Study Objectives: We sought to evaluate whether a targeted obstructive sleep apnea (OSA) consult (TOSAC) protocol that reduced sleep-specialist time spent with patients suspected of having OSA would improve quality of care compared with the previous clinical method for evaluation of patients internally referred for suspected OSA.

Methods: Prospective cohort design. TOSAC patients received oximetry and criteria screening prior to a split-night polysomnography and a 45-minute sleep-specialist consult, while control patients received consult, testing, and a follow-up visit (90 minutes of sleep-specialist time).

Results: We enrolled 186 TOSAC and 94 control patients. TOSAC patients completed their evaluation in a median of 7.0 days compared with 60.0 days for the controls (p < .001). At baseline, the TOSAC group was sleepier (Epworth Sleepiness Scale 13.9±4.5 vs 11.0±4.3; p < .001) and had a slightly lower quality of life (Functional Outcomes of Sleep Questionnaire 15.0±3.0 vs 16.8±2.2, p < .001) than controls. The apnea-hypopnea index noted at polysomnography was similar in TOSAC and control patients (28.6±29.5 vs 23.1±23.9, p = .156), and the prevalence of OSA was similar in both groups (75% vs 72%, p = .616). At 1 month of therapy, improvement in the Epworth Sleepiness Scale and overall patient satisfaction were similar between groups (all p > .10), while TOSAC patients had a slightly greater improvement on the Functional Outcomes of Sleep Questionnaire (p = .010). TOSAC patients reported better subjective continuous positive airway pressure compliance (median 42.0 vs 32.5 hours/week; p = .037).

Conclusions: A protocol-driven evaluation pathway for OSA that used screening with oximetry and less sleep-specialist time shortened access and produced similar diagnoses, improvements in sleepiness and quality of life, and overall satisfaction.

Keywords: Sleep apnea, sleep disorders, outcomes, clinical practice

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In contrast, the existing care model provided a 1-hour consult appointment, testing where indicated, followed by a 30-minute follow-up visit to review results and treatment recommendations (Figure). The TOSAC could potentially result in a 50% reduction in specialist time spent with patients, compared with the usual process.

We wanted to ensure that this change in practice did not result in a decline in quality of patient care or patient satisfaction. We conducted a trial to evaluate the impact of a TOSAC on measures of quality and satisfaction. The hypotheses of the project were (1) that the use of a TOSAC for patients internally referred for OSA would reduce the length of sleep apnea consultation times and improve access to clinical services in the Sleep Disorders Center and (2) that the standardized evaluation and patient education (TOSAC) would improve quality of care (as measured by changes in sleepiness, quality of life, and patient satisfaction), compared with the previous method for evaluation of patients internally referred for suspected OSA by reducing variability in medical practice.

METHODS

The study was approved by the Institutional Review Board of the Mayo Foundation in accordance with federal laws, and patients provided informed consent to participate in our evaluation. Patient recruitment began after the TOSAC was advertised among internal medicine divisions that had been our most frequent referrers (general internal medicine, cardiovascular diseases, pulmonary medicine, and endocrinology). Requests from these divisions for the TOSAC were accommodated on a priority basis. Other internally referred patients suspected of having OSA from any division were evaluated using the traditional appointment model and served as a comparison group.

There were 4 main components of the TOSAC:

1. A triage oximetry was performed on all patients for whom a TOSAC was requested using the Nonin 2500 oximetry device (Plymouth, Minn). This device stores data every 4 seconds, with a sampling rate of 75 per second and a display update every 4 seconds. Data collection included the mean oxygen saturation (SaO₂) and the total number of desaturations ≥ 4%, as well as the total recording time of the study. Artifactual data were excluded from analysis. Our oximetry criteria were designed to exclude patients with severe hypoventilation and very mild OSA. We required a mean SaO₂ ≥ 90% and an oxygen desaturation index > 5/hour.

2. The following day, nurse triage assessment was performed to ensure inclusion and exclusion criteria were met; assess any special patient needs; and provide video-assisted education regarding the nature of OSA, sleep testing, and CPAP therapy. The inclusion criteria were (a) an Epworth Sleepiness Scale (ESS) > 10 (a measure indicating pathologic sleepiness)14 (b) clinical suspicion of OSA, and (c) the patient was able to stay for evaluation. The exclusion criteria were (a) prominent insomnia complaints, (b) prominent parasomnia symptoms, (c) use of domiciliary oxygen or assisted breathing devices, (d) current congestive heart failure or history of cardiomypathy, (e) any degenerative neurologic or muscular diseases, or (f) any previous sleep evaluation or recommendations of CPAP therapy. If criteria were not met, patients were recommended to avail themselves of the next available regular sleep-specialist consultation appointment. At the time of the initial nursing triage visit, weight, height, blood pressure, heart rate, neck circumference, ESS, history of habitual snoring, witnessed apneas, near-miss or actual automobile accidents, and quality of life assessment using the Functional Outcomes of Sleep Questionnaire (FOSQ) were recorded.15

3. Sleep testing was preplanned to be a “split-night” protocol. Polysomnography was performed using a digital polygraph (NCI-LAMONT Medical Inc., Madison, WI) according to standard techniques, and sleep staging and arousals were scored using 30-second epochs.16-18 Apneas and hypopneas were scored, with apneas defined as cessation of flow for at least 10 seconds and hypopneas being visually significant declines in flow of at least 10 seconds duration accompanied by at least a 4% oxyhemoglobin desaturation from the local baseline saturation. Arousals were considered as caused by respiratory causes if associated with apneas or hypopneas or with other indicators of airflow limitation or if desaturations accompanied the arousal but did not meet criteria for apneas or hypopneas. Each study was started as a diagnostic study and continued for a minimum of 2 hours of sleep. At this point, a trial of CPAP was begun if there was either (a) an apnea-hypopnea index (AHI) ≥ 5 (AHI = number of apneas plus hypopneas per hour of sleep) or (b) 10 or more respiratory-related arousals per hour of sleep. A CPAP titration was considered successful when a pressure was found that eliminated obstructive apneas, hypopneas, respiratory-related arousals, and snoring and, if on treatment, rapid eye movement sleep had been observed.

4. A 45-minute consultation appointment with a sleep specialist followed the polysomnography (usually on the morning following testing), during which a history and physical examination were performed, an assessment was formulated, results of testing were reviewed, other sleep issues were discussed, and treatment and follow-up plans were recommended.

For the control group, patients referred for suspected OSA
from within the institution first met with a sleep specialist during a 60-minute consult visit. A split-night PSG (just as above) was performed, and, the following day, a report visit to review results and decide on treatment recommendations was completed.

Follow-up was requested via mailed questionnaires (2 attempts if necessary) 1 month after the consultation visit. Follow-up data included ESS, FOSQ, subjective CPAP compliance, and patient satisfaction measured by a study-specific questionnaire (Appendix A).

### Statistical Methods

Baseline characteristics were compared between TOSAC patients and controls using analysis of variance for continuous variables and the χ² test for categorical variables. The effect of the intervention on ESS, FOSQ, and subjective CPAP adherence were evaluated and compared between groups using analysis of variance. Additionally, ESS, FOSQ, and subjective CPAP compliance were compared between groups using analysis of covariance, adjusting for patient characteristics that differed at baseline. Patient satisfaction was evaluated between treatment groups using ordinal logistic regression. Patient satisfaction was also compared between groups using ordinal logistic regression, adjusting for baseline variables that were significantly different between groups. In all cases, 2-sided tests with p values ≤ .05 were considered statistically significant.

### RESULTS

We enrolled 186 TOSAC and 94 control patients. The baseline characteristics of patients are shown in Table 1. Of 186 TOSAC patients, 63 did not meet criteria and were referred to the next available SaO₂ appointment (but remained included in the TOSAC group for analysis), while 123 went on for the expedited testing (Figure). Eight of the 63 patients never kept initial interviews, so baseline data were incomplete. Other reasons for not meeting criteria included mean SaO₂ < 90% (n = 9), desaturation index < 5 (n = 39), and exclusionary medical problems at nurse triage (n = 7). There was no statistical difference in the ESS between the 63 TOSAC patients not meeting criteria and those that did (14.17 ± 0.58 vs 13.86 ± 4.5, p = .665). Overall, TOSAC patients completed their evaluation in a median of 7.0 days, compared with 60.0 days for the controls (p < .001). There was no difference in the days between an order for PSG and the completion of PSG between groups (median = 0 days for both groups, p = .665). Per design, TOSAC patients spent 45 minutes with a sleep specialist and about 13 to 20 minutes with a nurse, while control patients spent 90 minutes (2 appointments) with a sleep specialist and, in general, 0 minutes with a nurse.

The patients entering the TOSAC group were older (p = .003) but had witnessed apneas less often (p = .008). TOSAC patients were sleepier, as judged by the ESS (p < .001). The 2 groups were similar in body mass index and prevalence of hypertension. All domains of the baseline FOSQ were worse in the TOSAC patients than in controls (p = .003 for social outcome domain and p < .001 for all other domains).

In TOSAC patients, 10% (19 of 186) did not complete recommended polysomnography or avail themselves of the recommended sleep consultation, while only 3% (3 of 94) of the control patients completed their evaluation in a median of 7.0 days, compared with 60.0 days for the controls (p < .001). There was no difference in the days between an order for PSG and the completion of PSG between groups (median = 0 days for both groups, p = .665). Per design, TOSAC patients spent 45 minutes with a sleep specialist and about 13 to 20 minutes with a nurse, while control patients spent 90 minutes (2 appointments) with a sleep specialist and, in general, 0 minutes with a nurse.

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The TOSAC pilot study was designed to implement a patient-evaluation protocol that would reduce physician time, thereby improving appointment availability, and to evaluate the impact of the abbreviated evaluation on outcomes. We also anticipated that by evaluating patients primarily suspected of having OSA in a protocol that included consultation, testing, and standardized education, that we would reduce variability between individual evaluations.

**DISCUSSION**

The purpose of the TOSAC pilot study was to implement a patient-evaluation protocol that would reduce physician time, thereby improving appointment availability, and to evaluate the impact of the abbreviated evaluation on outcomes. We also anticipated that by evaluating patients primarily suspected of having OSA in a protocol that included consultation, testing, and standardized education, that we would reduce variability between individual evaluations.
physician practices and improve quality of care. The TOSAC appointment process decreases physician time spent with the patient directly by 50%, allowing the possibility to increase the number of patients evaluated and tested by the same amount. This analysis of time savings for the entire care system is incomplete because it does not account for nursing time that is spent in triage (approximately 15 minutes per patient) nor does it account for time instructing the patient in oximetry use and processing oximetry data. Nonetheless, in most settings, sleep specialists are less available than are technologists and nurses. Although the time until evaluation and the time sleep specialists spent evaluating patients did decrease with the TOSAC, our data show that the quality of care did not decrease. Our pilot project did not implement full application of the TOSAC in our appointment system, and we did not actually realize an increase in patient access during the time of the pilot. Subsequent to this study, we have implemented the TOSAC concept as a regular part of our practice and find that we are able to increase patient access as a result of increased appointment availability. Quality of care for sleep apnea patients can be assessed in a variety of ways. Patients should receive a thorough and accurate diagnostic evaluation, thoughtful education, and effective therapy and follow up. Therapy of OSA, especially if CPAP is used, should be shown to improve subjective sleepiness and quality of life.20-23 Finally, patients should feel as if they have received professional, courteous, and timely care. Outcomes measured in our study included change in sleepiness as assessed by the ESS, CPAP compliance as assessed by subjective report, change in quality of life as assessed by FOSQ, and patient satisfaction. At face value, there was no statistical difference in improvements in ESS or satisfaction between the 2 groups, and there was little difference in improvement in quality of life, as measured by the FOSQ. Subjective compliance to CPAP therapy was slightly higher in TOSAC patients.

Overall, our patients had characteristics similar to those in other studies that have evaluated patients with OSA. In randomized studies evaluating response of the ESS to CPAP treatment in patients with OSA, initial ESS have ranged from 11 to 16 and have improved to 5.9 to 9, for a mean improvement of 6.8.22-27 It is therefore disappointing that our patients experienced a mean improvement in ESS of only 3.0 overall. Reported subjective CPAP compliance averages 4 to 5.5 hours per night, compared with our patients’ reports, which averaged 4.9±3.1 hours per night for the TOSAC patients and 4.2±3.4 hours per night for the control group.23,27-29 Finally, FOSQ improvements following CPAP therapy in other studies typically average about 5 (adjusted for changes in FOSQ grading scale), while in our patients, change in FOSQ averaged only between 1 and 2 (1.63 for those who used CPAP >4 hours per night).29-32

TOSAC patients were different from the control patients in at least 3 possibly significant ways; TOSAC patients were slightly older, were sleepier, and had a higher prevalence of restless legs complaints. The selection criteria for patients entering the TOSAC require that they have an ESS of 10 or higher, and this may have skewed the distribution of ESS. The patients were also older, perhaps reflecting that nearly 75% of TOSAC patients who were referred from the divisions of pulmonary and critical care medicine, cardiovascular medicine, and general internal medicine, while control patients were more likely to be referred from family medicine, otorhinolaryngology, and other divisions that may serve a younger population. The concurrent diagnosis of restless legs syndrome has been reported in between 8.3% and 15% of patients with OSA and was seen in a higher proportion of our TOSAC patients.33,34 Another factor that may have influenced the TOSAC-patient baseline condition could have been drop out of patients who had fairly normal oximetry prior to polysomnography. Because of this, we may have expected the remaining TOSAC group to have more-severe OSA. However, despite baseline differences in age and measure of sleepiness, the quality of life scores, rendered diagnoses, and AHI were similar between groups.

Patient satisfaction was quite good among both the TOSAC and control patients and did not differ between groups. Interestingly, although there was a significant difference in the time from referral to completion of evaluation between the groups, both had similar assessments of the “timeliness of appointment.” This may reflect that timeliness is a less important criterion than is overall
satisfaction with the outcome of the visit or, alternatively, may indicate patients’ low expectations of receiving timely care. As patients become more aware of the importance and benefits of treating OSA, expectation for more-rapid assessment may grow, and one might anticipate dissatisfaction with significant delays in evaluation.

Our study has several limitations. This clinical pilot study did not employ a randomized design. Our groups were dissimilar at baseline, with older and sleepier patients in the TOSAC group. However, after adjusting for baseline variables that differed significantly at baseline, most TOSAC group outcomes were the same or only slightly better than those of the control group. Speculatively, the marginally greater improvement in FOSQ activity and total scores may reflect an observed association between FOSQ activity score and physical function scores, likely to be less fluid in the older control population. In any event, the overall effect differences were small. Secondly, we did not measure compliance objectively. Prior studies have found that sleepier patients are more compliant with CPAP. Conceivably, patients in the 2 groups could have a different expectation or general attitude toward therapy for OSA and could have overreported or underreported compliance. After controlling for differences in ESS and other baseline differences, there was still a small advantage in subjective CPAP compliance in the TOSAC patients compared with the control patients. We did not observe the expected improvements in ESS or FOSQ in either treatment arm. While this certainly is cause to reevaluate our overall treatment of patients, it is not clear how this would be of more importance to 1 or the other groups. Finally, most follow-up data were obtained via mail-in questionnaire, and response bias is possible. However, there was no statistical difference in response rates, and both groups would likely be similarly susceptible to such bias.

Our study has shown that a focused protocol-driven evaluation pathway for OSA that uses less physician time, but identifies technology in evaluation, produces similar results in types of diagnoses rendered as part of the evaluation by sleep experts, sleepiness improvement, quality of life, and overall satisfaction. There is ongoing emphasis on the development of new technologies to improve the efficiency and accuracy of evaluating patients with suspected OSA. This study suggests that careful screening of patients prior to evaluation can help curtail time spent in consultation with sleep specialists without markedly influencing outcomes. These results apply and have been incorporated into our particular practice. Introducing such changes in the evaluation process should, however, be subjected to assessment before being instituted on a broad scale or in other settings, since the treatment of sleep disorders inherently involves more than obtaining an AHI and writing a prescription for CPAP.

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REFERENCES

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APPENDIX

Patient Satisfaction Questionnaire. Patients completed the questionnaire (along with the FOSQ, the ESS, and questions about CPAP compliance) 1 month after the initial consultation.

How would you rate the following?  

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• The overall care that was provided by the doctors or nurses during your visit to the Sleep Disorders Center? □ □ □ □ □
• The ease of the appointment-making process? □ □ □ □ □
• The timeliness of the appointment you received? □ □ □ □ □
• The willingness of the healthcare providers to listen to you and your family? □ □ □ □ □
• The explanation about your condition and what to expect? □ □ □ □ □
• The helpfulness of the allied health staff (receptionists, other desk staff, and clinical assistants)? □ □ □ □ □
• The overall care you received? □ □ □ □ □

• How willing are you to recommend the Sleep Disorders Center to your family and friends? 

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