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COMMENTARY

Contact-free screening for obstructive sleep apnea: comfort, especially in a physically distanced brave new world

Commentary on Zhao R, Xue JB, Dong XS, et al. Screening for obstructive sleep apnea using a contact-free system compared with polysomnography. *J Clin Sleep Med*. 2021;17(5):1075–1082. doi:10.5664/jcsm.9138

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In-laboratory polysomnography is the gold standard method to assess sleep disorders in the clinical setting. Nevertheless, what constitutes polysomnography has evolved dramatically since the early descriptions and the initial codification. The first testing was technically burdensome and procedurally difficult and required specially trained personnel for the conduct of the study. Since then, numerous modifications and technological advances have been incorporated to simplify patient recordings by reducing the number of parameters measured while maximizing the information extracted. The hope remains that fewer sensors will improve patient comfort and thereby mitigate disturbances to sleep and sleep architecture. Furthermore, these less-cumbersome techniques have lent themselves to diagnostic evaluation outside the laboratory, specifically in the home where the patient's habitual sleep occurs and when sleeping pattern should be more representative. This trend toward home testing has dramatically changed the diagnostic evaluation of patients with high pretest probability for obstructive sleep apnea.[1]

In this issue of the *Journal of Clinical Sleep Medicine,* Zhao and colleagues continue this trend with a study of a new device for the in-laboratory screening of patients with suspected OSA.[2] The OrbSense device (Megahealth Medical, Shanghai, China) estimates respiratory effort using automated proprietary software to evaluate patient movement by microwave radar. Although the ultimate goal is likely to be at-home screening, limitations of this technology are particularly problematic for home use. The device needs to be positioned correctly (facing the right direction and in close proximity to the bedside, ideally within 100 cm) because this microwave embodiment is both directional and short-range. Furthermore, the cluttering of the bed, the configuration of the room with mundane items, pets and bed partners, and electrical interference from other devices in or near the home could interfere with the signal.

Nevertheless, in this validation study, 359 Han Chinese adults without a prior diagnosis of heart failure, obesity hypoventilation syndrome and/or other respiratory disorders, and possible central sleep apnea were admitted to the sleep laboratory for simultaneous assessment of the respiratory event index by microwave radar (which did not include oximetry) and of the apnea-hypopnea index by standard polysomnography (which included oximetry). The authors report a high correlation (r = .92; P < .001) by the Pearson coefficient and good agreement by Bland-Altman analyses: The mean difference between the methods was 1.5 events/h (95% confidence interval, –18.6 to 21.5 events/h), although at a higher apnea-hypopnea index (particularly ≥ 30 events/h), the systematic underestimation of the respiratory event index was greater. Using identical thresholds of 15 events/h for each method, the microwave radar device showed a sensitivity of 0.90, a specificity of 0.81, a false-positive rate of 3.5%, and a false-negative rate of 9.8% for the detection of moderate-severe obstructive sleep apnea.

Individual respiratory events were compared in a convenience sample of 119 adults who had been most recently enrolled in the study; obstructive events were accurately identified, but significantly fewer central and mixed events were detected.[2] The addition of pulse oximetry may have further improved agreement and correlation,[3,4] and it provided additional clinical relevance because repetitive oxygen desaturations of at least 4% are independently associated with cardiovascular disease.[5] Indeed, in that context the OrbSense manufacturer has innovated a Bluetooth oximeter built into a finger-ring, which can be coupled with the OrbSense device to provide minimally intrusive monitoring of both respiratory effort and blood oxygen saturation.[6] Other investigators have shown the feasibility of such a multimodal system to monitor patients with SARS-CoV-2 pneumonia in isolation wards and to reduce the number and duration of direct clinician contacts.[6] However, validation of this combination for the assessment of sleep disorders has not yet been reported.

An important caveat is that the study population had a high pretest probability of obstructive sleep apnea, which decreased the false-positive rate and increased the false-negative rate. High pretest probability is currently a requirement for choosing

at-home testing,[1] but deciding exactly whom to screen in this fashion remains problematic.[7] Notably, patients with confounding comorbidities, which could complicate the interpretation of the sensor findings, were excluded in this study by Zhao and colleagues.[2] Adults with extreme obesity (body mass index > 40 kg/m^2) were also excluded, and the device's accuracy in this population cannot be assumed because chest movements may be more difficult to detect by microwave in adults with morbid obesity. Therefore, the usefulness of this device for the assessment of unselected patients even in the sleep laboratory, where the technological complications of home testing can be set aside, remains to be determined.

Other technological advances may further inform the utility of these devices. A major limitation of standard polysomnography beyond the technical challenges of data acquisition is the requirement for visual scoring to determine sleep stage and respiratory events. Here the large datasets that can be stored in the cloud, computing power, and algorithmic advances in machine learning offer the greatest potential breakthrough for polysomnography.[8] Progress has already been made in the use of deep neural network analyses and other machine learning techniques to improve sleep and respiratory staging of the electroencephalogram and allow the determination of sleep stage and sleep-disordered breathing without electroencephalogram.[8] Note that large and diverse datasets are required for proper analyses because differences in sleep and sleep-disordered breathing because of ethnicity,[9,10] sex,[11] and age[12] are recognized. When linked to clinically relevant outcomes, novel machine learning analyses may lead to new diagnostic criteria and a deeper understanding of the impacts of disordered sleep. For example, body mass index cutoffs for the diagnosis of obesity differ between Asians and non-Asians because of differences in cardiovascular risk at different thresholds. Whether different diagnostic criteria are applicable according to sex, age, or ethnicity in sleep medicine requires further evaluation.

Recent technological breakthroughs, particularly in machine learning, promise a new world for the at-home evaluation of sleep disorders. However, technologies such as microwave detection and static-charge pads to provide a nontouch interface have previously been validated but have not met widespread clinical application or commercialization.[13] This circumstance may arise from technical issues or nontechnical characteristics, including the ability to garner reimbursement for performance of the testing. Nevertheless, the current device does not seem to represent a major technological breakthrough, because the limitations of directionality and proximity do not seem to be solved. However, the COVID-19 pandemic has accelerated the deployment of telemedicine and revolutionized the practice of medicine—changes that will likely persist with ongoing reimbursement.[14,15] In this brave new world, contact-free health care interactions, as proposed by Zhao and colleagues,[2] may become the new norm.

CITATION

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DISCLOSURE STATEMENT

All authors have read and approved the manuscript. The authors report no conflicts of interest.