



Setting Up a Pediatric Sleep Lab

Jyoti Krishna^{1,2,3} Gregory J. Omlor^{1,2,3,4}

¹Sleep Laboratory, Akron Children's Hospital, Akron, Ohio, United States

²Department of Pediatrics, Akron Children's Hospital, Akron, Ohio, United States

³Department of Pediatrics, Northeastern Ohio Medical University, Ohio, United States

⁴Lewis H. Walker Cystic Fibrosis Center, Akron Children's Hospital, Akron, Ohio, United States

Address for correspondence Jyoti Krishna, MD, Department of Pediatrics, Akron Children's Hospital, 215 West. Bowery Street, Akron, OH 44308, United States (e-mail: jkrishna@akronchildrens.org).

J Child Sci 2019;9:e30–e37.

Abstract

Obstructive sleep apnea occurs in a significant proportion of children and adolescents and requires a sleep study to diagnose the condition. However, there are relatively few sleep laboratories that serve this population. Consequently, this means sleep studies are not done in a timely manner, and many of these patients do not get studies performed when indicated. Building new pediatric-focused sleep laboratories or expanding service in an adult-focused laboratory to children can help overcome this barrier.

The decision to build or modify an existing sleep laboratory for children brings many considerations that are different than for adults. The location of the laboratory is partially determined by the need for the presence of a sleep technologist. Whether they are done in the community or a hospital will be affected by the patient's medical complexity. The design of the sleep laboratory can also be influenced by the presence of children. All children, under 18 years of age, will require a parent to sleep in the room with them. Safety will also be impacted. For example, electric outlets need to be protected, furniture should be child safe, and transportation to emergency facilities must be managed. In addition, service to children also raises technical issues. They require different types of leads and smaller equipment and the software must meet required pediatric specifications. The staff must understand pediatric developmental, social, and medical needs. It is also critical that they have a desire to work with children. This article is written to assist the reader in building a sleep laboratory with the pediatric patient in mind.

Keywords

- ▶ Polysomnography
- ▶ sleep laboratory
- ▶ design
- ▶ set up

Introduction

Sleep disordered breathing is a common problem in pediatrics and is probably the most prevalent sleep disorder affecting children. The prevalence of habitual snoring is up to 12% of children. A significant number of these children will require overnight polysomnography (PSG) to diagnose obstructive sleep apnea syndrome (OSAS) which occurs in up to 5.7% of children.¹ However, there are only a limited number of sleep

laboratories that perform PSG testing on children.² Furthermore, for a variety of technical and behavioral reasons, studies cannot be easily performed on children at home as they can for adults. As a result, more sleep laboratories that can perform sleep studies on children are required. This need can be met by building more exclusively pediatric sleep laboratories. However, pediatric-only sleep laboratories are usually associated with a tertiary hospital and the number of such laboratories clearly cannot meet the demand for sleep study services of the

received
September 18, 2018
accepted after revision
September 27, 2018

Issue Theme Sleep Disorders in Children; Guest Editors: David Gozal, MD, MBA, PhD (Hon), and Leila Kheirandish-Gozal, MD, MSc.

Copyright © 2019 Georg Thieme Verlag KG Stuttgart · New York

License terms



DOI <https://doi.org/10.1055/s-0038-1675608>.
ISSN 2474-5871.

population. On the other hand, primarily adult sleep centers are often in an area where there are no pediatric sleep laboratories and may have a desire to serve younger patients to provide more comprehensive service. In addition, sleep studies for adults are now primarily performed in the home. As a result, there is available space in the adult sleep laboratories and use of such facilities, if appropriately equipped and staffed, would be a reasonable solution for the space crunch and relative inaccessibility to sleep studies in children.

Performing sleep studies on children provide unique challenges as compared with adults. They have different physiological, medical, developmental, behavioral, and cultural needs than adults. These differences can stress the sleep laboratory from the time of referral to the process of interpreting the sleep study. Attention to details with a pediatric focus in mind is required to be successful in providing optimal services.³ This article is written to assist the reader in either setting up a pediatric sleep laboratory or expanding from primarily adult service to including children. Specific details of protocols, equipment, or the performance of sleep studies are beyond the scope of this article.

Decision to Perform Pediatric Studies

The first decision to make is whether pediatric sleep studies are needed in the desired service area. Evaluating the pediatric demographics in the service area is an important place to start. Other considerations are the availability of existing sleep laboratories that provide service for children and what ages do the existing laboratories serve? Many primarily adult laboratories will study adolescents down to 12 years of age, while others may be comfortable performing studies on children as young as 6 years of age. Another area to evaluate is the complexity of children other laboratories are performing studies on? Also, how comprehensive is the service? For example, does the laboratory perform a multiple sleep latency test (MSLT) on children? Finally, does an existing laboratory have more of a research focus than a clinical one?

Location

The next decision is the location of the laboratory. This may be predetermined if the studies will be in an existing adult laboratory. Even so, some adjustments will likely need to be made to service children. For a new laboratory, location can be critical in determining success. Factors to consider include whether the laboratory is part of an existing health care institution and what facilities are available in the desired service community? For example, is there a hospital in the area? Medical complexity of the children to be studied is an important factor as well. In otherwise healthy children, the sleep laboratory can more easily be in a community environment. However, if sleep studies will be done on children with other significant medical comorbidities, a sleep laboratory housed within a hospital setting would be more desirable. Access to parking, food, registration requirements, and emergency support are also considerations in determining location.

Sleep Laboratory Design

Planning for pediatric sleep studies will have a clear impact on architectural design, build, and decoration. For pediatric patients to be comfortable the space must be child friendly. An intimidating space could make the difference of whether a study can be completed or not. The American Academy of Sleep Medicine (AASM) has recommendations for room size and these must be kept in mind.⁴ However, a room for children may need to be larger to allow for a bed for parent/caregiver to sleep, access for special needs children or space for other medical equipment, such as feeding pumps and home ventilators. The room must also be large enough for emergency personnel to function. Medically complex children may require additional staffing, such as nurses, child life workers, social workers, and security staff (► Fig. 1).

Determining how many beds to have in the sleep laboratory is another important decision. Too few beds and there will be a backlog in the schedule. Too many, and money is wasted on the space and equipment. Pediatric demographics in the laboratories service area will help inform this decision too. Other factors include how many days per week the studies will be done and whether staffing issues impose any limitation. Available space in the building and whether individual showers and bathrooms are desired may also affect the number of beds.

The safety and comfort of the staff and regulatory requirements for the staff must be kept in mind when choosing space and designing the laboratory. Space will be needed for technical staff to take breaks. Staff restrooms and refrigerators are additional considerations (► Fig. 2).

All sleep laboratories need to consider lighting, patient restrooms, handicap accessibility, and electrical shielding when building a sleep laboratory. Furthermore, children tend to cry when they are upset. This can be mitigated with room spacing and/or sound proofing. Overhead paging must also be blocked if the laboratory is a part of a larger institution. Closets and/or shelves for stocking testing



Fig. 1 Picture of a study room in the authors' laboratory. The camera is in the ceiling (solid black arrow) to allow the best patient viewing even with a crib. Note the shelving for the PAP machine, end-tidal CO₂ monitor and other equipment (dashed black arrow). One bed is for the patient and the other is for a parent. The bedside stand is low and cannot be tipped over easily. PAP, positive airway pressure.



Fig. 2 Control room at the authors' sleep laboratory showing two of the six review stations (white arrows). The staff lounge is connected to the sleep laboratory (black arrow).

equipment, cleaning supplies, and safety equipment must also be considered. A final thought is if the space isn't being used during the day it could also potentially be used as an ambulatory sleep clinic with some alterations (► **Fig. 1**).

Pediatric Safety

Safety is a critical factor when designing, building, and operating any clinical area. This becomes even more important and brings different considerations when children are involved. Access to oxygen, air, and suction should be present, as well as child sized cannulas and suction catheters. A cardiopulmonary resuscitation cart should be stocked with child appropriate equipment, medications and dosage guides. Transportation to an emergency facility for children must also be thought through.

Child friendly furniture is important to make them comfortable but must also be safe. There must be developmentally appropriate beds with rounded corners, bedside stands, equipment, armoires, and other furniture that cannot be pulled over by a child. Another thing to keep in mind is buying waterproof mattresses so they can be easily cleaned in the case of enuresis or emesis. Some children may have medication that requires refrigeration and how this is handled must be considered by the laboratory personnel. One thought is to have a medication refrigerator. However, it must be kept in mind that medication must be kept separate from food and adequately labeled. Another possibility is to have the parent bring the medication in a cooler.

Once the space is built, it is important to perform a safety walk with child hazards in mind. These could include checking safety covers for electrical outlets, pull cords that could strangle a child, water that gets too hot and dangerous equipment in the reach of young hands. Staff training in pediatric basic life support is critical. One last step prior to opening the laboratory is to do a "dress rehearsal" to make sure that everything is present and working properly. Once the laboratory is running, regular mock emergency procedures should be performed to learn where issues may arise.

A final safety consideration when medically complex children are being studied is to make the larger hospital aware that such a child is present in the sleep laboratory in case their underlying condition worsens. For example, at Akron Children's Hospital, if a child is being studied that has a tracheostomy and/or home ventilator, a respiratory therapy supervisor evaluates the child as an independent assessment of the child's stability and also provides input as to what their needs might be if an emergency occurs.

Technical Concerns

Dealing with children of course generates technical considerations. Their bodies are smaller, they are physiologically different than adults, and they are developmentally more challenging. A crib will be required for young children, so beds must be mobile to allow movement in and out of a room. AASM and other requirements can be different for children.³ For example, the AASM recommends that all children have carbon dioxide monitored due to the increased likelihood of hypoventilation. The placement, size, and type of leads are often different for children. Examples include different placement for electrooculogram (EOG) and chin electromyogram (EMG) leads, and the pediatric oxygen saturation probe may be a wrap as opposed to a clip. Also, nasal cannulas, thermistors, and respiratory inductance plethysmography bands will all need to be pediatric sized.

When choosing a sleep software/hardware vendor a child's needs must be kept in mind. The vendor must meet AASM requirements for performing studies in children and if desired, infants.⁵ Technical requirements for doing the study, such as sampling rate, scoring a pediatric study such as using a two-breath duration for apneas and hypopneas, and the ability to score periodic breathing are all elements that need to be assessed. Pediatric report templates must be available from the vendor and support for customizing templates is very desirable. For example, oxygen for the treatment of central sleep apnea is more often used in young children than adults. The titration report must be able to handle this. In this day and age exporting a report to the institution's electronic medical record and/or with the area's health information exchange system is becoming a routine requirement. While HL7 interoperability is a must, systems may have differing versions of this standard and an older version may not handle pediatric specific information as well as the most recent versions of recommended documentation. Length of time during which the digital information containing the sleep study is stored may also be different for children. For example, in the United States the medical liability statute of limitations is often longer for children leading to larger storage capacity requirements for digital information.⁶

Given all these considerations, choosing a vendor for pediatric studies can be more difficult than for adult-only studies. Using a consultant with pediatric experience can be useful. Even so, it is useful to talk with colleagues that have used the PSG equipment and have met all the desired technical requirements. Of course, demonstrations must be done and care taken to verify what a vendor has said is

correct. Toward this end, visiting a pediatric laboratory that has experience in using the equipment can provide useful insights and prevent potential future problems. If needed, the vendor should be able to provide references for sleep laboratories using their equipment. Do not forget to include technical and administrative staff in these visits. Finally, do not forget to keep vendor technical support in mind. It is vital that they provide robust support with pediatric experienced staff both day and night once the equipment has been purchased.

Staffing for Pediatric Patients

Pediatric sleep studies call for additional requirements and training when looking for qualified sleep technologists to staff the sleep laboratory. Personnel must be trained in pediatric developmental, physiological, and behavioral aspects, and must have a family centered approach. Beyond that, they must have a desire and temperament for working with children. Sleep studies are done when a child and their parent are at their lowest capability for cooperating. Putting a technician that does not want to work with children and does not have proper training into this mix can be disastrous.

Finding technicians with the above skills can be challenging. Traditionally sleep technologists have a respiratory therapist or EEG technician background so a local pediatric hospital or hospital with a pediatric ward may be a source. Developing a relationship with the closest training school for sleep technologists can be very useful. Teaching a course at the college or hosting students at your laboratory for their clinical rotations can assist in this goal and provide valuable exposure to your laboratory. Another source for technicians is job posting sites at schools, the AASM or other professional societies, such as the American Association of Sleep Technologists.

Additional personnel that must have pediatric understanding and/or training includes the receptionist, the scheduler, registration and billing staff, information technology, and biomedical support. One of the most important staff in the sleep laboratory is the operations manager. This person keeps the laboratory running smoothly while also being a safe and effective place. They are responsible for hiring the right staff and providing them with resources and a good working environment. They have a critical role as a go-between for the night and day teams, clinic, and other areas outside the laboratory, such as durable medical equipment (DME) companies. They will make sure the staff is adequately trained, evaluate staff and make sure they maintain continuing education credits. A good operations manager will also make sure the laboratory receives patient satisfaction feedback and perform quality improvement work.

Policies and Procedures

An important process in the functioning of the laboratory is the creation of a policy and procedure manual. It creates a consistent and durable body of knowledge under which the laboratory operates. The development of good policies and procedures does take time and effort. This can be reduced by

starting with sample protocols and then adjusting them to your sleep laboratory's specific requirements. Sources of protocols can be obtained from colleagues, the AASM, and other professional societies. Other important considerations when creating policies are to include staff from the areas that involve them, make them as direct as possible, teaching the staff about the policies when created, and reviewing them on a regular basis.

Of course, it is important to have policies and procedures that take pediatric issues into account. Most pediatric sleep laboratories work closely with a tertiary care hospital or sleep-specialty clinic which is the primary source of patient referrals for testing. However, it is our experience that once sleep-related specialty services are established in a given community, awareness for screening and managing sleep disorders rapidly increases among area physicians and clinicians. Subsequently, they become an important source of direct-to-laboratory referrals for testing. Often, such clinicians will order tests ahead of, or even in lieu of a sleep-specialty consultation. Since these patients are not evaluated by a sleep specialist prior to testing, good policies and procedures will ensure that the appropriate order for the study is placed based on the child's clinical assessment in the referral documents. Along these lines, several issues become noteworthy. First, the reason for doing the study must meet standards of care. A test must be ordered for the right reasons and not just to "rule out a sleep disorder" in a child who "cannot sleep." Also, many conditions affecting sleep or involving sleep do not necessarily require a PSG for reaching the diagnosis. For example, childhood insomnia is a common reason for referral to a sleep laboratory that does not require a PSG to be done unless symptoms of OSAS or other specific sleep disorders are present. In the United States, the AASM has published guidelines for the indications of PSG and other sleep tests in respiratory and nonrespiratory conditions (→Table 1).^{7,8} Second, fiscal stewardship with healthcare expenditures demand that the correct test is ordered. For example, a patient with daytime sleepiness who is also at high risk for sleep apnea should not routinely be ordered an MSLT paired with a prior-night PSG since an MSLT is commonly known to most clinicians as indicated for the investigation of hypersomnia disorders. However, if the somnolence symptoms far exceed the common phenotypic presentation of sleepiness in a child, it may be worthwhile to exceptionally consider inclusion of the MSLT in the initial testing. Third, for logistical and safety reasons, the presence of devices such as vagal nerve stimulators,⁹ need for overnight gastrostomy feeds, nursing support, ventilator management, nighttime medication administration, or even the need for a hydraulic lift for physically challenged patients should not come as a surprise for the nighttime technologist. For example, while pre-tracheostomy tube decannulation sleep testing is often used to guide clinical decisions in children with tracheostomies, such a child should not undergo tracheostomy capping for the very first time in the sleep laboratory. Fourth, the patient and family should be appropriately counseled by the ordering provider regarding the sleep test. A routine overnight PSG may not work well for a teenager with a severely delayed sleep schedule. Thus, sleep hygiene and circadian rhythms may need to be addressed first

Table 1 Abbreviated key examples of respiratory and non-respiratory indications for PSG and MSLT testing in children

Standard indications	Generally accepted patient-care strategy with high degree of clinical certainty
	<ul style="list-style-type: none"> • Clinically suspected OSA before or after adenotonsillectomy, especially in patients at high risk for OSA (e.g. obese, craniofacial or Down syndrome, etc.)
	<ul style="list-style-type: none"> • For positive airway pressure titration
	<ul style="list-style-type: none"> • For the evaluation of narcolepsy (PSG followed by MSLT) or suspected periodic limb movement disorder
Guideline indications	Generally based on a moderate degree of clinical certainty
	<ul style="list-style-type: none"> • Clinically suspected hypoventilation in sleep
	<ul style="list-style-type: none"> • To follow-up PAP therapy over time
	<ul style="list-style-type: none"> • For the evaluation of hypersomnia and parasomnia under certain conditions
Optional indications	Implies uncertain clinical use
	<ul style="list-style-type: none"> • To guide treatment of OSA with rapid maxillary expanders or other oral appliances
	<ul style="list-style-type: none"> • For guiding non-invasive positive pressure ventilation titration, supplemental oxygen, ventilator settings, or before tracheostomy decannulation

Abbreviations: EEG, electroencephalogram; MSLT, multiple sleep latency test; OSA, obstructive sleep apnea; PAP, positive airway pressure; PSG, polysomnography.

Source: Modified from Aurora et al.^{7,8}.

unless the laboratory can synchronize the test to match the habitual sleep time. Finally, the family should not only be clear about the purpose of the test and what answers it can be expected to provide but they should also be made familiar with when, where, and how the test will run.

A well-designed referral form can capture the common respiratory and nonrespiratory conditions that merit a sleep study as described above. It can also provide the necessary information to ascertain the complexity of the child's clinical and behavioral status. This form should solicit pertinent demographic, medical (e.g., premature birth, muscular dystrophy) and surgical history (e.g., previous adenotonsillectomy, cleft palate repair), as well as current clinical status (e.g., witnessed apneas, sleep terrors). It should also include a brief description of the pertinent physical examination findings (e.g., obesity, micrognathia) and current medications. A process also needs to be in place to gather insurance information. Once the order is received, the sleep center should have a procedure in which all such referrals are scrutinized or "triaged" by a sleep specialist to ensure that the purpose of the test and the goal of any anticipated therapy, such as oxygen or continuous positive airway pressure (CPAP) are clear. Any omissions should be addressed by appropriate communication with the referring practitioner. Based on the triage process, there may be a need to override existing laboratory protocols based on clinical information specific to the case at hand. For example, it may be prudent to not wait for demonstration of severe sleep apnea before starting CPAP in a patient with a history of CPAP use who was simply being rechecked after a weight loss intervention. In cases such as this, laboratory protocols may appropriately be overridden to start CPAP at a lower apnea, and hypopnea index (AHI). The triage process should also consider the staffing ratio based on the complexity of the test. For example, if the child is very young or expected to

be uncooperative or disruptive, the decision may be to run the test with a 1:1 ratio (one patient for one technologist) instead of the standard 2:1 ratio. There needs to be a mechanism in place whereby the order and any clarifications or alerts made by the sleep specialist are available to the night technologist in the form of a final plan for the test.

Most sleep laboratories that do pediatric studies allow only one parent to be with the child during the sleep study. However, all too often families have not read the instructions or simply do not have any other options, so other children or family members come to the laboratory. A policy needs to be created to deal with this situation.

There are a dizzying number of laws and regulatory requirements that affect both medical and general employment issues. Many of them are specific to children. All sleep laboratories must have appropriate policies and procedures to avoid running into problems in this area. The specific regulations that any specific laboratory will need to follow depends on where the laboratory is located and whether it is part of a hospital or not.

As noted above, policies and procedures are important to ensure a seamless testing experience. Educating the referring provider and patient is another mechanism to make sure they are followed. In this regard, videos, brochures, or on-line descriptions of the various tests and pretest preparation are very useful. Such resources may also explain travel directions, arrival times, car parking, expected duration of various tests, and give a list of things to bring to keep the child comfortable. They may show videos or illustrations of the test environment and equipment which will serve to reduce anxiety for the procedure. Phone numbers for the sleep service should be readily available to answer questions. Toward this end, the authors routinely plan speaking engagements with area practitioners to educate them about sleep

disorders and the appropriate indications for these tests. The practitioner's staff can also be taught how to access needed information and to direct the patients to view the sleep laboratory's on-line educational resources prior to the test.

Performing and Reporting the Pediatric Polysomnography

Pediatric sleep laboratories perform PSG, positive airway pressure (PAP), and/or oxygen titration studies most frequently. MSLT is next most frequently performed. The maintenance of wakefulness test (MWT) and home testing are rarely performed in a pediatric laboratory. The standard PSG study is attended continuously by a sleep technologist and standard physiological parameters are measured. An abbreviated EEG is placed using landmarks and nomenclature described by the standard International 10–20 system since the full EEG array is not required to score sleep stages. Thus, scalp and face leads include left (E1–M2) and right (E2–M1) electrooculogram, frontal (F3–M2 and F4–M1), central (C3–M2 and C4–M1), and occipital (O1–M2 and O2–M1) EEG. Other channels include mental and submental EMG, left and right anterior tibialis EMG, ECG, snore microphone, continuous airflow with thermistor, and/or nasal pressure transducer, and/or PAP interface flow, chest and abdominal breathing effort via respiratory inductance plethysmography (R.I.P.) belts, pulse oximetry, end-tidal or transcutaneous capnography (ETCO₂ and/or TcpCO₂), and audio–video monitoring to include body position analysis (► Figs. 3, 4).

Depending on the clinical needs, the standard PSG setup may need to be altered. Variations may include a full 10–20 EEG montage if complex motor phenomena have raised suspicion of seizure disorder. The presence of a vagal nerve stimulator may call for extra leads to capture the firing of the device and inform the reviewer of the influence of this device on the cardiorespiratory signals.⁹ TcpCO₂ is preferred if PAP therapy is anticipated since ETCO₂ is less accurate when ambient in-mask flow rates are high. Often, children with tracheostomy will need to be studied to titrate supplemental oxygen settings or to test if the child will tolerate a capped tracheostomy. Depending on the circumstances, oronasal flow may need to be placed at a tracheal stoma or at the oronasal area based on the expected direction of airflow. Sometimes studies may call for evaluating non-PAP interventions for sleep-disordered breathing, such as body positioning devices or dental appliances. A busy tertiary care center may do well to invest in mobile sleep study equipment for the in-patient setting.

Many sleep centers have forms to elicit posttest feedback. Parental observations as to whether the night was typical for the child (e.g., snored and gasped as usual) or comments on test environment (e.g., awakened by a loud noise from an adjoining room) are critical for the interpreting physician. The standard sleep test report should take this feedback into account. Items to be addressed while reporting include sleep architecture, respiratory, cardiac, and EEG findings, as well as movement events and behavioral observations in accordance with the AASM requirements.⁵

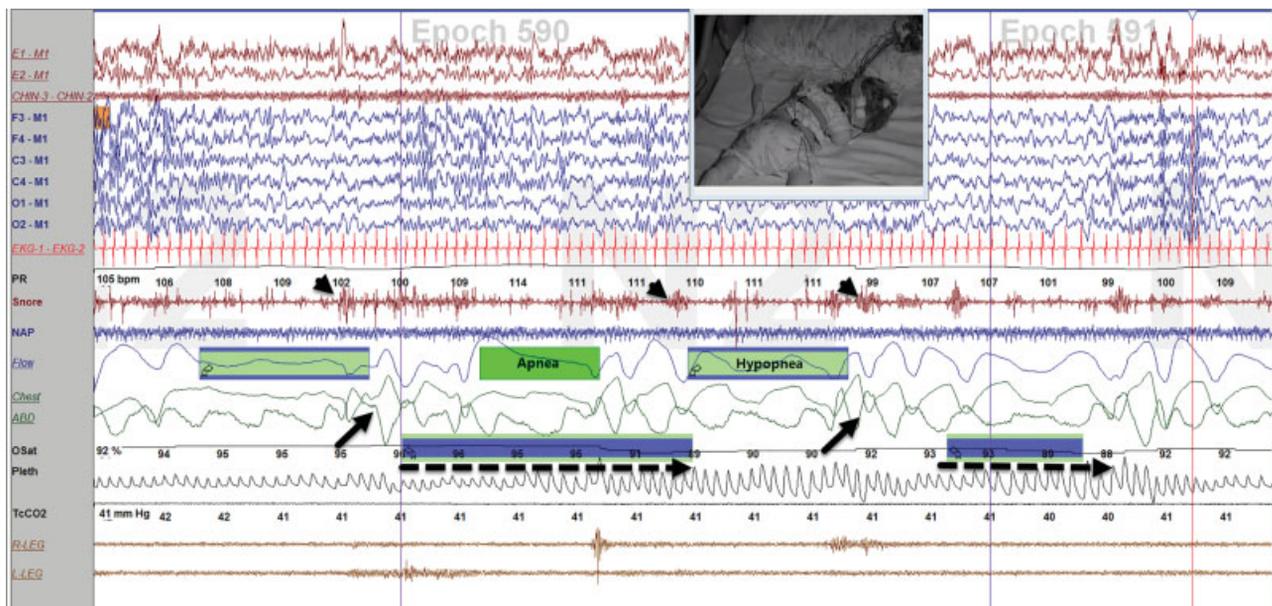


Fig. 3 A 60-second screenshot of a 2-year-old child with achondroplasia straddling the 590th 30-second epoch. On the left margin sequentially displayed channels include eyes (E1, E2); chin EMG; frontal (F3, F4), central (C3, C4), and occipital (O1, O2) EEG; EKG; pulse rate (PR); snore; nasal pressure transducer (NAP); thermistor (flow); thoraco-abdominal effort belts (chest, ABD); pulse oximeter (OSat) and its associated plethysmogram (Pleth); transcutaneous capnometer (TcCO₂); leg EMG (R-LEG, L-LEG). The inset picture shows a video frame snapshot of the child lying prone with a hyperextended neck to protect the patency of his airway. Nevertheless, snoring (arrowheads), paradoxical breathing (solid arrows) and desaturations (broken arrows) are present surrounding the episodes of apnea and hypopnea. The nonfunctioning NAP channel was due to the patient's refusal to wear the nasal cannula. This prompted the sleep technologist to substitute end-tidal CO₂ monitoring with transcutaneous capnometry. EEG, electroencephalogram; EKG, electrocardiogram; EMG, electromyogram.



Fig. 4 A teenage is being “hooked-up” for a polysomnogram. Note the EEG, EOG, chin EMG electrodes are covered with tape or cotton. The respiratory inductance effort belts are snugly but not tightly fitted. There is a pulse-oximeter probe on the left index finger (long arrow). The close-up (inset) picture shows the nasal pressure cannula and thermistor sensor stacked together in the oronasal area (broken arrow). An EKG lead is also in position (short arrow). Also visible is a mark on the center of the forehead from the skin-marking pencil used for the head measurements required for standard electrode placement. EEG, electroencephalogram; EOG, electrooculogram; EKG, electrocardiogram; EMG, electromyogram.

Quality Improvement and Team Building

As in any other center of excellence, quality improvement (QI) must be a day to day aspect of the service. To this end, the posttest feedback form may also be designed to gauge the overall testing experience to help with quality improvement efforts. Of course, evaluating clinical parameters is an important part of the quality improvement process. If the sleep team is unfamiliar with the QI process, training in this area can be very helpful.

Regular meetings with the daytime and nighttime staff go a long way toward building a cohesive team which can deliver an optimal patient experience and care. As the demand for the sleep service grows, a fully staffed pediatric sleep center would do well to include a clinical psychologist to help in the management of childhood behavioral issues, such as behavioral insomnia, poor PAP compliance, and

circadian rhythm disorders. A dedicated sleep nurse and respiratory therapist are very useful components of a comprehensive sleep team. A nurse practitioner or physician assistant can also be a valuable member of the sleep team.

Sleep medicine crosses paths with many other specialties. Wherever possible, collaboration should be built with colleagues in otolaryngology, neurology, pulmonology, dentistry, endocrinology, genetics, as well as craniofacial and plastic surgery. Finally, continuous education of local area physicians and the lay public at large by means of educational talks and media appearances also goes a long way in establishing a well-respected and popular service.

Conclusion

Children and adolescents constitute a substantial proportion of the number of PSGs required by the population. However, in many areas of the country and the world, there are not adequate numbers of beds to perform the required studies. This deficit can be overcome by building more pediatric specific sleep laboratories or by adult sleep laboratories adding the medical, technical, behavioral, and attitudinal skills to perform studies in pediatric patients. To perform sleep studies for these young patients, attention must be paid to many areas. It starts with the location and design of the sleep laboratory. As noted above, safety and technical considerations have important pediatric aspects that should be implemented. It is critical to have staff that enjoys working with children but they must also be trained to take care of pediatric patients. Good policies and procedures will go a long way toward making sure high-quality studies are performed. Finally, engaging in regular QI processes will allow continual improvement and can help keep make sure the sleep team is engaged and highly motivated. All these efforts entail substantial demands and costs, but in the end, providing a highly needed service to children is often enjoyable work and will be fraught with a deep sense of professional satisfaction and fulfillment for the team.

Conflict of Interest

None declared.

References

- 1 Marcus CL, Brooks LJ, Draper KA, et al; American Academy of Pediatrics. Diagnosis and management of childhood obstructive sleep apnea syndrome. *Pediatrics* 2012;130(03):e714–e755
- 2 Nixon GM, Kermack AS, Davis GM, Manoukian JJ, Brown KA, Brouillette RT. Planning adenotonsillectomy in children with obstructive sleep apnea: the role of overnight oximetry. *Pediatrics* 2004;113(1, Pt 1):e19–e25
- 3 Sorenson P, Owens JA. Setting up a child-friendly sleep laboratory. *Sleep Med Clin* 2014;9(02):245–250
- 4 American Academy of Sleep Medicine: standards for accreditation. Updated November, 2016. Available at: <https://aasm.org/resources/pdf/accreditationstandards.pdf>. Accessed October 21, 2018
- 5 Berry RB, Albertario CL, Harding SM, et al; American Academy of Sleep Medicine. The AASM manual for the scoring of sleep and

- associated events: Rules, terminology, and technical specifications. Version 2.5. Darien, IL: American Academy of Sleep Medicine; 2018
- 6 National Conference of State Legislatures: medical liability/malpractice statutes of limitation. March, 2014. Available at: <http://www.ncsl.org/research/financial-services-and-commerce/medical-liability-malpractice-statutes-of-limitation.aspx>. Accessed August 27, 2018
 - 7 Aurora RN, Zak RS, Karippot A, et al; American Academy of Sleep Medicine. Practice parameters for the respiratory indications for polysomnography in children. *Sleep (Basel)* 2011;34(03): 379–388
 - 8 Aurora RN, Lamm CI, Zak RS, et al. Practice parameters for the non-respiratory indications for polysomnography and multiple sleep latency testing for children. *Sleep (Basel)* 2012;35(11): 1467–1473
 - 9 Parhizgar F, Nugent K, Raj R. Obstructive sleep apnea and respiratory complications associated with vagus nerve stimulators. *J Clin Sleep Med* 2011;7(04):401–407