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Home Sleep Testing for Obstructive Sleep Apnea

One Night Is Enough!

Obstructive sleep apnea (OSA) is a common sleep disorder with a prevalence in the range of 5% to 15% in the general population.¹ Untreated OSA is

increasingly recognized as a risk factor for several health-related consequences, including hypertension,^{2,3} cardiovascular disease,⁴ stroke,^{5,6} and all-cause mortality.⁷ Undiagnosed OSA is also associated with higher rates of health-care use^{8,9} and potentially imposes an estimated burden of \$3.4 billion in added medical costs annually in the United States.¹⁰ Despite increasing awareness and identification by health-care professionals, OSA frequently remains unrecognized and underdiagnosed, even in patients with moderate to severe disease.^{11,12} The rather low level of case identification of OSA in the general community can be attributed, in part, to the inconvenience and cost associated with in-laboratory polysomnograms. Furthermore, some rural areas may not have the necessary testing facilities or the trained personnel, which adds to the incongruence between the current demand and availability of diagnostic services.¹³ With advances in technology and the development of portable monitors, home testing for sleep-related breathing disorders is now feasible and circumvents many of the limitations of an attended in-laboratory polysomnogram. In fact, in 2007, the US Centers for Medicare & Medicaid Services approved the use of portable monitoring for OSA, thereby increasing the means for diagnosing the disorder and potentially shortening the lead time for starting positive pressure therapy for many patients. In this issue of *CHEST* (see page 539), Nelson¹⁴ describes various types of out-of-center tests for OSA, along with their respective coding and billing procedures.

Despite the obvious advantages, the topic of portable monitoring in either an attended or an unattended setting has been a topic of much controversy since the early 1990s. Since then, a number of systematic reviews,^{15,16} commentaries,¹⁷⁻¹⁹ and clinical guidelines²⁰ on the use of portable monitors for OSA diagnosis have been published. The Agency for Healthcare Research and Quality Centers¹⁵ and the Center for Medicare & Medicaid Services have also published their respective reports outlining the evidence on the use of portable monitoring and national coverage decisions. Following these publications, the American Academy of Sleep Medicine provided its recommendation on the use of portable monitors in the diagnostic armamentarium for OSA.²⁰ The current consensus recommendations are that portable monitors can be used as an alternative to polysomnography for the diagnosis of OSA if used in conjunction with a comprehensive clinical sleep assessment. Portable monitoring should not be used in those with significant comorbid medical conditions (eg, congestive heart failure) or in those who may have other sleep-related problems (eg, circadian rhythm disorders). The recording montage needs to include at the least airflow and oxyhemoglobin saturation. The monitor

should be applied by a trained technician or the patient must be instructed in the correct application of the device and its associated sensors.

Although the availability of portable monitors may expedite the diagnosis of OSA for many, it is essential that health-care professionals using these methods recognize several inherent limitations. First, home sleep testing for OSA with monitors that do not record sleep can only yield information regarding the number of disordered breathing events per hour of recording time (ie, time in bed). The resulting metric (frequency of events/time in bed) is clearly not the same as that derived when sleep is monitored and the frequency of events is referenced to the number of hours of sleep. Second, disordered breathing events associated with arousals but without sufficient oxyhemoglobin desaturation (eg, hypopneas with <3% oxyhemoglobin desaturation or respiratory effort-related arousals) cannot be assessed, which may lead to an underestimation of disease severity. Third, sensor failure or drop-out during the night can lead to suboptimal recordings that may not yield useful information and thus may require additional testing. Fourth, the selection of specific sensors and the scoring methodology for portable monitoring are not as well formulated as they are for full-montage polysomnography. Fifth, because various portable monitors use different sensors, comparisons of the disordered breathing measures among devices are difficult to make. Finally, irrespective of whether sleep testing is conducted in the home or in the laboratory, a major challenge is the within-person night-to-night variability and its impact on accurately defining the severity of OSA. For example, normal subjects and patients with various pathologic conditions exhibit alterations in sleep quality²¹⁻²³ on the first night in the sleep laboratory, a problem which may not necessarily be obviated by the use of portable monitors in the home.

Studies in adult²⁴⁻³⁵ and pediatric³⁶⁻³⁸ patients with OSA have shown that a single night of monitoring is perhaps insufficient for a precise determination of disease severity and could misclassify a significant proportion of those affected as not having the disorder at all, or vice versa. Factors such as alcohol consumption, body position during sleep, and sleep stage distribution (eg, amount of rapid eye movement sleep) can have a significant impact on disease severity. Thus, night-to-night variability undoubtedly has important implications with regards to whether a patient is given a diagnosis of OSA and whether the patient has mild, moderate, or severe disease. Although a number of previous studies²⁴⁻³⁸ have specifically examined the variability in OSA severity over consecutive and nonconsecutive nights, the findings across these studies have generally been inconsistent. As a result, some have advocated the use of just one night of

monitoring,²⁹⁻³⁸ whereas others have recommended a more cautious approach of considering additional monitoring when the clinical history is suggestive of OSA but the initial diagnostic test is unrevealing.²⁴⁻²⁸ Such a discrepancy in recommendations is to be expected, given that most of the available data is based on small study samples that have considerable intersubject heterogeneity. Furthermore, the variability in the methods used to record, score, and quantify OSA severity across the available studies amplifies the problem of small study samples and therefore limits the ability to reach a generalizable consensus regarding multnight testing.

Because multnight sleep testing is a more realistic and feasible undertaking in the home than in the sleep laboratory, a practical and important issue that can and needs to be addressed for home monitoring is defining how many nights of recording are needed and how the resulting information will be used for diagnosing OSA. Specifically, are two nights or three nights of monitoring sufficient for a diagnosis of OSA or should an entire week be assessed, as is often done with actigraphy? Moreover, given that an apnea-hypopnea index (AHI) will be determined for each night, should the assessment of OSA severity use the lowest, highest, or an aggregate AHI value? For instance, if on three consecutive nights, a patient is noted to have an AHI of 4.9, 13.0, and 37.2 events/h, respectively, what is the severity of disease in this patient, assuming no differences in sleep quality and recording time across the three nights? Would this patient be classified as having no OSA (AHI, 4.9 events/h), mild OSA (AHI, 13.0 events/h), or severe OSA (AHI, 37.2 events/h)?

It could be easily argued that any one night that is diagnostic (AHI ≥ 5 events/h) should be used as the reference. In that context, the highest AHI value would be used to characterize the presence and severity of OSA. Although such an approach can increase case identification, it completely neglects the short-term biologic variability in breathing abnormalities and the imprecision in assessing these abnormalities, particularly with the manual scoring methods that are commonly used. Furthermore, using the highest AHI, or on the other extreme, the lowest AHI, assumes that the occurrence of apneas and hypopneas during sleep is an invariable fixed attribute of a patient, which is certainly incorrect. Therefore, a statistical measure of central tendency, such as the arithmetic or geometric mean, may be preferable. The issue of disease misclassification is not trivial because it can not only change how a patient is clinically assessed and managed but also influence our understanding of the public health implications of the disease process in future clinical and epidemiologic studies of OSA.

Additional research is urgently needed to carefully probe various questions concerning home sleep testing, including the usefulness of multnight testing. Only with carefully conducted studies can the optimal number of nights be determined and the appropriate summary metric (eg, average vs peak AHI) be identified that best correlates with health outcomes such as incident cardiovascular disease. Thus, although multnight home recordings are being conducted by many commercial providers, empirical data on the usefulness of recording several nights for the diagnosis of OSA are lacking. Given the absence of a strong empirical base justifying multnight home sleep testing, outlining reimbursement policies for such services poses a major challenge in the current cost-constrained health-care systems worldwide.

In light of the inevitable increase in and growing demand for identifying and treating OSA in the general population, an urgent need exists for implementing an evidence-based approach for the use of portable monitoring in the ambulatory setting. Aside from its obvious benefits of cost containment and convenience to the patient, portable monitoring clearly provides an alternative for diagnosing OSA that is accessible to sleep specialists and all health-care professionals. However, as the strategy of portable monitoring and home sleep testing is increasingly implemented, there has to be a concomitant increase in research efforts that address vexing questions to explicitly clarify the proper use of these diagnostic methods. A more precise understanding of OSA characteristics in the context of home sleep testing will guide physicians and researchers in making therapeutic decisions and in defining the health burden associated with this chronic ailment.

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Funding/Support: This article was supported by the National Institutes of Health [Grant HL07578].

Financial/nonfinancial disclosures: The authors have reported to *CHEST* the following conflicts of interest: Dr Patil was a paid consultant in the development of a home sleep-testing triage system for Sleep Services of America, Inc, a GE company. Drs Punjabi and Aurora have reported that no potential conflicts of interest exist with any companies/organizations whose products or services may be discussed in this article.

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DOI: 10.1378/chest.12-2699

ACKNOWLEDGMENTS

Role of sponsors: The sponsor had no role in the design of the study, the collection and analysis of the data, or in the preparation of the manuscript.

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