



# Is cost-effectiveness the “tie-breaker” when deciding between anatomic and functional evaluation in stable ischemic heart disease?

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Cardiovascular disease (CVD) and stroke evaluation and management remain the leading direct health expenditure in the United States (US) and account for 14% of every US healthcare dollar spent.<sup>1</sup> Percutaneous coronary intervention (PCI) accounts for more than \$10 billion per year in hospital costs alone.<sup>2</sup> While there were initial reductions in the volume of PCIs performed for stable coronary artery disease (CAD) after the publication of the Appropriate Use Criteria for Coronary Revascularization in 2009,<sup>3</sup> PCI rates have since then largely remained stable.<sup>4</sup> As such, an opportunity for intervention (pardon the pun) still exists in this domain. In this issue of the *Journal of Nuclear Cardiology*, Takura and colleagues help us to better understand the medical economics of stable CAD testing with the goal of optimizing resource utilization in an outcomes-centric system.<sup>5</sup>

In this investigation, the study authors evaluated the medical costs and cost-effectiveness, as well as adverse coronary events, in adult patients who underwent anatomical versus functional evaluation of stable CAD. The study was conducted as a retrospective analysis of 3477 cases gathered from TheBD (The Tokyo University Health Economy Big Data) database in Japan between April 2012 and March 2019. Cases were analyzed within three categories based on the initial

evaluation strategy: non-invasive and invasive with cardiac catheter testing (Category A), non-invasive (Category B), and invasive (Category C). Within each category, cases were divided into anatomical testing, including coronary computed tomography angiography (CTA) and conventional coronary angiography (CAG), and functional testing, including cardiac single-photon emission computed tomography (SPECT) and fractional flow reserve (FFR), groups and matched by propensity score. The authors found that the use of functional testing was associated with lower rates of revascularization overall (1.7% vs. 5.2% for patients undergoing an initial non-invasive strategy and 15.7% vs. 22.2% for patients undergoing an invasive evaluation strategy) with no significant differences in major adverse coronary events. Functional testing was also associated with lower, but not reaching statistical significance, cumulative medical costs and a significantly improved cost-effectiveness analysis (annual medical costs per life year; CEA) compared to the anatomical testing group (2431 ± 3433 US\$/LY vs. 2902 ± 5115 US\$/LY, respectively; *P* .043).

With the tremendous attention on utilization of multimodality imaging in patients with stable ischemic heart disease, this study adds another economic lens to the contrasting strengths and weaknesses of functional versus anatomical testing for stable CAD. The analysis is most interesting when applied to the group undergoing an initial non-invasive evaluation strategy similar to those studied in the recent PROMISE and SCOT-HEART trials.<sup>6,7</sup> In the mid-2000s, anatomical testing, specifically CTA, was associated with a 15% to 40% increase in costs when compared to stress perfusion imaging.<sup>8,9</sup> However, analysis from the PROMISE economic study cohort (2010–2013) showed that the magnitude of that difference was smaller and actually observed comparable net costs for CTA and functional

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stress testing strategies overall.<sup>10</sup> The present study reveals similar results, however, the authors add a new dimension to the analysis with the addition of CEA that showed significantly improved outcomes for functional compared to anatomical testing ( $1551 \pm 2188$  US\$/LY vs.  $2120 \pm 3750$  US\$/LY;  $P .009$ ).

While we cannot directly extrapolate the impact of the recent ISCHEMIA trial results to the present study due to different inclusion criteria, we wonder if and how the rates of angiography and revascularization both in Japan and the United States will change given the negative primary outcomes (and secondary individual outcomes of MI and death) in the early revascularization arm over optimal medical therapy alone in patients with stable coronary artery disease and moderate-to-severe ischemia.<sup>11</sup> If the growth rate of revascularization is blunted would medical costs decrease overall? Perhaps. Takura et al. found that the overall cost-effectiveness was greater for those who underwent an initial non-invasive evaluation (Category B) versus those who underwent an initial invasive evaluation (Category C).

Unless we prevent CVD and/or significantly curb care cost, total direct medical costs of CVD are projected to increase by 135% in the next 20 years.<sup>1</sup> Understanding cost effective analyses is critical for guideline development, healthcare policy, and the financial health of our healthcare system overall.

## Disclosures

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## References

1. Virani SS, Alonso A, Benjamin EJ, Bittencourt MS, Callaway CW, Carson AP, et al. Heart disease and stroke statistics-2020 update: A report from the American Heart Association. *Circulation* 2020;141:139-596.
2. Kwok CS, Amin AP, Shah B, Kinnaird T, Alkutan R, Balghith M, Ratib K, Nolan J, Bagur R, Mamas MA. Cost of coronary syndrome treated with percutaneous coronary intervention and 30-day unplanned readmission in the United States. *Catheter Cardiovasc Interv* 2021;97(1):80–93
3. Desai NR, Bradley SM, Parzynski CS, Nallamothu BK, Chan PS, Spertus JA et al. Appropriate use criteria for coronary revascularization and trends in utilization, patient selection, and appropriateness of percutaneous coronary intervention. *JAMA* 2015;314:2045-53
4. Raza S, Deo SV, Kalra A, Zia A, Altarabsheh SE, Deo VS et al. Stability after initial decline in coronary revascularization rates in the United States. *Ann Thorac Surg* 2019;108:1404–08
5. Takura T, Yokoi H, Tanaka N, Matsumoto N, Yoshida E, Nakata T et al. Health economics-based verification of functional myocardial ischemia evaluation of stable coronary artery disease in Japan: A long-term longitudinal study using propensity score matching. *J Nucl Cardiol* 2021; <https://doi.org/10.1007/s12350-020-02502-9>.
6. Douglas PS, Hoffmann U, Patel MR, Mark DB, Al-Khalidi HR, Cavanaugh B, et al. Outcomes of anatomical versus functional testing for coronary artery disease. *N Engl J Med* 2015;372:1291-1300.
7. SCOT-HEART Investigators, Newby DE, Adamson PD, Berry C, Boon NA, Dweck MR, et al. Coronary CT angiography and 5-year risk of myocardial infarction. *N Engl J Med* 2018;379:924-33.
8. Hlatky MA, Shilane D, Hachamovitch R, Dicarli MF, S Investigators. Economic outcomes in the study of myocardial perfusion and coronary anatomy imaging roles in coronary artery disease registry: The SPARC Study. *J Am Coll Cardiol* 2014;63:100208
9. Shreibati JB, Baker LC, Hlatky MA. Association of coronary CT angiography or stress testing with subsequent utilization and spending among Medicare beneficiaries. *JAMA* 2011;306:2128-36
10. Mark DB, Federspiel JJ, Cowper PA, Anstrom KJ, Hoffmann U, Patel MR, et al. Economic outcomes with anatomical versus functional diagnostic testing for coronary artery disease. *Ann Intern Med* 2016;165:94-102.
11. ISCHEMIA Trial Research Group, Maron DJ, Hochman JS, O'Brien SM, Reynolds HR, Boden WE, et al. International Study of Comparative Health Effectiveness with Medical and Invasive Approaches (ISCHEMIA) trial: Rationale and design. *Am Heart J* 2018;201:124-35.

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