

COMMENTARY

## Albeit ever more technological, there's no place like home

Commentary on Ioan, I, Weick D, Schweitzer C, Guyon A, Coutier L, Franco P. Feasibility of parent-attended ambulatory polysomnography in children with suspected obstructive sleep apnea. *J Clin Sleep Med*. 2020;16(7):1013–1019. doi:10.5664/jcsm.8372

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Obstructive sleep apnea (OSA) occurs in up to 5% of the pediatric population, and untreated OSA can result in a number of adverse developmental and medical outcomes.<sup>1</sup> The gold standard for diagnosing OSA in children is an attended nocturnal laboratory polysomnogram (PSG).<sup>2</sup> However, there are significant barriers to obtaining attended pediatric PSGs, including the relative scarcity of labs, clinicians, and technicians specializing in pediatric sleep and the cost of attended studies. The current COVID-19 pandemic has introduced an additional barrier, namely, the potential for in-lab studies to foster viral dissemination, disrupting the ability of sleep labs worldwide to perform PSGs.<sup>3</sup>

In an effort to overcome these barriers, many centers are turning to unattended home sleep apnea tests for adults with suspected OSA. However, the American Academy of Sleep Medicine currently does not recommend using home sleep apnea tests for the diagnosis of OSA in children.<sup>4</sup> Compared with adults, children with OSA are less likely to manifest oxyhemoglobin desaturations and more likely to have partial as opposed to complete upper airway collapse.<sup>5</sup> Additionally, there are limited data on the validity of home sleep apnea tests in children compared with gold standard PSG.

Unlike home sleep apnea tests, unattended PSG testing (type II monitors) include electroencephalogram and electrooculogram leads, allowing for sleep staging, the identification of cortical arousals, and the scoring of hypopneas that are not associated with oxyhemoglobin desaturations. Type II studies can also include videography and carbon dioxide monitoring.<sup>6</sup>

In this issue of the *Journal of Clinical Sleep Medicine*, Ioan and colleagues<sup>7</sup> report on the feasibility and technical reliability of home PSGs in 57 children aged 3–16 years using a type II home monitor (Nox-A1 PSG system, ResMed, France). The equipment was set up in the authors' clinic on the day of the study and technical adjustments were made at the bedside by the patients' home caregivers, who were taught to check equipment leads every 2 hours and reposition them if necessary. Study failure was defined as < 5 hours of artifact-free recording time or when 1 or more of the channels (nasal flow, thoracoabdominal belts, or oximetry) showed artifacts > 75% of recording time. With this methodology, 81% of the studies were found to be technically successful. The nasal pressure transducer provided a

satisfactory signal for > 75% of the recording in about 88% of the children. Compared with the overall group, there was a similar success rate for studies done with children with neurodevelopmental delays and other comorbidities. Overall, the method of type II monitoring described in this study appeared to be both feasible and reliable in this group of pediatric participants.

There have been few prior studies on the technical feasibility of home PSGs in children. Goodwin and colleagues<sup>8</sup> reported on home PSG in 162 children aged 5–12 years. The studies were done with a type II monitor (Compumedics PS-2 type II monitor, Abbotsford, Victoria, Australia) and were set up by a technician in the patient's home. Initially, 91% of studies were technically successful, defined as > 4 hours of interpretable data from the respiratory flow, oximetry, and electroencephalogram channels. The nasal pressure transducer had a scoreable signal for > 6 hours in only 52% of the studies. To assess validity, the results of an in-lab PSG was compared with the unattended type II test in 5 children; the paired test results showed no statistical difference in respiratory disturbance index.

Marcus and colleagues<sup>9</sup> studied home PSG in a cohort from the Caffeine for Apnea of Prematurity (CAPS) trial, consisting of 201 children aged 5–12 years, including 6 children with cerebral palsy. The type II test was set up in the home by a technician and used the Siesta 802 system (Compumedics, Charlotte, NC). Initially, 91% of studies were technically successful. Failure was defined as < 4 hours of recording time or displacement of a "major" signal (specifically, the arterial oxygen saturation channel, both respiratory effort channels, both airflow channels, or all electroencephalogram leads). The nasal pressure transducer provided a satisfactory signal for > 75% of the recording in only 67% of the children. To assess validity, 4 non-CAPS children underwent both in-lab PSG and type II monitoring. The paired tests showed similar results in terms of respiratory parameters, with longer sleep time and improved sleep efficiency at home.

Although these 2 earlier studies support the validity and feasibility of home-based PSG in children, both relied upon equipment set up by a sleep technician in the children's homes. Novel aspects of the current study include setting up the equipment in the clinician's office and training the caregivers to assess the equipment every

2 hours during the study and reposition any displaced leads. This strategy conserves personnel and resources by eliminating a home visit and should improve the technical quality of the home studies compared with prior methodologies. The bedside involvement of the caregivers should result in a better nasal flow signal, which is the data channel most at risk for disruption in home-based testing in pediatric patients and is needed for reliable scoring of hypopneas.<sup>10</sup>

There are several limitations of this study. Laboratory-based PSGs were not done and so the results of the home studies could not be validated. Although most caregivers are probably able and willing to do the equipment checks, compliance with the nightly protocol was not studied and could limit successful enactment of the methodology. Finally, although the study included a limited number of children with comorbidities and neurodevelopmental delays, there is a need for larger studies evaluating specific subpopulations to determine the best candidates for home pediatric PSGs.<sup>4</sup>

The COVID-19 pandemic has highlighted opportunities for technological and practice innovation in sleep medicine, building on existing trends toward home-based testing. Although the diagnosis of OSA in children presents special challenges, pediatric at-home PSG may offer important benefits in terms of patient and caregiver comfort, improved data quality (with the potential to reduce the “first-night effect” of in-lab studies), reduced costs, increased convenience, and improved access, decreasing the mismatch between clinical demand and the limited infrastructure for pediatric lab-based studies. Future feasibility studies should consider a uniform definition of what constitutes a technically successful study. Additional validation studies are needed, correlating the results of type II studies with PSGs, and more studies are needed to determine which pediatric populations are appropriate candidates for in-home testing. Additionally, the optimal choice of study channels requires clarification, including the feasibility of CO<sub>2</sub> monitoring during home-based testing to assess for obstructive hypoventilation, as well as the role of video monitoring.

With the medical, economic, and public health catalysts all in alignment, pediatric home studies are likely to become an increasingly important part of pediatric sleep medicine. Studies like this one are important, because they will determine the methodology and the equipment that we use.

## CITATION

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## DISCLOSURE STATEMENT

All authors have seen and approved this manuscript. Dr. Birnkrant is a clinical advisor to ABM Respiratory Care and has a financial interest in patents for respiratory devices that are licensed to ABM Respiratory Care. The other authors report no conflicts of interest.