



Your Sleep Study Results

Dear [REDACTED]

Thank you for completing your **Nox A1S** sleep titration study. Here is a simple breakdown of what we found, also for your primary care doctor, [REDACTED]

How Long We Monitored

The device recorded for a **Total Study Time** of **8h 39m** (from the moment you turned it on until you took it off). However, we are most interested in your **Total Sleep Time**, which was **7h 46m**. For most adults, 7-9 hours is considered a normal amount of sleep.

Key Findings: Breathing and Oxygen

This section looks at how often your breathing was disrupted during the night and what happened to your oxygen levels.

Apnea-Hypopnea Index (AHI) - PAP Period

- **Your Score: 1.4/h**
- **What this means:** This score is the average number of times per hour your breathing was partially or completely blocked during sleep.
 - An **apnea** is a complete, 10-second-or-longer pause in breathing.
 - A **hypopnea** is a partial blockage of breathing.
- **Normal Range: 5 or lower** is considered normal. A higher score suggests a sleep breathing disorder, like **Sleep Apnea**.

Oxygen Desaturation Index (ODI) - PAP Period

- **Your Score: 1.9/h**
- **What this means:** This is the average number of times per hour your blood oxygen level dropped by 3% or more. When your oxygen drops, your **heart has to work harder** to compensate.
- **Normal Range: 5 or lower** is considered a healthy range.



Looking at Your Deep Sleep

REM Sleep Percentage (PAP Period)

- **Your Percentage: 21.4%**
- **What this means: REM** stands for **Rapid Eye Movement**. This is a critical stage of sleep where we typically **dream**, and it's essential for your body and mind to be refreshed and restored.
- **Normal Range:** We look for this to be between **15% and 30%** of your total sleep time, depending on other health factors.

Please note: This is an abbreviated summary. Your doctor will review with you the rest of the details and full clinical implications not stated in this short report.

If you have any questions or would like to discuss these results further, please contact my front desk to schedule a follow-up appointment.



Titration Night Report

Patient Information

Name :		NRIC :		Study Date :	
DOB :		Age :	35 y.o	Gender :	Male
Height :	cm	Weight :	kg	BMI :	
BP :	-	EQ5D :	-		
ISI :	-	ESS :	-		
STOPBANG :	-	PLATO-11 :	-		
Pre-Diagnosis : ICD9-Obstructive Sleep Apnea Syndrome 780.53-0					
Referring Doctor :		Acquiring Technician :			
Reporting Doctor :		Scoring Technologist :			

Recording Information

Recording Date:		Device Type:	A1S
Recording Tags:			

Sleep Scoring

Analysis Start Time (Lights out):	9:51 pm	Sleep Latency (SL):	21.9m
Analysis Stop Time (Lights on):	6:30 am	REM Latency:	59.5m
Total Sleep Time (TST):	466.5 m	Wake After Sleep Onset (TRT-SL-TST):	31.3m
Analysis Duration (TRT):	519.7m	Sleep Efficiency (TST/TRT*100):	89.8%

Sleep Stages	Duration	% of TST	% of TRT
N1:	31m	6.6%	6%
N2:	214.5m	46%	41.3%
N3:	121m	25.9%	23.3%
REM:	100m	21.4%	19.2%
Wake:	53.2m	-	10.2%

Quality

Oximeter:	99.4%
Airflow:	1.7%
Abdomen RIP:	99.4%
Thorax RIP:	99.4%



PAP Titration Summary

	PAP Titration
Start Time	9:51 pm
Stop Time:	6:30 am
Period Duration:	519.5m
Apnea + Hypopnea Index (AHI):	1.4/h
Supine AHI:	1.6/h
Supine REM AHI:	0/h
Oxygen Desaturation Index (ODI):	1.9/h
Average Desat Drop:	4.5%
Supine REM (Duration)	54.5 mins

Hypoxic Burden

The hypoxic burden was determined to be 6.8 %min/hr.

PAP Period

Start Time (Lights out):	9:51 pm	Sleep Latency (SL):	43.6m
Stop Time (Lights on):	6:30 am	REM Latency:	103.1m
Total Sleep Time (TST):	466.5m	Wake After Sleep Onset (TRT-SL-TST):	31.2m
Duration (TRT):	519.5m	Sleep Efficiency (TST/TRT*100):	89.8%

PAP Overview	Pressure
Average:	8.8
Maximum:	14
Median:	7.1
95%:	14

Leak	
Median Leak:	3.5
95th Percentile Leak:	3.5
Maximum Leak:	29

PAP Titration

BPAP Summary

IPAP / EPAP	Duration (m)	AHI	OAI	MAI	CAI	HI	ODI	SpO2 (Ave)
12.0 / 6.0	109.6	1.9	1.2	0.0	0.0	0.6	2.5	94.1
13.0 / 7.0	120.7	2.0	0.0	0.0	0.5	1.5	2.0	95.5
14.0 / 7.0	280.3	1.0	0.0	0.2	0.2	0.5	1.7	95.3

BPAP Summary

IPAP / EPAP	Duration (m)	TST	REM (%)	NREM (%)	Arousal Index	PLMS Index	Snore (%)
12.0 / 6.0	109.6	96.7	19.7	80.3	3.1	0.0	6.3
13.0 / 7.0	120.7	120.7	14.1	85.9	5.0	0.0	0.9
14.0 / 7.0	280.3	249.2	25.7	74.3	7.9	0.0	2.9

Sleep Stages (PAP)	Duration	% of TST	% of TRT
N1:	31m	6.6%	6%
N2:	214.5m	46%	41.3%
N3:	121m	25.9%	23.3%
REM:	100m	21.4%	19.2%
Wake:	53m		10.2%

Respiratory Indices (PAP)	Index					Count
	Total	Supine	Non-supine	REM	Non-REM	
Apneas + Hypopneas (AH):	1.4/h	1.6/h	0/h	0/h	1.8/h	11
Apneas:	0.6/h	0.7/h	0/h	0/h	0.8/h	5
Obstructive (OA):	0.3/h	0.3/h	0/h	0/h	0.3/h	2
Mixed (MA):	0.1/h	0.1/h	0/h	0/h	0.2/h	1
Central (CA):	0.3/h	0.3/h	0/h	0/h	0.3/h	2
Hypopneas:	0.8/h	0.9/h	0/h	0/h	1/h	6
Obstructive (OH):	0/h	0/h	0/h	0/h	0/h	0
Central (CH):	0/h	0/h	0/h	0/h	0/h	0
Obstructive Apnea Hypopnea (OA + MA + OH):	0.4/h	0.4/h	0/h	0/h	0.5/h	3
Central Apnea Hypopnea (CA + CH):	0.3/h	0.3/h	0/h	0/h	0.3/h	2
Hypoventilation:	0/h	0/h	0/h	0/h	0/h	0
Cheyne-Stokes Breathing:	0/h	0/h	0/h	0/h	0/h	0
Respiration Rate (per m):	14.7/m	14.7/m	14.3/m	14.7/m	14.6/m	

	Percentage of Sleep					Duration
	Total	Supine	Non-supine	REM	Non-REM	
Snore:	3.1%	2.4%	8%	6.7%	2.1%	14.4m
Flow Limitation:	2.7%	2.8%	2.1%	2.9%	2.7%	1.6m
Paradoxical Breathing:	0%	0%	0%	0%	0%	0m

Oxygen Saturation (PAP)	Total	Supine	Non-supine	REM	Non-REM
Oxygen Desaturation Index (ODI):	1.9/h	2.1/h	1/h	1.2/h	2.1/h
Average SpO2:	95.1%	94.9%	96.1%	95.7%	94.9%
Minimum SpO2:	87%	87%	94%	93%	87%
SpO2 Duration < 90%	0.2% (0.9 m)	0.2%	0%	0%	0.2%
SpO2 Duration ≤ 88%	0.1% (0.4 m)	0.1%	0%	0%	0.1%
SpO2 Duration < 85%	0% (0 m)	0%	0%	0%	0%
Average Desat Drop:	4.5%	4.6%	3%	4.5%	4.5%

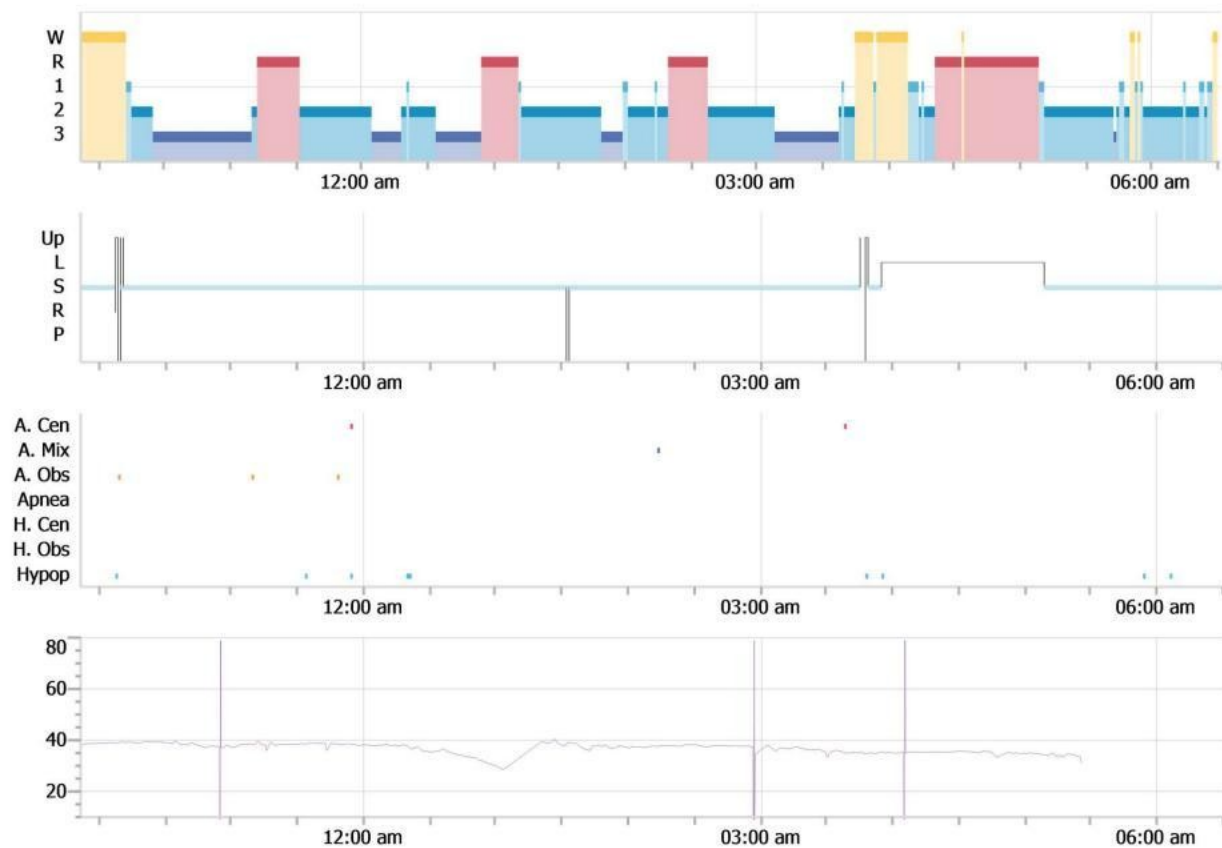
Periodic Limb Movements in Sleep (PAP)	Index	Count
All PLMS:	0/h	0
PLM Arousals:	0/h	0
PLMS in N1:	0/h	0
PLMS in N2:	0/h	0
PLMS in N3:	0/h	0
PLMS in REM:	0/h	0
PLM during Wake:	0/h	0

Position and Analysis Time (PAP)	Duration	Percentage
Supine (in TST):	407.5m	87.4%
Non-Supine (in TST):	58.7m	12.6%
Left (in TST):	58.5m	12.5%
Prone (in TST):	0m	0%
Right (in TST):	0m	0%
Unknown (in TST):	0.2m	0%
Upright (in TST):	0m	0%
Movement (in TST):	5.2m	1.1%
Invalid Data (Excluded):	0m	0%

Pulse in TST (PAP)	
Average:	44.8bpm
Maximum:	81bpm
Minimum:	39bpm
Duration < 40 bpm:	0.7m
Duration > 100 bpm:	0m
Duration > 90 bpm:	0m

Cardiac Events in TST (PAP)	Index	Count
Bradycardia	0/h	0
Asystole	0/h	0
Sinus Tachycardia	0/h	0
Narrow Complex Tachycardia	0/h	0
Wide Complex Tachycardia	0/h	0
Atrial Fibrillation	0/h	0

Transcutaneous CO₂ Report (PAP Period)



pCO ₂ - Sleep	Duration	Total	Supine	Non-Supine
Average		37.8 mmHg	38.1 mmHg	36.2 mmHg
Max		41.4 mmHg	41.4 mmHg	40.2 mmHg
Min		29.8 mmHg	29.8 mmHg	34.4 mmHg
pCO ₂ < 35 mmHg	26.3 min	5.6 %	5.9 %	3.6 %
pCO ₂ > 45 mmHg	0 min	0 %	0 %	0 %
pCO ₂ > 50 mmHg	0 min	0 %	0 %	0 %
pCO ₂ > 55 mmHg	0 min	0 %	0 %	0 %

pCO₂ - REM	Duration	Total	Supine	Non-Supine
Average		36.9 mmHg	37.7 mmHg	36.1 mmHg
Max		40.3 mmHg	40.3 mmHg	36.9 mmHg
Min		29.8 mmHg	29.8 mmHg	34.4 mmHg
pCO ₂ < 35 mmHg	9.7 min	9.7 %	13.9 %	4.7 %
pCO ₂ > 45 mmHg	0 min	0 %	0 %	0 %
pCO ₂ > 50 mmHg	0 min	0 %	0 %	0 %
pCO ₂ > 55 mmHg	0 min	0 %	0 %	0 %

pCO₂ - NREM	Duration	Total	Supine	Non-Supine
Average		38.1 mmHg	38.2 mmHg	36.5 mmHg
Max		41.4 mmHg	41.4 mmHg	40.2 mmHg
Min		31.3 mmHg	31.3 mmHg	36.3 mmHg
pCO ₂ < 35 mmHg	16.6 min	4.5 %	4.7 %	0 %
pCO ₂ > 45 mmHg	0 min	0 %	0 %	0 %
pCO ₂ > 50 mmHg	0 min	0 %	0 %	0 %
pCO ₂ > 55 mmHg	0 min	0 %	0 %	0 %

pCO₂ - Wake	Duration	Total	Supine	Non-Supine
Average		38 mmHg	39 mmHg	36.4 mmHg
Max		40.4 mmHg	40.3 mmHg	40.4 mmHg
Min		35.2 mmHg	35.2 mmHg	35.2 mmHg
pCO ₂ < 35 mmHg	0 min	0 %	0 %	0 %
pCO ₂ > 45 mmHg	0 min	0 %	0 %	0 %
pCO ₂ > 50 mmHg	0 min	0 %	0 %	0 %
pCO ₂ > 55 mmHg	0 min	0 %	0 %	0 %

Trend Overview (PAP Period)





Titration Summary

Sleep Parameter		
Analysis Start	9:51 pm	
Analysis Stop	6:30 am	
# of Awakenings	12	
	Duration (min)	TST (%)
Total Recording Time	519.5	
Total Stage N1 Sleep	31	6.6
Total Stage N2 Sleep	214.5	46
Total Stage N3 Sleep	121	25.9
Total REM Sleep	100	21.4
TST (mins)	466.5	
Latency to Sleep Onset	43.6 mins	
Latency to REM sleep	103.1 mins	
Sleep Efficiency (%)	89.8 %	
Body Position		
Left	58.5	12.5
Right	0	0
Supine	407.5	87.4
Prone	0	0
Arousal Summary		
	Count	Index
All Arousals	48	6.2 /h
Respiratory Arousals	2	0.3 /h
RERAs	0	0 /h
Spontaneous Arousals	40	5.1 /h
LM Arousals	0	0 /h
PLM Arousals	0	0 /h
Heart Rate Summary		
Average Heart Rate	45.8 bpm	
Minimum Heart Rate	25.8 bpm	
Maximum Heart Rate	200 bpm	
Oxygen Saturation Summary		
% TST < 90%	0.2 %	
Number of Desat >=3%	15	
ODI (3%)	1.9 /h	
Lowest SpO2	87 %	



Transcutaneous CO2 Summary		
Minimum TcCO2	29.8 mmHg	
Maximum TcCO2	41.4 mmHg	
Average TcCO2	37.8 mmHg	
Periodic Leg Movements Summary		
	Count	Index
All PLMS:	0	0 /h
PLMS in N1:	0	0 /h
PLMS in N2:	0	0 /h
PLMS in N3:	0	0 /h
PLMS in REM:	0	0 /h



Titration Report Interpretation Notes

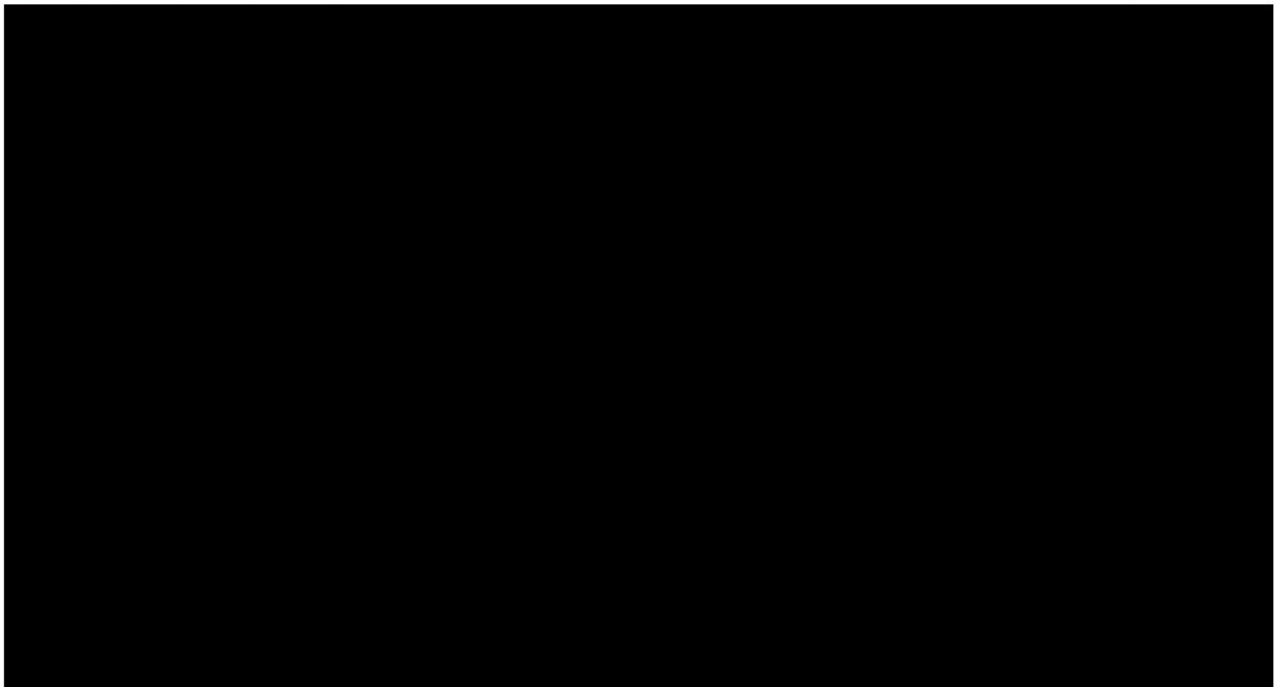
Patient Details

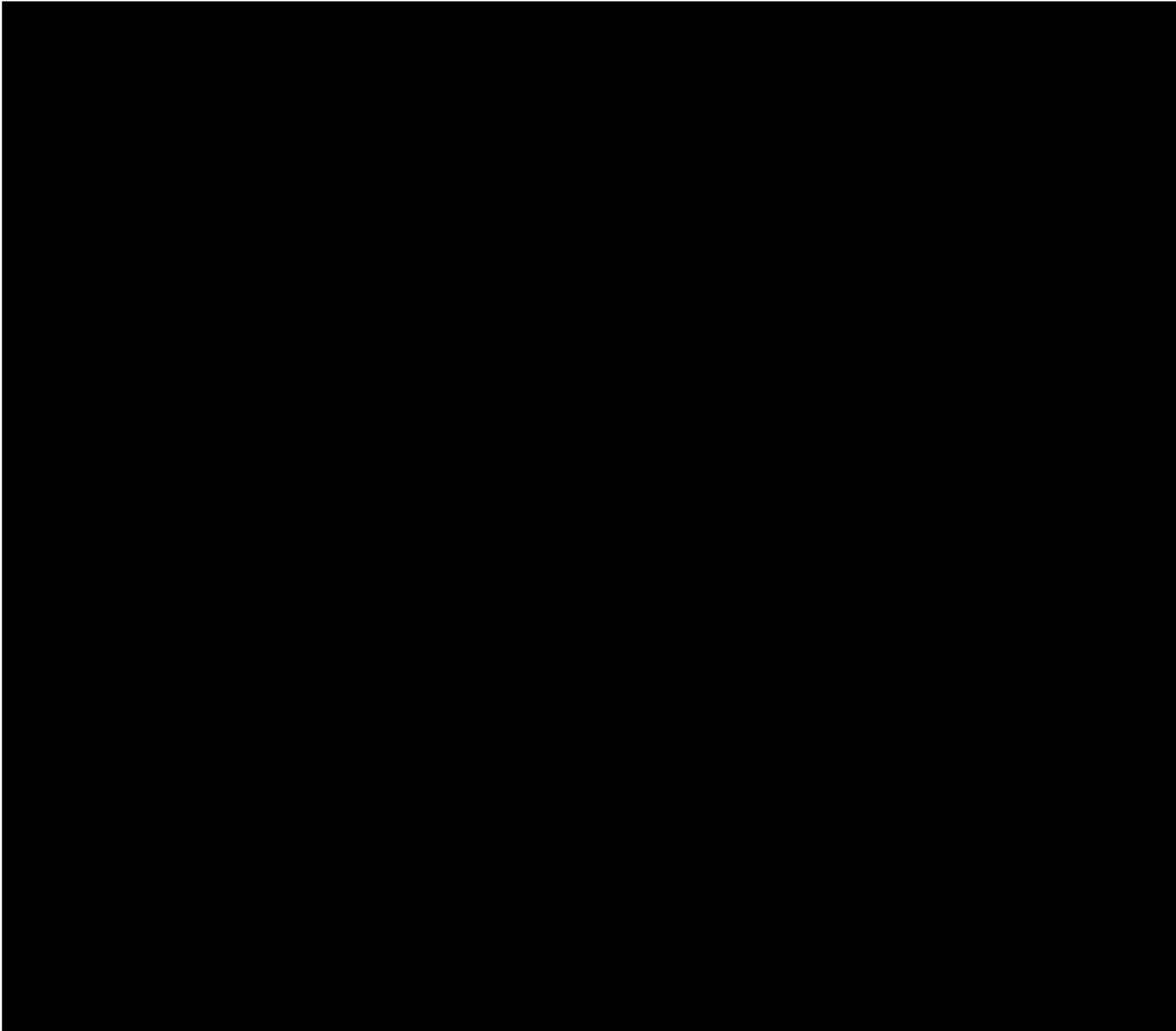
Name :		NRIC :		Study Date :	
DOB :		Age :		Gender :	Male
Height :	cm	Weight :	kg	BMI :	
BP :	-	EQ5D :	-		
ISI :	-	ESS :	-		
STOPBANG :	-	PLATO-11 :	-		
Pre-Diagnosis : ICD9-Obstructive Sleep Apnea Syndrome 780.53-0					
Referring Doctor :		Acquiring Technician :			
Reporting Doctor :		Scoring Technologist :			

1. Study Information

The sleep study was conducted using the Nox A1s PSG device. The acquisition monitored frontal, central, and occipital EEG and electrooculogram (EOG) for sleep staging, alongside submental EMG and anterior tibialis EMG for muscle tone and movement analysis. Respiratory function was assessed via nasal/oral airflow and thoracic/abdominal inductance plethysmography for effort. Oxygen saturation SpO₂ and electrocardiogram (ECG) were also monitored. Positive airway pressure was titrated on the Löwenstein Medical PrismaLAB.

2. Sleep Technologist's notes





2. Scoring Information

- AASM Scoring Manual Version 3 (released February 2023)
- The tracing was scored using 30-second epochs, with hypopneas scored per AASM 3% desaturation rule.
- Positive airway pressure was titrated in accordance with the consensus recommendations set forth by the Positive Airway Pressure (PAP) Titration Task Force of the American Academy of Sleep Medicine (AASM) ^[9]

**3. Physician's Interpretation****4. Physician's Recommendations****5. PAP Titration Study Grading Checklist****Patient and Study Summary Data:**

Parameter	Value
Baseline Respiratory Disturbance Index (RDI) / Apnea Hypopnea Index (AHI)	21.7 / hour
Final Selected Pressure (CPAP, IPAP/EPAP, etc.)	14/7 cm H ₂ O
RDI/AHI at Final Selected Pressure	1 / hour

I. Core Efficacy Criteria (Check all that apply at Final Selected Pressure):

Criterion	Achieved	Grade Implication
A. RDI is reduced to less than 5 per hour for 15 minutes.	☒ Yes	Optimal potential
B. RDI is reduced to 10 per hour (but not) for 15 minutes.	☐ Yes	Good potential
C. RDI is reduced by 50% or more if the baseline RDI was less than 15 per hour for 15 minutes.	☐ Yes	Good potential alternative
D. RDI is reduced by 75% from baseline (especially for severe Obstructive Sleep Apnea (OSA) patients), but still per hour.	☐ Yes	Adequate potential

II. Required Physiological and Sleep State Criteria (Check all that apply at Final Selected Pressure):

Criterion	Achieved
E. Supine REM sleep occurred and was not continually interrupted by spontaneous arousals or awakenings.	☒ Yes
F. Minimum sea level SpO₂ was above 90% .	☒ Yes
G. Leak was within the manufacturer's acceptable limit .	☒ Yes



Based on the criteria met above, select the highest applicable grade:

Grade	Criteria Required to Meet This Grade	Final Grade
Optimal	Criteria A AND E AND F AND G are met.	☒ Optimal
Good	(Criteria B OR C) AND E AND F AND G are met.	☐ Good
Adequate	Criteria D is met (and E is optional). OR Criteria for Optimal/Good are met, except criterion E (supine REM) did not occur.	☐ Adequate
Unacceptable	Does not meet the requirements for Optimal, Good, or Adequate.	☐ Unacceptable
Repeat Study Consideration	If the result is Unacceptable, or if the result is Adequate or less.	☐ Repeat PAP titration study should be considered



Glossary

American Academy of Sleep Medicine (AASM): The principal professional society in the US for sleep medicine, responsible for publishing diagnostic and scoring criteria for sleep disorders, including sleep apnea.^[1]

Apnea: Complete cessation of airflow for ≥ 10 seconds during sleep. In obstructive apnea, respiratory effort persists; in central apnea, effort is absent.^{[2][3]}

Apnea-Hypopnea Index (AHI): The number of apneas plus hypopneas per hour of sleep, used to classify sleep apnea severity: < 5 (normal), 5–14.9 (mild), 15–29.9 (moderate), ≥ 30 (severe).^{[2][3][4]} Scored per AASM criteria.

Oxygen Desaturation: A drop in arterial oxygen saturation, typically $\geq 3\%$ or 4% , associated with respiratory events during sleep.^{[3][5]} Severe oxygen desaturation has been classified as an oxygen saturation $< 85\%$ for more than 2% of the total PSG sleep time. Minimal or no desaturation has been classified as no PSG sleep saturation less than 90% .

Hypoxic Burden: The cumulative degree and duration of oxygen desaturation during sleep, reflecting the severity of intermittent hypoxia in sleep-disordered breathing.^{[2][3]}

Flow Limitations: Partial reductions in airflow due to increased upper airway resistance, not meeting criteria for apnea or hypopnea, but may cause sleep fragmentation.^[1]

Respiratory Effort-Related Arousals (RERAs): Events characterized by increased respiratory effort leading to arousal from sleep, without meeting criteria for apnea or hypopnea. Included in the Respiratory Disturbance Index (RDI) per AASM.^{[1][6]}

Paradoxical Breathing: Out-of-phase movement of the thorax and abdomen during obstructive events, indicating persistent respiratory effort against a closed airway.^[4]

Arousal: Abrupt shift in EEG frequency indicating transition to lighter sleep or wakefulness, often terminating respiratory events.^{[2][4]}

Central Apnea: Cessation of airflow for ≥ 10 seconds due to absent ventilatory effort, typically defined as $> 50\%$ of events being central.^{[2][7]}

Cheyne-Stokes Respiration: A form of central sleep apnea with cyclic crescendo-decrescendo breathing and periodic apneas, often seen in heart failure.^{[7][2]}

Continuous Positive Airway Pressure (CPAP): First-line therapy for obstructive sleep apnea, delivering constant air pressure to maintain airway patency during sleep.^{[3][6]}

Hypopnea: Partial reduction in airflow ($\geq 30\%$) for ≥ 10 seconds, associated with $\geq 3\%$ or 4% oxygen desaturation or arousal.^{[3][5]}



Obstructive Sleep Apnea (OSA): Recurrent episodes of partial or complete upper airway collapse during sleep, resulting in apneas or hypopneas, diagnosed by AHI criteria. ^{[2][4][5]}

Periodic Leg Movements: Repetitive, stereotyped limb movements during sleep, often detected by anterior tibialis EMG in polysomnography. ^[6]

Respiratory Disturbance Index (RDI): Number of apneas, hypopneas, and RERAs per hour of sleep. ^[1]

Positional Obstructive Sleep Apnea: OSA predominantly occurring in the supine position, with AHI significantly higher when supine. ^[6]

Rapid Eye Movement-Related Obstructive Sleep Apnea: OSA events predominantly occurring during REM sleep, often with greater severity in this stage. ^[6]

Hypoventilation, as defined by the American Academy of Sleep Medicine (AASM) scoring manual, is present during sleep if either of the following criteria are met: (1) there is a PaCO_2 (or validated surrogate such as transcutaneous or end-tidal PCO_2) >55 mm Hg for at least 10 minutes, or (2) there is an increase in PaCO_2 (or surrogate) of >10 mm Hg from the awake supine value to a value exceeding 50 mm Hg for at least 10 minutes. ^[8]



References

1. [Polysomnography for Obstructive Sleep Apnea Should Include Arousal-Based Scoring: An American Academy of Sleep Medicine Position Statement](#). Malhotra RK, Kirsch DB, Kristo DA, et al. *Journal of Clinical Sleep Medicine : JCSM : Official Publication of the American Academy of Sleep Medicine*. 2018;14(7):1245-1247. doi:10.5664/jcsm.7234.
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3. [Obstructive Sleep Apnea in Adults](#). Veasey SC, Rosen IM. *The New England Journal of Medicine*. 2019;380(15):1442-1449. doi:10.1056/NEJMcp1816152.
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6. [Adult Obstructive Sleep Apnoea](#). Jordan AS, McSharry DG, Malhotra A. *Lancet (London, England)*. 2014;383(9918):736-47. doi:10.1016/S0140-6736(13)60734-5.
7. [Sleep-Disordered Breathing and Cardiac Arrhythmias in Adults: Mechanistic Insights and Clinical Implications: A Scientific Statement From the American Heart Association](#). Mehra R, Chung MK, Olshansky B, et al. *Circulation*. 2022;146(9):e119-e136. doi:10.1161/CIR.0000000000001082.
8. [Rules for Scoring Respiratory Events in Sleep: Update of the 2007 AASM Manual for the Scoring of Sleep and Associated Events. Deliberations of the Sleep Apnea Definitions Task Force of the American Academy of Sleep Medicine](#). Berry RB, Budhiraja R, Gottlieb DJ, et al. *Journal of Clinical Sleep Medicine : JCSM : Official Publication of the American Academy of Sleep Medicine*. 2012;8(5):597-619. doi:10.5664/jcsm.2172.
9. Kushida, Clete A., et al. "Clinical Guidelines for the Manual Titration of Positive Airway Pressure in Patients with Obstructive Sleep Apnea." *Journal of Clinical Sleep Medicine: JCSM: Official Publication of the American Academy of Sleep Medicine*, vol. 4, no. 2, Apr. 2008, pp. 157–71. PubMed.



SLEEPWELL LABORATORY

Note: In compliance with Ministry of Health's Medical Technology Advisory Committee (MTAC) recommendation, the raw data of this sleep study has been reviewed and scored by a qualified sleep technologist. The results have been interpreted and reported by a specialist trained in Sleep Medicine.

