CLINICAL GUIDELINE

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Diagnosis of Obstructive Sleep Apnea in Adults: A Clinical Practice Guideline From the American College of Physicians

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Description: The American College of Physicians (ACP) developed this guideline to present the evidence and provide clinical recommendations on the diagnosis of obstructive sleep apnea in adults.

Methods: This guideline is based on published literature on this topic that was identified by using MEDLINE (1966 through May 2013), the Cochrane Central Register of Controlled Trials, and the Cochrane Database of Systematic Reviews. Searches were limited to English-language publications. The clinical outcomes evaluated for this guideline included all-cause mortality, cardiovascular mortality, nonfatal cardiovascular disease, stroke, hypertension, type 2 diabetes, postsurgical outcomes, and quality of life. Sensitivities, specificities, and likelihood ratios were also assessed as outcomes of diagnostic tests. This guideline grades the evidence and recommendations by using ACP's clinical practice guidelines grading system.

Recommendation 1: ACP recommends a sleep study for patients with unexplained daytime sleepiness. (Grade: weak recommendation, low-quality evidence)

Recommendation 2: ACP recommends polysomnography for diagnostic testing in patients suspected of obstructive sleep apnea. ACP recommends portable sleep monitors in patients without serious comorbidities as an alternative to polysomnography when polysomnography is not available for diagnostic testing. (Grade: weak recommendation, moderate-quality evidence)

Ann Intern Med. 2014;161:210-220. doi:10.7326/M12-3187 **www.annals.org**

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Obstructive sleep apnea (OSA) is caused by repetitive obstruction of the upper airway during sleep, resulting in hypopnea (reduced airflow during sleep) or apnea (complete airflow cessation during sleep). Persons with OSA may experience loud snoring, oxygen desaturation, frequent arousals, and disruption of sleep. Disrupted sleep can result in hypersomnolence and impaired concentration during the day (1), increased probability of motor vehicle and other accidents (2, 3), and decreased quality of life (4). Although evidence establishing a causal relationship is not currently available, OSA is associated with adverse clinical outcomes, including cardiovascular disease (5–8); hypertension (9–11); cognitive impairment and metabolic abnormalities, such as type 2 diabetes (6, 12–15); and an increased risk for postoperative cardiac and respiratory complications (16–18). The exact prevalence of OSA is unknown. Estimates range from 10% to 17% of the U.S. population, with the variation due in part to variable criteria used to define disease (for example, the number of apneic episodes per hour or whether individuals are required to have specific accompanying signs or symptoms) (19, 20). Prevalence of OSA increases with age, particularly in adults older than 60 years (21–25). The growing rate of obesity also contributes to increasing OSA prevalence (26).

Considerable controversy surrounds the type and level of respiratory abnormality, the presence and type of signs or symptoms, and the most appropriate sleep monitoring device for diagnosing OSA. Questionnaires are used to prescreen patients for further testing, the most common of which is the Epworth Sleepiness Scale (ESS) (27). Polysomnography (PSG), which must be performed in a sleep laboratory setting, is considered the reference standard for diagnosing OSA, but it is expensive and requires specialized resources. Type I monitors are facility-based PSG. Type II monitors are portable, measure most of the same channels (physiologic parameters) as type I monitors (including ≥2 respiratory channels), and can differentiate between sleep and awake states. Type III monitors also measure at least 2 respiratory channels but cannot reliably distinguish between sleep and awake states. Type IV monitors are those that do not fit into type III classification and can vary in the number of channels that they record. **Table 1** summarizes the types of monitors.

See also:

Summary for Patients. I-28

Web-Only
Supplement
CME quiz

* This paper, written by Amir Qaseem, MD, PhD, MHA; Paul Dallas, MD; Douglas K. Owens, MD, MS; Melissa Starkey, PhD; Jon-Erik C. Holty, MD, MS; and Paul Shekelle, MD, PhD, was developed for the Clinical Guidelines Committee of the American College of Physicians. Individuals who served on the Clinical Guidelines Committee from initiation of the project until its approval were Paul Shekelle, MD, PhD (*Chair*); Roger Chou, MD; Molly Cooke, MD; Paul Dallas, MD; Thomas D. Denberg, MD, PhD; Nick Fitterman, MD; Mary Ann Forciea, MD; Robert H. Hopkins Jr., MD; Linda L. Humphrey, MD, MPH; Tanveer P. Mir, MD; Holger J. Schünemann, MD, PhD; Donna E. Sweet, MD; David S. Weinberg, MD, MSc; and Timothy Wilt, MD, MPH. Approved by the ACP Board of Regents on 17 November 2012.

Table 1. **Types of Monitors for Diagnosis of Obstructive Sleep Apnea***

Type	Portability	Channels, *n*	Signals	≥2 Airflow/Effort Channels	Identifies Sleep and Awake States	Measures AHI
I	Facility-based	14–16	EEG, EOG, EMG, ECG/HR, airflow, effort SaO_2	Yes	Yes	Yes
II	Portable	≥7	EEG, EOG, EMG, ECG/HR, airflow, effort SaO_2	Yes	Yes	Yes
III	Portable	≥4	Airflow and/or effort, ECG/HR, SaO_2	Yes	No	No, but estimates AHI†
IV	Portable	1–3‡	All monitors that do not fit into type III classification	No	No§	No, but estimates AHI†

AHI = apnea–hypopnea index; ECG = electrocardiography; EEG = electroencephalography; EMG = electromyography; EOG = electro-oculography; HR = heart rate.
* Adapted from reference 28.
† Both type III and type IV monitors estimate the AHI by measuring the total number of episodes of apnea and hypopnea divided by the number of recording hours/time (as opposed to number of hours of sleep determined by EEG). Some type IV devices estimate sleep and awake states by peripheral arterial tone and estimate the AHI from the estimated sleep time.
‡ May have >3 channels provided that criteria for type III monitors are not met.
§ May include monitors that measure signals that are, in principle, able to identify arousals from sleep.

Polysomnography and portable monitors measure or estimate the apnea–hypopnea index (AHI), a measure of the number of apnea or hypopnea events per hour during sleep (**Table 1**). The AHI is used to diagnose and assess the severity of OSA. The American Academy of Sleep Medicine (AASM) sets a threshold of 15 events per hour with or without symptoms or 5 events per hour with symptoms for OSA diagnosis (29, 30). The Centers for Medicare & Medicaid Services reimburses for OSA treatment with continuous positive airway pressure (CPAP) devices for patients with an AHI score of at least 15 events per hour or those with at least 5 events per hour and symptoms, such as daytime somnolence, fatigue, insomnia, mood disorders, and cognitive impairment, or cardiovascular comorbid conditions, such as hypertension, ischemic heart disease, or prior stroke (31).

The purpose of this American College of Physicians (ACP) guideline is to address the screening and diagnosis of OSA by presenting a comparison of the effectiveness of the available diagnostic methods. The target audience for this guideline includes all clinicians, and the target patient population includes all adults with suspected OSA. This guideline is based on the comparative effectiveness review sponsored by the Agency for Healthcare Research and Quality (AHRQ) (28), the 2007 Technology Assessment of Home Diagnosis of Obstructive Sleep Apnea-Hypopnea Syndrome (32), and an updated literature review through May 2013. The recently published ACP guideline on the management of OSA in adults (33) provides guidance on treatment of OSA.

Methods

This guideline addresses the following key questions related to the screening and diagnosis of OSA:

1. How do different available tests compare in their ability to diagnose sleep apnea in adults with symptoms suggestive of disordered sleep? How do these tests compare in different subgroups of patients based on race, sex, body mass index, existing type 2 diabetes mellitus, existing cardiovascular disease, existing hypertension, clinical symptoms, previous stroke, or airway characteristics?

2. How does phased testing (screening tests or battery followed by full test) compare with full testing alone?

3. What is the effect of preoperative screening for sleep apnea on surgical outcomes?

4. In adults being screened for OSA, what is the relationship between the AHI and other patient characteristics with respect to long-term clinical and functional outcomes?

The literature search for the systematic review (28) was conducted using MEDLINE (1966 to September 2010), the Cochrane Central Register of Controlled Trials, and the Cochrane Database of Systematic Reviews and included peer-reviewed studies published in English. The evidence review was updated through 30 May 2013 by identifying literature in MEDLINE with the same search strategy and inclusion and exclusion criteria as the 2010 report (**Supplement**, available at www.annals.org). The included studies reported minimum AHI thresholds for OSA diagnosis ranging from 5 to 20 events per hour (28). Further details about the methods and inclusion and exclusion criteria applied in the evidence review are available in the AHRQ report (28) and the **Supplement**.

This guideline rates the evidence and recommendations by using ACP's guideline grading system (**Table 2**). Details of the guideline development process can be found in ACP's methods paper (34).

Comparison of Diagnostic Tests for OSA

Type II Monitors Versus PSG

Moderate-quality evidence from 9 studies showed that type II monitors may predict AHI scores suggestive of OSA (31, 35–42). The sensitivities and specificities for type II monitors to predict AHI scores greater than 5, 15, and 30 events per hour are summarized in **Table 3**.

Table 2. **The American College of Physicians' Guideline Grading System***

Quality of Evidence	Strength of Recommendation	
	Benefits Clearly Outweigh Risks and Burden or Risks and Burden Clearly Outweigh Benefits	Benefits Finely Balanced With Risks and Burden
High	Strong	Weak
Moderate	Strong	Weak
Low	Strong	Weak
Insufficient evidence to determine net benefits or risks		

* Adopted from the classification developed by the GRADE (Grading of Recommendations Assessment, Development, and Evaluation) workgroup.

Type III Monitors Versus PSG

Moderate-quality evidence from 34 studies (43–76) showed that type III monitors have the ability to predict AHI scores suggestive of OSA. The sensitivities and specificities for type III monitors to predict AHI scores greater than 5, 15, and 30 events per hour are summarized in **Table 3**. Type III monitors showed a wide range of difference in AHI estimates compared with PSG (28).

Type IV Monitors Versus PSG

Moderate-quality evidence from 37 studies (32, 77–113) showed that type IV monitors can predict AHI scores suggestive of OSA. The sensitivities and specificities for type IV monitors to predict AHI scores greater than 5, 15, and 30 events per hour are summarized in **Table 3**. Type IV monitors showed a wide range of difference in AHI estimates compared with PSG (28). Direct comparison between type III and type IV monitors was not possible, but indirect evidence from studies comparing each monitor with PSG suggested that type III monitors performed better than type IV monitors in predicting AHI scores suggestive of OSA.

Questionnaires Versus PSG

A total of 47 studies compared questionnaires and PSG (72, 102, 106, 114–156). The sensitivities and specificities of selected tests are summarized in **Table 3**. Low-quality evidence from 18 studies (72, 115, 116, 118–133) showed that the Berlin Questionnaire may be helpful in predicting risk for OSA. However, the sensitivity and specificity of the questionnaire had a wide range depending on the AHI cutoff level (**Table 3**). Low-quality evidence from 22 studies describing the ESS (72, 121–123, 128, 130, 134–149), 3 describing the Multivariate Apnea Prediction Index (102, 147, 150), 3 describing the Pittsburgh Sleep Quality Index (139, 141, 151), and 5 describing the STOP-BANG Questionnaire (135, 148, 152–154) showed that these questionnaires had low accuracy for diagnosis. Evidence was insufficient to determine the diagnostic accuracy of the other questionnaires.

Table 3. **Accuracy of Portable Monitors and Questionnaires for Diagnosis of Obstructive Sleep Apnea**

Tool	Overall Quality of Evidence	AHI Cutoff, *events/h*	Sensitivity, %	Specificity, %
Type II monitor	Moderate	5	88–94	36–77
		15	79–100	71–100
		30	61–77	96–98
Type III monitor	Moderate	5	83–97	48–100
		15	64–100	41–100
		30	70–96	79–100
Type IV monitor				
≥2 channels	Moderate	5	75–100	43–100
		15	67–98	50–100
		30	80–100	74–98
1 channel/oximetry	Moderate	5	27–100	67–100
		15	39–100	32–100
		30	18–100	29–100
Berlin Questionnaire	Low	5	37–93	17–95
		15	40–83	20–97
		30	17–87	37–77
Epworth Sleepiness Scale	Low	5	24–96	29–89
		15	21–50	43–83
		30	36–50	70–79
Multivariate Apnea Prediction Index	Low	5	84	46
		15	86	31
		30	90	66
Pittsburgh Sleep Quality Index	Low	5	72	0
		15	14	86
		30	No data	No data
STOP-BANG Questionnaire	Low	5	36–97	18–89
		15	44–99	11–77
		30	56–100	11–74

AHI = apnea–hypopnea index.

Table 4. **The AHI as a Predictor of Clinical Outcomes**

Outcome	Evidence	Overall Quality of Evidence	Reference
All-cause mortality	Association with increased risk with AHI score >30 events/h	High	19, 20, 171, 172, 176
Cardiovascular mortality	Inconsistent results	Insufficient	5, 20
Nonfatal cardiovascular disease	Association with increased risk with AHI score ≥30 events/h and no CPAP treatment	Insufficient	5, 177
Stroke	No association	Insufficient	169
Hypertension	Unclear conclusions	Insufficient	10, 173, 178
Type 2 diabetes	Association with increased risk with AHI score >30 events/h	Low	170, 174
Quality of life	No association	Insufficient	175

AHI = apnea–hypopnea index; CPAP = continuous positive airway pressure.

Clinical Prediction Rules Versus PSG

Thirteen studies (102, 144, 157–167) assessed a total of 16 internally validated clinical prediction rules (refer to the AHRQ report [28] and the **Supplement** for descriptions of each of these tools). Most of the rules used information that was available through clinical history and examination, and all were compared with facility-based PSG. Studies were highly heterogeneous with respect to populations assessed, type of reference test used, and OSA definitions, and only 1 study was identified for each prediction rule. Overall, low-quality evidence suggested that some clinical prediction rules can be used to effectively predict OSA diagnosis. However, the applicability of these rules to the general population cannot be determined from the existing literature. In addition, none of the studies examined the potential clinical utility of applying these rules to clinical practice.

Comparison of Phased Testing Versus Full Testing

Phased testing involves a series of tests that may be done depending on the results of initial tests, whereas full testing involves overnight PSG. Evidence was insufficient to determine the utility of phased testing for diagnosing OSA; 1 low-quality prospective study was subject to verification bias (168), and another reported a positive likelihood ratio of at least 3.9 and a negative likelihood ratio of 0.06 (102).

Predictors of Long-Term Clinical and Functional Outcomes

Fourteen studies met the inclusion criteria for predictors of long-term clinical outcomes, such as mortality, stroke, hypertension, and cardiovascular disease (5, 10, 19, 20, 169–178). Results were inconclusive to establish a causal relationship and are summarized in **Table 4**.

Summary

Polysomnography performed in a sleep laboratory has been the standard method to diagnose OSA; however, it requires specialized facilities, is resource-intensive and expensive, and requires patients to spend the night under observation in a foreign environment. In addition to PSG, portable monitors (types II, III, and IV) can be used to diagnose OSA, although the measured AHI score can differ substantially from that measured with PSG. Low-quality evidence showed that type II monitors may identify AHI scores suggestive of OSA. No study directly compared different portable monitors with each other, although current evidence supports greater diagnostic accuracy with type III monitors than type IV monitors (28). The utility of portable monitors for diagnosing OSA in patients with comorbid conditions, including chronic lung disease, congestive heart failure, or neurologic disorders, is uncertain because most studies excluded these patients. Also, compared with PSG, type II, III, and IV monitors had a wide range of difference in AHI estimates (28).

A significant limitation of type IV monitors is that they cannot differentiate between obstructive and central apneas. In contrast to OSA, where airflow is disrupted because of airway obstruction, central sleep apnea results from a temporary failure of the brain to send signals to breathe. Because CPAP may be contraindicated in patients with central sleep apnea, an accurate diagnosis is important. Patients with cardiac, respiratory, or neurologic disease may be at the greatest risk for central sleep apnea, and the AASM does not recommend the use of portable monitors for diagnosis in these patients (179).

Although the evidence was insufficient to determine the utility of most questionnaires compared with PSG for OSA screening, low-quality evidence indicated that the Berlin Questionnaire may be used to screen for OSA. However, questionnaires may not be applicable to the general population because they include subjective questions about sleepiness and not all patients, even those with severe OSA, report sleepiness. For example, the Wisconsin Sleep Cohort Study found that only 37% of patients with severe OSA (AHI score ≥30 events/h) reported daytime sleepiness and that mortality associated with long-term OSA was independent of subjective sleepiness (20).

Evidence was insufficient to determine the effectiveness of phased testing for the diagnosis of OSA or the utility of preoperative screening for OSA to improve postsurgical outcomes.

Evidence was mixed to correlate OSA with predictors of long-term clinical outcomes, and no causal relationships have been established. High-quality evidence showed an association between an AHI score greater than 30 events per hour and greater all-cause mortality. Low-quality evidence showed an association between higher AHI score and incident diabetes, although obesity was probably a confounding variable in these studies. However, a randomized trial showed that CPAP treatment did not reduce mortality or coronary heart disease events in patients with OSA who did not have daytime sleepiness. Although CPAP seems to reduce blood pressure in patients with symptomatic OSA who adhere to it, its effect on blood pressure in adults with OSA who do not have daytime sleepiness is less well-established (180). The short-term effect of CPAP on blood pressure in patients with moderate to severe OSA with or without daytime sleepiness and resistant hypertension is small (3 mm Hg) and of unknown clinical benefit (42).

Recommendations

Recommendation 1: ACP recommends a sleep study for patients with unexplained daytime sleepiness. (Grade: weak recommendation, low-quality evidence)

Clinicians should target their assessment of OSA to individuals with unexplained daytime sleepiness. This assessment should include evaluation of the risk factors and common presenting symptoms for OSA. The best-documented risk factor for OSA is obesity. Clinical symptoms for OSA include unintentional sleep episodes during wakefulness, daytime sleepiness, unrefreshing sleep, fatigue, insomnia, and snoring. If other causes have been ruled out (for example, thyroid disease, gastroesophageal reflux disease, or other respiratory diseases), further evaluation for OSA may be warranted in patients with daytime sleepiness, which is the clinically relevant OSA symptom most responsive to treatment. Evidence is lacking on the effect of CPAP on improving other outcomes, including hypertension, diabetes, coronary heart disease events, and mortality, especially among individuals without daytime sleepiness. For guidance on treatment, clinicians should refer to the ACP guideline on management of OSA (33). Sleepiness questionnaires, such as the ESS, help in assessing the symptom severity of OSA but cannot assess the AHI (a necessary but not sufficient component of OSA) and lack sufficient sensitivity and specificity to replace a sleep study in diagnosing OSA.

Recommendation 2: ACP recommends polysomnography for diagnostic testing in patients suspected of obstructive sleep apnea. ACP recommends portable sleep monitors in patients without serious comorbidities as an alternative to polysomnography when polysomnography is not available for diagnostic testing. (Grade: weak recommendation, moderate-quality evidence)

Full-night, attended, in-laboratory PSG is considered the reference standard diagnostic test and is recommended in patients with suspected OSA. However, in the absence of PSG, portable monitors may be used as an alternative diagnostic test in such patients. Both the AASM and the Centers for Medicare & Medicaid Services consider an AHI score of at least 15 events per hour or at least 5 events per hour with symptoms (such as daytime somnolence and fatigue) as criteria for OSA diagnosis. Evidence shows that compared with PSG, type II, III, and IV monitors have a wide range of difference in AHI estimates. These monitors have a high positive likelihood ratio and low negative likelihood ratio for various AHI cutoff levels to predict OSA. Monitors with more channels perform better than those with fewer channels, and type IV monitors have an important limitation in that they are unable to distinguish obstructive from central sleep apnea. There is no direct evidence from head-to-head comparisons of type III and IV monitors, but indirect evidence from studies comparing each monitor with PSG suggested that type III monitors performed better than type IV monitors in predicting AHI scores suggestive of OSA. Although portable monitors may be useful, data loss of 3% to 20% has been reported for type III and IV monitors (181). Furthermore, inadequate data resulting in limited interpretation of results from the use of type III monitors has been reported for 13% to 20% of the evaluations (182). The utility of portable monitors for patients with serious comorbid conditions, including chronic lung disease, congestive heart failure, or neurologic disorders, has not been verified.

Evidence from studies comparing one monitor with another is lacking. The **Figure** summarizes the recommendations and clinical considerations.

Inconclusive Areas of Evidence

Preoperative Screening for OSA

Detection of OSA in patients having surgery is an area of considerable interest. However, the current evidence does not provide enough information on the effect of preoperative screening for sleep apnea on surgical outcomes. Four low-quality studies provided inconclusive evidence (115, 183–185). Hence, at this point, ACP's Clinical Guidelines Committee cannot determine the benefits and harms of preoperative screening for OSA.

Phased Testing for OSA

The current evidence from 1 low-quality study was insufficient to draw conclusions about phased testing compared with full PSG testing for diagnosis of OSA.

Assessment in Patients With Comorbid Conditions

The utility of portable monitors for diagnosing OSA in patients with comorbid conditions, such as chronic lung disease, congestive heart failure, or neurologic disorders, is unknown because few studies included these patients.

Figure. **Summary of the American College of Physicians guideline on diagnosis of OSA in adults.**

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SUMMARY OF THE AMERICAN COLLEGE OF PHYSICIANS GUIDELINE ON DIAGNOSIS OF OBSTRUCTIVE SLEEP APNEA IN ADULTS

Disease/Condition	OSA
Target Audience	Internists, family physicians, and other clinicians
Target Patient Population	Adults with suspected OSA
Screening and Diagnostic Tests	PSG Type II, III, and IV portable monitors Questionnaires
Interventions	Strategies to manage OSA
Outcomes	All-cause mortality, cardiovascular mortality, nonfatal cardiovascular disease, stroke, hypertension, type 2 diabetes, postsurgical outcomes, and quality of life
Recommendations	*Recommendation 1: ACP recommends a sleep study for patients with unexplained daytime sleepiness. (weak recommendation, low-quality evidence)* *Recommendation 2: ACP recommends polysomnography for diagnostic testing in patients suspected of obstructive sleep apnea. ACP recommends portable sleep monitors in patients without serious comorbidities as an alternative to polysomnography when polysomnography is not available for diagnostic testing. (weak recommendation, moderate-quality evidence)*
High-Value Care	Clinicians should target their assessment of OSA to individuals with unexplained daytime sleepiness.
Clinical Considerations	The utility of portable monitors for diagnosing OSA in patients with comorbid conditions, such as chronic lung disease, congestive heart failure, or neurologic disorders, is unknown. Although portable monitors may be used to diagnose OSA, AHI measurements from these devices may differ significantly from those taken with PSG. CPAP treatment does not reduce CHD events and mortality in patients with OSA who do not have daytime sleepiness.

AHI = apnea–hypopnea index; CHD = coronary heart disease; CPAP = continuous positive airway pressure; OSA = obstructive sleep apnea; PSG = polysomnography.

ACP High-Value Care

Evidence shows that before diagnosis, patients with OSA have higher rates of health care use, more frequent and longer hospital stays, and greater health care costs than after diagnosis (18, 186). Clinicians should target evaluation of OSA to patients with unexplained daytime sleepiness. This assessment should include evaluation of the risk factors and common presenting symptoms for OSA. The best-documented risk factor is obesity. Clinical symptoms include unintentional sleep episodes during wakefulness, daytime sleepiness, unrefreshing sleep, fatigue, insomnia, and snoring. Assessment of OSA in the absence of daytime sleepiness or treatment of persons with low AHI scores is low-value care because evidence to date indicates that neither improves clinical outcomes.

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Note: Clinical practice guidelines are "guides" only and may not apply to all patients and clinical situations. Thus, they are not intended to override clinicians' judgment. All ACP clinical practice guidelines are considered automatically withdrawn or invalid 5 years after publication or once an update has been issued.

Disclaimer: The authors of this article are responsible for its contents, including any clinical or treatment recommendations. No statement in this article should be construed as an official position of the U.S. Department of Veterans Affairs.

Financial Support: Financial support for the development of this guideline comes exclusively from the ACP operating budget.

Disclosures: Dr. Shekelle reports a grant from the Agency for Healthcare Research and Quality during the conduct of the study; personal fees from ECRI Institute and the U.S. Department of Veterans Affairs outside the submitted work; grants from the Agency for Healthcare Research and Quality, U.S. Department of Veterans Affairs, Centers for Medicare & Medicaid Services, and Office of the National Coordinator outside the submitted work; and a patent with royalties paid to UpToDate. Authors not named here have disclosed no conflicts of interest. Authors followed the policy regarding conflicts of interest described at www.annals.org/article.aspx?articleid=745942. Disclosures can also be viewed at www.acponline.org/authors/icmje/ConflictOfInterestForms.do?msNum=M12-3187. A record of conflicts of interest is kept for each Clinical Guidelines Committee meeting and conference call and can be viewed at www.acponline.org/clinical_information/guidelines/guidelines/conflicts_cgc.htm.

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