

Letters

RESEARCH LETTER

Participation in Cardiac Rehabilitation Programs Among Older Patients After Acute Myocardial Infarction

A recent clinical practice guideline strongly supports cardiac rehabilitation for patients after acute myocardial infarction (AMI).¹ Cardiac rehabilitation programs are multifaceted outpatient interventions that include individualized exercise regimens, health education, and structured support focused on cardiovascular risk reduction and medication adherence.² Patients typically attend 2 to 3 sessions weekly for up to 36 sessions. Cardiac rehabilitation improves survival after AMI³ and is associated with improvements in lifestyle, functional capacity, and quality of life for older adults.^{4,5} Despite these benefits, rates of referral and participation have traditionally been low, especially among older adults.^{6,7}

Using a national quality improvement registry, we assessed rates of enrollment in cardiac rehabilitation, as well as completeness of participation (number of sessions attended), among older adults and compared characteristics between patients who did and did not participate after referral.

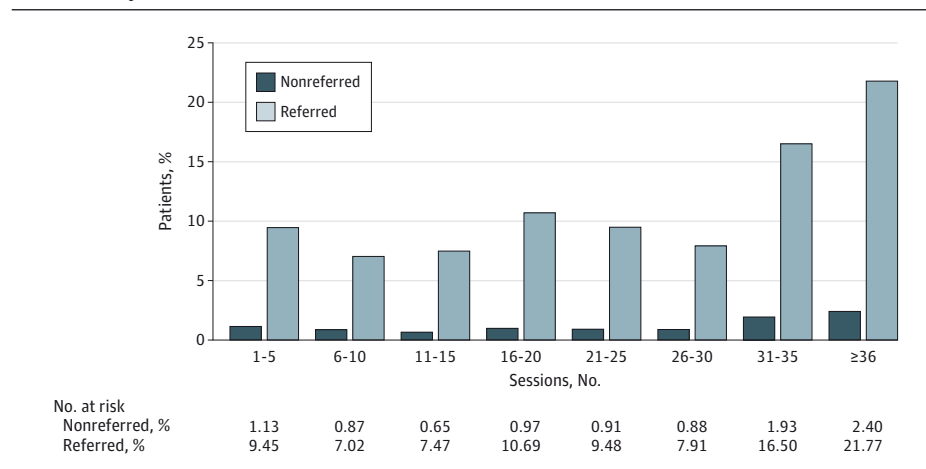
Methods | We linked clinical data from the National Cardiovascular Data Registry Acute Coronary Treatment Intervention Outcomes Network Registry-Get With the Guidelines to Medicare claims for patients 65 years or older presenting with AMIs from January 2007 through December 2010 (n = 74 798). This registry was either approved by an institutional review board, or considered quality assurance data

and not subject to institutional review board approval based on individual site determinations. We excluded patients unlikely to be eligible for cardiac rehabilitation, including those who died during the index hospitalization, were transferred to another hospital, discharged to hospice or comfort care, left against medical advice, or were discharged on no post-AMI secondary prevention medications (eg, aspirin, β -blocker, statin, P2Y₁₂ receptor inhibitor, or angiotensin converting enzyme inhibitor and/or angiotensin receptor blocker). Cardiac rehabilitation referral was captured as part of the registry data collection form. Program attendance was identified using Current Procedural Terminology codes (93797 and 93798) and Healthcare Common Procedure Coding System codes (G0422 and G0423) in Medicare claims. Baseline characteristics and treatment variables were compared using χ^2 tests for categorical variables and Wilcoxon rank sum tests for continuous variables.

Results | From 2007 to 2010, we identified 58 269 older patients eligible for cardiac rehabilitation after AMI and who met our inclusion criteria. Of these, 36 376 (62.4%) were referred to cardiac rehabilitation at the time of hospital discharge. Of those referred, 11 862 (32.6%) attended at least 1 session within the next year. Among those not initially referred, 1795 (8.2%) attended at least 1 session. Among participants, the median number of sessions attended was 26 (interquartile range, 14-35), with 3305 (24.2%) of participants attending at least 36 sessions and 1188 (8.7%) attending fewer than 5 sessions (**Figure**). In total, 13 657 of 58 269 (23.4%) AMI patients attended 1 or more cardiac rehabilitation sessions; 3175 (5.4%) completed 36 sessions or more.

Compared with those who did not participate, patients who participated in at least 1 session of cardiac rehabilitation were

Figure. Cardiac Rehabilitation Sessions Attended Among Patients 65 Years or Older After Acute Myocardial Infarction



This figure illustrates the percentage of referred and nonreferred patients 65 years or older who attended cardiac rehabilitation sessions after acute myocardial infarctions.

Table. Baseline and In-hospital Characteristics of Patients Referred for Cardiac Rehabilitation According to Participation

Characteristics	Nonparticipants (n = 24 514)	Participants (n = 11 862)
Demographics ^a		
Age, median, y	76	74
Male, %	55.2	62.9
White, %	89.0	94.3
BMI, median	27	28
Clinical history, % ^b		
Current or recent smoker	18.3	13.0
Dyslipidemia	64.1	63.7
Diabetes	34.4	26.4
Prior myocardial infarction	28.7	18.3
Prior heart failure	16.4	5.9
Prior PCI	26.9	19.4
Prior CABG	21.4	14.0
Prior stroke	10.6	6.0
Peripheral arterial disease	14.7	8.7
Charlson comorbidity index >3	30.1	19.4
Presentation characteristics, %		
STEMI	32.9	43.6
Cardiogenic shock at presentation	2.4	2.6
Signs of heart failure at presentation	20.5	10.9
Ejection fraction <50%	48.1	44.8
In-hospital characteristics		
Revascularization strategy, %		
PCI	60.2	69.9
CABG	8.9	17.6
Medical therapy alone	30.7	12.4
In-hospital complication, %		
Myocardial infarction	0.8	0.9
Stroke	0.4	0.2
Major bleeding ^c	11.6	8.2

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); CABG, coronary artery bypass graft; PCI, percutaneous coronary intervention; STEMI, ST-segment elevation myocardial infarction.

^a Continuous variables presented as median.

^b $P < .001$ for all comparisons with the exception of dyslipidemia ($P = .47$), cardiogenic shock at presentation ($P = .17$), in-hospital myocardial infarction ($P = .36$), and in-hospital stroke ($P = .01$).

^c Major bleeding defined as an absolute hemoglobin drop of ≥ 4 g/dL, intracranial hemorrhage, retroperitoneal bleed, any transfusion with baseline hemoglobin ≥ 9 g/dL, or any transfusion with a baseline hemoglobin < 9 g/dL and a suspected bleeding event. To convert hemoglobin to g/L, multiply by 10.

younger and more likely to be male, white, nonsmokers, and to have fewer baseline comorbidities (Table). Presentation with ST-segment elevation myocardial infarction was more common among participants. Participation was more common for patients treated with coronary artery bypass graft (2085/4271 [48.8%]) than those treated with percutaneous coronary interventions (8296/23 040 [36.0%]) or medical management (1469/9000 [16.3%]).

Discussion | The rate of participation in cardiac rehabilitation is low in the United States, even among patients with AMI who are referred. Our analysis identifies opportunities to improve the use of cardiac rehabilitation by older adults. We found that 37.6% of patients were not referred when they were discharged from the hospital, and approximately two-thirds of the patients who were referred did not attend an initial session. About three-quarters of participants dropped out prior to completing the 36 sessions that are typically covered by health insurance. Quality improvement efforts should focus not only on increasing referral rates but also on addressing barriers to attending rehabilitation sessions, such as travel distance, copayments, and lack of coordination between inpatient and outpatient clinicians. Alternative methods of providing cardiac rehabilitation, such as home-based programs, may be needed to improve participation rates.

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Study concept and design: Doll, Wang.

Acquisition, analysis, or interpretation of data: Doll, Hellkamp, Ho, Kontos, Whooley, Peterson, Wang.

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Invited Commentary

Closing the Treatment Gap for Cardiac Rehabilitation

Comprehensive, multidisciplinary cardiac rehabilitation programs reduce cardiovascular morbidity and mortality. They also improve exercise capacity, atherosclerotic risk markers, quality of life (QOL), and patient adherence to medication and lifestyle recommendations. They are best viewed as aggressive programs of secondary prevention. The multifaceted interventions these programs offer include exercise training, nutrition counseling, cardiovascular risk factor reduction strategies, and psychosocial and vocational support.

Nevertheless, cardiac rehabilitation programs are grossly underused (**Box**). In this issue of *JAMA Internal Medicine*,¹ Doll and colleagues describe rates of referral to cardiac rehabilitation programs at hospital discharge and participation in cardiac rehabilitation in over 50 000 Medicare beneficiaries after acute myocardial infarction (AMI). Only 62.4% of the patients were referred, and the initial enrollment rate was only 32.6%. Fewer than 10% of the patients who were not initially referred eventually enrolled in a program and attended at least 1 session. Aragam et al² reported similarly

Box. Patient, Clinician, and Health System Factors That Reduce Participation in Cardiac Rehabilitation Programs

Patient

- Female sex
- Older age
- Language, culture
- Multiple comorbidities
- Socioeconomic status
- Education level
- Impediments to participation (eg, job and/or family)
- Insurance copay obstacles
- Personal choice

Clinician

- Failure to prescribe
- Delay in prescribing
- Failure to communicate benefits of program
- Physician-patient relationship

Health System

- Lack of automated referral mechanism at time of discharge
- Delays in processing new patient referrals immediately upon discharge
- Concentration of resources at facilities difficult to access and remote from patient home and/or place of work
- Lack of patient navigators to facilitate enrollment and maximize chances for participation to completion
- Reliance on center-based activities to the exclusion of personalized programs that can be followed remotely
- Lack of multilingual translator services for non-English-speaking patients and families
- Cost of program

low referral rates after percutaneous coronary intervention. In their study, referral rates demonstrated significant inter-hospital variability related to such factors as procedure volume, bed number, geographic region (eg, Midwest vs Northeast), proximity to a cardiac rehabilitation site, and hospital type (private and/or community vs public).

The Centers for Medicare & Medicaid Services track referral to cardiac rehabilitation after a qualifying diagnosis (AMI, percutaneous coronary intervention, coronary artery bypass graft surgery, heart failure, valve surgery) as a performance measure. Low referral rates compare unfavorably with hospital performance on other quality measures, such as aspirin and β -blocker use after myocardial infarction. System-based mechanisms to improve referral rates are needed, but are unlikely to meaningfully narrow this treatment gap unless they are supplemented by other efforts. Referral to cardiac rehabilitation does not assure that a patient will enroll or complete a recommended treatment course. Although referral is obviously important, relatively little attention has been paid to the relationship between the number of rehabilitation sessions attended and patient outcomes. Patients who complete a prescribed course of cardiac rehabilitation (usually 36



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sessions over 12-18 weeks) have better survival than those who leave the program prematurely.³

Balady et al⁴ have outlined several strategies to increase completion of cardiac rehabilitation programs, including policy initiatives to support alternative delivery models that center on the patient. Such patient-centered approaches include selective use of home-based exercise programs coupled with smartphone applications to track heart rate, blood pressure, glucose, lipids, body weight, and daily activity levels, along with Internet or mobile phone and/or text-based coaching and motivational strategies. Social media adds another layer of communication to optimize patient adherence and may provide a platform for friendly competition among participants who keep track of their weekly step counts outside of the program. In contrast to intensive rehabilitation programs at centers supervised by physicians, nurses, exercise physiologists, and case managers can oversee many aspects of personalized rehabilitation programs, thus lowering costs. Although discussed, it is unlikely in our view that cardiac rehabilitation can be offered to patients with a qualifying diagnosis free of charge, as some have recommended for the provision of essential medications following AMI. Current reimbursement policies do not account for the potential downstream cost savings associated with reduced readmissions. Current reimbursement policies are also generally inadequate to cover expenses associated with the infrastructural requirements of a center-based program and require direct hospital or health system support. Whether new payment mechanisms in the era of Accountable Care Organizations will alter this dynamic remains to be seen.

Several early lines of evidence point to the success of home-based and digital and/or e-health strategies. For example, a Cochrane review of 12 randomized clinical trials comprising 1938 patients found no difference in short- or intermediate-term outcomes (including death, recurrent AMI, QOL, and cost) between center- and home-based cardiac rehabilitation.⁵ A meta-analysis of 9 trials that compared telehealth and center-based cardiac rehabilitation showed no significant differences between groups in body weight, blood pressure, smoking, lipid profiles, QOL, or mortality.⁶ Blasco et al⁷ reported improved risk factor, blood pressure, hemoglobin A_{1c}, and body mass index outcomes for patients randomized to lifestyle counseling plus mobile phone-enabled messaging compared with patients who received lifestyle counseling alone. Varnfield et al⁸ randomized patients after AMI to traditional cardiac rehabilitation or a smartphone-based home delivery program including exercise monitoring, motivational and educational material delivery, and weekly monitoring consultations. The smartphone-based program had significantly higher rates of participation and completion, and was associated with significant improvements in patient emotional status and QOL. Several ongoing trials are evaluating the effectiveness of web- or smartphone-based interactive tools and comprehensive cardiac telerehabilitation.⁹

Cardiac rehabilitation is a tremendously important component of the care of patients after AMI and/or coronary revascularization. The path forward to improve utilization in-

volves novel approaches that center on the patient. We have seen only glimpses of what can be accomplished with digital and e-health strategies. Wide-scale change will require patients, clinicians, insurers, and health systems to adopt and catch up with what is already digitally achievable.

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Comparison of the Expression and Granting of Requests for Euthanasia in Belgium in 2007 vs 2013

Belgium legalized euthanasia in 2002.¹ Between 2007 and 2013, the prevalence of euthanasia in Flanders, the Dutch-speaking part of Belgium, increased from 1.9% to 4.6% of all deaths.² Here we describe the shifts (overall and in specific groups of patients) in the expression and granting of euthanasia requests during this period and the reasons that physicians granted or denied these requests.

Methods | Approval was obtained from the Ethical Review Board of the University Hospital of the Vrije Universiteit



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