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Cardiac Rehabilitation Uptake After Myocardial Infarction: Why Referral Is Not the Bottleneck

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Abstract

Referral to cardiac rehabilitation after myocardial infarction is widely treated as the policy target that matters most, and quality-improvement effort has followed accordingly. National US registry data show why that framing is increasingly incomplete: referral after myocardial infarction rose from 72.9% to 80.7% between 2007 and 2012, and exceeded 85% at the best-performing hospitals well before this review's timeframe. Yet among Medicare beneficiaries eligible for cardiac rehabilitation in 2016, only around one in four attended even a single session, and roughly one in twenty completed the full recommended course. The gap between referral and attendance, not between eligibility and referral, is now where most of the loss occurs. This review sets out the referral-enrollment-completion cascade, the demographic and structural barriers that concentrate at the enrollment step — sex, race, age, distance, cost and psychological comorbidity — and the intervention evidence, which shows that changing how enrollment itself is scheduled and delivered (automatic pre-approved referral, early outpatient education, home-based delivery) moves attendance far more than any further push on referral rates could. It closes with two honest complications: the trial-level evidence for exercise-based cardiac rehabilitation shows a clear cardiovascular mortality and readmission benefit but no significant all-cause mortality benefit, a more modest claim than the observational dose-response data that motivate completion targets; and higher-dose completers in observational cohorts are probably also healthier and more mobile to begin with, a confounding-by-indication problem the field has not fully resolved.

Keywords: *Cardiac rehabilitation; Myocardial infarction; Referral; Health disparities; Secondary prevention*

Introduction

Exercise-based cardiac rehabilitation is a class I guideline recommendation after myocardial infarction in both US and European practice, and the case for referring eligible patients is no longer contested in principle [1,2]. What has changed over the past two decades is less the strength of that recommendation than the empirical picture of where patients are actually lost between an inpatient event and a completed course of rehabilitation. Early US claims data described referral itself as the primary failure: a 1997 Medicare claims analysis found only 14% of patients were referred after myocardial infarction, and 31% after coronary artery bypass grafting, low enough that referral improvement absorbed most subsequent policy attention [3].

That attention appears to have worked. Figure 1 sets out the scale of the shift: by the most recent large national registry data available for this review, referral after myocardial infarction is no longer the dominant point of loss it once was, even though overall program uptake remains low. This review asks a narrower, more current question than "how do we raise referral": given that referral has already risen substantially in many settings, where does the remaining loss actually happen, and what, specifically, closes that gap.

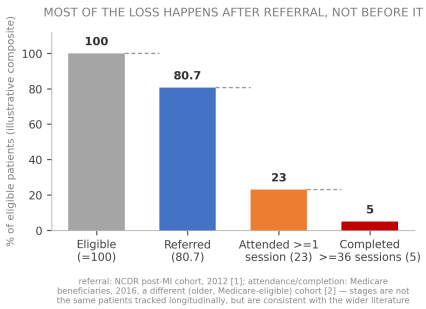

Figure 1: Most of the loss in the cardiac rehabilitation cascade after myocardial infarction now happens after referral, not before it; referral and attendance/completion figures are drawn from different national cohorts, as noted in the figure [4,7].

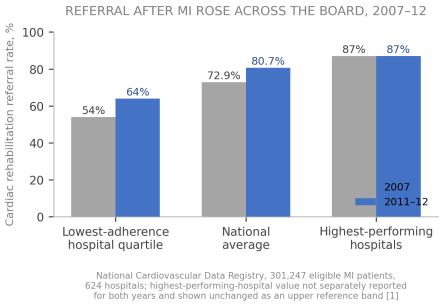

Figure 2: Referral after myocardial infarction rose across hospital performance tiers, 2007-2012: National Cardiovascular Data Registry, 301,247 eligible patients, 624 hospitals [4].

Material and Methods

This is a narrative review, not a systematic review or meta-analysis. It adopts the referral-enrollment-completion framework used in the American Heart Association's presidential advisory on the subject [16]. Literature was assembled by searching for national registry and Medicare claims studies of cardiac rehabilitation referral, enrollment and completion after myocardial infarction; demographic disparities in referral and enrollment by sex, race and age; structural barriers including distance, cost and psychological comorbidity; and randomized and implementation-science evidence on interventions that change enrollment and completion rates, supplemented by the current Cochrane review of exercise-based cardiac rehabilitation and of home-based versus center-based delivery. Every percentage and odds ratio reproduced here is taken directly from the cited source; none was recalculated by the present authors. Figure 1's cascade combines a national MI-registry referral rate with a separate Medicare attendance/completion cohort, as its caption states explicitly, because no single publicly available dataset reports all three stages for the same patients; it is illustrative of a consistent pattern in the wider literature, not a single cohort's longitudinal record.

Results

Referral has improved substantially, and is no longer the main bottleneck it once was

The National Cardiovascular Data Registry followed cardiac rehabilitation referral among 301,247 eligible myocardial infarction patients across 624 US hospitals from 2007 to 2012, finding referral rise from 72.9% to 80.7% nationally over that period [4]. The improvement was not confined to already-strong performers: hospitals in the lowest quartile of adherence to other acute-MI performance measures rose from 54% to 64% referral over the same interval, while the highest-performing hospitals held steady at roughly 87%, essentially the ceiling most quality-improvement programs target [4]. Figure 2 sets out this trend by hospital tier.

A separate contemporary registry found roughly 60% referral among patients undergoing percutaneous coronary intervention specifically, with striking geographic variation: small Midwestern hospitals frequently exceeded 80% referral, while some major teaching hospitals on the coasts referred fewer than 20% of eligible patients, a pattern that reflects local program capacity and referral workflow as much as clinician attitude [5]. Referral also remained systematically lower for women and non-white patients even as it improved across the board, a disparity this review returns to below [4]. Despite this unevenness, the headline national trajectory is unambiguous: referral after myocardial infarction is already well above the level at which most further gains in overall program uptake could plausibly come from raising it further.

Attendance and completion remain the dominant point of loss

The contrast becomes stark once referral is set against what happens afterward. A study of 58,269 older US patients referred to cardiac rehabilitation after acute myocardial infarction found only 23% of the total attended even one session, and just 5% completed 36 or more sessions, the historically recommended full course [6]. National tracking of Medicare beneficiaries eligible for cardiac rehabilitation in 2016 — more than 366,000 patients — found a closely consistent picture: about 25% participated in at least one session, about 24% initiated care within 21 days of the qualifying event, and about 27% of those who did participate went on to complete the program [7]. Figure 1 places these figures against the referral rate above; the gap between the second and third bars, not the first and second, is where most of the loss now sits.

Attendance and completion also vary sharply by age, falling from around 32% among beneficiaries aged 65 to 74 to around 10% among those 85 and older, a decline plausibly reflecting mobility, comorbidity burden and transport dependence rather than eligibility or clinician judgment about appropriateness, since guideline eligibility itself does not narrow by age in this range [7], consistent with broader evidence that age itself is an independent barrier to completing

structured exercise programs [17]. This age gradient is at least as steep as the sex and race gradients discussed next, underscoring that the enrollment step, not the referral step, is where demographic and structural disadvantage concentrates.

Sex, race and age gaps concentrate at enrollment, not referral

A meta-analysis of 26 studies covering 297,719 patients found women had substantially lower odds of enrolling in cardiac rehabilitation than men, a pooled odds ratio of 0.64 (95% CI 0.57-0.72), even after referral had occurred [8]. National Medicare tracking found a similar pattern in raw participation rates: about 29% of men versus about 19% of women eligible for cardiac rehabilitation actually participated [7]. Racial disparity compounds sex disparity rather than substituting for it: in one single-center cohort of 253 women after myocardial infarction, only 12% of Black women were referred to cardiac rehabilitation compared with 24% of white women, and only 9% enrolled compared with 19%, though with a sample this size the adjusted odds ratios (roughly 0.45 for referral, 0.42 for enrollment) did not reach conventional statistical significance (p=.059 for both) [9]. A related meta-analysis of referral specifically, rather than enrollment, found the same pattern: women were less likely than men to be referred to cardiac rehabilitation in the first place [18]. Figure 3 sets these disparities alongside the age gradient described above, all measured against the same approximate national participation baseline.

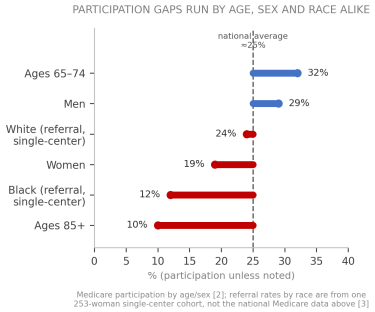

Figure 3: Cardiac rehabilitation participation gaps by age and sex (national Medicare data) and by race (one 253-woman single-center referral cohort), plotted against an approximate 25% national participation baseline [7,9].

These are not small effects, and they sit on top of, rather than instead of, the structural barriers described next. A clinician's decision to refer is necessary but is evidently not sufficient to produce equitable attendance, since the disparities widen rather than resolve once referral has already happened.

Distance, cost and psychological comorbidity are structural barriers concentrated at enrollment

Distance to the nearest cardiac rehabilitation center is itself a measurable predictor of non-attendance: one analysis found a distance greater than 16 km from a center was associated with increased probability of non-attendance, and a driving time of 60 minutes or more reduced both referral and enrollment [10]. A national geographic analysis found average distance to the nearest center accounted for roughly 11% of the geographic variation in program initiation among Medicare beneficiaries, and identified 40, predominantly urban, US counties home to 14% of the population aged 65 and older with disproportionately low program access — a reminder that "cardiac rehabilitation deserts" are not simply a rural phenomenon [11]. Cost compounds distance: Medicare copayments run around $20 per session, other insurers' copayments range from $0 to $100, and the total cost of a full 36-session course can reach $720 to $3,600 out of pocket, a sum that falls disproportionately on lower-income patients already least likely to enroll [10].

Barrier domain	Representative finding	Source
Distance / travel time	Greater than 16 km from center, or 60+ min drive time, predicts non-attendance	[10,11]
Cost	Copayments $0-$100/session; full course $720-$3,600 out of pocket	[10]
Psychological	~1 in 5 depressed at hospitalization; depression -> 3x non-adherence	[10]
Time / employment	Session scheduling conflicts with work and caregiving obligations	[10]

Table 1: Structural and patient-level barriers concentrated at the enrollment and completion steps of the cardiac rehabilitation cascade, rather than at referral [10,11].

Psychological comorbidity adds a further, less visible barrier: about one in five patients meets diagnostic criteria for depression while hospitalized for a cardiac event, and up to one in three experiences clinically significant anxiety, with depressed patients roughly three times as likely to be non-adherent with physician recommendations generally [10]. A longitudinal cohort study confirmed this association persists throughout an actual rehabilitation program, not only at hospitalization [19], consistent with older evidence that depression independently predicts more disability days and lost work time, the same functional burden that also limits attendance [22]. None of these barriers operate at referral; all of them act after a referral has already been made, which is precisely why raising referral rates further, absent action on these barriers, has a shrinking return.

Among patients who do enroll, completed dose tracks survival

The clinical stakes of the enrollment and completion gap are not merely theoretical. A large observational Medicare cohort found a clear dose-response relationship between sessions attended and survival: patients completing the full 36 sessions had 47% lower all-cause mortality than those who attended only a single session, with each additional six sessions attended associated with an approximate further 6% reduction in mortality [7]. Figure 4 sets out this relationship.

This dose-response signal is genuinely striking, but it is observational, not randomized, and the most plausible alternative explanation — that patients healthy and mobile enough to complete 36 sessions were already at lower mortality risk before they ever attended a single one — cannot be excluded by this study design. This distinction, between what the randomized evidence supports and what the observational dose-response data merely suggest, is one of this review's two honest complications and is addressed directly in the Discussion.

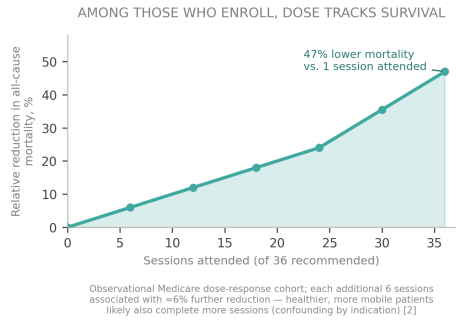

Figure 4: Relative reduction in all-cause mortality by cardiac rehabilitation sessions attended, observational Medicare cohort; healthier, more mobile patients likely also complete more sessions, a confounding-by-indication limitation discussed below [7].

What actually moves enrollment: system design, not exhortation

If enrollment, not referral, is now the binding constraint, the relevant evidence is which interventions change enrollment itself. A multi-site implementation-science study tested several strategies directly: a "PRE-APPROVED" pathway, in which an allied health provider could complete and pre-approve a referral without requiring a separate physician signature, increased enrollment with an odds ratio of 2.91 (95% CI 2.20-3.85); an "EARLY-ED" strategy, delivering outpatient education shortly after discharge rather than waiting for a scheduled intake visit, increased enrollment with an odds ratio of 4.85 (95% CI 2.96-7.95) [12]. Sites using these enrollment-focused strategies achieved 65% to 84% enrollment, compared with 40% to 53% at sites relying on usual referral practice alone, roughly two to five times the access of usual care [12]. Figure 5 places these intervention effects on the same axis as the demographic enrollment gaps described above, to compare their relative magnitude, not to imply a single pooled model.

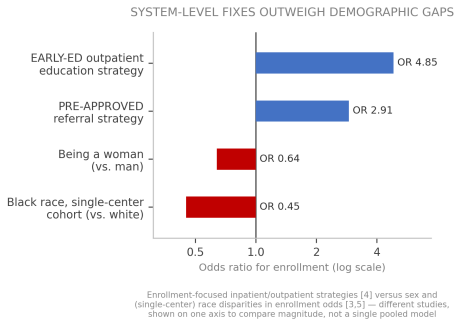

Figure 5: Enrollment-focused system interventions produce larger swings in enrollment odds than the demographic disparities they must operate against; strategies and disparities are drawn from different studies, shown for magnitude comparison only [8,9,12].

Home-based delivery directly addresses the distance and cost barriers described above without sacrificing outcomes. A current Cochrane review comparing home-based with center-based cardiac rehabilitation found no significant difference in mortality (risk ratio 1.19, 95% CI 0.65-2.16, low-certainty evidence), no meaningful difference in exercise capacity (standardised mean difference -0.10, 95% CI -0.24 to 0.04), equivalent completion rates (risk ratio 1.03, 95% CI 0.99-1.08), and no meaningful difference in quality of life across the large majority of comparisons assessed [13]. Figure 6 sets out this equivalence across the four outcomes the review reported in most detail.

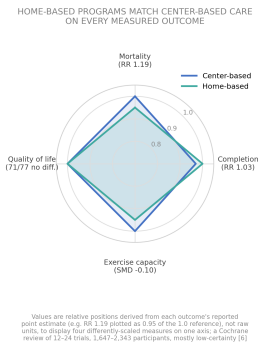

Figure 6: Home-based cardiac rehabilitation matches center-based delivery across mortality, completion, exercise capacity and quality of life; Cochrane review, 12-24 trials, 1,647-2,343 participants, mostly low-certainty evidence [13].

Two further interventions target cost and access directly. A randomized trial of financial incentives for Medicaid beneficiaries improved both participation and session adherence relative to usual care [20], and digital, mobile-technology-enabled delivery is under active development as a further alternative to fixed-location programs, though its evidence base remains smaller than home-based delivery's [21]. Table 2 summarizes the interventions with the clearest evidence of moving enrollment or completion.

Intervention	Effect	Evidence base
Pre-approved allied-health referral pathway	Enrollment OR 2.91 (95% CI 2.20-3.85)	Multi-site implementation study [12]
Early post-discharge outpatient education	Enrollment OR 4.85 (95% CI 2.96-7.95)	Multi-site implementation study [12]
Home-based delivery	Equivalent mortality, completion, QoL	Cochrane review, 12-24 trials [13]
Financial incentives (Medicaid)	Improved participation and adherence	Randomized trial [20]

Table 2: Interventions with the clearest evidence of moving cardiac rehabilitation enrollment or completion, as distinct from interventions aimed only at referral [12,13,20,21].

Discussion

Two honest complications belong at the center of this review rather than at its margins. The first concerns the strength of the evidence that completion itself saves lives. The trial-level evidence for exercise-based cardiac rehabilitation, drawn from 85 randomized controlled trials and 23,430 participants, shows a clear 26% relative reduction in cardiovascular mortality at longest follow-up (risk ratio 0.74, 95% CI 0.64-0.86) and a 23% reduction in all-cause hospital readmission (risk ratio 0.77, 95% CI 0.67-0.89), but no statistically significant reduction in all-cause mortality (risk ratio 0.96, 95% CI 0.89-1.04) [14]. That is a more modest claim than the 47% all-cause mortality difference in the observational Medicare dose-response cohort above, and the discrepancy is exactly what confounding by indication would predict: randomization balances baseline health between arms, an observational comparison of completers against single-session attenders does not. The honest summary is that randomized evidence firmly supports a cardiovascular-mortality and readmission benefit, while the larger all-cause mortality numbers used to motivate completion campaigns rest on a design that cannot separate attending more sessions from already being well enough to attend them.

The second complication is that this review's central claim — that referral is no longer the main bottleneck — describes aggregate national trends in one health system, not every hospital. Referral still varied from under 20% to over 80% by hospital even at the end of the 2007-12 registry period, and remained lower for women and non-white patients throughout [4,5]. Where referral remains genuinely low, raising it is still the correct first priority; this review's argument is that, where referral has already reached the 70-90% range documented here, further referral-focused effort has a shrinking marginal return relative to enrollment-focused system redesign.

Taken together, these findings argue for reallocating quality-improvement effort: from campaigns increasing referral where it is already high, toward the specific interventions — pre-approved referral pathways, early outpatient education, home-based delivery — shown to move enrollment and completion directly, alongside attention to the sex, race, age and distance gradients concentrated at that same step.

Study limitations

This is a narrative synthesis, not a systematic review. Figure 1's referral, attendance and completion figures come from different cohorts, as its caption states, and illustrate a pattern rather than a single tracked cascade. Figure 3's racial data come from one 253-woman single-center cohort, did not reach statistical significance, and may not generalize; larger national referral data by race were not identified. Most of the data describe US practice; a country-series review found meaningfully different structures elsewhere, such as Canada, so these findings may not transfer directly [15].

Conclusion

National registry data show that referral after myocardial infarction has risen substantially, reaching 80.7% nationally and exceeding 85% at top-performing hospitals, while attendance and completion have not kept pace: around one in four eligible patients attend even one session, and around one in twenty complete a full course. Most of the remaining loss, and most of the sex, race and age disparity in use, concentrates at enrollment and completion rather than referral; enrollment-focused interventions — pre-approved referral pathways, early outpatient education, home-based delivery — produce larger gains than further referral-focused effort where referral is already high. Two honest complications remain: randomized evidence supports a cardiovascular-mortality and readmission benefit rather than a proven all-cause mortality benefit, and this review's claim describes an aggregate national pattern, not every hospital [4,14].

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