SPECIAL ARTICLE

Achieving High-Value Cardiac Imaging: Challenges and Opportunities

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Cardiac imaging is under intense scrutiny as a contributor to health care costs, with multiple initiatives under way to reduce and eliminate inappropriate testing. Appropriate use criteria are valuable guides to selecting imaging studies but until recently have focused on the test rather than the patient. Patient-centered means are needed to define the true value of imaging for patients in specific clinical situations. This article provides a definition of high-value cardiac imaging. A paradigm to judge the efficacy of echocardiography in the absence of randomized controlled trials is presented. Candidate clinical scenarios are proposed in which echocardiography constitutes high-value imaging, as well as stratagems to increase the likelihood that high-value cardiac imaging takes place in those circumstances. (J Am Soc Echocardiogr 2014;27:1-7.)

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Cardiac imaging has come under intense scrutiny as a contributor to rising health care costs in the United States. Attention has been focused on the number of cardiac imaging studies performed, including echocardiography. Volume is easy to measure; a far more difficult, and more important, task is to ascertain the value of imaging for specific patients or groups of patients. The critical issue is not how many studies are being done but that they are done in circumstances in which the results will enhance the patient care—and not done when the results will not make a difference—so that studies lead to better outcomes.

Increased demand for testing is due to both patient-related and physician-related factors.[1,2] Among the drivers are physician training that encourages a culture of completeness regardless of cost or of effects on others; misaligned financial incentives; effective marketing of new technologies to physicians in the absence of comparative effectiveness data with which physicians can assess the value of that technology; and fear of malpractice suits, encouraging the practice of defensive medicine. On the patient side, Americans are enamored of high technology and may perceive that more tests are by definition equal to better care. Direct-to-consumer marketing influences patients' preferences for testing, and a health care system in which patients are insulated from the true fiscal costs of testing also drives demand.

Recent data indicate that the rate at which cardiac imaging is performed not only is no longer increasing but has begun to drop. While the US General Accounting Office reported in 2008 that Medicare spending on imaging services under the Part B physician fee schedule more than doubled from 2000 through 2006, a subsequent Medicare Payment Advisory Commission report to Congress noted that annual rate of growth in the number of echocardiograms provided per Medicare beneficiary was only 2.6% between 2005 and 2009 and decreased by 0.8% per year between 2009 and 2010.[3] On the cost side, payments to cardiologists for noninvasive diagnostic imaging decreased by a total of 33% between 2006 and 2010, reversing the increases seen during the preceding 6 years.[4] Multiple explanations have been cited for this phenomenon, which is sometimes referred to as "bending the cost curve." They include the promulgation of appropriate use criteria for cardiac imaging by professional societies such as the American College of Cardiology Foundation (ACCF) and the American Society of Echocardiography, among others. These documents evaluate the relative benefits and risks of an imaging study to determine whether it is reasonable to consider performing the study for a specific indication.[5] The terminology used to describe the three appropriateness categories has evolved for greater clarity since their original publication. Studies for specific indications were initially divided into appropriate, uncertain, and inappropriate categories. The terminology has been revised to "appropriate care," "may be appropriate care," and "rarely appropriate care," recognizing that a study that is rarely appropriate may be precisely correct for a specific patient.[6] Stated another way, the goal for rarely appropriate studies is not zero. Education programs such as the American Board of Internal Medicine's Choosing Wisely campaign have been directed at patients and providers. Commercial insurers have turned to radiology benefits managers in an attempt to reduce test ordering they deem inappropriate, while Medicare has adopted payment reductions to providers.

REDUCING OVERUTILIZATION

The interest in limiting inappropriate cardiac testing stems not just from containing costs. Excess testing carries the potential for downstream ill effects. When a study that may have good specificity is ordered in a population in which a disorder has a low prevalence, the few "abnormal" results are more likely to be false-positives than true-positives. This can cause anxiety on the part of patients and lead to unwarranted further testing, which carries its own inherent risks. Conversely, a false-negative result provides false reassurance and the potential for delayed diagnosis. These concepts are explicitly recognized by the ACCF in its definition of an appropriate imaging

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Abbreviation
ACCF = American College of Cardiology Foundation

study as "one in which the expected incremental information, combined with clinical judgment, exceeds the expected negative consequences by a sufficiently wide margin for a specific indication that the procedure is generally considered acceptable care and a reasonable approach for the indication."[5]

Appropriate use stratagems have been used to examine and vet imaging studies once they have been ordered, to determine whether they are being ordered for appropriate reasons. Methodologies focusing on studies after they have been ordered are suited to reducing overutilization. Research in community as well as academic settings has shown that 9% to 20% of transthoracic and stress echocardiographic studies are ordered for inappropriate indications.[7-11] A much smaller proportion of requested transesophageal studies is rated as inappropriate.[12] The reasons for the disparity have not been studied but might include differences in specialties of the ordering physicians (i.e., cardiologists vs noncardiologists) for transesophageal studies compared with transthoracic or stress echocardiography. The ease with which a transthoracic or stress echocardiographic study can be ordered, contrasted with the fact that transesophageal studies are semi-invasive and are directly performed by cardiologists who must actively assent to their performance, may play a role in differing rates of appropriateness. Applying appropriate use criteria had previously been a manual undertaking, consisting of matching the clinical scenario to a list of criteria on paper and uncovering the appropriateness score. An application for myocardial perfusion imaging is available for both major smart phone platforms, and one for echocardiography has been announced. The American College of Cardiology has designed Imaging in FOCUS, a voluntary, Web-based decision support program designed to reduce inappropriateness in cardiac imaging. FOCUS demonstrated a reduction in inappropriate single-photon emission computed tomographic myocardial perfusion imaging ordering among participants, from 11% of studies before using FOCUS to 5% afterward.[13] The American Society of Echocardiography has codeveloped a FOCUS module for transthoracic echocardiography. It is reasonable to expect comparable improvements in the degree of study appropriateness when this tool is applied to transthoracic echocardiography, but this hypothesis has yet to be tested beyond a pilot study.[11] FOCUS is evolving into a robust, multimodality program that links with commercially available electronic health records and provides integrated decision support at the point of order entry.[14]

DEFINING AND IDENTIFYING HIGH-VALUE IMAGING

In the quest for high-value imaging, rooting out cardiac imaging studies that are of questionable appropriateness by looking at the studies is one part of the solution. However, if examining appropriateness begins once a test has been ordered, the process is entered at the midpoint of the dimensions of care framework for evaluating the quality of cardiac imaging described by the ACCF (Figure 1). This framework starts with the patient, recognizing that efforts at enhancing the value of imaging studies must be patient centered rather than test centered. Focusing efforts at the patient level uncovers not only which patients do not need an imaging study but also identifies patients who should undergo imaging studies to detect or risk-stratify diseases. Such high-value imaging may lead to management changes that improve outcomes or, alternatively, lead to the

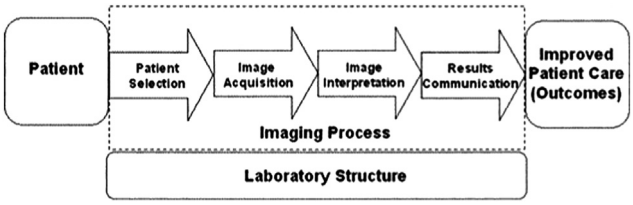

Figure 1 Dimensions of care framework for evaluating quality of cardiovascular imaging. Reproduced with permission from Douglas P, Chen J, Gillam L, Hendel R, Jollis J, Iskandrian AE, et al. Achieving quality in cardiovascular imaging: proceedings from the American College of Cardiology-Duke University Medical Center Think Tank on Quality in Cardiovascular Imaging. J Am Coll Cardiol 2006; 48:2141-2151.

imaging study that most conclusively and efficiently excludes a disease, thereby reducing both patient anxiety and downstream costs. This approach might better be conceptualized as "bending the value curve," because the goal of managing cardiac imaging is not just lower costs but higher value to patients and the health system. The concept of developing an outcomes-based imaging cycle backed by evidence is not new[15] but bears explication, particularly as the American health care system continues to transform.

Value in health care has been defined as health outcomes achieved per dollar spent.[16] Determining what is high-value cardiac imaging requires measurable outcomes that are specific to a given condition. Outcomes, in the numerator, must be achieved efficiently; that is, the total cost of care for the condition must be calculated, and not merely the cost of an individual service. A more expensive test that reduces the overall cost of care may be a good investment of health care dollars. Diagnostic studies do not by themselves cure, or change outcomes. Yet high-value imaging, by being performed in the correct part of the care cycle, conceptually can reduce the overall cost of care if it leads to a better health outcome. Although the most critical outcomes for patients are increased survival, and recovery or improved health, other metrics include time to recovery, avoiding treatment-related side effects, avoidance of complications, sustained health and function, and avoiding care-induced illnesses.

The highest level of evidence for the value of an imaging study would come from a randomized controlled trial that measures specified outcomes. An example of such a study is the Prospective Multicenter Imaging Study for Evaluation of Chest Pain trial, a randomized trial funded by the National Heart, Lung, and Blood Institute of the clinical effectiveness of diagnostic strategies in patients with chest pain, who are randomized to either functional (exercise electrocardiography, stress echocardiography, or stress nuclear imaging) testing versus anatomic testing (coronary computed tomographic angiography).[17] Randomized trials for an accepted technology that is already in clinical use, such as echocardiography, as part of a diagnostic and treatment strategy are unlikely to be conducted because of the large number of conditions for which echocardiography is performed and perhaps also because of the lack of sponsor enthusiasm for investing in what are perceived to be mature technologies.

An alternate, frequently cited paradigm to judge the value of imaging uses a six-tiered, hierarchical model to conceptualize diagnostic imaging as part of a larger system whose goal is to treat patients effectively and efficiently. Level 1 is technical efficacy, comprising variables needed to produce a high-quality image. Level 2 is diagnostic accuracy efficacy, such as the percentage of correct diagnoses, positive and negative predictive value, sensitivity and specificity, as well