

and a 2-grade discordance was seen in 9 of 50 patients, a problem most common in patients with functional MR.

Our finding of a single echo-derived measurement of RV correlating well with CMR RV is in agreement with previous work (4). A unique observation from our study is that the integrated assessment by echo worsens the agreement with CMR. Because this is the currently recommended approach to estimating MR severity by echo, further confirmation of this is warranted.

Uretsky et al. (1) found that echo correlated weakly with CMR ($r = 0.60$), overestimated RV, and did not predict post-surgical LV remodeling as well as CMR. Our correlation between techniques was better and did not show a systematic overestimation by echo. Although many factors could explain intermodality differences, when echo and CMR are performed on the same day and compare similar measurements, there is reasonable agreement between techniques.

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REFERENCES

1. Uretsky S, Gillam L, Lang R, et al. Discordance between echocardiography and MRI in the assessment of mitral regurgitation severity: a prospective multicenter trial. *J Am Coll Cardiol* 2015;65:1078-88.
2. Zoghbi WA, Enriquez-Sarano M, Foster E, et al. Recommendations for evaluation of the severity of native valvular regurgitation with two-dimensional and Doppler echocardiography. *J Am Soc Echocardiogr* 2003; 16:777-802.

3. Lang RM, Badano LP, Mor-Avi V, et al. Recommendations for cardiac chamber quantification by echocardiography in adults: an update from the American Society of Echocardiography and the European Association of Cardiovascular Imaging. *Eur Heart J Cardiovasc Img* 2015;16: 233-70.

4. Cawley PJ, Hamilton-Craig C, Owens DS, et al. Prospective comparison of valve regurgitation quantitation by cardiac magnetic resonance imaging and transthoracic echocardiography. *Circ Cardiovasc Img* 2013;6: 48-57.

Patient and Provider Attitudes on Appropriate Use Criteria for Myocardial Perfusion Imaging



Appropriate use criteria (AUC) have been developed for a variety of cardiovascular tests and services. AUC are based on the best available evidence with the goal of identifying which clinical scenarios are likely to result in net patient benefit or harm. Little is known about how well physicians on the clinical care frontlines know about and apply AUC when making decisions about care. Patients do not have a role in developing AUC; their reflections on appropriateness of care have not been well studied.

We conducted an anonymous survey of patients and health care providers and asked them to rate the appropriateness of myocardial perfusion imaging (MPI) for a series of clinical scenarios. We also gathered data on attitudes and awareness of issues related to AUC. We hypothesized that patients and providers would overestimate the appropriateness of MPI compared with the published AUC. We asked respondents to use the same scale used to develop the AUC; they rated 5 clinical scenarios from 1 ("bad idea"/inappropriate) to 9 ("good idea"/appropriate). Responses were compared with the 2009 AUC for the same scenarios (1).

The survey was completed by 456 respondents: 342 patients (56% veterans, 69% male) and 114 providers (62.3% academic, 27.2% Veterans Affairs, 7.9% private practice). Most of the providers were physicians (86.8%), with the remainder being advanced practice providers. Of the 5 clinical scenarios, the patient and provider ratings agreed with the published AUC for 2 criteria; there was a categorical difference from published AUC for the remaining 3 criteria (Table 1). In 2 of 3 cases, the patient rating was higher than the provider or published rating (AUC indication #1: 5.0 vs. 3.5 and 3.0; $p < 0.0001$; AUC indication #12: 5 vs. 2 and 1; $p < 0.0001$). In the third case, the provider rating was lower than both the patient and published rating (AUC indication #60: 2 vs. 6 and 6; $p < 0.0001$). For all 5 scenarios, the patient ratings ran the entire 9-point scale; 3 scenarios had a rating of 5 as the mode. In contrast, provider ratings were more closely

TABLE 1 Patient and Provider Rated Appropriateness Compared With Published AUC Indications

Clinical Scenario	2009 AUC Indication	Patient Median (Q1, Q3 Quartiles)	Providers Median (Q1, Q3 Quartiles)	AUC (Q1, Q3 Quartiles)	p Value (Patient vs. AUC)	p Value (Provider vs. AUC)
1	55	7 (5, 9)*	8 (7, 8)*	8 (8, 9)*	0.003	0.008
2	1	5 (4, 7)†	3.5 (2, 7)†	3 (2, 4)‡	<0.0001	0.059
3	12	5 (3, 7)†	2 (2, 3)‡	1 (1, 1)‡	<0.0001	<0.0001
4	3	7 (5, 8)*	7 (5, 7)*	7 (7, 8)*	0.85	0.23
5	60	6 (4, 8)†	2 (1, 3)‡	6 (4, 7)†	0.74	0.0002

*Appropriate; †uncertain; ‡inappropriate.
 AUC = appropriate use criteria.

clustered around the median response. Using a logistic regression model, we did not find any correlation between the baseline characteristics of the patients and the overestimation for the clinical scenarios.

Most providers (55.4%) believed that having 0% to 5% of tests rated as inappropriate would be acceptable. Some providers (36.6%) had never heard of AUC, whereas 12.5% reported using AUC regularly. Providers reported that they believed that the use of guidelines from specialty societies improved decision-making (80.2%), lowered cost (69.4%), and enhanced quality of care (65.8%); however, only 34.2% reported that AUC improved the health of their patients.

In this novel investigation of the opinions that patients and providers had about AUC, we observed that patients tended to overestimate the appropriateness of testing. The reasons for patients to overestimate appropriateness are unclear. Although this could reflect patient values that differed from the published AUC, we suspected, based on the wide distribution of responses, that patients had low confidence in this exercise and/or were poorly informed about the appropriate use of MPI. This raises the question as to whether patients should play any role in future iterations of AUC. Although the choices and values of the patients are important considerations when deciding on a course of action, they are most applicable when there is clinical equipoise or no clear indication and/or contraindication. Patient opinion may be more valuable in areas such as choice of elective percutaneous coronary intervention.

Overall, the provider-based appropriateness ratings were in agreement with the published AUC. Because >10% of MPIs are rarely appropriate in real-world data (2), we suspect that the responses of the providers were at least partially driven by response bias. We were disappointed to observe that, despite the fact that the first AUC for nuclear MPI were published a decade ago, awareness and regular use of

AUC was low among our providers, with more than one-third having never heard of the guidelines at all.

Our investigation was limited because it was conducted at a single site; survey responses might be biased and not representative of the actual clinical decision making and ordering habits of providers. This was offset by the anonymous nature of the survey. The survey was designed around the 2009 AUC for MPI because regulatory submission occurred before publication of the most contemporary version of the AUC.

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REFERENCES

1. Hendel RC, Berman DS, Di Carli MF, et al. ACCF/ASNC/ACR/AHA/ASE/SCCT/SCMR/SNM 2009 appropriate use criteria for cardiac radionuclide imaging. *J Am Coll Cardiol* 2009;53:2201-29.
2. Elgendy IY, Mahmoud A, Shuster JJ, Doukky R, Winchester DE. Outcomes after inappropriate nuclear myocardial perfusion imaging: a meta-analysis. *J Nucl Cardiol* 2016;23:680-9.