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Appropriateness Of Cardiac Stress Test Use Among Primary Care Physicians and Cardiologists In The United States

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Appropriate use criteria (AUC) for cardiac stress testing address concerns about utilization growth, high costs, and radiation safety.^{1,2} While significant attention has focused on cardiac stress test use among cardiologists, less is known about comparative utilization patterns among primary care physicians and other specialists, and evidence thus far has been conflicting.^{3,4} Understanding the extent and nature of potential differences in appropriate use across specialties is important because it informs approaches to reduce unnecessary testing—and it may help insurers and policymakers better shape payment policies and target interventions. In this study, we use nationally-representative data to examine differences in appropriate use of cardiac stress testing between cardiologists and primary care physicians (PCPs) in the US.

We analyzed data from the National Ambulatory Medical Care Survey (NAMCS), a nationally-representative US sample of visits to office-based physicians, from 1993–2010 and 2012 (2011 data unavailable). The National Center for Health Statistics (NCHS) and the Centers for Disease Control and Prevention conduct the NAMCS annually on a nationally representative sample of visits to office-based physicians in the United States. Each physician in the survey is randomly assigned to a 1-week reporting period during which a systematic random sample of visits are surveyed. Using patient record forms, physicians, their staff members, or US Census Bureau staff collect data on patients' symptoms and demographic characteristics, physicians' diagnoses, medications ordered or provided, and medical services provided. For these reasons, the NAMCS provides a sufficient amount of clinical data to identify cardiac stress tests that are rarely appropriate. Performance or referral for a rarely appropriate cardiac stress test in adult patients (≥ 18 years) was the

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All authors had access to the data and a role in writing the manuscript.

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primary outcome. PCPs included physicians in family practice, internal medicine, and obstetrics/gynecology. Our methods have been previously described,⁵ but more information on the methods used for NAMCS sampling, data collection, and weighting are available at www.cdc.gov/nchs/ahcd.htm.

We assessed appropriateness of cardiac stress testing using AUC developed collaboratively by several medical specialty societies.⁶ Because the 2012 NAMCS did not distinguish between imaging and nonimaging stress tests, we adapted the most liberal stress electrocardiogram/imaging stress appropriateness criteria for all years, so as to uniformly apply appropriateness criteria, maximize our specificity, and minimize the likelihood of incorrectly categorizing appropriate tests as rarely appropriate (see Table footnote for specific criteria). Appropriateness comparisons between specialties were limited to 2005–2012, the years after which AUC were adopted. Early (2005–2008) and late (2009–2012) appropriateness rates were also compared within specialties, though PCP analyses were extended to 2003 for statistical reliability.

All analyses accounted for the NAMCS's complex sampling design. Multivariable logistic regression models adjusted for patients' clinical and demographic characteristics, insurance, region, and physician specialty. Analyses were performed using Stata.

Over the 17-year period, the rate of cardiac stress test use among US office-based physicians was substantially higher among cardiologists compared to PCPs, but cardiologists' testing rates were stable while total visits grew, so total referrals grew in proportion to visit volume (Figure). In the early years of AUC (2005–2008), the proportion of tests that were rarely appropriate was 17.6% among PCPs and 8.3% among cardiologists. Corresponding rates in later years (2009–2012) were 23.8% and 9.3%, respectively, and there was no evidence of a difference between the two time periods for either specialty (time period OR for PCPs=0.92, 95% CI 0.44–1.95; OR for cardiologists=1.14, 95% CI 0.59–2.19).

In adjusted analyses, PCPs were more likely to order rarely appropriate cardiac stress tests (aOR=3.08, 95% CI 1.88–5.05). A sensitivity analysis limited to 2009–2012 yielded similar findings.

Using permissive criteria to determine appropriateness, we found that primary care physicians are more likely to order or perform a rarely appropriate cardiac stress test than cardiologists. AUC interventions have largely focused on cardiologists' ordering patterns but programs tailored to PCPs—who ordered nearly one-third of cardiac stress tests in the US from 2009–2012—may help reduce unnecessary testing and radiation exposure in their patient populations.

Our study is limited because the AUC we used were published in 2014 and retrospectively adapted from the most liberal stress electrocardiography/imaging stress criteria, while the overwhelming majority of cardiac stress tests in the US are performed with imaging.⁵ In light of this, we may underestimate the proportion of rarely appropriate tests among physicians across all specialties. In addition, differences between PCPs and cardiologists in the comprehensiveness and detail of their completed patient record forms may also explain the differences we observed in appropriateness, particularly if cardiologists were more likely

to document appropriate indications for cardiac stress testing. Nonetheless, we conclude that payers and policymakers designing appropriate use programs should consider these overall patterns and specialty patterns in their decision-making.

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Figure 1.

Annual Number and Rate of Cardiac Stress Test Referrals for Adults in U.S. Ambulatory Care Visits, 1995–2012

Note: Error bars represent 95% CI. Total visits to cardiologists grew while their overall testing rate was stable, so total referrals grew in proportion to visit volume

Table 1

Prevalence and Adjusted Odds of Rarely Appropriate Cardiac Stress Test Referrals in U.S. Ambulatory Care Visits, 2005–2012

Office-based Visits				
	Rarely appropriate rate*	Adjusted OR	95% CI	P value
Age, yrs				
18–64	13	1.00		
65	14	0.97	0.56 to 1.68	0.90
Gender				
Male	12	1.00		
Female	15	1.31	0.85 to 2.02	0.22
Race/ethnicity				
White	12	1.00		
Black	21	1.65	0.88 to 3.11	0.12
Other [†]	20	1.58	0.49 to 5.16	0.44
Private Insurance				
No	15	1.00		
Yes	12	0.63	0.37 to 1.09	0.10
Region				
Northeast [‡]	7	1.00		
Midwest	12	1.39	0.57 to 3.42	0.47
South	15	2.00	0.95 to 4.24	0.07
West	16	1.94	0.83 to 4.50	0.12
Physician specialty				
Cardiology	9	1.00		
Primary care	21	3.08	1.88 to 5.05	<0.001
Other	22	2.65	1.17 to 6.04	0.02
Smoker				
No	11	1.00		
Yes	10	0.87	0.48 to 1.60	0.66
Unknown	19	1.59	0.93 to 2.72	0.09
Visit diagnosis [¶]				
Hypertension	11	0.62	0.41 to 0.93	0.02
Dyslipidemia	13	1.14	0.75 to 1.73	0.54

Abbreviations: CI, confidence interval; OR, odds ratio; CHD, coronary heart disease

Note: Does not include hospital outpatient visits or community health centers in 2012, but less than 1% of cardiac stress tests originate in community health centers

* A test was considered appropriate/maybe appropriate if ANY off the following were present: chest pain/angina, ischemic equivalents (including jaw or shoulder pain, palpitations, and dyspnea), CHD, CHD risk equivalents, intermediate Framingham CHD risk status, congestive heart failure, electrocardiogram abnormalities, syncope, or pre-operative testing.

[†]Test prevalence may be unreliable for other race/ethnicity and northeast region due to small number of rarely appropriate tests.

[¶]Reference for each diagnosis category includes all visits without the diagnosis category

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