

Sleep Medicine and Telemedicine

Home Sleep Testing and Remote Compliance Monitoring.

The application of telemedicine/internet modalities to the delivery of healthcare in the area of sleep disorders medicine.

- 3 levels
 - ▶ The clinical interaction with the patient
 - ▶ Sleep testing
 - ▶ Compliance monitoring

Presentation to the sleep clinic

- ▶ Snoring, choking, gasping
- ▶ Daytime sleepiness
- ▶ Insomnia: Perception of inability to sleep or disrupted sleep
- ▶ Comorbidities
 - diabetes mellitus
 - hypertension
 - atrial fibrillation

Sleep apnea

- The most common sleep disorder.
- Basic physiology of sleep apnea
- Comorbidities

What is sleep apnea

Sleep apnea starts with snoring

- Snoring is due to a narrow airway
- Snoring is the sound of vibration of the structures of the upper airway while breathing in through a narrow airway.
 - See the diagram =>
- Snoring is not a problem for the patient !!!
- Snoring is a problem for the spouse (or spouse equivalent)

Sites of obstruction

- Nasal obstruction
 - ▶ Both acute and chronic rhinitis
 - ▶ Simple colds will induce a transient sleep apnea from nasal obstruction
- Retropalatal
 - ▶ Movement of the palate
 - ▶ Uvula
 - ▶ Tonsils
 - ▶ Size of palatal arch
- Retrolingual
 - ▶ Jaw movement in the A-P direction
 - ▶ Tongue size and movement
 - ▶ Peripharyngeal fat deposition
 - ▶ Pharyngeal motor tone

Snoring

Why is the airway narrow?

- Mucus and inflammation as from a cold or allergies
- Tonsils
- Nasal septal deviation
- Floppy tissue in the airway- as we get older, everything sags and gets floppy
- Oropharyngeal anatomy
 - ▶ narrow airway
 - ▶ low lying palate
 - ▶ tongue position
 - ▶ neck

So what happens if the airway is narrow and there is reduced airflow as you breathe in?

- Drop in oxygen => not good
 - ▶ Heart needs oxygen
 - ▶ Brain needs oxygen
 - ▶ Fluid retention - compensating mechanism for low oxygen
- Wake up
 - ▶ Sleep deprived the next day => Sleepy
 - ▶ Loss of memory
 - ▶ Mood change
- Outpouring of stress hormones, primarily adrenalin
 - ▶ Rapid heart beat
 - ▶ Elevated blood sugar - diabetes is associated with sleep apnea
 - ▶ Elevated blood pressure

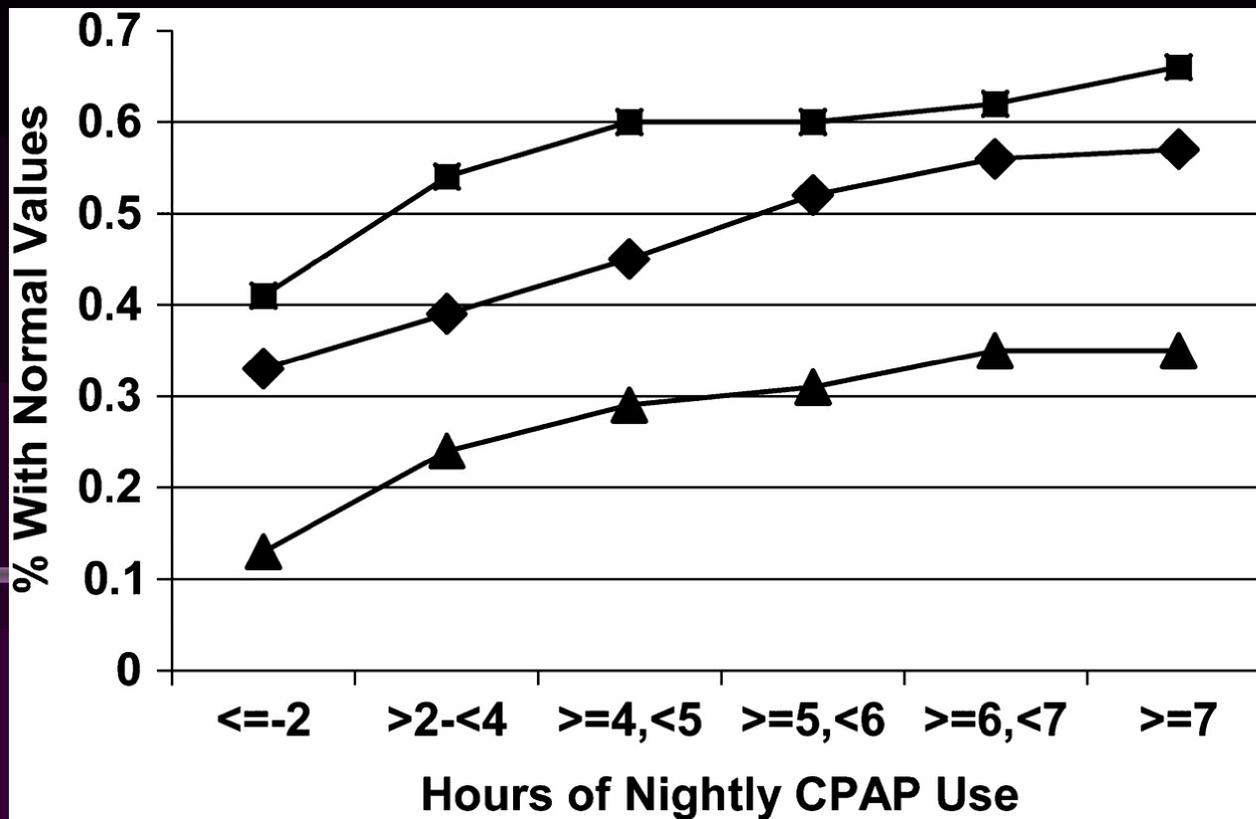
Sleep apnea and public policy

■ Daytime sleepiness and driver safety

- ▶ Among the estimated 14 million U.S. commercial motor vehicle drivers, the prevalence of obstructive sleep apnea is reported to be 17% to 28%. (Workplace Health Saf. 2013 Nov;61(11):479-85. doi: 10.3928/21650799-20131016-03. Epub 2013 Oct 23.)
 - Federal law does not require that truck drivers be screened for obstructive sleep apnea.
 - CDL regulations vary by state.
- ▶ Nontreatment-adherent OSA-positive drivers had a fivefold greater risk of serious preventable crashes, but were discharged or quit rapidly
 - Current Federal regulations allow nonadherent OSA cases to drive at another firm by keeping their diagnosis private..
- ▶ Policies of the National Transportation Safety Board enacted after the Dec 2013 train crash on metro north in New York resulting in 4 deaths and 59 injuries.
 - Subsequent investigations revealed a number of other crashes that were related to sleep apnea,
 - Screening measures were implemented to screen railroad workers for sleep apnea

Sleep apnea and noncompliance with therapy

- ▶ Adherence to CPAP therapy is associated with reduced norepinephrine levels and improved glucose control and blood pressure (Diabetes Obes Metab. 2017 Mar;19(3):452-456. doi: 10.1111/dom.12823. Epub 2016 Dec 12.)(Curr Hypertens Rep. 2014 Jan;16(1):411. doi: 10.1007/s11906-013-0411-y.)
- ▶ Nonadherence to CPAP is associated with increased 30-day all-cause and cardiovascular-cause readmission in patients with OSA. Ensuring CPAP adherence is crucial in addressing general and cardiovascular-related healthcare utilization and morbidity in patients with OSA. (J Clin Sleep Med. 2018 Jan 16. pii: jc-17-00238. [Epub ahead of print])
- ▶ What is optimal CPAP compliance
 - Evidence suggests that use of CPAP for longer than 6 hours decreases sleepiness, improves daily functioning, and restores memory to normal levels. AnnalsATS Issues > Vol. 5, No. 2 | Feb 15, 2008



- Cumulative proportion of participants obtaining normal threshold values on the Epworth Sleepiness Scale (*squares*), Multiple Sleep Latency Test (*triangles*), and Functional Outcomes of Sleep Questionnaire (*diamonds*). CPAP = continuous positive airway pressure. Reprinted by permission from Reference 24.

The clinic interaction

- Distance can be problem is in Wyoming,and even in New Jersey
- Telemedicine sleep clinic - Brings the patient and the doctor together
 - Clinic visit at an established medical facility such as an office, or the pulmonary/sleep lab: Evanston Regional Hospital Sleep Disorders Center
 - Simple computer and laptop with camera; Respiratory therapist acts as the presenter
 - Web portal for Face-to-face interaction
- Basics of vital signs are easy to obtain with
 - Home blood pressure monitor, home pulse oximeter, home fingerstick glucose
 - There are even iPhone sensors that will detect and in many patients with atrial fibrillation do their own home monitoring: Kardia <https://www.alivecor.com/>
 - Need a good look at the oral pharynx: Dental camera, Can even use the iphone, InTouch robot camera
- ▶ Electronic medical records allows access to data from other physicians and the hospital\

Home sleep study

- The vast majority sleep studies are now done as home studies.
- Technology has caught up quite nicely
- Respiratory data
- Heart rate, though no specific recording of rhythm. For the actual EKG, a lab study is necessary
- Earlier systems primarily just recorded respiratory channel data and the big dilemma was whether or not the patient was actually sleeping.
- Using Fit Bit type technology , actigraphy, very good quality sleep data can now be obtained and we can know whether or not the patient is sleeping when respiratory events occur, and there is even the capability to do some simple sleep staging to know deep sleep light sleep or even REM sleep.

Home sleep study

- ▶ SleepView by CleveMed
- ▶ ARES by SleepMed
- ▶ WatchPat by Itamar Medical



Home sleep testing

- Sometimes the home sleep study is of better quality than the lab study because of the enhanced patient comfort.
- Companies have programs where the units can now actually be sent to the patient so the patient does not even have to come to the lab. This enhances patient acceptance of the test and overcomes issues of distance and travel
- The testing unit is returned to the facility and it is then scored and the physician reads the study.

CPAP therapy - AutoPAP

- Based on the study, in most cases CPAP can be ordered.
- CPAP therapy can often begin as Auto Pap.
- Based on an algorithm of airflow and pressure, the pressure is adjusted over range, usually 5 to 15 cm,
- CPAP settles into a certain range which is therapeutic for the patient.

How do we know that the CPAP is working?

- ▶ Ask the patient.
- ▶ This can be addressed on the follow-up face-to-face visit over the video portal.
- ▶ We have a standard format of questions that need to be asked of the patient.
- ▶ Patients really know if they feel good or if they feel bad

How do we know that the CPAP is working?

- ▶ Compliance
- ▶ Definition of compliance
 - >4 hours per day for 70% of the days/nights
 - Associated with improved outcomes of sleepiness and reduced comorbidity.
- ▶ The machine does calculations to measure an apnea hypopnea index based on tiny pulses of pressure that are so small that the patient can't detect these pulses
- ▶ Measurement of mask or system leak

Format of our compliance report:

- Settings
 - ▶ CPAP or BiPAP =
 - ▶ autoPAP = 5-15 cm with EPR
 - Median pressure is cm.
 - Max pressure is
 - ▶ Ramp = On/Off
 - ▶ EPR or Cflex =
- Leak =
- **AHI** =
- Usage
 - ▶ > 4 hrs =
 - ▶ < 4 hrs =
- Compliance over
 - ▶ 30 days =
 - ▶ 60 days =
 - ▶ 90 days =

Compliance can be read remotely on the two major units being sold today

- ResMed Air Sense S-10 and the AirMini
 - ▶ AirView:
 - patients download or update the latest app, and opt in to upload data to the cloud,
 - home medical equipment (HME) providers can view the same reports, charts, notes, and therapy thresholds in AirView like they can for ResMed's bedside Air10 device
 - ▶ MyAir - self monitoring program for patients
- Resironics DreamStation
 - ▶ DreamMapper for compliance
 - ▶ SleepMapper self monitoring program for patients
- Based on the compliance data and the doctor/patient interaction, adjustments can be made to machine **remotely**

Application of telemedicine

- Large-scale screening of drivers and workers with risk of accidents related to sleepiness
- Management of patients with reduced ability to travel in bad weather
- Older patients or patients with limited physical mobility
- Reduced time off from work to deal with managing medical matters on generally healthy patients