

# How to interpret your sleep study

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- You go to your doctor/sleep specialist for consultation (or your bed partner tells you to), because of symptoms of
  - Snoring, gasping/choking, stop breathing at night
  - Daytime sleepiness or tiredness
  - Drowsy driving
  - Morning headaches, dry mouth, sore throat
  - Decreased sex drive, waking up often to urinate
  - Mood, memory, attention problems, drowsy driving
  - Twitching and jerking in limbs at night
  - Difficulty falling or staying sleep
- Your doctor/sleep specialist recommends an overnight sleep study (polysomnogram)
  - Intimidating test: fill out questionnaires, sleep in a strange environment (sleep lab/center), no family members allowed, hooked up to electrodes and wires, feel you are being watched, woken up early, made to fill out more questionnaires and kicked out
- A few days later, your doctor/sleep specialist call you to give you the results and what to do next
- You may or may not get a copy of your sleep study report, which is as intimidating as the test itself
- The goal of my talk is to help you understand what is going on and how to make sense your report.....

# Indications for sleep studies (polysomnogram or PSG)

- Commonest indication:
  - Sleep disordered breathing (**obstructive sleep apnea**, upper airway resistance syndrome, primary snoring)
- Less common indications:
  - Severe parasomnias
  - REM behavior disorder
  - Nocturnal seizures
  - Narcolepsy
  - Periodic limb movement disorder
  - Bruxism
  - Occasionally insomnia

# Sleep Study (Polysomnogram)

- Noninvasive, pain-free procedure that usually requires spending a night or two in a sleep facility. The testing bedrooms are designed to resemble a typical bedroom, with décor and televisions to help make you feel as relaxed as possible.
- Occasionally daytime studies are performed (night shift workers, MSLT and MWT)
- During a polysomnogram, a sleep technologist, will hook you up to electrodes and wires so that they can simultaneously record multiple biological functions during your sleep, on a digital recording
- Depending on the physician's orders, patients may be given therapy during the course of the study, which may include device called continuous positive airway pressure therapy (CPAP), oxygen, oral appliance or allowed to take their own medication.
- After a full night's sleep is recorded, the data will be tabulated by a technologist, scored by a registered polysomnographic technologist and presented to for interpretation.

# Interpretation of sleep studies

- The interpreting physician is a board certified sleep physician who must
  - *Review the entire history, techs and scorers notes, patient questionnaires*
  - *Review entire scored digital recording (raw data).*
  - *Simultaneously review tabulated data*
- Form a summary, impression and recommendations
- The clinical judgment of the sleep specialist is a key element in the interpretation.

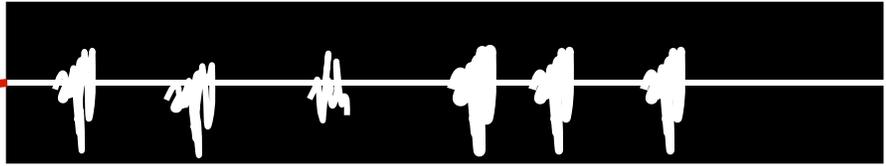
# Channels commonly recorded during a PSG

- Brain wave activity (EEG),
- Eye movement (EOG),
- Muscle tone (chin EMG),
- Airflow via thin catheters placed in front of nostrils and mouth
- Breathing effort via belts placed over chest and abdomen
- Snoring (microphone placed over the neck)
- heart rhythm (EKG)
- Oxygen level (SpO2)
- Leg muscle activity (PLM)
- Body position
- Video recording

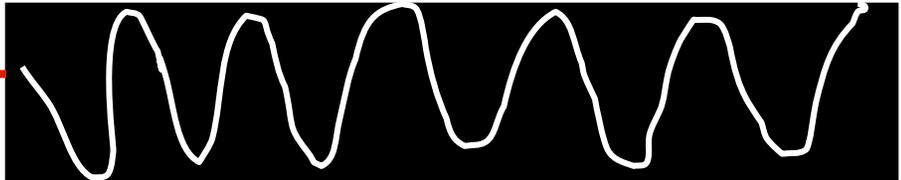
Intercom to communicate with technician



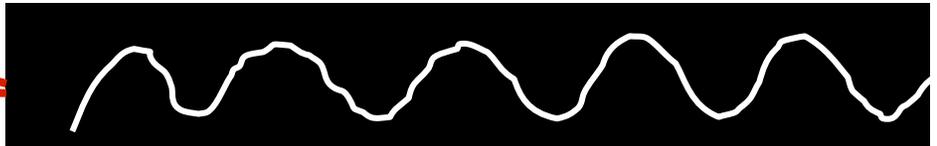
**Snoring sound transducer**



**Nasal and Oral Airflow**



**Chest and abdomen Respiratory Effort**



**Leg muscle activity**



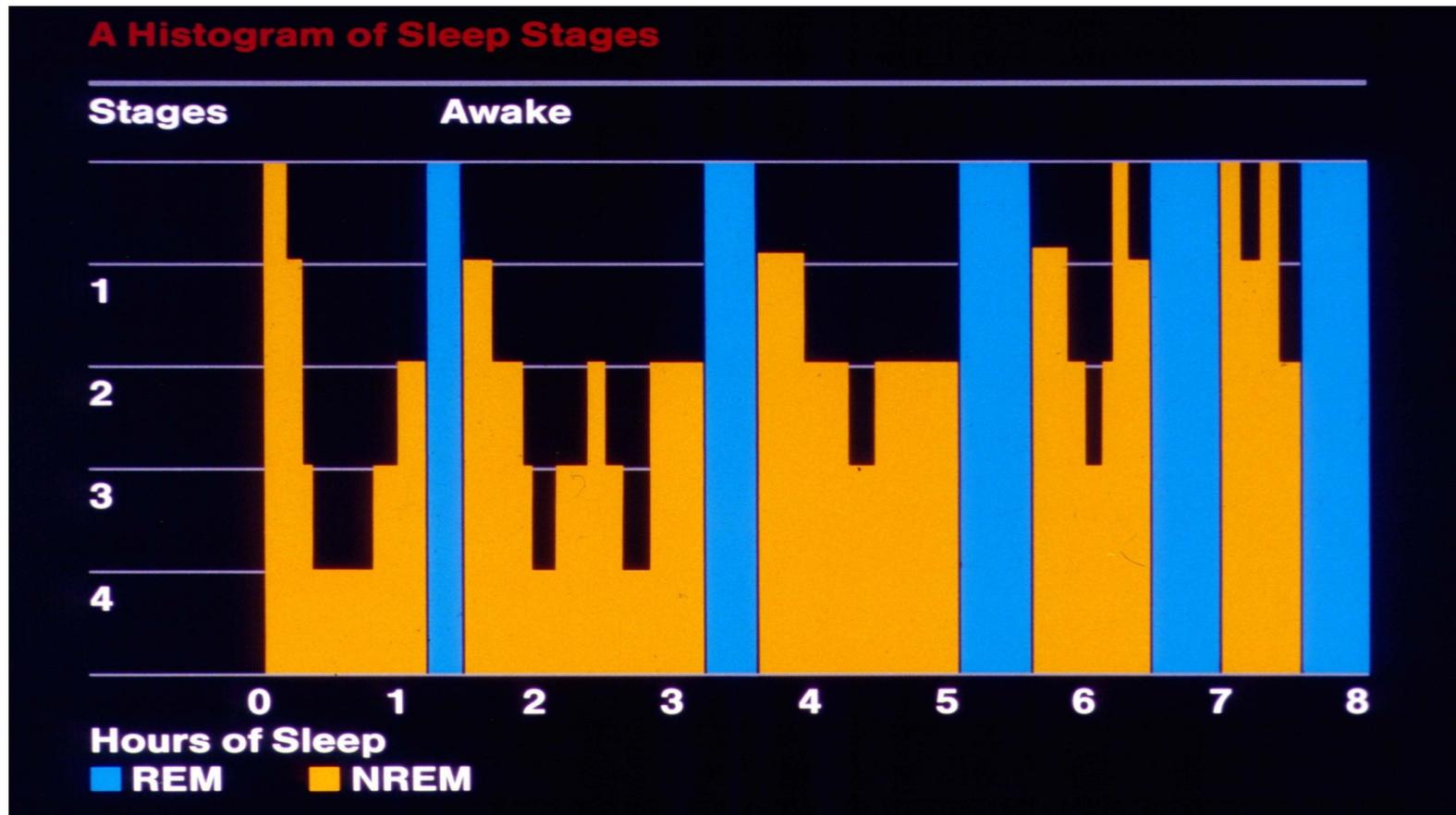
# Stages of Sleep

- Stage W (Wakefulness)
- Stage NREM
  - Stage N1
  - Stage N2
  - Stage N3
- Stage R (REM)

# Sleep Cycles

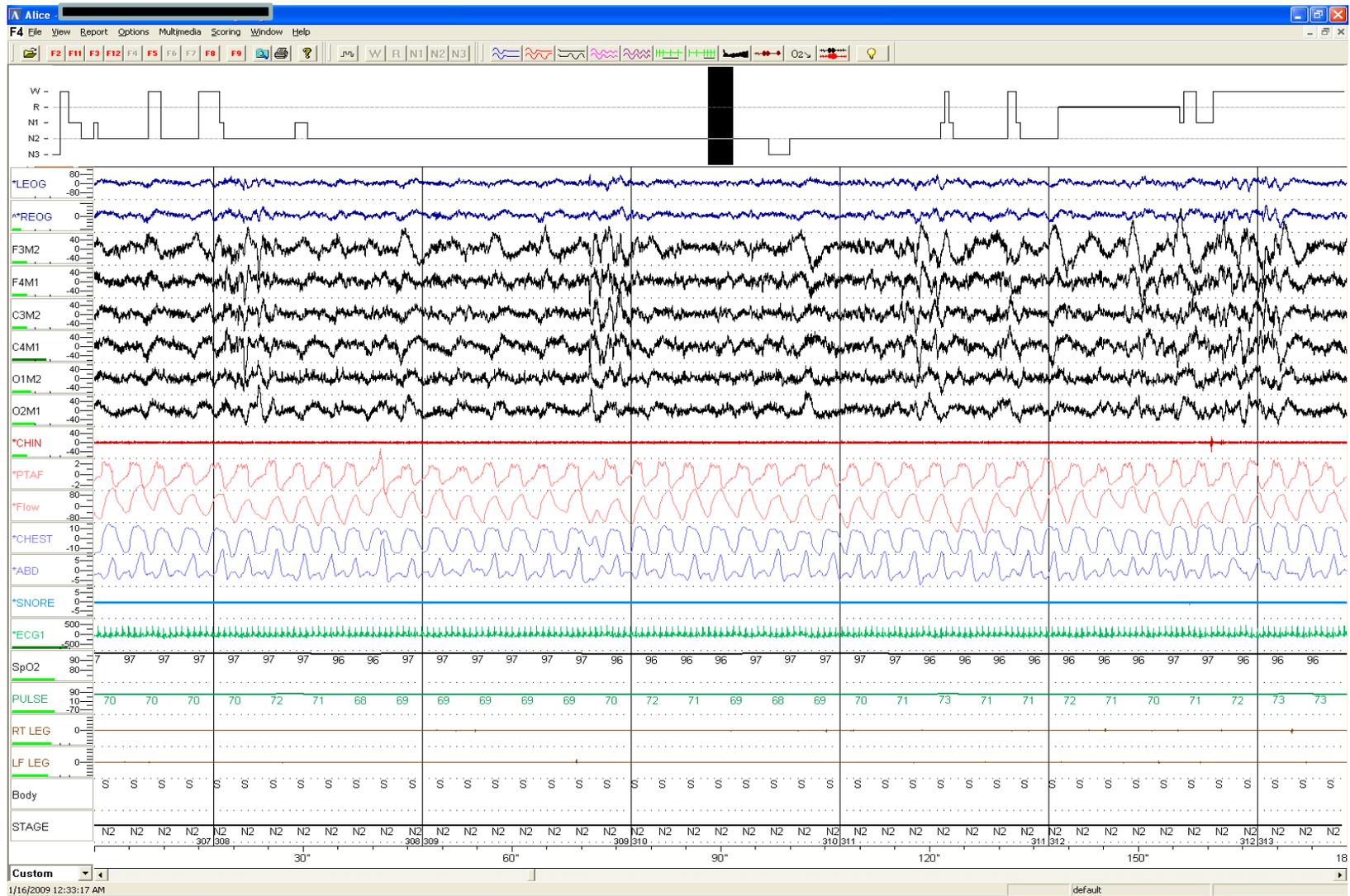
- Normal sleep consists of 4 - 6 cycles of NREM sleep alternating with REM sleep every 90-120 minutes
- First two cycles are predominantly NREM
- Later stages (early am) are predominantly REM

# Hypnogram of Normal Sleep Stages

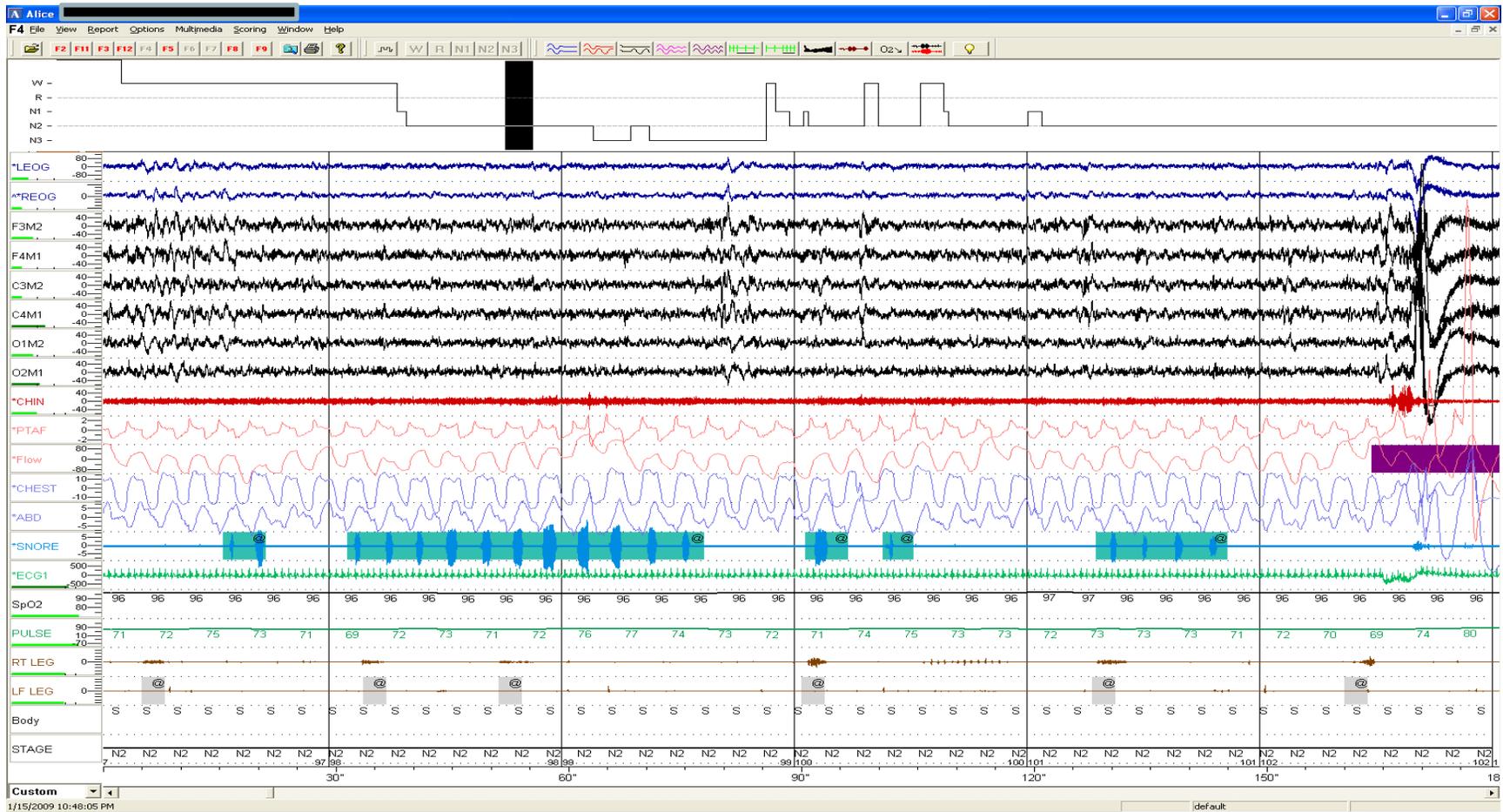




# At fast speed



# Snoring

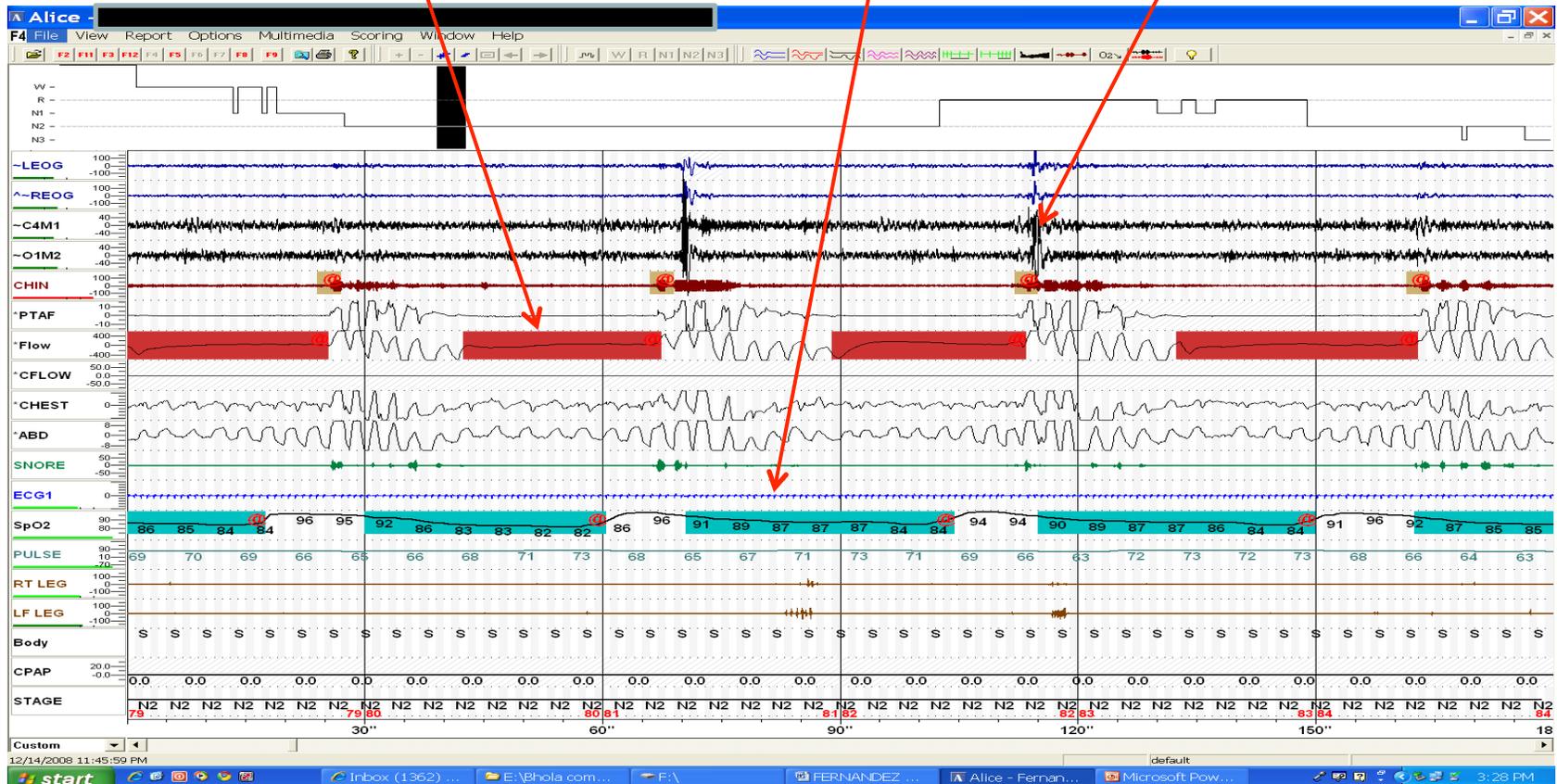


# Apneae

- *Obstructive*
- *Central*
- *Mixed*

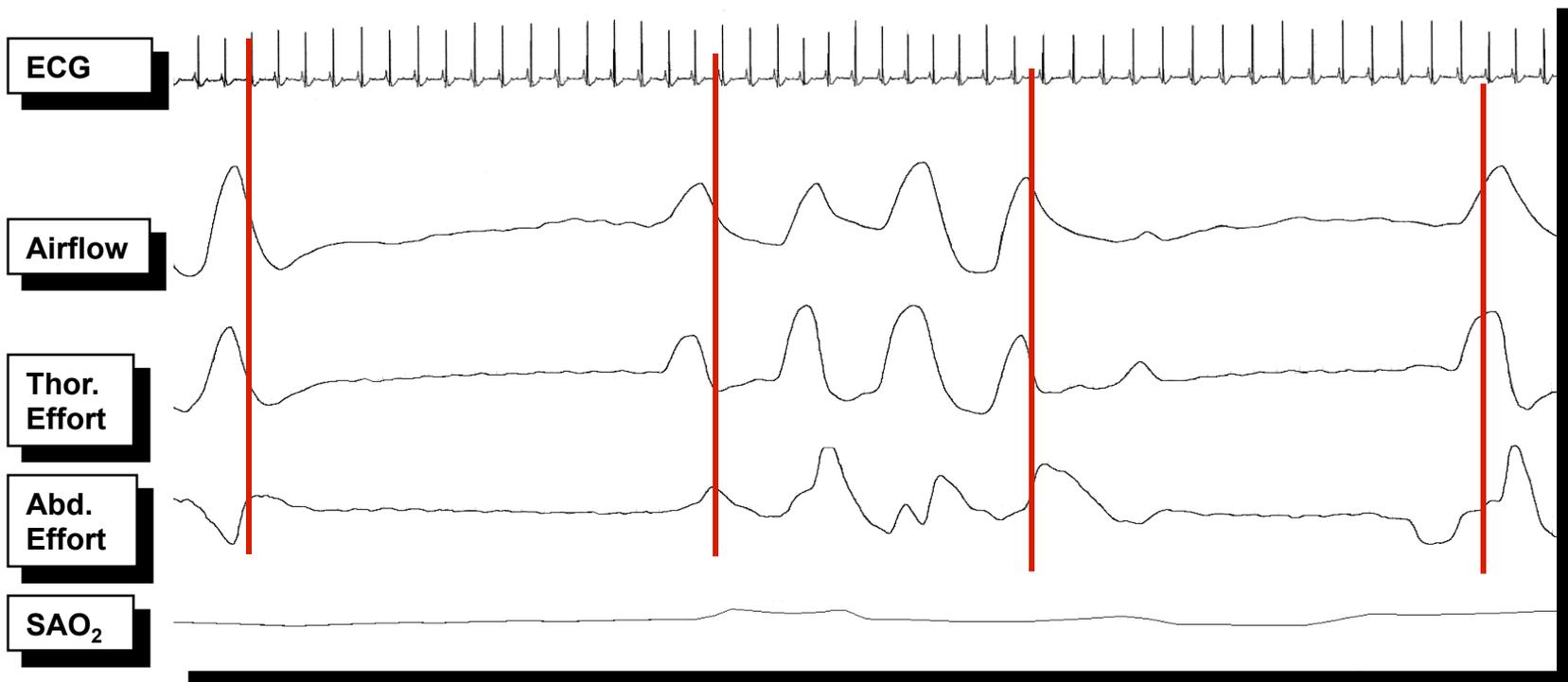
# Obstructive Apnea

Complete airway collapse causing cessation of airflow at nose and mouth for at least 10 secs, with drop in oxygen level and arousal from sleep



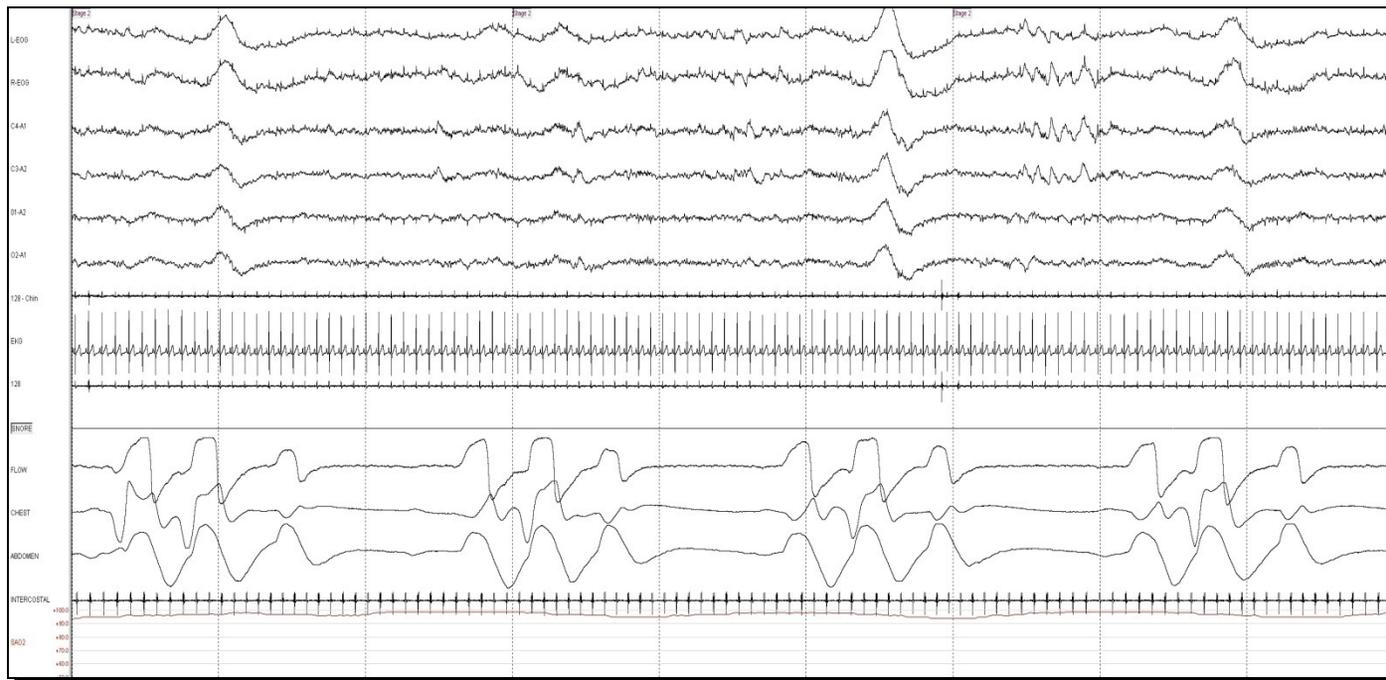
# Central Apnea

- *Complete absence of airflow* for >10 secs accompanied by a *complete absence of respiratory effort*
- *Signal from the brain to breathe is delayed*
- *Types: idiopathic, high altitude, narcotic induced, CSR*



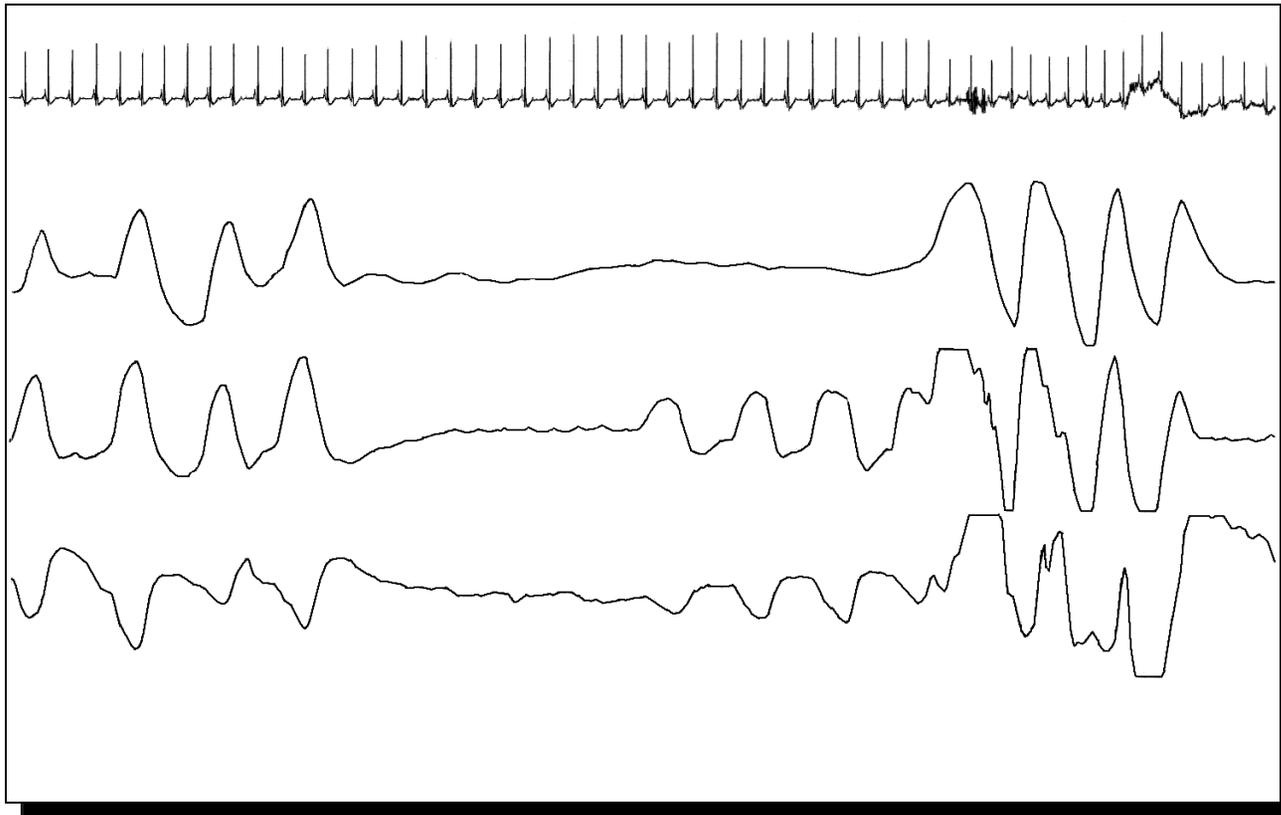
# Cheyne-Stokes respiration

- A crescendo-decrescendo respiratory pattern
- Usually associated with CHF, neurologic disease
- Atrial fibrillation may be present



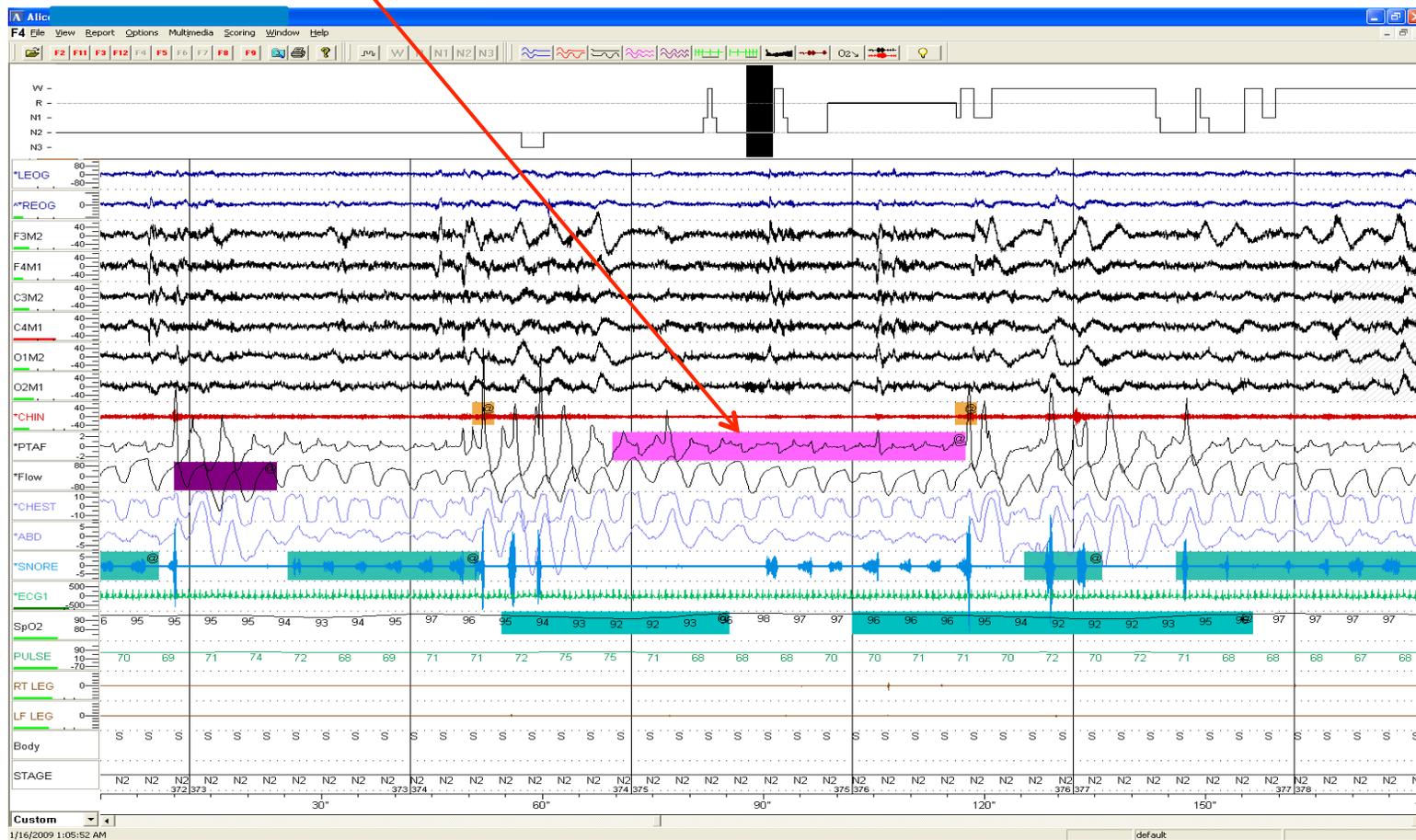
## Mixed apnea

- A *complete absence of airflow* for >10 secs accompanied by *complete absence of respiratory effort at the beginning* of the event, followed by a *gradual increase in effort* which eventually breaks the apnea



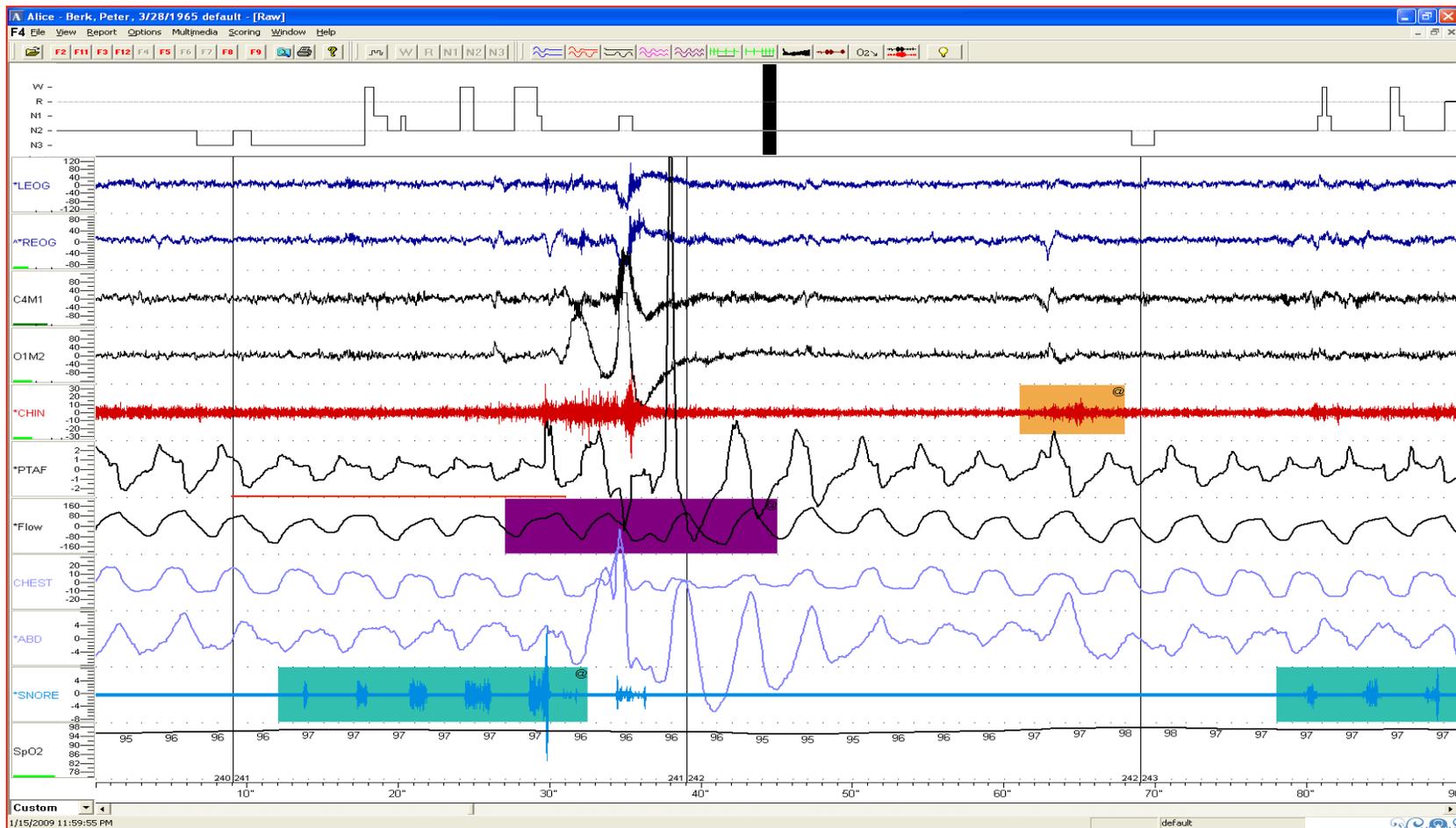
# Hypopnea:

- Partial airway collapse causing shallow breathing (airflow reduced by at least 30-50%) during sleep, lasting 10 seconds or longer, usually associated with a fall in blood oxygen saturation.
- Physiologically same as an apnea



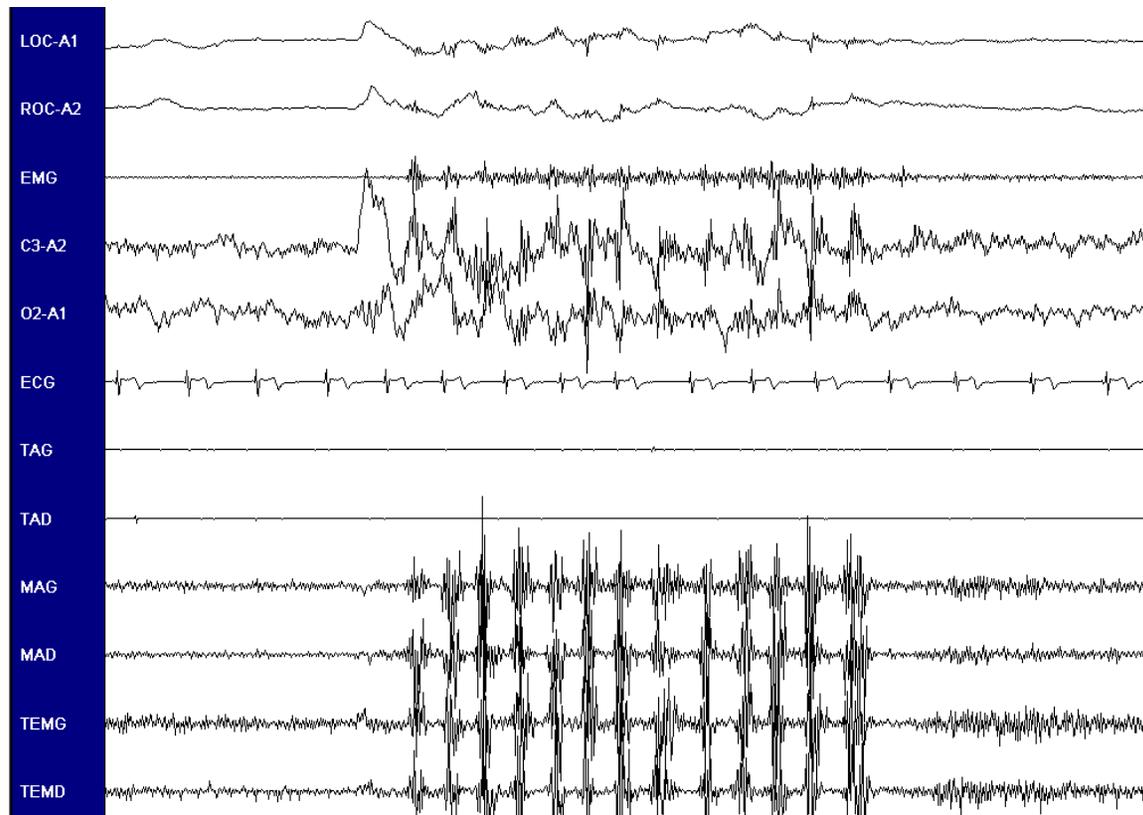
# Respiratory Effort Related Arousal (RERA)

- A sequence of breaths characterized by *marked decreased in airflow* for at least 10 secs, with *increased respiratory effort, no desaturation* and *which leads to an arousal from sleep*



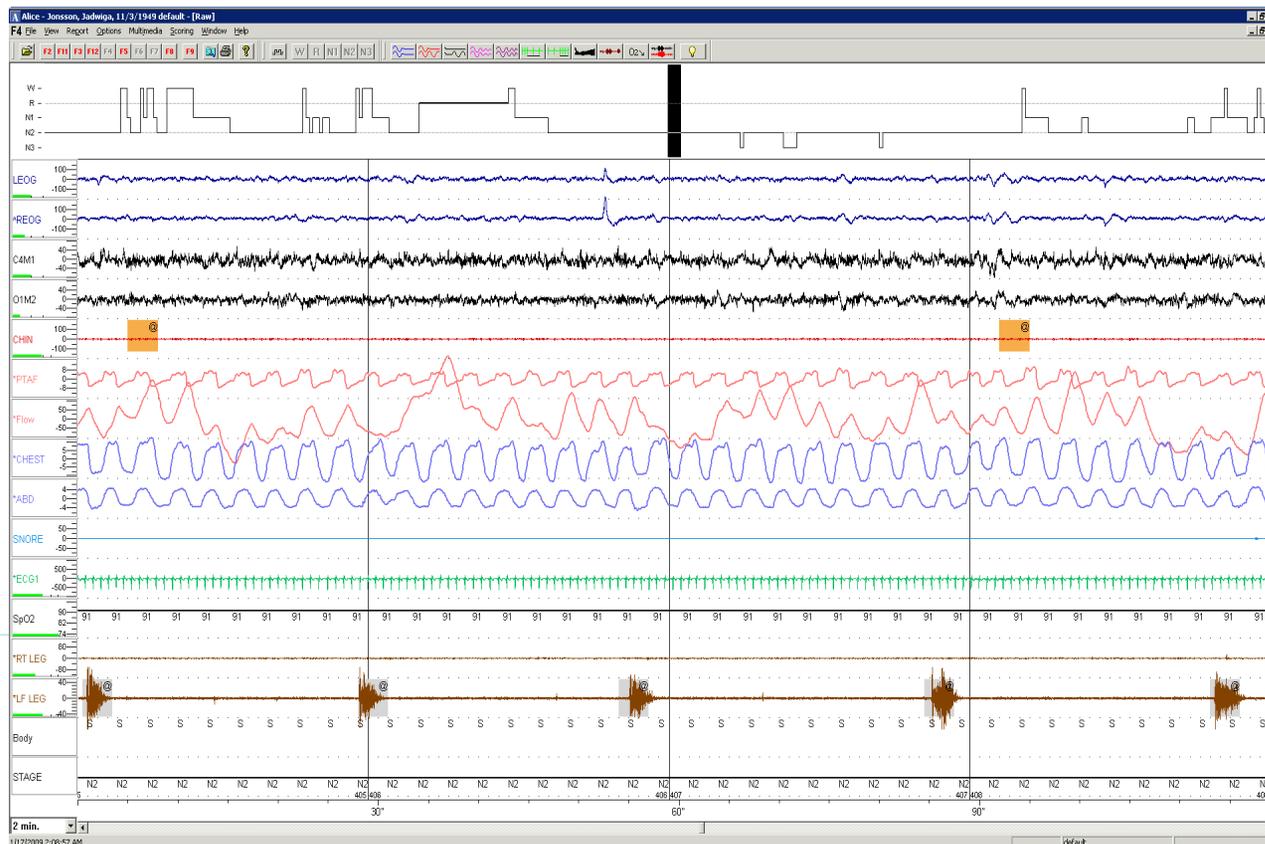
# Bruxism (teeth grinding)

- In sleep, jaw contraction frequently occurs.
- Detected on chin EMG electrodes
- Additional *electrodes* may be placed



# Leg movements (Periodic Leg Movements)

- **Total number of periodic limb movements of sleep (PLMS)**
  - Counted from R and L leg electrodes
  - Movements must occur as part of **4 consecutive movements**
- **PLM index**=number of PLMS per hour of sleep (>15/hr significant)
- **PLM arousal index**=PLMS associated with arousals per hour of sleep
- **PLMS can be seen**
  - during CPAP titration and generally dissipate upon treatment
  - Can be seen in RLS/PLMD
  - secondary to medications



## Also look for

- EEG abnormalities
  - alpha intrusion (seen in pain syndromes)
  - seizure waveforms
- Behavioral abnormalities (sleep talking etc)
- Parasomnias: defined as undesirable motor, or verbal phenomena that arise from sleep or sleep-wake transition (confusional arousals, night terrors, REM behavior disorder)





# Review of Sleep Study Times, formulas and calculations:

- Sleep statistics
  - Lights Out
  - Light On
  - Total Recording Time
  - Total Sleep Time
  - Sleep Latency
  - Sleep Efficiency
  - Rem Latency
  - WASO (wake after sleep onset)
  - Time and percentage in each sleep stage

# Sleep architecture

*Distribution (percentage) of Sleep Stages during Normal Sleep*

NREM stage

Stage N1

Stage N2

Stage N3 (slow wave sleep)

Stage REM

Absent or decreased N3 and/or REM often seen in obstructive sleep apnea

Rebound often seen with CPAP titration

# Distribution of Sleep Stages during Normal Sleep

- 75-80% of total sleep is typically NREM

<u>NREM stage</u>	<u>% Total sleep time</u>
Stage 1	3-8
Stage 2	45-55
Stage 3/4	15-20

- 20-25% of total sleep is in stage REM

# Arousals

- “Micro-awakenings”
- Abrupt change of EEG from a deeper stage of NREM sleep to a lighter stage, or from REM sleep toward wakefulness, with the possibility of awakening as the final outcome.
- An arousal may be accompanied by increased chin (EMG) activity and heart rate, as well as by an increased number of body movements
- Minimum duration is 3 secs
- Types: respiratory, PLMs, spontaneous
- Increased arousals are associated with increased daytime sleepiness and decreased performance, similar to that seen in sleep deprivation
- *Arousal index*=the number of arousals per hour=measure of sleep fragmentation
- Age dependent
  - *10-12/hr are normal at age 20*
  - *20-22/hr are normal at age 50-60*
- Increase in Insomnia and severe sleep apnea

# Respiratory Events

- Number of obstructive apneas
- Number of mixed apneas
- Number of central apneas
- Number of hypopneas
- Respiratory effort related arousals (RERAs)

## Apnea Hypopnea index (AHI)

**AHI**= All apneas+hypopneas/Total sleep time (hrs)

*supine AHI*

*REM and NREM AHI*

**RDI**=All apneas+hypopneas+RERAs/Total sleep time (hrs)

# EKG abnormalities during sleep

- Heart rate too fast (tachycardia) or too slow (bradycardia)
- Heart rhythm irregular
- Pauses

# Oxygen saturation

- Baseline oxygen saturation (at the start of the study)
- **Lowest oxygen saturation during sleep**
  - Above 90% normal
  - 85-90% mild
  - 75-85% moderate
  - <75% severe

**Sleep Disordered  
Breathing**

```
graph TD; A[Sleep Disordered Breathing] --- B[Snoring]; A --- C[UARS (+/-snoring)]; A --- D[OSA (+/-snoring)];
```

**Snoring**

**UARS  
(+/-snoring)**

**OSA  
(+/-snoring)**

# Primary Snoring

- Incidence: at least 24% adult women, 40-50% of adult men and 10% children
- Bed partner reporting
- Not associated with airflow limitation, arousals from sleep, or oxygen desaturation
- Risk of developing OSA with age or weight gain
- Higher prevalence of CV disease (hypertension, stroke, ischemic heart disease) in snorers, on epidemiological studies

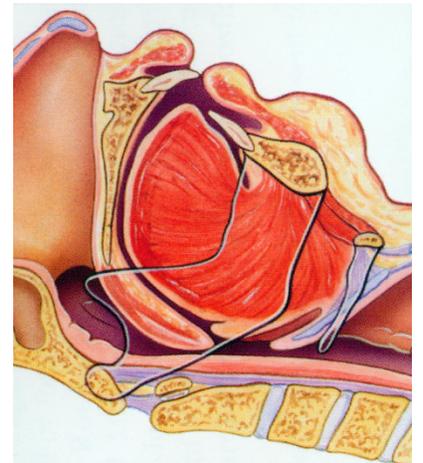
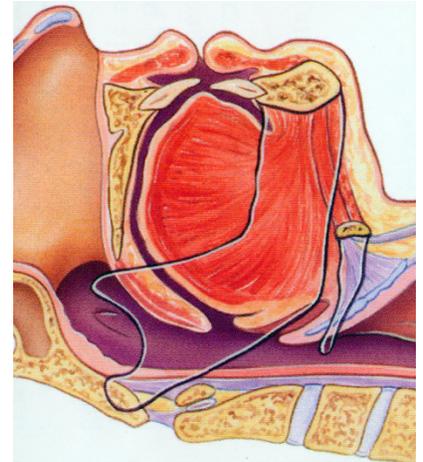
## Upper Airway Resistance Syndrome

- Now included as part of the OSA diagnosis
- UARS: > 5 RERA's per hour of sleep

# Obstructive Sleep Apnea

- The disorder is characterized by
  - recurrent episodes of upper airway obstruction
  - episodic oxyhemoglobin desaturation during sleep
  - recurrent arousals

**Typically worse in supine, REM**



# Diagnosis of OSA:

**AHI > 5/hr**

## **Severity of Obstructive Sleep Apnea**

AHI/RDI 5-15 mild

AHI/RDI 15-30 moderate

AHI/RDI > 30 severe

# Central Sleep Apnea Syndrome

- Central apneas  $\geq 5$ /hr and symptoms of either excessive sleepiness or disrupted sleep
- Central apneas frequently co-exist with obstructive or mixed apneas and hypopneas
- If  $> 50\%$  of events are purely central = CSAS

# When do we treat OSA

CMMS's\* Definition of Obstructive Sleep Apnea (OSA)

**CPAP** will be covered for adults with sleep disordered breathing if:

AHI/RDI > 15 *OR*

AHI/RDI 5-15 with

Daytime sleepiness

Hypertension

Stroke

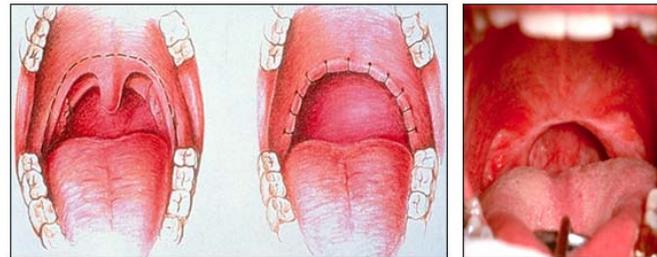
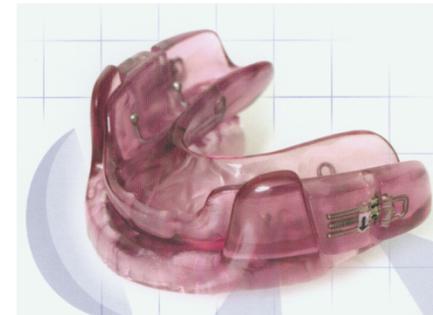
Ischemic heart disease

Insomnia

Mood disorders

# OSA Rx

- CPAP
- Dental Appliance
- ENT Surgery
- Positional Rx
- Wt loss
- Avoid sedatives/ETOH
- Maximize nasal patency



# CPAP

- Pneumatic splint-keeps airway open
- Non invasive
- Continuous pressure

## Types of Sleep Reports

- Diagnostic PSG Reports
- CPAP Titration Reports
- Split Night Reports
- MSLT/MWT Reports

Lexington Medical Services, PLLC  
Sleep Disorders Center  
New York, NY

## DIAGNOSTIC SLEEP REPORT

**MEDICAL  
CONDITIONS  
ASSOCIATED  
WITH OSA**

Name:	John Doe	Birthdate:	10/1/1956
Test Date:	11/28/2008	Age:	52 yrs
Interpreting Physician:	Anita Bhola, MD	Gender:	Male
Scoring Technologist:	T. Oram RPSGT	Test Description:	NPSG

**SYMPTOMS  
CONSISTENT  
WITH OSA**

**Brief Summary of Statistics: Lights Out: 10:12:25 PM ~ Lights On: 5:12:25 AM**

Mr. Doe is a 52 year-old male referred by Dr. Sleepy with symptoms of snoring witnessed apneas and daytime sleepiness. His physical examination is significant for a Mallampati class 3 oropharynx. His Epworth Sleepiness Score is 8. The patient is 73 inches in height and 225 pounds in weight, with a Body Mass Index (BMI) of 30. Medical history provided by the patient and/or referral sheet from the referring physician, is significant for hypertension, coronary artery disease and he is s/p CABG in 2003. His current medications are metoprolol, furosemide, Lipitor, amlodipine, isorbide and hydrochlorothiazide. The patient's normal bedtime is 10:00 pm. **Nocturnal Polysomnography (NPSG)** was ordered to rule out the diagnosis of obstructive sleep apnea (OSA).

During this the following were monitored: frontal, central and occipital EEG, electrooculogram (EOG), submental EMG, nasal and oral airflow, thoracic wall motion, anterior tibialis EMG, and electrocardiogram. Arterial oxygen saturation was monitored with a pulse oximeter. Patient was monitored by video. The tracing was scored using 30 second epochs. Sleep latency was defined as lights out to the first epoch of any sleep (AASM). Hypopneas were scored per AASM definition

**DECREASED  
SLEEP  
EFFICIENCY**

**Sleep Architecture**

Total Recording Time (min)	420	N1:	39.9% (139.0 min.)	Wake After Sleep Onset (WASO):	58.5 min.
Sleep Period Time (min)	406.5	N2:	36.4% (126.5 min.)	Sleep Latency (min)	13.5
Total Sleep Time (min)	348	N3:	0.0% (0.0 min.)	REM Latency (min)	80
Sleep Efficiency (%)	82.9	Stage R:	23.7% (82.5 min.)		

**Arousal Statistics**

	Total #	Respiratory	Limb Movement	Snore	Spontaneous
REM	62	60	0	0	2
NREM	173	158	0	2	13
WAKE	0	0	0	0	0
TOTAL	235	218	0	2	15
INDEX	40.5	37.6	0	0.3	2.6

**INCREASED  
AHI**

**Respiratory Events**

# Obstr. Apnea:	1	RDI (/hr):	38.6
# of Mixed Apnea:	0	AHI (/hr):	38.3
# of Hypopneas:	221	AHI NREM (/hr):	36.4
# of Central Apnea:	0	AHI REM (/hr):	44.4
# RERA:	2	AHI supine (/hr):	59.2

**AHI  
ELEVATED  
IN REM**

**AHI ELEVATED  
IN THE SUPINE  
POSITION**

**SpO2 Statistics**

Baseline Saturation:	97%
Lowest Sat During Sleep:	78%

**DECREASED  
OXYGEN  
SATURATION**

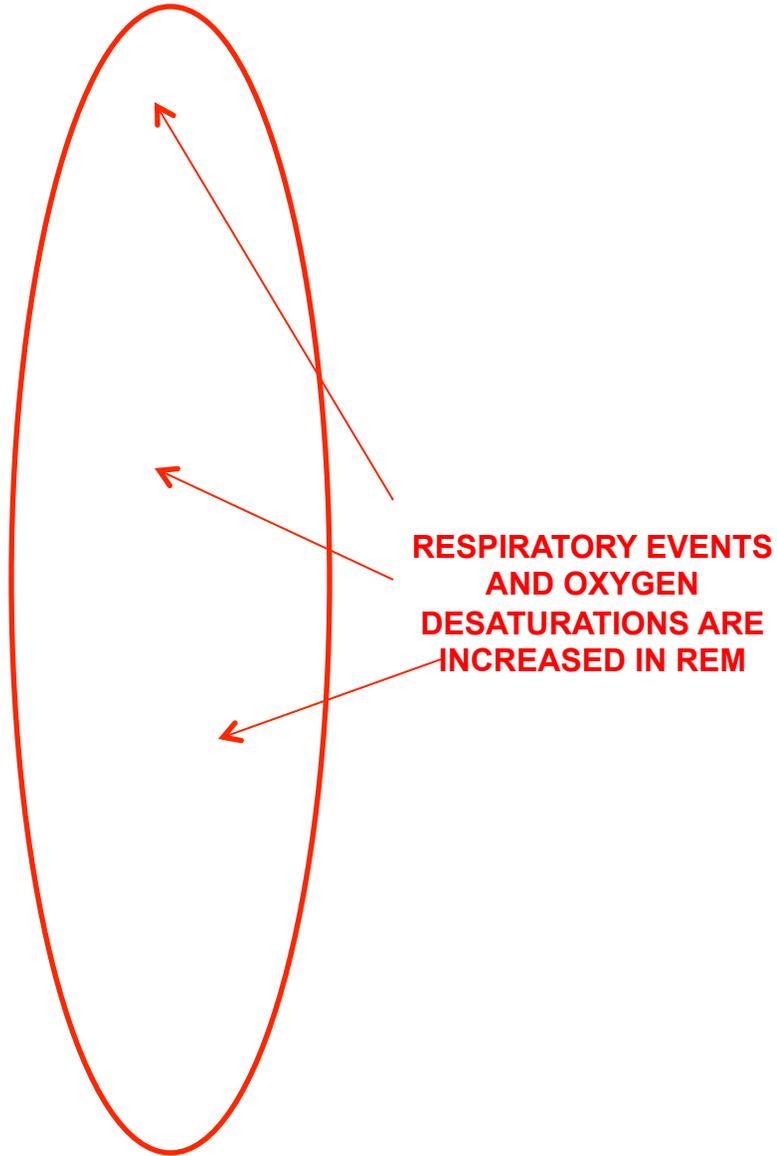
**PLM Events**

PLM:	12
PLM Index (/hr):	2.2 (/hr)
PLM Arousals:	6
PLM Arousal Index (/hr):	0.8 (/hr)

**INSIGNIFICANT #  
OF LEG  
MOVEMENTS**

Obstructive sleep apnea syndrome,  
severe, with desaturation in REM sleep

**The patient is advised to return for a  
CPAP titration study.**



## CPAP Titration Study

- Overnight study with same hook up as NPSG, with the addition of CPAP
- Occasionally a non-benzodiazepine sleep aid may be prescribed if poor sleep efficiency is detected on the PSG
- Prior to starting study, mask fitting and desensitization with lowest level of CPAP and humidification
- CPAP increased, once asleep, to eliminate airway collapse, snoring and correct drop in oxygenation (goal is AHI <5/hr)
- Occasionally need to switch to
  - BiPAP: if pressure requirements too high, patient has difficulty exhaling against the pressure of the machine
  - C-Flex or Expiratory pressure relief: for patient comfort to offer breath by breath exhalation relief
- Once optimal CPAP pressure is determined, order is placed with DME
- Recommendations are made for follow up with the physician
- Rarely patients may need to return for repeat testing if no optimal pressure is determined

*Lexington Medical Services, PLLC*  
*Sleep Disorders Center*  
*New York, NY*  
**CPAP TITRATION REPORT**

Name:	John Doe	Birthdate:	3/12/1959
Test Date:	1/9/2009	Age	49 yrs
Interpreting Physician:	Anita Bhola, MD	Gender:	Male
Scoring Technologist:	T. Oram RPSGT	Test Description:	CPAP Titration

**HISTORY OF SEVERE OSA**

**Brief Summary of Statistics: Lights Out: 10:28:46 PM ~ Lights On: 5:20:46 AM**

Mr. Doe is a 49 year-old male, initially referred by Dr. Sleepy with symptoms of snoring witnessed apnea and daytime sleepiness. His physical examination is significant for a Mallampati class 3 oropharynx. His Epworth Sleepiness Score is 8. The patient is 73 inches in height and 225 pounds in weight, with a Body Mass Index (BMI) of 30. Medical history provided by the patient and/or referral sheet from the referring physician, is significant for hypertension, coronary artery disease and he is s/p CABG in 2003. His current medications are metoprolol, fosinopril, Lipitor, amlodipine, isorbide and hydrochlorothiazide.

The patient's normal bedtime is 10:00 pm. Mr. Doe had a previous NPSG study done on 11/28/2008 at Lexington Medical Service's Sleep Disorders Center, which revealed an AHI of 38.3 and lowest saturation of 78% in REM sleep, consistent with a diagnosis of severe obstructive sleep apnea with desaturation. **CPAP Titration** was ordered to determine if CPAP is an effective treatment for the patient's condition and to determine the optimal CPAP pressure.

During this the following were monitored: frontal, central and occipital EEG, electrooculogram (EOG), submentalis EMG, nasal and oral airflow, thoracic wall motion, anterior tibialis EMG, and electrocardiogram. Arterial oxygen saturation was monitored with a pulse oximeter. Patient was monitored by video. The tracing was scored using 30 second epochs. Sleep latency was defined as lights out to the first epoch of any sleep (AASM). Hypopneas were scored per AASM definition

**Sleep Architecture**

Total Recording Time (min)	412	N1:	29.5% (100.5 min.)	Wake After Sleep Onset (WASO):	71.0 min.
Sleep Period Time (min)	406.5	N2:	43.8% (149.5 min.)	Sleep Latency (min)	0
Total Sleep Time (min)	341	N3:	0.0% (0.0 min.)	REM Latency (min)	119
Sleep Efficiency (%)	82.8	Stage R:	26.7% (91.0 min.)		

**Arousals**

	Total #	Respiratory	Limb Movement	Snore	Spontaneous
REM	19	8	0	3	8
NREM	42	15	3	2	22
WAKE	0	0	0	0	0
TOTAL	61	23	3	5	30
INDEX	10.7	4	0.5	0.9	5.3

**AHI WITHIN NORMAL RANGE**

**Respiratory Events**

# Obstr. Apnea:	2	RDI (/hr):	8.4
# of Mixed Apnea:	0	AHI (/hr):	2.6
# of Hypopneas:	12	AHI NREM (/hr):	2.6
# of Central Apnea:	1	AHI REM (/hr):	2.6
# RERA:	33	AHI supine (/hr):	2.5
AHI at Final Pressure:			

**SpO2 Statistics**

Baseline Saturation:	98%
Lowest Sat During Sleep:	90%

**SPO2 WITHIN NORMAL RANGES**

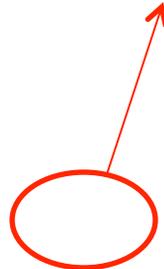
**PLM Events**

PLM:	12
PLM Index (/hr):	2.1
PLM Arousals:	2
PLM Arousal Index (/hr):	0.4

**INSIGNIFICANT LEG MOVEMENTS**



**ELIMINATION OF  
RESPIRATORY  
EVENTS DURING  
SUPINE REM  
SLEEP**



**Summary: (CPAP TITRATION)**

1. Prior to hook-up, the patient was fitted with a large Res Med Micro Mirage mask and desensitized to CPAP. The patient tolerated the fitting and desensitizing well.
2. During the present study, sleep latency was zero as sleep occurred immediately upon Lights Out. This is likely secondary to severe sleepiness. Sleep efficiency was mildly secondary to frequent arousals and awakenings.
3. Following application and titration of CPAP from 4 to 8.0 cmH<sub>2</sub>O, using warm humidification, sleep architecture mildly compared to the NPSG, slow wave sleep remained absent. REM rebound was noted. Respiratory disturbances were . The **optimal CPAP pressure was 8.0 cmH<sub>2</sub>O**, with in overall AHI to 1.1 events/hour of sleep in the supine position. Sustained REM sleep achieved in the supine position. Snoring eliminated and were noted at this pressure.
4. EKG monitoring showed **with occasional PVCs**.
5. There were 12 periodic limb movements (PLM's) during the study, resulting in a PLM index of 2.1 per hour of sleep. This is consistent with PLM activity.
6. The patient tolerated the procedure

**Impression:**

1. 327.23 Obstructive sleep apnea syndrome, severe

**Recommendations:**

- Treatment of severe obstructive sleep apnea syndrome is recommended with the nightly use of CPAP.
- The patient is advised to use **CPAP nightly at a pressure of 8.0 cmH<sub>2</sub>O pressure with warm humidification and a large Res Med Micro Mirage mask.**
- CPAP follow up is recommended in 2-4 weeks.
- Weight loss is recommended.
- General recommendations include maximization of nasal patency, **avoidance of the supine position**, and avoiding alcohol, nicotine, benzodiazepine sedative-hypnotics and sleep deprivation as these can make sleep apnea worse.
- The patient is advised not to drive or operate any large machinery while sleepy, until the daytime sleepiness is adequately treated.
- Follow up with referring ENT physician is recommended.

CPAP	Duration (min)	% Sleep	% RE M	% SWS	#CA	#OA	#MA	#Hyp	#RERA	AHI	RDI
4	34.2	59.1	0.0	0.0	0	0	0	0	3	0.0	8.9
5	42.1	48.9	0.0	0.0	0	0	0	1	7	2.9	23.3
6	69.2	88.4	23.3	0.0	0	0	0	10	1	9.8	10.8
7	15.4	87.0	83.8	0.0	0	0	0	0	1	0.0	4.5
<b>8</b>	<b>244.3</b>	<b>91.8</b>	<b>25.1</b>	<b>0.0</b>	<b>1</b>	<b>2</b>	<b>0</b>	<b>1</b>	<b>21</b>	<b>1.1</b>	<b>6.7</b>

**AHI WITHIN  
NORMAL  
RANGE  
WHILE  
ON 7-8  
CMH2O**

# Split Night Study

- Initial diagnostic PSG followed by CPAP titration during the *same night*
- Typically need 2 hours of sleep prior to applying CPAP followed by 3 hours of CPAP titration
- Compares the 2 sections of the test side by side
- Is an alternative to one full night of diagnostic PSG followed by a second full night of titration if
  - high likelihood for severe OSA
  - patient reluctant or unable to undergo 2 full night studies
- Most labs have protocols for performing emergency Split night studies based on AHI and lowest oxygen level observed

*Lexington Medical Services, PLLC*  
 200 A East 62<sup>nd</sup> Street  
 New York, NY 10065

**SPLIT NIGHT REPORT**

<b>Name:</b>	John Doe	<b>DOB:</b>	4/25/1943
<b>Test Date:</b>	10/17/2008	<b>Age:</b>	65 yrs
<b>Interpreting Physician:</b>	Anita Bhola, MD	<b>Gender:</b>	Male
<b>Scoring Technologist:</b>	R. Territo RPSGT/T. Oram RPSGT	<b>Test Description:</b>	Split Night

Brief Summary of Sleep Statistics	Total Study	Diagnostic Portion	Therapy Portion
Total Recording Time (min)	443	149	294
Sleep Period Time (min)	439	135	280.5
Total Sleep Time (min)	400	123.5	276.5
Sleep Efficiency (%)	90.3	82.9	94
Sleep Latency (min)	4	4	13.5
REM Latency (min)	175	N/A	N/A
Awake (WASO) (min):	39	N/A	N/A
N1:		8.50%	2.70%
N2:		91.50%	40.30%
N3:		0.00%	25.10%
Stage R:		0.00%	31.80%
Respiratory Statistics	Total Study	Diagnostic Portion	Therapy Portion
# Obstr. Apnea:		0	0
# of Mixed Apnea:		0	0
# of Hypopneas:		123	22
# of Central Apnea:		0	0
# RERA:		0	2
AHI (/hr):		59.8	4.8
Baseline Saturation:		96%	96%
Lowest Sat During Sleep:		88%	92%
Leg Movement Statistics	Total Study	Diagnostic Portion	Therapy Portion
PLM:		N/A	N/A
PLM Index (/hr):		N/A	N/A
PLM Arousals:		N/A	N/A
PLM Arousal Index (/hr):		N/A	N/A

Mr. Doe is a 65 year-old male referred by Dr. Sleepy with symptoms of snoring, witnessed apneas and daytime sleepiness/fatigue. His physical examination is significant for a Mallampati class 3 oropharynx. His Epworth Sleepiness Score is 3. The patient is 67 inches in height and 205 pounds in weight, with a Body Mass Index (BMI) of 32. Medical history provided by the patient and/or referral sheet from the referring physician, is significant for allergies/nasal obstruction, hypertension, mild obesity, enlarged prostate and hypercholesterolemia. His current medications are Flomax, Avodart, simvastatin and Ecotrin. Split Night Nocturnal Polysomnography was ordered to rule out the diagnosis of obstructive sleep apnea and to perform CPAP titration, if indicated, to determine if CPAP is an effective treatment for the patient's condition.

→ CPAP FOR > 3 hrs.

During this the following were monitored: frontal, central and occipital EEG, electrooculogram (EOG), submental EMG, nasal and oral airflow, thoracic wall motion, anterior tibialis EMG, and electrocardiogram. Arterial oxygen saturation was monitored with a pulse oximeter. Patient was monitored by video. The tracing was scored using 30 second epochs. Sleep latency was defined as lights out to the first epoch of any sleep (AASM). Hypopneas were scored per AASM definition

→ SLOW WAVE N3 AND REM SLEEP REBOUND

Pressure Distribution											
CPAP	Duration (min)	% Sleep	% REM	% SWS	#CA	#OA	#MA	#hyp	#RERA	AHI	RDI
4	26.3	51.7	0	0	0	0	0	3	0	13.2	13.2
6	103.9	97.1	31.3	49.6	0	0	0	14	0	8.3	8.3
7	23.9	97.9	0	0	0	0	0	4	2	10.3	15.4
8	117.7	99.6	47.2	15.3	0	0	0	1	0	0.5	0.5
9	20.1	100	0	0	0	0	0	0	0	0	0

→ SpO2 IMPROVED

→ AHI DECREASED TO <5/hr.

### Summary (Split Night):

1. During the present study, sleep latency was reduced. Sleep efficiency was within the normative range.

**2. During Diagnostic Portion** of the study, sleep architecture was severely abnormal with a high percentage of N1 at 8.5%, a high percentage of N2 at 91.5%, **and absent slow wave N3 and REM sleep.** Snoring was mild and present for 0.8 minutes or 0.6% of total sleep time. There were a severe number of respiratory disturbances seen during the study. The overall apnea/hypopneas index (AHI) **was 59.8** events/hour, predominantly in the supine position. Oximetry showed a baseline SaO<sub>2</sub> of 96%. The mean saturation during respiratory events was 92%, and the **lowest observed desaturation was 88%**. This is consistent with mild desaturation during the study. \*Desaturations based on 3% or greater drop from baseline.

**3. The Therapy Portion** of the study, consisted of the application and titration of CPAP from 4 to 9.0 cmH<sub>2</sub>O, using warm humidification and a Medium Respironics Comfort Gel nasal mask.

4. Sleep architecture and **slow wave N3 and REM sleep rebound was noted.** Respiratory disturbances were . The **optimal CPAP pressure was 8.0 cmH<sub>2</sub>O**, with in overall AHI to 0.5 events/hour of sleep in the supine position. Sustained REM sleep achieved in the supine position. Snoring eliminated and were noted at this pressure.

5. EKG monitoring showed .

6. There were no significant PLMs during the study.

7. The patient tolerated the procedure very

### Impression:

1.327.23 Obstructive Sleep Apnea syndrome, severe

### Recommendations:

- Treatment of obstructive sleep apnea is recommended with the nightly use of CPAP.

- The patient is advised to use **CPAP nightly at a pressure of 8.0 cm H<sub>2</sub>O pressure with warm humidification and a Medium Respironics Comfort Gel nasal mask.**

- CPAP follow-up is recommended in 2-4 weeks.

- Weight loss is recommended.

- General recommendations include maximization of nasal patency, avoidance of the supine position, and avoiding alcohol, nicotine, benzodiazepine sedative-hypnotics and sleep deprivation as these can make sleep apnea worse.

- The patient is advised not to drive or operate any large machinery while sleepy, until the daytime sleepiness is adequately treated.

- Follow up with referring ENT physician is recommended.

# CPAP compliance is extremely important

- Only ~ 35% of patients use CPAP three years after prescription-Adherence and compliance are a problem
- Heated humidifiers and patient education have helped
- After 12 weeks meet face to face with doctor
- Usage of >4 hours/night, 70% of nights, over 30 consecutive days of therapy

# Multiple Sleep Latency Test (MSLT)

- Indications: R/O narcolepsy or other hypersomnias
  - Severe excessive daytime sleepiness
  - Fragmented nocturnal sleep
  - Cataplexy
  - Hypnagogic hallucinations
  - Sleep paralysis
- Multiple sleep latency test:
  - gold standard test for objective assessment of EDS
  - assess ability to fall asleep in a quiet environment
  - 4-5 daytime naps (20 mins) after an overnight PSG
- Criteria for narcolepsy:
  - mean sleep latency of 8 minutes or less and
  - two or more sleep-onset REM periods (SOREMPS)

# Maintenance of wakefulness test (MWT)

- Validated measure of an individual's degree of alertness during waking hours
- Most commonly used when an *individual's ability to remain awake becomes a personal or professional/public safety issue*.
- The Federal Aviation Administration requires pilots with treated obstructive sleep apnea to undergo an MWT to assess alertness prior to return to work
- Typically preceded by overnight sleep study during which the patient wears their CPAP, followed by four 40-minute *daytime* sessions conducted at 2-hour intervals to assess response to therapy.
- Mean sleep latencies less than 8 minutes are considered abnormal

.....Thank You