 70% of nights had similar therapeutic PAP levels compared to adherent subjects.

	Adherent ***N=500***	**Non-Adherent** ***N=140***	**p-value**
Mean Pressure, cmH2O	8.65 (2.35)	8.68 (2.49)	0.897
Pressure >90% Time, cmH2O	11.0 (2.75)	10.8 (2.92)	0.522
Peak Pressure, cmH2O	12.2 (2.95)	12.6 (3.21)	0.190