CLINICAL GUIDELINE

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Cardiac Screening With Electrocardiography, Stress Echocardiography, or Myocardial Perfusion Imaging: Advice for High-Value Care From the American College of Physicians

Roger Chou, MD, for the High Value Care Task Force of the American College of Physicians*

Background: Cardiac screening in adults with resting or stress electrocardiography, stress echocardiography, or myocardial perfusion imaging can reveal findings associated with increased risk for coronary heart disease events, but inappropriate cardiac testing of low-risk adults has been identified as an important area of overuse by several professional societies.

Methods: Narrative review based on published systematic reviews; guidelines; and articles on the yield, benefits, and harms of cardiac screening in low-risk adults.

Results: Cardiac screening has not been shown to improve patient outcomes. It is also associated with potential harms due to false-positive results because they can lead to subsequent, potentially unnecessary tests and procedures. Cardiac screening is likely to be particularly inefficient in adults at low risk for coronary heart disease given the low prevalence and predictive values of testing in this population and the low likelihood that positive findings will affect treatment decisions. In this patient population, clinicians should focus on strategies for mitigating cardiovascular risk by treating modifiable risk factors (such as smoking, diabetes, hypertension, hyperlipidemia, and overweight) and encouraging healthy levels of exercise.

High-Value Care Advice: Clinicians should not screen for cardiac disease in asymptomatic, low-risk adults with resting or stress electrocardiography, stress echocardiography, or stress myocardial perfusion imaging.

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Cardiovascular disease results in 1 of every 3 deaths in the United States, or approximately 800 000 per year (1). Coronary heart disease (CHD) accounts for more than half of all cardiovascular events in adults younger than 75 years and is the leading cause of death (2). Direct and indirect costs of CHD in 2009 were estimated at $195 billion (2).

An important challenge in preventing the negative consequences of CHD is that its first clinical manifestation can be catastrophic, including sudden cardiac death or acute myocardial infarction (3). Among those who die suddenly of CHD, more than half have no antecedent symptoms (2). In addition, myocardial infarction is frequently silent (4, 5), causing no recognized symptoms but negatively affecting prognosis (4, 5).

"Screening" refers to testing for a disease or condition in asymptomatic persons to identify the condition before it manifests clinically. Several tests are available to screen for CHD, including resting or stress electrocardiography (ECG) and stress testing in conjunction with cardiac imaging with echocardiography or myocardial perfusion imaging (MPI) (**Table 1**) (6–10). Electrocardiography is among the most commonly performed diagnostic tests in the United States, and the use of cardiac imaging studies is increasing (11–13), although reliable data are not available on the number of screening studies performed.

See also:

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Despite its intuitive appeal, the benefit of cardiac screening in low-risk adults has long been questioned (14, 15). For screening to be warranted, showing that tests can accurately identify unrecognized CHD or determine the level of risk is insufficient. The findings must also lead to actions resulting in improvements in clinical outcomes that are superior to those resulting from delaying treatment until symptoms appear (16, 17). Most important, the benefits should be greater than what is observed on the basis of risk assessment without such testing (for example, assessment of traditional cardiovascular risk factors, such as age, sex, lipid levels, blood pressure, smoking status, and presence of diabetes) and must outweigh any harms, all at an acceptable cost relative to the benefits (18). Costs of testing include both the direct costs of the procedure itself (**Table 1**) and downstream costs from additional tests, follow-up, and referrals. In some cases, screening can lead to invasive follow-up tests, such as angiography, and procedures, such as percutaneous revascularization, with their attendant costs and harms. It is therefore important to critically examine practices around cardiac testing. Inappropriate cardiac testing in low-risk adults

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Table 1. Estimated Costs of Cardiac Screening Tests*

Test	Healthcare Bluebook "Fair Price"†	CostHelper Health-Estimated Out-of-Pocket Cost‡		Dartmouth-Hitchcock Medical Center–Estimated Out-of-Pocket Cost for Uninsured Patients§
		Insured Patients	Uninsured Patients	
Resting electrocardiography	35	30–100	500–3000	NA
Stress electrocardiography	155	200–400	1000–5000	NA
Stress echocardiography	371‖	NA	1000–3000‖	3529
Myocardial perfusion imaging	709	NA	NA	4728

NA = not available.
* Values are in dollars.
† Estimated typical fee accepted by providers from insurance companies. Includes the total amount for physician (interpretation) and technical (imaging) fees for the Portland, Oregon, area. Obtained from www.healthcarebluebook.com/page_Default.aspx.
‡ Includes physician and technical fees. Obtained from http://health.costhelper.com.
§ Includes physician and technical fees, with discount, for uninsured patients. Obtained from http://patients.dartmouth-hitchcock.org/billing_questions/out_of_pocket_estimator.html.
‖ Transthoracic echocardiography without stress testing.

has been identified by several professional organizations, including the American College of Physicians (ACP), as one of the most overused clinical practices (19). The purpose of this article is to provide practical advice on cardiac screening with ECG, stress echocardiography, or MPI. It does not address the use of coronary computed tomography or nontraditional risk factors, such as C-reactive protein levels or carotid intima–media thickness (20).

METHODS

The evidence in this article came from a systematic review (21) and recommendations from the U.S. Preventive Services Task Force (USPSTF) on screening with ECG (22); guidelines and standards developed by the American College of Cardiology in conjunction with other professional societies (7, 23, 24); and articles on the yield, benefits, and harms of cardiac screening. This article is not based on a formal systematic review, but instead seeks to provide practical advice based on the best available evidence. The target audience is all clinicians, and the target patient population is asymptomatic, low-risk adults (defined as those with an estimated 10-year risk for CHD events of <10% [25] unless otherwise noted). This article does not address screening of children or adolescents, preparticipation screening of athletes, preoperative evaluation, ECG screening for purposes of drug monitoring, or evaluation of symptoms suggestive of cardiac disease (20, 26). The article was reviewed and approved by the ACP's High Value Care Task Force, whose members are physicians trained in internal medicine and its subspecialties and experts in evidence synthesis. At each meeting, all members of the task force declared any potentially relevant financial and nonfinancial conflicts of interest.

WHAT ARE THE EVIDENCE-BASED RECOMMENDATIONS FOR THE USE OF CARDIAC TESTING IN ASYMPTOMATIC ADULTS?

The USPSTF recommends against screening low-risk adults with rest or exercise ECG (22). Other groups also do not recommend ECG screening in this population (7, 27–29). A search for primary care, cardiology, or radiology guidelines that recommend cardiac screening in low-risk adults found none.

A systematic review commissioned by the USPSTF found that many abnormalities on screening rest or exercise ECG are associated with an increased risk for subsequent cardiovascular events after adjustment for traditional risk factors (21). However, it found no study on effects of screening on clinical outcomes or on the use of risk-reducing therapies, such as statins or aspirin. In addition, the predictive utility of abnormal findings was relatively weak (pooled adjusted hazard ratios ranged from 1.4 to 2.1), and no study evaluated how accurately resting or exercise ECG reclassified participants into different risk categories compared with traditional risk factor assessment alone (30–33). Although 1 study published after the USPSTF review reported reclassification rates after resting ECG in a population of older adults with a high prevalence of baseline ECG abnormalities, effects were most pronounced in intermediate-risk patients and the reclassification rate in low-risk patients was not reported (34). This is a critical research gap given that treatment decisions about cardiovascular risk–reducing therapies are often based on the 10-year risk classification level (25, 35), although the thresholds used to categorize risk vary (for example, <10% [25] vs. <7.5% [36] for low risk). Regardless of the threshold used (37), in populations at very low risk (≤5%) for CHD events, the presence of a screening ECG abnormality will generally not move a patient from a lower-risk to a higher-risk category, resulting in little effect on clinical treatment decisions. Based on the Framingham Risk Score, this includes almost all nondiabetic women of any age without cardiovascular risk factors (total cholesterol level >5.2 mmol/L [>200 mg/dL], high-density lipoprotein cholesterol level <1.3 mmol/L [<50 mg/dL], smoker, and hypertensive or normotensive while receiving treatment), women younger than 60 years with 1 or 2 risk factors, and men younger than 55 years with no risk factors (Table 2). For example, a 60-year-old woman with average lipid levels (total cholesterol level of 5.5 mmol/L [211 mg/dL] and high-density lipoprotein cholesterol level of 1.5 mmol/L [59

Table 2. Estimated 10-y Probability of Coronary Heart Disease Based on Traditional Risk Factors

Age, *y*	Smoker	Systolic Blood Pressure, *mm Hg*	Receiving Medication for Hypertension	Total Cholesterol Level		HDL Cholesterol Level		Risk Score, %*
				mmol/L	*mg/dL*	*mmol/L*	mg/dL	
Women								
40	Yes	140	Yes	5.18	200	1.04	40	5
40	No	150	Yes	6.21	240	1.04	40	2
50	No	130	No	5.18	200	1.04	40	1
60	No	130	No	5.18	200	1.04	40	3
60	No	130	No	6.21	240	1.04	40	4
60	No	130	Yes	5.18	200	1.04	40	4
60	Yes	130	No	5.18	200	1.04	40	6
Men								
40	No	140	Yes	5.18	200	1.04	40	2
40	Yes	140	Yes	5.18	200	1.04	40	11
40	No	150	Yes	6.21	240	1.04	40	4
50	No	130	No	5.18	200	1.04	40	5
60	No	120	No	4.66	180	1.55	60	6
60	No	130	No	4.66	180	1.29	50	8
60	No	130	No	5.18	200	1.04	40	11

HDL = high-density lipoprotein.
* Estimated 10-y risk for myocardial infarction. Scores are based on the National Heart, Lung, and Blood Institute calculator, which is based on the Framingham Heart Study and is available at http://cvdrisk.nhlbi.nih.gov/calculator.asp.

mg/dL]) (38) and no other risk factors would have a 10-year estimated risk for CHD of 2%. Based on an adjusted hazard ratio of 1.5, the presence of left bundle branch block on ECG would increase this patient's risk to about 3%—still well within the low-risk category.

Similarly, the American College of Cardiology Foundation and the American Heart Association recommend against stress echocardiography or MPI for cardiovascular risk assessment in low-risk, asymptomatic adults (23). These recommendations are based on the lack of evidence showing that screening improves clinical outcomes, unclear effects on risk reclassification and the use of risk-reducing therapies, and the relatively low prevalence of disease. Appropriate use criteria have also been developed to help evaluate imaging use patterns and identify areas of overuse and underuse (39, 40). Consistent with clinical practice guidelines, appropriate use criteria jointly developed by several professional societies classify screening of low-risk adults as generally not appropriate (24, 41).

One reason that cardiac screening in low-risk patients might be ineffective is that for many of the abnormalities found, there is no proven, effective treatment. For example, treatments for left ventricular hypertrophy that improve clinical outcomes (other than blood pressure management) are lacking (42). Similarly, there are no clear treatments for asymptomatic bundle branch block or nonspecific repolarization abnormalities on ECG. Although exercise training can alleviate chronotropic incompetence and impaired exercise tolerance or functional capacity, such interventions have not been shown to reduce CHD events (43). Conversely, interventions for modifiable CHD risk factors, such as smoking, hypertension, diabetes, and overweight, are generally indicated regardless of cardiac screening test findings.

For silent ischemia, evidence is also insufficient to determine whether treatment prolongs life. Although older randomized trials found evidence of beneficial effects of treatment with atenolol or coronary revascularization (percutaneous transluminal coronary angioplasty or coronary artery bypass graft surgery) for silent ischemia, the differences were not statistically significant for atenolol (relative risk, 0.55 [95% CI, 0.22 to 1.33]). In addition, drug therapies were not optimized and do not reflect current practice, and 25% to 30% of patients previously had revascularization, which limits generalizability to screening (44, 45).

Another potential use of screening ECG is as a baseline study for future comparison when symptoms develop. However, limited evidence suggests that having ECG at baseline rarely affects clinical decisions (46, 47).

The effectiveness of cardiac screening in low-risk adults is also limited by the small number of patients who might benefit from revascularization. In addition to the low overall CHD prevalence, only a small subset of patients will have the type of CHD in which revascularization is associated with survival benefit (left main disease or ≥70% stenosis in ≥2 major coronary arteries, particularly with left anterior descending artery involvement) (48, 49). In the well-conducted Coronary Artery Surgery Study, among patients having coronary angiography for evaluation of nonspecific chest pain, 40% of men and 24% of women had coronary atherosclerosis, but only 3% and 0.6%, respectively, had at least 50% left main stenosis or at least 70% 3-vessel stenosis (50). Although revascularization can be appropriate for symptom relief in patients with lesser degrees of CHD, such benefits obviously cannot be experienced by asymptomatic patients. In addition, most trials showing benefits of revascularization were conducted before the routine use of aspirin, β-blockers, and statins. More recent high-quality evidence suggests that outcomes of revascularization may be similar to those of current optimal medical therapy in symptomatic patients, includ-

ing those with multivessel disease (51). No trial compared outcomes of revascularization versus medical therapy in asymptomatic patients, but benefits are unlikely given the lower incidence of cardiovascular events.

WHAT ARE THE POTENTIAL HARMS OF SCREENING?

Potential harms are a particularly important consideration for screening because patients are asymptomatic and any harms are iatrogenic. More than 90% of low-risk adults will not have a cardiac event in the next 10 years and cannot benefit from additional cardiac screening over that period.

Direct harms seem to be trivial for resting ECG and minimal for exercise ECG (52, 53). For the latter, the overall estimated risk for sudden death or an event requiring hospitalization is about 1 per 10 000 tests (53). Pharmacologic agents to induce stress can cause myocardial ischemia, arrhythmia, hypotension, bronchospasm, and other symptoms, although rates of serious adverse events seem to be low (54, 55).

Myocardial perfusion imaging results in radiation exposure from the use of radionuclide tracers. Medical imaging procedures are the primary source of radiation exposure, with higher cumulative exposure associated with increased risk for subsequent cancer (56). Myocardial perfusion imaging is associated with an average effective radiation dose of 15.6 mSv compared with 0.02 mSv for posteroanterior chest radiography and 8 mSv for abdominal computed tomography (56, 57). One study of persons aged 50 years estimated a risk of 2 to 25 additional cancer cases per 10 000 MPI scans (58), depending on the imaging technique and tracers used.

Harms may also occur due to false-positive results. In low-prevalence populations, even screening tests with high sensitivity and specificity are associated with a low positive predictive value (high rate of false-positive results) (59). Up to three quarters of asymptomatic men with exercise-induced ST-segment depression on ECG have no significant angiographic coronary artery disease (21, 60). Because resting ECG is less accurate, the positive predictive value is even lower. Although the accuracy of stress imaging is higher than that of stress ECG, the positive predictive value is still relatively low (61, 62). Based on a positive likelihood ratio of 8.6 (CI, 5.9 to 12) for stress echocardiography (59), in a population with a pretest probability of CHD of 5%, the estimated posttest probability after a positive test result would be only 31% (61).

Harmful effects may also occur in patients with true-positive screening results because of labeling, health insurance denials, or increased insurance premiums. However, evidence on effects of such harms as a result of cardiac screening is not available.

Harms may also result from follow-up testing and interventions. In studies of asymptomatic or primarily asymptomatic patients, rates of subsequent angiography after an abnormal exercise ECG result ranged from 0.6% to 2.9% (21, 63, 64). In 2 studies, 0.1% and 0.5% of patients who had screening exercise ECG had a revascularization procedure that may have been unnecessary (63, 64). A significant proportion of inappropriate percutaneous coronary interventions are related to treatment of asymptomatic patients. One study of national registry data classified 11.6% of procedures as inappropriate, with more than half of these performed in persons without angina (65).

Downstream harms can occur as a result of these follow-up tests and interventions. Angiography is associated with a risk of about 1.7% for serious adverse events, including death (0.1%), myocardial infarction (0.05%), stroke (0.07%), and arrhythmia (0.4%) (66). Coronary angiography is associated with an average effective radiation dose of 7 mSv (56), and follow-up tests after cardiac screening, such as computed tomography, coronary angiography, and MPI, are also associated with radiation exposure.

DOES PRACTICE FOLLOW THE EVIDENCE?

Despite widespread concordance among clinical practice guidelines, cardiac screening tests are still frequently done in clinical practice, and their use may be increasing. One study of national survey data found that screening ECG use at general medical examination visits increased from 6.1% to 11.3% from 1999 to 2009 (67). A systematic review found overuse rates of 9.2% for ECG and 3.0% to 52% for cardiac stress tests (68). In a *Consumer Reports* survey, 39% of asymptomatic adults without high blood pressure or a high cholesterol level reported having ECG within the past 5 years, and 12% reported undergoing exercise ECG (69). More than half reported that their physician recommended it as part of their routine health care.

For cardiac stress imaging, 3 studies found that about 15% of stress MPI and echocardiography examinations did not meet appropriateness criteria, with evaluation of low-risk, asymptomatic patients accounting for about half of the cases in 2 studies and 25% in the other (70–72).

WHAT FORCES PROMOTE THE OVERUSE OF CARDIAC TESTING IN ASYMPTOMATIC ADULTS?

Several factors may promote overuse of cardiac testing in asymptomatic adults. Clinicians may overestimate the benefits of revascularization on the basis of trials of symptomatic patients that used outdated medical treatment regimens (55, 73). In addition, harms may be underestimated. False-positive results are often overlooked as harms, even though they may result in unnecessary tests and treatment. Harms related to downstream tests and interventions may be unrecognized, and effects of radiation exposure may not manifest for years.

Clinicians may also assume that negative cardiac screening test results provide some benefit by reassuring patients. However, a search identified no studies to support this assumption.

Table 3. Cardiovascular Risk Calculators

Calculator	Risk Factors Included	Web Site
Framingham Risk Score	Age, sex, total and HDL cholesterol levels, smoking status, systolic blood pressure, and antihypertensive medications	http://cvdrisk.nhlbi.nih.gov/calculator.asp
SCORE	Age, sex, total–HDL cholesterol ratio, smoking status, and systolic blood pressure	www.heartscore.org/Pages/welcome.aspx
PROCAM*	Age, LDL and HDL cholesterol levels, smoking status, systolic blood pressure, family history, diabetes, and triglyceride levels	www.myhealthywaist.org/evaluating-cmr/assessing-cvd-risk-traditional-approaches/procam/page/5/index.html
Reynolds Risk Score	Age, HbA_{1c} level†, smoking status, systolic blood pressure, total and HDL cholesterol levels, hsCRP levels, and parental history of MI at age <60 y	www.reynoldsriskscore.org
Pooled Cohort Equation risk calculator	Age, sex, race, total and HDL cholesterol levels, systolic blood pressure, antihypertensive treatment, diabetes, and smoking status	www.cardiosource.org/en/Science-And-Quality/Practice-Guidelines-and-Quality-Standards/2013-Prevention-Guideline-Tools.aspx

HbA_{1c} = hemoglobin A_{1c}; HDL = high-density lipoprotein; hsCRP = high-sensitivity C-reactive protein; LDL = low-density lipoprotein; MI = myocardial infarction; PROCAM = Prospective Cardiovascular Münster; SCORE = Systematic Coronary Risk Evaluation.
* Specific for men.
† In women with diabetes.

Financial incentives may also promote unnecessary testing. One study based on Medicare data found greater relative increases in payments for MPIs (a relatively highly reimbursed procedure) to cardiologists than radiologists, suggesting a potential increase in inappropriate self-referrals by cardiologists (74). Another study found that follow-up stress MPI and echocardiography after revascularization procedures were more frequent among patients treated by physicians who billed for technical or professional fees than those who did not bill for those services (75).

Patients often overestimate the effectiveness of early detection and preventive interventions (73, 76), potentially leading to overenthusiasm for screening tests in general (77). One study of cancer screening found that nearly three quarters of respondents preferred a total-body computed tomographic scan over $1000 in cash (78). Such expectations are often communicated to physicians and affect clinical decisions, and they may be particularly influential when patient satisfaction is linked to financial incentives (79). Past experiences in receiving cardiac screening tests may also condition patient expectations around future screening. In some cases, cardiac screening is offered as part of a routine physical examination "package."

Direct-to-consumer cardiac screening, which often includes ECG and other cardiac testing, can bypass clinicians seeking to serve as conscientious gatekeepers. Such screening often takes advantage of consumer concerns about cardiac disease and promotes messages of patient empowerment but provides little in the way of informed decision making, clinical oversight, or follow-up (80).

Overuse of cardiac testing could also be related to the perceived risk for missing a serious diagnosis (81). Cardiac testing may be viewed as a way to protect against lawsuits related to such cases. "Defensive medicine" is the alteration of clinical behavior due to concerns over malpractice liability, with unnecessary diagnostic testing the most frequently reported defensive act (82).

How Can Physicians Reduce Overuse of Cardiac Testing?

Adhering to recommendations to not perform cardiac screening with ECG, MPI, or echocardiography in low-risk patients would help reduce overuse. Cardiovascular risk assessment should start with a global risk score that combines individual risk factor measurements into a single quantitative estimate of risk (81). Many global risk calculators are available, although the risk factors and populations addressed vary (Table 3). For example, the Framingham Risk Score, which was developed and validated in U.S. populations, excludes patients with diabetes and does not incorporate family history of early CHD. Although some tools include these risk factors, they have not been as extensively validated as the Framingham Risk Score in U.S. cohorts (83). Early CHD (typically defined as occurring in a first-degree male relative aged <55 years or a first-degree female relative aged <65 years) is a relatively modest predictor of CHD, with a relative risk of 1.5 to 2.0 after adjustment for other factors (23). Some guidelines consider diabetes a "CHD equivalent" for the purposes of risk categorization (25). Regardless of the risk calculator used, patients can be classified as low-risk according to specified thresholds (for example, 10-year risk for a CHD event of <7.5% or <10%). In patients in the low-risk category, cardiac screening is not indicated. Rather, strategies should focus on treating modifiable risk factors (such as smoking, diabetes, hypertension, hyperlipidemia, and overweight) and encouraging healthy levels of exercise.

Recommendations for cardiac screening in higher-risk patients are less clear-cut (84). The USPSTF found insufficient evidence to determine whether benefits of screening ECG outweigh harms (22), and the American College of Cardiology Foundation and American Heart Association recommend MPI as a potential option for cardiovascular risk assessment in high-risk patients (23). These recommendations are based on the higher prevalence of disease as well as the greater likelihood that findings could affect treatment decisions. Indeed, the greatest potential benefits of screening may be in pa-

tients with assessed risk close to the threshold for interventions. One study of adults aged 70 to 79 years that was published after the USPSTF review found that resting ECG correctly reclassified 14% of intermediate-risk adults (34). However, evidence on effects of cardiac screening on clinical outcomes in higher-risk patients is sparse and does not clearly show clinical benefits (85), and cost-effectiveness is uncertain (86). If screening is considered in patients with assessed risk close to treatment thresholds, it is important that they be informed of the important evidence gaps and potential harms before being screened. In patients who meet criteria for treatment on the basis of traditional risk factor assessment, further cardiac screening may be of limited value. Because of the lack of demonstrated benefits, high costs, and potential harms, coronary angiography and revascularization procedures are generally not indicated after cardiac screening, even in high-risk, asymptomatic patients (87).

Efforts to decrease overuse of cardiac screening in low-risk adults should address factors contributing to overuse. Clinician incentives should be based on delivery of appropriate care and not primarily on patient satisfaction, which could reward unnecessary testing. Efforts to reduce overuse related to physician self-referral are also important (88, 89). Enhanced oversight of direct-to-consumer cardiovascular screening is needed, including requirements for informed consent, counseling, and access to follow-up care (90).

Reducing inappropriate cardiac testing practices in clinical practice can be a challenge (91, 92). Efforts are likely to be more effective when they are more active and include individualized feedback (13). The use of health information technology, such as computer-based reminders about appropriate indications for testing at the time the order is placed, is another promising strategy (93).

CONCLUSION

Health care practices associated with high costs and limited or no benefits provide little value. There is no evidence that cardiac screening of low-risk adults with resting or stress ECG, stress echocardiography, or stress MPI improves patient outcomes, but it is associated with increased costs and potential harms. Implementing recommendations that focus on initial cardiovascular risk assessment based on traditional cardiovascular risk factors and using a global risk score, addressing modifiable risk factors, and not performing additional cardiac screening in low-risk patients would improve patient care while avoiding unnecessary harms and costs. To be most effective, efforts to reduce the use of imaging should be multifocal and should ad-

Figure. Summary of the American College of Physicians advice for high-value care on cardiac screening with electrocardiography, stress echocardiography, or myocardial perfusion imaging.

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SUMMARY OF THE AMERICAN COLLEGE OF PHYSICIANS ADVICE FOR HIGH-VALUE CARE ON CARDIAC SCREENING WITH ELECTROCARDIOGRAPHY, STRESS ECHOCARDIOGRAPHY, OR MYOCARDIAL PERFUSION IMAGING

Disease/Condition	Cardiovascular disease
Target Audience	Internists, family physicians, and other clinicians
Target Patient Population	Asymptomatic adults with low probability of cardiovascular disease
Interventions	Electrocardiography (resting or stress) Stress echocardiography Stress myocardial perfusion imaging
Outcomes	Mortality (all-cause and disease-specific) Cardiovascular events (myocardial infarction, congestive heart failure exacerbation, arrhythmia, or cardiac death)
Benefits of Screening	Identification of undiagnosed coronary heart disease Identification of persons at increased risk for cardiovascular disease events
Harms of Screening	Stress testing: sudden death or an event requiring hospitalization, adverse effects of pharmacologic agents to induce stress Myocardial perfusion imaging: radiation exposure False-positive results: anxiety, additional unnecessary tests and treatments Disease labeling Downstream harms due to follow-up testing and interventions
High-Value Care Advice	*High-Value Care Advice: Clinicians should not screen for cardiac disease in asymptomatic, low-risk adults with resting or stress electrocardiography, stress echocardiography, or stress myocardial perfusion imaging.*
Clinical Considerations	Cardiovascular risk assessment in asymptomatic adults should start with a global risk score using a risk calculator (Table 3). Adhering to recommendations would help reduce overuse. In low-risk, asymptomatic adults, clinicians should focus on strategies for mitigating cardiovascular risk by treating modifiable risk factors (such as smoking, diabetes, hypertension, hyperlipidemia, and overweight) and encouraging healthy levels of exercise.

dress clinician behaviors, patient expectations, direct-to-consumer screening programs, and financial incentives.

ACP HIGH-VALUE CARE ADVICE

High-Value Care Advice: Clinicians should not screen for cardiac disease in asymptomatic, low-risk adults with resting or stress electrocardiography, stress echocardiography, or stress myocardial perfusion imaging.

Screening with rest or stress ECG or stress cardiac imaging is not indicated in asymptomatic, low-risk patients. In this population, clinicians should focus on strategies for mitigating cardiovascular risk by treating modifiable risk factors (such as smoking, diabetes, hypertension, hyperlipidemia, and overweight) and encouraging healthy levels of exercise.

The **Figure** summarizes the recommendation and clinical considerations.

From Oregon Health & Science University, Portland, Oregon.

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