INTERPRETING YOUR SLEEP STUDIES

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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
  - 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 Studies (Polysomnograms)

- Noninvasive, pain-free procedure that usually requires spending a night or two in a sleep facility, hooked up to electrodes and wires. The testing bedrooms are designed to resemble a typical bedroom, with décor and televisions to help make you feel as relaxed as possible.

- During a polysomnogram, a sleep technologist simultaneously records multiple biological functions during 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 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.*
  - *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)
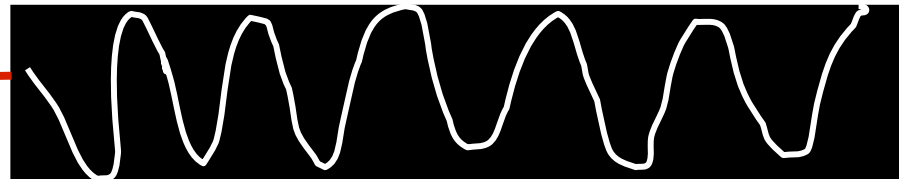- Body position
- Video recording

Intercom to communicate with technician

Snoring sound transducer
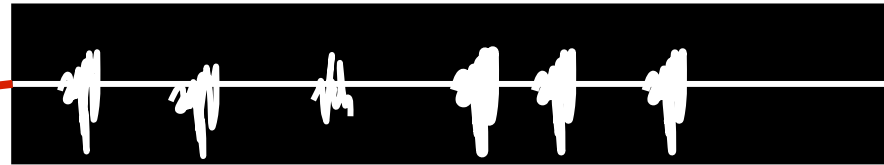
Nasal and Oral Airflow

Chest and abdomen Respiratory Effort

Leg muscle activity

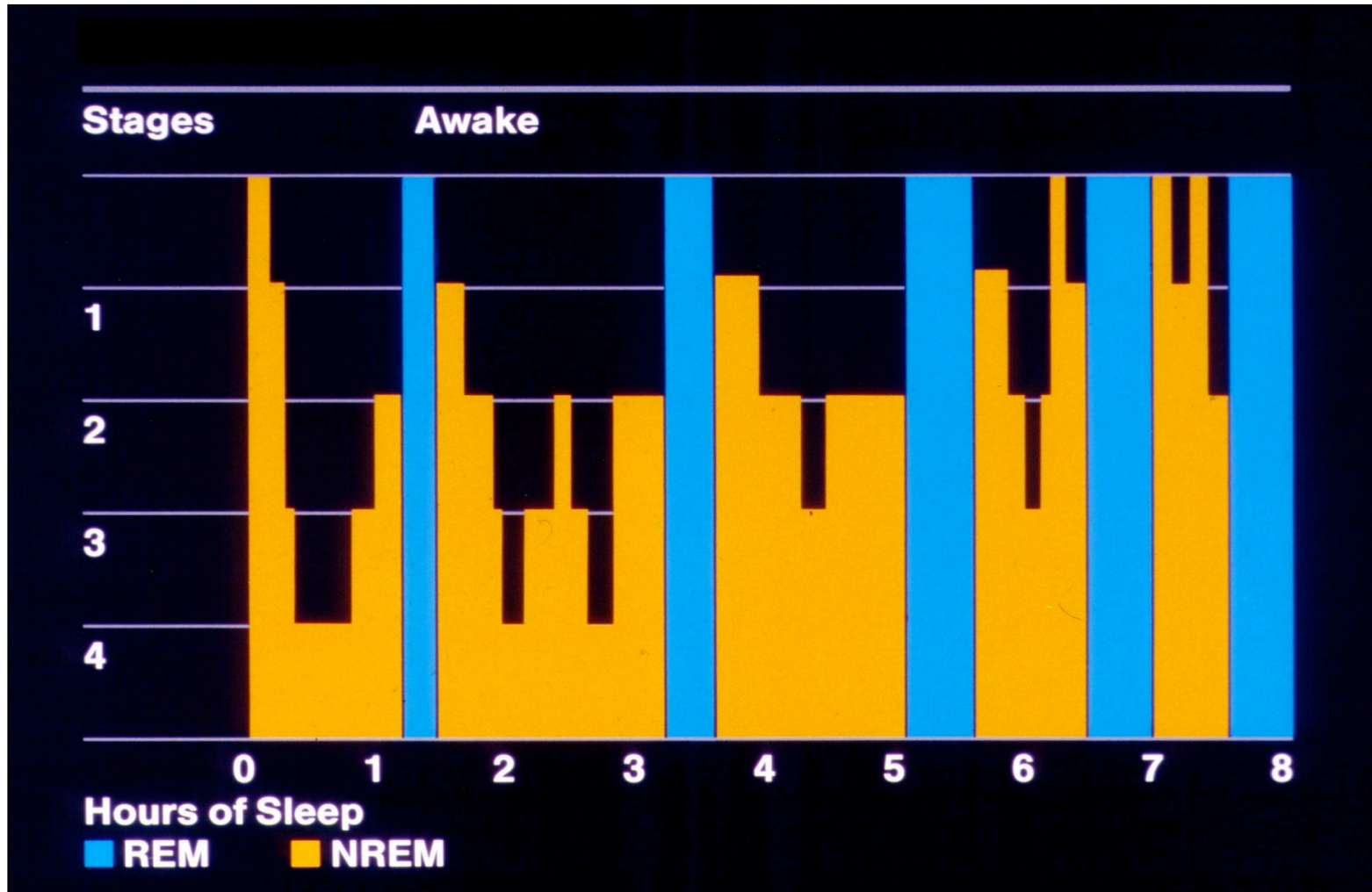# Stages of Sleep

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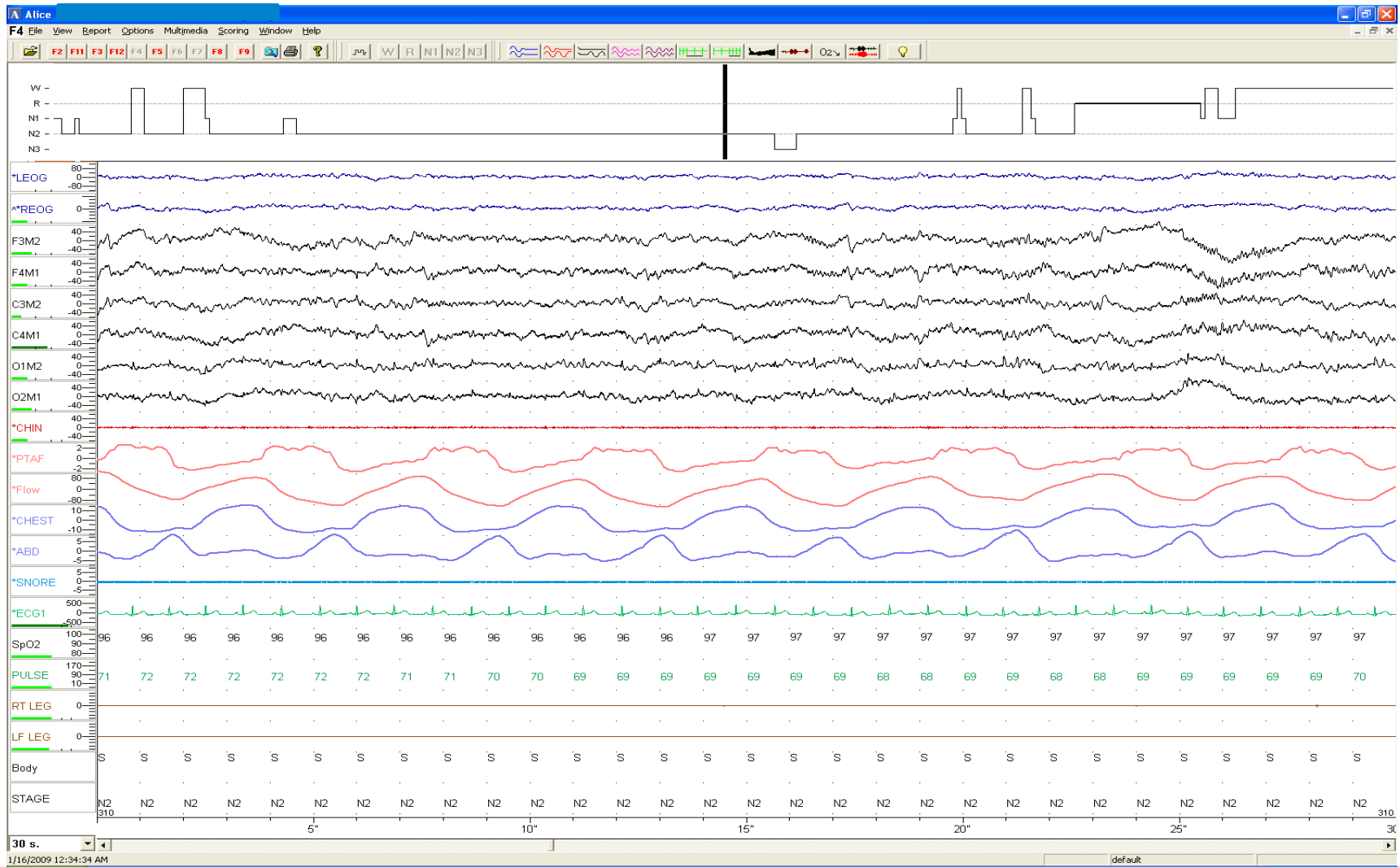- Stage R (REM)

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

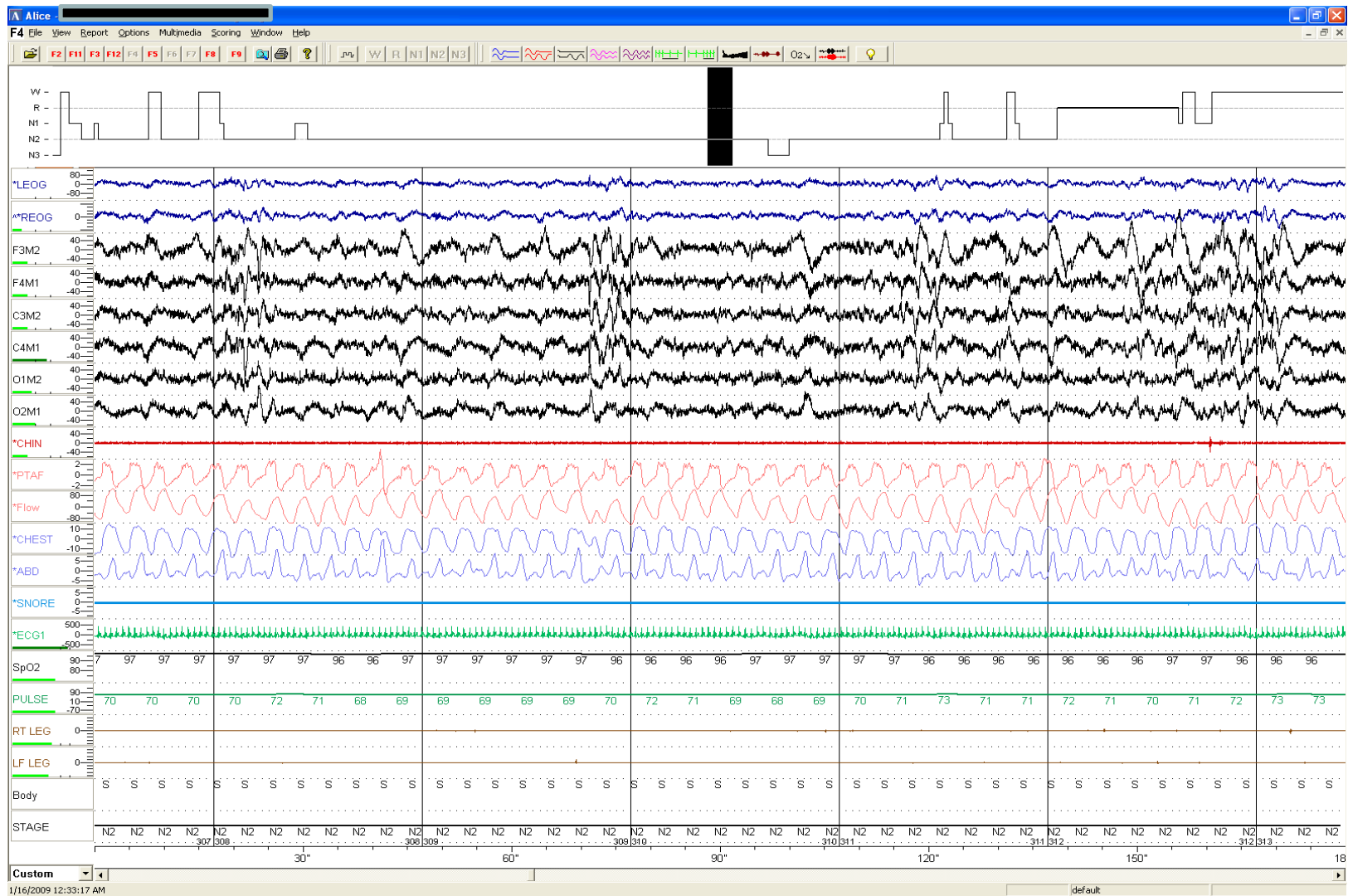- Later stages (early am) are predominantly REM
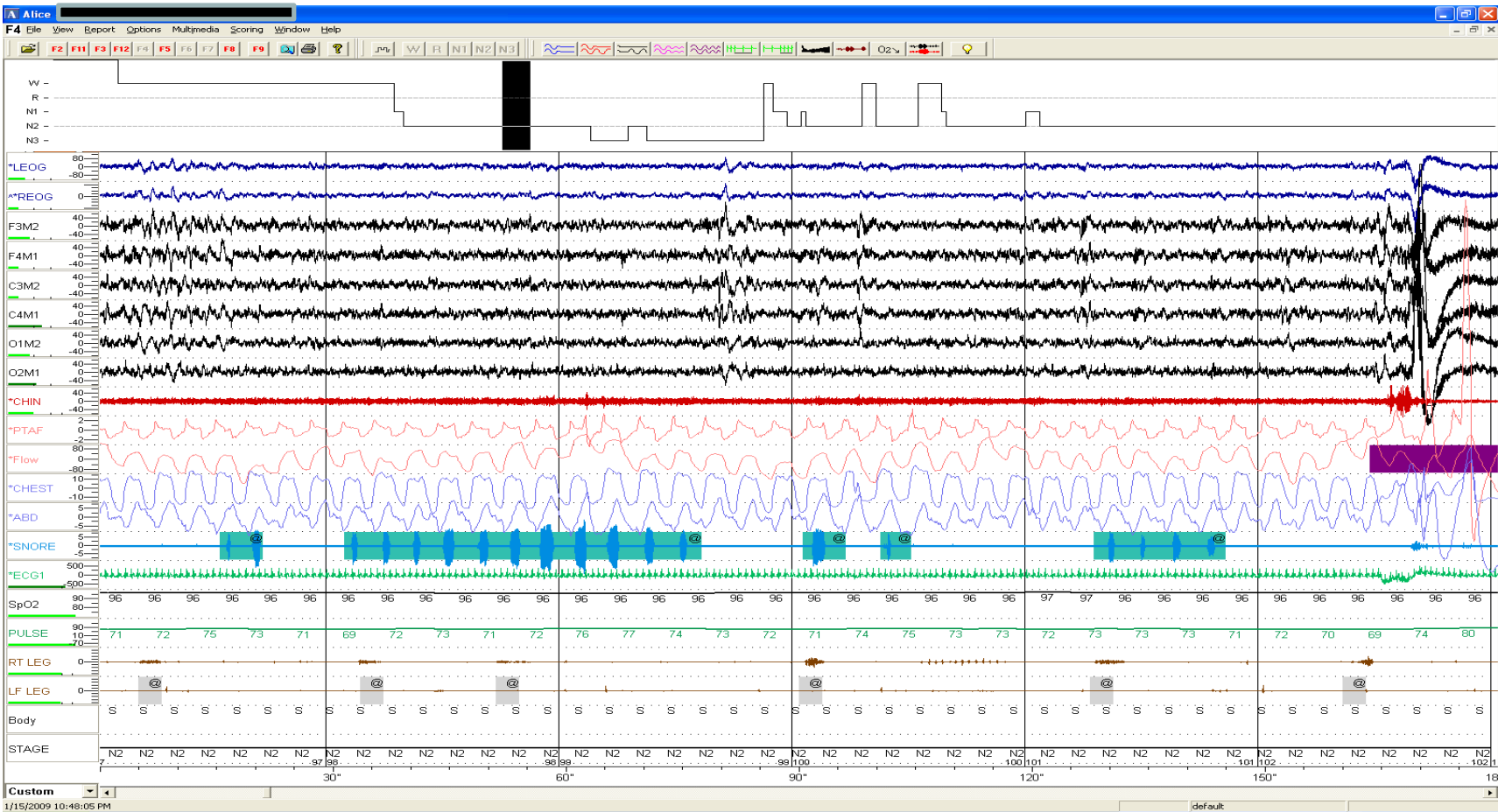
Hypnogram of Normal Sleep Stages

Polysomnogram recording at normal speed

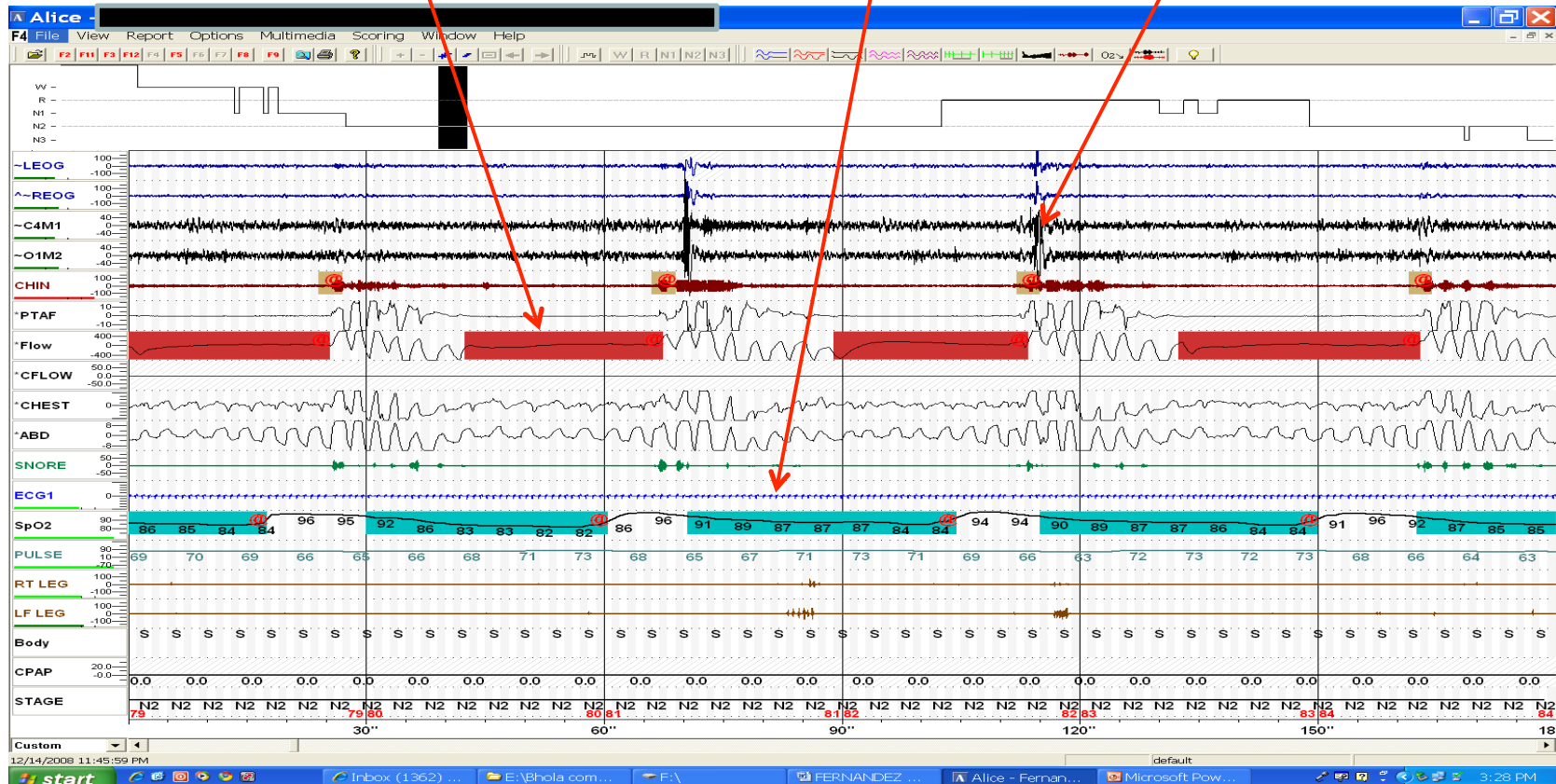# At fast speed

Snoring

Apneas

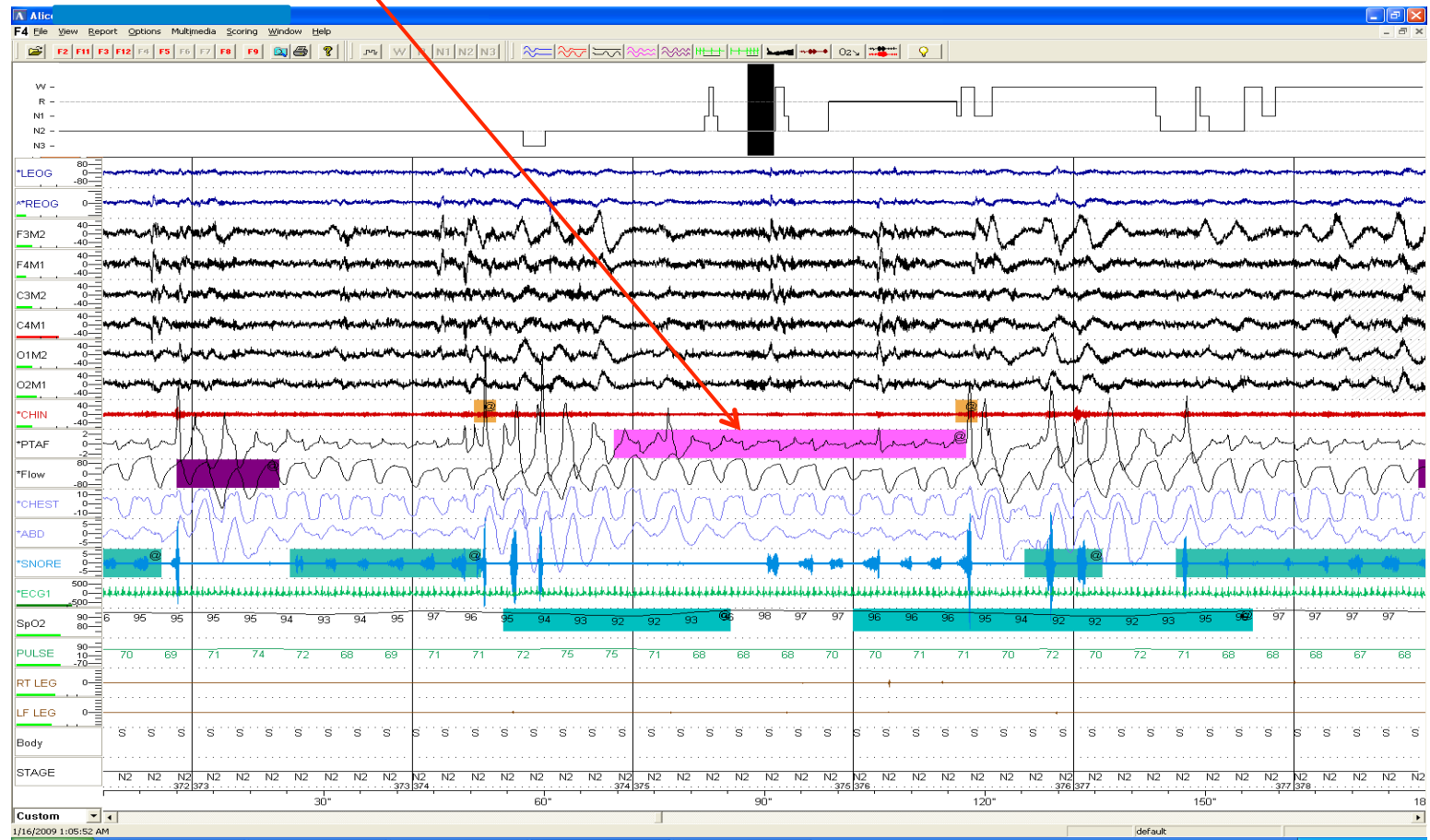- *Obstructive*
- *Central*

Obstructive Apnea

Complete airway collapse with drop in oxygen level and arousal from sleep

Hypopnea:

Partial airway collapse

Review of Sleep Study Times, formulas and calculations:

- ## Sleep statistics
  - Lights Out
  - Light On
  - Total Sleep Time
  - Total Recording Time
  - Sleep Latency
  - Rem Latency
  - WASO
  - Sleep Efficiency
  - 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

Arousals

- The number of arousals and type
- The arousals per hour (arousal index)

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)

All apneas+hypopneas per hour of sleep

supine AHI

REM and NREM AHI

# 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**

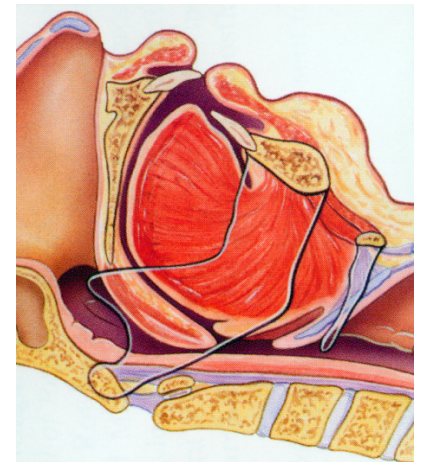# Leg movements (Periodic Leg Movements)

- – Total number of periodic limb movements of sleep (PLMS)
- – *PLM index*=number of PLMS per hour of sleep
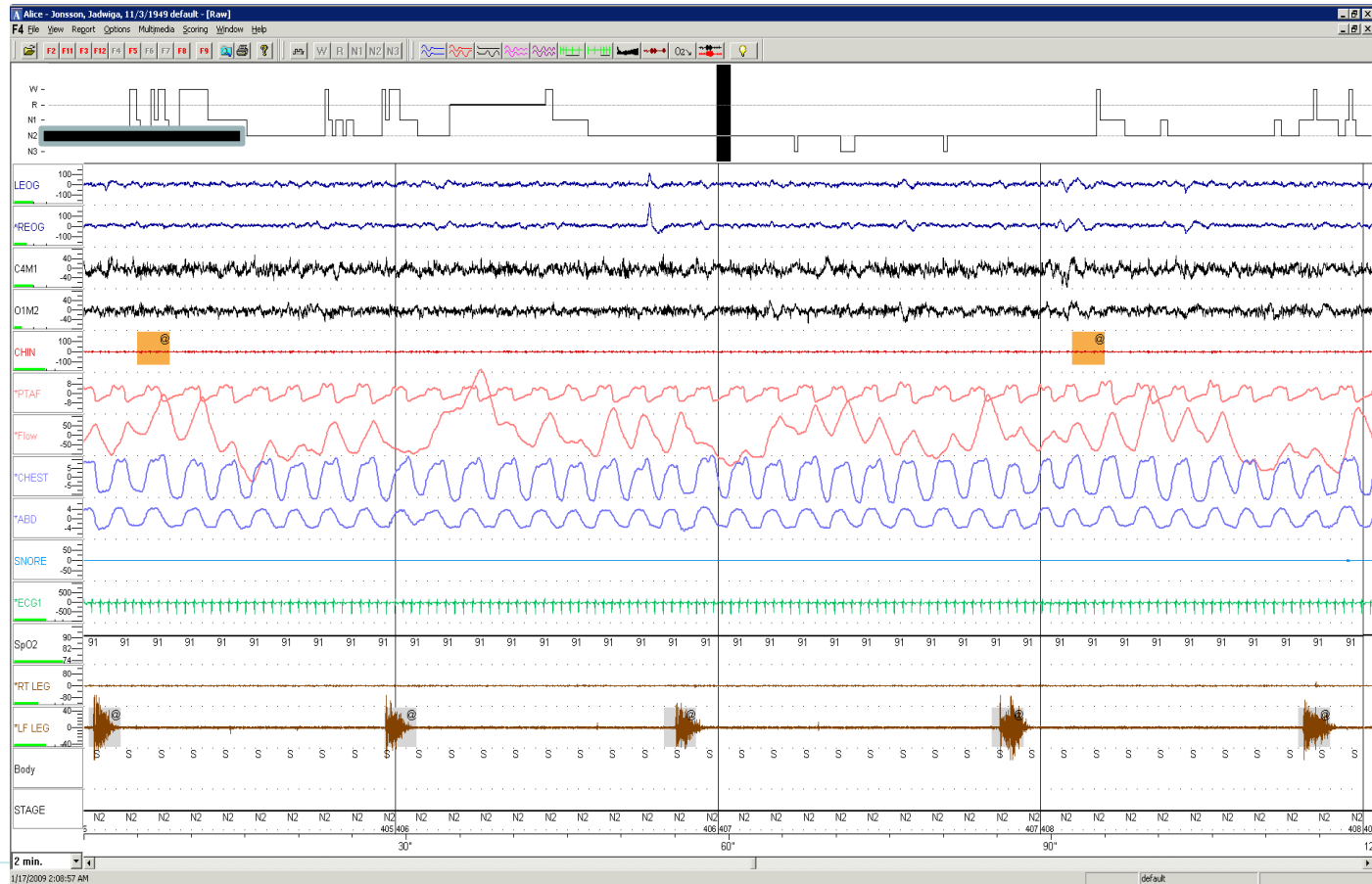
Obstructive Sleep Apnea

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

Typically worse in supine, REM
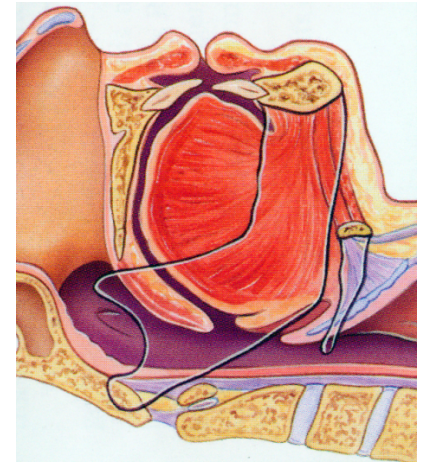
Diagnosis of OSA:

AHI > 5/hr

Severity of Obstructive Sleep Apnea

AHI/RDI   5-15 mild

AHI/RDI   15-30 moderate

AHI/RDI   > 30 severe

OSA Rx

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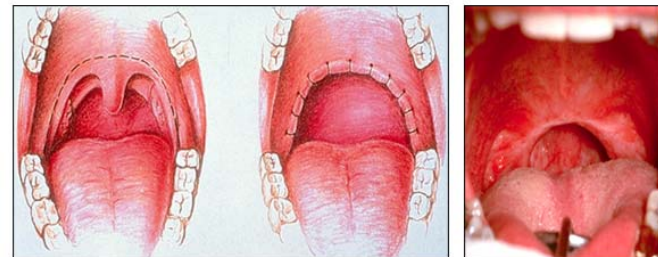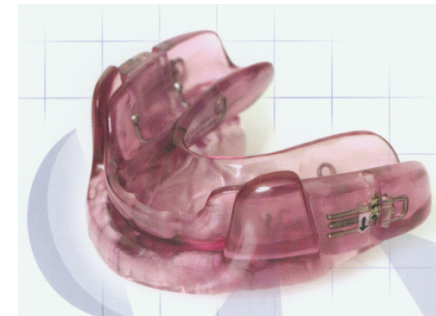- Positional Rx
- Wt loss
- Avoid sedatives/ETOH
- Maximize nasal patency

CPAP

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

Common types of Sleep Reports

- Diagnostic NPSG Report
- CPAP Titration Report
- Split Night Report

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DIAGNOSTIC SLEEP REPORT

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

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

MEDICAL CONDITIONS ASSOCIATED WITH OSA

SYMPTOMS CONSISTENT WITH OSA

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 artey disease and he is s/p CABG in 2003. His current medications are metroprolol, fosinopril, 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), 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

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

AHI ELEVATED IN REM

AHI ELEVATED IN THE SUPINE POSITION

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

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.

RESPIRATORY EVENTS AND OXYGEN DESATURATIONS ARE INCREASED IN REM
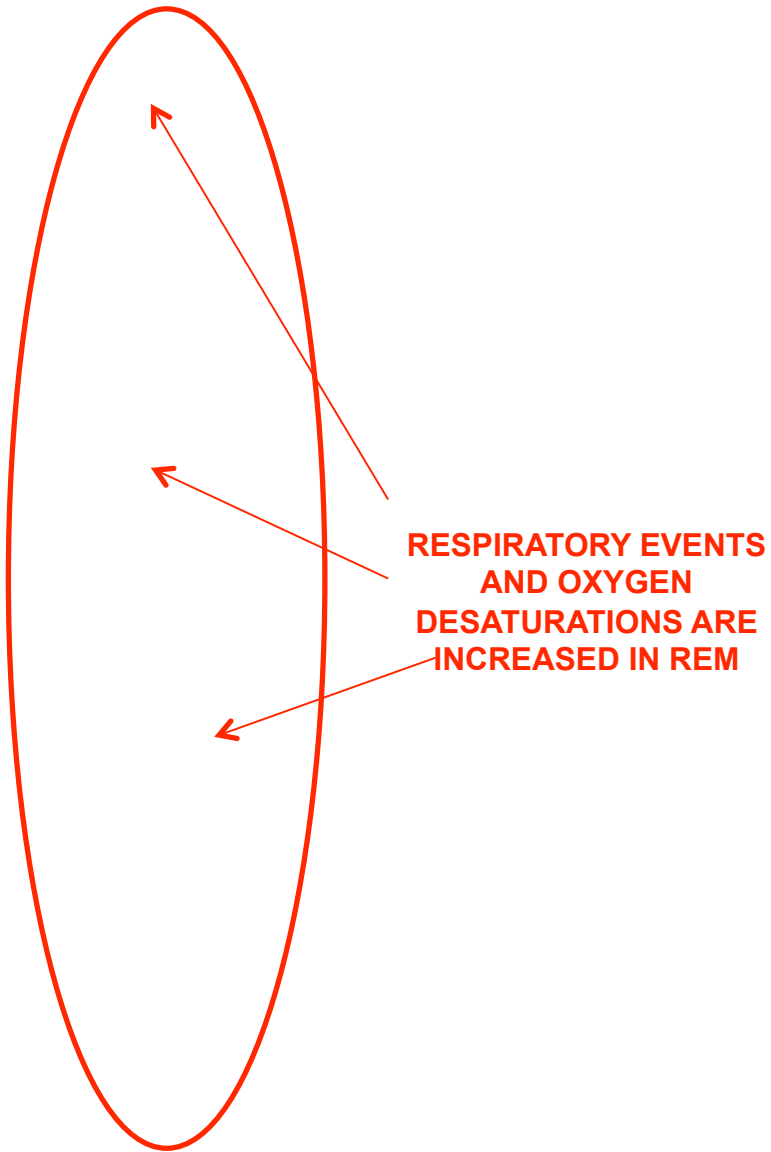
CPAP Titration Study

- Overnight study with same hook up as NPSG, with the addition of CPAP

- 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

- Once optimal CPAP pressure is determined, order is placed with DME

Split Night Study

- Initial diagnostic PSG followed by CPAP titration during the same night

- 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

CPAP compliance is extremely important

…………Thank You