Obstructive Sleep Apnea: Feasibility of a Disease Management Strategy Utilizing Primary Care Case Finding

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Obstructive sleep apnea (OSA) is a prevalent disorder, affecting 2% to 4% of the adult population [1]. It is characterized by recurrent apneas and hypopneas during sleep with resultant oxyhemoglobin desaturations and sleep fragmentation. The clinical sequelae of OSA may be severe and include daytime hypersomnolence, cognitive impairment, systemic and/or pulmonary hypertension, myocardial infarction, cardiac arrhythmias, stroke, and increased risk of motor vehicle accidents [2]. The economic consequences of OSA are also significant, with costs of care for undiagnosed patients twice that for age- and sex-matched controls [3]. Although OSA and other sleep disorders have received recent media attention, the detection and management of OSA by primary care practitioners appears suboptimal. Physicians generally have varying amounts of knowledge about OSA [4], and the majority of patients with OSA go unrecognized and untreated [5,6].

Increasingly, disease management strategies are being used for a variety of disorders. A disease management program is most effective when there is a high prevalence of the targeted disorder, a need for integrated guidelines, a high cost of treatment (or lack of treatment), a lack of certainty regarding “best practices,” and the need to track and improve patient outcomes [7]. OSA is an ideal disorder for application of a disease management approach given its high prevalence, the wide variability in diagnostic and treatment approaches, and the high costs associated with both diagnosis and treatment (particularly surgical options) and underdiagnosis and no treatment.

We developed a disease management strategy targeting OSA that focuses on the identification of patients at risk in the primary care setting, the performance of diagnostic polysomnography, and the institution of appropriate interventions. This paper reports on our pilot test of this program.

Methods

Three internal medicine practices associated with the University of Pennsylvania Health System (UPHS) agreed to participate in the program. UPHS is an integrated academic health system that serves a large patient population within the greater Philadelphia area. The Hospital of the University of Pennsylvania, located in West Philadelphia, serves not only a local urban population but also functions as a regional tertiary care center. The other area hospitals, 2 multispecialty facilities, and an affiliated primary care provider network are located in both urban and suburban settings, serving patients from various socioeconomic backgrounds. Eight primary care physicians from the 3 practices were involved.

The Penn Center for Sleep Disorders is a clinical center within the UPHS staffed with faculty with clinical expertise in pulmonary medicine, neurology, psychiatry, otolaryngology, and oral-maxillofacial surgery. Most patients seen at the center are referred by an UPHS primary care provider. A group from the sleep center consisting of 1 or 2 physicians and a nurse met with each practice to provide an overview of the disease management program. Physicians were asked to identify patients at risk for OSA by using a case identification strategy consisting of 4 symptom questions and 2 physical examination findings (Table 1) and to refer patients meeting criteria to the Penn Center for Sleep Disorders for evaluation and appropriate intervention.

All patients coming for an office visit were asked to complete the 4-item symptom questionnaire in the physician’s reception area. The physician then performed a physical examination and evaluated the patient’s responses on the questionnaire. If 2 or more symptom questions were answered positively, the patient was referred for a polysomnogram. If only 1 symptom question was answered positively, then at least 1 physical examination finding needed to be present to refer the patient for a polysomnogram. Patients younger than...
18 years or with a prior documented history of a sleep disorder were excluded from the study.

One-night polysomnography was performed at the Penn Center for Sleep Disorders using a Nihon Kohden Model EEG 4418 A/K polygraph (Nihon Kohden Corp., Tokyo, Japan) or the Sandman Computerized System with MMC amplifier (Melville Diagnostics, Ottawa, Ontario, Canada). The polysomnogram was performed within 2 weeks of the patient’s referral to the sleep center. A standard protocol was used with a 7- to 8-hour opportunity for sleep. During the sleep studies, standard parameters were monitored including central, occipital, and frontal electroencephalograms; right and left electrooculograms; chin electromyogram; right and left anterior tibialis electromyogram; nasal and/or oral airflow (single port nasal thermistors [Nihon Kohden America Inc., Irvine, CA] or oral single channel thermocouples [Protech Services, Woodsville, WA]); chest and abdominal wall motion (RESP-EZ belt [EPM Systems, Midlothian, VA]); electrocardiogram; snoring, with a microphone attached to the lateral surface of the thyroid gland; and oxyhemoglobin saturation (SaO₂) (Ohmeda Biox 3700 pulse oximeter, Boulder, CO). The polysomnograms were scored by a registered polysomnographic technologist according to the criteria of Rechtschaffen and Kales [8] using 30-second epochs. The following definitions were used: (1) apnea—cessation of airflow for greater than 10 seconds; and (2) hypopnea—a reduction in airflow of at least 50% associated with a greater than 4% decrease in oxyhemoglobin saturation and/or an arousal. Patients who appeared to have apneas or hypopneas during the initial portion of the study underwent a split-night polysomnogram in which the diagnosis of OSA was made during the first half of the study and an appropriate continuous positive airway pressure (CPAP) was determined that abolished respiratory events and maintained the oxyhemoglobin saturation above 90% during the second half of the study. Patients with no or relatively few apneas or hypopneas under went a baseline polysomnogram without the application of CPAP. An accredited clinical polysomnographer scored each sleep study. Parameters derived from the polysomnography included the respiratory disturbance index (RDI), defined as the mean number of apneas and hypopneas per hour of sleep, and SaO₂ nadir during sleep. A sleep physician interpreted each polysomnogram.

Patients were seen at the sleep center outpatient practice 1 week after polysomnography. A complete history was taken, a general physical examination performed, and results of the recent polysomnogram were reviewed with the patient. For patients without OSA (RDI < 5), treatment options for snoring were discussed with those patients who snored and who wanted this symptom addressed. For patients diagnosed with OSA (RDI ≥ 5), CPAP therapy and other treatment options were discussed and a therapeutic plan implemented.

Patients who received CPAP therapy were contacted by telephone by a registered nurse prior to beginning CPAP; at 24 to 48 hours after initiation of CPAP; within 1 week of starting CPAP; and at 1, 2, 3, 6, and 12 months after starting CPAP. Patients were asked about hours of use, air leaks, any snoring while on CPAP, symptoms related to CPAP use (ie, nasal congestion, rhinorrhea, and dry mouth), and resolution of presenting complaints (snoring, snorting/gasping, and/or excessive daytime somnolence). Additionally, the home care companies involved in the CPAP set-up at patients’ homes provided adherence data by objectively reporting the hours of use to the sleep center nurse. Patients returned to the sleep center for a follow-up visit with the sleep physician 1 month after starting CPAP therapy.

Patients who did not like or tolerate CPAP during the split-night polysomnogram received information about alternative treatment options including weight loss, upper airway surgery (including uvulopalatopharyngoplasty [UPPP] and laser-assisted uvuloplasty), and the use of an oral appliance. Those interested in these treatment options were referred to a UPHS otorhinolaryngologist, oral-maxillofacial surgeon, or to a weight loss program via their primary care physician. Selection of treatment alternative was based on patient preference and consideration of the patient’s craniofacial and oropharyngeal anatomy.

All patients diagnosed and treated for OSA were seen at the sleep center 6 months after their polysomnogram, and their symptomatic improvement was followed clinically. Primary care physicians received the sleep study report and a letter from the sleep physician each time their patient was seen in the sleep clinic.

**Results**

Between July 1997 and December 1998, 12 men and 14 women met case identification criteria and were referred for polysomnography. We did not determine the total number of patients who were given questionnaires or who refused them. Mean ± SD age was 61 ± 10 years for men and 62 ± 13 years for women. Mean body mass index (BMI) did
not greatly differ between the 2 groups (men, 32.7 ± 7.5 kg/m²; women, 34.1 ± 7.1 kg/m²). Patient demographic data are summarized in Table 2.

All 26 patients underwent polysomnography. The mean RDI for all patients was 16 events/hour. Men had a greater mean RDI (20 events/hour) than did women (12 events/hour). Of 26 patients, 15 (7 men and 8 women) had a positive polysomnogram as defined by a RDI of > 5 events/hour [9–11]. Among these patients, the mean RDI was 25 events/hour, with men having a greater RDI (33 events/hour) than women (19 events/hour). Eleven patients had a negative polysomnogram. Results are summarized in Table 3.

The sensitivity and specificity of each question or physical finding used in our case identification strategy was calculated, and the results are shown in Table 4. For these calculations, OSA is considered to be present when the RDI is ≥ 5 events/hour and absent when the RDI is < 5 events/hour. No single question or physical finding had both high sensitivity and specificity. Excessive daytime somnolence (EDS) was notable for a sensitivity of 100%; however, the specificity was only 18%. Obesity alone had a sensitivity of 80% but a specificity of only 27%. Conversely, witnessed apneas had a high specificity (91%) but a low sensitivity (20%). Similar results were noted when combinations of symptoms and/or physical findings were evaluated (Table 4). When obesity was combined with symptom questions, specificity increased but sensitivity decreased. The overall positive predictive value of the case identification strategy was 58%.

A variety of treatment options was utilized for the 15 patients diagnosed with OSA (Table 5); 1 patient (RDI, 5) refused treatment. Six patients opted for CPAP, 4 were referred for an oral appliance, 2 began a weight loss program, and 1 underwent tonsillectomy. The most severely affected patient in the study (RDI, 83) underwent a combined UPPP and genioplasty after a brief trial of CPAP therapy. Of the 6 patients who began CPAP therapy, only 3 were using this modality at 1 year, with 1 of the 3 using it inconsistently; 2 patients stopped using the CPAP and refused further therapy, and 1 initial CPAP user was subsequently fitted for an oral appliance and used it consistently. Of the 4 patients initially referred for an oral appliance, 2 decided not to utilize this treatment option and were lost to follow-up. One patient used her oral appliance consistently and 1 patient died prior to receiving his oral appliance. Of the 2 patients in the weight loss group, one lost 7 kg and the other gained 5 kg. Overall, 14 patients with OSA were initially referred for treatment, but after 1 year, only 8 had received or were receiving treatment.

### Discussion

Our study demonstrates the feasibility of applying a disease management approach to improve the identification and treatment of OSA. Using a simple case finding strategy to identify patients at risk, primary care physicians referred patients to a sleep center where diagnostic polysomnograms were performed within 2 weeks and study results and therapeutic options were discussed and instituted within 3 weeks after case finding.

Distribution of treatment modalities employed by the patients in our disease management program differed from that typically seen in a sleep clinic population. CPAP is the most common treatment modality utilized by sleep clinics; in contrast, only 6 of 15 OSA patients elected to utilize CPAP therapy in our study. This may be due to the fact that our case identification strategy detected patients with milder disease than those typically presenting to a sleep disorders clinic.
Our case finding strategy was not highly specific: only 15 of the 26 patients who met referral criteria had an RDI ≥ 5 events/hour. Further refinement of this risk assessment strategy is needed. However, the program did appear to enhance physician awareness of OSA, with referrals for sleep evaluations continuing long after the pilot program had concluded. Hence, by requiring the primary care physicians to use the case identification scenario repeatedly, the OSA disease management program served as an educational tool for the primary care physicians in the program.

Despite the significant clinical sequelae of untreated OSA, primary care practitioners are not always effective at identifying and treating the disorder. Haponick et al [12] examined the history-taking behavior among 3 physician groups (experienced primary care physicians, medical interns, and medical interns who had received prior instruction regarding sleep disorders) using interviews with simulated patients. They found that 13% of the medical interns and none of the primary care practitioners asked about sleep, but of those interns who received prior sleep instruction, 82% asked about sleep. The authors concluded that focused training about sleep could influence physician behaviors. A study by Collinson et al [4] evaluated the level of awareness about sleep apnea among primary care providers and specialists in Alberta, Canada, using a 36 true-false–item questionnaire. The range of knowledge was quite variable, with the most influential predictor of sleep apnea knowledge being the number of years since completing an internship. The second best predictor of sleep apnea knowledge was the number of people with sleep apnea known to the physicians queried. There was no significant difference in sleep apnea awareness between primary care practitioners and specialists. The authors concluded that more sleep apnea education was necessary for physicians at all levels. Both studies imply that further education is essential for the identification of sleep disorders by physicians.

In the Walla Walla Project [13], sleep disorder experts from the Stanford University School of Medicine provided local physicians in Walla Walla, Washington, with the education, equipment, and technical expertise to identify and care for patients with sleep apnea in the community. Two local physicians devoted extra time to sleep disorders education and evolved into local sleep consultants. In the first 2 years, diagnostic testing increased nearly eightfold, from 0.27% to 2% of all patients seen by the local primary care practitioners tested; 77% of patients tested were found to have OSA. The Walla Walla model brings sleep expertise to communities where it would not otherwise be available and relies on several local physicians to assume the role of “sleep experts.” It therefore seems most useful for smaller, rural communities and less useful for suburban or urban communities where sleep expertise is more widely available. Our disease management strategy, which provides a framework for the detection of OSA by the primary care provider and directs referrals to a sleep laboratory, may be more generalizable given the tertiary care/referral model that is more commonly in use.

Our study has some limitations, including a small sample size. However, this study was intended only as an initial feasibility study. Another limitation was that polysomnography was not performed on the primary care patients who completed questionnaires but did not fulfill the initial case identification criteria. Thus, an overall positive predictive value was obtained for our case identification strategy, but overall negative predictive value, sensitivity, or specificity was not determined. Finally, the sensitivities and specificities of the symptom questions and physical findings (both individually and in combination) were quite variable. These findings are consistent with results from other screening strategies using questionnaire data alone [14–16]. The addition of risk factors (particularly BMI) to symptom questionnaires improves the predictive values of a variety of screening models for OSA [17–23].

Kushida et al [24] developed a predictive model for OSA that assesses craniofacial dysmorphism, an independent risk factor for the development of OSA. The model incorporates BMI, neck circumference, and 4 oral cavity measurements. Their results demonstrated a sensitivity of 97.6%, specificity of 100%, positive predictive value of 100%, and negative predictive value of 88.5%. The authors concluded that the model has clinical utility and predictive value for patients in whom OSA is suspected and proposed that primary care physicians use the model as a screening tool to decide which patients should be referred to sleep centers for the evaluation of possible OSA. However, the high sensitivity, specificity, and predictive values obtained may be due to bias. The area-under-the-curve (AUC) values for the receiver-operating characteristic curves in the morphometric study were 0.996 for the morphometric model and 0.938 for BMI alone. Thus, the morphometric information actually added little information to that obtained from the BMI alone. In comparison with other studies [17,22], the

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No. of Patients</th>
<th>Mean RDI events/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>CPAP</td>
<td>6</td>
<td>30.3</td>
</tr>
<tr>
<td>Oral appliance</td>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>Weight loss</td>
<td>2</td>
<td>8.5</td>
</tr>
<tr>
<td>Tonsillectomy</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>UPPP/ genioplasty</td>
<td>1</td>
<td>83</td>
</tr>
<tr>
<td>Refused</td>
<td>1</td>
<td>5</td>
</tr>
</tbody>
</table>

CPAP = continuous positive airway pressure; RDI = respiratory disturbance index; UPPP = uvulopalatopharyngoplasty.
AUC values for BMI alone were much higher in the morphometric study than previously reported values of 0.7258 [22] and 0.734 [17]. This suggests that the apneic subjects in the morphometric study were significantly more obese than the nonapneic subjects, thus introducing significant bias.

It is essential to consider the constraints placed on primary care providers before involving them in any type of screening strategy. In the current medical milieu, primary care practitioners have a limited amount of time to spend with individual patients. In addition, they are under increasing pressure to implement multiple disease management programs. Therefore, a screening strategy should be very simple and require minimal time to implement (perhaps 1 to 2 minutes at most). The morphometric model of Kushida et al [24], which incorporates BMI, neck circumference, and 4 oral cavity measurements, takes approximately 5 minutes to perform. A very simple case identification strategy such as the one utilized in our study may be more convenient to use in a busy primary care office. The challenge remains to further refine the case identification criteria to improve sensitivity and specificity while keeping the instrument simple to administer by a primary care provider. Further directions for an OSA disease management program include developing physician and patient education initiatives, improving CPAP adherence, and assessing short- and long-term clinical outcomes.

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**References**


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