

**DIAGNOSTIC POLYSOMNOGRAM REPORT**

<b>Patient Name:</b>	Greg	<b>Psychotropic Medications:</b>	Melatonin, Gabapentin	<b>PCP/Referring:</b>	None
<b>Study Date:</b>	2017	<b>Evening/Bedtime Medications:</b>	-	<b>Sleep Specialist:</b>	Barry Krakow, MD
<b>Date of Birth:</b>	-			<b>Recording Tech:</b>	-
<b>Age:</b>	-			<b>Scoring Tech:</b>	-
<b>Height (in.)/Weight (lbs.):</b>	70.0 / 165.0				
<b>B.M.I:</b>	22				
<b>Study Indications:</b>	-				

*Diagnostic Legend*

*Standard Treatment Legend*

*Advanced Treatment Legend*

PSG = polysomnography  
 SDB = sleep-disordered breathing  
 UARS = upper airway resistance syndrome  
 OSA = obstructive sleep apnea  
 CSA = central sleep apnea  
 CompSA = complex sleep apnea  
 RLS = restless leg syndrome  
 PLMD = periodic limb movement disorder  
 CAP = cyclic alternating pattern  
 EBM = evidence-based medicine  
 MSLT = Multiple Sleep Latency Test  
 MWT = Maintenance of Wakefulness Test

AHI = apnea/hypopnea index  
 RDI = respiratory disturbance index  
 CAI = central apnea index  
 PAP = positive airway pressure  
 CPAP = continuous positive airway pressure  
 IPAP = inspiratory positive airway pressure  
 EPAP = expiratory positive airway pressure  
 BPAP = IPAP/EPAP  
 NDS = nasal dilator strips  
 OAT = oral appliance therapy

ABPAP = auto adjusting IPAP/EPAP  
 ASV = adaptive servoventilation  
 CBT = cognitive behavioral therapy  
 IRT = imagery rehearsal therapy  
 EFT = emotion focused therapy  
 SSSM = Sound Sleep, Sound Mind book  
 IC = Insomnia Cures book  
 TNID = Turning Nightmares into Dreams  
           (workbook and audio series)  
 NTC = Nightmare Treatment Clinic  
 PTSD-SC = PTSD Sleep Clinic

**Diagnostic Polysomnogram**

**Background Sleep History:** Male patient who presents with unrefreshing sleep, fair sleep quality, somewhat light sleep, and moderate daytime sleepiness and fatigue. The patient's chief complaints, by severity, are a sleep breathing problem (x8yrs), poor sleep quality (x8yrs), and nightmares (x20yrs)... End organ SDB symptoms include difficulty with attention, concentration, and memory, dry mouth upon awakening, and nocturia x3. This presentation suggests a physiological sleep disorder, and a diagnostic study was scheduled.

**Current Sleep Medical History:** He reports choking and sweating in his sleep, waking feeling anxious, and persistent daytime sleepiness. He tries to avoid napping but takes one 3-4 times a week for about half an hour, sometimes waking refreshed and sometimes not. He does not consume alcohol or caffeine.

**Nasal/Oral Airway History:** Rare to occasional symptoms of allergic rhinitis and occasional symptoms of non-allergic rhinitis which patient treats with rare use of saline washes. Tonsils surgically absent. No history of nasal trauma or surgery. Reports of mouth breathing during sleep. Is recovering from a sinus infection for which he was taking antibiotics for 2 months.

**Special Sleep Problems Update:**

*Insomnia:* The patient was given a copy of *Insomnia Cures*.

*RLS/PLMD:* No symptoms of RLS/PLMD.

*Nightmares:* The patient reports 4 nightmares per month and was made aware of the nightmare treatment clinic.

*Parasomnia:* Parasomnia symptoms include waking up yelling or making disruptive noises or body movements.

*Narcolepsy/Hypersomnia:* Narcolepsy symptoms include attacks of sleepiness, sleep paralysis, and dream like visions when falling asleep or waking up.

*Cardiac:* No known cardiac conditions.

**Past medical history:** Chronic Pain, Sinus Problems,

**Past mental health history:** None

**Current medications:** Cholestyramine, Gabapentin, Melatonin, Multivitamins, Vitamin A, B, C, and D, Curcumin, Fish Oil, CoQ10

**Questionnaire data:** ISI: 19, consistent with moderate insomnia. SDB-30: sleep breathing symptoms include 28 of 30 symptoms in

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the mild to severe intensity range. SHC-21: good sleep hygiene, notable for the patient's recognition of not removing, avoiding, or otherwise overcoming distractions in his/her bedroom that might be interfering with his/her sleep. STAT-10: Occasional to constant time monitoring behavior in relationship to his insomnia and a mild to moderate degree of frustration associated with it. ESS: 14, consistent with moderate sleepiness. DDNSI: 4 nightmares a month. Q-LES-Q: Fair overall life satisfaction. FOSQ: mild to severe impairment, mostly occurring with concentration and memory, operating a motor vehicle over short and long distances, visiting with family or friends in their home, maintaining a relationship with family, friends, or work colleagues, watching a movie, becoming physically active in the morning and evening, and his desire for intimacy. HSC-25: Mild anxiety and moderate depression. DSSI: no suicidal ideation. TIS: no traumatic imagery. PSS-SR: no signs of posttraumatic stress.

**Interpretation:** Patient exhibited a mixed pattern of UARS and Hypopneas with frequent oxygen fluctuations in the 90% range. Sustained flow limitations (UARS type breathing events that extend over several minutes before the actual arousal emerges) were also common as the patient exhibited no normal breathing the entire night. Sleep architecture showed 5 Stage REM periods (normal 4 to 6), REM consolidation index 9.1 (normal >15), 21 awakenings (normal < 20/night), and 61 sleep stage transitions (normal <50), indicative of mild sleep fragmentation and fair REM consolidation. Moderately severe insomnia limited data collection and likely underestimated SDB severity. Leg jerks were sparse part of the night and may reflect an independent movement disorder in this patient who reports no leg movement symptoms and Melatonin an Gabapentin, both drugs of which can treat leg movements.

**Prognostic & Motivation Indicators:** At intake the patient presented with awareness of a sleep breathing problem and was aware of resulting sleep fragmentation. Upon completion and review of his PSG study, the patient had a good understanding of pertinent sleep quality issues and the impact of SDB on his sleep problems.

**Recommendation:** Patient should return for a full night PAP therapy titration to test pressures and reassess leg jerks if he chooses to consider PAP therapy. Most likely he would benefit from an ABPAP or ASV type device, but he could also be a candidate for OAT. The patient may also choose to consider other innovations in the treatment of sleep disordered breathing such as oromyofascial exercises, tongue neurostimulation or site-specific ENT surgery. Efforts to improve nasal patency with nasal hygiene treatments and NDS therapy should be continued, including a review of our Nasal Breathing video series. And, we will need to review with the patient any prescription nasal sprays he has used in the past or is currently using. If he has not tried nasal steroid sprays, or azelastine or ipratropium, one or more of these may be an important addition to his treatment regimen. Although leg jerks do not appear to be a problem, we cannot be certain as he is using two medications that might treat RLS/PLMD, therefore the patient should complete bloodwork for ferritin, vitamin D, and magnesium. The patient may benefit from the *Sound Sleep, Sound Mind* book as well as followup appts to discuss progress in applying its treatment program. Parasomnia behavior and nightmares should be reassessed after other sleep disorders are fully treated, albeit use of PAP therapy often decreases disturbing dreams and parasomnias.

**Technician's Study Narrative (reviewed and edited by Dr. Krakow):**

**Pre-study initiation:** The patient arrived early and was escorted to bed 1 where he completed his paperwork. The patient was educated on SDB and its health related risks and the use of mental imagery was also discussed. **Sitting BP: 124/83, Sitting HR: 85bpm Height: 70inches Weight: 165lbs. Collection notes:** Lights off at 9:17pm. 12:22am Tech in to check on patient. Difficulty sleeping, sensitive to chemicals and our detergent is bothering him. Changed the blanket out with one he brought from home. Would like to attempt to sleep. Lights on at 4:33am **Tech Impression: SDB:** Flow limitation with scattered hypopneas; **OXYGENATION:** O<sub>2</sub> levels in 90% range; **RLS/PLMS:** Scattered leg movements which appear respiratory related; **SLEEP:** Severe sleep fragmentation; **EKG:** NSR. **Post Sleep:** Preliminary information was discussed with patient.

**Technical Profiles**

**Sleep Profile:** The sleep recording started at 9:17:23 PM hours and ended at 5:33:25 AM hours. Total time in bed was 489.5 minutes; total sleep time was 242.1 minutes; sleep efficiency of 49.4%. Sleep onset latency was 15.0 minutes. Stage N1 was 6.4%; stage N2 was 74.8%; stage N3 was 0.0%; REM sleep was 18.8%.

**Respiratory Profile:** There were 4 total apneas of which 3 were central apneas. The patient's CAI was 0.7, AHI was 5.7 events / hr and RDI was **19.6 events/hr.**

**Oximetry:** Mean awake oxyhemoglobin saturation was 95.3%. The mean sleep oxyhemoglobin saturation was 94.3% with an oxygen nadir 90.0%.

**Cardiac Profile:** NSR. Mean heart rate was 75.1 bpm with a minimum heart rate of 59.0 bpm and a maximum heart rate of 128.0 bpm.

**Periodic Limb Movement Profile:** The patient had a Wake Limb Movement Index of 9.9 events/hr and a Sleep Limb Movement Index of 2.0 events/hr.

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**Sleep Architecture**

Analysis Start Time – Lights Off :	9:17:23 PM	Sleep Onset <sup>2</sup> :	15.0 min.
Analysis End Time – Lights On :	5:33:25 AM	Total Stage Shifts :	61
Total Recording Time (TRT) :	496.0 min.	Awakenings (during sleep period) <sup>3</sup> :	21
Sleep Period Time (SPT)	481.1 min.	REM Latency :	63.5 min.
Time in Bed (TIB) <sup>1</sup> :	489.5 min.	REM Time:	45.5 min.
Total Sleep Time (TST) :	242.1 min.	REM Periods :	5
Sleep Efficiency (TST/TIB):	49.4%	REM %:	18.8%
Wake After Sleep Onset (WASO)	239.0 min.	REM Consolidation Index <sup>4</sup> :	9.1

1. Sleep Onset = Time from Lights Off to beginning of first sleep episode (i.e. first sleep-scored epoch ≥ 30 sec.) 2. Persistent Sleep Onset = Time from Lights Off to beginning of first episode of at least 10 contiguous epochs of sleep (i.e. first contiguous sleep-scored epochs ≥ 5 min.) 3. Number of periods of congruent wake-scored epochs after sleep onset. 4. Total REM time divided by the number of REM Periods.

**Apnea Hypopnea Index (AHI) = 5.7 events / hr**  
**Respiratory Disturbance Index (RDI) = 19.6 events/hr**

RESPIRATORY EVENTS	Count	Index	Avg. Duration (sec)	Non-REM Index	REM Index
All Apneas	4	1.0	11.7	0.9	1.3
Central Apneas	3	0.7	12.2	0.6	1.3
Obstructive Apneas	1	0.2	10.0	0.3	0.0
Hypopneas <sup>1</sup>	19	4.7	34.8	2.1	15.8
Hypopneas w/4% desat**	0	0.0	N/A	0.0	0.0
Apneas + Hypopneas <sup>1</sup>	23	5.7	30.8	3.1	17.1
RERE <sup>2</sup>	56	13.9	117.9	15.0	9.2
Respiratory Total	79	19.6	92.5	18.0	26.4
RERSCA <sup>3</sup>	49	12.1	105.6	10.4	19.8
Research Respiratory Total*	128	31.7	198.1	28.4	46.2

1. Hypopneas are scored according to AASM Scoring criteria VIII.4.B. 2. RERE = Respiratory Effort Related Events; does not include RERSCA. 3. RERSCA = Respiratory Effort-Related Sub-Cortical Arousal event; change in EEG frequency is not present with these events; meets research criteria sleep breathing event. **Note:** Counts and Indices do not contain Cheyne Stokes Breathing, Hypoventilation, or Periodic Breathing. \*Combined AASM+Research Breathing events. \*\*Hypopneas scored according to Medicare Hypopnea scoring definition and criteria.

Sleep Stage Distribution	Duration (min)	% TST	Normative % TST	Latency (min)
WASO	239.0	-	-	-
N1	15.5	6.4%	2-5%	0.0
N2	181.1	74.8%	45-55%	5.5
N3	0.0	0.0%	13-23%	N/A
REM	45.5	18.8%	20-25%	63.5

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RESPIRATORY EVENTS (by Body-Position)	Supine Sleep		Prone Sleep		Left-Side Sleep		Right-Side Sleep		Upright Sleep	
	Count	Index	Count	Index	Count	Index	Count	Index	Count	Index
Duration (min/sec/%):	0.0	0.0%	0.0	0.0%	127.6	52.7%	114.5	47.3%	0.0	0.0%
Obstructive Apneas:	N/A	N/A	N/A	N/A	0	0.0	1	0.5	N/A	N/A
Central Apneas:	N/A	N/A	N/A	N/A	2	0.9	1	0.5	N/A	N/A
Hypopneas <sup>1</sup> :	N/A	N/A	N/A	N/A	4	1.9	15	7.9	N/A	N/A
RERE <sup>2</sup> :	N/A	N/A	N/A	N/A	41	19.3	15	7.9	N/A	N/A
Total:	N/A	N/A	N/A	N/A	47	22.1	32	16.8	N/A	N/A
RERSCA <sup>3</sup> :	N/A	N/A	N/A	N/A	14	6.6	35	18.3	N/A	N/A
Research Respiratory Total*	0	0.0	0	0.0	61	28.7	67	35.1	0	0.0

1. Hypopneas are scored according to AASM Scoring criteria VIII.4.B. 2. RERE = Respiratory Effort Related Events; does not include RERSCA. 3. RERSCA = Respiratory Effort-Related Sub-Cortical Arousal event; change in EEG frequency is not present with these events; meets research criteria sleep breathing event. **Note:** Counts and Indices do not contain Cheyne Stokes Breathing, Hypoventilation, or Periodic Breathing. \*Combined AASM+Research Breathing events.

RESPIRATORY AWAKENINGS	Count	Index	Avg. Duration (sec)	Non-REM Index	REM Index	Supine Index	Non-Supine Index
Apneas + Hypopneas	3	0.7	48.0	0.6	1.3	N/A	0.7
RERA w	17	4.2	95.0	4.0	5.3	N/A	4.2
Respiratory Total	20	5.0	-	4.6	6.6	0.0	5.0

RESPIRATORY AROUSAL	Count	Index	Avg. Duration (sec)	Non-REM Index	REM Index	Supine Index	Non-Supine Index
Apneas + Hypopneas	19	4.7	29.0	2.4	14.5	N/A	4.7
RERA	39	9.7	127.9	11.0	4.0	N/A	9.7
Respiratory Total	58	14.4	-	13.4	18.5	0.0	14.4

Hypopneas with 4% Desaturations	Count	Index	Avg. Duration (sec)	Non-REM Index	REM Index	Supine Index	Non-Supine Index
Apneas + Hypopneas	7	1.7	20.3	0.9	0.0	N/A	1.7
Hypopneas w/ 4%	0	0.0	N/A	0.0	0.0	N/A	0.0
Respiratory Total	7	1.7	-	0.9	0.0	0.0	1.7

RESPIRATORY SUB-CORTICAL AROUSALS	Count	Index	Avg. Duration (sec)	Non-REM Index	REM Index	Supine Index	Non-Supine Index
RERSCA	49	12.1	105.6	10.4	19.8	N/A	12.1

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Spontaneous Arousal Activity*	Count	Index
Arousals	0	0.0
Awakenings	0	0.0
Micro-Arousals	0	0.0

\* EEG Arousal activity not associated with Respiratory or PLM events.

MSAS LIMB MOVEMENTS	Total LMs	
	Count	Index
Total Wake Time:	41	9.9
Total Sleep Time:	8	2.0
Total Events	49	11.9
LMS w/Arousal	0	0.0
LMS w/o Arousal	0	2.0

AASM LIMB MOVEMENTS (by sleep stage)	LM w/ Arousals		LM w/o Arousals		Total LMs		PLM Series	
	Count	Index	Count	Index	Count	Index	Count	Index
Total Sleep Time:	0	0.0	8	2.0	8	2.0	0	0.0
N1:	0	0.0	0	0.0	0	0.0	0	0.0
N2:	0	0.0	4	1.3	4	1.3	0	0.0
N3:	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
R:	0	0.0	4	5.3	4	5.3	0	0.0

SLEEP FRAGMENTATION SUMMARY	EVENTS/HR
Respiratory Disturbance Index (RDI)	19.6
Sleep LM Index	2.0
Spontaneous EEG Arousal Index	0.0
Total Sleep Event Index	21.6
Respiratory Sub-Cortical Arousals	12.1
Research RDI	31.7

OXYGEN SATURATION	Wake	Non-REM	REM	TST	TIB
Max. SpO2%:	100.0	96.0	97.0	97.0	100.0
Mean SpO2%:	95.3	94.3	94.4	94.3	94.8
Min. SpO2%:	90.0	92.0	93.0	92.0	90.0
SpO2% <= 88% (min.)	0.0	0.0	0.0	0.0	0.0
% Time in range					
90 – 100%:	99.5%	100.0%	100.0%	100.0%	99.7%
80 – 89%:	0.0%	0.0%	0.0%	0.0%	0.0%
70 – 79%:	0.0%	0.0%	0.0%	0.0%	0.0%
60 – 69%:	0.0%	0.0%	0.0%	0.0%	0.0%
% Artifact / Bad Data:	0.5%	0.0%	0.0%	0.0%	0.3%

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OXYGEN DESATURATION EVENTS	Count	Index
Total Sleep Time:	4	1.0
Wake (after sleep onset):	0	0.0
Non-REM:	2	0.6
REM:	2	2.6
Total Recording Time:	4	0.5

HEART RATE RESULTS	Wake	Non-REM	REM	TST	TIB
Max. HR (bpm):	128.0	90.0	90.0	90.0	128.0
Mean HR (bpm):	82.2	68.3	66.5	67.9	75.1
Min. HR (bpm):	64.0	61.0	59.0	59.0	59.0
<b>% Time in range</b>					
> 100 (bpm):	1.1%	0.0%	0.0%	0.0%	0.5%
90 – 100 (bpm):	7.3%	0.0%	0.0%	0.0%	3.7%
80 – 89 (bpm):	50.6%	0.4%	0.9%	0.5%	25.8%
70 – 79 (bpm):	38.4%	20.8%	12.8%	19.3%	29.0%
60 – 69 (bpm):	2.1%	78.8%	83.6%	79.7%	40.5%
50 – 59 (bpm):	0.0%	0.0%	2.6%	0.5%	0.2%
< 50 (bpm):	0.0%	0.0%	0.0%	0.0%	0.0%
% Artifact / Bad Data:	0.5%	0.0%	0.0%	0.0%	0.3%

CARDIAC EVENTS	Brady.	Cardiac Pause	Tachy.	Narrow Complex Tachy.	Wide Complex Tachy.	Atrial Fibrillation	Accel.	Decel.
Count :	0	0	0	0	0	0	0	0
Shortest Event (min:sec):	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Longest Event (min:sec):	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sum Duration (min:sec):	0:00	0:00	0:00	0:00	0:00	0:00	0:00	0:00
Absolute Max. Rate (bpm):	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Absolute Min. Rate (bpm):	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

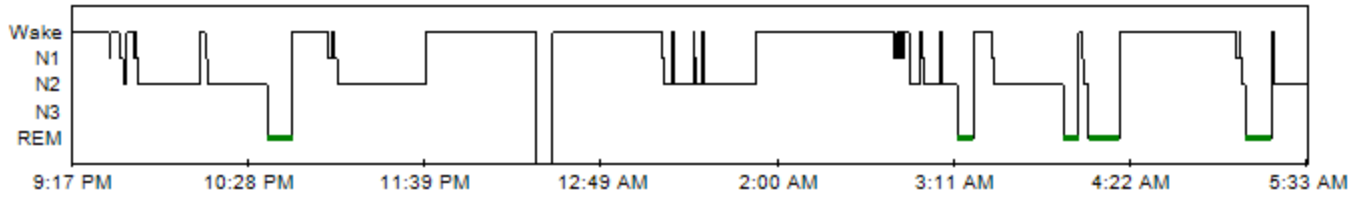
ETCO2	Wake	Non-REM	REM	TIB	TST
Mean	100.0	100.0	100.0	100.0	100.0
Max	100.0	100.0	100.0	100.0	100.0
Min	100.0	100.0	100.0	100.0	100.0
<b>% Time in Range:</b>					
20–30 (mmHg)	100.0%	100.0%	100.0%	100.0%	100.0%
30–35 (mmHg)	100.0%	100.0%	100.0%	100.0%	100.0%
35–40 (mmHg)	100.0%	100.0%	100.0%	100.0%	100.0%
40–45 (mmHg)	100.0%	100.0%	100.0%	100.0%	100.0%
45–50 (mmHg)	100.0%	100.0%	100.0%	100.0%	100.0%
50–55 (mmHg)	100.0%	100.0%	100.0%	100.0%	100.0%
55–60 (mmHg)	100.0%	100.0%	100.0%	100.0%	100.0%
60–70 (mmHg)	100.0%	100.0%	100.0%	100.0%	100.0%
% Artifact / Bad Data:	100.0%	100.0%	100.0%	100.0%	100.0%

\*ETCO<sub>2</sub> values < 20 mmHg or > 70 mmHg are considered artifact.

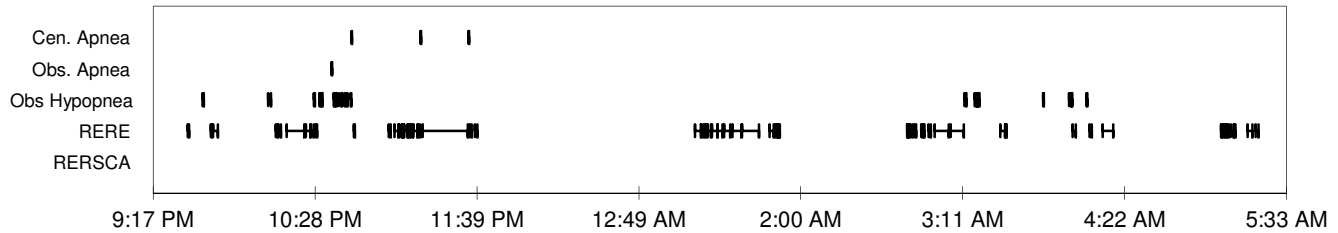
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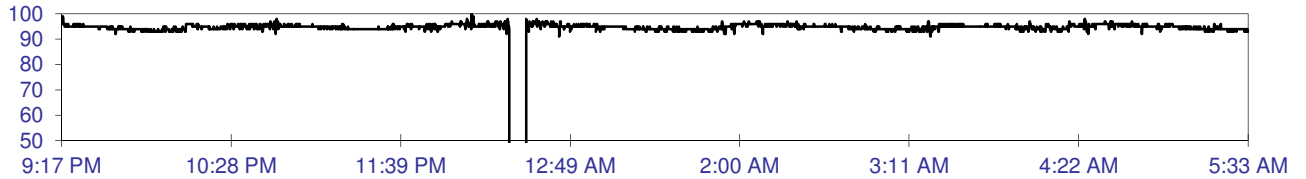
**Hypnogram**



**Respiratory Events**



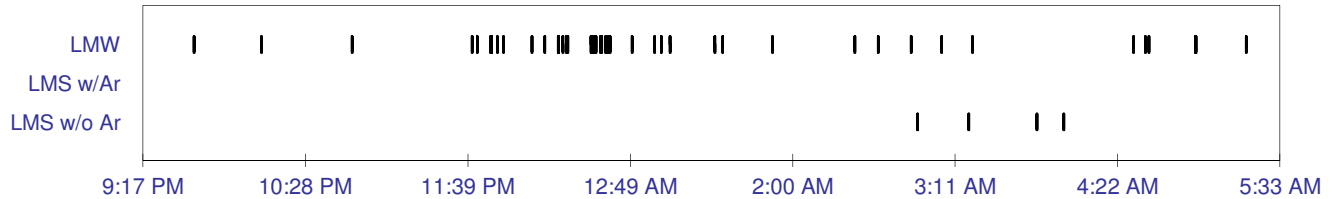
**SpO2%**



**Body Position**



**Limb Movement Events**



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**STUDY PARAMETERS:** The study was performed with a sleep technologist in attendance for the entire test period. Video monitoring was carried out throughout the study, and the following clinical parameters were recorded:

**Channel information Chart**

Channel Input Label	Channel Name	Channel Type	Frequency
A (Amp 1)	Thermister	AirFlow	32
B (Amp 1)	NASAL PRESSURE A/	Nasal Canula,1	32
E (Amp 1)	CHEST	Chest	32
F (Amp 1)	ABDOMEN	Abdomen	32
G (Amp 1)	SNORE	Snore	512
1 (Amp 1)	M1	EEG,A1,CZ	128
2 (Amp 1)	M2	EEG,A2,CZ	128
3 (Amp 1)	C3	EEG,C3,CZ	128
4 (Amp 1)	C4	EEG,C4,CZ	128
5 (Amp 1)	O1	EEG,O1,CZ	128
6 (Amp 1)	O2	EEG,O2,CZ	128
7 (Amp 1)	F3	EEG,F3,CZ	128
8 (Amp 1)	F4	EEG,F4,CZ	128
9 (Amp 1)	E1	Ocular,Left	128
10 (Amp 1)	E2	Ocular,Right	128
11 (Amp 1)	EMG1	EMG,1	512
12 (Amp 1)	EMG2	EMG,2	512
13 (Amp 1)	EMG3	EMG,3	512
23 (Amp 1)	ECG1	EKG,1	512
24 (Amp 1)	ECG2	EKG,2	512
25 (Amp 1)	ECG3	EKG,3	512
29 (Amp 1)	L-LEG1	Legs,Left,1	512
30 (Amp 1)	L-LEG2	Legs,Left,2	512
31 (Amp 1)	R-LEG1	Legs,Right,1	512
32 (Amp 1)	R-LEG2	Legs,Right,2	512
SpO2 (Amp 1)	SpO2	SaO2	32
Pulse (Amp 1)	PULSE	Pulse	32
GK425 (Pressure) (Amp 1)	GK Pressure	CPAP (Pressure)	32
GK425 (BPM) (Amp 1)	GK BPM	CPAP (BPM)	32
GK425 (IE Ratio) (Amp 1)	GK I/E Ratio	CPAP (IE Ratio)	32
GK425 (Leak) (Amp 1)	GK Leak	CPAP (Leak)	32
GK425 (Flow) (Amp 1)	GK Flow	CPAP (Flow)	32
DC X1 (Box 1)	NPTAF	Nasal Canula,2	32
DC X2 (Box 1)	VPAP Flow	BiLevel (Flow)	32
DC X3 (Box 1)	VPAP Pressure	BiLevel (Pressure)	32
DC X4 (Box 1)	VPAP Leak	BiLevel (Leak)	32
DC X5 (Box 1)	VPAP Tidal Volume	BiLevel (TV)	32
DC X6 (Box 1)	VPAP Minute Ventilatio	BiLevel (Other),1	32
DC X7 (Box 1)	VPAP ASV Target MV	BiLevel (Other),2	32
DC X8 (Box 1)	EtCO2	EtCO2	32