

## EDITORIAL COMMENT

# Is Appropriateness Appropriate?\*

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Improvements in prevention and treatment have resulted in striking reductions in age-adjusted mortality rates related to cardiovascular disease during the past several decades (1). These impressive results have been catalyzed by new therapies, many of which have been substantiated in large-scale multicenter clinical trials that provide the foundation for evidence-based practice guidelines. During the same time period, diagnostic testing has proliferated at an astonishing rate. Stress imaging tests in particular have increased at an annual rate of 6.1% since 1993 in individuals covered by Medicare (2). It is estimated that nearly 8 million single-photon emission computed tomography (SPECT) studies are now performed annually in the U.S., compared with 4 million in 1998 (3). Diagnostic imaging has increased more rapidly than any other component of medical care (4). The increase in cardiovascular imaging procedures is not related to changes in disease prevalence or severity, and it has been difficult to tie the increase in imaging to improved health outcomes. It is not surprising that imaging is now under close scrutiny by the payers of health care. Does the proliferation of diagnostic imaging represent added value or added cost?

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Unlike prevention and treatment strategies supported by evidence-based practice guidelines, the evidence base for imaging is anecdotal, fragmented, and lacking in prospective clinical trials. Thus, as the field of cardiovascular medicine evolves from clinical practice guidelines to clinical performance measures (5,6), metrics to measure quality of imaging will be elusive. It is rarely possible to demonstrate that performance of an imaging test leads directly to improved health outcomes. Rather than outcome measures, quality might be assessed by measures of laboratory structure, such as equipment, staff training, and laboratory protocols, or measures of laboratory

process, such as image acquisition, image interpretation, and reporting. More importantly, one might measure patient selection, as this key variable will impact directly on subsequent clinical management, downstream testing procedures, and costs (7).

Against this backdrop, the American College of Cardiology has provided the needed leadership in addressing these quality issues by spearheading the recent development of appropriateness criteria for cardiovascular imaging (8,9), which are designed to define the appropriate test for the appropriate indication in the appropriate patient. The first such criteria were developed for SPECT myocardial perfusion imaging (MPI) in conjunction with the American Society of Nuclear Cardiology (10). The process for appropriateness criteria development is only partially evidence-based and is heavily weighted by expert consensus (8). The writing committee examined 52 possible applications of SPECT, identifying 27 as appropriate indications, using an arbitrary threshold value of 7 or greater on a scale of 9, and 13 as inappropriate indications, using a threshold value of 3 or less. Importantly, however, 12 applications (nearly 25% of the total) achieved values ranging from 4 to 6 and were deemed to have an "uncertain" indication.

The only means to determine whether these appropriateness criteria are themselves appropriate as surrogates for quality is to evaluate them in clinical practice. The important study by Gibbons et al. (11) in this issue of the *Journal* is the first such investigation to critically evaluate the American College of Cardiology Foundation/American Society of Nuclear Cardiology appropriateness criteria for stress SPECT-MPI in the setting of busy imaging laboratories at a large academic medical center. Gibbons et al. (11) demonstrate that the application of these criteria in practice, although desirable, may be met with considerable challenges and difficulties. The authors point out the many assumptions required to apply the criteria and, despite these assumptions, the difficulty in determining appropriateness of testing in many patients, even in a large volume system with an established database and highly experienced nurse abstractors. The nurse abstractors encountered difficulty in categorizing many patients, in that 11% were not classifiable, and there was often lack of agreement among the nurses. Presumably, application of the criteria in the setting of a smaller clinical practice with fewer resources will be even more troublesome.

Appropriateness criteria for echocardiography have also been published recently using similar methodology (12), but the criteria for stress echocardiography are still in development. To assess how appropriateness criteria for stress echocardiography might perform in practice, Gibbons et al. (11) extrapolated the criteria for SPECT-MPI to their stress echocardiography laboratory. Their results demonstrate a remarkably concordant degree of appropriate testing in nuclear cardiology and stress echocardiography (64% in both laboratories) and a low and similar degree of inappropriate testing (14% vs. 18%, respectively). The similarity of appropriate and inappropriate

\*Editorials published in the *Journal of the American College of Cardiology* reflect the views of the authors and do not necessarily represent the views of *JACC* or the American College of Cardiology.

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testing between the nuclear and stress echocardiography laboratories is interesting, as is the similar number of unclassifiable patients, but these results are also difficult to fully interpret. As noted by the authors, applying the appropriateness criteria designed for nuclear stress testing to stress echocardiography may not be valid, and this represents a limitation of the study.

On the other hand, the finding that the vast majority of inappropriate indications for testing were confined to only a small number of indications is quite important, because it identifies an opportunity for quality improvement and educational programs to achieve measurable improvement in results. The report from Gibbons et al. (11) represents the first step in the process of evaluating and refining the strategy of using appropriateness criteria as a measure of quality in cardiovascular imaging. Patients in this study underwent imaging before the appropriateness criteria were published, and it is possible that different results might now be obtained. Additional studies in other laboratories in diverse practice settings should be encouraged as they will lead to an iterative process in which the criteria are continually refined and improved upon, thus with time becoming more "appropriate" as appropriateness criteria.

There is no doubt that imaging has transformed, and will continue to transform, the practice of cardiovascular medicine. The continuing advances in noninvasive imaging create a unique opportunity to improve diagnosis and medical management, but also create challenges in patient selection, clinical training, integration with established clinical practice, and resource utilization and cost effectiveness. As a cardiovascular community we need to provide rigorous evidence that imaging, and in particular appropriate imaging, enhances quality of care.

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## REFERENCES

1. Ford ES, Ajani UA, Croft JB, et al. Explaining the decrease in U.S. deaths from coronary disease, 1980–2000. *N Engl J Med* 2007;356:2388–98.
2. Lucas FL, DeLorenzo MA, Siewers AE, Wennberg DE. Temporal trends in the utilization of diagnostic testing and treatments for cardiovascular disease in the United States, 1993–2001. *Circulation* 2006;113:374–9.
3. The Myocardial Perfusion Imaging Market Guide (U.S.) Supplement to the U.S. Imaging Market Guide. Malvern, PA: Arlington Medical Resources, Inc., 2007.
4. Iglehart JK. The new era of medical imaging—progress and pitfalls. *N Engl J Med* 2006;354:2822–8.
5. Bonow RO, Bennett S, Ganiats TG, et al. ACC/AHA clinical performance measures for adults with chronic heart failure: a report of the American College of Cardiology/American Heart Association Task Force on Performance Measures (Writing Committee to Develop Heart Failure Clinical Performance Measures). *J Am Coll Cardiol* 2005;46:1144–78.
6. Krumholz HM, Anderson JL, Brooks NH, et al. ACC/AHA clinical performance measures for adults with ST-elevation and non-ST-elevation myocardial infarction: a report of the American College of Cardiology/American Heart Association Task Force on Performance Measures (Writing Committee to Develop Performance Measures on ST-Elevation and Non-ST-Elevation Myocardial Infarction). *J Am Coll Cardiol* 2006;47:236–65.
7. Douglas P, Iskandrian AE, Krumholz HM. Achieving quality in cardiovascular imaging. Proceedings from the American College of Cardiology–Duke University Medical Center Think Tank on Quality in Cardiovascular Imaging. *J Am Coll Cardiol* 2006;48:2141–51.
8. Patel MR, Spertus JA, Brindis RG, et al. ACCF proposed method for evaluating the appropriateness of cardiovascular imaging. *J Am Coll Cardiol* 2005;46:1606–13.
9. Douglas PS, MD, Wolk MJ, Brindis R, MD, Hendel RC. Appropriateness criteria: breaking new ground. *J Am Coll Cardiol* 2005;46:2143–4.
10. Brindis RG, MD, Douglas PS, MD, Hendel RC, et al. ACCF/ASNC appropriateness criteria for single-photon emission computed tomography myocardial perfusion imaging (SPECT MPI): a report of the American College of Cardiology Foundation Quality Strategic Directions Committee Appropriateness Criteria Working Group and the American Society of Nuclear Cardiology. *J Am Coll Cardiol* 2005;46:1587–605.
11. Gibbons RJ, Miller TD, Hodge D, et al. Application of appropriateness criteria to stress single-photon emission computed tomography sestamibi studies and stress echocardiograms in an academic medical center. *J Am Coll Cardiol* 2008;51:1283–9.
12. Douglas PS, Khandheria B, Stainback RF, Weissman NJ. ACCF/AHA/ASE/ACEP/ASNC/SCAI/SCCT/SCMR 2007 appropriateness criteria for transthoracic and transesophageal echocardiography. *J Am Coll Cardiol* 2007;50:187–204.