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Sleep Medicine Care Under One Roof: A Proposed Model for Integrating Dentistry and Medicine

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Integrating oral appliance therapy into the delivery of care for sleep-related breathing disorders has been a challenge for dental and medical professionals alike. We review the difficulties that have been faced and propose a multidisciplinary care delivery model that integrates dental sleep medicine and sleep medicine under the same roof with educational and research components. The model promises to offer distinct advantages to improved patient care, continuity of treatment, and the central coordination of clinical and insurance-related benefits.

Keywords: Integrated sleep medicine, dental sleep medicine, delivery of care

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Although sleep science has significantly advanced in the last decade, the delivery of care for sleep-related breathing disorders remains fragmented. Oral appliances in particular have historically been underutilized. This article discusses some of the challenges we have faced and proposes a care delivery model that is designed to integrate the disciplines of dental sleep medicine and sleep medicine. While in the past there has been a natural tendency to build separate "shops" for each specialty (separate-office model), the current emphasis on multidisciplinary care stresses the need to be able to play in the same "sandbox" (care-under-one-roof model). As will be discussed below, this model offers distinct advantages to improved patient care, continuity of treatment, and the central coordination of benefits, both insurance-related and clinical.

Past Challenges to Integrated Care

Reasons for the inability of dental sleep medicine to integrate fully with the delivery of sleep medicine care have been many. First, the growth of dental sleep medicine has not kept pace with the exponential growth of sleep medicine in the treatment of obstructive sleep apnea syndrome (OSA). Dentists who provide appliance therapy for sleep-related breathing disorders are seemingly few in number. Although the American Academy of Dental Sleep Medicine (AADSM) website (http://www.aadsm.org/FindADentist.aspx) lists about 3,000 US dentists as members, only about 200 dentists have obtained diplomate status with the American Board of Dental Sleep Medicine (ABDSM) (http://www.abdsm.org/Diplomates.aspx), and only about a dozen dental practices have been accredited as dental sleep centers. (http://www.aadsm.org/PDFs/AccreditationStandards.pdf). Thus, with the possible exception of using these websites, the thousands of sleep disorders centers (both accredited and non-accredited) in the United States have found no easy way to identify dental sleep medicine experts to whom patients can be referred for evaluation and treatment with oral appliances and for whom the specialized training and experience in oral appliance therapy can be assured.

Second, the lack of education in the specialized use of oral appliance therapy for sleep disordered breathing among dentists and sleep physicians has been a limiting factor.[1] A survey of dentists found that 40% knew little or nothing about oral appliances for treatment of OSA.[2] Moreover, 49 responding dental schools of the 58 US schools recently surveyed reported only 3 hours of total curriculum time devoted to sleep medicine.[3] With the exception of short courses offered by the AADSM, dentists have relied on training from marketing groups often associated with specific appliances and products for sleep medicine. Knowledge of new materials, techniques, procedures, and continuing education has also been attained from dental journals, periodicals, and advertisements. Efforts are under way to formalize dental sleep medicine training in our dental schools. The University of North Carolina School of Dentistry is hosting a conference for dental educators across the United States and Canada to begin the process of developing pre-doctoral DDS and clinical residency programs.

Education to sleep physicians and technologists about oral appliances has been virtually nonexistent. Indeed, there have been recent efforts to train physicians to practice oral appliance therapy at professional meetings. Although this practice raises awareness of oral appliance therapy, it can undermine recognition of the training dental sleep experts undergo to properly evaluate the integrity of the teeth, the surrounding bone, and temporomandibular joints; to obtain accurate impressions and fit removable oral appliances (such as dentures and bite guards) to the teeth; and to minimize negative side effects of their presence.

Third, communications between sleep physicians and dentists have been suboptimal in most healthcare settings. Even in academic settings, interactions between medical and dental

professionals have been limited by their separate and different clinics, patient record systems, administrative priorities, and business models. There has been little need to co-treat patients in the past; thus the infrastructure and administrative support to encourage good communication between medical and dental sleep providers are lacking.

Fourth, the co-treatment of patients with dental clinicians has been viewed as vaguely competitive to some physicians who provide CPAP as the primary treatment modality. This view has likely limited referral of patients for oral appliance therapy. However, a truly successful relationship between physicians and dentists will only be established by close communication and sharing the common goal of patient-centered treatment.

Fifth, referrals to dentists have been discouraged by the lack of, or limited reimbursement for, oral appliances by insurance carriers. Although the AASM recognized oral appliance therapy in 2005 as a potential first-line therapy for mild and moderate OSA and for patients with severe OSA who fail positive airway pressure therapy, many medical insurance carriers (including Medicare) are now only beginning to provide benefits for oral appliance therapy.[4,5] Progress on this front has been slow and severely challenged by (i) claims processing centers that are not prepared administratively to negotiate contracts with, or process claims from, dentists who are treating a medical condition, (ii) dental practices that are unfamiliar with submission of medical insurance claims and the appeal process upon denial, and (iii) reduced reimbursement rates for appliances that may not meet the dentist's costs for high quality oral appliances and the chair time required for comprehensive follow-up care.

Sixth, post-intervention care with oral appliances has left much to be desired. Many patients are reluctant to return to the referring physician for follow-up evaluation of the efficacy of the oral appliance therapy, often citing the costs of another sleep study or its inconvenience as reasons for their reluctance. In one study, only 18% of patients receiving oral appliances underwent polysomnography after the initiation of therapy.[6] For those patients who do return for a follow-up sleep study and for whom there is residual sleep disordered breathing, another sleep study with yet further costs and inconvenience may be indicated after the dentist or patient adjusts the appliance.

Seventh, outcome measures have not been well documented for oral appliance therapy. While some controlled trials have shown improvement in daytime sleepiness and blood pressure on a short-term basis, the impact of oral appliances on cardiovascular disease on a long-term basis remains largely unknown.[7-9] Such data on robust outcomes measures are needed to substantiate the long-term benefit of oral appliance therapy when compared to those of nightly use of positive airway pressure.

Future Demand for Integrated Care

The future of sleep medicine will invariably be influenced by healthcare system reforms to focus more on prevention, multidisciplinary care, and longitudinal disease management in a patient-centered medical home concept. It is, therefore, in the best interest of sleep medicine that a dialogue on innovative improved models of care be reviewed, discussed, and implemented to address the above-mentioned barriers to achieve comprehensive care. We feel that a strong partnership model, based at least initially in academic tertiary care centers, will be able to initiate and to build all aspects of the program including clinical, educational, and research components. Such an integrated model will be able to provide the much needed leadership and backbone that can then successfully form a blueprint for community-based programs.

Our model is based on an integration of the academic center's sleep medicine program (American Academy of Sleep Medicine [AASM]-accredited sleep disorders center) and its dental school to form a partnership in clinical, educational, and research activities and to include the longitudinal collection and analysis of outcome measures. We believe that the unique scope of practice for physicians and dentists can be preserved and business success achieved. Implementation of the model across the country will require a significant and novel commitment of dental schools to educate students in the field of sleep medicine and to demonstrate how the dentist can play a significant role in the success of oral appliance therapy by working closely with sleep physician colleagues.[1]

The Care-Under-One-Roof Concept

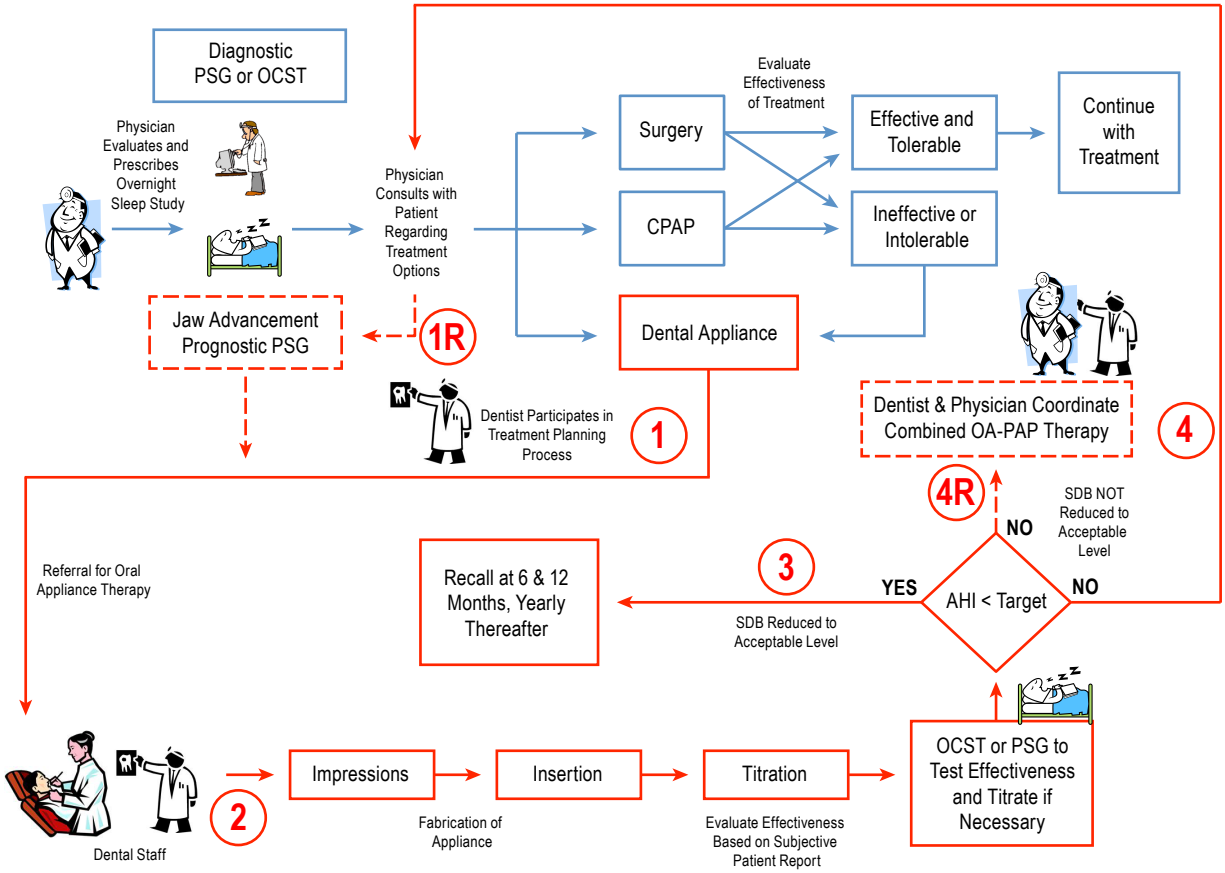
Since fragmentation of care and limited communication have been major stumbling blocks to comprehensive care, we propose a care-under-one-roof ("one sandbox") concept allowing sleep physicians to be in face-to-face contact with dental sleep faculty for discussion of patient care issues pertaining to diagnosis, treatment, follow-up, and to provide the necessary dental care that must be delivered prior to rendering dental appliance treatment. We anticipate that co-treatment of patients in the same facility would raise expectations and clinical successes within the facility and improve patient care. Care-under-one-roof would effectively minimize patient travel from office to office. This would ensure that patients are treated, that patients receive follow-up care and post-treatment evaluation, and that all medical caregivers receive communication on the patient's treatment plan. This approach has been well validated in other disease models and has been shown to improve outcomes.[10,11]

A care-under-one-roof model also provides a ready venue for the practitioners to effectively collaborate. For example, the current AADSM-approved protocol for oral appliance therapy for sleep disordered breathing in adults (http://www.aadsm.org/PDFs/TreatmentProtocolOAT.pdf) includes the possibility of combining positive airway pressure and oral appliances for patients who have a subtherapeutic response to oral appliances alone.[12-14] However this therapy is rarely offered to patients because of the lack of a setting in which the dental (oral appliance and its titration) and medical (PAP and its titration) components can be implemented together or the lack of business plan to bill insurance companies for the combined service. The care-under-one-roof model offers a means to overcome these limitations as well as the venue for the conduct of much needed clinical research on combination therapy.

Preliminary Organizational Structure and Personnel

Any integrative and collaborative model should adhere to accreditations standards set by the AASM. Sleep disorders centers should comply with AASM practice parameters including comprehensive assessment of patients by, or under the supervision of, a board certified sleep specialist (http://www.aasmnet.org/accred_centerstandards.aspx). The Medical Director of the

Figure 1—Schematic diagram of the proposed care-under-one-roof model for integrating dental sleep medicine and sleep medicine within the university-based sleep disorders center



Research components are indicated by dashed lines (see **1R** and **4R**).

center is ultimately responsible for maintaining the standards and assuring quality delivery of all aspects of care. We propose that a faculty member of the dental school who is a diplomate of the (ABDSM) serve as the dental sleep expert at the sleep disorders center. This individual would be expected to develop and streamline dental treatment and assessment while taking into consideration center-specific infrastructure and patient management procedures. However, unlike in the existing separate office model of care, the dental sleep expert would be available on a scheduled basis to consult with patients during their visits to the sleep disorders center and advise on their candidacy for oral appliance therapy. In addition, the dental sleep expert would participate in multidisciplinary staff conferences during which treatment plans for the more difficult-to-manage patients are generated (see **1** in **Figure 1**).

In accord with a patient centric model, the patient after diagnosis of obstructive sleep apnea would be counseled on different treatment options including oral appliances and patient preference taken into account. A study by Krucien et al., using a discrete choice experiment model revealed that patients preferred CPAP 60% and OA 36% of the time.[15] However, the model assumed that oral appliances were effective 40% of the time compared to CPAP (100% of the time)—neither estimate of which is consistent with contemporary literature.[16,17]

Potential candidates for oral appliance therapy would complete a battery of questionnaires and receive a standardized orofacial and dental examination within the comprehensive sleep disorders center. Impressions and records would be taken for fabrication of the dental appliance (see **2** in **Figure 1**). In the nearby dental facility, dental radiographs would be taken as necessary to complete the evaluation.

The patient would return to the sleep disorders center for fitting of the appliance and post-insertion instructions on its use, cleaning, and titration. For the latter, the patient would increase the extent of jaw advancement on a set schedule until his symptoms were eliminated or wear of the appliance became uncomfortable. Titration protocols can be home based, in which titration is done based on patient and family feedback.[18] This technique can take several weeks and has a potential of resulting in incomplete treatment of OA. Because elimination of symptoms does not necessarily guarantee normalization of the apnea-hypopnea index (AHI), out-of-center sleep testing (OCST) or in-lab polysomnography may guide additional advancement of the jaw.[17,19,20,21] OCST may be considered in patients for whom OCST is appropriate, as described by AASM practice parameters.[22] The use of OCST is also recognized in the current AADSM approved protocol for oral appliance therapy for sleep disordered breathing in adults (http://www.aadsm.

org/PDFs/TreatmentProtocolOAT.pdf). Thus, in the proposed model the patient would be scheduled for administration of OCST by the sleep disorders center or in-lab polysomnography at the sleep disorders center, once adjustments in the appliance to eliminate the patient's symptoms had been made. Published studies have shown that a higher proportion of patients can be treated effectively if the custom-fabricated oral appliance is adjusted during an overnight sleep study.[17,20,21]

Patients who respond to OAT with AHI normalized as determined during OCST or polysomnography reevaluation, would be seen for routine follow-up in the sleep center in 6 months, 12 months, and yearly intervals thereafter in accordance to recommendations of the AASM practice parameters (see **3** in **Figure 1**).[4] On the yearly visits, the patient would be seen by the dental team and the sleep center healthcare professional, who would evaluate compliance with therapy and assure continuity of medical care.

Patients whose sleep disordered breathing could not be corrected solely with an OAT would be reevaluated for CPAP or surgical procedures (see **4** in **Figure 1**) or undergo CPAP titration while wearing the dental appliance (see **4R** in **Figure 1**). Because the jaw is stabilized in a forward and upward position, the effective pressure may be less than that required without an appliance, thereby decreasing pressure-related patient complaints.[13,14] Moreover, support for nasal pillows or a mask can be obtained directly from the appliance, eliminating all straps and contact with the patient's face except for the nasal or perinasal region.

There are other advantages to patient care of an integrated care-under-one-roof delivery model. There is growing interest in determining which patients are good candidates for oral appliance therapy prior to treatment. Cephalometric measurements may help predict patients who may benefit from OA.[23]

Alternatively, in-lab "prognostic" titration has been shown not only to produce rapid results but can also be helpful in predicting patient response.[24-27] During the titration study, the teeth are engaged by upper and lower trays of impression material that can be slid apart manually or by remote control to advance the mandible. The goal is to determine if the patient's sleep disordered breathing can be alleviated by jaw advancement and to estimate the extent of advancement required. The procedure is anticipated to be particularly important in the assessment of patients who have failed CPAP repeatedly and who have been considered poor candidates for oral appliance therapy based on other factors such as a high BMI.[28] The authors are already investigating this newly validated approach to patient care and have included it as a research component for select patients in the care-under-one-roof model (see **1R** in **Figure 1**).

Patients may also be offered a trial of jaw advancement using a less expensive boil and bite appliance, before a custom-fabricated appliance is suggested.[29] We feel that prognostic sleep studies and temporary oral appliances can be successfully used to determine the efficacy of jaw advancement and acceptance by a segment of patients before ordering a more expensive permanent appliance. For example, temporary appliances are indicated for patients who are undergoing dental treatments over an extended period of time. However, custom-fabricated appliances have been shown to be more efficacious and compliance is higher.[29,30]

Safety and Compliance Monitoring

Safety and compliance monitoring would be conducted every 4-6 weeks after an appliance is delivered until treatment efficacy and patient adherence have been established. In addition to compliance, patient adverse effects would be documented and addressed by the attending dental sleep expert. Noncompliance (compliance being defined as $\geq$ 4 h use for $\geq$ 70% the nights) or failure due to intolerance of oral appliance therapy would trigger an alternative treatment strategy in consultation with the sleep specialist. These might include hybrid therapy, PAP therapy, or surgical intervention in select cases. A sleep specialist would manage any concomitant sleep disorders, which a patient may have to avoid overlap of visits. Cardiovascular and cognitive markers would be recorded for outcome data analysis and quality control.

Outcomes Measures

We recommend outcome measures form the backbone of the proposed model's care of patients with obstructive sleep apnea. Outcome measures would serve as benchmarks for quality assurance and improve our understanding of the natural history of the disease with different interventions. Several outcome measures would be evaluated for quality assurance including compliance (patient-reported until reliable low-cost objective measures can be obtained), post intervention reductions in the AHI and excessive daytime sleepiness (e.g., Epworth Sleepiness Scale) and improvements in scales of neurocognitive functioning (e.g., psychomotor vigilance testing). Recently, mouth temperature-sensing compliance-monitoring chips embedded in oral appliances have been shown to be useful in recording hours per night and nights per week of therapy.[31] This technology will provide oral appliance data similar to compliance monitoring of positive airway pressure therapy. Long-term follow-up and monitoring of blood pressure, cardiac and cerebrovascular events, and mortality would be undertaken, so that the benefits of oral appliance and positive airway pressure therapies can be compared. A concomitant surveillance of adverse effects (both short-term and long-term) would be documented.

Educational Activity

The integrated care-under-one-roof model provides educational opportunities at all levels consistent with the mission of the medical and dental schools of the faculty working at the sleep disorders center. The weekly multidisciplinary conferences would provide a forum for cross-training of medical and dental personnel as well as other healthcare professionals present (e.g., otorhinolaryngology and pulmonary medicine). Dental school residents (particularly those in general practice residency programs, advanced education in general dentistry programs, and orofacial pain residency programs) would be given the opportunity to rotate in the sleep disorders center to practice the dental sleep medicine skills taught at the dental school by both medical and dental faculty. Fellows at the sleep disorder center and the dental residents would present clinical cases during ground round presentations with literature reviews. It is anticipated that sleep medicine education would eventually be incorporated into the pre-doctoral M.D. and D.D.S. curricula. Opportunities would develop for continuing education of physician and dentists in private practice, as well as for sleep tech-

nologists and respiratory technicians providing CME, CDE, and CEU credits, as appropriate.

Research

The establishment of a strong and productive integrated care-under-one-roof program would naturally motivate research activities. The collection and analysis of outcome measures for oral appliance therapy from short-term efficacy to long-term compliance and impact on medical comorbidities of untreated OSA would be most vital. Clinical trials on combined oral appliance/positive airway pressure therapies are needed and would be made readily possible with a single healthcare visit. Depending on infrastructure and support, we suggest that research from outcome measures, prospective trials on combined therapies, and therapy compliance be a mission of the integrated care-under-one-roof program.

Maintaining Defined Scopes of Practice

There are specific Medical and Dental Licensing Laws and Practice Acts, which dictate the scope of practice for physicians and dentists (http://www.aasmnet.org/resources/pdf/AADSMJointOSApolicy.pdf). As per individual state law, laws only a licensed physician can make a diagnosis and treatment plan for sleep disordered breathing. Similarly, a dentist's scope of practice includes evaluating the candidacy of patients for oral appliance therapy as well as construction and fitting of the appliances. The proposed "care-under-one-roof model" will be structured within the practice parameters established by the AASM.[4] Updated practice parameters are currently being prepared by the AASM for publication.[32]

Responsibilities of sleep physician specialist:

1. Assess patients with sleep-related complaints.
2. Order appropriate diagnostic tests and diagnose obstructive sleep apnea.
3. Discuss treatment options with the patient based on practice parameters and standard of care guidelines.
4. Counsel on behavioral therapy, sleep hygiene, weight loss, and driving precautions.
5. Manage concomitant sleep disorders which often accompany OSA, such as restless legs syndrome (RLS)/periodic limb movement disorder (PLMD), circadian rhythm disorders, and insomnia.
6. Follow and document comorbid conditions and impact of treatment on hypertension, diabetes, heart failure, arrhythmia, and neurocognitive function.
7. Engage in active consultation with staff dental sleep expert on treatment plan.
8. Participate in periodic multidisciplinary rounds and conferences.
9. Provide follow-up sleep testing after OSA therapy has been instituted.
10. Provide ongoing and routine follow-up patient care.

Responsibilities of staff dental sleep expert:

1. Evaluate patients for dental sleep medicine therapies.
2. Discuss treatment options (mandibular advancement splints, combination MAS/PAP therapy, tongue retaining device, maxillofacial surgery, etc.).
3. Manage coexistent dental disorders, such as bruxism.
4. Counsel on dental hygiene and daily maintenance of oral appliances.
5. Follow-up patients every 4-6 weeks until treatment efficacy and patient adherence to therapy have been established.
6. Review compliance and manage potential complications or adverse effects of therapy.
7. Maintain communication with sleep physician specialist for outcome measures monitoring.
8. Assess the need for change in treatment, or repeat PSG for either re-titration or resolution of sleep disordered breathing.
9. Establish protocols at the sleep disorders center on oral device titration, technician training, consent procedure, off-hour call coverage issues.
10. Participate in periodic multidisciplinary rounds and conferences.
11. Provide ongoing and routine patient follow-up care.

Business Model

Sustainability of the integrated care-under-one-roof model would depend on development of a business model that can successfully address the financial challenges faced by many dentists today who provide oral appliance therapy. Ideally, the sleep clinic administration would negotiate contracts with medical insurance companies for the dental providers in much the same way the physicians are enrolled to deliver contracted services and are credentialed as providers. The clinic office would ideally handle preauthorization and file insurance claims for the dental component of the patient's evaluation and treatment. A single, unified electronic medical record (EMR) system would be used by all providers. Financial sustainability would be made possible, in part, by the efficiency of care delivery and the quantity of care delivered. The dental sleep expert may be able to bill for his services provided to the patient at the sleep disorders center even if seen on the same day as the sleep specialist, as services provided are different and performed by two different specialists.

The care-under-one-roof model raises legal concerns that would need to be addressed to comply with individual state and federal laws. For example, dentists in some states are bound by a "corporate practice" doctrine, which prevents non-dentists from owning any part of the dental practice. Moreover, compliance with the federal Stark laws also require that the referring physician have no financial interest in any business that provides positive airway pressure (CPAP provider) or oral appliance (dentist), as both are viewed as durable medical equipment (DME) providers by the Centers for Medicare and Medicaid Services. However, several large hospitals and institutions now have DME services and can provide integrated care-under-one-roof with appropriate safeguards. Due to these limitations, we believe that this model is best suited initially for use in an academic/institutional setting with a community-based model evolving from the experience of these centers.

Community-Based Non-Academic Model

Although the above model is proposed with academic institutions in mind, this model can be adapted for non-academic

centers. We propose that this collaboration take place in AASM-accredited sleep disorders centers. Board-certified sleep physicians at the center should form alliance with dedicated dental practitioners who have adequate training in sleep medicine and are motivated to serve this population. The dental expert should have scheduled clinic hours at the sleep center where a comprehensive dental evaluation may be performed. Dentist "chair" is a small investment which the sleep center or the dentist has to make (a refurbished chair can be obtained for around $3,000.00). The use of radiographs is essential to the treatment decision (http://www.aadsm.org/PDFs/TreatmentProtocolOAT.pdf), but these can be obtained from the patients' general dentists. Many dentists have digital offices and therefore are able to email the radiographs upon patients' permission. This will all be done in conjunction with a comprehensive dental exam, periodontal screening, muscle evaluation, TMJ evaluation, and review of medical history.

From a business perspective, the sleep center charges the dental sleep expert for renting space and equipment. The dental sleep expert, by his presence and expertise, determines which patients are good candidates for OA. The dentist utilizes the center's expertise to titrate patients either by OCST or in-lab titration, and in long-term follow-up.

Oral appliances for OSA are considered durable medical equipment, so several models out in the real world can exist. Under one model, the sleep center provides DME, and the dentist is contracted to provide under the DME services of that group. This model allows the DME company to bill on behalf of the dentist for those services. Other models have the dentist with their own DME, then provide services and bill for their services. The advantage of the dentist contracting under the sleep center DME is that most of these DME companies already have insurance contracts in place to provide CPAP, another DME item. It is then easy for the contracts to be extended to oral appliances.

While the reimbursement for OA is varied, it is a covered benefit to most patients with private insurance. Medicare has also come on board in reimbursing for these appliances with fairly strict coverage and mandating delivery by a dentist.

We feel this model will not only improve patient care and comfort, but it is also financially viable and professionally satisfying.

CONCLUSION

Integrating oral appliance therapy into the delivery of care for obstructive sleep apnea syndrome has been a challenge and few effective models exist so far. It is imperative that the sleep medicine community develops a realistic and effective model of this underutilized but promising treatment modality. We believe that the best structure is to integrate dental sleep medicine with the sleep disorders program is via a care-under-one-roof concept. Training, communication, education, marketing, and evaluating outcome data are vital. Such centers of excellence at academic institutions are best suited to lay this foundation. These institutional centers can provide care in their community as well as serve as a model of integrated care delivery for sleep medicine throughout the country in non-academically based sleep centers.

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DISCLOSURE STATEMENT

This was not an industry supported study. Dr. Sharma served on the Speaker Bureau of Actelion and Gilead pharmaceuticals and has a portable sleep device grant from Cadwell Industries. Dr. Essick has received devices for research on loan from SleepImage and from Airway Management, Inc. He has also received teaching materials at no charge from Airway Management, Inc. and serves as the chair of the Research and Ethics Committees of the American Academy of Dental Sleep Medicine. Dr. Schwartz is on the Academy Faculty of Somnomed. Dr. Aronsky serves on the Board of Directors of the American Academy of Sleep Medicine.