



ΕΝΩΣΗ ΠΝΕΥΜΟΝΟΛΟΓΩΝ ΕΛΛΑΔΑΣ

ΕΤΗΣΙΟ ΣΥΝΕΔΡΙΟ



30 Μαΐου - 2 Ιουνίου 2019

Αθήνα, Ξενοδοχείο Royal Olympic

Νυκτερινή οξυμετρία ενδείξεις και κατ'οίκον παρακολούθηση

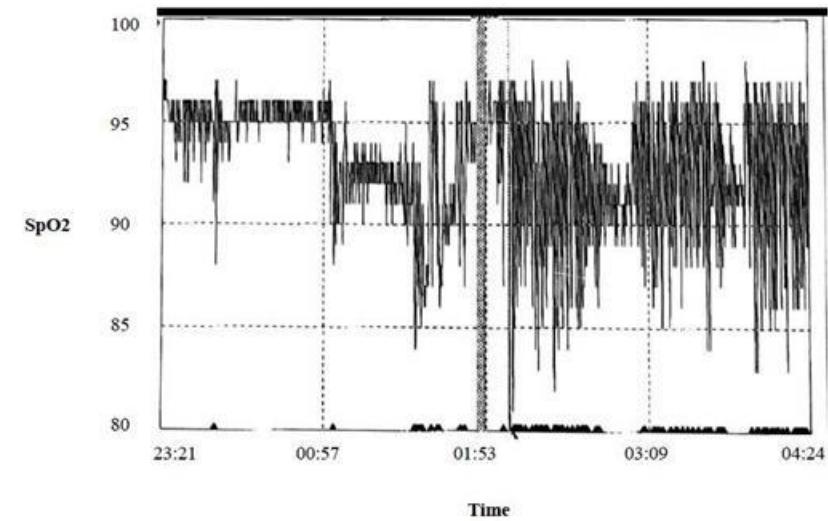
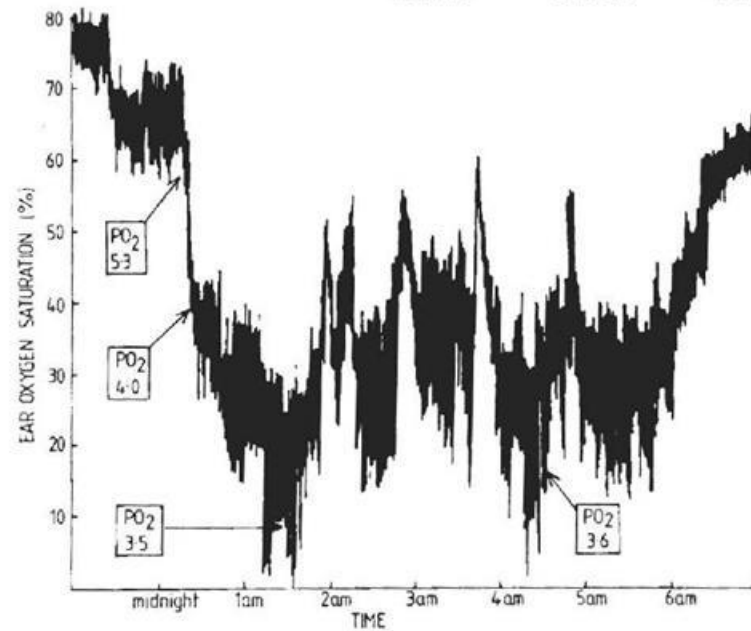
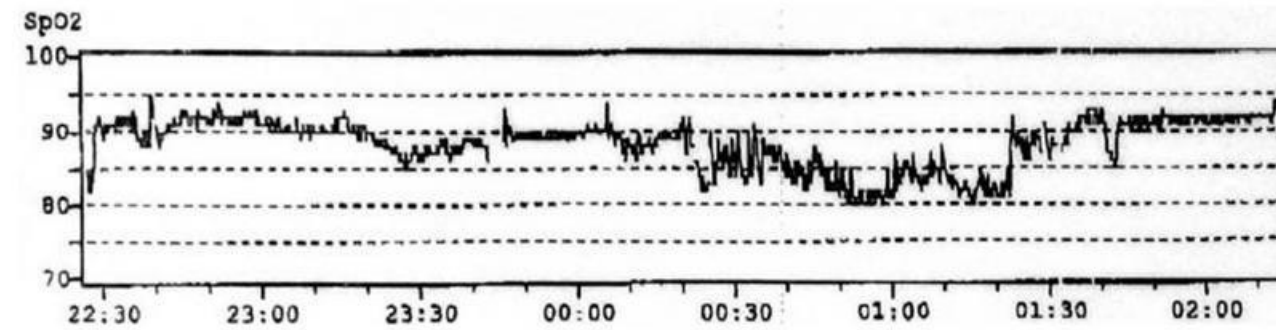
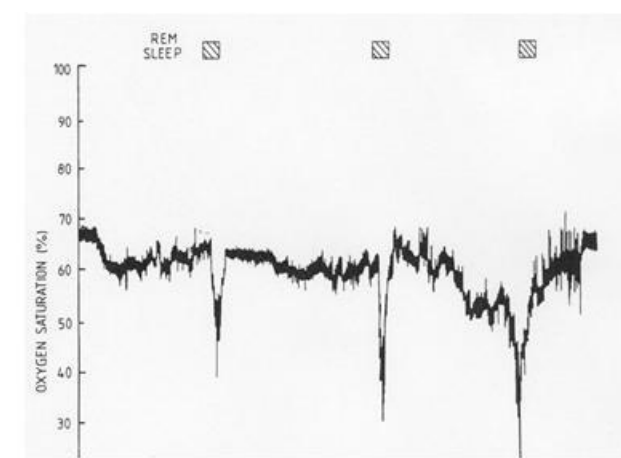
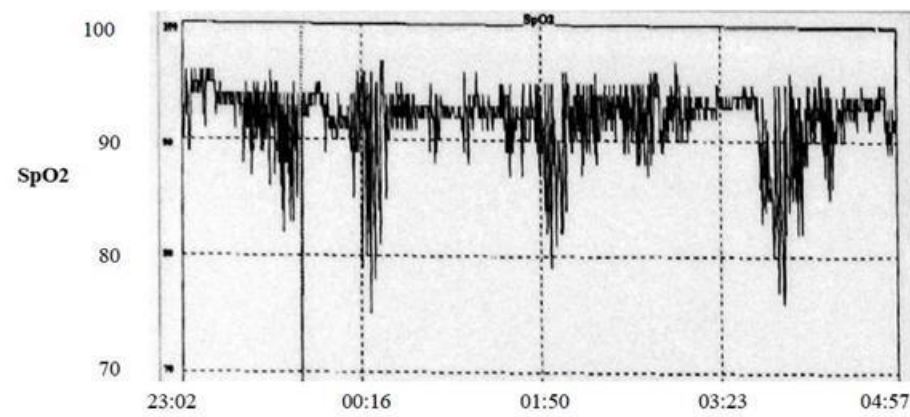
Πασχάλης Στειρόπουλος
Επίκουρος Καθηγητής Πνευμονολογίας
Τμήμα Ιατρικής ΔΠΘ

Δήλωση σύγκρουσης συμφερόντων (Honorarium fees, travel grants)

- AstraZeneca
- Boehringer Ingelheim
- Chiesi
- Elpen
- Menarini
- Novartis

Δομή

- Εισαγωγή
- Νυκτερινή Υποξυγοναιμία
- Παρακολούθηση Μηχανικού αερισμού
- Διαταραχές της αναπνοής κατά τον ύπνο



Παλμική οξυμετρία

Πλεονεκτήματα

- cheap
- simple
- easy to use
- quick response

Μειονεκτήματα

- perfusion
- false alarms
- motion artefact
- oxygen dissociation curve

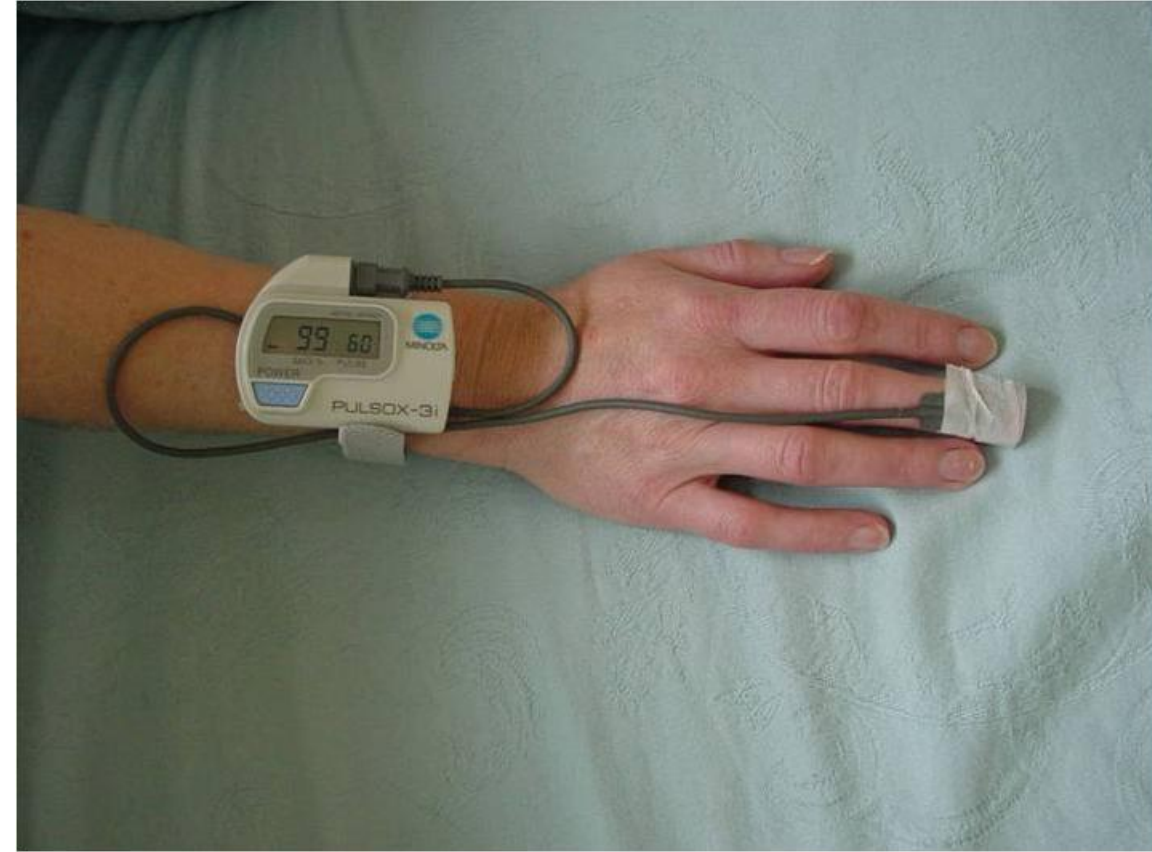
Πρακτικά ζητήματα στη χρήση οξύμετρου για νυκτερινή καταγραφή

Οξύμετρία:

- Machines differ in sensitivity, sampling frequency, artefact rejection and averaging time
- Analysis differs e.g. $> 4\%$ or time below 90%
- Give an indication of arousals (increase in HR $> 6\text{bpm}$)

Πρακτικά ζητήματα στη χρήση οξύμετρου για νυκτερινή καταγραφή

1. Θέση: Storage capacity: 8 h
2. Λοβός αυτιού > δάκτυλο
3. Βαθμονόμηση
4. Συχνότητα λήψης μετρήσεων (1-10 Hz)
5. Averaging time (3 sec)
6. Motion tolerant



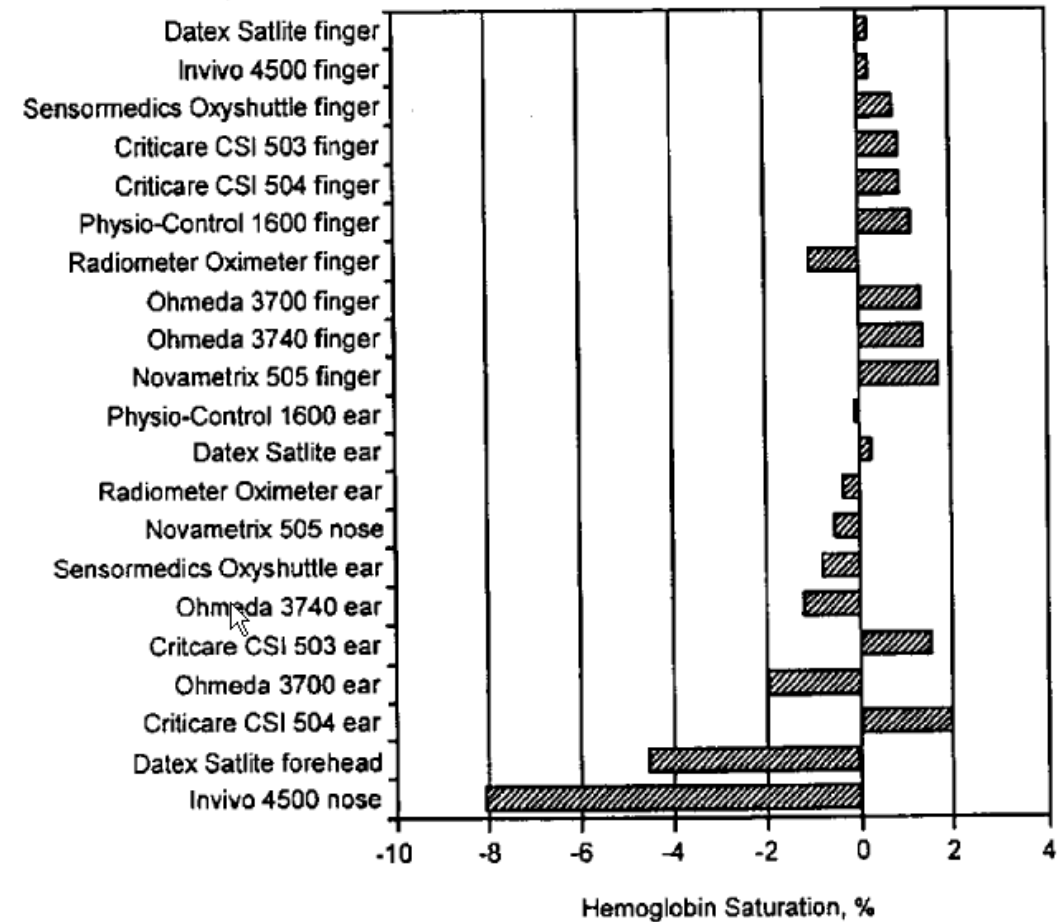
Παλμική οξυμετρία

A pulse oximeter records the arterial oxygen saturation and the pulse rate

This allows the estimation of the number of apnoeic episodes that occur during sleep as calculated by counting the number of acute drops in arterial oxygen saturation (usually using a threshold of 4% drop).

Oxygen desaturation index (4%) or ODI

The software also usually calculates the number of acute spikes in pulse rate (a 6 beat per minute threshold is commonly used).



Δομή

- Νυκτερινή Υποξυγοναιμία

Sleep Related Hypoxemia

ICD-9-CM code: 327.26

ICD-10-CM code: G47.36

Alternate Names

Nocturnal oxygen (or oxyhemoglobin) desaturation, low nocturnal oxygen saturation, nocturnal hypoxemia, sleep related hypoxemia, sleep related oxygen desaturation.

Διαγνωστικά κριτήρια

Sleep Related Hypoxemia

ICD-9-CM code: 327.26

ICD-10-CM code: G47.36

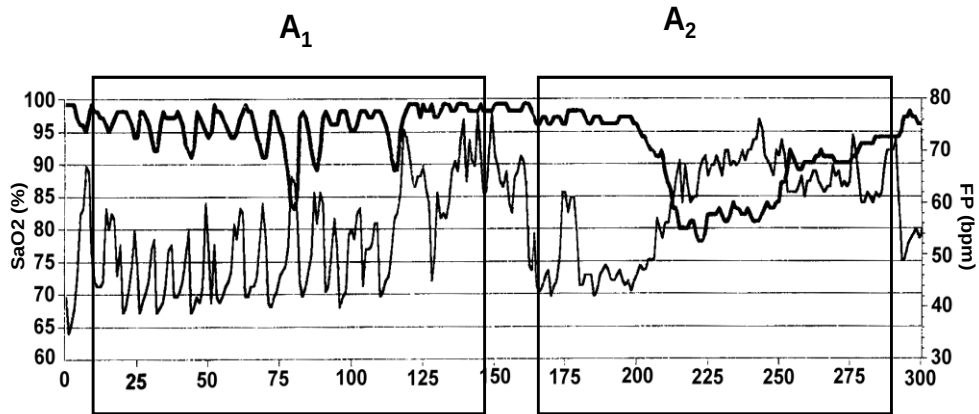
Alternate Names

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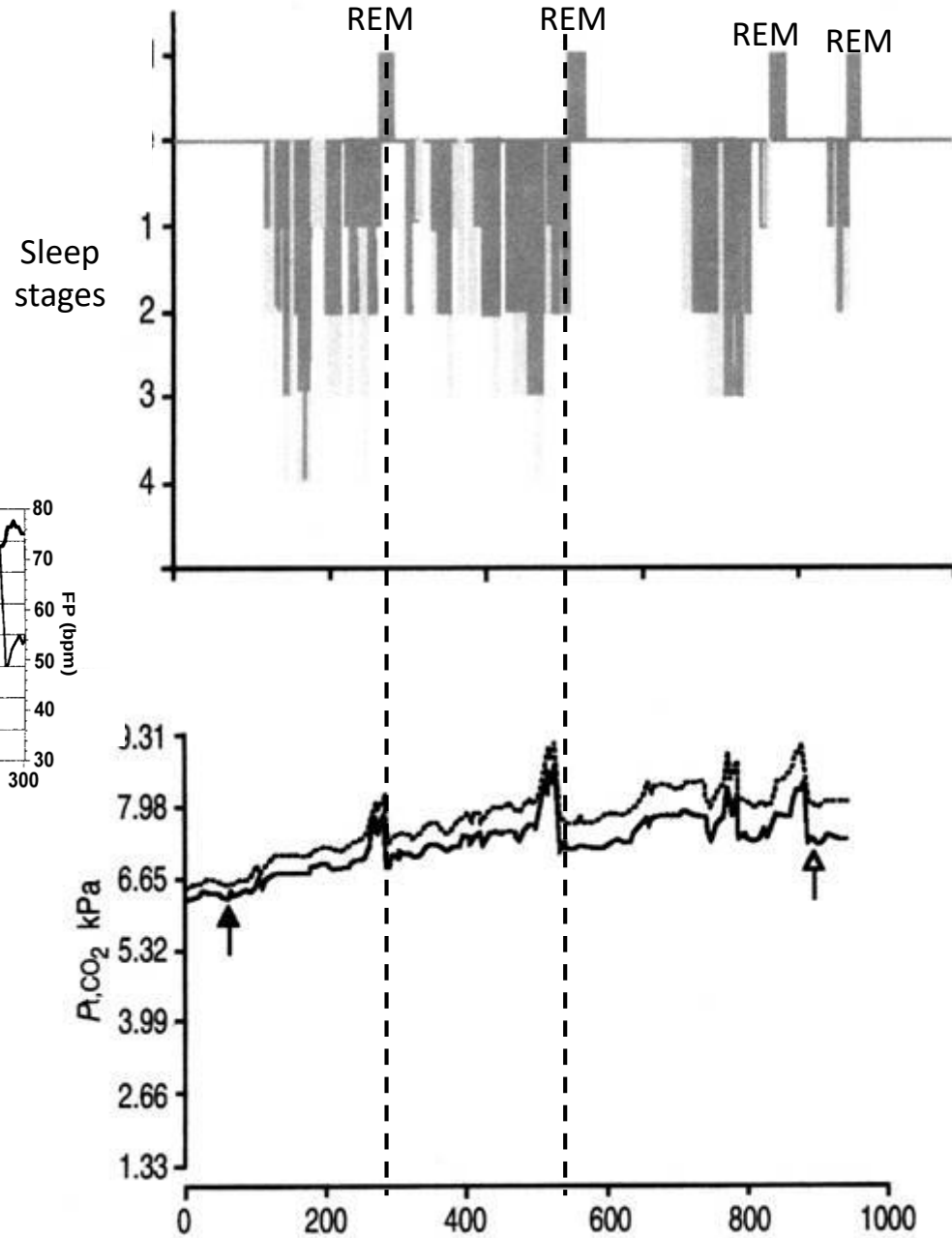
Criteria A and B must be met

- A. PSG, OCST or nocturnal oximetry shows the arterial oxygen saturation (SpO₂) during sleep of $\leq 88\%$ in adults or $\leq 90\%$ in children for ≥ 5 minutes.
- B. Sleep related hypoventilation is not documented.

**Εικόνα αργού και επίμονου
αποκορεσμού με προοδευτική αύξηση
της καρδιακής συχνότητας, τυπική
εικόνα κυψελδικού υποαερισμού**

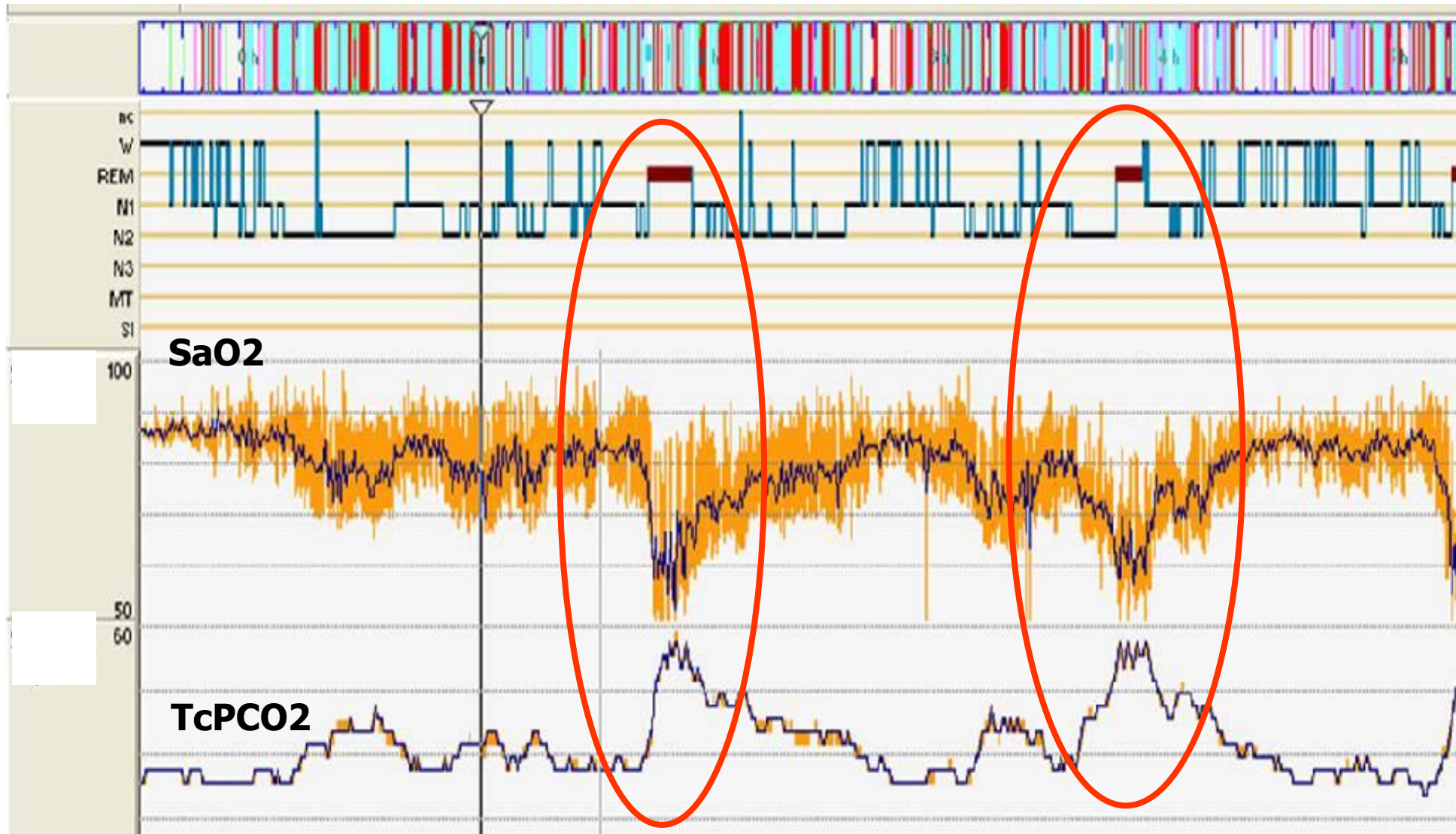


**Ιδανικά: πρέπει να
καταγράφονται
τουλάχιστον τιμές SaO_2
and PtCO_2**



Σύνδρομο παχυσαρκίας- υποαερισμού

OSA and REM sleep hypoventilation



Υποξυγοναιμία στη νυκτερινή οξυμετρία

■ Ανίχνευση νυκτερινής υποξυγοναιμίας

Ορίζεται ως

- $SpO_2 < 88\%$ για >5 συνεχή λεπτά, $\min SpO_2 = 85\%$
- $SpO_2 < 90\%$ για το 30% του χρόνου καταγραφής

■ Δείκτης αποκορεσμού αιμοσφαιρίνης (oxygen desaturation index, ODI)

Δομή

- Παρακολούθηση Μηχανικού αερισμού

Nocturnal oximetry under NIV

- **Advantages**

- Simple
- Inexpensive

- **Limitations**

- Only partially evaluate the efficacy of nocturnal NIV
- If normal, cannot exclude alveolar hypoventilation (especially if additional O₂ is needed)
- Does not identify the mechanisms of SpO₂ abnormalities (apneas, glottis closure, leaks, asynchronies, hypoventilation)

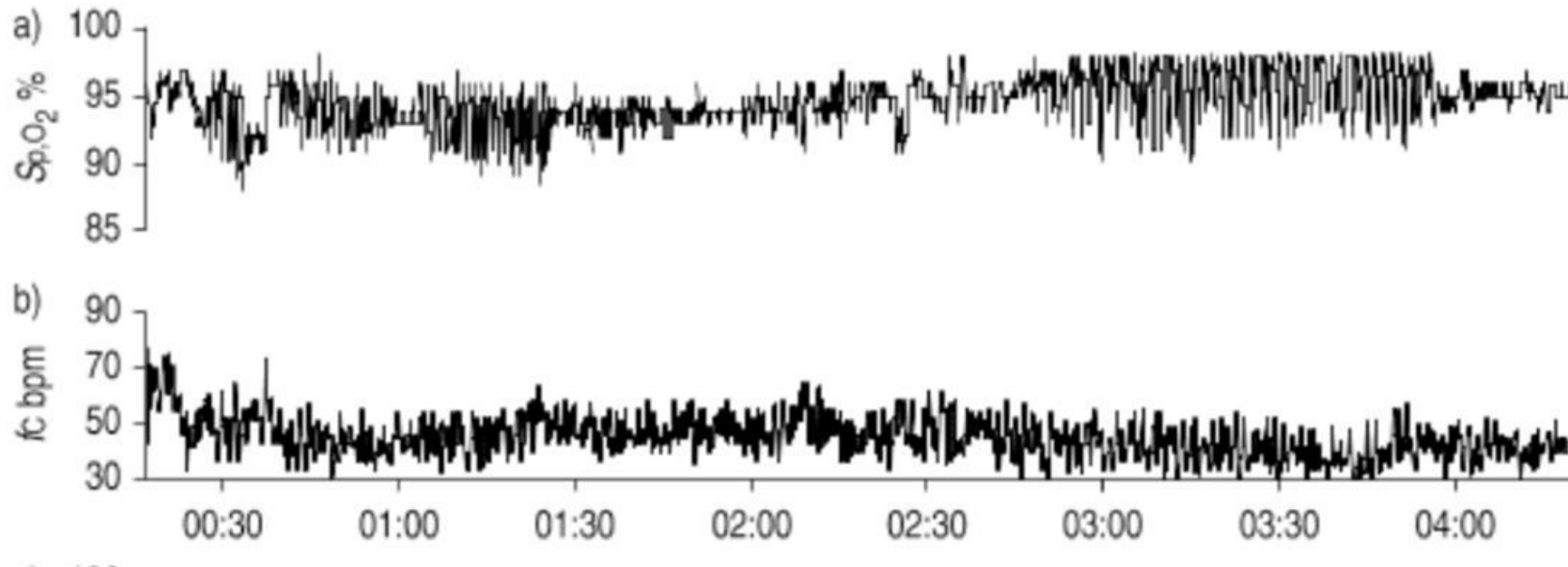
- **Perhaps necessary but not sufficient**

(R. Ramsey et al, Chest 2007)

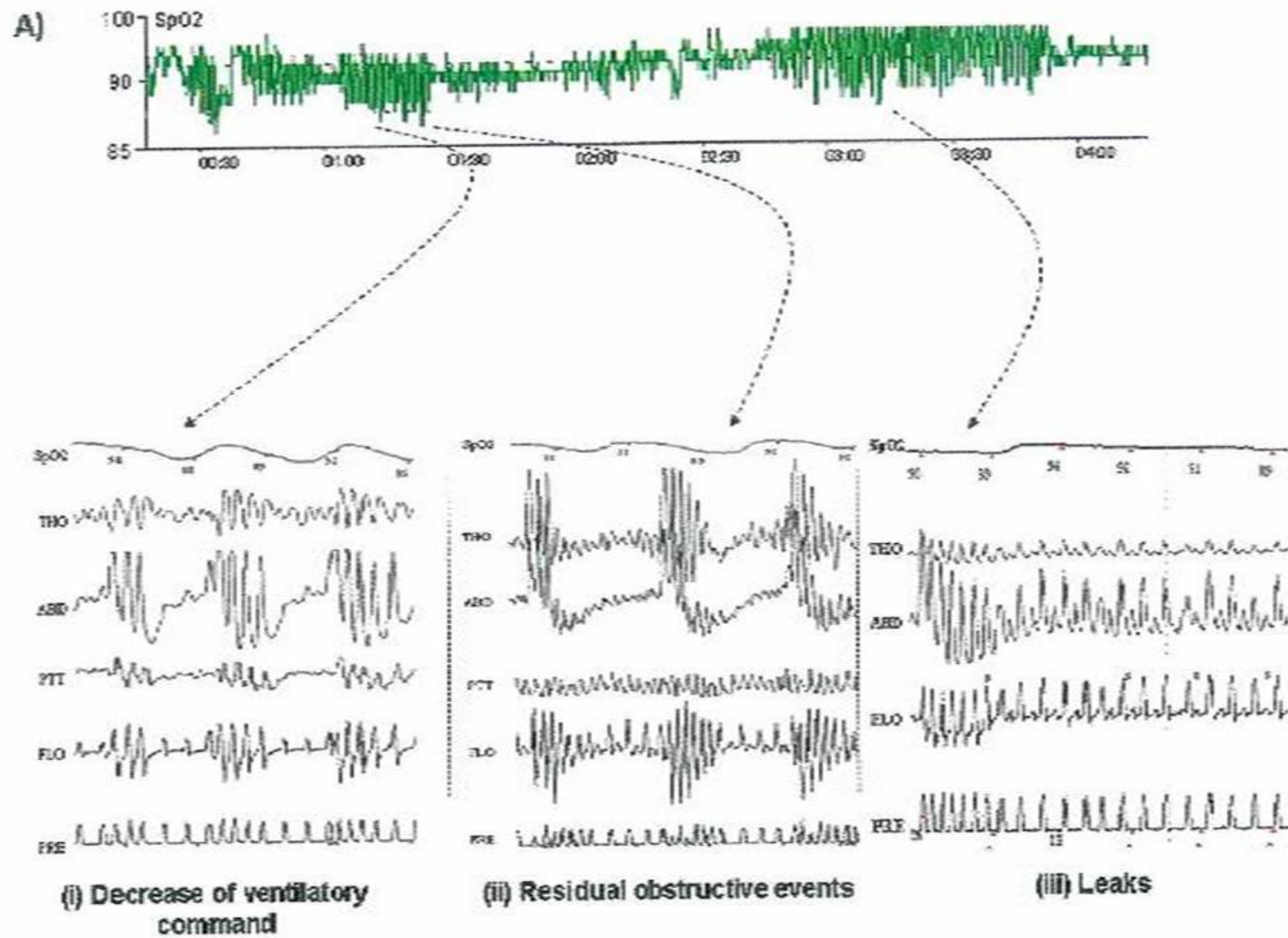
Αναγνώριση τύπου αποκορεσμού

- Κυκλικές μεταβολές του κορεσμού
- Παρατεταμένης διάρκειας αποκορεσμοί

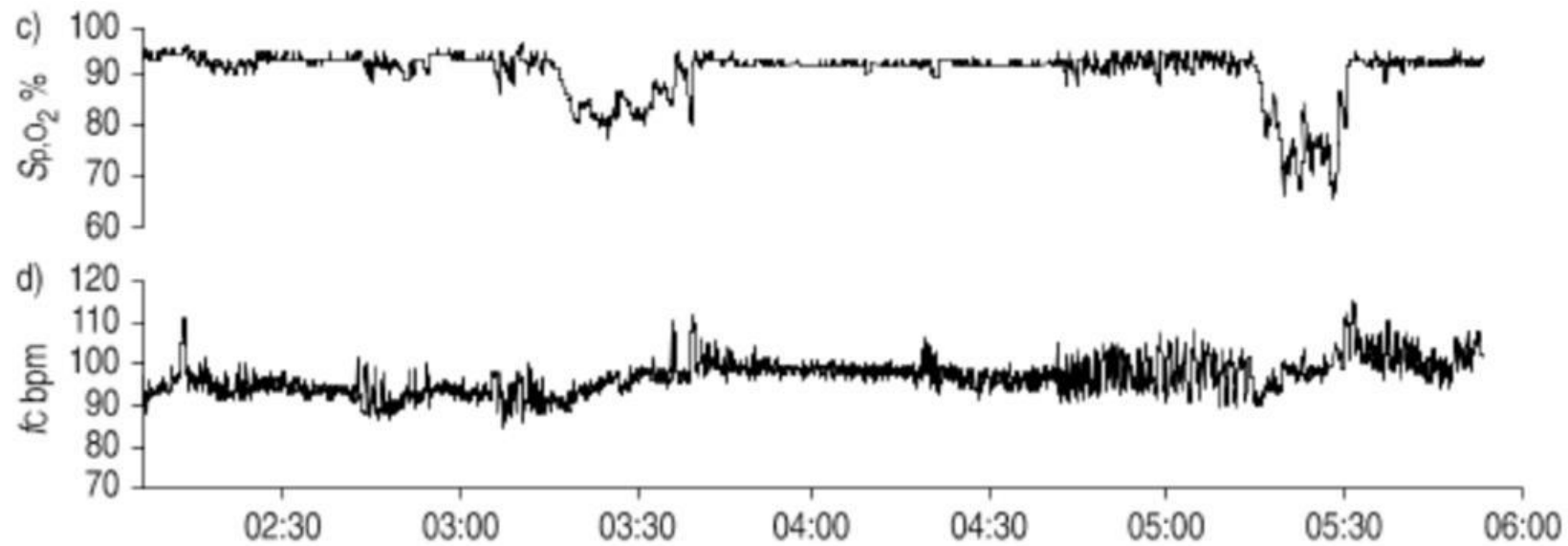
Νυχτερινή οξυμετρία-κυκλικές μεταβολές του κορεσμού



- Αποφρακτικές ή κεντρικές άπνοιες
- Συγχρονισμός ασθενή-αναπνευστήρα
- Διαρροές-μικροαφυπνίσεις



Νυχτερινή οξυμετρία-παρατεταμένης διάρκειας αποκορεσμοί



- Ύπνος REM - υποξυγοναιμία λόγω υποαερισμού
- Διαρροές
- Ανεπαρκής υποστήριξη πίεσης

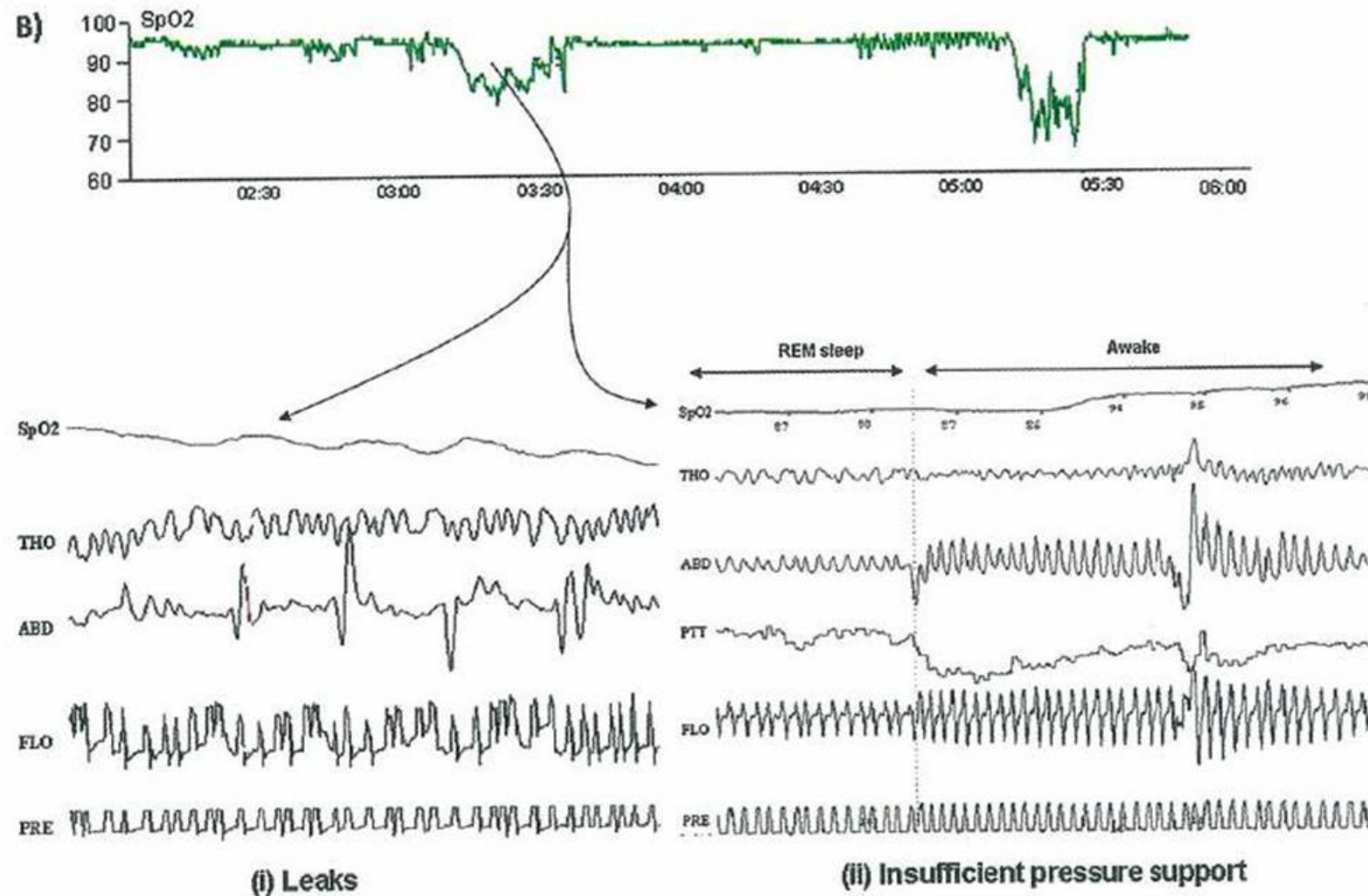


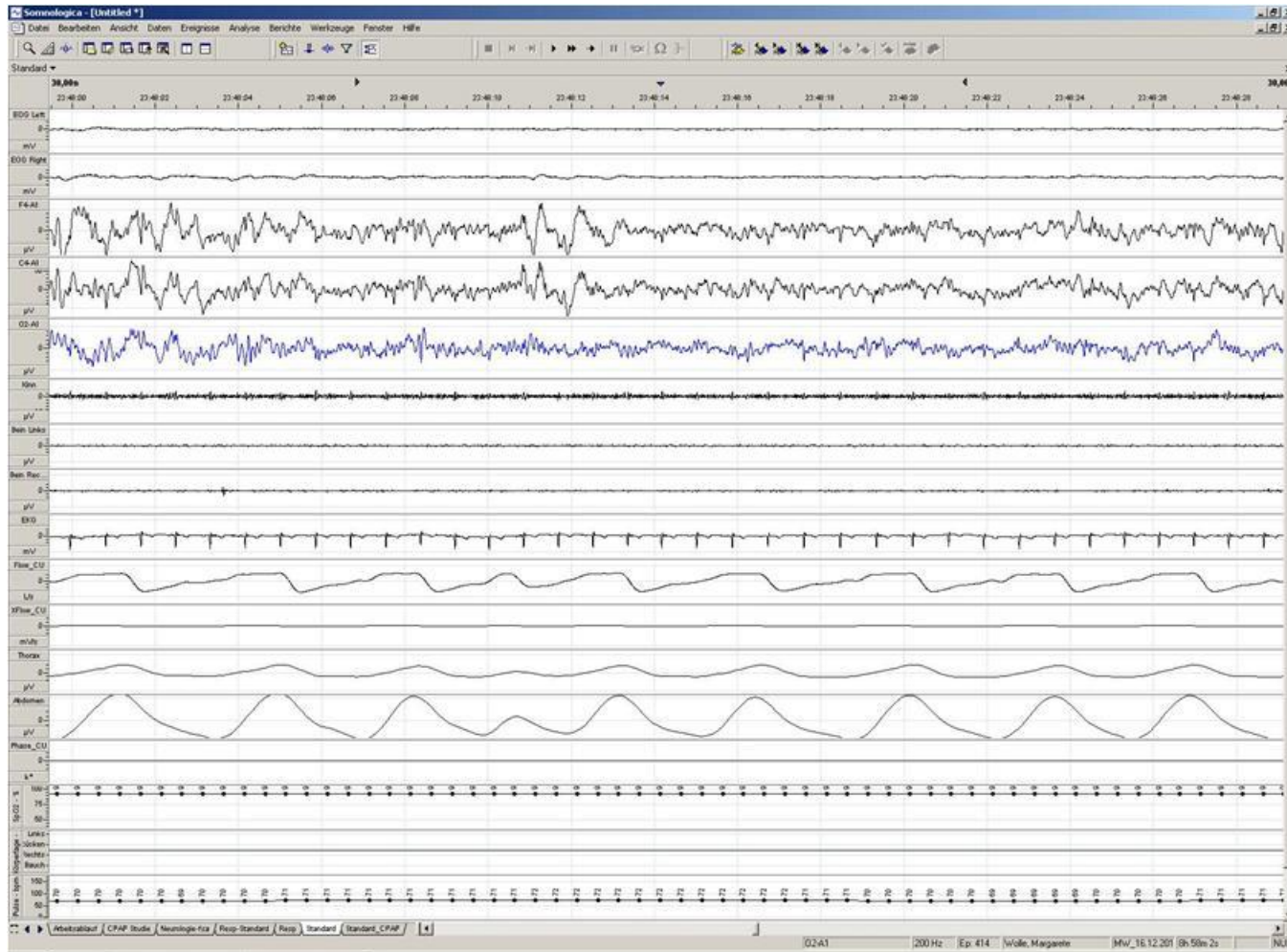
Figure 1 Interpretation of oxygen saturation measured by pulse oximetry (SpO_2) patterns in patients using non-invasive ventilation (NIV). (A) Recurrent oscillations of SpO_2 in a patient treated with NIV. This pattern is sensitive but not specific and can be associated with (i) central events resulting from respiratory instability under NIV, (ii) persistent obstructive events occurring in upper airways, (iii) intermittent non-intentional leaks. (B) Sustained SpO_2 desaturations during NIV (>10 min). This non-specific pattern can result from residual hypoventilation or prolonged non intentional leaks

Δομή

- Διαταραχές της αναπνοής κατά τον ύπνο



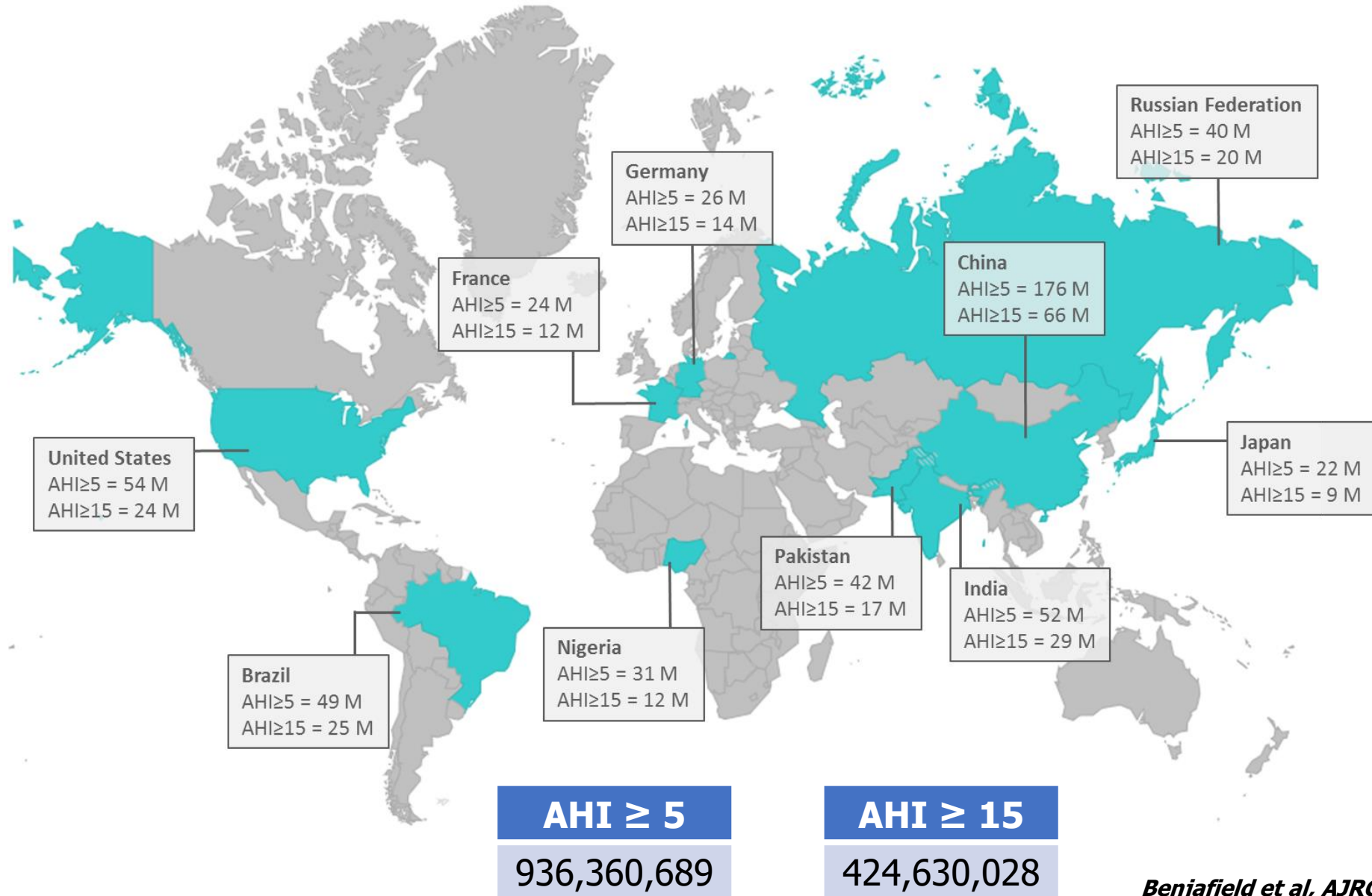
Πολυπνογραφία



Sleep, respiration, cardiovascular signals, video monitoring, snoring



Global OSA Prevalence





DESTROYED BY DOCTOR BILLS

Insured? Confident? Be careful:
A Harvard study finds costly
illnesses are bankrupting
millions of middle-class families

Why medical
treatments must be
made as cost effective
as possible.

BANKRUPTCY BY THE NUMBERS

- Every 45 seconds, an American family goes bankrupt
- More kids have to endure parents' bankruptcies than divorces
- Half of all bankruptcies are due to illness and medical bills

Source: Harvard study

THE BRUNNERS, NORMAN, OKLA. MEDICAL CRISIS: CHILD INGESTS A SMALL PLASTIC SHARD

COSTS AFTER LOSS OF INSURANCE:

- Emma's four-day stay in the intensive care unit
- Emma's ambulance ride to the hospital

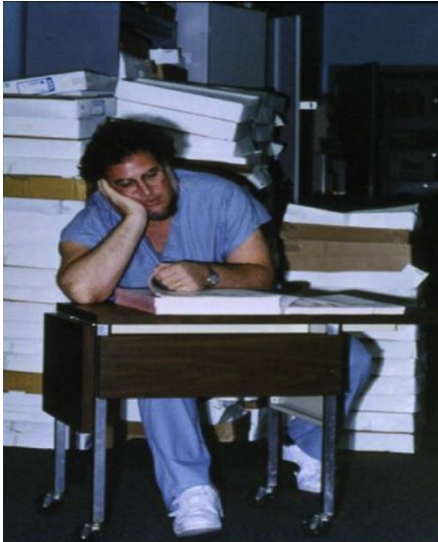
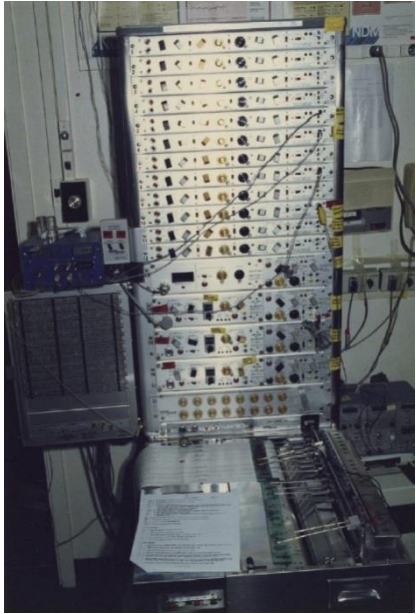
OUT-OF-POCKET TAB: \$28,000 BANKRUPT: 2003

by medical bankruptcy. In a new study released on Feb. 2, Harvard University researchers offer a pair of startling findings: Half of all bankruptcies in the U.S. stem from a medical crisis—and the group hardest hit is the middle class. "We thought we were going to find these were poor people, uninsured," says Dr. David Himmelstein, the study's lead investigator. "By and large, we found it was the middle class."

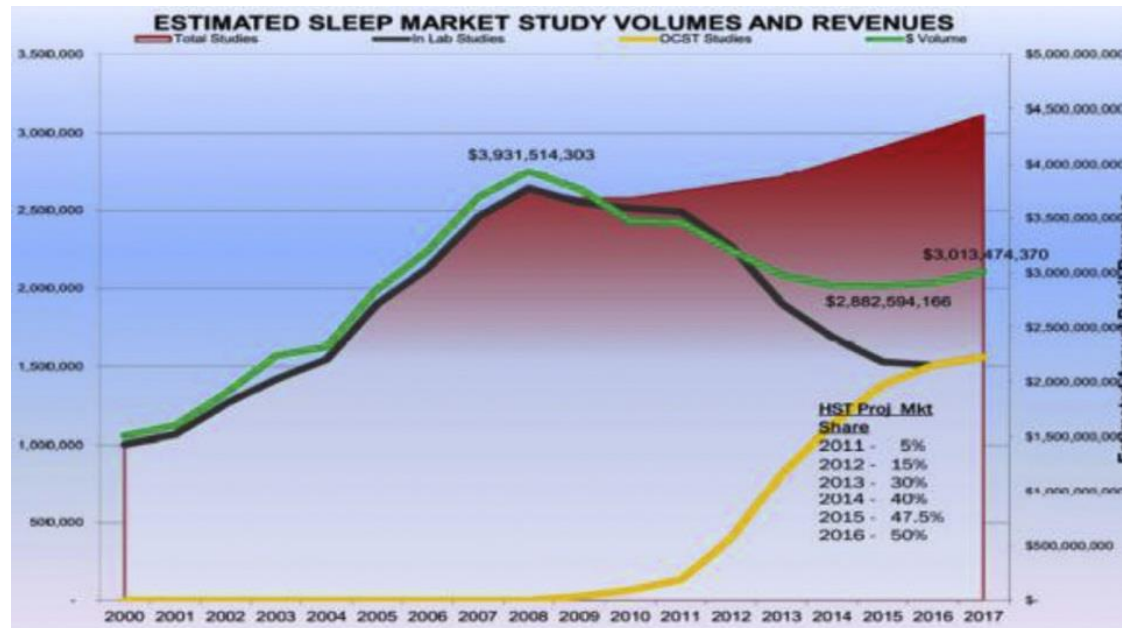
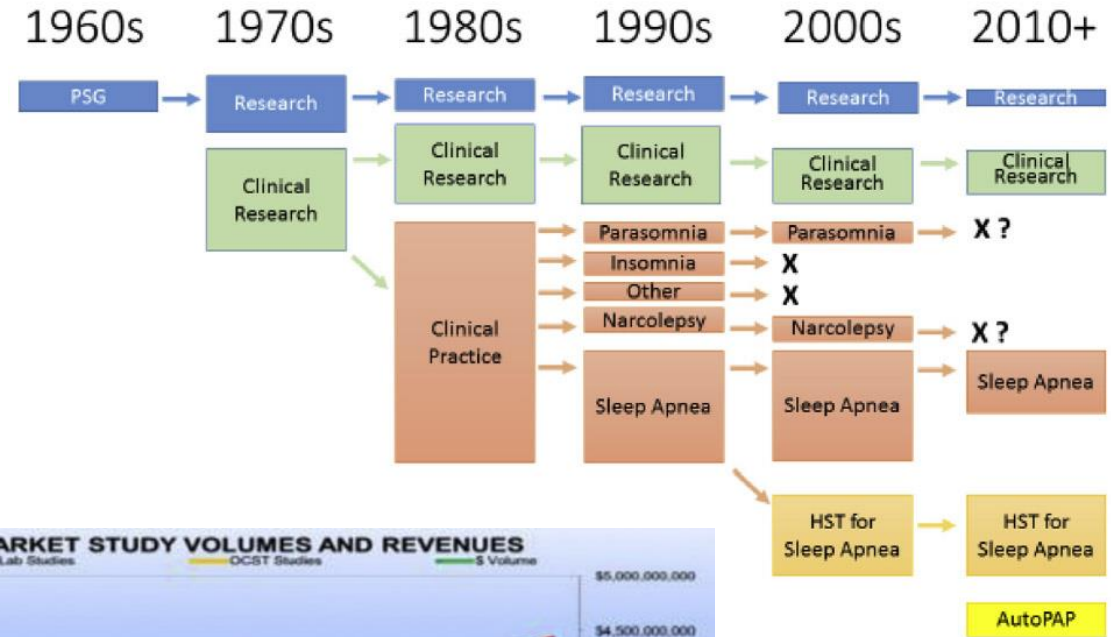
More specifically, of the 700,000 households that are driven into bankruptcy each year by medical crises, three-quarters had health insurance at the onset of their illness, more than half were homeowners, and 50 percent included a member with a college education. "These aren't abstract numbers," says U.S. Sen. Chris Dodd (D-Conn.), who cham-

The NHS cannot
afford unnecessary
costs either

The future of polysomnography - indications

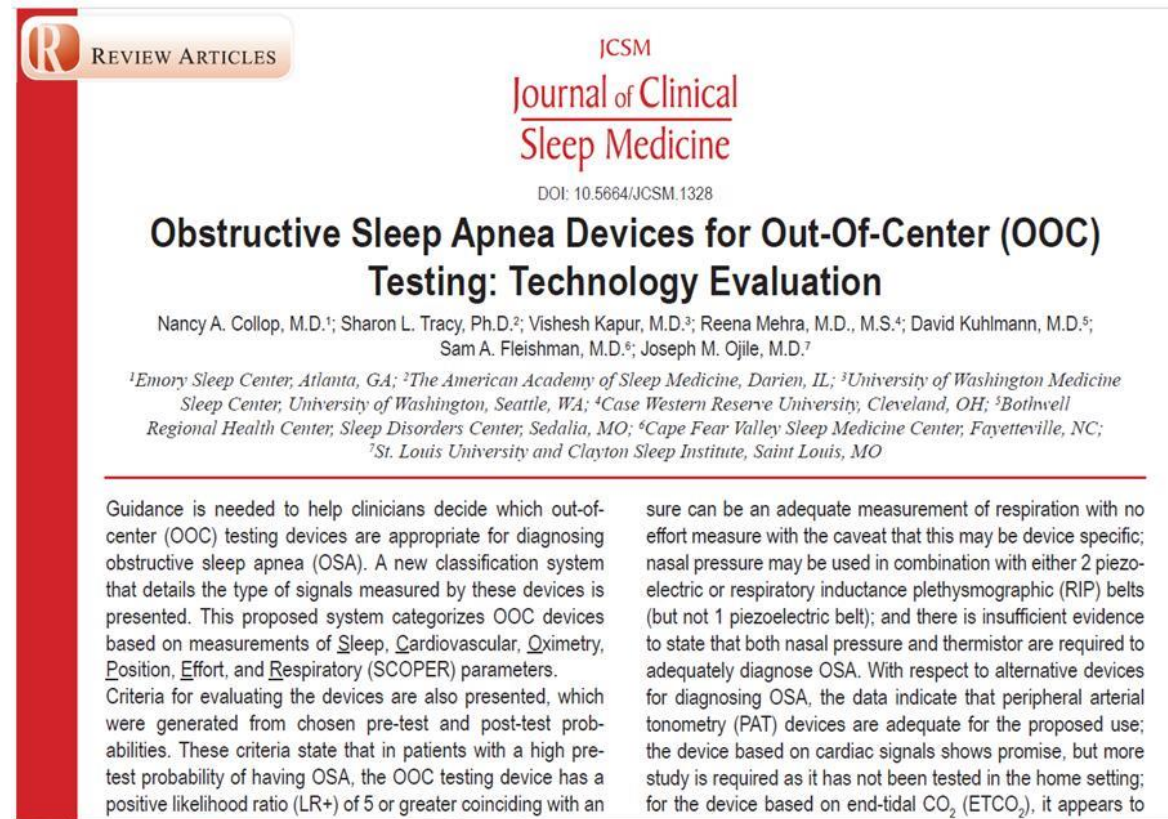


Hirshkowitz M. Polysomnography Challenges Sleep Med Clin 11: 403–411 (2016)



Μελέτη ύπνου στο σπίτι

Home sleep apnoea testing HSAT or OOC



Introduction of **SCOPER**: Sleep, Cardiovascular, Oximetry, Position, Effort, Respiratory

SCOPER (Sleep, Cardiovascular, Oximetry, Position, Effort, Respiratory) criteria

Table 1—SCOPER Categorization System

Sleep	Cardiovascular	Oximetry	Position	Effort	Respiratory
S ₁ – Sleep by 3 EEG channels* with EOG and chin EMG	C ₁ – more than 1 ECG lead – can derive events	O ₁ – Oximetry (finger or ear) with recommended sampling	P ₁ – Video or visual position measurement	E ₁ – 2 RIP belts	R ₁ – Nasal pressure and thermal device
S ₂ – Sleep by less than 3 EEG* with or without EOG or chin EMG	C ₂ – Peripheral arterial tonometry	O _{1x} – Oximetry (finger or ear) without recommended sampling (per Scoring Manual) or not described	P ₂ – Non-visual position measurement	E ₂ – 1 RIP belt	R ₂ – Nasal pressure
S ₃ – Sleep surrogate: e.g. actigraphy	C ₃ – Standard ECG measure (1 lead)	O ₂ – Oximetry with alternative site (e.g. forehead)		E ₃ – Derived effort (e.g. forehead versus pressure, FVP)	R ₃ – Thermal device
S ₄ – Other sleep measure	C ₄ – Derived pulse (typically from oximetry)	O ₃ – Other oximetry		E ₄ – Other effort measure (including piezo belts)	R ₄ – End-Tidal CO ₂ (ETCO ₂)
	C ₅ – Other cardiac measure				R ₅ – Other respiratory measure

Collop et al. JCSM 7:531-548 (2011)

Proper oximetry sampling is defined as 3 s averaging and a minimum of 10 Hz sampling rate (25 Hz desirable).¹*3 EEG channels defined as frontal, central and occipital. EEG, electroencephalography; EOG, electrooculography; EMG, electromyography; ECG, electrocardiography; RIP, respiratory inductance plethysmography.

Ταξινόμηση μελετών ύπνου ως προς τη διαγνωστική ακρίβεια

AASM classifies sleep recording techniques into 4 types (*)

- Type 1: full **attended** PSG (≥ 7 channels) in a laboratory setting
- Type 2: full **unattended** PSG (≥ 7 channels)
- Type 3: limited channel devices (usually using 4 – 7 channels)
- Type 4: 1 or 2 channels usually including oximetry

Μελέτη ύπνου στο σπίτι



Nox: T3

Airflow
Respiratory effort / snoring
Oxygen saturation
Pulse rate / heart rate
Body position



Somnomedics: Somnotouch



Resmed: Apnealink

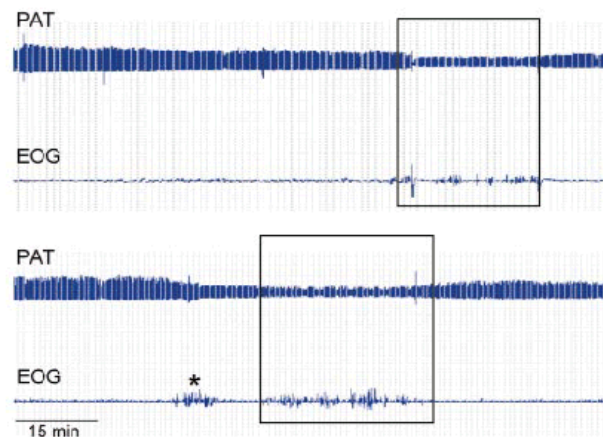
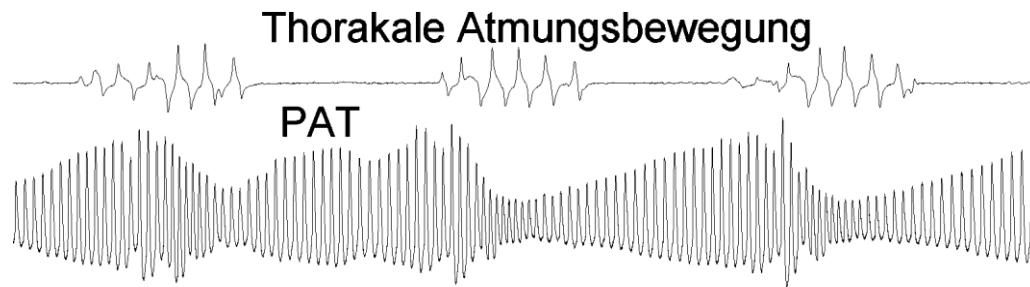
Itamar: Watch-PAT



Περιφερειακός αρτηριακός τόνος

Parameter:

- Peripheral arterial tone
- Pulse oximetry
- Actigraphy



Schnall RP et al. Sleep 22:939-946 (1999)

Lavie P et al. Nature Medicine 6:606 (2000)

Penzel et al. Physiol. Meas. 25: 1025-1036 (2004)

Accuracy of Monitors and Questionnaires - ACP Guideline



Tool	AHI Cutoff, events/h	Sensitivity, %	Specificity, %
Type II monitor	15	79-100	71-100
Type III monitor	15	64-100	41-100
Type IV monitor ≥2 channels	15	67-98	50-100
1 channel/oximetry	15	39-100	32-100
Berlin Questionnaire	15	40-83	20-97
Epworth Sleepiness Scale	15	21-50	43-83
STOP-BANG Questionnaire	15	44-99	11-77

Simple screening: airflow or SaO₂ is not enough

Micromesam recorded signals:

- Airflow (pressure changes)
- Snoring (pressure changes)
- only one sensor: nasal prongs



Oximetry:

- oxygen saturation
- pulse rate



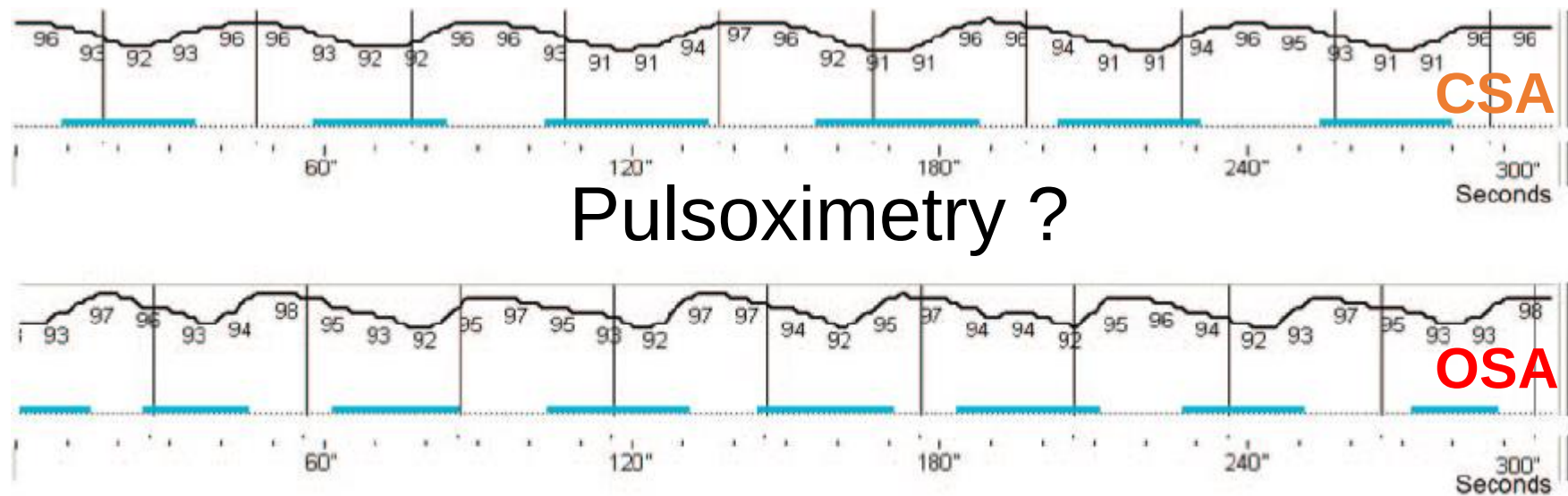


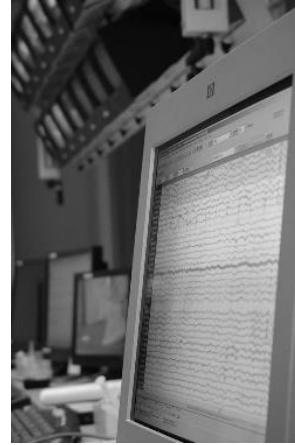
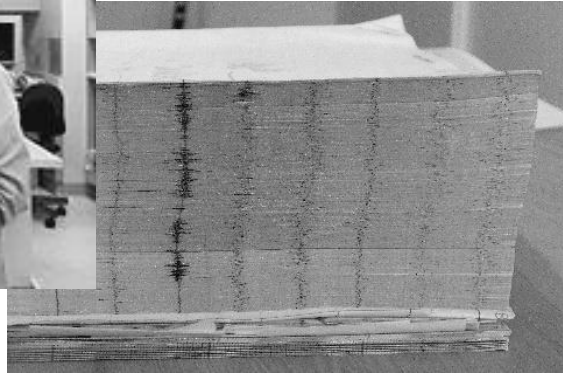
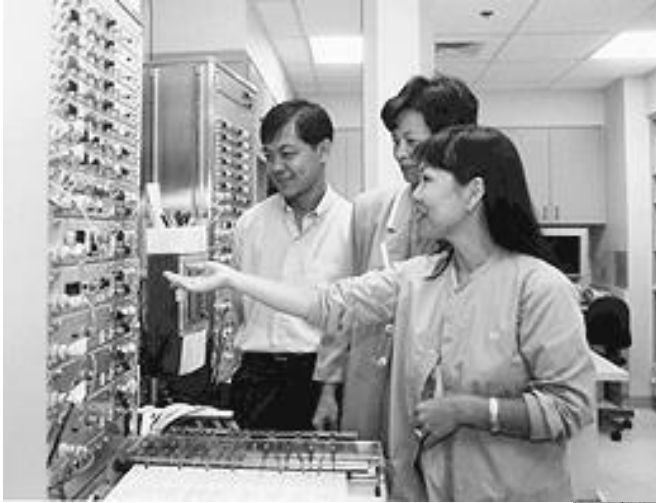
FIGURE 1. Typical examples of oximetry recordings demonstrating regular SpO_2 falls that are suggestive of SRBDs. *Top, A:* the symmetry of the desaturation/resaturation pattern suggests CSA. *Bottom, B:* a slow desaturation pattern is followed by a rapid increase in SpO_2 characteristic of OSA.

N= 50, home pulsoximetry and polysomnography

Home oximetry had a 85% sensitivity and a 93% specificity ($p < 0.001$) for SRBD.

Desaturation pattern cannot distinguish OSA and CSA

PSG will be substantially transformed by the digital revolution



Smartphone Applications



Sleepcycle zum Wecken

Movement analysis
Microphone analysis
Other single use sensors

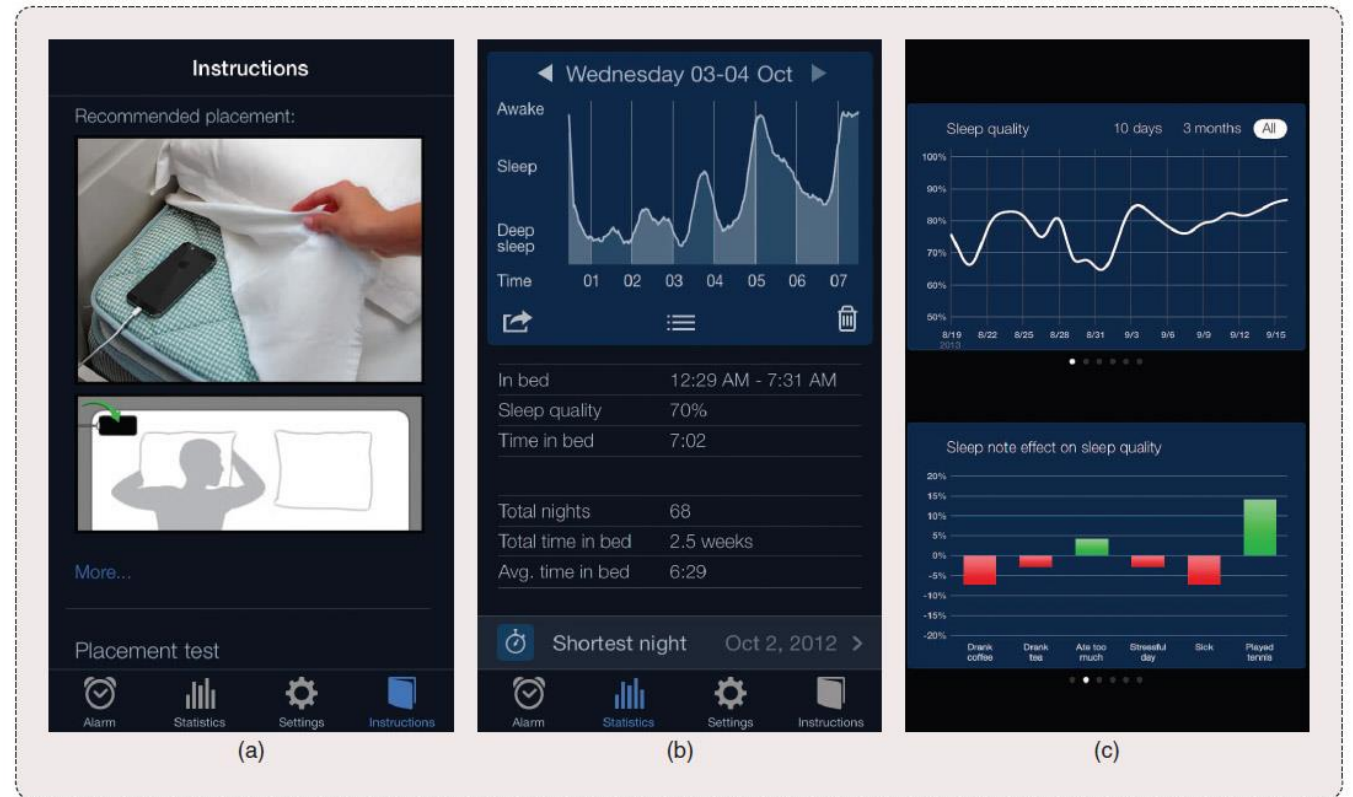
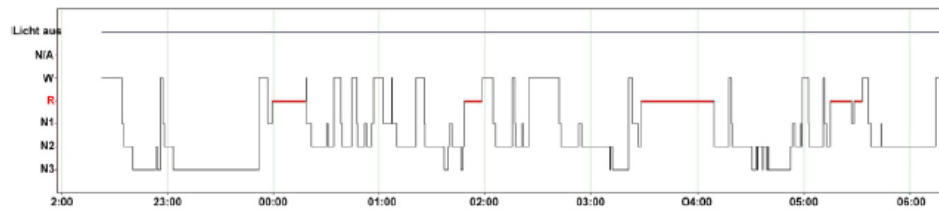


FIGURE 1 Sleep Cycle uses the accelerometer in smartphones to detect movement. The app uses these readings to attempt to graph a user's sleep patterns. The screenshots show (a) the recommended placement of the smartphone, (b) the user's sleep statistics, and (c) sleep quality graphs. (Image courtesy of Sleep Cycle.)

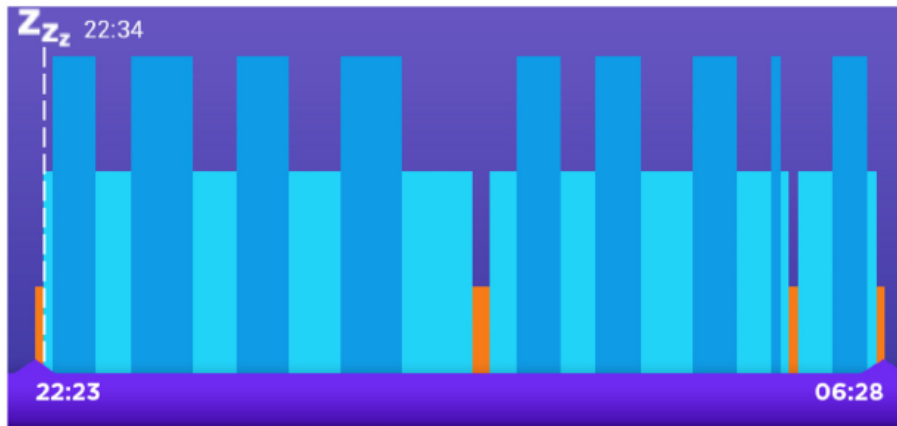
Estimating sleep using smartphone apps

Polysomnography

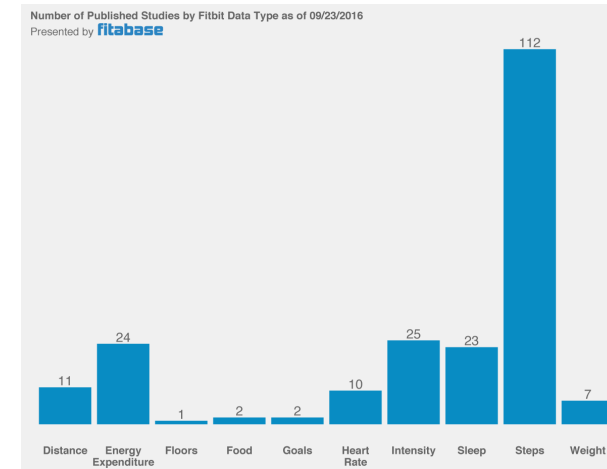


Stage 1: 37 min (9.2% TST)
 Stage 2: 185 min (46.2% TST)
 Stage 3: 92 min (23 % TST)
 REM sleep: 85.5 min (21.6% TST)
 Wake after sleep onset: 69.4 min

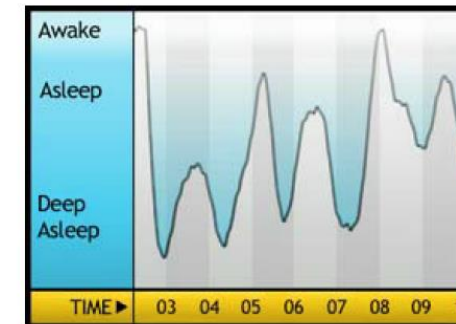
Wearable actigraphy



Light sleep: 432 min
 Deep Sleep: 229 min
 Awake for: 22 min



- SleepApps raise interest
- Validation against reference (PSG)



Fietze: Sleep Medicine Clinics 11: 461-468 (2016)

Smartphone apps for sleep apnea

BEST IPHONE APPS FOR SLEEP APNEA

CARLY MESSMER

PRODUCTS SLEEP APNEA TECH & GADGETS



f 40 t 13 @

Last updated on December 16th, 2016

HERE ARE SOME OF THE BEST IPHONE APPS THAT CAN HELP SLEEP APNEA SUFFERERS

CLINICAL PRACTICE GUIDELINES

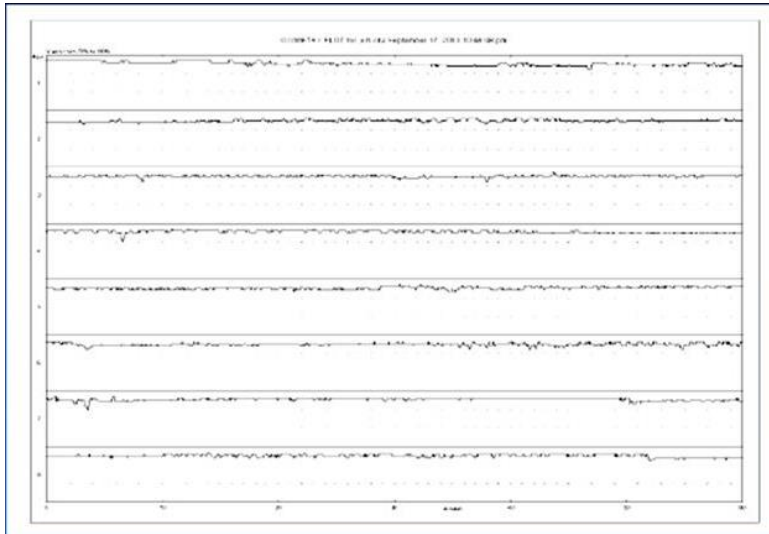
Clinical use of pulse oximetry: Official guidelines from the Thoracic Society of Australia and New Zealand

JEFFREY J. PRETTO,^{1,2} TEANAU ROEBUCK,³ LUTZ BECKERT^{4,5} AND GARUN HAMILTON^{6,7}

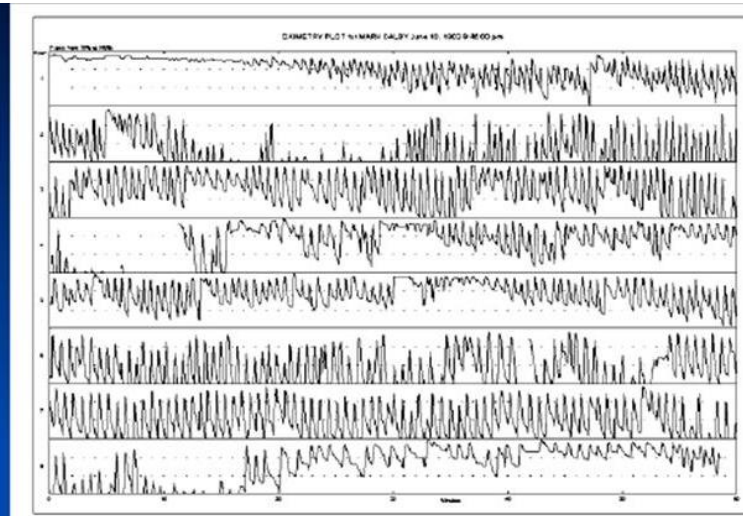
Table 1 List of clinical applications for pulse oximetry and issues to consider relevant to each application

Detection of nocturnal breathing disorders in the laboratory	Sleep laboratory	• Use oximeter in 'sleep' mode or with alarms disabled • Set averaging time to 3 s or less • Set data sampling and storage rate to a minimum of 10 Hz • Ability to output data in real time to capture on polysomnograph system
Detection of nocturnal breathing disorders in the home setting	Overnight domiciliary monitoring	• Use oximeter in 'sleep' mode or with alarms disabled • Set averaging time to 3 s or less • Set data sampling and storage rate to a minimum of 1 Hz • Adequate data storage capacity (minimum of 8 h) • Download/analysis software required for report generation

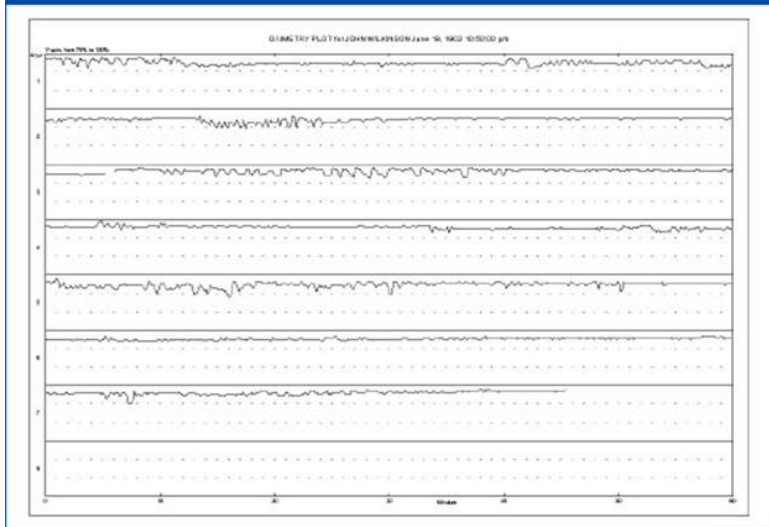
Παραδείγματα καταγραφών νυχτερινής οξυμετρίας (8h)



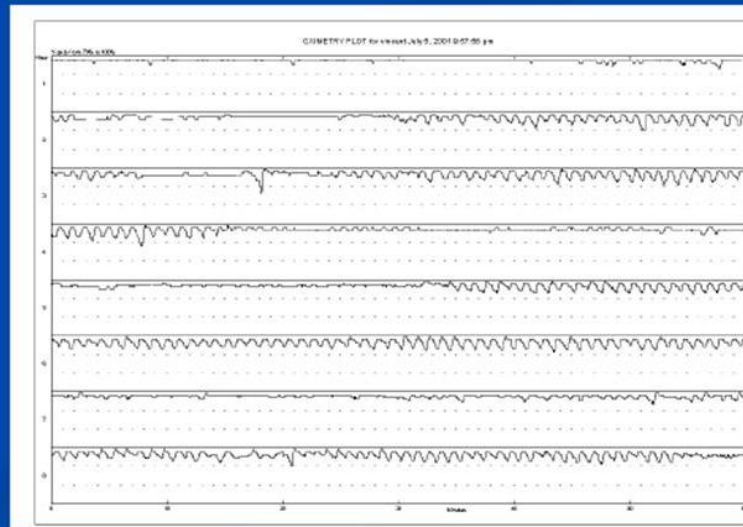
Normal



Severe OSA

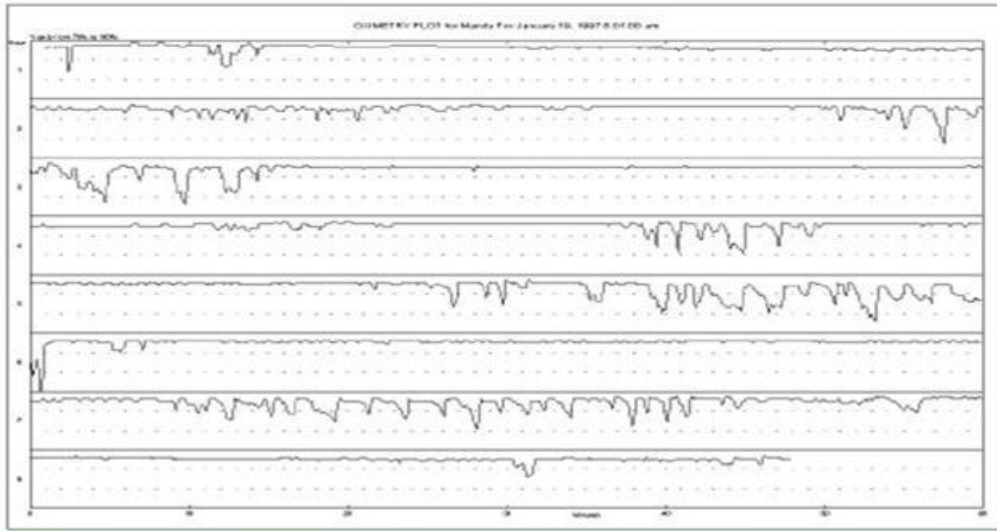


Sleep onset periodic ventilation

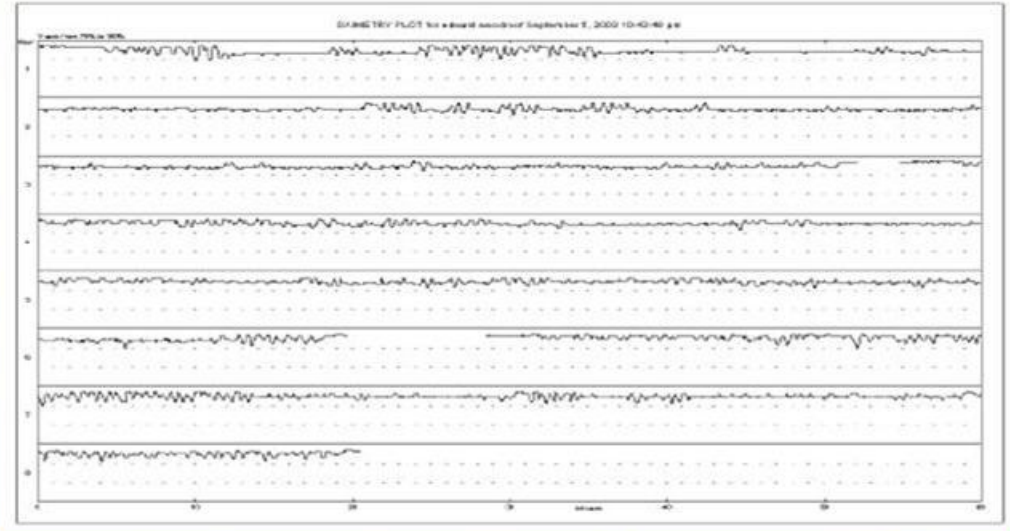


Cheyne Stokes ventilation

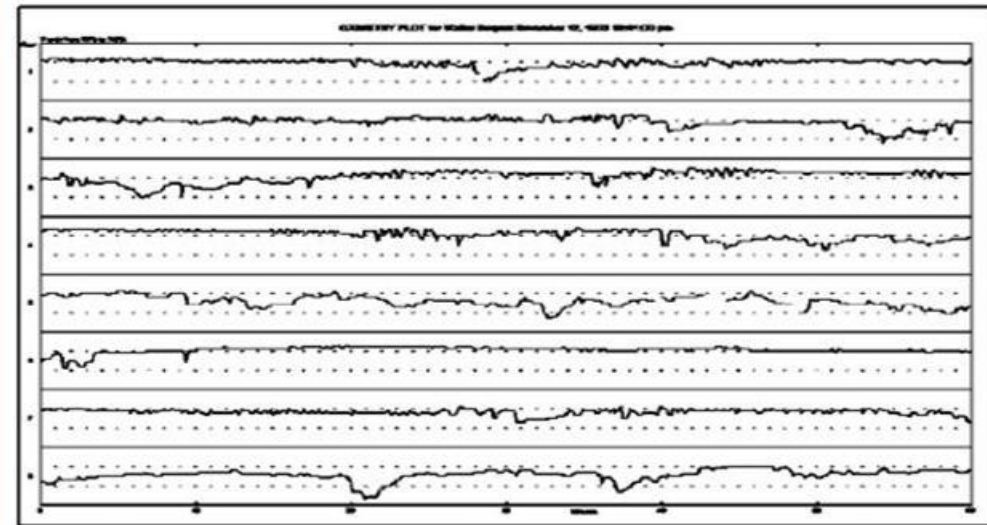
Παραδείγματα καταγραφών νυχτερινής οξυμετρίας (8h)



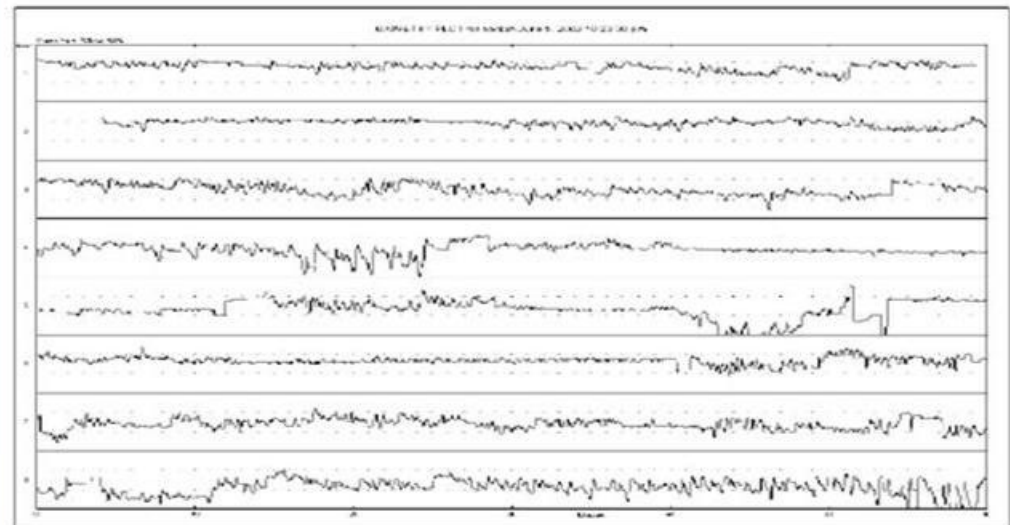
REM sleep hypoventilation in scoliosis



Moderate OSA with <4% SaO₂ dips



Nocturnal hypoxaemia in COPD



Overlap syndrome – COPD and OSA

Clinical Resources

Career Development

Education

Professional Accreditation

ATS Podcasts

ATS Webinars

Calendar of Events

Ethics and COI

Job Board

Pulmonary Function Testing

Research

ATS Resources

ATS Store

APCCSD

Pediatric Division Directors

Wellbeing Collaborative

A 77 year old man underwent overnight oximetry to assess severity of nocturnal desaturations after discontinuing CPAP therapy due to intolerance. His underlying medical conditions include ischemic cardiomyopathy, with left ventricular ejection fraction estimated at 35%, obesity, and hypertension. A sleep study greater than one year ago demonstrated severe sleep disordered breathing with AHI of 103 and oxygen saturation nadir of 67%. On examination in clinic, notable findings included presence of obesity, irregular heart beat, and trace peripheral edema.

Images:

Below is a portion of his home based overnight oximetry. Hash-marks denote 5 minute time increments.

Figure 1: Oximetry on supplemental oxygen alone

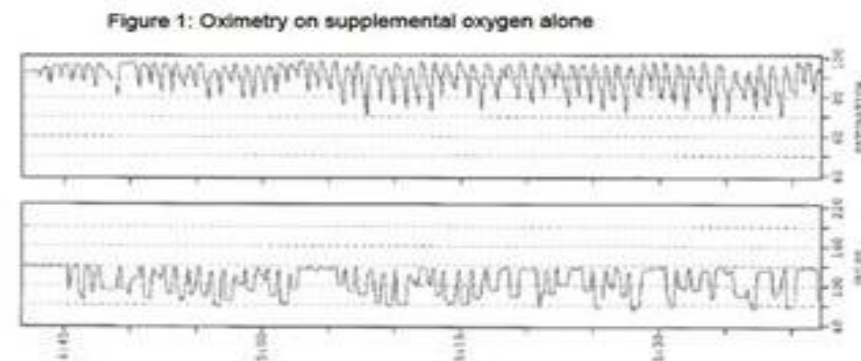


Figure 2: Oximetry after intervention



Interaction of Sleep Apnea With Cardiovascular Disease

Aug 01, 2014 | Faisal Fiazuddin Syed, MB CHB, FACC; Seth H. Sheldon, MD, FACC; Sean Caples, DO

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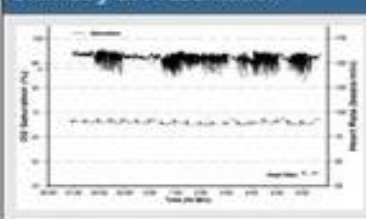
A 67-year-old man presents with a three-month history of pauses in breathing during sleep, witnessed by his wife. There is no history of snoring or difficulty falling asleep, although he has been waking up occasionally due to shortness of breath which resolves several minutes after sitting upright. He has recently been diagnosed with heart failure and his medications are aspirin, lisinopril, atorvastatin, and metoprolol. Vitals: temperature 36.6 °C (97.9 °F), left arm BP 128/78 mm Hg, pulse rate 88/min, respiration rate 16/min, body mass index 24 kg/m². Cardiorespiratory examination demonstrates regular pulse, an S3 without any murmurs, JVP 6 cm, bibasilar crackles and trace bilateral edema. Overnight sleep oximetry reveals baseline saturations of 94% on room air with frequent desaturations (Figure 1). On polysomnography, there is characteristic Cheyne-Stokes ventilation.

Which of the following is the next best therapeutic intervention for this patient?

- ☐ A. Continuous positive airways pressure (CPAP).
- ☐ B. Adaptive servoventilation (ASV).
- ☐ C. Diuretic therapy.
- ☐ D. Nocturnal oxygen.
- ☐ E. Theophylline.

Answer

Figure 1: Overnight Sleep Oximetry at Presentation



Conclusions – which sleep study?

Forced to conclude that the type of sleep study may not be that important

Oximetry alone with expert interpretation and a clinical assessment seems to be as good as any other approach

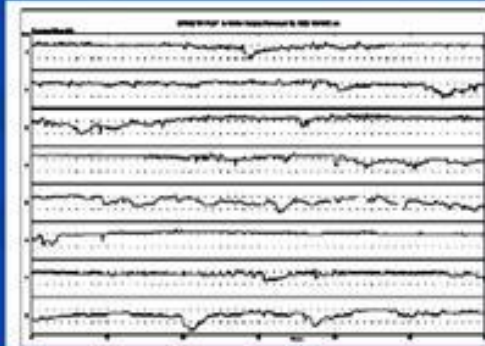
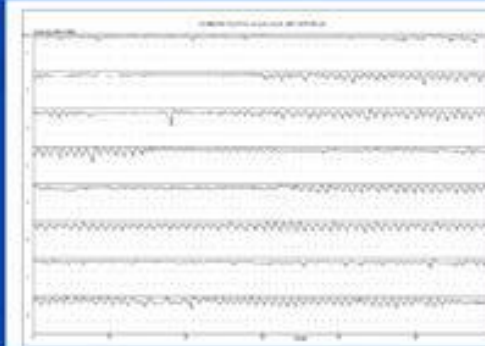
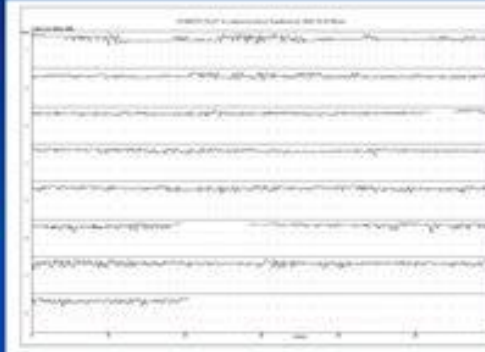
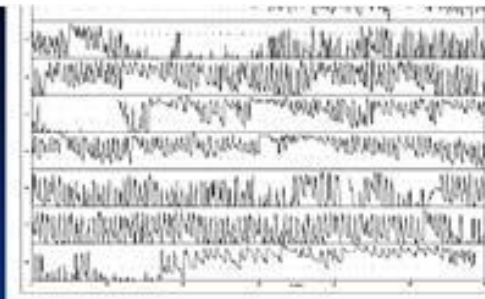
There are important caveats however:-

Young, thin individuals can have significant OSA with very little desaturation and may be overlooked

Cheyne Stokes breathing can look like OSA

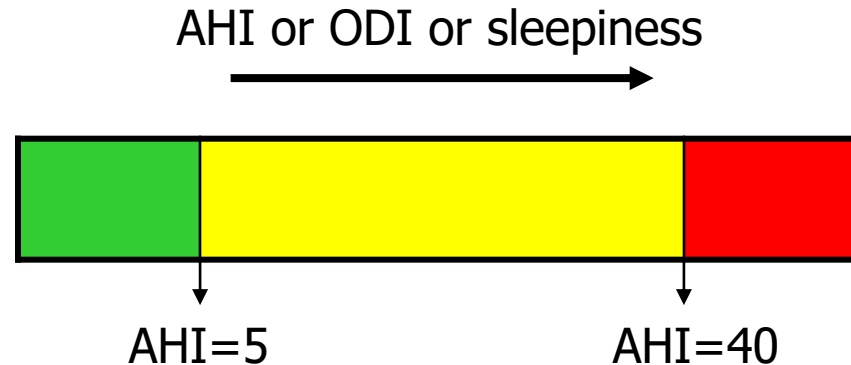
Nocturnal hypoxia in COPD can sometimes look a bit like OSA

Extra channels and video prevent these errors



Ενδείξεις μελέτης ύπνου στο σπίτι

- Who should use portable monitoring: certified sleep physicians
- Indications for portable monitoring: sleep apnea
- High pre-test probability for sleep apnea: daytime symptoms
- Therapy control studies in sleep disordered breathing
- Strategy for easy portable monitoring decision



Αντενδείξεις μελέτης ύπνου στο σπίτι

No use of portable monitoring:

- comorbid and other sleep disorders
- exclusion of sleep disordered breathing
- population screening

Π.Μ.Σ. Ιατρική του Ύπνου

• Έναρξη: 10-12 Οκτώβρη 2013

• 1^{ος} κύκλος: 19/19 απόφοιτοι - 100%

10 υποψήφιοι διδάκτορες – 2 ολοκλήρωσαν το PhD

• 2^{ος} κύκλος: 22/22 απόφοιτοι - 100%

3 υποψήφιοι διδάκτορες – 1 ολοκλήρωσε το PhD

1 MSc

• 3^{ος} κύκλος: 21 φοιτητές – 6 απόφοιτοι

2 υποψήφιοι διδάκτορες

2 MSc

• 4^{ος} κύκλος: 8 φοιτητές (Γ' εξάμηνο Σπουδών)

• 5^{ος} κύκλος: 9 φοιτητές



**Ευχαριστώ για την
προσοχή σας**