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Association Between Procedure Appropriateness and Patient Reported Outcomes after Percutaneous Coronary Intervention

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Abstract

Objective: The Appropriate Use Criteria (AUC) has been used to identify individuals who are likely to benefit from percutaneous coronary intervention (PCI) for stable ischemic heart disease (SIHD). However, whether physicians reliably grade PCI appropriateness and whether AUC categories stratify symptomatic improvement in real world practice is unclear.

Methods: Patient reported outcomes measures (PROMs) for angina (Seattle Angina Questionnaire [SAQ-7]), dyspnea (Rose Dyspnea Scale [RDS]), and depression (Patient Health Questionnaire-2 [PHQ-2]) were collected on patients undergoing elective coronary angiography at an academic medical center. Retrospectively, two physicians independently determined PCI appropriateness by the AUC criteria.

Results: Interrater agreement on appropriateness was moderate ($\kappa = 0.48$, 95% CI 0.32–0.63). Of PCI procedures evaluated, 57 (47.1%) were appropriate (A-PCI) and 62 (51.2%) were maybe appropriate (MA-PCI) and two (1.6%) were rarely appropriate. At baseline, A-PCI compared to MA-PCI patients had worse RDS scores (2.0 vs. 1.2, $p = 0.01$). At 30 days, the change in SAQ-7 summary score was similar between groups (A-PCI vs. MA-PCI, +27.1 vs. +20.7, $p = 0.11$). The

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mean change in RDS score was greater in A-PCI than MA-PCI (−1.0 vs. −0.5, p for group by time interaction = 0.03). PHQ-2 scores were similar and did not improve at 30-days.

Conclusion: In patients undergoing PCI with PROMs collected before and 30-days after PCI, similar improvements in angina were observed regardless of appropriateness. Interrater agreement on PCI appropriateness was only moderate. Use of PROMs may improve reliability of physician assessments of PCI appropriateness.

Keywords

patient reported outcome measures; appropriate use criteria; quality; percutaneous coronary intervention; stable angina

INTRODUCTION

Percutaneous coronary intervention (PCI) is frequently performed for the management of stable ischemic heart disease (SIHD). As prior studies have not suggested a clear benefit of PCI over optimal medical therapy for reducing myocardial infarction (MI) and death (1), PCI is often performed to improve angina in those with symptoms despite optimal medical therapy (2).

To promote the rational use of coronary revascularization, eight cardiovascular societies published the Appropriate Use Criteria (AUC) for Coronary Revascularization in SIHD in 2017 (3). While rates of inappropriate PCIs in the United States have declined since this publication, few studies have used standardized measures of angina in real world practice to assess whether PCI appropriateness identifies individuals at greater likelihood of symptomatic benefit from revascularization (4–6). Additionally, whether providers can reliably grade angina severity and PCI appropriateness has previously been questioned (7–9).

A number of standardized health questionnaires, known as patient reported outcome measures (PROMs), exist to measure health-related quality of life. These PROMs have been validated and recommended for use in SIHD (10–14) and predict mortality and repeat revascularization (15).

In this study, we collected baseline and follow-up PROMs for angina, dyspnea, and depressive symptoms on all patients with SIHD undergoing diagnostic coronary angiography at Beth Israel Deaconess Medical Center from 2017–2018 and graded PCI appropriateness to 1) compare the degree of symptomatic improvement after PCI by appropriateness rating, 2) determine the reliability of physician assessments of appropriateness by these criteria, and 3) evaluate if PCI appropriateness identifies individuals with greater short-term symptomatic improvement.

METHODS:

Study participants

All patients presenting for elective coronary angiography at the Beth Israel Deaconess Medical Center (BIDMC) between December 18, 2016 and January 19, 2018, who completed both baseline and 30-day follow-up PROMs surveys were eligible for inclusion (eFigure). Urgent and emergent coronary angiography recipients or those who did not receive PCI were excluded. Full details of the study participants, methods of enrollment, and inclusion/exclusion criteria have previously been published (16).

Patient Reported Outcome Measures

PROMs collected include the Seattle Angina Questionnaire-7 (SAQ-7), the Rose Dyspnea Scale (RDS), and the Patient Health Questionnaire-2 (PHQ-2). The SAQ-7 is the short form version of the 19 question Seattle Angina Questionnaire, consisting of 7 questions across 4 domains of angina severity (angina frequency, physical limitation due to angina, quality of life, and a summary measure), scored on a scale of 0–100 with lower scores indicating worse symptoms (10,14). The RDS is a validated instrument consisting of 4 questions evaluating dyspnea, scored on a scale of 0–4 with higher scores indicating worse dyspnea (17). The PHQ-2 consists of 2 questions evaluating depressive symptoms, scored on a scale of 0–6 with higher scores indicating greater severity of depression (18). These PROMs have been previously validated and recommended for use in the setting of SIHD (12, 18–20).

Data Collection

PROMs were administered by cardiac catheterization laboratory holding area nurses and front-desk staff who provided tablet computers to patients in the waiting room or preprocedural holding area. Tablets were configured to collect basic demographic information and administer the short form SAQ-7, the RDS, and PHQ-2 via a secure web-based data entry application (REDCap) (21). Participants were sent automated emails at 30 days after their procedure with requests to complete the questionnaire again. Nonresponding patients were contacted by phone by a research coordinator. Reflective of actual practice, patients were not blinded to receipt of PCI. However, as appropriateness status was adjudicated retrospectively, PCI providers were not explicitly aware of the AUC category of PCI recipients. This study was approved by the BIDMC institutional review board.

Covariates and Outcomes

Demographics, comorbidities, and procedural details were obtained from direct linkage via medical record numbers to internal catheterization laboratory data collected for the purposes of reporting to the National Cardiovascular Data Registry: CathPCI Registry (version 4) (22). These data are routinely collected by cardiologists at the time of coronary angiography, inputted into a data collection form that stores this information electronically, and reviewed for accuracy and completeness by a trained clinical data quality specialist. Antianginal medications were defined as beta blockers, calcium channel blockers, long-acting nitrates, and ranolazine. Outcomes included the mean change in SAQ-7 summary scores, as well as

subdomains (e.g. physical limitation, angina frequency, and quality of life), Rose Dyspnea Scale, and Patient Health Questionnaire-2 at 30 days following the date of initial PCI.

Review of PCI appropriateness

Retrospectively, two physician reviewers (JXY and MJS) independently reviewed the electronic health records of all study patients who underwent PCI and judged the appropriateness of each PCI according to the 2017 AUC for Coronary Revascularization in Patients with SIHD (4). Cases were deemed appropriate if both reviewers agreed the case was appropriate. If at least one reviewer deemed the case “rarely appropriate” the case was deemed rarely appropriate, with all others considered “maybe appropriate.” As the number of “rarely appropriate” cases was small ($N = 2$), this group was excluded from analyses. Patients were determined to be asymptomatic or have ischemic symptoms based on detailed review of clinic notes and preprocedural documentation.

Statistical Analysis:

Baseline demographics and comorbidities of included patients are presented as means and standard deviations for continuous variables and frequencies and proportions for categorical variables, and compared across grades of appropriateness using t-tests, Wilcoxon rank sum tests, Fisher’s exact tests, and Chi Square tests. Baseline and 30-day PROMs were stratified by PCI appropriateness and compared from baseline to 30 days and between PCI appropriateness groups using repeated measures analysis of variance (ANOVA) and evaluating a group by time interaction term. The association between baseline PROMs and PROMs at 30-day follow-up was assessed using analysis of covariance. The number of studies deemed appropriate, maybe appropriate, and rarely appropriate by physician reviewer (JXY and MJS) was determined and kappa statistics used to assess inter-reviewer agreement. As the AUC are intended to account for the main patient characteristics associated with symptom improvement (3), no multivariable modeling was performed. All analyses were conducted with JMP Pro version 13 (SAS Institute, Cary, NC) using a two-tailed p-value <0.05 .

Patient and Public Involvement:

Validated questionnaires were used to capture patient self-reported symptoms with the intention that these survey results would be useful for ongoing care discussions with their medical providers. Additionally, the questionnaires used were initially developed with patient input including the frequency and recent changes in their symptoms, their satisfaction with treatment, and the degree to which these symptoms impact their quality of life. While patients were not directly involved in the design of the study, the writing or editing of this document, or the interpretation or dissemination of the results, all outcomes were chosen based on the degree to which they reliably captured patient reported symptoms.

RESULTS:

Study Population Characteristics:

Between December 18, 2016 to January 19, 2018, 613 baseline surveys were collected on patients undergoing 1,448 elective coronary angiography procedures (average response rate

42.3%). Of these 613 responders, 590 were eligible for 30-day follow-up surveys at the time of the study's conclusion and 331 (56.1%) of these eligible responders completed 30-day follow-up PROMS, of which 121 (36.6%) underwent PCI (eFigure). Respondents were healthier than non-respondents, and those with a positive stress test were more likely to respond to the survey (eTable 1) (16). Those completing 30-day follow-up PROM surveys had similar baseline angina severity to those not completing 30-day follow-up (SAQ-7 physical limitation: $p = 0.22$; angina frequency: $p = 0.82$; quality of life: $p = 0.39$; summary score: $p = 0.60$). Of these, 57 (47.1%) were judged to have had an appropriate PCI (A-PCI), 62 (51.2%) had a maybe appropriate PCI (MA-PCI), and 2 (1.7%) had a rarely appropriate PCI (Table 1, eTable2).

There was no significant difference in mean age between the appropriate and maybe appropriate groups (A-PCI vs. MA-PCI, age [standard deviation {SD}]: 66.9 [10.0] vs. 66.5 [10.3], $p = 0.07$). The majority were male (A-PCI vs. MA-PCI: 71.9% vs. 74.2%, $p = 0.84$) and the two groups were similar in racial composition ($p = 0.53$). Overall, the A-PCI group had a higher proportion with severe angina (A-PCI vs. MA-PCI: CCS grade 3–4 angina: 63.2% vs. 53.2%, $p = 0.003$). The A-PCI group had higher rates of prior MI (A-PCI vs. MA-PCI: 56.1% vs. 35.5%, $p = 0.03$) and prior surgical revascularization (A-PCI vs. MA-PCI: 31.6% vs. 14.5%, $p = 0.03$). Additionally, patients receiving A-PCI higher rates of antianginal use (A-PCI vs. MA-PCI: 96.5% vs 79.0%, $p = 0.005$). In particular, use of nitrates was higher in those receiving A-PCI (A-PCI vs. MA-PCI: 47.4% vs 6.5%, $p < 0.001$). A-PCI patients were more likely to undergo non-imaging stress tests (A-PCI vs. MA-PCI: 19.3% vs. 9.7%, $p < 0.001$) while MA-PCI patients were more likely to utilize imaging (A-PCI vs. MA-PCI: 42.1% vs. 67.7%, $p = 0.009$). The A-PCI group had more severe coronary artery disease (mean [SD] maximal coronary stenosis in left main coronary artery, A-PCI vs. MA-PCI: 11.3 [25.0] vs. 2.6 [9.7], $p = 0.0009$; in right coronary artery, A-PCI vs. MA-PCI: 73.8 [31.0] vs. 48.6 [37.3], $p < 0.001$; in left circumflex coronary artery, A-PCI vs. MA-PCI: 54.2 [37.8] vs. 33.5 [37.5], $p = 0.004$).

Agreement between reviewers:

Reviewer 1 (MJS) and Reviewer 2 (JXY) had moderate disagreement on PCI appropriateness (Table 2). Reviewer 1 judged 7 (60.3%) of the cases as appropriate for PCI, 47 (38.8%) as maybe appropriate for PCI, and one (0.8%) as rarely appropriate for PCI. Reviewer 2 judged 70 (57.9%) of the cases as appropriate for PCI, 50 (41.3%) as maybe appropriate for PCI, and once (0.8%) as rarely appropriate for PCI. Interrater agreement on PCI appropriateness was moderate ($\kappa = 0.48$, 95% CI 0.32–0.63).

Patient Reported Outcome Measures:

There was no significant difference between baseline summary SAQ-7 scores of the two groups (A-PCI vs. MA-PCI, mean [SD] score, 63.0 [17.5] vs. 70.6 [19.6], $p = 0.11$) (Table 3). Both groups experienced significant improvements in angina at 30 days across all domains (e.g. physical limitation, angina frequency, quality of life) of the SAQ-7 (Figure). The mean change in summary score was similar across groups (A-PCI vs. MA-PCI, mean [SD] change in SAQ-7 summary score, +27.1 [23.1] vs. +20.7 [18.8], p -value for group by time interaction = 0.11).

The A-PCI group had a higher baseline RDS score (A-PCI vs. MA-PCI, 2.0 vs. 1.2, $p = 0.01$) (Table 3). Both A-PCI and MA-PCI groups experienced significant improvement in their dyspnea at 30 days ($p < 0.001$) with A-PCI patients having a significantly greater change in RDS score (A-PCI vs. MA-PCI: mean [SD] change in RDS, -1.0 [1.3] vs. -0.5 [1.1], p -value for group by time interaction = 0.03).

At baseline, few patients reported depression with no significant difference between the baseline PHQ-2 between groups (A-PCI vs. MA-PCI, mean [SD] PHQ-2: 0.09 [0.29] vs. 0.15 [0.36], $p = 0.73$) (Table 3). Neither group experienced a significant change in their PHQ-2 scores at 30 days and PHQ-2 score changes were not different across groups (A-PCI vs. MA-PCI, mean [SD] change in PHQ-2: $+0.01$ [0.28] vs. -0.04 [0.35], p -value for within group difference over time = 0.76; p -value for group by time interaction = 0.78). Baseline PROMs, with the exception of the SAQ-7 physical limitation domain, were strongly associated with PROMs at 30-day follow-up (Table 4).

DISCUSSION:

In this study of patients undergoing PCI at Beth Israel Deaconess Medical Center with PROMs collected pre-procedure and at 30-days, we found that PCI resulted in significant improvements in PROMS as measured by the SAQ-7 and RDS at 30 days, regardless of whether the patient was considered appropriate or maybe appropriate. Baseline PROMs were significantly associated with PROMs at 30-days. Interrater agreement on PCI appropriateness by two physician reviewers was only moderate, suggesting that using AUCs to assess patient benefit from PCI may provide significant variability in characterizing the appropriateness of patients' interventions. Collectively, these data suggest that direct measurement of patients' symptoms with validated PROMs may be a better method for quantifying the appropriateness of PCI.

Our findings that PCI improves anginal symptoms are consistent with findings from prior studies using PROMs (1,23–26). Despite similar or higher baseline SAQ-physical limitation scores in our study than the Clinical Outcomes Utilizing Revascularization and Aggressive Drug Evaluation (COURAGE) trial (73.8 vs. 66) and the Objective Randomized Blinded Investigation with Optimal Medical Therapy of Angioplasty in Stable Angina (ORBITA) trial (73.8 vs. 71.3), overall angina improvement with PCI was greater than in both COURAGE and ORBITA (1,23), potentially reflecting the lower baseline rates of anti-anginal medication use in our study. In contrast to the COURAGE and ORBITA trials where a majority of patients were on 2–3 anti-anginal medications at baseline, less than half of our study patients were on 2 anti-anginal medications. Additionally, as patients in the present study were unblinded, this may have contributed to a greater placebo effect.

In our study, both A-PCI and MA-PCI groups demonstrated improvements in angina and dyspnea at 30-day follow-up. The A-PCI group showed a significantly greater change in RDS scores compared to the MA-PCI group. However, as the A-PCI group had significantly worse RDS scores at baseline, the greater improvement in scores observed in this group may be due to regression to the mean. By contrast, similar improvements in angina were observed at 30 days regardless of appropriateness group. There was no significant change in

patient-reported depression at 30-days after PCI, which may reflect the low PHQ-2 scores observed at baseline in our population.

Our real-world results contrast with those from the COURAGE trial participants (6). When stratified by AUC, the trial patients categorized as appropriate demonstrated greater improvement in angina with PCI compared to those patients categorized as maybe or rarely appropriate. This difference between real-world and trial findings may be attributable to increased difficulty in reliably categorizing AUC levels in clinical practice compared to standardized trial case report forms, use of 2009 AUC criteria in the trial, inadequate power to detect an improvement in symptoms in the current study, or differences in case mix population between the COURAGE trial and clinical practice.

Agreement on appropriateness between two physician reviewers after detailed manual chart review was only moderate (kappa statistic of 0.48). The high rates of disagreement between reviewers is indicative of the difficulty in reliably grading PCI appropriateness with a prior study finding rates of non-agreement among physicians approaching 70% (9). For example, patients may underreport anginal symptoms or reduce their workload to compensate. In this analysis, 6 patients (5.0%) were deemed by their physicians to be asymptomatic, whereas only 2 patients (1.7%) reported an angina frequency score of 100, denoting absence of symptoms. This may suggest a bias in the way that angina is reported to or recorded by physicians, which has been previously recognized (7, 27–28), and confirms the need for PROMs assessment to assess symptom severity in a reliable fashion (29). This subjectivity in grading leaves open the possibility of upcoding PCI as suggested by recent research (8). To counter this subjectivity, validated constructs such as the SAQ-7 should be used in the definition of appropriateness to mitigate uncertainty associated with applying the AUC to individual patients (30–31). In contrast to appropriateness category, baseline SAQ-7 scores were strongly associated with angina at 30 days. As the SAQ-7 evaluates not just frequency but also the functional impact of angina on quality of life, it may function as a more reliable marker of angina severity to determine appropriateness.

Our study should be interpreted in the context of the following potential limitations. As a single center study, our findings are potentially subject to referral bias and the selection practices of our cardiologists. Our cohort was primarily white and male which is reflective of patients receiving PCI at our facility. Further, only 42.3% of patients undergoing coronary angiography during the study period completed baseline and 30-day PROMs due to challenges obtaining patient-reported information, reducing the power to detect an effect of appropriateness (16). However, we have previously shown that clinical characteristics of non-participants and participants were similar and thus results are likely externally valid to those receiving PCI (16). Ceiling and floor effects from PROMs may additionally limit the detection of change in symptoms when baseline symptoms are at the extremes of PROM values, but this was not evident in the disease-specific SAQ. Finally, a majority of patients in our study had either appropriate or maybe appropriate PCIs and it was not possible to explicitly compare the PROM outcomes for patients who underwent rarely appropriate PCIs. Future work will be needed to better compare the benefits of PCI in those judged rarely appropriate.

CONCLUSION

In individuals undergoing PCI for SIHD at our institution, the 2017 appropriate use criteria did not identify improvement in angina or depressive symptoms as measured by validated PROMs. Baseline PROMs were strongly associated with PROMs at 30-days. There was only moderate interrater agreement on appropriateness levels as judged by two physician reviewers. Collectively, these data suggest that the direct assessment of PROMs may be a more accurate and reproducible means of quantifying the appropriateness of PCI than the 2017 AUC.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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KEY QUESTIONS:**What is already known about this subject?**

PCI is an effective treatment for stable angina in patients with coronary artery disease. Standardized PROMS have been used to gauge the magnitude of this therapeutic effect.

What does this study add?

It is not clear whether PCI appropriateness as determined by the AUC effectively stratifies patients into tiered degrees of therapeutic benefit from PCI. Our study attempts to answer this question using PROMS collected from patients who underwent PCI and fall into the various AUC categories of appropriateness. We found that patients symptomatically improved to a similar degree regardless of their appropriateness category.

How might this impact on clinical practice?

Clinicians commonly use the AUC to inform their decisions to pursue PCI in their patients. Our research suggests that the AUC in its current form may not help clinicians determine which of their patients is more likely to benefit from PCI.

Figure: Boxplots Demonstrating Change in the Short-Form Seattle Angina Questionnaire Summary Score by PCI Appropriateness

Boxplots indicate the median and interquartile range for values of the Short-Form Seattle Angina Questionnaire Summary Score at baseline and 30-day follow-up according to PCI appropriateness. The Short-Form Seattle Angina Questionnaire (i.e. SAQ-7) is scaled from 0–100 with lower scores indicating more severe angina.

Table 1.

Baseline Characteristics of Included Patients by PCI Appropriateness

Variable	Appropriate (N = 57)	Maybe appropriate (N = 62)	p-value
Mean Age – years (SD)	66.9 (10.0)	66.5 (10.3)	0.07
Female - no. (%)	16 (28.1)	16 (25.8)	0.84
Race - no. (%)			0.53
Caucasian	51 (89.5)	53 (85.5)	
Hispanic	1 (1.8)	0 (0.0)	
Black	1 (1.8)	2 (3.2)	
Asian	0 (0.0)	1 (1.6)	
Other	2 (3.5)	2 (3.2)	
Unable to obtain	0 (0.0)	2 (3.2)	
Height – cm (SD)	170.8 (9.6)	170.3 (9.6)	0.77
Weight – kg (SD)	85.0 (17.2)	87.2 (19.8)	0.51
Insurance - no. (%)			
Private	29 (50.9)	39 (62.9)	0.20
Medicare	17 (29.8)	18 (29.0)	>0.99
Medicaid	1 (1.8)	0 (0.0)	>0.99
Preoperative Evaluation for Non-Cardiac Surgery - no. (%)	5 (8.8)	4 (6.5)	0.74
Angina CCS Class - no. (%)			0.003
I	0 (0.0)	6 (9.7)	
II	21 (36.8)	15 (24.2)	
III	22 (38.6)	16 (25.8)	
IV	14 (24.6)	17 (27.4)	
Recent Smoker - no. (%)	1 (1.8)	8 (12.9)	0.03
Hypertension - no. (%)	53 (93.0)	53 (85.5)	0.25
Hypercholesterolemia - no. (%)	55 (96.5)	58 (93.5)	0.68
Family history of CHD - no. (%)	13 (22.8)	22 (35.5)	0.16
Prior MI - no. (%)	32 (56.1)	22 (35.5)	0.03
Heart Failure - no. (%)	14 (24.6)	8 (12.9)	0.16
New York Heart Association Class - no. (%)			0.11
II	9 (15.8)	4 (6.5)	
III	2 (3.5)	5 (8.1)	
IV	0 (0.0)	1 (1.6)	
Prior Valvular Surgery - no. (%)	3 (5.3)	1 (1.6)	0.35
Prior Percutaneous Coronary Intervention - no. (%)	32 (56.1)	30 (48.4)	0.46
Prior Coronary Artery Bypass Grafting - no. (%)	18 (31.6)	9 (14.5)	0.03
History of Renal Failure - no. (%)	1 (1.8)	3 (4.8)	0.62
History of Cerebrovascular Disease - no. (%)	6 (10.5)	7 (11.3)	>0.99
History of Peripheral Vascular Disease - no. (%)	11 (19.3)	6 (9.7)	0.19
Chronic Lung Disease - no. (%)	6 (10.5)	6 (9.7)	>0.99

Variable	Appropriate (N = 57)	Maybe appropriate (N = 62)	p-value
Diabetes Mellitus - no. (%)	19 (33.3)	17 (27.4)	0.55

*
Two patients with rarely appropriate PCIs were excluded from the analysis.

Table 2:

Inter-reviewer Agreement in PCI Appropriateness Categorization

		Reviewer 2 (JXY)			
		Appropriate – no. (%)	Maybe – no. (%)	Rarely – no. (%)	Total – no. (%)
Reviewer 1 (MJS)	Appropriate – no. (%)	57 (47.1)	16 (13.2)	0 (0.0)	73 (60.3)
	Maybe – no. (%)	13 (10.7)	33 (27.3)	1 (0.8)	47 (38.8)
	Rarely – no. (%)	0 (0.0)	1 (0.8)	0 (0.0)	1 (0.8)
	Total – no. (%)	70 (57.9)	50 (41.3)	1 (0.8)	121 (100.0)

 κ for agreement: 0.48, 95% CI 0.32–0.63

Table 3:

Baseline and 30-day PROMs among PCI Recipients Stratified by PCI Appropriateness Category

Group	Baseline PROMs – mean (SD)	30-days PROMs – mean (SD)	Change in PROMs - mean (SD)	p-value
Seattle Angina Questionnaire – 7 – Physical Limitation				
Appropriate (N = 53)	66.0 (26.1)	93.1 (16.6)	26.1 (32.5)	< 0.001 [†]
Maybe Appropriate (N = 72)	75.5 (24.6)	91.7 (14.8)	15.4 (22.8)	
p-value [*]	0.18			0.05 [‡]
Seattle Angina Questionnaire – 7 – Angina Frequency				
Appropriate (N = 53)	71.2 (22.1)	91.9 (16.8)	20.6 (24.7)	< 0.001 [†]
Maybe Appropriate (N = 72)	76.8 (22.1)	93.9 (12.6)	17.7 (21.9)	
p-value [*]	0.24			0.52
Seattle Angina Questionnaire – 7 – Quality of Life				
Appropriate (N = 53)	52.0 (23.1)	88.2 (22.2)	35.3 (29.9)	< 0.001 [†]
Maybe Appropriate (N = 72)	59.5 (26.5)	89.9 (18.7)	29.2 (27.6)	
p-value [*]	0.16			0.26 [‡]
Seattle Angina Questionnaire – 7 – Summary Measure				
Appropriate (N = 53)	63.0 (17.5)	91.0 (16.8)	27.1 (23.1)	< 0.001 [†]
Maybe Appropriate (N = 72)	70.6 (19.6)	91.8 (12.7)	20.7 (18.8)	
p-value [*]	0.11			0.11 [‡]
Rose Dyspnea Scale				
Appropriate (N = 53)	2.0 (1.3)	1.0 (1.2)	−1.0 (1.3)	< 0.001 [†]
Maybe Appropriate (N = 72)	1.2 (1.3)	0.7 (1.1)	−0.5 (1.1)	
p-value [*]	0.01			0.03 [‡]
Patient Health Questionnaire – 2				
Appropriate (N = 53)	0.09 (0.29)	0.10 (0.30)	0.01 (0.28)	0.76 [‡]
Maybe Appropriate (N = 72)	0.15 (0.36)	0.11 (0.31)	−0.04 (0.35)	
p-value [*]	0.73			0.78 [‡]

* Represents the p-value for comparison of PROMs across categories of appropriateness.

[†] Represents the p-value for within group difference over time.[‡] Represents the p-value for significance of the group by time interaction term.

Table 4:

Results of analysis of covariance evaluating relationship of baseline PROMs and values at 30-day follow-up

PROM Measurement	Mean (95% CI) change in 30-day PROMs for a 1-unit increase in baseline values	p-value
SAQ-7 Summary Measure	0.83 (0.68–0.98)	0.03
SAQ-7 Angina Frequency	1.18 (1.06–1.30)	0.004
SAQ-7 Quality of Life	1.16 (1.00–1.32)	0.04
SAQ-7 Physical Limitation	1.07 (0.95–1.19)	0.24
Rose Dyspnea Scale	1.48 (1.33–1.62)	< 0.001
PHQ2 Depression Scale	1.46 (1.30–1.63)	< 0.001

95% CI = 95% confidence interval. SAQ-7 = the Short-Form Seattle Angina Questionnaire. PHQ2 = the Patient Health Questionnaire 2-question depression survey.

Correlation between baseline PROMs and Change in PROMs at 30 days

PROM Measurement	Pearson Correlation Coefficient (95% CI)	P-value
SAQ7 Summary Measure	0.82 (0.67 to 0.97)	< 0.0001
SAQ7 Angina Frequency	0.82 (0.70 to 0.94)	< 0.0001
SAQ7 Quality of Life	0.83 (0.67 to 0.98)	< 0.0001
SAQ7 Physical Limitation	0.95 (0.83 to 1.06)	< 0.0001
Rose Dyspnea Scale	−0.53 (−0.68 to −0.39)	< 0.0001
PHQ2 Depression Scale	−0.55 (−0.71 to −0.39)	< 0.0001