Sleep Reports

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Types of Reports

- Diagnostic Report
- Titration Report
- Split Night Report
- MSLT Report

Terminology

Lights out

- ✓ Beginning of study at which patient first attempts to fall asleep

- ✓ Impedance checks, amplifier calibrations and physiologic calibrations are completed and artifacts checked before lights out

Lights On

- ✓ The end of study
- ✓ Post test calibrations are performed after lights on

Total Recording Time (TRT)

- ✓ Time from lights out to lights on

- ✓ TRT= Total Sleep Time (TST) + Total Wake Time (TWT)

Total Sleep Time (TST)

- ✓ Total time spent asleep

- ✓ TST= TRT-TWT

Total Wake Time (TWT)

- ✓ Total Time spent awake during the study

Total Time spent in each Sleep stage

✓ Total scores entered for each respective Sleep Stage

Sleep period Time (SPT)

✓ Time interval from sleep onset to the last epoch of Sleep

✓ SPT=TST+WASO

Percentage sleep stage formulae

- % Stage N1 = Minutes of N1/TST × 100

- % Stage N2 = Minutes of N2/TST × 100

- % Stage N3 = Minutes of N3/TST × 100

- % Stage R = Minutes of R/TST × 100

- % Wake time = Minutes of wake/Sleep Period Time (SPT) × 100

- TST=200min
- TRT=250min
- WASO=0min
- N1 duration=20min
- N2 duration=100min
- N3 duration=40min
- R duration=40min

- %N1=?
- %N2=?
- %N3=?
- %R=?
- %NREM=?
- %Wake=?

Sleep Stage as %TST

NREM sleep: 75-80%

N1:   3-8%

N2:   45-55%

N3:   15-20%

REM Sleep: 20-25%

- **Increase N1-** with aging and disturbed Sleep, OSA

- **Decrease N3-** with aging, OSA and Insomnia

- **Increase N3-** Drugs

- **Decreased REM Sleep-** OSA and Insomnia

- **Increase N3 and REM-** After successful CPAP titration of OSA patient

Sleep Efficiency (SE)

✓ Percentage of TRT the patient was asleep

✓ SE= TST/TRT

✓ In adults SE>90%

✓ SE=100%?

✓ SE=0%?

Wake After Sleep Onset (WASO)

✓ Total time spent awake after the first epoch of Sleep

✓ WASO= TRT-TST-Sleep Latency

WASO Significance

- Increased in patients with

✓ Broken Sleep
✓ Sleep maintenance Insomnia
✓ Early morning awakening Insomnia
✓ OSA
✓ RLS
✓ Increases with aging

Sleep Onset

✓ First epoch of sleep, regardless of stage

Sleep Latency (SL)

✓ Time from lights out to Sleep Onset in minutes

✓ In MSLT we calculate mean, mode and median Sleep Latency

Sleep Latency Significance

- Normal Sleep latency is 10-20 min

- **Decreased Sleep Latency**

  ✓ Sleep deprivation
  ✓ OSA
  ✓ Narcolepsy
  ✓ Idiopathic Hypersomnia
  ✓ Hypothyroidism
  ✓ Drugs- Hypnotics
  ✓ Alcohol

- **Increased Sleep Latency**

  ✓ Uncomfortable Sleep environment
  ✓ Sleep Onset Insomnia (SL>30min)
  ✓ Hyperthyroidism
  ✓ Anxiety
  ✓ RLS
  ✓ Stimulant drugs- Amphetamines
  ✓ Caffeine

Stage R Latency

- ✓ Time in minutes from sleep onset to Stage R onset
- ✓ =0?
- ✓ =None?

Stage R Onset

- ✓ First epoch of Stage R

% Stage R

- ✓ Percentage of TST spent in Stage R
- ✓ % Stage R= Total REM Time/TST

- **Decreased REM Latency**

  ✓ Sleep deprivation
  ✓ Depression
  ✓ Withdrawal of REM suppressing drugs
  ✓ Narcolepsy
  ✓ OSA (due to Sleep deprivation)

- **Increased REM Latency**

  ✓ First night effect
  ✓ REM suppressant drugs
  ✓ Stimulant drugs
  ✓ Alcohol

- **Normal Stage R latency is 90-120min**

Apnea Hypopnea Index (AHI)

- ✓ Total no. of apneas plus hypopneas per hour of sleep

- ✓ AHI= (Apneas+ Hypopneas)/TST in hrs

- ✓ Reported as total AHI, NREM AHI, REM AHI, Supine and non-supine AHI

Respiratory Disturbance Index (RDI)

- ✓ Total no. of apneas plus hypopneas plus RERA's per hour of sleep

- ✓ RDI= (Apneas+ Hypopneas+RERA's)/TST in hrs

AHI/RDI

- <5events/hr- Normal

- 5-<15events/hr- Mild SDB

- 15-30events/hr- Moderate SDB

- >30events/hr- Severe SDB

- **Postural OSA**
✓ AHI Supine>2 times AHI non-supine

- **REM OSA**
✓ AHI NREM<5events/hr and AHI REM at least 5events/hr with at least 30 min of REM Sleep **OR**

✓ AHI REM/AHI NREM>2 and AHI NREM<15events/hr

Night to Night AHI/RDI Variability

- Change in %age of REM Sleep
- Change in body position
- Change in nasal resistance
- Use of alcohol
- Use of muscle relaxant, sedative
- Change in weight over a period of time

Apnea Index

✓ Total no. of apneas per hour of Sleep

✓ Can be expressed as Obstructive Apnea Index (**OAI**) or Central Apnea Index (**CAI**)

Hypopnea Index (HI)

✓ Total no. of hypopneas per hour of Sleep

Problems

- TRT=240min
- TST=200min
- Obstructive Apnea=40
- Central Apnea=10
- Mixed Apnea=10
- RERA=0
- Hypopneas=20
- AHI=?
- RDI=?
- SE=?
- OAI=?
- CAI=?
- HI=?

- TRT=300min
- TST=250min
- Obstructive Apnea=80
- Central Apnea=50
- Mixed Apnea=10
- RERA=20
- Hypopneas=20
- AHI=?
- RDI=?
- SE=?
- OAI=?
- CAI=?
- HI=?

- TRT=300min
- TST=250min
- Obstructive Apnea=20
- Central Apnea=50
- Mixed Apnea=10
- RERA=0
- Hypopneas=20
- AHI=?
- RDI=?
- SE=?
- OAI=?
- CAI=?
- HI=?

- TRT=300min
- TST=250min
- Obstructive Apnea=0
- Central Apnea=0
- Mixed Apnea=50
- RERA=0
- Hypopneas=0
- AHI=?
- RDI=?
- SE=?
- OAI=?
- CAI=?
- HI=?

OSAS

A, B and D

A. at least one of the following:
- Unintentional sleep episodes during wakefulness, daytime sleepiness, unrefreshing sleep, fatigue, or insomnia
- Patient wakes with breath holding, gasping, or choking
- Bed partner reports loud snoring, breathing interruptions or both   during sleep

B. Polysomnographic recording shows ≥ 5 respiratory events (apneas, hyponeas or RERAs) per hour of sleep

D. The disorder is not better explained by another sleep disorder, medical or neurological disorder, medication use, or substance use disorder

OR

C and D

c. Polysomnographic recording shows ≥ 15 respiratory events per hour of sleep

D. The disorder is not better explained by another sleep disorder, medical or neurological disorder, medication use, or substance use disorder

CMS Definition of CSAS

- AHI > 5; *and*

- Central apnea/ hypopnea >50% of the total AHI; *and*

- Central Apnea or Hypopneas > 5; *and*

- Symptom of EDS or disrupted sleep

- Frequently co-exist with Obstructive or mixed apneas/ hypopneas

Periodic Limb Movement Index (PLMI)

- ✓ Total no. of limb movements part of PLM sequence per hour of sleep

- ✓ PLMI= Total no.of PLM/TST in hrs

- • **PLMD**
- ✓ PSG shows highly stereotyped limb movements

- ✓ **PLMI>5/hr in children and PLMI>15/hr in adults**
- ✓ Clinical Sleep disturbance or a complaint of fatigue
- ✓ Not explained by another medical disorder

Arousal Index (AI)

✓ Total no. of EEG arousals per hour of Sleep

✓ AI=EEG Arousals/TST in hrs

- **Arousal Index**

✓ Normal range of Arousal Index- relatively little data

✓ Increases with age

✓ Measure of Sleep fragmentation

Oxygen Desaturation Index (ODI)

- ✓ No. of desaturation events per hour of Sleep

- ✓ 3% or 4% relative desaturation events

- ODI>10/hr has sensitivity of 93% and specificity of 75% for moderate to severe SDB

- ODI>5/hr, 15 &30 has 87%, 84% & 93% accuracy in predicting SDB with AHI>5/hr, 15/hr & 30/hr respectively

REPORTING

- Basic study information
- Patient demographics
- Procedure performed
- Sleep Summary
- Respiratory Summary
- ECG Summary
- Periodic Limb Movement Summary
- Arousal Summary
- Oximetry Summary
- Titration Summary (In case of Titration study)
- Technologist Comments
- Impression and Recommendation

G3 report, page 1, upper tables

The standard Polysomnography Report from Sleepware G3 provides the statistics calculated from the scoring of the test, whether manual or auto scored. First, the patient information, along with the testing times, referring and interpreting physicians and a description of the test performed.

Polysomnography Report

Recording Identification

Patient name:	Patient	Acq #:	20005
First name:	Sample	Type:	Adult
Sex:	Male	Started:	5/11/2011 at 9:18:55 PM
Birth date:	1/20/1944	Stopped:	5/12/2011 at 4:19:19 AM
Patient age:	67 years	Duration:	7:00:24 hours (420.4 min)
Height:	70.0 in.	Weight:	250.0 lbs.
BMI:	35.9 lb/in²	Epworth:	17 / 24
Neck:	18 in.	Referring physician:	Referring, Physician
		Interpreting physician:	Interpreting, Physician
Recording Tech:	Recording Tech	Scoring Tech:	Scoring Tech
CPT Code:	95810	CPT Code Description:	Attended Polysomnography 4 or more channels

Procedure

Polysomnography was conducted on the night of 5/11/2011. The following parameters were monitored: frontal, central and occipital EEG, electrooculogram (EOG), submentalis EMG, nasal and oral airflow, anterior tibialis EMG, body position and electrocardiogram. Additionally, thoracic and abdominal movements were recorded by inductance plethysmography. Oxygen saturation (SpO2) was monitored using a pulse oximeter. The tracing was scored using 30 second epochs. Hypopneas were scored per AASM definition VIII.4.B (3% desaturation).

G3 report, page 1, lower tables

The next section shows the stages of sleep, time to stages from lights out, duration of each stage, sleep efficiency and distribution of sleep for this test.

Sleep Data

LIGHTS OFF (LO) : 9:40:25 PM   LIGHTS ON (LON) : 4:11:13 AM

LATENCIES	From Lights Off (min)
Sleep Onset	9.0 min
N1 :	9.0 min
N2 :	18.0 min
N3 :	34.5 min
REM :	57.5 min

DURATIONS

Time in Bed:	390.8 min		
Sleep Period Time:	361.5 min	Sleep Efficiency:	75.6%
Total Sleep Time:	295.5 min	WASO:	86.3 min
SWS Time:	44.5 min	TWK Time (tot):	95.3 min
REM Time:	73.0 min	Inter-Sleep WK:	18.3%
NREM Time:	222.5 min	Stage Shifts:	91

Sleep Stage Distribution

	Episodes (# of)	Duration (min)	TIB (%)	TST (%)
WK (SPT):	18	66.0		
WK (TIB) :	20	95.3	24.4	
REM:	11	73.0	18.7	24.7
N1 :	20	96.5	24.7	32.7
N2 :	23	81.5	20.9	27.6
N3 :	17	44.5	11.4	15.1

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G3 report, page 2, upper tables

On the second page begins the tabulation of the scoring results from the respiratory channels.

Calculations of the numbers of each event type, lengths of events, totals, and association with REM NREM stages.

Patient, Sample
Study Date: 5/11/2011

Page 2

Respiratory Data

	CA	OA	MA	Apnea	Hypop*	A+ H	RERA	Total
Number:	0	3	0	3	58	61	0	61
Mean Dur : (sec)	0.0	15.2	0.0	15.2	15.3	15.3	0.0	15.3
Max Dur (sec):	0.0	17.0	0.0	17.0	20.5	20.5	0.0	20.5
Total Dur (min) :	0.0	0.8	0.0	0.8	14.8	15.5	0.0	15.5
% of TST:	0.0	0.3	0.0	0.3	5.0	5.3	0.0	5.3
Index (#/h TST) :	0.0	0.6	0.0	0.6	11.8	12.4	0.0	12.4
REM Count:	0	0	0	0	9	9	0	9
NREM Count:	0	3	0	3	49	52	0	52
REM Index (#/h):	0.0	0.0	0.0	0.0	7.4	7.4	0.0	7.4
NREM Index (#/h):	0.0	0.8	0.0	0.8	13.2	14.0	0.0	14.0

*Above Index Values Based on Total Sleep Time ■ Hypopneas scored based on 3% or greater desaturation

Cheyne Stokes Breathing: None observed during study.

What are your observations?

|	CA	OA	MA	Apnea	Hypop*	A+ H	RERA	Total
Number:	2	36	1	39	22	61	0	61
Mean Dur : (sec)	19.3	18.5	36.0	19.0	33.2	24.1	0.0	24.1
Max Dur (sec):	28.0	38.0	36.0	38.0	99.0	99.0	0.0	99.0
Total Dur (min) :	0.6	11.1	0.6	12.4	12.2	24.5	0.0	24.5
% of TST:	0.7	12.1	0.7	13.5	13.3	26.8	0.0	26.8
Index (#/h TST) :	1.3	23.6	0.7	25.6	14.4	40.0	0.0	40.0
REM Count:	1	5	0	6	0	48.0/h	0	48.0/h
NREM Count:	1	31	1	33	22	55	0	55
REM Index:	8.0/h	40.0/h	0/h	48.0/h	0/h	48.0/h	0/h	48.0/h
NREM Index:	0.7/h	22.1/h	0.7/h	23.6/h	15.7/h	39.3/h	0.0/h	39.3/h

G3 report, page 2, lower tables

Next is the oximetry report summary, followed by the snoring summary. These tables and graphs on page 2 provide a look at the level of possible sleep disordered breathing recorded during this test.

Oximetry Summary

Average SpO2 (TST):	95.50%	Total Sleep Time 90 - 100%:	294.20 min
Average SpO2 (TIB):	96%	Percent Sleep Time 90 - 100%	99.56%
# Desaturations:	2	Total Sleep Time 80 - 89%:	1.30 min
Desaturation Index:	0.3 /hr	Percent Sleep Time 80 - 89%	0.44%
Min SpO2 Value During TIB:	85%	Total Sleep Time <88%:	0.30 min
Min SpO2 value During TST:	85%	Percent Sleep Time <88%	0.10%

Oximetry Evolution
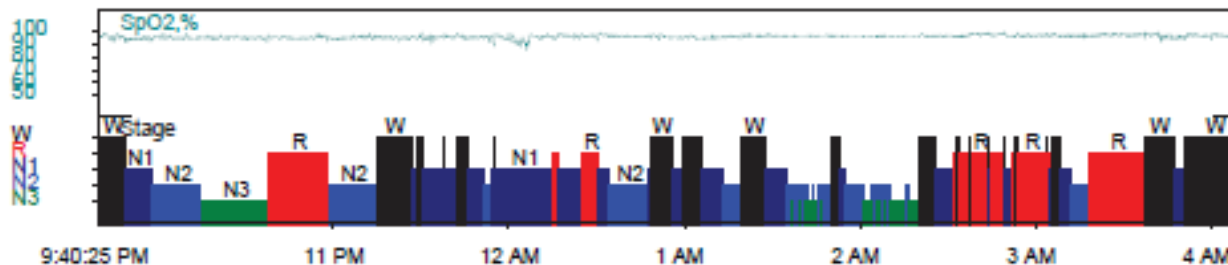
Snoring Summary

Snoring Episodes:	7
Snoring Index:	1.42 /hr of sleep
Total Time with Snoring:	0.1 min (0.0% of sleep)

SpO2>90%	Normal
SpO2 85-90%	Mild Desaturation
SpO2 75-85%	Moderate Desaturation
SpO2 <75%	Severe Desaturation

Sleep Related Hypoventilation/Hypoxemia

- At least one of the following

✓ SpO2<90% during Sleep for >5min with nadir of at least 85%

✓ >30% of TST with SpO2<90%

✓ Sleeping PaCO2 > waking PaCO2 disproportionately high

What is your observation?

G3 report, page 3, upper tables

The third page starts with the movement, arousal, and position summaries.

Leg Movements Summary

	Count	Index (#/h)
Total Leg Movements:	12	2.0
PLMS:	8	1.3
PLMS Arousals:	0	N/A

Arousal Summary

	REM	NREM	Arousals	Awakenings	Ar + Aw	Ar + Aw Index
Respiratory:	1	1	2	0	2	0.3
Leg Movements:	0	0	0	0	0	0.0
Snore:	0	0	0	0	0	0.0
Spontaneous:	1	1	3	0	3	0.5
Total:	2	2	5	0	5	0.8
Arousal Index:	1.6	0.5	0.8	0.0	0.8	

Events occurring during Wake are not included in the table above.

Body Position Summary

	Sleep (min)	TST (%)	REM (min)	NREM (min)	CA (#)	OA (#)	MA (#)	HYP (#)	AHI (#/h)	RERA (#)	RDI (#/h)	Desat (#)
Supine	19.4	6.57	0.0	19.4	0	0	0	8	12.7	0	12.7	0
Non-Supine	276.10	93.43	73.00	203.10	0.00	3.00	0.00	53.00	12.17	0	12.17	2.00
Left:	205.7	69.61	52.5	153.2	0	0	0	26	6.2	0	6.2	2
Right:	70.4	23.82	20.5	49.9	0	3	0	27	25.6	0	25.6	0

|	Duration (min)	TST (%)	REM (%)	NREM (%)	CA (#)	OA (#)	MA (#)	HYP (#)	AHI (#/h)	RERA (#)	RDI (#/h)	Desat (#)
Supine	11.0	3.83	0.0	31.8	0	3	0	0	51.4	0	51.4	5
Non-Supine	94.40	96.17	100.00	0.00	2.00	33.00	1.00	22.00	39.55	0	39.55	95.00
Left:	67.5	71.58	11.1	85.9	2	29	1	15	43.1	0	43.1	72
Right:	26.9	24.59	0.0	83.6	0	4	0	7	29.3	0	29.3	23

G3 report, page 3, lower tables

The last table is the Cardiac Summary and Cardiac Event Observations. The event observations are from the scored cardiac events noted during scoring of the test.

Cardiac Summary

Average Pulse Rate During Sleep (TST):	92 bpm
Highest Pulse Rate During Sleep (TST):	101 bpm
Highest Pulse Rate During Recording (TIB):	112 bpm

Cardiac Event Observations

Type	Yes	No	Rate / Duration
Bradycardia:	✓		Lowest HR Scored: 49 bpm
Unclassified Tachycardia:	✓		Highest HR Scored: 51 bpm
Sinus Tachycardia During Sleep:		✓	Highest HR Scored: N/A
Narrow Complex Tachycardia:	✓		Highest HR Scored: 50 bpm
Wide Complex Tachycardia:	✓		Highest HR Scored: 52 bpm
Asystole:		✓	Longest Pause: N/A
Atrial Fibrillation:	✓		Duration Longest Event: 8.5 sec

G3 report, page 4, hypnograms

This last page contains a hypnogram showing the stages of sleep, heart rate, oxygen saturation, each type of breathing event with duration, limb movements, arousals, and body positions. All displayed by time of occurrence. Altogether this report shows the basics to allow the interpreting physician to understand the results and use this information to make an accurate diagnosis.
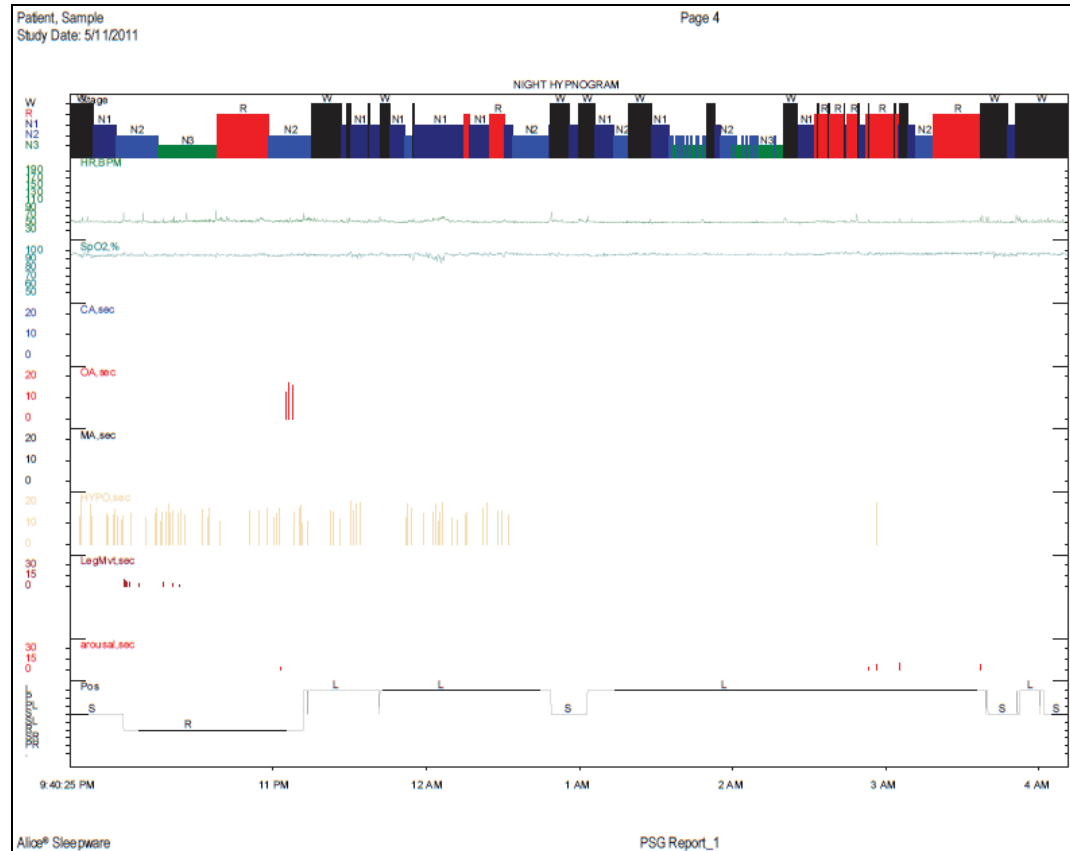
Titration report, page 4, pressure tables

This table shows the pressures used during the study, the time spent at each pressure and time spent in REM sleep at each pressure setting.
All breathing events scored at each pressure setting as well as the minimum oxygen saturations are also presented.

Patient, Sample   Page 4
Study Date: 5/11/2011

Pressure Distribution

CPAP	TIB (min)	Sleep (min)	REM (min)	Apneas CA#	OA#	MA#	Index	Hypopneas #	Index	RERAs #	Index	AHI	RDI	Min SpO2
5	7.3	2.8	0.0	0	0	0	0.0	0	0.0	0	0.0	0.0	0.0	93
7	22.6	14.2	0.0	0	0	0	0.0	0	0.0	0	0.0	0.0	0.0	93
10	105.5	86.0	26.5	0	0	0	0.0	1	0.6	0	0.0	0.6	0.6	95
11	44.1	32.0	18.5	0	0	0	0.0	0	0.0	0	0.0	0.0	0.0	91

What is your observation?

| IPAP	EPAP	TIB (min)	Sleep (min)	REM (min)	Apneas CA#	OA#	MA#	Index	Hypopneas #	Index	RERAs #	Index	AHI	RDI	Min SpO2
4	4	6.2	2.6	0.0	0	0	0	0.0	0	0.0	0	0.0	0.0	0.0	94
5	5	6.6	3.6	0.0	0	0	0	0.0	0	0.0	0	0.0	0.0	0.0	90
6	6	8.1	6.4	0.0	0	0	0	0.0	0	0.0	0	0.0	0.0	0.0	93
7	7	6.0	3.8	0.0	0	0	0	0.0	0	0.0	0	0.0	0.0	0.0	91
8	8	4.4	4.4	0.0	0	0	0	0.0	0	0.0	0	0.0	0.0	0.0	94
9	9	3.7	3.7	1.3	0	0	0	0.0	1	16.2	0	0.0	16.2	16.2	89
10	10	124.7	121.7	42.9	2	0	1	1.5	1	0.5	0	0.0	2.0	2.0	89
11	11	91.9	88.5	24.0	0	0	0	0.0	0	0.0	0	0.0	0.0	0.0	92
12	11	5.2	2.7	0.0	0	0	1	22.2	0	0.0	0	0.0	22.2	22.2	93

Titration report, pressure tables

In the pressure tables are areas displaying the type and size of mask used during the study. Beginning pressure, maximum, and optimal pressures are also included in the summary table.

Beneath that area of the report are two places for technician notes: Recording Tech Notes and Scoring Tech Notes. A sleep facility can determine what is to be put in these areas to best assist the interpreting physician with the job of prescribing the best mask and PAP therapy for the patient. Perhaps noting if the patient has facial hair or if the patient was intimidated by the mask and CPAP machine or if a strap was used to help keep the mouth closed during therapy.

Pressure Summary

Starting Pressure:	4	Mask Type:	Full Face
Maximum Pressure:	18	Mask Size:	Large
Optimal Pressure:	18	Ramp / C-Flex Setting:	3

Technician Notes

Recording Tech Notes: Notes Notes Notes

Scoring Tech Notes: Notes Notes Notes

# Titration report, page 5, hypnograms

This last page contains a hypnogram showing the stages of sleep, heart rate, oxygen saturation, each type of breathing event with duration, limb movements, arousals, body positions and the CPAP pressure used for this patient. All displayed by time of occurrence. This report shows the basics to allow the interpreting physician to understand the results of a CPAP titration and use this information to accurately prescribe PAP therapy for the patient.

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What are your observations?

All Night Hypnogram
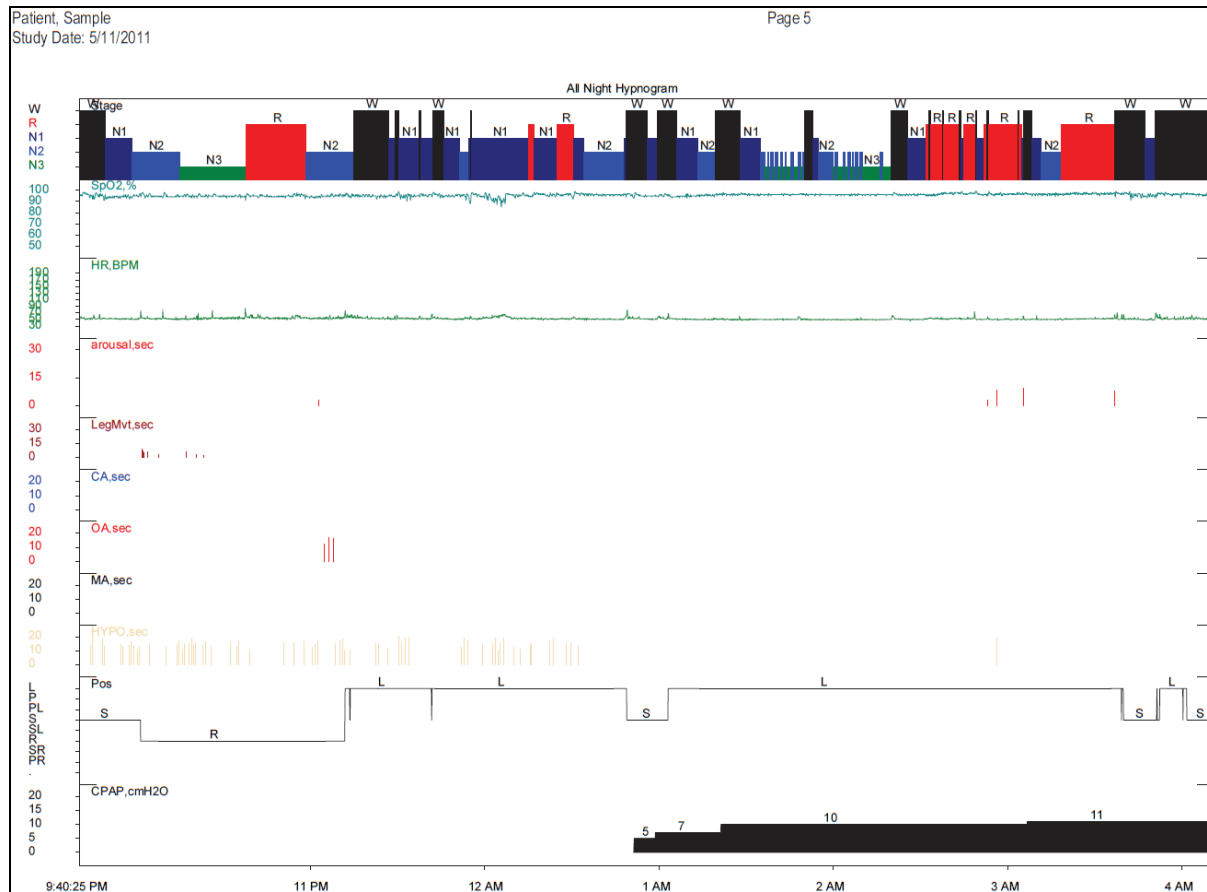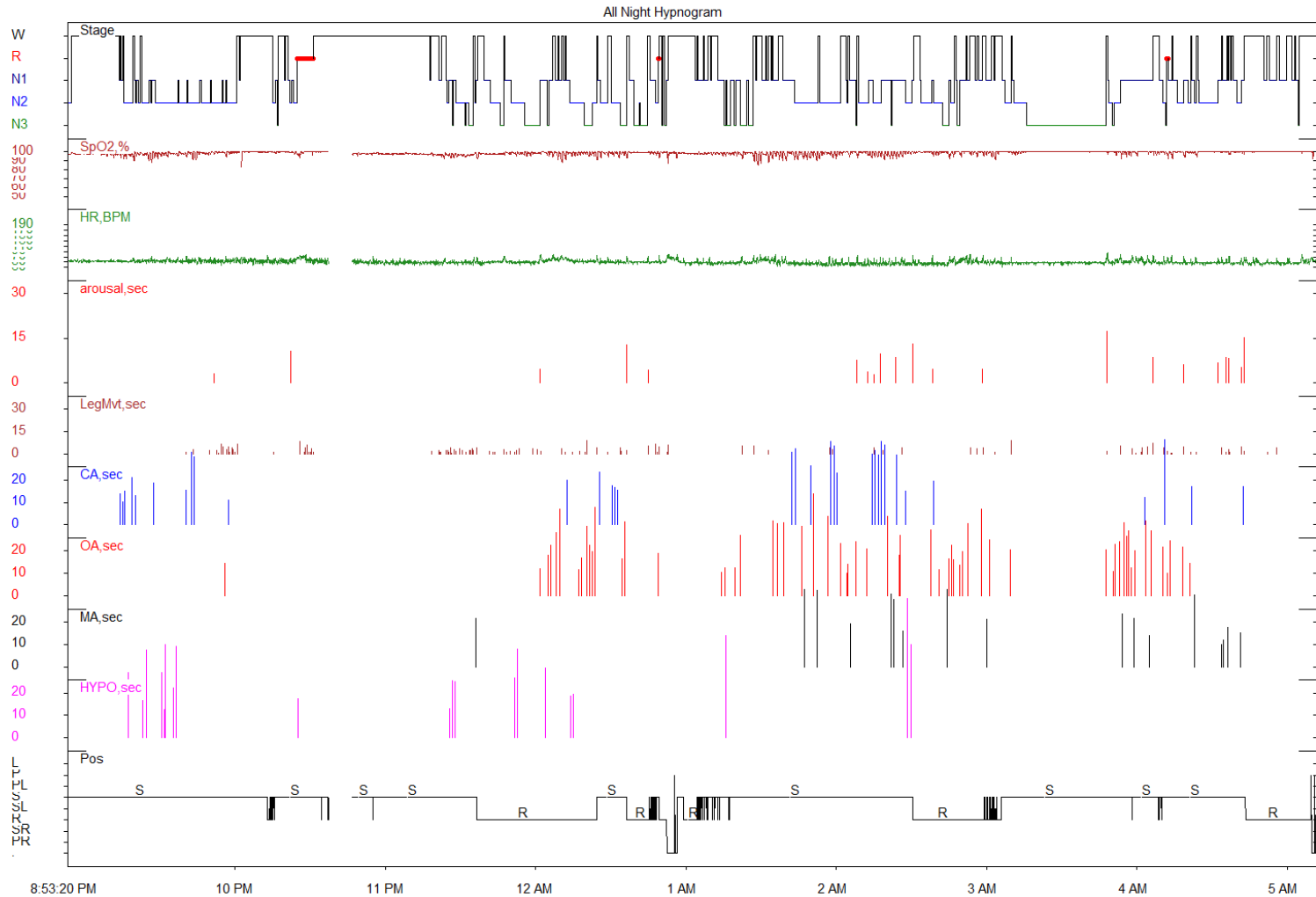
What are your observations?
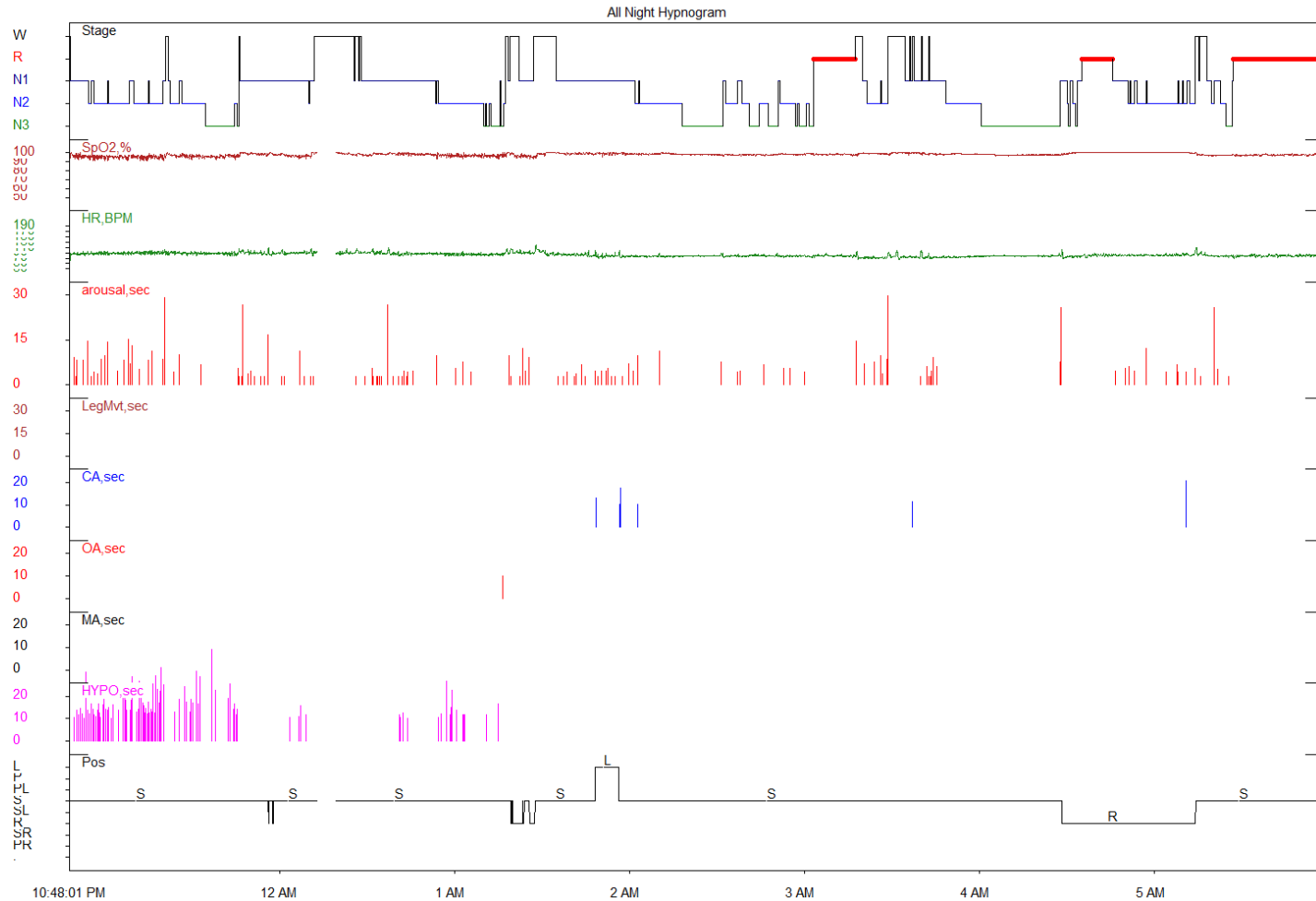
Split Night Report

- Contains all the information of diagnostic and treatment portions side by side

What are your observations?

Thank You

I thanks Richard Swanson for sharing some of the Slides on G3 Report template.