EDITORIAL

How Few Signals are Needed to Diagnose Sleep Apnea?

Commentary on Masa et al. Effectiveness of home single-channel nasal pressure for sleep apnea diagnosis. SLEEP 2014;37:1953-1961.

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A prevailing trend (perhaps *the* prevailing trend) over the past 5 years in the management of sleep apnea patients has been the growth in testing for sleep apnea with more limited devices than full polysomnography and in locations other than sleep laboratories, typically the patient's own bedroom. The types of diagnostic devices primarily used for home sleep apnea testing (HSAT) have been, for the most part, 4-channel monitors which measure airflow, oximetry, respiratory effort (usually with one belt around the chest), and some measure of heart rate or EKG. The evidence for home diagnosis for sleep apnea is strong enough now for home diagnosis to considered equal to laboratory diagnosis for a large number of patients, likely the majority.[1-5] For clinicians, this has resulted in a significant shift in how they practice medicine, and the change has not always been welcome. Nonetheless, HSAT is here to stay, and adjustments in the practicalities of managing patients have also been made.

One next step in the evolution of home testing is the development of monitors with even fewer than 4 signals. This makes sense if one considers the large number of undiagnosed sleep apnea patients across the globe and the relative high expense of polysomnography. Having a robust and accurate diagnostic testing system with just one parameter for sleep apnea diagnosis would be a step forward for the sleep medicine field. Diagnostic devices with a single channel of airflow as the single bio-parameter have been developed and used in several small studies prior to this one.[6-8] The existing literature on HSAT with airflow only has been promising but inconclusive due to small sample sizes and single-site designs. However, interest in simpler devices has been growing.

With this background in mind, Masa and his colleagues[9] in the Spanish Sleep Network have conducted a large study of an airflow-only monitor used to diagnose sleep apnea in a group of diverse patients referred to one of multiple sleep laboratories in Spain for a sleep apnea evaluation. Their results are presented in this issue of *SLEEP*. The 787 subjects in the study underwent both laboratory PSG and home based airflow monitoring with the ApneaLink monitor, a single channel recorder which can record breath-by-breath airflow for a single night. In this study, the data were uploaded to a computer and then both auto-analyzed by the proprietary scoring algorithm developed by the manufacturer and personally by trained sleep laboratory technologists. The polysomnograms (PSGs) were personally scored by the sleep laboratory technologists using standard criteria very similar to those used in the United States. For the airflow monitor, apneas and hypopneas were defined by reduction in airflow alone for both manual and automatic scoring. A minimum study duration of 3 hours was set for both sleep studies. In addition to the clinical study, the authors calculated the costs of performing both types of studies in terms of personnel costs, supplies, and travel to and from the sleep laboratory. They also compared costs of computer scoring and manual scoring of the home tests. Their analysis was classically Bayesian, focusing on sensitivity, specificity, negative and positive likelihood ratios, and receiver operator characteristics for various cutoffs for the apnea hypopnea index (AHI).

The findings of Masa et al.[9] are interesting and instructive. First, they showed that the home airflow monitor performed well across a range of AHI comparisons with the PSG results for manually scored HSATs and somewhat less well with the computer scored HSATs. These results are shown in their Figure 3, in which the areas under the curve (AUC) for the receiver operator characteristics varied hardly at all from a PSG AHI > 5 to an AHI > 30 for the manually scored HSAT. As shown in Table 3, the computer scoring of the HSAT studies did not meet the pre-specified positive criteria (a combination of likelihood ratio values and post-test probabilities) until the HSAT value was at least 25. Secondly, in the AUC analysis shown in Figure 3, the difference between manually scored HSATs and computer scored HSATs were greatest at lower levels of PSG AHI (5 and 10) and essentially identical at AHIs above that. Thus, once the HSAT level reaches 15, the AUC is virtually the same regardless of whether the HSAT is scored by a human or by a computer.

In their cost analysis (see Figure 2 in paper[9]), the authors found that higher costs were associated with computer scoring compared to manual scoring at lower levels, largely due to the costs associated with repeating studies. At higher levels of AHI, the cost difference between manual and automated studies was negligible (see Table 4 in paper[9]). Regardless of whether HSATs were manually scored or automatically scored, they are far less expensive than PSGs.

How can we understand these results in the context of home testing for sleep apnea? Computer scored HSATs with airflow-only give comparable results to PSG performed in a sleep laboratory when the sleep apnea is moderate to severe. Human scoring for these studies is not required. Below that level, practitioners should be cautious about excluding sleep apnea based on a computer-scored HSAT study. Those studies should be manually scored to confirm the result. Manually scored studies

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at an AHI less than 15 have a higher AUC compared to computer scored studies. To be practical about scoring of HSAT studies, one could initially computer score all studies and then focus human talent on rescoring the studies with an AHI less than 15. Based on this interesting study by the Spanish Sleep Network, this is a very defensible approach that optimizes clinical efficiency and accuracy of diagnosis. What we still need to know is if this approach could be replicated outside Spain and in networks of physicians and other healthcare providers who are not expert in sleep apnea management but that can be assisted by an expert as needed.

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DISCLOSURE STATEMENT

Dr. Atwood has indicated no financial conflicts of interest.

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