<table>
<thead>
<tr>
<th>Page</th>
<th>Title</th>
<th>Supporting Author(s)</th>
<th>Journal/Year/Volume</th>
<th>Supporting Paper?</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Diagnosis or Obstructive Sleep Apnea by Peripheral Arterial Tonometry.</td>
<td>Yalamanchali et al.</td>
<td>JAMA Otolaryngol Head Neck Surg, 2013.5338</td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>The Effect of the Transition to Home Monitoring for the Diagnosis of OSAS on Test Availability, Waiting Time, Patients’ Satisfaction, and Outcome in a Large Health Provider System.</td>
<td>Saladi, et al., J Sleep Disorders, Published 24 April 2014</td>
<td>J Sleep Disorders, Published 24 April 2014</td>
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</tbody>
</table>
OSA validation against PSG gold standard

Diagnosis or Obstructive Sleep Apnea by Peripheral Arterial Tonometry (Meta-analysis) Yalamanchali et al. JAMA Otolaryngol Head Neck Surg, 2013.5338


Objective:

To assess the correlation between sleep indexes measured by the WatchPAT device and those measured by the gold standard, polysomnography (PSG).

Methods:

Review incl. 14 studies (909 patients) with data suitable for pooling, that assessed correlation of the respiratory disturbance index (RDI), apnea-hypopnea index (AHI), and oxygen desaturation index (ODI).

The studies were reviewed by 2 independent reviewers in a systematic manner.

Results:

WatchPAT and PSG indices of RDI, AHI and ODI, were all significantly correlated with r values of 0.879 (RDI), 0.893 (AHI), and 0.942 (ODI) (all P<0.001). RDI combined with AHI were highly correlated (r = 0.889, p < .001).

Analysis of publication bias revealed a non-significant Egger regression intercept.

Conclusion:

Respiratory indices determined by WatchPAT positively correlated with those of PSG. Strengthened by the blinded design of 13/14 of the included studies, WatchPAT represents a viable alternative to PSG for confirmation of clinically suspected sleep apnea.

Key takeaways:

Compared with PSG, the WatchPAT HST offers an accurate diagnosis, highly convenient and low cost.

WatchPAT consistently demonstrated a high degree of correlation in sleep variables when compared to PSG.

The WatchPAT device is well validated in various countries, patient populations, both in attended in-lab and un-attended home settings, by highly valued sleep centres.

PAT technology is relatively unknown to the otolaryngology community, making this meta-analysis important because it presents a viable option for the diagnosis and subsequent treatment of OSA.

Review of correlation values over time-line reveals an improvement since change of WatchPAT analysis in 2006.

Overall Correlation of the Respiratory Disturbance Index (RDI) and Apnea-Hypopnea Index (AHI) Between Polysomnography (PSG) and Peripheral Arterial Tonometry (PAT)

<table>
<thead>
<tr>
<th>Source</th>
<th>Study Setting</th>
<th>Device</th>
<th>Correlation r Value</th>
<th>Statistics</th>
<th>p Value</th>
<th>Negative Correlation</th>
<th>Positive Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Åkerström et al.2016</td>
<td>L, (B)</td>
<td>AHF</td>
<td>0.920</td>
<td>(0.740-0.977)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Pérez et al.*2016</td>
<td>B</td>
<td>AHF</td>
<td>0.876</td>
<td>(0.725-0.960)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Barreto et al.*2016</td>
<td>B</td>
<td>AHF</td>
<td>0.870</td>
<td>(0.742-0.937)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Pichotka et al.*2016</td>
<td>B</td>
<td>AHF</td>
<td>0.870</td>
<td>(0.757-0.916)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Pérez et al.2016</td>
<td>B</td>
<td>AHF</td>
<td>0.800</td>
<td>(0.626-0.893)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Pérez et al.*2016</td>
<td>B</td>
<td>RIH</td>
<td>0.770</td>
<td>(0.459-0.939)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Penza et al.*2015</td>
<td>B</td>
<td>AHF</td>
<td>0.880</td>
<td>(0.716-0.942)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Park et al.*2014</td>
<td>B</td>
<td>AHF</td>
<td>0.920</td>
<td>(0.816-0.966)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Toerien et al.*2017</td>
<td>B</td>
<td>AHF</td>
<td>0.870</td>
<td>(0.865-0.974)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Nikolakopoulos et al.*2011</td>
<td>B</td>
<td>RIH</td>
<td>0.970</td>
<td>(0.834-0.986)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Order et al.*2012</td>
<td>B, (B-group 2)</td>
<td>AHF</td>
<td>0.920</td>
<td>(0.835-0.962)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Order et al.*2012</td>
<td>B, (B-group 2)</td>
<td>AHF</td>
<td>0.940</td>
<td>(0.871-0.973)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Weems et al.*2011</td>
<td>B, (B-group 2)</td>
<td>AHF</td>
<td>0.920</td>
<td>(0.833-0.966)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Yucel et al.*2015</td>
<td>B</td>
<td>AHF</td>
<td>0.900</td>
<td>(0.816-0.942)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
<tr>
<td>Yucel et al.*2015</td>
<td>B</td>
<td>RIH</td>
<td>0.900</td>
<td>(0.816-0.942)</td>
<td>&lt;.001</td>
<td>-0.095</td>
<td>0.920</td>
</tr>
</tbody>
</table>

Overall correlation corresponds to the relative weight assigned in the pooled analysis. B indicates blinded; H, home setting; L, laboratory setting, and NB, non-blinded. Study reported the value as RDI; however, recent American Academy of Sleep Medicine criteria defined the value as AHI.
OSA validation against PSG gold standard

Validation a Portable Monitoring Device for Sleep Apnea Diagnosis in a Population Based Cohort Using Synchronized Home Polysomnography.
Zou D, Grote L, Peker Y, Lindblad U, Hedner

Objective:
• To assess the accuracy of The WatchPAT device based on peripheral arterial tonometry (PAT) to diagnose obstructive sleep apnea (OSA).
• To propose a new standard for HST validation using synchronized polysomnography (PSG) home recordings and a population-based cohort.

Methods:
• A single comparative unattended PSG and WatchPAT sleep test, at home environment recorded in a in a synchronized manner.
• Subject consecutively recruited from the Skaraborg Hypertension and Diabetes Project.
• Data included ninety-eight subjects (55 men; age, 60 ± 7 year; body mass index, 28 ± 4 kg/m²).

Results:
• Mean PSG-AHI was 25.5 +/- 22.9 events per hour.
• WatchPAT RDI, AHI, and ODI correlated closely with corresponding PSG indices (R=0.88, 0.90, and 0.92; p < .0001, respectively).
• The areas under the curve for the ROC curves for WatchPAT AHI and RDI were 0.93 and 0.90 for PSG-AHI and RDI thresholds 10 and 20 (p < .0001, respectively).
• Agreement of the sleep-wake assessment based on 30-second bins between the 2 systems was 82 +/- 7%

Conclusion:
• WatchPAT was reasonably accurate for unattended home diagnosis of OSA in a population sample not preselected for OSA symptoms.
• Simultaneous home PSG, is proposed as a validation standard for assessment of simplified recording tools for OSA diagnosis.

Key takeaways:
• The WatchPAT HST offers an accurate and simple diagnosis of OSA with minimal number of sensors for the patient to apply.
• The WatchPAT is the only HST that has been validated in the unattended home settings by simultaneous recording with PSG.

Table 2 — Sleep and breathing characteristics comparing Polysomnography and Watch_PAT 100

<table>
<thead>
<tr>
<th>Sleep Parameter</th>
<th>Monitoring Method</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Polysomnography</td>
</tr>
<tr>
<td>TST</td>
<td>6.4±1.2</td>
</tr>
<tr>
<td>AHI</td>
<td>25.5±22.9</td>
</tr>
<tr>
<td>RDI</td>
<td>31.6±22.7</td>
</tr>
<tr>
<td>ODI</td>
<td>13.3±15.3</td>
</tr>
</tbody>
</table>

Data are presented as mean ± SD events per hour, except total sleep time (TST), which is given in hours. WP_100 refers to Watch_PAT 100. AHI, apnea-hypopnea index; RDI, respiratory disturbance index; ODI, oxygen desaturation index.

*p < .0001

Figure 4 — Receiver-operator characteristic (ROC) analysis shows the specificity and sensitivity of obstructive sleep apnea diagnosis of Watch-PAT (WP_100) a limited-channel recording technique based on PAT, detected OSA in the unattended home setting with reasonable accuracy. To the best of our knowledge, this study showed that WP_100, a limited-channel recording device used for OSA diagnosis in the unattended home setting with reasonable accuracy.
Objective:

- To compare a clinical pathway using portable monitoring (PM) for diagnosis and unattended auto-titration of positive airway pressure (APAP), for selecting an effective continuous positive airway pressure (CPAP), with a pathway using polysomnography (PSG) for diagnosis and treatment of obstructive sleep apnea (OSA).

Methods:

- 106 patients with daytime sleepiness and a high likelihood of having OSA were randomized to the PSG pathway or the WatchPAT–APAP pathway.

Results:

- The AHI in the PM-APAP group was 29.2 ± 2.3/h and in the PSG group was 36.8 ± 4.8/h (P = NS).
- Patients with an AHI >5 were offered CPAP treatment. Those accepting treatment (WatchPAT–APAP 45, PSG 43) were begun on CPAP using identical devices at similar mean pressures (11.2 ± 0.4 versus 10.9 ± 0.5 cm H2O).
- At a clinic visit 6 weeks after starting CPAP, 40 patients in the WatchPAT–APAP group (78.4% of those with OSA and 88.8% started on CPAP) and 39 in the PSG arm (81.2% of those with OSA and 98.6% of those started on CPAP) were using CPAP treatment (P = NS).
- The mean nightly adherence (WatchPAT–APAP: 5.20 ± 0.28 versus PSG: 5.25 ± 0.38 h/night), decrease in Epworth Sleepiness Scale score (−6.50 ± 0.71 versus −6.97 ± 0.73), improvement in the global Functional Outcome of Sleep Questionnaire score (3.10 ± 0.05 versus 3.31 ± 0.52), and CPAP satisfaction did not differ between the groups.

Conclusion:

- A clinical pathway utilizing WatchPAT and WatchPAT APAP titration resulted in CPAP adherence and clinical outcomes similar to one using PSG.

Key takeaways:

- The WatchPAT can be used for the full cycle of diagnosing and treating OSA.
- This is a perfect option for remote areas, where sleep centres are few or in large medical facilities where waiting lists delay assessment and treatment of OSA.
Sleep Staging Based on Autonomic Signals: A Multi-Center Validation Study
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3113970/

Sleep Staging and Sleep/Wake Validation Against Gold Standard – PSG

Objective:
• To assess the WatchPAT based algorithm for determining wake, light sleep, deep sleep, and REM sleep based on epoch-by-epoch comparisons to polysomnography (PSG).

Methods:
• Total of 237 patients data were analysed (38 normal; 189 with obstructive sleep apnea [OSA])
• Subjects underwent simultaneous, synchronized overnight recordings with PSG and the WatchPAT
• Light/deep sleep and REM sleep from the WatchPAT recording were automatically scored based on features extracted from time series of peripheral arterial tone amplitudes and inter pulse periods.
• The PSG scored sleep stages 1 and 2 were classified as light sleep for epoch-by-epoch comparisons.

Results:
• The overall agreement in detecting light/deep and REM sleep were 88.6% ± 5.9% and 88.7% ± 5.5%, respectively.
• There was a good agreement between PSG and the WatchPAT in quantifying sleep efficiency (78.4% ± 9.9% vs. 78.8% ± 13.4%), REM latency (237 ± 148 vs. 225 ± 159 epochs), and REM percentage (14.4% ± 6.5% vs. 19.3% ± 8.7%).
• OSA severity did not affect the sensitivity and specificity of the algorithm.

Conclusion:
• WatchPAT can detect sleep stages with moderate agreement to PSG in normal subjects and OSA patients. This novel algorithm may provide insights on sleep and sleep architecture when applying the PAT recorder for OSA diagnosis.
• This study shows that sleep staging based on actigraphy and signals recorded by the WatchPAT is of reasonable accuracy. This may be of substantial interest and importance in the era of a shift toward unattended home sleep testing.

Key takeaways:
• Sleep architecture, obtained by the WatchPAT analysis, provides important added information to the physician when assessing the sleep test. This is mostly important when assessing results of mild OSA where patients with mild OSA presenting poor sleep architecture may be treated while a patient with mild OSA but normal sleep architecture may not be treated.
• Sleep architecture enables diagnosis of REM related OSA and insomnia.
Detecting REM Sleep From the Finger: Automatic REM Sleep Algorithm Based on Peripheral Arterial Tone (PAT) and Actigraphy
Herscovici et al., Physiol Meas 2007; 28(2): 129-140
http://sleepmedicinenetwork.org/pdf/WatchPat/Lavie-DetectingREMsleepfromthefinger.pdf

Objective:
• To evaluate an automatic REM detection algorithm based on the peripheral arterial tone (PAT) and actigraphy signals recorded with the Watch-PAT.

Methods:
• The algorithm was developed using a training data set of 30 patients recorded simultaneously with polysomnography (PSG) and WatchPAT in a synchronized manner.
• Sleep records were divided into 5 min intervals and two time series were constructed from the PAT amplitudes and PAT-derived inter-pulse periods in each interval.
• A prediction function based on 16 features extracted from the above time series that determines the likelihood of detecting a REM epoch was developed.
• The coefficients of the prediction function were determined using a genetic algorithm (GA) optimizing process, tuned to maximize a price function depending on the sensitivity, specificity and agreement of the algorithm in comparison with the gold standard of PSG manual scoring.

Results:
• Based the validation set of 30 patients, overall sensitivity, specificity and agreement of the automatic algorithm to identify standard 30 s epochs of REM sleep were 78%, 92%, 89%, respectively.

Conclusion:
• Deploying this REM detection algorithm in the WatchPAT device could be very useful for unattended ambulatory sleep monitoring.
• The innovative method of optimization using a genetic algorithm has been proven to yield robust results in the validation set.

Key takeaways:
• The convenience of obtaining information on REM sleep with the WatchPAT may be valuable in assessing the effect of OSA on sleep structure and identifying patients with REM-related sleep apnea.

Figure 3. A graph describing the Bland-Altman of error in % REM detection versus mean value of % REM from the polysomnography (PSG) and the automatic REM detection algorithm (ARDA). Error in % REM = ARDA % REM – PSG % REM.

• As post-treatment increase in REM sleep is associated with subjective improvement in sleep quality, this added feature of the Watch PAT will be useful in evaluating the efficacy of treatment in sleep apnea patients.
• Sleep architecture enables diagnosis of REM related OSA and insomnia.
Obstructive Sleep Apnea During REM Sleep and Hypertension
Mokhlesi et al., American Journal of Respiratory and Critical Care Medicine 2014; 190(10): 1158-1167
http://europepmc.org/abstract/med/25295854

Objective:
• To quantify the independent association of OSA during REM sleep with prevalent and incident hypertension.

Methods:
• Study population: adults enrolled in the longitudinal community-based Wisconsin Sleep Cohort Study with at least 30 minutes of REM sleep obtained from overnight in-laboratory polysomnography (PSG).
• Studies were repeated at 4-year intervals to quantify OSA.
• Repeated measures logistic regression models were fitted to explore the association between REM sleep OSA and prevalent hypertension in the entire cohort (n = 4,385 sleep studies on 1,451 individuals) and additionally in a subset with ambulatory blood pressure data (n = 1,085 sleep studies on 742 individuals).
• Conditional logistic regression models were fitted to longitudinally explore the association between REM OSA and development of hypertension.
• All models controlled for OSA events during non-REM sleep, either by statistical adjustment or by stratification.

Results:
• Fully adjusted models demonstrated significant dose–relationships between REM apnea-hypopnea index (AHI) and prevalent hypertension.
• Increased relative odds of hypertension were most evident with REM AHI greater than or equal to 15.
• In individuals with non-REM AHI less than or equal to 5, a two-fold increase in REM AHI was associated with 24% higher odds of hypertension (odds ratio, 1.24; 95% confidence interval, 1.08-1.41).
• Longitudinal analysis revealed a significant association between REM AHI categories and the development of hypertension (P trend = 0.017).
• Non-REM AHI was not a significant predictor of hypertension in any of the models.

Conclusion:
• REM OSA is cross-sectionally and longitudinally associated with hypertension.
• This is clinically relevant because treatment of OSA is often limited to the first half of the sleep period leaving most of REM sleep untreated.

Key takeaways:
• REM-related OSA may identify patients minimally symptomatic and frequently do not complain of excessive daytime sleepiness, which may lead to delay in diagnosis and therapy.
• Without detection of REM related OSA, patient might not be treated, exposing the patient to higher risk of HP.
• As post-treatment increase in REM sleep is associated with subjective improvement in sleep quality, this added feature of the Watch PAT will be useful in evaluating the efficacy of treatment in sleep apnea patients.
Differentiating Between Light and Deep Sleep Stages Using an Ambulatory Device Based on Peripheral Arterial Tonometry
Bresler et al., Physiol Meas. 2008; 29(5): 571-584
http://iopscience.iop.org/article/10.1088/0967-3334/29/5/004/meta;jsessionid=0FB0S86C5282E11F6302BE647DB49.c1

Objective:
• Assessment of an automatic algorithm based on peripheral arterial tone (PAT) measured by WatchPAT to differentiate between light, deep and NREM sleep stages, in addition to NREM and REM sleep differentiation.

Methods:
• Patients underwent simultaneous recording of WatchPAT device and PSG in a synchronized manner.
• The algorithm was developed using a training set of 49 patients.
• Algorithm was validated using a separate set of 44 patients.

Results:
• Overall sensitivity, specificity and agreement of the automatic algorithm to identify standard 30 s epochs of light and deep sleep stages were as follows:
  For the training set – sensitivity 66%, specificity 89%, agreement 82%; for the validation set – sensitivity 65%, specificity 87% and agreement 80%.

Conclusion:
• Together with the previous algorithms for REM, NREM and wake detection, the capability provides a close to full stage detection method based solely on PAT and actigraphy signals, which could be very useful for unattended ambulatory sleep studies when EEG recordings are not available.

Key takeaways:
• The WatchPAT can be a feasible alternative to costly in-lab sleep tests as it can provide information about the patient’s sleep architecture, providing additional information for assessing OSA severity (especially in mild or moderate OSA), in addition to detection of REM related OSA.

Table 2. Sensitivity, specificity and agreement mean values by subject for the three groups.

<table>
<thead>
<tr>
<th>Group</th>
<th>RDI &lt; 20</th>
<th>20 &lt; RDI &lt; 40</th>
<th>RDI &gt; 40</th>
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<tbody>
<tr>
<td>Sensitivity (%)</td>
<td>61 ± 26</td>
<td>55 ± 23</td>
<td>72 ± 32</td>
</tr>
<tr>
<td>Specificity (%)</td>
<td>89 ± 10</td>
<td>87 ± 13</td>
<td>87 ± 6</td>
</tr>
<tr>
<td>Agreement (%)</td>
<td>82 ± 7</td>
<td>78 ± 13</td>
<td>85 ± 6</td>
</tr>
</tbody>
</table>
### Objective:
- To validate a novel automatic algorithm, developed for actigraphic studies in normal subjects and patients with obstructive sleep apnea, by comparing it on an epoch-by-epoch basis to standard polysomnography (PSG).

### Methods:
- A total of 228 subjects from 3 different sleep centres participated.
- Simultaneous synchronized recording of PSG and WatchPAT an ambulatory device with a built-in actigraph.
- The automatic sleep/wake algorithm is based on both the quantification of motion (magnitude and duration) and the various periodic movement patterns, such as those occurring in patients with moderate to severe obstructive sleep apnea.

### Results:
- The overall sensitivity and specificity to identify sleep was 89% and 69%, respectively. The agreement ranged from 86% in normal subjects to 84%, and 80% in the patients with mild, moderate, and severe OSA, respectively.
- There was a tight agreement between actigraphy and PSG in determining sleep efficiency (78.4 +/- 9.9 vs 78.8 +/- 13.4%), total sleep time (690 +/- 152 vs 690 +/- 154 epochs), and sleep latency (35.2 +/- 31.4 vs 33.2 +/- 45.4 epochs).
- For most individuals differences between PSG and actigraphy were relatively small, but for some there was a substantial disagreement.

### Conclusion:
- The new actigraphy algorithm provides a reasonably accurate estimation of sleep and wakefulness in normal subjects and OSA patients.
- This simple method for assessment of total sleep time may provide a useful tool to facilitate accurate quantification of obstructive sleep apnea in the home environment.

### Key takeaways:
- The WatchPAT HST offers an accurate diagnosis of OSA as sleep indices are based on total sleep time (TST) and not on total recording time (TRT). This affects mostly patients with mild to moderate OSA.
- The WatchPAT is the only HST that provides TST for the calculation of sleep disturbance indices.

#### Table 4—Sleep Indexes in the Groups with the Various Severities of Obstructive Sleep Apnea

<table>
<thead>
<tr>
<th>Level of OSA severity</th>
<th>Sleep Efficiency, %</th>
<th>Total Sleep Time, epochs</th>
<th>Sleep Latency, epochs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>PSG</td>
<td>ASWA</td>
<td>PSG</td>
</tr>
<tr>
<td>Mild</td>
<td>80.7 ± 12.2</td>
<td>80.6 ± 11.6</td>
<td>707 ± 134</td>
</tr>
<tr>
<td>Moderate</td>
<td>80.0 ± 12.1</td>
<td>79.4 ± 11.2</td>
<td>702 ± 152</td>
</tr>
<tr>
<td>Severe</td>
<td>74.7 ± 14.9</td>
<td>73.6 ± 13.8</td>
<td>673 ± 162</td>
</tr>
<tr>
<td>All</td>
<td>78.8 ± 13.4</td>
<td>78.4 ± 9.9</td>
<td>690 ± 154</td>
</tr>
</tbody>
</table>

*P < 0.05 polysomnography (PSG) vs automatic sleep-wake analysis (ASWA). OSA refers to obstructive sleep apnea.
Comparison of AHI Using Recording Time versus Sleep Time
Schutte - Rodin et al., J Sleep Abs supl 2014, p. A373

Objective:
• To compare the HST-AHI and PSG-AHI using existing PSG data.
• To determine if different AHI calculation methods change the patient’s categorization of no apnea (AHI = 0-4.9), mild (AHI = 5-14.9), moderate (AHI = 15-29.9), or severe apnea (AHI > 30).

Methods:
• Data from 11,213 Penn Sleep full-night PSGs (1/06-6/13) were reviewed.
• Total number of apneas-hypopneas, TST (true sleep time), and TRT (total recording time) were used to calculate HST-AHI and PSG-AHI.
• Patients were categorized into no, mild, moderate, and severe apnea by PSG –AHI and HST-AHI. Frequencies of category changes using TST and TRT were analysed.

Results:
• For 11,213 PSG studies, the mean HST-AHI was 10.7 (SD12.1) and the mean PSG-AHI was 15 (SD17.64).
• For 4564 patients with no apnea by HST-AHI, 81% had no OSA, 18.5% had mild, 0.4% had moderate, and 0.2% had severe OSA by PSG-AHI.
• For 2995 patients with mild apnea by HST-AHI, 70% had mild, 27.4% had moderate, and 2.5% had severe apnea by PSG-AHI.
• For 1898 patients with moderate apnea, 63.2% had moderate and 36.8% had severe OSA.
• All 756 with severe HST-AHI had severe PSG-AHI.
• The difference between HST-AHI and PSG-AHI was greater for men (P < 0.001 for all calculations).

Conclusion:
• Use of TRT (HST) underestimates apnea and affects treatment options for a significant number of patients. The diagnosis was missed in nearly 20% and underestimated for 27% with mild (HST) apnea and 37% with moderate (HST) apnea. This difference was greater for men.
Objective:

- OSA is a known predictor for onset and recurrence of AF. This review was aimed to evaluate the cumulative effect of treatment of obstructive sleep apnea (OSA) with continuous positive airway pressure (CPAP) on atrial fibrillation (AF) recurrence.

Methods:

- The authors searched MEDLINE, EMBASE, CINAHL, Google Scholar and the Cochrane Trial Registry for relevant studies.
- Systematic review of 452 relevant citations through June 2014 were identified with 18 potentially relevant articles retrieved. 7 studies were ultimately included in the analysis meeting the predetermined inclusion criteria with a cumulative total of 1,087 patients.
- The primary outcome evaluated AF recurrence in CPAP users and nonusers in patients with OSA.
- The secondary outcome evaluated AF recurrence in CPAP users and nonusers following pulmonary vein isolation (PVI).

Results:

- Use of CPAP was associated with a significant reduction in AF recurrence (relative risk: 0.58, 95% confidence interval: 0.51 to 0.67; heterogeneity chi-square p = 0.91, I² = 0%).
- The beneficial effect of CPAP use was statistically significant with both those who underwent catheter ablation with PVI and those who did not undergo ablation and were managed medically.
- No other study covariates had any significant association with these outcomes of AF reduction.

Key takeaways:

- The use of CPAP is associated with a 42% relative risk reduction in AF recurrence in patients with OSA
- This reduction of AF recurrence appears to be independent of medical or catheter ablation therapy and is consistent across patient groups with OSA.
- These results advocate for active screening for undiagnosed OSA in patients with AF when OSA is clinically suspected.

Table 3

<table>
<thead>
<tr>
<th>Study ID</th>
<th>n (Non-PVI)</th>
<th>n (PVI)</th>
<th>AF Recurrence</th>
<th>RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kanagala et al</td>
<td>186 of 557 [33.3%] vs. 308 of 530 [57.6%]</td>
<td>0.58 (0.51, 0.67)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Bazan et al</td>
<td>0.58 (0.51, 0.67)</td>
<td>0.58 (0.51, 0.67)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Subtotal (I² = 0.0%, p = 0.611)</td>
<td>0.58 (0.51, 0.67)</td>
<td>0.58 (0.51, 0.67)</td>
<td>0.001</td>
<td></td>
</tr>
<tr>
<td>Jongeengraag et al</td>
<td>0.70 (0.40, 1.24)</td>
<td>0.61 (0.51, 0.73)</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>Patel et al</td>
<td>0.44 (0.24, 0.82)</td>
<td>0.56 (0.37, 0.81)</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>Fein et al</td>
<td>0.52 (0.37, 0.74)</td>
<td>0.58 (0.37, 0.81)</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>Naruse et al</td>
<td>0.58 (0.37, 0.81)</td>
<td>0.58 (0.37, 0.81)</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>Subtotal (I² = 0.0%, p = 0.782)</td>
<td>0.58 (0.37, 0.81)</td>
<td>0.58 (0.37, 0.81)</td>
<td>0.37</td>
<td></td>
</tr>
<tr>
<td>Overall (I² = 0.0%, p = 0.919)</td>
<td>0.58 (0.51, 0.67)</td>
<td>0.58 (0.51, 0.67)</td>
<td>0.37</td>
<td></td>
</tr>
</tbody>
</table>

CPAP Use on Recurrence of AF in Patients With OSA

FIGURE 2 Forest Plot to Compare AF Recurrence in Users Versus Nonusers of CPAP in Patients With OSA

FIGURE 3 AF Recurrence in Users Versus Nonusers of CPAP in 2 Groups of Patients With OSA: PVI and Non-PVI Groups

PVI = pulmonary vein isolation; other abbreviations as in Figure 2.
Objective:
- OSA is a predictor of AF recurrence following PVI. The impact of CPAP therapy on PVI outcome in patients with OSA is poorly known. The aim of the study was to examine the effect of continuous positive airway pressure (CPAP) therapy on atrial fibrillation (AF) recurrence in patients with obstructive sleep apnea (OSA) undergoing pulmonary vein isolation (PVI).

Methods:
- Retrospective study assessing a database of 426 patients who underwent PVI between 2007 and 2010, 62 patients had a polysomnography-confirmed diagnosis of OSA. Of these, 32 patients were “CPAP users” the remaining 30 patients were “CPAP nonusers.”
- The recurrence of any atrial tachyarrhythmia, use of antiarrhythmic drugs, and need for repeat ablations were compared between the groups during a follow-up period of 12 months.
- The Control group included a group of patients from the same PVI cohort without OSA and a cohort of 22 OSA patients using CPAP whose AF was treated medically by either electrical cardioversion and/or antiarrhythmic drug therapy.

Results:
- CPAP therapy resulted in higher AF-free survival rate (71.9% vs. 36.7%; p = 0.01) and AF-free survival off antiarrhythmic drugs or repeat ablation following PVI (65.6% vs. 33.3%; p = 0.02).
- AF recurrence rate of CPAP-treated patients was similar to a group of patients without OSA (HR: 0.7, p = 0.46).
- AF recurrence following PVI in CPAP non-user patients was significantly higher (HR: 2.4, p < 0.02) and similar to that of OSA patients managed medically without ablation (HR: 2.1, p = 0.68).

Conclusion:
- CPAP therapy in OSA patients undergoing PVI may improve ablation outcome.
- PVI offers limited value to OSA patients not treated with CPAP.

Key takeaways:
- These results advocate for active screening for undiagnosed OSA in patients with AF when OSA is clinically suspected.
- PVI success rate of AF patients with OSA treated with CPAP is similar to that of AF patients with no OSA.
Objective:
- To determine the effect of sleep apnea (SA) on cardiac structure in patients with atrial fibrillation (AF).
- To evaluate whether therapy for SA was associated with beneficial cardiac structural remodelling.
- Assess whether beneficial cardiac structural remodelling reduces risk of recurrence of AF after pulmonary venous isolation (PVI).

Methods:
- A consecutive group of 720 patients underwent a cardiac magnetic resonance study before PVI.
- The presence or absence of SA was prospectively determined before PVI with the use of a standardized questionnaire administered to all patients.
- All patients diagnosed with SA underwent a formal sleep study.
- The diagnosis of SA was established in accordance with the sleep study criteria recommended by the American Academy of Sleep Medicine.
- Treated SA was defined as duration of continuous positive airway pressure therapy of >4 hours per night.

Results:
- Patients with SA (n=142, 20%) were more likely to be male, diabetic, hypertensive and have an increased pulmonary artery pressure, right ventricular volume, atrial dimensions, and left ventricular mass. Treated SA patients (n=71, 50%) were more likely to have paroxysmal AF, a lower blood pressure, lower ventricular mass, and smaller left atrium.
- During a follow-up of 42 months, AF recurred in 245 patients.
- The cumulative incidence of AF recurrence was 51% in patients with SA, 30% in patients without SA, 68% in patients with untreated SA, and 35% in patients with treated SA.
- In a multivariable model, the presence of SA (hazard ratio 2.79, CI 1.97 to 3.94, P<0.0001) and untreated SA (hazard ratio 1.61, CI 1.35 to 1.92, P<0.0001) were highly associated with AF recurrence.

Conclusion:
- Patients with SA have an increased blood pressure, pulmonary artery pressure, right ventricular volume, left atrial size, and left ventricular mass. PVI offers limited value to OSA patients not treated with CPAP.
- Therapy with continuous positive airway pressure is associated with lower blood pressure, atrial size, and ventricular mass, and a lower risk of AF recurrence after PVI.

Key takeaways:
- Assessment for SA in symptomatic patients before PVI may improve PVI outcome.
- Early assessment of OSA may reduce cardiac structural modification.
- Patients identified with structural cardiac modifications and are symptomatic for OSA, should be undergo a sleep test.
Follow-up Assessment of CPAP Efficacy in Patients with Obstructive Sleep Apnea Using an Ambulatory Device Based on Peripheral Arterial Tonometry

Objective:
• To assess the accuracy of the PAT technology using the WatchPAT for detecting residual episodes of respiratory disturbance during continuous positive airway pressure (CPAP) therapy.

Methods:
• 70 patients using CPAP to treat obstructive sleep apnea (OSA) for at least 3 months, who underwent an in-lab titration to determine the optimal therapeutic positive airway pressure, participated in this study.
• Symptoms indicating suboptimal therapy were not required for participation, but self-reported adherence to CPAP therapy was necessary for inclusion.
• The study was conducted in three sleep laboratories affiliated with tertiary care academic medical centers.
• Simultaneous in-lab polysomnography (PSG) and Watch-PAT recording were performed.
• PSG was used as the reference standard to identify sleep disordered breathing (SDB) events.

Results:
• Based on the PSG results, using Chicago criteria for assessing RDI (RDI.C), 19% of the participants had moderate-severe SDB (PSG RDI.C>15 events per hour) on their prescribed pressure.
• For PAT RDI >15, the area under the ROC curve was 0.95 (SE 0.03, p < 0.0001, 95% CI 0.89 to 1.00), the LR+ was 8.04 (95% CI 3.64-17.7), and the LR- was 0.17 (95% CI 0.05-0.62).
• The mean difference between the PAT RDI and PSG RDI.C was 3 events per hour (2SD 14.5).

Conclusion:
• Residual moderate-severe SDB on CPAP was not uncommon in a multicenter population, self-reporting adherence to CPAP therapy

Key takeaways:
• The WatchPAT device accurately identified participants with residual moderate-severe SDB while using CPAP in the attended setting of a sleep laboratory

The WatchPAT is a feasible HST for the evaluation of residual OSA in patients treated with CPAP.
• Patients using CPAP therapy should be evaluated periodically for assessment of residual OSA.
• This study included subjects who self-reported low adherence to CPAP; it did not include subjects based on symptoms. It is safe to assume that had symptomatic subjects been included too, the rate of patients with suboptimal CPAP titration values and residual OSA would increase, further emphasizing the urgency for assessing patient periodically.
Objective:

- To compare a clinical pathway using portable monitoring (PM) for diagnosis and unattended auto-titration of positive airway pressure (APAP), with a pathway using polysomnography (PSG) for diagnosis and treatment of obstructive sleep apnea (OSA).

Methods:

- 106 patients with daytime sleepiness and a high likelihood of having OSA were randomized to the PSG pathway or the PM-APAP pathway.

Results:

- The AHI in the PM-APAP group was 29.2 ± 2.3/h and in the PSG group was 36.8 ± 4.8/h (P = NS).
- Patients with an AHI > 5 were offered CPAP treatment. Those accepting treatment (PM-APAP 45, PSG 43) were begun on CPAP using identical devices at similar mean pressures (11.2 ± 0.4 versus 10.9 ± 0.5 cm H2O).
- At a clinic visit 6 weeks after starting CPAP, 40 patients in the PM-APAP group (78.4% of those with OSA and 88.8% started on CPAP) and 39 in the PSG arm (81.2% of those with OSA and 90.6% of those started on CPAP) were using CPAP treatment (P = NS).
- The mean nightly adherence [PM-APAP: 5.20 ± 0.28 versus PSG: 5.25 ± 0.38 h/night], decrease in Epworth Sleepiness Scale score (−6.50 ± 0.71 versus −6.97 ± 0.73), improvement in the global Functional Outcome of Sleep Questionnaire score (3.10 ± 0.05 versus 3.31 ± 0.52), and CPAP satisfaction did not differ between the groups.

Conclusion:

- A clinical pathway utilizing PM and WatchPAT APAP titration resulted in CPAP adherence and clinical outcomes similar to one using PSG.

Key takeaways:

- The WatchPAT can be used for the full cycle of diagnosing and treating OSA.
- This is a perfect option for remote areas, where sleep centres are few or in large medical facilities where waiting lists delay assessment and treatment of OSA.

<table>
<thead>
<tr>
<th>Table 4—Treatment Outcomes</th>
<th>PM-APAP</th>
<th>PSG</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>Change in ESS</td>
<td>−6.50 ± 0.71</td>
<td>−6.97 ± 0.73</td>
<td>NS</td>
</tr>
<tr>
<td>Change in FOSQ (3-15)</td>
<td>1.10 ± 0.05</td>
<td>3.31 ± 0.52</td>
<td>NS</td>
</tr>
<tr>
<td>CPAP satisfaction (1-15)</td>
<td>12.8 ± 0.4</td>
<td>12.2 ± 0.2</td>
<td>NS</td>
</tr>
<tr>
<td>Machine estimate of residual AHI (hour)</td>
<td>3.5 ± 0.3</td>
<td>5.3 ± 0.7</td>
<td>NS</td>
</tr>
</tbody>
</table>
Reliability of the Watch-PAT 200 in Detecting Sleep Apnea in Highway Bus Drivers
http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3601312/

Objective:
• To assess the validity of WatchPAT device for diagnosing sleep disordered breathing (SDB) among highway bus drivers.

Methods:
• 90 highway bus drivers underwent polysomnography (PSG) and WatchPAT test simultaneously.

Results:
• The sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were 89.1%, 76.9%, 82% and 85.7% for RDI > 15, respectively.
• WatchPAT RDI, ODI, mean SaO2 and SaO2< 90% duration results were well correlated with PSG results.
• In sensitivity and specificity analysis, for cut-off values of RDI of 5, 10 and 15, AUC were 0.84, 0.87 and 0.91, respectively.
• There were no statistically significant differences between total sleep times, nREM and REM durations, and PSG stages1+2 vs. WatchPAT light sleep, but PSG stage 3 was significantly different to WatchPAT Deep.

Conclusion:
• WatchPAT device is helpful in detecting SDB with RDI > 15 in highway bus drivers, especially in drivers older than 45 years, but has limited value in drivers younger than 45 years old who have less risk for OSA. Therefore, WatchPAT can be used in the former group when PSG is not easily available.

Key takeaways:
• This study does not discuss the tamper proof bracelet, which is an additional advantage for testing these populations with the WatchPAT.
• The WatchPAT can be used in a wide range of professions that require assessment of OSA.

• The long waiting lists, the high cost and the inconvenience of spending a night in a sleep lab can make the WatchPAT an attractive option.
Cardiovascular Benefits of Oral Appliance Therapy in Obstructive Sleep Apnea: A Systematic Review
*supporting non-WP paper - EndoPAT was used in this study

Objective:
• To perform a systematic review of the current evidence regarding the cardiovascular benefits of oral appliance (OA) therapy in obstructive sleep apnea (OSA) patients.

Methods:
• A systematic review of relevant articles retrieved from online databases (PubMed, Web of Science, Medline, OvidSP) was conducted.

• Review included all relevant studies published prior to January 20, 2013 that examined the effects of OA on any of the cardiovascular parameters.

Results:
• OA therapy could have a beneficial effect on blood pressure (BP), endothelial function (EF), and left ventricular (LV) cardiac function.

• Eleven articles were included in this systematic review; 7 of 8 studies showed a significant reduction in BP with a mean BP decrease of 4.2 mm Hg, 2 studies showed significant improvement in EF, and 1 study showed significant improvement in LV heart function.

Conclusion:
• OA therapy showed beneficial effects on the cardiovascular comorbidity in OSA patients. In studies comparing OA to CPAP therapy, effects of OA therapy were in the same order of magnitude as the effect of CPAP therapy.

Key takeaways:
• Dentists are first line identifiers of subjects with suspected OSA and can be key players in OSA treatment.
• Dentists should be “educated” about the possible benefits of OA on the cardiovascular system.

Table 2—Summary of OA treatment studies assessing blood pressure parameters.

<table>
<thead>
<tr>
<th>Study</th>
<th>Year</th>
<th>N</th>
<th>Pre AHI/h (mean ± SD)</th>
<th>Post AHI/h (mean ± SD)</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otsuka et al.</td>
<td>2006</td>
<td>61</td>
<td>49 ± 11</td>
<td>79% (53)</td>
<td>28 ± 5</td>
</tr>
<tr>
<td>Barnes et al.</td>
<td>2004</td>
<td>114</td>
<td>46 ± 11</td>
<td>12 weeks</td>
<td>24 ± 5</td>
</tr>
<tr>
<td>Yoshida et al.</td>
<td>2005</td>
<td>161</td>
<td>54 ± 14</td>
<td>10 weeks</td>
<td>25 ± 4</td>
</tr>
<tr>
<td>Otsuka et al.</td>
<td>2008</td>
<td>11</td>
<td>52 ± 7</td>
<td>32 weeks</td>
<td>29 ± 4</td>
</tr>
<tr>
<td>Andrén et al.</td>
<td>2009</td>
<td>26</td>
<td>57 ± 10</td>
<td>3 years</td>
<td>29 ± 4</td>
</tr>
<tr>
<td>Andrén et al.</td>
<td>2013</td>
<td>72</td>
<td>58 ± 8</td>
<td>3 months</td>
<td>29 ± 6</td>
</tr>
<tr>
<td>Lam et al.</td>
<td>2007</td>
<td>34</td>
<td>45 ± 11</td>
<td>10 weeks</td>
<td>27 ± 4</td>
</tr>
<tr>
<td>Phillips et al.</td>
<td>2012</td>
<td>108</td>
<td>49 ± 11</td>
<td>1 month</td>
<td>29 ± 5</td>
</tr>
</tbody>
</table>

SD, standard deviation; 24-h (or 20-h), automatic BP measurement during 24 hours a day (or 20 h); Clinical, BP measurement manual or electric; BMI, body mass index (kg/m2); AHI, apnea-hypopnea index; RCT, randomized controlled trial.
Clinical Usefulness of Watch-PAT for Assessing the Surgical Results of Obstructive Sleep Apnea Syndrome

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3869067/

Objective:
• To assess the accuracy and clinical efficacy of WatchPAT in evaluating the outcome of sleep surgeries such as septoplasty, tonsillectomy, or uvuloplasty.

Methods:
• Patient population: 35 patients diagnosed with OSA who underwent sleep surgeries such as septoplasty, tonsillectomy, or uvuloplasty.
• WatchPAT-derived respiratory disturbance index (RDI), apnea and hypopnea index (AHI), lowest oxygen saturation, and valid sleep time were measured before and after surgery.

Results:
• RDI, AHI, lowest oxygen saturation, and valid sleep time recovered to within normal range after surgery in 28 subjects.
• Good agreement was found between WatchPAT-derived factors and visual analogue scales for changes in subjective symptoms, (snoring, apnea, and daytime somnolence).
• In 7/35 patients, who showed no improvement for their subjective symptoms after surgery, RDI and AHI were not reduced and lowest oxygen saturation and valid sleep time were not elevated.

Conclusion:
• WatchPAT is a highly sensitive portable device for estimating treatment results and symptomatic changes in OSA patients after sleep surgery for correction of airway collapse.
• This study demonstrates that the watchPAT may be efficiently applied not only to the diagnosis of OSA, but also to accurately assess treatment results of sleep surgeries.

Key takeaways:
• The WatchPAT is a feasible option for ENT doctors for assessing sleep surgery outcome.
• The watchPAT is easy to use for home sleep studies, with a low failure rate and minimal technical effort.

The results of watchPAT can be interpreted more simply than full PSG and provide useful information about the efficacy of sleep surgeries.
Objective:

• To assess the correlation between sleep indexes measured by the WatchPAT device and those measured by the gold standard, polysomnography (PSG).

Methods:

• Review incl. 14 studies [909 patients] with data suitable for pooling, that assessed correlation of the respiratory disturbance index (RDI), apnea-hypopnea index (AHI), and oxygen desaturation index (ODI).

• The studies were reviewed by 2 independent reviewers in a systematic manner.

Results:

• WatchPAT and PSG indices of RDI, AHI and ODI were all significantly correlated with r values of 0.879 (RDI), 0.893 (AHI), and 0.942 (ODI) (all P < .001). RDI combined with AHI were highly correlated (r = 0.889, p < .001).

• Analysis of publication bias revealed a non-significant Egger regression intercept.

Conclusion:

• Respiratory indices determined by WatchPAT positively correlated with those of PSG Strengthened by the blinded design of 13/14 of the included studies, WatchPAT represents a viable alternative to PSG for confirmation of clinically suspected sleep apnea.

Key takeaways:

• Compared with PSG, the WatchPAT HST offers an accurate diagnosis, highly convenient and low cost.

• WatchPAT consistently demonstrated a high degree of correlation in sleep variables when compared to PSG.

• The WatchPAT device is well validated in various countries, patient populations, both in attended in-lab and un-attended home settings, by highly valued sleep centres.

Overall Correlation of the Respiratory Disturbance Index (RDI) and Apnea-Hypopnea Index (AHI) Between Polysomnography (PSG) and Peripheral Arterial Tonometry (PAT)

<table>
<thead>
<tr>
<th>Study Setting</th>
<th>Design</th>
<th>Subgroup</th>
<th>Correlation (95% CI)</th>
<th>Z Value</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>WatchPAT</td>
<td>PSG</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- RDI
- AHI
- ODI

Calculated overall correlation using the random-effects model. Size of the data marker corresponds to the relative weight assigned in the pooled analysis. B indicates blinded; H, home setting; L, laboratory setting, and NB, non-blinded. Study reported the value as RDI; however, recent American Academy of Sleep Medicine criteria defined the value as AHI.
Obstructive Sleep Apnea Devices for Out-Of-Center (OOC) Testing: Technology Evaluation

**Collop et al., J Clin Sleep Med 2011;7(5):531-548**

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3190859/

**Objective:**
- Since the classification of portable devices for assessing OSA established in 1994 is outdated, an AASM task-force, describes a new classification system for out-of-center (OOC) testing devices for diagnosing OSA.
- To determine a more specific and inclusive method of classifying and evaluating sleep testing devices other than polysomnography (PSG) used in the diagnosis of OSA in the OOC setting.

**Methods:**
- A series of questions to evaluate the OOC devices was established.
- The Task force defined OSA-positive as an AHI > 5.
- To account for the various different output measures provided by the different OOC devices the task force defined the positive likelihood ratio (LR+) delivered by applying a given test and obtaining a “positive” result. This allows comparisons across a wide variety of devices less sensitive to variations in case definitions.
- Devices were judged on whether or not they can produce an LR+ of at least 5 and a sensitivity of at least 0.825 at an in-lab AHI of at least 5.
- A device categorization scheme that is adaptable, descriptive, and workably specific, was developed based on following measures: Sleep, Cardiovascular, Oximetry, Position, Effort, and Respiratory (SCOPER system).
- A systematic literature search was performed; data on devices were extracted according to standardized methodology. These data were used to categorize the devices according to the SCOPER scheme. Devices that were used in more than 1 configuration have more than 1 SCOPER categorization.

**Results:**
- Oximetry is mandatory for scoring AHI, a thermistor alone is not adequate, but requires 2 effort belts; nasal pressure can be an adequate measurement of respiration with no effort measure.
- Amongst alternative devices, WatchPAT is deemed adequate, the cardiac signals based device shows promise, but requires more study, the end-tidal CO2 device appears to be adequate for a hospital population, and data is insufficient to determine if acoustic signals in lieu of airflow are adequate to diagnose OSA.

**Conclusion:**
- Standardized research is needed on OOC devices that report LR+ at the appropriate AHI (5) and scored according to the recommended definitions, while using appropriate research reporting and methodology to minimize bias.
- WatchPAT is endorsed by AASM task force.

**Key takeaways:**
- The WatchPAT is accepted by the AASM task force, it has 4 of the 6 categories: Sleep, Cardiovascular, Oximetry and Position.

**Table 8—Devices using PAT signal (WatchPAT)**

<table>
<thead>
<tr>
<th>Device/Author (year)</th>
<th>Evidence Level</th>
<th>Setting</th>
<th>LR+</th>
<th>LR-</th>
<th>Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>C.O.,P.,F.R (2003)</td>
<td>IA</td>
<td>LL</td>
<td>1.0</td>
<td>0.0</td>
<td>0.83</td>
</tr>
<tr>
<td>S.C.O.P.,Zou et al. (2006)</td>
<td>IA</td>
<td>HH</td>
<td>0.11</td>
<td>0.89</td>
<td>0.83</td>
</tr>
<tr>
<td>S.C.O.P.,Pang et al. (2007)</td>
<td>IA</td>
<td>LL</td>
<td>0.075</td>
<td>0.94</td>
<td>0.94</td>
</tr>
<tr>
<td>S.C.O.P.,Patman et al. (2004)</td>
<td>IA</td>
<td>LL</td>
<td>0.03</td>
<td>0.97</td>
<td>0.97</td>
</tr>
<tr>
<td>S.C.O.P.,H. (2005)</td>
<td>IA</td>
<td>L/Hospital</td>
<td>0.05</td>
<td>0.95</td>
<td>0.95</td>
</tr>
</tbody>
</table>

*Calculated from original figure in paper at AHIPG 10 and REI/WatchPAT scored according to Chicago criteria. §Scored according to Chicago criteria; if “converted” to standard criteria (see Section 1.0), at REI > 15 the LR+ is 6, which is adequate. ¶Scored according to Chicago criteria; if “converted” to standard criteria (see Section 1.0), at AHI 15 the LR+ is 3.5, which is also inadequate.
Objective:

- Clalit Health Services (CHS), the largest health insurance provider in Israel, has transitioned from in-lab diagnosis (PSG) of sleep apnea to Home Sleep Test (HST) [WatchPAT by Itamar-Medical, Israel].
- The objective of the paper was to assess the effects of this change on accessibility, waiting time, patient satisfaction, costs, and CPAP purchase by the patients.

Methods:

- The study was mostly retrospective, with a small prospective component:
  - Retrospective component: Data was retrieved from a database of 650,000 patients for the following information:
    - Number of sleep studies
    - Number of acquired CPAPs
    - PSG waiting time.
  - Prospective component: Patient satisfaction was assessed utilizing a phone
- Data comparison was performed between the period of 2007-2008 and period of 2010-2011 (2009 was excluded during the transition from PSG to HST implementation)

Results:

- 90% increase of sleep study tests following the transition to HST (increase in total insured people during same period was less than 5%)
- Oximetry is mandatory for scoring
- Despite increase in the number of tests, shift to HST was accompanied by over a 20% decrease in overall expense of OSA diagnosis
- Average waiting time decreased significantly from 9.9 weeks during 2007-2008 to just 1.1 week during 2010-2011
- Number of CPAPs purchased 2007-2008 was 597 devices vs. 831 during 2010-2011 (39% increase)
- Similar outcomes of compliance to CPAP treatment, daily CPAP usage, improvement in daytime sleepiness and quality of life, and patients satisfaction for both home-test and in-lab patients
- No significant difference in patient satisfaction was reported over the two periods. In retrospect, 56% of patients who underwent in-lab tests and 72% of people who underwent home tests preferred the home sleep test

Key takeaways:

- Transition from in-lab testing to unattended home sleep testing has had a positive impact. This stems from improved OSA diagnosis test accessibility, reduced waiting time, reduced overall OSA diagnosis costs and maintained patient satisfaction.
**Objective:**
- The rise in prevalence of obstructive sleep apnea is due to multiple factors and more cases coming to the attention of physicians because of the wide availability of diagnostic equipment.
- The apnea-hypopnea index (AHI) is an imperfect metric for the definition of obstructive sleep apnea with respect to symptoms and outcomes.
- The purpose of this review is to provide recent insights and discoveries in obstructive sleep apnea, focusing on rapid changes in clinical practice towards novel diagnostics and treatments, establishing a home-based (rather than laboratory-based) management approach and the transition from a so-called “one size fits all” approach to an individualized treatment approach.

**Methods:**
- Review of peer-reviewed journal articles between January 1 and December 31, 2014 related to obstructive sleep apnea.
- Selection for inclusion was based on the reviewers’ expertise and perception of the relevance and impact on the field of sleep medicine.
- Older articles were also included to provide background information and context.

**Results:**
- New data suggests that moderate-to-severe OSA is highly prevalent. 90% increase of sleep study.
- OSA might represent a range of diseases rather than a definable cutoff.
- As a result of improved diagnostic technologies, improved therapeutic approaches, and readily available clinical outcome data, today the pathogenesis of OSA is recognized as multifactorial.
- The diagnosis of OSA is transitioning from gold standard polysomnography in sleep laboratories to home sleep testing (HST).
- HST devices that record total sleep time, and not only sleep duration are more likely to provide more accurate sleep study results.
- HST devices that reliably track body position are beneficial in diagnosing supine predominant obstructive sleep apnea.
- HST devices that are able to assess wake / sleep as well as sleep stages provide crucial diagnostic data.
- Future work will focus on the causes of obstructive sleep apnea at the individual patient level and therapy will be tailored accordingly.

**Key takeaways:**
- The WatchPAT is a HST that matches all the specific criteria mentioned in the review.
- Measures body position to enable assessing position related OSA
- TST – for better assessment of OSA (especially mild, moderate cases)
- Provides REM related OSA diagnosis – for better treatment assessment and better follow up.
- Provides sleep architecture – to provide impact of OSA on sleep quality

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**Table: Recent developments in obstructive sleep apnea**

<table>
<thead>
<tr>
<th>Pathogenesis</th>
<th>Where next?</th>
</tr>
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<tbody>
<tr>
<td>New data suggest that moderate-to-severe OSA is highly prevalent if rigorous methods are used in diagnostic approaches</td>
<td>OSA might represent a range of disease rather than a definable cutoff; public health measures might be needed to increase awareness and to tackle the burden of disease</td>
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<tr>
<td>Pathogenesis</td>
<td>Non-anatomical traits are important in some patients</td>
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<td>Diagnostics</td>
<td>Personalised treatment</td>
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<tr>
<td>Shift from laboratory-based testing to home sleep testing</td>
<td>Patient initiated testing (ie, smartphone applications)</td>
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<td>Ability to measure some physiological traits from clinical polysomnograms</td>
<td>Ability to measure traits from home studies</td>
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<td>Outcomes</td>
<td>Recognition that different sequelae of OSA are important for different outcomes—eg, annual from sleep affects memory consolidation and 6% oxygen desaturation predicts hypertension</td>
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<td>Personalised risk profile</td>
<td>Continued understanding of OSA treatment in different patient groups, and specific strategies to improve adherence</td>
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<tr>
<td>Treatment of OSA in various patient populations—eg, elderly patients have suboptimal benefit from PAP</td>
<td>Define the role of novel devices</td>
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<td>Hypoglossal nerve stimulation</td>
<td>Comparative efficacy research</td>
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<tr>
<td>PAP is superior to oxygen therapy for blood pressure reduction</td>
<td>Optimise strategies for medical and surgical weight loss and weight maintenance</td>
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<tr>
<td>Substantial reductions in blood pressure with medical weight loss</td>
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