Use of non-indicated cardiac testing in low-risk patients: Choosing Wisely

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INTRODUCTION

In 2011, the American Board of Internal Medicine Foundation created the Choosing Wisely initiative, which encourages physicians to be responsible stewards of finite healthcare resources.[1] Through this programme, specialty societies have created lists of "Five Things Physicians and Patients Should Question". Cardiac testing in low-risk patients appears on the Choosing Wisely lists of six specialty societies (see online supplementary table S1). A challenge in studying potential waste or creating incentives for improving healthcare efficiency is the scarcity of accepted definitions of low-value or potentially harmful care. To date, Choosing Wisely recommendations have not been translated into claims-based algorithms for measurement purposes and thus neither the prevalence of these services nor the associated spending has been estimated at a population level.

Using Medicare administrative data from 2006 to 2011, we estimated the proportion of low-risk Medicare beneficiaries receiving non-invasive cardiac screening tests without a clear, pertinent symptomatic indication, as well as the regional variation in and spending associated with these tests. For comparison and as a validation of our patient risk assignment, we measured cardiac testing in beneficiaries with or at high risk for cardiac disease.

METHODS

Using the Medicare 40% denominator file, we identified all fee-for-service Medicare beneficiaries enrolled in Medicare Parts A, B and D (inpatient, outpatient and prescription coverage), 2006–2011, and created six annual enrolment cohorts (see online supplementary table S1 for an expanded version of methods). Each beneficiary was assigned a cardiovascular disease risk status (low or high) based on records in Medicare Carrier, Outpatient, MedPAR, Hospice and Prescription Drug Event files using a combination of *International Classification of Disease* codes and drug ingredient codes. For each annual enrolment cohort, beneficiaries with no evidence of significant cardiovascular disease or cardiovascular risk were deemed low-risk, and the remaining beneficiaries were deemed high-risk for cardiovascular disease or cardiovascular events.

We identified cardiac tests in each calendar year for beneficiaries in the low-risk cohort and, for comparison, the high-risk cohort, using current procedural terminology codes for ECGs, cardiovascular stress tests, echocardiograms and advanced cardiac imaging (CT, MRI, positron emission tomography). To quantify use of low-value tests, we excluded testing events that had diagnosis codes in any of the first four fields on a claim involving cardiac disease, cardiac-related symptoms or any conditions that might justify the test. As a result, the tests we included in our analysis were considered potentially 'non-indicated'.

RESULTS

Cohort and validation

We identified 8.2 million low-risk person-years and 10.1 million high-risk person-years for inclusion in our analysis across 2006–2011 (table 1). Each year, low-risk beneficiaries accounted for 42%–46% of total observation time. At the hospital referral region (HRR) level, the mean proportion of person-years assigned to the low-risk group in 2011 was 45.9%, with an SD of 5.0. The mean age of the beneficiaries was similar overall in the two risk groups given the restriction placed on the age range in both groups. Patients in the high-risk cohort, compared with the low-risk cohort, were more likely to be black (9.9% vs 6.2%),

Table 1 Characteristics of the study population by risk assignment, 2006–2011

Characteristics	High-risk cohort (N=10 077 959 person-years)	Low-risk cohort (N=8 194 085 person-years)
Mean age (SD)	72.4 (4.3) years	71.4 (4.2) years
Female	56.9%	64.6%
Race/ethnicity		
Black	9.9%	6.2%
Hispanic	7.6%	6.5%
Other	82.5%	87.3%
Medicaid enrolled	30.7%	19.5%
Mortality	5.8%	0.6%
Mean annual payments (SD)		
Total	$15 031 ($161)	$2623 ($40)
Physician	$3866 ($31)	$1353 ($13)
Hospital/skilled nursing facility	$7506 ($124)	$572 ($27)
Outpatient	$1921 ($27)	$503 ($9)
Home health	$865 ($18)	$117 ($9)

Payments were weighted by mean follow-up time and price-adjusted. Payment information was not available for 673 person-years in the high-risk cohort and 1745 person-years in the low-risk cohort.

Hispanic (7.6% vs 6.5%), Medicaid-eligible (30.7% vs 19.5%) (a poverty indicator) and men (43.1% vs 35.4%). High-risk beneficiaries had higher average Medicare spending (total $15 031 vs $2623) and higher mortality rates (5.8% vs 0.6%), validating the approach used to discriminate risk status.

We performed a sensitivity analysis to explore the validity of our cohort assignments by measuring the rate of significant cardiovascular events (acute myocardial infarction and stroke) in 6 years among the 2006 low-risk and high-risk cohorts. We found the cumulative prevalence of acute myocardial infarction was 7.6% in the high-risk cohort and 2.2% in the low-risk cohort (8.6% and 3.1% among men) after 6 years. Similarly, the prevalence of stroke was 6.3% in the high-risk cohort and 2.3% in the low-risk cohort (6.3% and 2.7% among men).

Prevalence

Nationally, the per cent of low-risk and high-risk beneficiaries with one or more potentially non-indicated cardiac tests in a given calendar year was relatively constant from 2006 to 2011. In the low-risk cohort, the rate of non-indicated cardiac testing ranged from a low rate of 11.7% in 2007 to a high rate of 12.8% in 2011. By comparison, for the high-risk cohort, rates of cardiac testing without a pertinent indication each year ranged from 18.9% in 2006 to a high rate of 20.2% in 2011. Testing rates were primarily driven by use of ECGs (table 2). Testing rates were comparable among black, Hispanic and other beneficiaries in both cohorts. Estimated 2011 Medicare payments for potentially non-indicated cardiac tests among low-risk, fee-for-service beneficiaries, aged 66–80 years, totalled approximately $9.4 million.

Regional variation

Low-value testing in the low-risk cohort was the least common in the central and north-western parts of the USA (figure 1). In 2011, the non-indicated cardiac testing prevalence across HRRs ranged from 6.6% to 23.6% (coefficient of variation (CV)=0.25) in the low-risk cohort and from 11.5% to 28.2% (CV=0.31) in the high-risk cohort. HRR-level non-indicated cardiac screening in the low-risk cohort was highly correlated with non-indicated screening in the high-risk cohort (r=0.77). Non-indicated cardiac screening in the low-risk cohort in 2006 was also positively correlated with the HRR-specific number of cardiologists per capita in 2006 (r=0.57).

DISCUSSION

In each year from 2006 to 2011, we found a modest 13% of low-risk Medicare beneficiaries received cardiac tests (largely ECGs) without clear evidence of a pertinent indication, as well as significant geographical variation in the use of these potentially non-indicated tests. The strong association between potentially non-indicated cardiac testing in low-risk groups and cardiac testing in high-risk groups demonstrates that some physicians use more cardiac tests regardless of the clinical scenario, including in low-risk, low-value situations. Our study builds on previous efforts to understand overall testing prevalence and testing among high-risk patients,[2–6] inappropriate use of particular advanced imaging modalities[7] and regional variation in cardiologists' propensity to test and treat.[8]

This analysis is built on Medicare claims submitted for billing purposes, which has important limitations; we do not have the clinical detail available in health records. We have used all information available to us (including pharmaceutical claims), however, to conservatively define a low-risk cohort, we have eliminated testing events associated with symptoms and conditions that would appropriately prompt testing. Our data are reassuring in that mortality, acute vascular events and testing rates among our defined high-risk cohort are substantially higher than among the low-risk cohort. The difference in testing rates persists even after excluding testing events with symptomatic indications. A final important limitation of the study is that our criteria for inclusion in the low-risk cohort may select distinct populations in different regions due to differences in coding or intensity of treatment. Prior research has shown substantial differences in diagnostic practices that are unlikely to be related to patient characteristics across the US regions.[9] This may result in a potentially 'healthier' low-risk group in more intense regions and, more importantly, lead to misclassification of low-risk patients as high-risk in

Table 2 Variation in potentially non-indicated cardiac testing prevalence for high-risk and low-risk cohorts across 306 hospital referral regions, 2011

	Composite (all tests)		ECGs		Cardiovascular stress tests		Echocardiograms		Advanced cardiac imaging	
	High-risk	Low-risk	High-risk	Low-risk	High-risk	Low-risk	High-risk	Low-risk	High-risk	Low-risk
Mean	20.2%	12.8%	19.4%	12.4%	0.71%	0.30%	0.64%	0.25%	0.15%	0.04%
Coefficient of variation	0.31	0.25	0.14	0.26	0.47	0.52	0.90	1.04	0.93	1.46
IQR	18.2–21.9%	10.4–14.7%	17.5–21.1%	10.0–14.3%	0.47–0.92%	0.19–0.41%	0.24–0.93%	0.06–0.37%	0.04–0.22%	0.00–0.05%

Testing prevalence indicates per cent of beneficiaries with one or more tests without associated symptomatic indication in the calendar year. Data reflect 1.9 million person-years in the high-risk cohort and 1.6 million person-years in the low-risk cohort.

these areas. Thus, it is likely that our estimates of unnecessary testing in areas with more intense diagnostic coding are conservative.

Our methodology also does not allow us to estimate the full impact of unnecessary tests and treatments. Greater use of ECGs for low-risk patients in some areas, for example, may represent a cost savings relative to practice patterns in which low-risk patients routinely receive higher cost cardiac imaging. On the other hand, even low-cost tests like ECGs may have significant effects on costs and outcomes by way of incidental or false positive findings that generate further testing and intervention.

The long-standing debate about the appropriateness of cardiac screening may make it especially challenging for Choosing Wisely cardiac-specific recommendations to achieve acceptance and adherence. The debate largely centres on the most common form of such screening, ECGs. Prior to 2009, Medicare required a screening ECG as part of the Initial Preventive Physical Exam. After 2009, this screening was optional, but reimbursed.[10 11] In 2012, the US Preventive Services Task Force (USPSTF) recommended against ECG screening in asymptomatic adults at low risk for coronary heart disease, giving such tests a 'D' recommendation ('moderate or high certainty that the service has no net benefit or that the harms outweigh the benefits').[12] The USPSTF also found 'insufficient evidence' to provide a recommendation for or against ECG screening in patients at medium-risk and high-risk for coronary heart disease. American College of Cardiology (ACC) and American Heart Association (AHA) guidelines suggest that resting ECGs are 'reasonable' in asymptomatic patients with diabetes or hypertension and 'may be considered' in asymptomatic patients without diabetes or hypertension (evidence ranked C, indicating 'the primary source of the recommendation was consensus opinion, case studies, or standard of care').[13] The discord between the USPSTF and the ACC and AHA on this issue exemplifies the challenge of identifying low-value services in healthcare.

In this study, we specifically focus on low-value cardiac testing as defined on Choosing Wisely lists, and we believe our interpretation was conservative. Our identification of overuse is, however, retrospective; risk is hard to estimate with precision at the point of care. Commonly used risk calculators would assign a 10%, 10-year risk to most American men over 65 years of age,[14] demonstrating the challenge physicians face in identifying low-risk patients with confidence. Our categorisation of patients with hypertension as low risk may not resonate with those who suggest asymptomatic testing in these patients is 'reasonable'. Our study will not resolve this debate. We note, however, that 33% of the ECGs administered in our low-risk cohort had an associated primary diagnosis of screening. This finding quantifies the potential

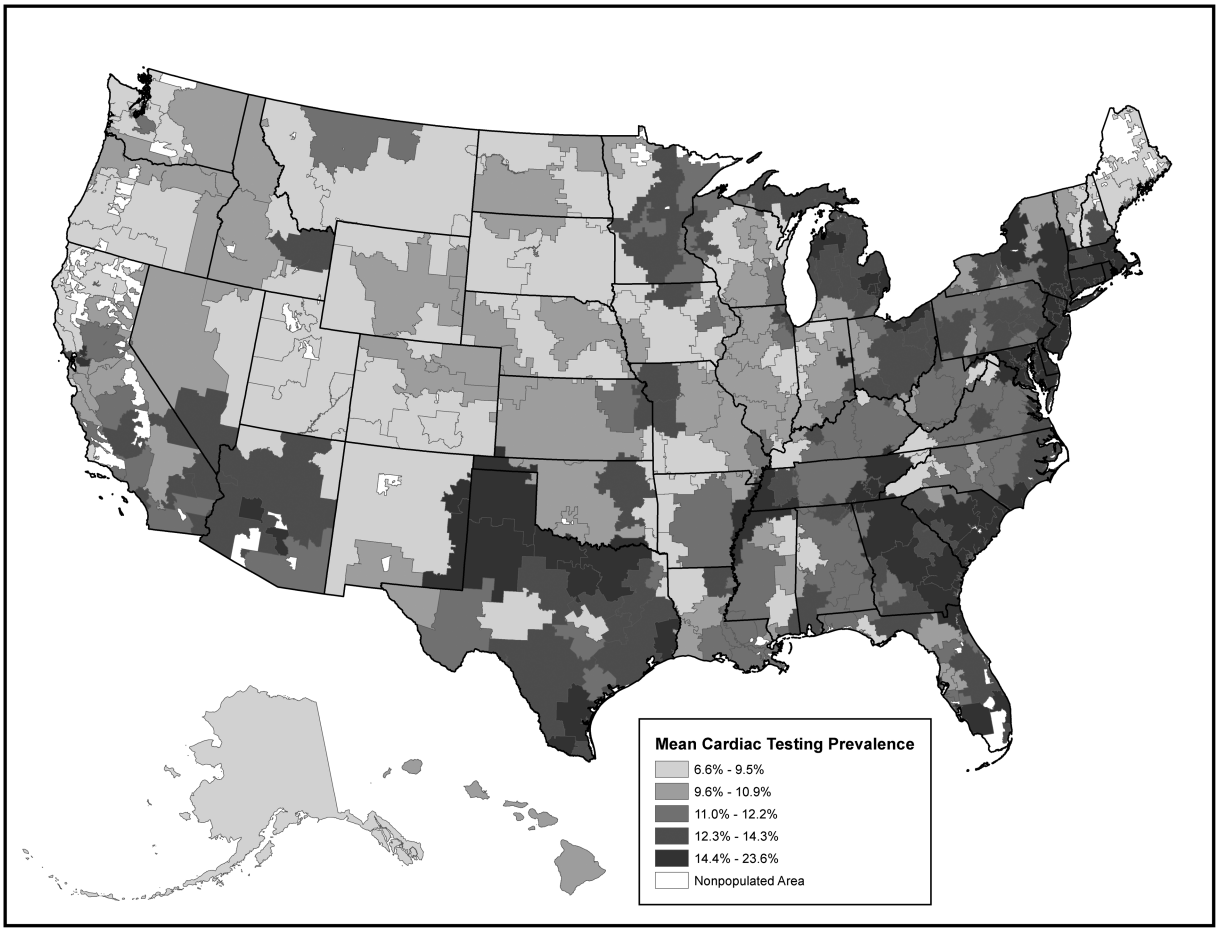

Figure 1 Map of the potentially non-indicated cardiac testing prevalence for the low-risk cohort across 306 hospital referral regions, 2011. Testing prevalence indicates per cent of beneficiaries with one or more tests in the calendar year. Cardiac testing was higher in the southern and eastern regions of the USA. Data reflect 1.6 million person-years in the low-risk cohort.

impact of this disagreement and highlights the need for an evidence-based approach to risk stratification, screening indications and ideally a consensus definition for non-indicated tests, the latter being the aim of the Choosing Wisely campaign.

The Choosing Wisely initiative has put the weight of physician specialty societies behind the identification of low-value services and care. While identifying low-value services is complex and important, the value of the endeavour would be greater with higher-impact recommendations. The Choosing Wisely lists have been criticised for identifying low-impact and/or long agreed upon services; this appears the case for the Choosing Wisely selected cardiac testing services we studied in the Medicare population.[15] Quantifying the extent to which the observed care patterns are also experienced by the under 65-year-olds would determine with greater precision the true magnitude of low-value cardiac testing in the USA. As definitions of appropriate and wasteful care (based on both efficacy and cost) are improved and providers are educated on the risks of overtreatment, measurement of value can incorporate use of high-value services and avoidance of low-value services.

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