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

Carrie H Colla, Thomas D Sequist, Meredith B Rosenthal, William L Schpero, Daniel J Gottlieb, Nancy E Morden

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. 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%),
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 variation in cardiologists per capita in 2006 (r=0.57).

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. 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
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

<table>
<thead>
<tr>
<th>Composite (all tests)</th>
<th>Advanced cardiac imaging</th>
<th>Echocardiograms</th>
<th>Cardiovascular stress tests</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>High-risk</strong></td>
<td><strong>Low-risk</strong></td>
<td><strong>High-risk</strong></td>
<td><strong>Low-risk</strong></td>
</tr>
<tr>
<td>Mean</td>
<td>20.2%</td>
<td>12.8%</td>
<td>19.4%</td>
</tr>
<tr>
<td>Coefficient of variation</td>
<td>0.31</td>
<td>0.25</td>
<td>0.31</td>
</tr>
<tr>
<td>IQR</td>
<td>18.2–21.9%</td>
<td>10.4–14.7%</td>
<td>17.5–21.1%</td>
</tr>
</tbody>
</table>

Testing prevalence indicated 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.

**Table 2** Variation in potentially non-indicated cardiac testing prevalence for high-risk and low-risk cohorts across 306 hospital referral regions, 2011.
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.\(^1\) 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.

**Author affiliations**

1. The Dartmouth Institute for Health Policy & Clinical Practice, Geisel School of Medicine at Dartmouth, Lebanon, New Hampshire, USA
2. Norris Cotton Cancer Center, Dartmouth-Hitchcock Medical Center, Lebanon, New Hampshire, USA
3. Department of Health Care Policy, Harvard Medical School, Boston, Massachusetts, USA
4. Division of General Internal Medicine, Brigham and Women’s Hospital, Boston, Massachusetts, USA
5. Partners HealthCare, Boston, Massachusetts, USA
6. Department of Health Policy and Management, Harvard School of Public Health, Boston, Massachusetts, USA
7. Department of Community and Family Medicine, Geisel School of Medicine at Dartmouth, Lebanon, New Hampshire, USA

**Contributors** CHC and NEM had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: CHC, TDS, MBR, WLS, DJG, NEM. Acquisition of data: CHC. Analysis and interpretation of data: CHC, WLS, DJG. Drafting of the manuscript: CHC, TDS, MBR, WLS, DJG, NEM. Critical revision of the manuscript for important intellectual content: CHC, TDS, MBR, WLS, DJG, NEM. Statistical analysis: WLS, DJG. Obtained funding: CHC, TDS. Study supervision: CHC.

**Funding** This study was supported by grants from the National Institute on Aging (P01 AG019783 and K23 AG035030), the Robert Wood Johnson Foundation’s Changes in Health Care Financing and Organization (HCFO) Initiative (#70729) and The Commonwealth Fund (#20130339).

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.
Competing interests None.

Ethics approval This study was approved by the institutional review board at Dartmouth College, Hanover, NH, USA.

Provenance and peer review Not commissioned; externally peer reviewed.

Data sharing statement Study data are available from the corresponding author on request.

REFERENCES