

1b.2. Provide performance scores on the measure as specified (current and over time) at the specified level of analysis. (This is required for maintenance of endorsement. Include mean, std dev, min, max, interquartile range, scores by decile. Describe the data source including number of measured entities; number of patients; dates of data; if a sample, characteristics of the entities include). This information also will be used to address the sub-criterion on improvement (4b1) under Usability and Use.

2015 and 2016 Performance Scores									
Year	Number of Providers	Number of Patients	Minimum	Mean	Maximum	Lower Quartile	Upper Quartile	Quartile Range	Standard Deviation
2015	4954	270448	0.00%	5.51%	24.18%	1.38%	13.33%	11.95%	17.41%
2016	2752	216773	0.00%	5.42%	26.05%	1.14%	13.50%	12.36%	18.03%

2015 and 2016 Performance Scores by Decile										
Year	Decile 10	Decile 20	Decile 30	Decile 40	Median	Decile 60	Decile 70	Decile 80	Decile 90	Maximum
2015	0.00%	0.78%	1.91%	3.66%	5.51%	8.20%	11.24%	16.00%	24.18%	24.18%
2016	0.00%	0.00%	1.91%	3.66%	5.42%	8.00%	11.31%	16.34%	26.05%	26.05%

1b.4. Provide disparities data from the measure as specified (current and over time) by population group, e.g., by race/ethnicity, gender, age, insurance status, socioeconomic status, and/or disability. (This is required for maintenance of endorsement. Describe the data source including number of

[illegible]

2016 Disparities Data by Decile (in percent)

[illegible]

<h1>PINNACLE Registry®</h1>		NCDR® PINNACLE Registry® v1.5 (CardioEncounters) Data Collection Form Practice Innovation and Clinical Excellence	
MRN ¹⁵⁰⁰ :	Encounter Date ¹⁵¹⁰ : mm / dd / yyyy	Practice ID ¹⁵²⁰ :	Location ID ¹⁵³⁰ :
Provider NPI ¹⁵⁵⁰ :	Encounter TIN ¹⁵⁵⁵ :	Patient new to the Practice ¹⁵⁶⁰ : <input type="radio"/> No <input type="radio"/> Yes	
A. PATIENT DEMOGRAPHICS			
Patient Name (Last, First, MI) ^{2000, 2010, 2020} :		SSN ²⁰³⁰ :	Patient ID ²⁰⁴⁰ : (auto) Patient Zip ²²⁰⁰ :
Date of Birth ²⁰⁵⁰ : mm / dd / yyyy	Sex ²⁰⁶⁰ : <input type="radio"/> Male <input type="radio"/> Female	<input type="checkbox"/> Patient Deceased ²⁰⁶⁵ → Date ²⁰⁶⁷ mm / dd / yyyy	
Race: <input type="checkbox"/> White ²⁰⁷⁰ <input type="checkbox"/> Black/African American ²⁰⁷¹ <input type="checkbox"/> American Indian/Alaskan Native ²⁰⁷³ (Check all that apply) <input type="checkbox"/> Asian ²⁰⁷² → If Yes, <input type="checkbox"/> Asian Indian ²⁰⁸⁰ <input type="checkbox"/> Chinese ²⁰⁸¹ <input type="checkbox"/> Filipino ²⁰⁸² <input type="checkbox"/> Japanese ²⁰⁸³ <input type="checkbox"/> Korean ²⁰⁸⁴ <input type="checkbox"/> Vietnamese ²⁰⁸⁵ <input type="checkbox"/> Other ²⁰⁸⁶ <input type="checkbox"/> Native Hawaiian/Pacific Islander ²⁰⁷⁴ → If Yes, <input type="checkbox"/> Native Hawaiian ²⁰⁹⁰ <input type="checkbox"/> Guamanian or Chamorro ²⁰⁹¹ <input type="checkbox"/> Samoan ²⁰⁹² <input type="checkbox"/> Other Island ²⁰⁹³			
Hispanic or Latino Ethnicity²⁰⁷⁶: <input type="radio"/> No <input type="radio"/> Yes → If Yes, Ethnicity Type: (Check all that apply) <input type="checkbox"/> Mexican, Mexican-American, Chicano ²¹⁰⁰ <input type="checkbox"/> Puerto Rican ²¹⁰¹ <input type="checkbox"/> Cuban ²¹⁰² <input type="checkbox"/> Other Hispanic, Latino or Spanish Origin ²¹⁰³			
Insurance Payers: (Check all that apply) <input type="checkbox"/> Medicaid (fee for service) ³⁰³⁰ <input type="checkbox"/> Medicare (fee for service) ³⁰²⁸ <input type="checkbox"/> Private Health Insurance ³⁰²⁰ <input type="checkbox"/> Medicaid (managed care) ³⁰³¹ <input type="checkbox"/> Medicare (managed care) ³⁰²⁹ <input type="checkbox"/> Military Health Care ³⁰²³ <input type="checkbox"/> State Specific Plan (non-Medicaid) ³⁰²⁴ <input type="checkbox"/> Indian Health Service ³⁰²⁵ <input type="checkbox"/> Non-US Insurance ³⁰²⁶ <input type="checkbox"/> None ³⁰²⁷			
Payer ID ³¹⁰⁰ : _____			
B. DIAGNOSES/CONDITIONS/CO-MORBIDITIES (CHECK ALL THAT APPLY) NOTE: INDICATE IF THE PATIENT HAS A HISTORY OF ANY OF THE FOLLOWING.			
<input type="checkbox"/> Coronary Artery Disease ⁴⁰⁰⁰ → Date ⁴⁰⁰² mm / dd / yyyy <input type="checkbox"/> Atrial Fibrillation/Flutter ⁴⁰¹⁰ → Date ⁴⁰¹² mm / dd / yyyy <input type="checkbox"/> Dyslipidemia ⁴⁰²⁰ → Date ⁴⁰²² mm / dd / yyyy <input type="checkbox"/> Diabetes Mellitus (Any) ⁴¹⁵⁰ → Date ⁴¹⁵² mm / dd / yyyy <input type="checkbox"/> Hypertension ⁴⁰³⁰ → Date ⁴⁰³² mm / dd / yyyy <input type="checkbox"/> Peripheral Vascular Disease ⁴²³⁰ → Date ⁴²³² mm / dd / yyyy <input type="checkbox"/> Peripheral Arterial Disease ⁴⁰⁹⁰ → Date ⁴⁰⁹² mm / dd / yyyy <input type="checkbox"/> PAD – Acute Limb Ischemia ⁴¹⁰⁰ → Date ⁴¹⁰² mm / dd / yyyy <input type="checkbox"/> PAD – Claudication ⁴¹¹⁰ → Date ⁴¹¹² mm / dd / yyyy <input type="checkbox"/> PAD – Critical Limb Ischemia ⁴¹²⁰ → Date ⁴¹²² mm / dd / yyyy <input type="checkbox"/> PAD – Foot/Leg cellulitis ⁴¹³⁰ → Date ⁴¹³² mm / dd / yyyy <input type="checkbox"/> PAD – Lower Extremity Osteomyelitis ⁴¹⁴⁰ (with or without limb ischemia) → Date ⁴¹⁴² mm / dd / yyyy		<input type="checkbox"/> Heart Failure ⁴⁰⁴⁰ → Date ⁴⁰⁴² mm / dd / yyyy → If Yes, <input type="checkbox"/> New diagnosis ⁴⁰⁵⁰ (within 12 months) → If Yes, Etiology ⁴⁰⁵² <input type="radio"/> Ischemic <input type="radio"/> Hypertensive <input type="radio"/> Valvular <input type="radio"/> Congenital <input type="radio"/> Idiopathic/dilated <input type="radio"/> Peripartum <input type="radio"/> Chemotherapy induced <input type="radio"/> Substance related <input type="radio"/> Tachycardia <input type="checkbox"/> CAD - Unstable Angina ⁴⁰⁸⁰ → Date ⁴⁰⁸² mm / dd / yyyy <input type="checkbox"/> CAD - Stable Angina ⁴⁰⁶⁰ → Date ⁴⁰⁶² mm / dd / yyyy → If Yes, <input type="checkbox"/> New diagnosis ⁴⁰⁷⁰ (within 12 months) <input type="checkbox"/> Ischemic Vascular Disease ⁴²²⁰ → Date ⁴²²² mm / dd / yyyy <input type="checkbox"/> Chronic Kidney Disease ⁴²⁴⁰ → Date ⁴²⁴² mm / dd / yyyy <input type="checkbox"/> Chronic Liver Disease ⁴²⁵⁰ → Date ⁴²⁵² mm / dd / yyyy	
C. CARDIAC EVENTS NOTE: INDICATE IF THE PATIENT HAS A HISTORY OF ANY OF THE FOLLOWING.			
SPECIFY ALL EVENT(S) AND IF AVAILABLE, EVENT DATE(S) THAT OCCURRED.			
EVENT ⁵¹³⁵	EVENT DATE(S) ⁵¹³⁶	EVENT ⁵¹³⁵	EVENT DATE(S) ⁵¹³⁶
CAD – Myocardial Infarction ^{E001}	mm / dd / yyyy	Minor Hemorrhage ^{E006}	mm / dd / yyyy
PCI (Any) ^{E029}	mm / dd / yyyy	Intracranial Hemorrhage ^{E007}	mm / dd / yyyy
PCI – Bare Metal Stent Implant ^{E002}	mm / dd / yyyy	Non Intracranial Major Hemorrhage (Any) ^{E032}	mm / dd / yyyy
PCI – Drug Eluting Stent Implant ^{E003}	mm / dd / yyyy	Non Intracranial Major Hemorrhage Location – Intra-articular (Atraumatic) ^{E009}	mm / dd / yyyy
PCI – Other (non-stent) Intervention ^{E004}	mm / dd / yyyy	Non Intracranial Major Hemorrhage Location – Intra-ocular ^{E010}	mm / dd / yyyy
Coronary Artery Bypass Graft ^{E017}	mm / dd / yyyy	Non Intracranial Major Hemorrhage Location – Intra-spinal ^{E011}	mm / dd / yyyy
Systemic Embolism ^{E005}	mm / dd / yyyy		
Hemorrhage (Any) ^{E031}	mm / dd / yyyy	PTCA ^{E026}	mm / dd / yyyy

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MRN:		Encounter Date: mm / dd / yyyy		Practice ID:		Location ID:	
PLAN OF CARE							
BMI	<input type="checkbox"/> Body Mass Index Screen Performed ⁶⁹⁰⁰ → Date ⁶⁹⁰² mm / dd / yyyy				<input type="checkbox"/> BMI Management Plan ⁶⁹¹⁰		
	<div style="display: flex; justify-content: space-between;"> <div> Cardiac Rehabilitation Referral or Plan for Qualifying Event/Diagnosis in past 12 months⁶⁴⁵⁰: <small>(Note: Cardiac event/diagnoses includes Myocardial Infarction, Valve surgery, Heart Transplant, CABG, PCI or new Stable Angina diagnosis.)</small> Referral for Consideration for Coronary Revascularization⁶⁴⁶⁰: Referral for Additional Evaluation/Treatment of Anginal Symptoms⁶⁴⁷⁰: Discussion of Lifestyle Modifications Documented⁶¹⁰⁰: </div> <div> <input type="radio"/> Yes – Referral/Plan Documented <input type="radio"/> No Qualifying Event/Diagnosis <input type="radio"/> Patient Already Participating in Rehab <input type="radio"/> No <input type="radio"/> No <input type="radio"/> No <input type="radio"/> No </div> <div> <input type="radio"/> No Referral/Plan – Medical Reason <input type="radio"/> No Referral/Plan – System Reason <input type="radio"/> No <input type="radio"/> Yes <input type="radio"/> Yes <input type="radio"/> Yes </div> </div>						
CAD							
EF	LVEF Assessed Date ⁶⁴⁰⁰ : mm / dd / yyyy LVEF ⁶⁴¹⁰ : _____ % LV Qualitative Assessment ⁶⁴²⁰ : <small>(Note: If a LVEF range is documented, take the average, round up and refer to the LVEF Status ranges (right) to code.)</small>						
	<div style="display: flex; justify-content: space-between;"> <div> <input type="radio"/> Hyperdynamic: > 70 <input type="radio"/> Mildly reduced: 40 – 49 <input type="radio"/> Severely reduced: ≤ 29 </div> <div> <input type="radio"/> Normal: 50 – 70 <input type="radio"/> Moderately reduced: 30 – 39 </div> </div>						
HF	HF Education Completed/Documented: (Check all that apply) <input type="checkbox"/> All of the following ⁶²⁸⁰ <input type="checkbox"/> Weight Monitoring ⁶²⁸¹ <input type="checkbox"/> Diet (Sodium Restriction) ⁶²⁸² <input type="checkbox"/> Symptom Management ⁶²⁸³ <input type="checkbox"/> Physical Activity ⁶²⁸⁴ <input type="checkbox"/> Smoking Cessation ⁶²⁸⁵ <input type="checkbox"/> Medication Instruction ⁶²⁸⁶ <input type="checkbox"/> Prognosis/end-of-life Issues ⁶²⁸⁷ <input type="checkbox"/> Minimizing or Avoiding use of NSAIDs ⁶²⁸⁸ <input type="checkbox"/> Referral for visiting nurse or specific educational or management programs ⁶²⁸⁹						
	ICD Counseling ⁶³⁰⁰ : <input type="radio"/> Yes – Patient Counseled <input type="radio"/> No – Patient Not Counseled <input type="radio"/> No Counseling – Medical Reason HF Plan of Care ⁶³¹⁰ : <input type="radio"/> No <input type="radio"/> Yes						
ATRIAL FIBRILLATION/FLUTTER ASSESSMENT AND TREATMENT							
AFIB	AFib/Flutter Duration ⁶⁵⁰⁰ : <input type="radio"/> First diagnosed <input type="radio"/> Paroxysmal <input type="radio"/> Persistent <input type="radio"/> Long-standing Persistent <input type="radio"/> Permanent AFib/Flutter Type ⁶⁵¹⁰ : <input type="radio"/> Non-Valvular <input type="radio"/> Valvular <input type="checkbox"/> AFib/Flutter Etiology – Transient/Reversible Cause ⁶⁵²⁰ (e.g., pneumonia, hyperthyroidism, pregnancy, post-surgery)						
	INR Value ⁶⁵³⁰ : _____ → Date ⁶⁵³² mm / dd / yyyy Atrial Fibrillation Symptom Frequency ⁶⁵⁷⁰ : (every) _____ days <input type="checkbox"/> EP Study ⁶⁵⁴⁰ → Date ⁶⁵⁴² mm / dd / yyyy Atrial Fibrillation Symptom Duration ⁶⁵⁸⁰ : <input type="checkbox"/> Atrial Ablation ⁶⁵⁵⁰ → Date ⁶⁵⁵² mm / dd / yyyy <input type="radio"/> < 48 hours <input type="radio"/> ≥ 48 hours – 7 days <input type="radio"/> > 7 days – 3 months <input type="radio"/> > 3 months <input type="checkbox"/> Atrial Fibrillation Recurrence ⁶⁵⁶⁰ → Date ⁶⁵⁶² mm / dd / yyyy <input type="checkbox"/> Rate Control Therapy ⁶⁵⁹⁰ <input type="checkbox"/> Rhythm Control Therapy ⁶⁵⁹⁵						
	<div style="display: flex; justify-content: space-between;"> <div> CHADS₂ Score⁶⁶⁰⁰: _____ CHA₂DS₂-VASc Score⁶⁶¹⁰: _____ HAS-BLED Score⁶⁶²⁰: _____ </div> </div>						
E. LABORATORY RESULTS NOTE: ENTER ALL LAB RESULTS AND/OR INDICATE THE LABS ORDERED DATES.							
CAD	Lipid Panel Obtained Date ⁷⁰⁰⁰ : mm / dd / yyyy Total Cholesterol ⁷⁰¹⁰ : _____ mg/dL High Density Lipoprotein (HDL) ⁷⁰²⁰ : _____ mg/dL Low Density Lipoprotein (LDL) ⁷⁰³⁰ : _____ mg/dL Direct Low Density Lipoprotein (LDL) ⁷⁰⁴⁰ : _____ mg/dL Triglycerides ⁷⁰⁵⁰ : _____ mg/dL				Diabetes	Glucose timing ⁷⁰⁶⁰ : <input type="radio"/> Fasting <input type="radio"/> Random Plasma Glucose Results ⁷⁰⁷⁰ : _____ mg/dL → Date ⁷⁰⁷² mm / dd / yyyy HbA1c ⁷⁰⁸⁰ : _____ % → Date ⁷⁰⁸² mm / dd / yyyy HgB ⁷⁵¹⁰ : _____ g/dL → Date ⁷⁵¹² mm / dd / yyyy	
HF	Potassium ⁷¹¹⁰ : _____ mEq/L → Date ⁷¹¹² mm / dd / yyyy Sodium ⁷¹¹⁵ : _____ mEq/L → Date ⁷¹¹⁷ mm / dd / yyyy B-type Natriuretic Peptide ⁷¹²⁰ : _____ pg/mL → Date ⁷¹²² mm / dd / yyyy N-terminal pro b-type Natriuretic Peptide ⁷¹²⁵ : _____ pg/mL → Date ⁷¹²⁷ mm / dd / yyyy						
RENAL	Estimated Glomerular Filtration Rate ⁷²⁰⁰ : _____ mL/min → Date ⁷²⁰² mm / dd / yyyy Creatinine Clearance ⁷²²⁰ : _____ → Date ⁷²²² mm / dd / yyyy Serum Creatinine ⁷²³⁰ : _____ mg/dL → Date ⁷²³² mm / dd / yyyy						

MRN:		Encounter Date: mm / dd / yyyy		Practice ID:		Location ID:					
F. MEDICATIONS		PLEASE LEAVE BLANK IF THERE IS NO CLINICAL INDICATION FOR A MEDICATION TO BE PRESCRIBED, OR IF NO DOCUMENTATION EXISTS AS TO IF A MEDICATION WAS PRESCRIBED/CONTINUED.									
MEDICATION ⁹³⁰⁰ <small>* DENOTES THAT THE MEDICATION(S) ARE REQUIRED FOR SPECIFIC PERFORMANCE MEASURES OR PQRS MEASURES</small> <small>+ INDICATES A MEDICATION IS NOT YET BEEN APPROVED.</small>		DOSE STRENGTH <small>9301</small>	DOSING MEASURE <small>9302</small> <small>(E.G. MG, ML)</small>	DOSING FREQUENCY <small>9303</small>	SOURCE MEDICATION CODE <small>9307</small>	SOURCE MEDICATION CODE SYSTEM ¹ <small>9309</small>	ADMINISTERED ⁹³⁰⁵				
							YES <small>(PRESCRIBED)</small>	No <small>(MEDICAL REASON)</small>	No <small>(PATIENT REASON)</small>	No <small>(SYSTEM REASON)</small>	
ANTIANGINAL	Nitroglycerin						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
	Ranolazine						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
ANTIARRHYTHMIC	Antiarrhythmic (Any)						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
	Amiodarone						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
	Dronedarone						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
ANTICOAGULANTS*	Apixaban						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
	Dabigatran						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
	Edoxaban						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
	Rivaroxaban						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
	Warfarin						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
ANGIOTENSION RECEPTOR-NEPRILYSIN INHIBITOR	Sacubitril/Valsartan						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
ANTIHYPERTENSIVE	ACE Inhibitor*						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
	ARB*						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
	Combination Antihypertensive						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
	CA CHANNEL BLOCKERS	Calcium Channel Blocker (any)						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		Dihydropyridine						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		Non-Dihydropyridine						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	DIURETICS*	Diuretic (Any)						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		Loop Diuretic						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		Thiazide Diuretic						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		Potassium Sparing Diuretic						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
ANTIPLATELETS	Aspirin						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
	Aspirin-dipyridamole (Aggrenox)						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	
	P2Y12 INHIBITOR	Clopidogrel						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		Ticlopidine						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		Prasugrel						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
		Ticagrelor						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
THROMBIN RECEPTOR ANTAGONIST	Vorapaxar (Zontivity)						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	

¹PLEASE PROVIDE SOURCE MEDICATION CODE SYSTEM VALUE: 1. GPI 2. MMSL 3. NDC 4. RxNORM 5. SNOMED-CT 6. OTHER

MRN:		Encounter Date: mm / dd / yyyy		Practice ID:		Location ID:					
F. MEDICATIONS		PLEASE LEAVE BLANK IF THERE IS NO CLINICAL INDICATION FOR A MEDICATION TO BE PRESCRIBED, OR IF NO DOCUMENTATION EXISTS AS TO IF A MEDICATION WAS PRESCRIBED/CONTINUED.									
MEDICATION ⁹³⁰⁰ <small>* DENOTES THAT THE MEDICATION(S) ARE REQUIRED FOR SPECIFIC PERFORMANCE MEASURES OR PQRS MEASURES</small> <small>+ INDICATES A MEDICATION IS NOT YET BEEN APPROVED.</small>		DOSE STRENGTH <small>9301</small>	DOSING MEASURE <small>9302</small> <small>(E.G. MG, ML)</small>	DOSING FREQUENCY <small>9303</small>	SOURCE MEDICATION CODE <small>9307</small>	SOURCE MEDICATION CODE SYSTEM ¹ <small>9309</small>	ADMINISTERED ⁹³⁰⁵				
							YES <small>(PRESCRIBED)</small>	NO <small>(MEDICAL REASON)</small>	NO <small>(PATIENT REASON)</small>	NO <small>(SYSTEM REASON)</small>	
BETA BLOCKER	Beta Blocker (Any)						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Atenolol						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Metoprolol Tartrate						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Sustained release metoprolol succinate						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Bisoprolol						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Carvedilol						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Nebivolol						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
HEART RATE LOWERING	Ivabradine						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
GLUCOSE LOWERING	Insulin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Metformin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Pioglitazone						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	Rosiglitazone						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	SGLT-2 INHIBITORS	Canagliflozin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Dapagliflozin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Empagliflozin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	DPP-4 INHIBITORS	Sitagliptin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Saxagliptin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Linagliptin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Alogliptin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	ALPHA-GLUCOSIDASE	Acarbose						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Miglitol							<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
LIPID LOWERING	Lipid Lowering Non-Statins						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
	STATIN	Lipid Lowering Statin (Any)						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Atorvastatin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Rosuvastatin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Simvastatin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Low Intensity Statin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Moderate Intensity Statin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		High Intensity Statin						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	PCSK9 INHIBITORS	Alirocumab						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
		Evolocumab						<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

¹ PLEASE PROVIDE SOURCE MEDICATION CODE SYSTEM VALUE: 1. GPI 2. MMSL 3. NDC 4. RxNORM 5. SNOMED-CT 6. OTHER

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F. MEDICATIONS		PLEASE LEAVE BLANK IF THERE IS NO CLINICAL INDICATION FOR A MEDICATION TO BE PRESCRIBED, OR IF NO DOCUMENTATION EXISTS AS TO IF A MEDICATION WAS PRESCRIBED/CONTINUED.								
MEDICATION ⁹³⁰⁰ <small>* DENOTES THAT THE MEDICATION(S) ARE REQUIRED FOR SPECIFIC PERFORMANCE MEASURES OR PQRS MEASURES</small> <small>+ INDICATES A MEDICATION IS NOT YET BEEN APPROVED.</small>		DOSE STRENGTH ⁹³⁰¹	DOSING MEASURE ⁹³⁰² <small>(E.G. MG, ML)</small>	DOSING FREQUENCY ⁹³⁰³	SOURCE MEDICATION CODE ⁹³⁰⁷	SOURCE MEDICATION CODE SYSTEM ¹ ⁹³⁰⁹	ADMINISTERED ⁹³⁰⁵			
							YES <small>(PRESCRIBED)</small>	No <small>(MEDICAL REASON)</small>	No <small>(PATIENT REASON)</small>	No <small>(SYSTEM REASON)</small>
SMOKING CESSATION	Bupropion						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Nicotine Replacement Therapy						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Varenicline						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
OTHER	Corticosteroids						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Digoxin (Any)						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	NSAID						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	Proton Pump Inhibitor						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
	SSRI						<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
¹ PLEASE PROVIDE SOURCE MEDICATION CODE SYSTEM VALUE: 1. GPI 2. MMSL 3. NDC 4. RxNORM 5. SNOMED-CT 6. OTHER										
G. HOSPITALIZATIONS										
Hospital Admission Date ⁹⁵⁰⁰ : mm / dd / yyyy → If Admitted, Primary Reason ⁹⁵⁰⁵ : _____ Coding Standard ⁹⁵¹⁰ : <input type="radio"/> ICD-9 <input type="radio"/> ICD-10 Discharge Date ⁹⁵⁰² : mm / dd / yyyy Secondary Diagnosis ⁹⁵⁰⁷ : _____										

Having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including, for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.

Note:

If the patient has multiple race origins, specify them using the other race selections in addition to this one.

American Indian or Alaskan Native (Race)

Having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment.

Note:

If the patient has multiple race origins, specify them using the other race selections in addition to this one.

Native Hawaiian or Pacific Islander (Race)

Having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands.

Note:

If the patient has multiple race origins, specify them using the other race selections in addition to this one.

Hispanic or Latino Ethnicity

A person of Cuban, Mexican, Puerto Rican, Cuban, South or Central American, or other Spanish culture or origin, regardless of race. The term, "Spanish origin," can be used in addition to "Hispanic or Latino."

Note:

If the patient has multiple race origins, specify them using the other race selections in addition to this one.

Myocardial Infarction (within 12 months)

Indicate if MI is documented within the past 12 months.

Coronary Artery Bypass Graft (CABG) (within 12 months)

Indicate if the patient had coronary artery bypass graft (CABG) surgery in the past 12 months.

Cardiac Valve Surgery (within 12 months)

Indicate if the patient had cardiac valve surgery in the past 12 months. Any surgical or transcatheter cardiac valve procedure (repair or replacement)

Heart Transplantation (within 12 months)

Indicate if the patient had a heart transplantation surgery in the past 12 months.

PCI - Stent Implant (within 12 months)

Indicate if the patient had PCI that included a stent implant in the past 12 months

PCI - Other (non-stent) Intervention (within 12 months)

Indicate if the patient had percutaneous coronary intervention (PCI) that did not include a stent implant in the past 12 months.

This includes non-stenting procedures such as balloon angioplasty, atherectomy and thrombectomy.

Stable Angina (within 12 months)

Indicate if the patient has been diagnosed with stable angina in the past 12 months.

Note:

Angina without a change in frequency or pattern for the 6 weeks prior to this visit. Angina is controlled by rest and/or oral or transcutaneous medications.

Current Diagnosis

Indicate if the patient is currently experiencing stable angina.

Note:

For stable angina to be considered a qualifying event, the patient must be currently experiencing stable angina.

Referral Documentation

-Yes, documentation that patient was referred to CR from this provider/facility

Indicate if the patient has been referred to cardiac rehabilitation by this provider or facility within 365 calendar days from the event. Do **NOT** include patients who have not already participated in an early outpatient cardiac rehabilitation/secondary prevention (CR) program as a qualifying event/diagnosis. Cardiac events includes Myocardial Infarction, Valve Replacement, Heart Transplant, CABG, or PCI.

Note(s):

Cardiac rehabilitation is a medically supervised program to help cardiac patients slow and stabilize the progression of cardiovascular disease thus reducing the risk of heart disease, another cardiac event or death.

Cardiac rehabilitation programs include patient counseling, an exercise program, nutrition counseling and risk factor education (smoking, obesity, high blood pressure, high cholesterol).

-Yes, documentation that patient was referred to CR from another provider/facility and/or was participating in CR prior to encounter with provider from this office/facility

Documentation that patient has already been referred to CR by another provider/facility such as the hospital where the patient was hospitalized for the qualifying CR event/diagnosis.

-No, referral to CR not documented, but medical exception documented for this qualifying event/diagnosis

List the specific reasons the patient was not referred to cardiac rehabilitation. Examples include, but are not limited to

- Medical exceptions: patient deemed by provider to have a medically unstable, life-threatening condition

-No, referral to CR not documented, but patient exception documented for this qualifying event/diagnosis

List the specific reasons the patient was not referred to cardiac rehabilitation. Examples include, but are not limited to

- Patient exceptions: patient resides in long term nursing care facility

-No, referral to CR not documented, but health care system exception documented for this qualifying event/diagnosis

List the specific reasons the patient was not referred to cardiac rehabilitation. Examples include, but are not limited to

- Health care system exceptions: no cardiac rehabilitation program available within 60 minutes of travel time from the patient's home

-No, referral not documented and no exceptions documented

- Patient evaluated who did not experience AMI, CABG surgery, PCI, cardiac valve surgery, or cardiac transplantation or who have chronic stable angina in the past 12 months. For example the patient experience atrial fibrillation or suffers from non specific chest pain.

This document is confidential and must not be copied or shared unless authorized by ACCF, AHA, or AACVPR staff.

Communication of Cardiac Rehabilitation Referral

Referral to cardiac rehabilitation is defined as an official communication between the healthcare provider and the patient to recommend and carry out a referral order to an early outpatient CR program. This includes the provision of all necessary information to the patient that will allow the patient to enroll in an early outpatient CR program (e.g., the patient's cardiovascular history, testing, and treatments). This also includes a written or electronic communication between the healthcare provider or healthcare system and the cardiac rehabilitation program that includes the patient's enrollment information for the program.

Documentation could include:

- Hospital discharge summaries
- Office notes
- Clinical notes and medical records
- Orders (Written/electronic)
- Prescriptions (e.g. contact information for cardiac rehabilitation specialist)
- Or other parts of clinical record that documents patient information

Please note that all communications must maintain appropriate confidentiality as outlined by the 1996 Health Insurance Portability and Accountability Act (HIPAA).

What data collection challenges or other comments did you encounter/have (Any feedback on the specifics of this record would be appreciated)?

Identify what difficulty you had in finding the data elements requested. Comments specifically on feasibility challenges would be greatly appreciated.

Total Time Taken:

Identify the total time (in minutes) taken to complete the abstraction of data elements requested on the data abstraction form.

Cardiac rehabilitation and secondary prevention (CR/SP) services are significantly associated with positive health outcomes in a variety of patients with cardiac disorders¹⁻⁷ yet only a minority of eligible patients ever participate in CR/SP.⁸⁻¹⁰ The American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR), American College of Cardiology Foundation (ACCF), and American Heart Association (AHA)¹¹ have developed, and the National Quality Forum (NQF) has endorsed, performance measures (PM's) for CR/SP referral to increase the delivery of CR/SP to appropriate patients (see Table 1).¹²⁻¹⁷ In addition, the Centers for Medicare and Medicaid Services (CMS) has included these measures in the Physician Quality Reporting System, and will begin reporting audits of these PMs in the outpatient setting in 2015.

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Assessment of the reliability of data collection for performance measurement is an important step included in the ACCF/AHA methodology for the development and identification of high-value performance measures^{18, 19}. However, to our knowledge, no studies have been published that have evaluated the reliability of collecting CR/SP performance measures. To address this need, and to respond to NQF requirements to provide such data as part of their endorsement process, we carried out a multi-site study, the Cardiac Rehabilitation Referral Reliability (CR3) Project, aimed at analyzing the reliability of abstracting the CR/SP PMs from inpatient and outpatient records.

METHODS

Hospitals and outpatient cardiology practices in the United States were identified from the ACCF, AHA, and AACVPR databases and were invited to participate. We sought a variety of hospitals and clinics, based on different geographical locations, community sizes, and

hospital/practice types/sizes (Figure 1). All 540 outpatient cardiology practices that were members of the ACCF outpatient quality and outcomes data registry (known as the PINNACLE network) as of October 1, 2011 were invited by email to participate in the CR3 Project as outpatient sites. The PINNACLE Network helps cardiovascular teams achieve practice success through quality measurement, performance improvement, and peer-to-peer learning through an interactive community that connects practices across the country. In addition, an invitation to participate in the CR3 Project as an inpatient and/or an outpatient site was sent by email to 2916 members of AACVPR, and targeted invitations were sent to 5 Board members, 6 Past Presidents, and 11 Committee Chairs of AACVPR, as well as to the CR/SP programs that were participating in the Wisconsin State Cardiac Rehabilitation Registry (70 centers) and the Montana State Cardiac Rehabilitation Registry (145 programs). Twenty-nine hospitals and 23 outpatient practices responded, expressing interest in participating in the project.

Based on available resources to carry out the CR3 Project, we initially planned to include a maximum of 12 sites in the project, with varied geographical locations and center characteristics. An additional site was added since it was able to participate without the need for CR3 Project resources, resulting in a total of 7 inpatient and 6 outpatient practices that participated in the project. Inclusion criteria included a willingness to participate, and ability to: (1) provide a study coordinator and 2 separate chart abstractors, (2) complete the project within the specified timeline, and (3) obtain local IRB clearance to carry out the project in their setting. Once each hospital and practice completed and submitted their required data, they were sent a small incentive as a token of appreciation for their participation and submission of complete project data from their site (\$200 gift card). Completed data were received from 7 hospitals and 6 outpatient cardiology practices.

Chart Abstraction

For inpatient facilities, charts of patients who had an index hospitalization (ie, a hospitalization for a cardiac event that is a qualifying diagnosis or procedure for CR/SP) between August 1, 2009 and August 1st 2010 were eligible for review and inclusion. For outpatient centers, charts of patients who had an outpatient visit between August 1, 2009 and August 1, 2010 were eligible for review and inclusion. However, since the performance measure allows as long as 12 months for a patient to complete CR/SP following a qualifying cardiac event, chart abstraction included a search for a qualifying cardiac event between August 1, 2009 and August 1, 2010, along with a search of records for up to 12 months after the cardiac event, to search for documentation of CR/SP referral during that time period.

Study sites designated 1 study coordinator and 2 chart abstractors. Each study coordinator identified 35 patients from a consecutive sample of patients: 30 patients with an eligible diagnosis for CR/SP referral, and 5 without an eligible diagnosis for CR/SP (see below for additional details). The 2 abstractors at each site reviewed the same 35 patient records that had been selected from their site twice (once at baseline, and again 1 week later). Abstractors had a range of experience reviewing charts, from less than 1 month to greater than 5 years.

Abstractors were blinded as to which patients in their sample had a qualifying diagnosis and which patients had exceptions for CR/SP. Only the site coordinator, who did not participate in the abstraction process, had access to this information. Patients considered to have qualifying events for CR/SP, as defined by CMS and therefore as specified in the performance measure, had 1 or more of the following: myocardial infarction, percutaneous coronary intervention, coronary artery bypass graft surgery, heart valve surgery, heart transplantation surgery, and chronic stable angina. Patients without a qualifying event, for the purpose of this abstraction project, were to

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10 have had documented 1 or more of the following diagnoses that are not currently considered by
11 CMS to be a covered indication for CR/SP:
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- 13 • *For inpatient centers:* atrial fibrillation, heart failure, or syncope during the index
14 hospitalization period under review (with no documented qualifying events for CR during
15 that same hospitalization)
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17 • *For outpatient centers:* atypical chest pain, palpitations, or dyspnea during the 12 months
18 prior to the index outpatient visit (with no documented qualifying events for CR referral
19 during that same time period).
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25 The CR3 Project workgroup created chart abstraction forms, site coordinator instructions,
26 abstractor instructions, a frequently asked questions document, and site tracking forms to allow
27 the study coordinator to track and report site specific results for intra-abstractor (1 abstractor
28 reviewing the chart 2 times) and inter-abstractor (2 abstractors reviewing 1 chart) reliability. The
29 workgroup held a kickoff call with each center's study coordinator to train them prior to the start
30 of the CR3 project. Thereafter, the workgroup communicated weekly with site coordinators to
31 address any questions or operational concerns that arose. The training of site coordinators was
32 carried out during 1-2 one-hour conference calls prior to starting the project. When coordinators
33 had questions, they contacted the staff liaison to the CR3 working group directly by email or
34 telephone. New questions and their corresponding answers were communicated weekly to all site
35 coordinators. The entire project took approximately 20 weeks to complete (October 2011
36 through February 2012).
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51 **Definitions**

52 The following definitions were developed for use in the study:
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Eligible patients for CR/SP referral:

- Inpatient: a patient who survived the index hospitalization and who had a qualifying event/diagnosis for referral to CR/SP during the index hospitalization period under review.
- Outpatient: a patient who had a qualifying event/diagnosis for referral to CR/SP within the previous 12 months prior to the index outpatient visit.

Patients not eligible for CR/SP referral:

- Inpatient: a patient who had a cardiac event/diagnosis (atrial fibrillation, heart failure, or syncope for purposes of this study) during the index hospitalization period under review and no indication for CR/SP referral as specified in the performance measure.
- Outpatient: a patient who had a cardiac event/diagnosis (atypical chest pain, palpitations, or dyspnea for purposes of this study) during the 12 months prior to the index outpatient visit, and no indication for CR/SP referral as specified in the performance measure.

CR/SP referral:

- Inpatient: documentation in a patient's hospital medical records that the patient was referred to an outpatient CR/SP program.
- Outpatient: documentation in a patient's outpatient clinical medical records that the patient has been referred to an outpatient CR/SP program within 12 months after a qualifying event/diagnosis.

For purposes of this project, documentation in the medical record could include any of the following sources: hospital discharge summaries, office notes, clinical notes and medical records, orders (written/electronic), prescriptions (e.g. contact information for CR/SP specialist), or other parts of the clinical record that documents patient information.

Exceptions

Because there are valid reasons why certain patients should not be referred to a CR/SP program, exceptions to the CR/SP measures are allowed. When a clinician is allowed to document exceptions he or she is given the flexibility to decide whether or not to institute a given intervention/process depending upon the overall benefits and risks to the patient. Exceptions allow clinicians this flexibility without the threat of being “penalized” for not referring a patient to CR/SP. Without the presence of exceptions, potential negative unintended consequences could arise such as forcing CR/SP on patients who are unstable. Furthermore, analysis of exception rates for quality improvement purposes allows providers and health systems to test the effects of process changes within their practices and communities that may facilitate CR/SP referral. Relatively few patients would be expected to qualify for an exception to CR/SP referral. Such exceptions would generally be limited to factors that may make CR/SP unsafe, ineffective, or lack of accessibility to a CR/SP program within a reasonable commuting distance.

Such exceptions would generally be limited to factors that may make CR/SP unsafe or ineffective, or that otherwise prohibit access to a CR/SP program. Examples of exceptions from referral to CR/SP include:

- Patient exceptions (eg, patient resides in a long-term nursing care facility)
- Medical exceptions (eg, presence of an acute medical condition that makes the patient unstable and unsafe for exercise training)
- System exceptions (eg, lack of an available CR/SP program within 60 minutes of travel time from the patient’s home)

Since the measures look only at whether patients were referred, not whether they enrolled, patient refusal was not considered to be an exception. If a healthcare provider recommended

CR/SP referral to a patient, the patient refused the referral, and the provider documented the patient refusal, then that encounter was judged to have met the performance measure since the provider complied with the expectation to recommend referral to CR/SP.

Data Analyses

Both Cohen's kappa (κ) statistic and percent agreement were used to measure the intra-abtractor and inter-abtractor reliability for the following qualitative ratings: (1) documented eligibility for CR/SP referral, (2) exception documented for CR/SP referral, and (3) documentation of CR/SP referral. The κ statistic is a chance-corrected index of agreement ranging from -1 to 1, with $\kappa < 0$ representing observed agreement worse than that due to chance alone. We interpreted a κ over 0.75 as excellent, 0.40 to 0.75 as fair to good, and below 0.40 as poor, following the guidelines of Fleiss et al.^{20,29} Unlike the κ statistic, percent agreement does not take into account the agreement occurring by chance, but can be informative in situations for which the prevalence of a given response is very high or low and the interpretation based solely on the value of κ may be misleading. This phenomenon known as the kappa paradox^{21, 22} occurs when the observed proportion of agreement is high but the value of the κ statistic is low.

For brevity, intra-abtractor reliability is reported for only 1 of the 2 abstractors (arbitrarily-designated "abstractor 1" at each site), and inter-abtractor reliability only for the initial set of ratings (ie, "time 1"). Stratifying on inpatient vs. outpatient setting, reliability was analyzed 1) on the overall group with sites pooled together, and 2) within sites and summarizing the site-specific results across the overall group. All analyses were performed using the SAS statistical software package (version 9.2, SAS Institute Inc., Cary, NC).

RESULTS

Characteristics of the 234 inpatients and 211 outpatients (total 445) included in the CR3 Project are shown in Table 2. The majority of patients from both inpatient and outpatient sites were male, white, and younger than 65 years of age. A total of 1746 chart reviews were performed for the CR3 Project (415 (93%) of the total 445 patient charts were reviewed as specified in the CR3 Project protocol, each 1 being reviewed 4 times (2 by each abstractor), while incomplete reporting of data resulted in 26 that were reviewed only 3 times each, and 4 that were each reviewed only twice).

Participating centers represented a variety of practice types and settings, including the following: Rural, suburban, or urban area locations; teaching and non-teaching centers; and single specialty and multispecialty centers. One hospital was from the Pacific Northwest, 4 from the Midwest, 1 from the Northeast, and 1 from the Southeast. Three inpatient centers used paper medical records, 5 used electronic medical records, and 2 used both. Outpatient clinics in the CR3 Project were located throughout the Midwest and in the Southeastern part of the United States. Two outpatient clinics used paper medical records and 4 used electronic medical records, while none used both.

Site abstractors involved in the CR3 Project had varying degrees of experience with chart abstraction prior to participating in the project, with 54% of abstractors having 2 years of experience or less and 23% having less than one month of experience. Among the 13 inpatient and outpatient sites, the pair of abstractors had similar levels of experience at 11 sites). Excluding the 2 sites in which the pairs of abstractors had discordant levels of experience, we found that ratings of CR/SP eligibility, exceptions, and referral were not more reliable from abstractors having more than 2 years of experience. Interestingly, some of these ratings reflected

more favorable reliability in abstractors having less than 2 years of experience (data not shown). In addition, we did not find a difference between the reliability of the first abstractions and the second abstractions, suggesting that there was no “learning effect” among abstractors. The mean \pm SD time per chart abstraction, reported by abstractors was 4.9 \pm 3.2 minutes for inpatient abstractions and 6.8 \pm 4.7 minutes for outpatient abstractions.

Reliability Outcomes

Inpatient Sites (Table 3)

Intra-abstractor reliability analysis of pooled inpatient data demonstrated excellent repeatability for ratings of CR/SP eligibility (100% agreement, κ =1.00), CR/SP exceptions (96% agreement, κ =0.76), and CR/SP referral (98% agreement, κ =0.95). Based on site-specific inpatient data, each of the three CR/SP items showed high percent agreement (\geq 90%) at all sites, and excellent repeatability ($\kappa \geq$ 0.75) in the majority of sites (100% of sites for patient eligibility, 67% for patient exceptions, and 80% for patient referral).

Pooled analysis of inpatient sites demonstrated excellent inter-abstractor reliability analysis for ratings of CR/SP eligibility (94% agreement, κ =0.77) and CR/SP exceptions (97% agreement, κ =0.79), and modest agreement between abstractors for rating CR/SP referral (86% agreement, κ =0.70). Consistent with the pooled results, site-specific analyses demonstrated excellent inter-abstractor reliability (as measured by $\kappa \geq$ 0.75) in the majority of inpatient sites for ratings of eligibility (71% of sites) and exceptions (67% of sites), but in less than half (40%) of sites for the rating of CR/SP referral.

Outpatient Sites (Table 3)

Pooled analyses of the 6 outpatient sites demonstrated excellent intra-abstractor reliability for the 3 ratings of CR/SP eligibility, exceptions, and referral (agreement $\geq 95\%$, $\kappa \geq 0.88$). From site-specific analysis of intra-abstractor reliability, percent agreement $\geq 90\%$ was observed in all 6 sites for ratings of CR/SP eligibility and exceptions, and in all but 1 site for rating of CR/SP referral. Likewise, excellent repeatability ($\kappa \geq 0.75$) was demonstrated in the majority of outpatient sites (100% of sites for rating of eligibility, 67% for exceptions, and 67% for referral).

Regarding inter-abstractor reliability for outpatient sites, pooled analyses reflected excellent agreement between abstractors for ratings of both CR/SP eligibility ($\kappa = 0.78$) and CR/SP referral ($\kappa = 0.80$), and poor to fair agreement in rating patient exceptions for CR/SP referral ($\kappa = 0.43$). Similarly, according to site-specific results, excellent inter-abstractor reliability was observed in most (two-thirds) of the outpatient sites for rating CR/SP eligibility, and in none of the sites for rating CR/SP exceptions. Interestingly, despite excellent inter-abstractor agreement for rating CR/SP referral obtained from pooled analysis, site-specific results varied considerably (range of κ across six sites, -0.07 to 1.00), with excellent reliability seen in only one-third of outpatient sites (and percent agreement below 90% in half the sites).

DISCUSSION

This study demonstrates high reliability for assessing CR/SP eligibility, referral, and exceptions using the CR/SP outpatient and inpatient performance measures. Data abstraction of patient records was performed by abstractors with varying amounts of abstraction experience at a variety of inpatient and outpatient centers, suggesting generalizability of our findings.

Reliability testing is one of 3 important steps in developing high value PMs, as outlined by the ACCF/AHA Task Force on Performance Measures¹⁹. The 3 steps include: (1) construction of the measurement set, (2) assessment of feasibility and reliability of data collection, and (3) measurement of clinician performance. Construction of the CR/SP PM set has previously been reported¹²⁻¹⁷.

Our testing generally found high reliability for comparisons between abstractors for the 3 key components of the CR/SP PM's: patient eligibility for CR/SP, patient exceptions to CR/SP referral, and patient referral to CR/SP. We included 2 measures of reliability, each shedding important light on the reliability of PM abstraction: percent agreement and the kappa statistic. "Percent agreement" is a helpful assessment of reliability, but given that over 80% of patients in the study sample were eligible for CR/SP, and more than 90% of patients were absent exceptions to CR/SP participation, the percent agreement may have been somewhat inflated, since by chance alone abstractors may have chosen the correct eligibility or exception status.

Conversely, the kappa statistic performs best when there is nearly equal chance of study outcomes. When there is a high likelihood of one of the 2 outcomes, as in our study (high likelihood of CR/SP eligibility), the results of the kappa analyses can underestimate true reliability due to a phenomenon known as the "kappa score paradox" in which there is high percent agreement, yet a low kappa score^{21, 22}. Indeed, we observed this paradox in some centers. The true reliability of abstracting our PMs most likely lies between the results from the 2 methods of assessment we used. Since the "percent agreement" method generally suggests very high reliability of the CR/SP measures and the kappa statistic generally suggests moderate to high reliability, the true reliability of the CR/SP performance measure would appear overall to be high.

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10 Data abstractors reported that data abstraction time was modest for the inpatient (4.9
11 minutes) and outpatient (6.8 minutes) CR/SP PMs, and reported minimal barriers to their
12 abstraction activities. If the CR/SP PMs are included in sets of other PM's, such as the PM set
13 for CABG surgery, for example, it is likely that efficiencies of scale will result in less time being
14 required for the CR/SP PM assessment.
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21 **Limitations**

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23 We selected participating centers to reflect variation in the location, size, and type of centers.
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25 However, our study is based on the experience of a relatively small number of centers from
26 around the United States that volunteered to be in the project and may not be representative other
27 centers from different regions.
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33 **Lessons Learned**

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35 Outpatient abstraction of the CR/SP performance measure data was more time-consuming and
36 somewhat less reliable than the abstraction of inpatient data. This is explained in large part by
37 the fact that the review of inpatient data is limited to the time of the patient index hospitalization
38 (ie, the time of the cardiac event that qualified them for CR/SP). Review of outpatient data is
39 broader, including a review of records for up to 12 months previous to the outpatient visit and
40 also a review of records for up to 12 month after the outpatient visit, due to the fact that patients
41 are eligible for CR/SP for up to 12 months following their qualifying cardiac event.
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51 **Future Directions**

Healthcare provider education through effective communication channels is critically important to help providers understand and document appropriate exceptions to CR/SP referral, as well as the key components of CR/SP referral documentation: 1) that the patient has been referred to CR/SP, 2) that the patient has been given information and guidance to help them enroll in CR/SP, and 3) that the receiving CR/SP program has been sent patient information to expedite CR/SP enrollment).

Current practices and existing ACCF and AHA registries only require documentation that the patient has been referred to a CR/SP program. Published evidence suggests that the use of additional communication components, as specified in the measures, may increase the predictive validity of the measures.^{23,23} Going forward, with the advent of better data collection systems for CR/SP referral and the ability now to track CR/SP enrollment through the AACVPR Outpatient Cardiac Rehabilitation Registry, we expect to be able to test the hypothesis that this more detailed definition of CR/SP referral will increase enrollment in CR/SP. Furthermore, computerized decision support, made more widely available through efforts to enhance the meaningful use of electronic health records, may also provide value by increasing the ability to track and improve the appropriate utilization of CR/SP.

Reliability of CR/SP performance measure abstraction is high. Data abstractors reported minimal barriers to the abstraction process and required a relatively small amount of time per patient to carry out the abstractions. These results contribute to published evidence regarding the soundness and generalizability of the CR/SP PMs. Further work will need to be carried out to assess the impact of the CR/SP PMs on patient referral rates and patient outcomes.

References

1. Goel K, Lennon RJ, Tilbury RT, Squires RW, Thomas RJ. Impact of cardiac rehabilitation on mortality and cardiovascular events after percutaneous coronary intervention in the community. *Circulation*. 2011;123:2344-2352
2. Hammill BG, Curtis LH, Schulman KA, Whellan DJ. Relationship between cardiac rehabilitation and long-term risks of death and myocardial infarction among elderly medicare beneficiaries. *Circulation*. 2010;121:63-70
3. Oldridge NB, Guyatt GH, Fischer ME, Rimm AA. Cardiac rehabilitation after myocardial infarction. Combined experience of randomized clinical trials. *Jama*. 1988;260:945-950
4. Suaya JA, Stason WB, Ades PA, Normand SL, Shepard DS. Cardiac rehabilitation and survival in older coronary patients. *J Am Coll Cardiol*. 2009;54:25-33
5. Taylor RS, Unal B, Critchley JA, Capewell S. Mortality reductions in patients receiving exercise-based cardiac rehabilitation: How much can be attributed to cardiovascular risk factor improvements? *Eur J Cardiovasc Prev Rehabil*. 2006;13:369-374
6. Williams MA, Ades PA, Hamm LF, Keteyian SJ, LaFontaine TP, Roitman JL, Squires RW. Clinical evidence for a health benefit from cardiac rehabilitation: An update. *Am Heart J*. 2006;152:835-841
7. Witt BJ, Jacobsen SJ, Weston SA, Killian JM, Meverden RA, Allison TG, Reeder GS, Roger VL. Cardiac rehabilitation after myocardial infarction in the community. *J Am Coll Cardiol*. 2004;44:988-996
8. Receipt of cardiac rehabilitation services among heart attack survivors--19 states and the district of columbia, 2001. *MMWR Morb Mortal Wkly Rep*. 2003;52:1072-1075
9. Suaya JA, Shepard DS, Normand SL, Ades PA, Prottas J, Stason WB. Use of cardiac rehabilitation by medicare beneficiaries after myocardial infarction or coronary bypass surgery. *Circulation*. 2007;116:1653-1662
10. Thomas RJ, Miller NH, Lamendola C, Berra K, Hedback B, Durstine JL, Haskell W. National survey on gender differences in cardiac rehabilitation programs. Patient characteristics and enrollment patterns. *J Cardiopulm Rehabil*. 1996;16:402-412
11. Fonarow GC, Abraham WT, Albert NM, Stough WG, Gheorghiade M, Greenberg BH, O'Connor CM, Pieper K, Sun JL, Yancy C, Young JB. Association between performance measures and clinical outcomes for patients hospitalized with heart failure. *Jama*. 2007;297:61-70
12. Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J. Aacvpr/acc/aha 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services. *J Cardiopulm Rehabil Prev*. 2007;27:260-290
13. Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J. Aacvpr/acc/aha 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services. *Circulation*. 2007;116:1611-1642

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14. Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J. Aacvpr/accf/aha 2010 update: Performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services endorsed by the american college of chest physicians, the american college of sports medicine, the american physical therapy association, the canadian association of cardiac rehabilitation, the clinical exercise physiology association, the european association for cardiovascular prevention and rehabilitation, the inter-american heart foundation, the national association of clinical nurse specialists, the preventive cardiovascular nurses association, and the society of thoracic surgeons. *J Am Coll Cardiol*. 2010;56:1159-1167
15. Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J. Aacvpr/accf/aha 2010 update: Performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services: A report of the american association of cardiovascular and pulmonary rehabilitation and the american college of cardiology foundation/american heart association task force on performance measures (writing committee to develop clinical performance measures for cardiac rehabilitation). *J Cardiopulm Rehabil Prev*. 2010;30:279-288
16. Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J. Aacvpr/accf/aha 2010 update: Performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services: A report of the american association of cardiovascular and pulmonary rehabilitation and the american college of cardiology foundation/american heart association task force on performance measures (writing committee to develop clinical performance measures for cardiac rehabilitation). *Circulation*. 2010;122:1342-1350
17. Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J, Bonow RO, Estes NA, 3rd, Goff DC, Grady KL, Hiniker AR, Masoudi FA, Radford MJ, Rumsfeld JS, Whitman GR. Aacvpr/acc/aha 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services endorsed by the american college of chest physicians, american college of sports medicine, american physical therapy association, canadian association of cardiac rehabilitation, european association for cardiovascular prevention and rehabilitation, inter-american heart foundation, national association of clinical nurse specialists, preventive cardiovascular nurses association, and the society of thoracic surgeons. *J Am Coll Cardiol*. 2007;50:1400-1433
18. Spertus JA, Bonow RO, Chan P, Diamond GA, Drozda JP, Jr., Kaul S, Krumholz HM, Masoudi FA, Normand SL, Peterson ED, Radford MJ, Rumsfeld JS. Accf/aha new insights into the methodology of performance measurement: A report of the american college of cardiology foundation/american heart association task force on performance measures. *Circulation*. 2010;122:2091-2106
19. Spertus JA, Eagle KA, Krumholz HM, Mitchell KR, Normand SL. American college of cardiology and american heart association methodology for the selection and creation of performance measures for quantifying the quality of cardiovascular care. *J Am Coll Cardiol*. 2005;45:1147-1156
20. Fleiss JL, Levin B, Cho Park M. Statistical methods for rates and proportions. 1981:352

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21. Feinstein AR, Cicchetti DV. High agreement but low kappa: I. The problems of two paradoxes. *J Clin Epidemiol.* 1990;43:543-549

22. Lantz CA, Nebenzahl E. Behavior and interpretation of the kappa statistic: Resolution of the two paradoxes. *J Clin Epidemiol.* 1996;49:431-434

23. Grace SL, Russell KL, Reid RD, Oh P, Anand S, Rush J, Williamson K, Gupta M, Alter DA, Stewart DE. Effect of cardiac rehabilitation referral strategies on utilization rates: A prospective, controlled study. *Arch Intern Med.* 2011;171:235-241

Abstract:

Background: Assessment of the reliability of performance measure (PM) abstraction is an important step in PM validation. Reliability has not been previously assessed for abstracting PM's for the referral of patients to cardiac rehabilitation and secondary prevention (CR/SP) programs. To help validate these PM's, we carried out a multicenter assessment of their reliability.

Methods and Results: Hospitals and clinical practices from around the U.S. were invited to participate in the CR3 Project. Twenty-nine hospitals and 23 outpatient centers expressed interest in participating. Seven hospitals and 6 outpatient centers met participation criteria and submitted completed data. Site coordinators identified 35 patients whose charts were reviewed by 2 site abstractors twice, one week apart. Percent agreement and Cohen's kappa statistic were used to describe intra- and inter-abstractor reliability for patient eligibility for CR/SP, patient exceptions for CR/SP referral, and documented referral to CR/SP. Results were obtained from within-site data, as well as from pooled data of all inpatient and all outpatient sites.

We found that intra-abstractor reliability reflected excellent repeatability ($\geq 90\%$ agreement, $\kappa \geq 0.75$) for ratings of CR/SP eligibility, exceptions, and referral, both from pooled and site-specific analyses of inpatient and outpatient data. Similarly, the inter-

abstractor agreement from pooled analysis ranged from good to excellent for the three items, although with slightly lower measures of reliability.

Conclusions: Abstraction of PM's for CR/SP referral has high reliability, supporting the use of these PM's in quality improvement initiatives aimed at increasing CR/SP delivery to patients with cardiovascular disease.

Reliability of Abstracting Performance Measures: Results of the Cardiac Rehabilitation Referral and Reliability (CR3) Project

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Figure 1:

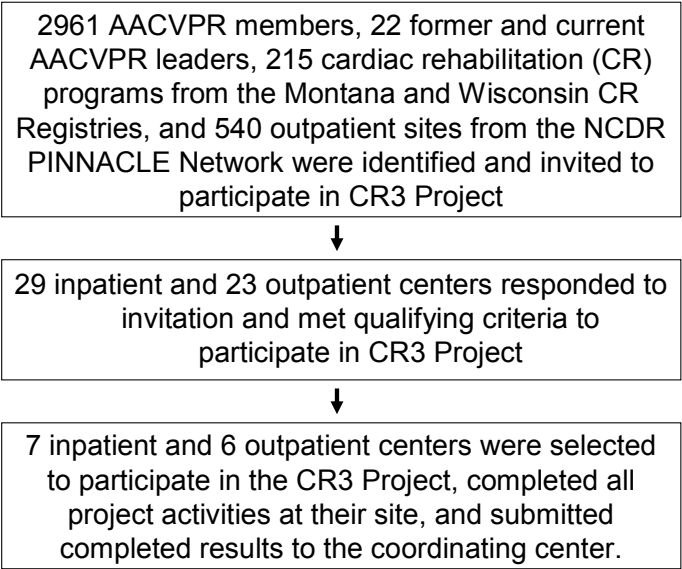


Table 1: AACVPR/ACCF/AHA performance measures for referral to a cardiac rehabilitation program from an in-patient (A) and out-patient (B) setting (12, 15)

A: Performance measure for referral to a cardiac rehabilitation program from an in-patient setting

Component	Details
Performance Measure	All patients hospitalized with a primary diagnosis of an acute myocardial infarction or chronic stable angina, or who during hospitalization have undergone coronary artery bypass graft surgery, a percutaneous coronary intervention, cardiac valve surgery, or cardiac transplantation are to be referred to an early outpatient cardiac rehabilitation/secondary prevention program.
Numerator	Number of eligible patients with a qualifying event/diagnosis who have been referred to an outpatient cardiac rehabilitation program prior to hospital discharge or have a documented medical or patient-centered reason why such a referral was not made
Denominator	Number of hospitalized patients in the reporting period hospitalized with a qualifying event/diagnosis who do not meet any of the exception criteria
Exceptions	<ul style="list-style-type: none"> (1) Patient-oriented factors (patient discharged to a nursing care facility for long-term care, for example) (2) Medical factors (patient deemed to have a medically unstable, life-threatening condition, for example) (3) Healthcare system factors (lack of cardiac rehabilitation program near a patient's home, for example)

B: Performance measure for referral to a cardiac rehabilitation program from an out-patient setting

Component	Details
Performance Measure	All patients evaluated in an outpatient setting who within the past 12 months have experienced an acute myocardial infarction, coronary artery bypass graft surgery, a percutaneous coronary intervention, cardiac valve surgery, or cardiac transplantation, or who have chronic stable angina and have not already participated in an early outpatient cardiac rehabilitation/secondary prevention program for the qualifying event/diagnosis are to be referred to such a program.
Numerator	Number of patients in an outpatient clinical practice who have had a qualifying event/diagnosis during the previous 12 months, who have been referred to an outpatient cardiac rehabilitation program
Denominator	Number of patients in an outpatient clinical practice who have had a qualifying event/diagnosis during the previous 12 months and who do not meet any of the exception criteria, and who have not already participated in an outpatient cardiac rehabilitation program since the qualifying event.
Exceptions	<ul style="list-style-type: none"> (1) Patient oriented factors (patient discharged to a nursing care facility for long-term care, for example) (2) Medical factors (patient deemed to have a medically unstable, life-threatening condition, for example) (3) Healthcare system factors (lack of cardiac rehabilitation program near a patient's home, for example)

Table 2: Sociodemographic characteristics of patients in CR3 Project

	Patients from Inpatient Sites (n = 234)	Patients from Outpatient Sites (n = 211)
Age		
18-39 years old	3%	5%
40-64 years old	40%	50%
65-79 years old	45%	33%
≥ 80 years old	12%	12%
Sex		
Female	35%	36%
Race and Ethnicity		
White	84%	84%
Black	8%	8%
Asian	0.5%	0.5%
American Indian	1%	0.5%
Native Hawaiian/Pacific Islander	0.5%	0.5%
Other	5.5%	5.5%
Hispanic Ethnicity	0.5%	1%

Table 3: Reliability testing results from pooled and site-specific data analyses from CR3 Project for inpatient and outpatient sites

Setting	Reliability	Item	Percent Agreement (PA)		Kappa (κ)	
			Pooled Data (#abstractions in agreement/total # abstractions)	Range Across Study Sites	Pooled Data (95% CI)	Range Across Study Sites
Inpatient	Intra-rater	eligibility	100% (232/232)	100% - 100%	1.00 (-)	1.00 - 1.00
		exception	96% (189/196)	90% - 100%	0.76 (0.60, 0.93)	0.67 - 1.00
		referral	98% (172/176)	92% - 100%	0.95(0.90, 0.99)	0.62 - 1.00
	Inter-rater	eligibility	94% (218/231)	77% - 100%	0.77 (0.65, 0.89)	0.31 - 1.00
		exception	97% (185/191)	90% - 100%	0.79 (0.63, 0.95)	0.66 - 0.91
		referral	86% (148/172)	58% - 100%	0.70 (0.59, 0.81)	0.23 - 1.00
Outpatient	Intra-rater	eligibility	98% (191/194)	97% - 100%	0.94 (0.87, 1.00)	0.88 - 1.00
		exception	99% (146/148)	92% - 100%	0.89 (0.74, 1.00)	0.70 - 1.00
		referral	95% (130/137)	68% - 100%	0.88 (0.79, 0.96)	0.39 - 1.00
	Inter-rater	eligibility	94% (190/203)	81% - 100%	0.78 (0.66, 0.89)	0.46 - 1.00
		exception	95% (139/146)	83% - 100%	0.43 (0.09, 0.78)	0.40 - 0.46
		referral	91% (124/136)	70% - 100%	0.80 (0.70, 0.91)	-0.07 - 1.00



July 3, 2013

Mark Williams, PhD
Editor-in-Chief
Journal of Cardiopulmonary Rehabilitation and Prevention

Dear Dr. Williams:

We are submitting to you an original manuscript entitled, “Reliability of Abstracting Performance Measures: Results of the Cardiac Rehabilitation Referral and Reliability (CR3) Project”.

This manuscript describes a recently completed project aimed at assessing the reliability of abstracting the AACVPR/ACCF/AHA Cardiac Rehabilitation Referral Performance Measures. This paper is important for your readers for the following reasons:

First, with the emergence of performance measures in the field of medicine today, it is important that proper methods are followed that identify high value performance measures. This study describes efforts to do just that—to measure the reliability of a set of performance measures aimed at improving the delivery of cardiac rehabilitation/secondary prevention services.

Second, to our knowledge, this is the first paper to study the reliability of abstracting the cardiac rehabilitation performance measures.

Third, this paper comes at a time when performance measures for cardiac rehabilitation/secondary prevention are gaining support and interest from the Centers for Medicare and Medicaid Services, and other national healthcare organizations. These cardiac rehabilitation performance measures, in fact, are to be implemented in an outpatient setting by CMS beginning in 2014.

Of note, the data included in this manuscript have not been presented at national meetings, nor have they been published in any form in another journal. The data were submitted, however, to the National Quality Forum earlier this year for consideration of endorsement of the measures by that organization. (Representatives of NQF have completed their review of these measures, and have voted to formally endorse them.)

Funding for statistical support for the CR3 Project was provided by the Division of Cardiovascular Diseases at the Mayo Clinic in Rochester, Minnesota. Funding for the site incentives used in the CR3 Project was provided by the AACVPR, ACCF, and AHA.

All authors have read and approved of the manuscript. The authors have no conflicts of interest to disclose with the exception of the following:

David Goff: Operations Committee Member for a clinical trial of a glucose lowering medication marketed by Merck, and DSMB Member for a clinical trial of a glucose lowering medication marketed by Takeda (both modest), and stipend for CME meeting presentation (Merck, small).

All individuals who are recognized in the acknowledgement section below have given their approval to be included.

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Thank you for your kind consideration of this manuscript for your journal.

Sincerely,



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Introduction

Cardiac rehabilitation and secondary prevention (CR/SP) services are significantly associated with positive health outcomes in a variety of patients with cardiac disorders[1-7] yet only a minority of eligible patients ever participate in CR/SP[8-10]. The American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR), American College of Cardiology Foundation (ACCF), and American Heart Association (AHA) [11] have developed, and the National Quality Forum (NQF) has endorsed, performance measures (PM's) for CR/SP referral to increase the delivery of CR/SP to appropriate patients (see Table 1)[12-17]. In addition, the Centers for Medicare and Medicaid Services (CMS) has included these measures in the Physician Quality Reporting System, and will begin reporting audits of these PM's in the outpatient setting in 2015.

Assessment of the reliability of data collection for performance measurement is an important step included in the ACCF/AHA methodology for the development and identification of high-value performance measures [18, 19]. However, to our knowledge, no studies have been published that have evaluated the reliability of collecting CR/SP performance measures. To address this need, and to respond to NQF requirements to provide such data as part of their endorsement process, we carried out a multi-site study, the Cardiac Rehabilitation Referral Reliability (CR3) Project, aimed at analyzing the reliability of abstracting the CR/SP PM's from inpatient and outpatient records.

Methods

Participating Hospitals and Practices

Hospitals and outpatient cardiology practices in the United States were identified from the ACCF, AHA, and AACVPR databases and were invited to participate. We sought a variety of hospitals and clinics, based on different geographical locations, community sizes, and hospital/practice types/sizes (see Figure 1). All 540 outpatient practices that were members of the PINNACLE network data registry through the ACCF as of October 1, 2011 were invited by email to participate in the CR3 Project as outpatient sites. The PINNACLE Network helps cardiovascular teams achieve practice success through quality measurement, performance improvement, and peer-to-peer learning through an interactive community that connects practices across the country. In addition, an invitation to participate in the CR3 Project as an inpatient and/or an outpatient site was sent by email to 2916 members of AACVPR, and targeted invitations were sent to 5 Board members, 6 Past Presidents, and 11 Committee Chairs of AACVPR, as well as to the CR/SP programs that were participating in the Wisconsin State Cardiac Rehabilitation Registry (70 centers) and the Montana State Cardiac Rehabilitation Registry (145 programs). Twenty-nine hospitals and 23 outpatient practices responded, expressing interest in participating in the project.

Based on available resources to carry out the CR3 Project, we initially planned to include a maximum of 12 sites in the project, with varied geographical locations

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4 and center characteristics. An additional site was added since it was able to
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6 participate without the need for CR3 Project resources, resulting in a total of 7
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8 inpatient and 6 outpatient practices that participated in the project. Inclusion
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10 criteria included a willingness to participate, and ability to: (1) provide a study
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12 coordinator and 2 separate chart abstractors, (2) complete the project within the
13
14 specified timeline, and (3) obtain local IRB clearance to carry out the project in
15
16 their setting. Once each hospital and practice completed and submitted their
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18 required data, they were sent a small token of appreciation (\$200 gift card).
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20 Completed data were received from 7 hospitals and 6 outpatient cardiology
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22 practices.
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31 *Chart Abstraction*

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33 For inpatient facilities, charts of patients who had an index hospitalization
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35 between August 1, 2009 and August 1st 2010 were eligible for review and
36
37 inclusion. For outpatient centers, charts of patients who had an outpatient visit
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39 between August 1, 2009 and August 1, 2010 were eligible for review and
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41 inclusion. However, since the performance measure allows as long as 12 months
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43 for a patient to complete CR/SP following a qualifying cardiac event, chart
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45 abstraction included a search for a qualifying cardiac event between August 1,
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47 2009 and August 1, 2010, along with a search of records for up to 12 months
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49 after the cardiac event, to search for documentation of CR/SP referral during that
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51 time period.
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Study sites designated one study coordinator and two chart abstractors. Each study coordinator identified 35 patients from a consecutive sample of patients: 30 patients with an eligible diagnosis for CR/SP referral, and 5 without an eligible diagnosis for CR/SP (see below for additional details). The two abstractors at each site reviewed the same 35 patient records that had been selected from their site twice (once at baseline, and again one week later). Abstractors had a range of experience reviewing charts, from less than one month to greater than 5 years.

Abstractors were blinded as to which patients in their sample had a qualifying diagnosis and which patients had exceptions for CR/SP. Only the site coordinator, who did not participate in the abstraction process, had access to this information. Patients considered to have qualifying events for CR/SP, as defined by CMS and therefore as specified in the performance measure, had one or more of the following: myocardial infarction, percutaneous coronary intervention, coronary artery bypass graft surgery, heart valve surgery, heart transplantation surgery, and chronic stable angina. Patients without a qualifying event, for the purpose of this abstraction project, were to have had documented one or more of the following diagnoses that are not currently considered by CMS to be a covered indication for CR/SP:

- *For inpatient centers:* atrial fibrillation, heart failure, or syncope during the index hospitalization period under review (with no documented qualifying events for CR during that same hospitalization)

- *For outpatient centers:* atypical chest pain, palpitations, or dyspnea during the 12 months prior to the index outpatient visit (with no documented qualifying events for CR referral during that same time period).

The CR3 Project workgroup created chart abstraction forms, site coordinator instructions, abstractor instructions, a frequently asked questions document, and site tracking forms to allow the study coordinator to track and report site specific results for intra-abstractor (1 abstractor reviewing the chart two times) and inter-abstractor (2 abstractors reviewing 1 chart) reliability. The workgroup held a kickoff call with each center's study coordinator to train them prior to the start of the CR3 project. Thereafter, the workgroup communicated weekly with site coordinators to address any questions or operational concerns that arose. The training of site coordinators was carried out during 1-2 one-hour conference calls prior to starting the project. When coordinators had questions, they contacted the staff liaison to the CR3 working group directly by email or telephone. New questions and their corresponding answers were communicated weekly to all site coordinators. The entire project took approximately 20 weeks to complete (October 2011 through February 2012).

Definitions

The following definitions were developed for use in the study:

Eligible patients for CR/SP referral:

- Inpatient: a patient who survived the index hospitalization and who had a qualifying event/diagnosis for referral to CR/SP during the index hospitalization period under review.
- Outpatient: a patient who had a qualifying event/diagnosis for referral to CR/SP within the previous 12 months prior to the index outpatient visit.

Patients not eligible for CR/SP referral:

- Inpatient: a patient who had a cardiac event/diagnosis (atrial fibrillation, heart failure, or syncope for purposes of this study) during the index hospitalization period under review and no indication for CR/SP referral as specified in the performance measure.
- Outpatient: a patient who had a cardiac event/diagnosis (atypical chest pain, palpitations, or dyspnea for purposes of this study) during the 12 months prior to the index outpatient visit, and no indication for CR/SP referral as specified in the performance measure.

CR/SP referral:

- Inpatient: documentation in a patient's hospital medical records that the patient was referred to an outpatient CR/SP program.
- Outpatient: documentation in a patient's outpatient clinical medical records that the patient has been referred to an outpatient CR/SP program within 12 months after a qualifying event/diagnosis.

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4 For purposes of this project, documentation in the medical record could include
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6 any of the following sources: hospital discharge summaries, office notes, clinical
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8 notes and medical records, orders (written/electronic), prescriptions (e.g. contact
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10 information for CR/SP specialist), or other parts of the clinical record that
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12 documents patient information.
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16 17 18 19 Exceptions:

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21 Because there are valid reasons why certain patients should not be referred to a
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23 CR/SP program, exceptions to the CR/SP measures are allowed. When a
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25 clinician is allowed to document exceptions he or she is given the flexibility to
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27 decide whether or not to institute a given intervention/process depending upon
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29 the overall benefits and risks to the patient. Exceptions allow clinicians this
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31 flexibility without the threat of being “penalized” for not referring a patient to
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33 CR/SP. Without the presence of exceptions, potential negative unintended
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35 consequences could arise such as forcing CR/SP on patients who are unstable.
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37 Furthermore, analysis of exception rates for quality improvement purposes allows
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39 providers and health systems to test the effects of process changes within their
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41 practices and communities that may facilitate CR/SP referral. Relatively few
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43 patients would be expected to qualify for an exception to CR/SP referral. Such
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45 exceptions would generally be limited to factors that may make CR/SP unsafe,
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47 ineffective, or lack of accessibility to a CR/SP program within a reasonable
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49 commuting distance.
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Such exceptions would generally be limited to factors that may make CR/SP unsafe or ineffective, or that otherwise prohibit access to a CR/SP program (e.g., long commuting distance from a CR/SP program).

Examples of exceptions from referral to CR/SP include:

- Patient exceptions (e.g., patient resides in a long-term nursing care facility)
- Medical exceptions (e.g., presence of an acute medical condition that makes the patient unstable and unsafe for exercise training)
- System exceptions (e.g., lack of an available CR/SP program within 60 minutes of travel time from the patient's home)

Since the measures look only at whether patients were referred, not whether they enrolled, patient refusal was not considered to be an exception. If a healthcare provider recommended CR/SP referral to a patient, the patient refused the referral, and the provider documented the patient refusal, then that encounter was judged to have met the performance measure since the provider complied with the expectation to recommend referral to CR/SP.

Data analyses

Both Cohen's kappa (κ) statistic and percent agreement were used to measure the intra-abstractor and inter-abstractor reliability for the following qualitative ratings: (1) documented eligibility for CR/SP referral, (2) exception documented

for CR/SP referral, and (3) documentation of CR/SP referral. The κ statistic is a chance-corrected index of agreement ranging from -1 to 1, with $\kappa < 0$ representing observed agreement worse than that due to chance alone. We interpreted a κ over 0.75 as excellent, 0.40 to 0.75 as fair to good, and below 0.40 as poor, following the guidelines of Fleiss et al[20]. Unlike the κ statistic, percent agreement does not take into account the agreement occurring by chance, but can be informative in situations for which the prevalence of a given response is very high or low and the interpretation based solely on the value of κ may be misleading. This phenomenon known as the kappa paradox[21, 22] occurs when the observed proportion of agreement is high but the value of the κ statistic is low.

For brevity, intra-abtractor reliability is reported for only one of the two abstractors (arbitrarily-designated “abtractor 1” at each site), and inter-abtractor reliability only for the initial set of ratings (i.e., “time 1”). Stratifying on inpatient vs. outpatient setting, reliability was analyzed 1) on the overall group with sites pooled together, and 2) within sites and summarizing the site-specific results across the overall group. All analyses were performed using the SAS statistical software package (version 9.2, SAS Institute Inc., Cary, NC).

Results

Descriptive Characteristics

Characteristics of the 234 inpatients and 211 outpatients (total 445) included in the CR3 Project are shown in Table 2. The majority of patients from both inpatient and outpatient sites were male, white and younger than 65 years of age. A total of 1746 chart reviews were performed for the CR3 Project (415 (93%) of the total 445 patient charts were reviewed as specified in the CR3 Project protocol, each one being reviewed 4 times (2 by each abstractor), while incomplete reporting of data resulted in 26 that were reviewed only 3 times each, and 4 that were each reviewed only twice).

Participating centers represented a variety of practice types and settings, including the following: Rural, suburban or urban area locations; teaching and non-teaching centers; and single specialty and multi-specialty centers. One hospital was from the Pacific Northwest, four from the Midwest, one from the Northeast, and one from the Southeast. Three inpatient centers used paper medical records, five used electronic medical records, and two used both.

Outpatient clinics in the CR3 Project were located throughout the Midwest and in the Southeastern part of the United States. Two outpatient clinics used paper medical records and four used electronic medical records, while none used both.

Site abstractors involved in the CR3 Project had varying degrees of experience with chart abstraction prior to participating in the project, with 54% of abstractors having 2 years of experience or less and 23% having less than one month of experience. Among the 13 inpatient and outpatient sites, the pair of abstractors

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4 had similar levels of experience at 11 sites (both abstractors had less than 2
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6 years of experience at 6 sites, and both had more than 2 years of experience at 5
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8 sites). Excluding the 2 sites in which the pairs of abstractors had discordant
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10 levels of experience, we found that ratings of CR/SP eligibility, exceptions, and
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12 referral were not more reliable from abstractors having more than 2 years of
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14 experience. Interestingly, some of these ratings reflected more favorable
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16 reliability in abstractors having less than 2 years of experience (data not shown).
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18 The mean \pm SD time per chart abstraction, reported by abstractors was 4.9 ± 3.2
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20 minutes for inpatient abstractions and 6.8 ± 4.7 minutes for outpatient
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22 abstractions.
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31 *Reliability Outcomes*

32 *Inpatient Sites (See Table 3)*

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34 Intra-abtractor reliability analysis of pooled inpatient data demonstrated
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36 excellent repeatability for ratings of CR/SP eligibility (100% agreement, $\kappa = 1.00$),
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38 CR/SP exceptions (96% agreement, $\kappa = 0.76$), and CR/SP referral (98%
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40 agreement, $\kappa = 0.95$). Based on site-specific inpatient data, each of the three
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42 CR/SP items showed high percent agreement ($\geq 90\%$) at all sites, and excellent
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44 repeatability ($\kappa \geq 0.75$) in the majority of sites (100% of sites for patient eligibility,
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46 67% for patient exceptions, and 80% for patient referral).
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55 Pooled analysis of inpatient sites demonstrated excellent inter-abtractor
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57 reliability analysis for ratings of CR/SP eligibility (94% agreement, $\kappa = 0.77$) and
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CR/SP exceptions (97% agreement, $\kappa = 0.79$), and modest agreement between abstractors for rating CR/SP referral (86% agreement, $\kappa = 0.70$). Consistent with the pooled results, site-specific analyses demonstrated excellent inter-abstractor reliability (as measured by $\kappa \geq 0.75$) in the majority of inpatient sites for ratings of eligibility (71% of sites) and exceptions (67% of sites), but in less than half (40%) of sites for the rating of CR/SP referral.

Outpatient Sites (See Table 3)

Pooled analyses of the six outpatient sites demonstrated excellent intra-abstractor reliability for the three ratings of CR/SP eligibility, exceptions, and referral (agreement $\geq 95\%$, $\kappa \geq 0.88$). From site-specific analysis of intra-abstractor reliability, percent agreement $\geq 90\%$ was observed in all six sites for ratings of CR/SP eligibility and exceptions, and in all but one site for rating of CR/SP referral. Likewise, excellent repeatability ($\kappa \geq 0.75$) was demonstrated in the majority of outpatient sites (100% of sites for rating of eligibility, 67% for exceptions, and 67% for referral).

Regarding inter-abstractor reliability for outpatient sites, pooled analyses reflected excellent agreement between abstractors for ratings of both CR/SP eligibility ($\kappa = 0.78$) and CR/SP referral ($\kappa = 0.80$), and poor to fair agreement in rating patient exceptions for CR/SP referral ($\kappa = 0.43$). Similarly, according to site-specific results, excellent inter-abstractor reliability was observed in most (two-thirds) of the outpatient sites for rating CR/SP eligibility, and in none of the sites

for rating CR/SP exceptions. Interestingly, despite excellent inter-abstractor agreement for rating CR/SP referral obtained from pooled analysis, site-specific results varied considerably (range of κ across six sites, -0.07 to 1.00), with excellent reliability seen in only one-third of outpatient sites (and percent agreement below 90% in half the sites).

Discussion

This study demonstrates high reliability for assessing CR/SP eligibility, referral, and exceptions using the CR/SP outpatient and inpatient performance measures. Data abstraction of patient records was performed by abstractors with varying amounts of abstraction experience at a variety of inpatient and outpatient centers, suggesting generalizability of our findings.

Reliability testing is one of 3 important steps in developing high value PM's, as outlined by the ACCF/AHA Task Force on Performance Measures[19]. The 3 steps include: (1) construction of the measurement set, (2) assessment of feasibility and reliability of data collection, and (3) measurement of clinicians' performance. Construction of the CR/SP PM set has previously been reported[12-17].

Our testing generally found high reliability for comparisons between abstractors for the 3 key components of the CR/SP PM's: patient eligibility for CR/SP, patient

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4 exceptions to CR/SP referral, and patient referral to CR/SP. We included two
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6 measures of reliability, each shedding important light on the reliability of PM
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8 abstraction: percent agreement and the kappa statistic. “Percent agreement” is
9
10 a helpful assessment of reliability, but given that over 80% of patients in the
11
12 study sample were eligible for CR/SP, and more than 90% of patients were
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14 absent exceptions to CR/SP participation, the percent agreement may have been
15
16 somewhat inflated, since by chance alone abstractors may have chosen the
17
18 correct eligibility or exception status.
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24
25
26 Conversely, the kappa statistic performs best when there is nearly equal chance
27
28 of study outcomes. When there is a high likelihood of one of the two outcomes,
29
30 as in our study (high likelihood of CR/SP eligibility), the results of the kappa
31
32 analyses can underestimate true reliability due to a phenomenon known as the
33
34 “kappa score paradox” in which there is high percent agreement, yet a low kappa
35
36 score[21, 22]. Indeed, we observed this paradox in some centers. The true
37
38 reliability of abstracting our PM’s most likely lies between the results from the two
39
40 methods of assessment we used. Since the “percent agreement” method
41
42 generally suggests very high reliability of the CR/SP measures and the kappa
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44 statistic generally suggests moderate to high reliability, the true reliability of the
45
46 CR/SP performance measure would appear overall to be high.
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54
55 Data abstractors reported that data abstraction time was modest for the in-patient
56
57 (4.9 minutes) and out-patient (6.8 minutes) CR/SP PM’s, and reported minimal
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4 barriers to their abstraction activities. If the CR/SP PM's are included in sets of
5
6 other PM's, such as the PM set for CABG surgery, for example, it is likely that
7
8 efficiencies of scale will result in less time being required for the CR/SP PM
9
10 assessment.
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15 16 *Lessons Learned* 17

18
19 Outpatient abstraction of the CR/SP performance measure data was more time-
20
21 consuming and somewhat less reliable than the abstraction of inpatient data.
22
23 This is explained in large part by the fact that the review of inpatient data is
24
25 limited to the time of the patient's index hospitalization (i.e., the time of the
26
27 cardiac event that qualified them for CR/SP). Review of outpatient data is
28
29 broader, including a review of records for up to 12 months previous to the
30
31 outpatient visit and also a review of records for up to 12 month after the
32
33 outpatient visit, due to the fact that patients are eligible for CR/SP for up to 12
34
35 months following their qualifying cardiac event.
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43 *Future Directions* 44

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46 Healthcare provider education through effective communication channels is
47
48 critically important to help providers understand and document appropriate
49
50 exceptions to CR/SP referral, as well as the key components of CR/SP referral
51
52 documentation: 1) that the patient has been referred to CR/SP, 2) that the patient
53
54 has been given information and guidance to help them enroll in CR/SP, and 3)
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4 that the receiving CR/SP program has been sent patient information to expedite
5
6 CR/SP enrollment).

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11 Current practices and existing ACCF and AHA registries only require
12
13 documentation that the patient has been referred to a CR/SP program. Published
14
15 evidence suggests that the use of additional communication components, as
16
17 specified in the measures, may increase the predictive validity of the measures
18
19 [23]. Going forward, with the advent of better data collection systems for CR/SP
20
21 referral and the ability now to track CR/SP enrollment through the AACVPR
22
23 Outpatient Cardiac Rehabilitation Registry we expect to be able to test the
24
25 hypothesis that this more detailed definition of CR/SP referral will increase
26
27 enrollment in CR/SP. Furthermore, computerized decision support, made more
28
29 widely available through efforts to enhance the meaningful use of electronic
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31 health records, may also provide value by increasing the ability to track and
32
33 improve the appropriate utilization of CR/SP.
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43 Reliability of CR/SP performance measure abstraction is high. Data abstractors
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45 reported minimal barriers to the abstraction process and required a relatively
46
47 small amount of time per patient to carry out the abstractions. These results
48
49 contribute to published evidence regarding the soundness and generalizability of
50
51 the CR/SP PM's. Further work will need to be carried out to assess the impact of
52
53 the CR/SP PM's on patient referral rates and patient outcomes.
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References

1. Goel, K., et al., *Impact of cardiac rehabilitation on mortality and cardiovascular events after percutaneous coronary intervention in the community*. Circulation. 2011;123: 2344-52.
2. Hammill, B.G., et al., *Relationship between cardiac rehabilitation and long-term risks of death and myocardial infarction among elderly Medicare beneficiaries*. Circulation. 2010;121: 63-70.
3. Oldridge, N.B., et al., *Cardiac rehabilitation after myocardial infarction. Combined experience of randomized clinical trials*. JAMA : the journal of the American Medical Association. 1988;260: 945-50.
4. Suaya, J.A., et al., *Cardiac rehabilitation and survival in older coronary patients*. Journal of the American College of Cardiology, 2009;54:25-33.
5. Taylor, R.S., et al., *Mortality reductions in patients receiving exercise-based cardiac rehabilitation: how much can be attributed to cardiovascular risk factor improvements?* European journal of cardiovascular prevention and rehabilitation : official journal of the European Society of Cardiology, Working Groups on Epidemiology & Prevention and Cardiac Rehabilitation and Exercise Physiology. 2006;13:369-74.
6. Williams, M.A., et al., *Clinical evidence for a health benefit from cardiac rehabilitation: an update*. American heart journal. 2006;152:835-41.
7. Witt, B.J., et al., *Cardiac rehabilitation after myocardial infarction in the community*. Journal of the American College of Cardiology. 2004;44:988-96.
8. *Receipt of cardiac rehabilitation services among heart attack survivors--19 states and the District of Columbia, 2001*. MMWR. Morbidity and mortality weekly report. 2003;52:1072-5.
9. Suaya, J.A., et al., *Use of cardiac rehabilitation by Medicare beneficiaries after myocardial infarction or coronary bypass surgery*. Circulation. 2007;116:1653-62.
10. Thomas, R.J., et al., *National Survey on Gender Differences in Cardiac Rehabilitation Programs. Patient characteristics and enrollment patterns*. Journal of cardiopulmonary rehabilitation. 1996;16:402-12.
11. Fonarow, G.C., et al., *Association between performance measures and clinical outcomes for patients hospitalized with heart failure*. JAMA : the journal of the American Medical Association. 2007;297:61-70.
12. Thomas, R.J., et al., *AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services*. Circulation. 2007;116:1611-42.
13. Thomas, R.J., et al., *AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services*. Journal of cardiopulmonary rehabilitation and prevention. 2007;27:260-90.
14. Thomas, R.J., et al., *AACVPR/ACCF/AHA 2010 Update: Performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services: A report of the American Association of Cardiovascular and Pulmonary Rehabilitation and the American College of Cardiology*

- Foundation/American Heart Association Task Force on Performance Measures (Writing Committee to Develop Clinical Performance Measures for Cardiac Rehabilitation). *Journal of cardiopulmonary rehabilitation and prevention*. 2010;30:279-88.
15. Thomas, R.J., et al., AACVPR/ACCF/AHA 2010 update: performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services: a report of the American Association of Cardiovascular and Pulmonary Rehabilitation and the American College of Cardiology Foundation/American Heart Association Task Force on Performance Measures (Writing Committee to Develop Clinical Performance Measures for Cardiac Rehabilitation). *Circulation*. 2010;122:1342-50.
16. Thomas, R.J., et al., AACVPR/ACCF/AHA 2010 Update: Performance Measures on Cardiac Rehabilitation for Referral to Cardiac Rehabilitation/Secondary Prevention Services Endorsed by the American College of Chest Physicians, the American College of Sports Medicine, the American Physical Therapy Association, the Canadian Association of Cardiac Rehabilitation, the Clinical Exercise Physiology Association, the European Association for Cardiovascular Prevention and Rehabilitation, the Inter-American Heart Foundation, the National Association of Clinical Nurse Specialists, the Preventive Cardiovascular Nurses Association, and the Society of Thoracic Surgeons. *Journal of the American College of Cardiology*. 2010;56:1159-67.
17. Thomas, R.J., et al., AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services endorsed by the American College of Chest Physicians, American College of Sports Medicine, American Physical Therapy Association, Canadian Association of Cardiac Rehabilitation, European Association for Cardiovascular Prevention and Rehabilitation, Inter-American Heart Foundation, National Association of Clinical Nurse Specialists, Preventive Cardiovascular Nurses Association, and the Society of Thoracic Surgeons. *Journal of the American College of Cardiology*. 2007;50:1400-33.
18. Spertus, J.A., et al., ACCF/AHA new insights into the methodology of performance measurement: a report of the American College of Cardiology Foundation/American Heart Association Task Force on performance measures. *Circulation*. 2010;122:2091-106.
19. Spertus, J.A., et al., American College of Cardiology and American Heart Association methodology for the selection and creation of performance measures for quantifying the quality of cardiovascular care. *Journal of the American College of Cardiology*. 2005;45:1147-56.
20. Fleiss, J., ed. *Statistical Methods for Rates and Proportions, 2nd Edition*. 2nd ed. 1981, Wiley-Interscience: New York. 352.
21. Feinstein, A.R. and D.V. Cicchetti, *High agreement but low kappa: I. The problems of two paradoxes*. *Journal of clinical epidemiology*. 1990;43:543-9.
22. Lantz, C.A. and E. Nebenzahl, *Behavior and interpretation of the kappa statistic: resolution of the two paradoxes*. *Journal of clinical epidemiology*. 1996;49:431-4.
23. Grace, SL, Russell KL, Reid RD, Oh P, Anand S, Rush J, Williamson K, Gupta M, Alter DA, Stewart DE; Cardiac Rehabilitation Care Continuity Through

Automatic Referral Evaluation (CRCARE) Investigators. Effect of cardiac rehabilitation referral strategies on utilization rates: a prospective, controlled study. Arch Intern Med. 2011 Feb 14;171(3):235-41.

Figure 1: Performance measures for referral to cardiac rehabilitation/secondary prevention programs from the in-patient (A) and out-patient (B) settings

Figure 2: Recruitment of participating centers in the CR3 Project

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September 24, 2013

Mark Williams, PhD
Editor-in-Chief
Journal of Cardiopulmonary Rehabilitation and Prevention

Dear Dr. Williams:

We are submitting the revisions that you requested for our original manuscript entitled, "Reliability of Abstracting Performance Measures: Results of the Cardiac Rehabilitation Referral and Reliability (CR3) Project". Please see the attachment that contains a point-by-point explanation of our responses to the reviewers' requests.

Thank you for your kind consideration of this manuscript for your journal.

Sincerely,

A handwritten signature in black ink, appearing to read 'Randal J. Thomas'.

Randal J. Thomas, MD, MS
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Mayo Clinic
Rochester, MN 55905
(507) 284-8087

Introduction

Cardiac rehabilitation and secondary prevention (CR/SP) services are significantly associated with positive health outcomes in a variety of patients with cardiac disorders[1-7] yet only a minority of eligible patients ever participate in CR/SP[8-10]. The American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR), American College of Cardiology Foundation (ACCF), and American Heart Association (AHA) [11] have developed, and the National Quality Forum (NQF) has endorsed, performance measures (PM's) for CR/SP referral to increase the delivery of CR/SP to appropriate patients (see Table 1)[12-17]. In addition, the Centers for Medicare and Medicaid Services (CMS) has included these measures in the Physician Quality Reporting System, and will begin reporting audits of these PM's in the outpatient setting in 2015.

Assessment of the reliability of data collection for performance measurement is an important step included in the ACCF/AHA methodology for the development and identification of high-value performance measures [18, 19]. However, to our knowledge, no studies have been published that have evaluated the reliability of collecting CR/SP performance measures. To address this need, and to respond to NQF requirements to provide such data as part of their endorsement process, we carried out a multi-site study, the Cardiac Rehabilitation Referral Reliability (CR3) Project, aimed at analyzing the reliability of abstracting the CR/SP PM's from inpatient and outpatient records.

Methods

Participating Hospitals and Practices

Hospitals and outpatient cardiology practices in the United States were identified from the ACCF, AHA, and AACVPR databases and were invited to participate.

We sought a variety of hospitals and clinics, based on different geographical locations, community sizes, and hospital/practice types/sizes (see Figure 1). All

540 outpatient cardiology practices that were members of the ACCF's outpatient quality and outcomes data registry (known as the PINNACLE network) ~~data~~

~~registry through the ACCF~~ as of October 1, 2011 were invited by email to

participate in the CR3 Project as outpatient sites. The PINNACLE Network helps cardiovascular teams achieve practice success through quality measurement, performance improvement, and peer-to-peer learning through an interactive community that connects practices across the country. In addition, an invitation to participate in the CR3 Project as an inpatient and/or an outpatient site was sent by email to 2916 members of AACVPR, and targeted invitations were sent to 5 Board members, 6 Past Presidents, and 11 Committee Chairs of AACVPR, as well as to the CR/SP programs that were participating in the Wisconsin State Cardiac Rehabilitation Registry (70 centers) and the Montana State Cardiac Rehabilitation Registry (145 programs). Twenty-nine hospitals and 23 outpatient practices responded, expressing interest in participating in the project.

Based on available resources to carry out the CR3 Project, we initially planned to include a maximum of 12 sites in the project, with varied geographical locations and center characteristics. An additional site was added since it was able to participate without the need for CR3 Project resources, resulting in a total of 7 inpatient and 6 outpatient practices that participated in the project. Inclusion criteria included a willingness to participate, and ability to: (1) provide a study coordinator and 2 separate chart abstractors, (2) complete the project within the specified timeline, and (3) obtain local IRB clearance to carry out the project in their setting. Once each hospital and practice completed and submitted their required data, they were sent a small incentive as a token of appreciation for their participation and submission of complete project data from their site (\$200 gift card). Completed data were received from 7 hospitals and 6 outpatient cardiology practices.

Chart Abstraction

For inpatient facilities, charts of patients who had an index hospitalization (i.e., a hospitalization for a cardiac event that is a qualifying diagnosis or procedure for CR/SP) between August 1, 2009 and August 1st 2010 were eligible for review and inclusion. For outpatient centers, charts of patients who had an outpatient visit between August 1, 2009 and August 1, 2010 were eligible for review and inclusion. However, since the performance measure allows as long as 12 months for a patient to complete CR/SP following a qualifying cardiac event, chart abstraction included a search for a qualifying cardiac event between August 1,

2009 and August 1, 2010, along with a search of records for up to 12 months after the cardiac event, to search for documentation of CR/SP referral during that time period.

Study sites designated one study coordinator and two chart abstractors. Each study coordinator identified 35 patients from a consecutive sample of patients: 30 patients with an eligible diagnosis for CR/SP referral, and 5 without an eligible diagnosis for CR/SP (see below for additional details). The two abstractors at each site reviewed the same 35 patient records that had been selected from their site twice (once at baseline, and again one week later). Abstractors had a range of experience reviewing charts, from less than one month to greater than 5 years.

Abstractors were blinded as to which patients in their sample had a qualifying diagnosis and which patients had exceptions for CR/SP. Only the site coordinator, who did not participate in the abstraction process, had access to this information. Patients considered to have qualifying events for CR/SP, as defined by CMS and therefore as specified in the performance measure, had one or more of the following: myocardial infarction, percutaneous coronary intervention, coronary artery bypass graft surgery, heart valve surgery, heart transplantation surgery, and chronic stable angina. Patients without a qualifying event, for the purpose of this abstraction project, were to have had documented one or more of the following diagnoses that are not currently considered by CMS to be a covered indication for CR/SP:

- *For inpatient centers:* atrial fibrillation, heart failure, or syncope during the index hospitalization period under review (with no documented qualifying events for CR during that same hospitalization)
- *For outpatient centers:* atypical chest pain, palpitations, or dyspnea during the 12 months prior to the index outpatient visit (with no documented qualifying events for CR referral during that same time period).

The CR3 Project workgroup created chart abstraction forms, site coordinator instructions, abstractor instructions, a frequently asked questions document, and site tracking forms to allow the study coordinator to track and report site specific results for intra-abstractor (1 abstractor reviewing the chart two times) and inter-abstractor (2 abstractors reviewing 1 chart) reliability. The workgroup held a kickoff call with each center's study coordinator to train them prior to the start of the CR3 project. Thereafter, the workgroup communicated weekly with site coordinators to address any questions or operational concerns that arose. The training of site coordinators was carried out during 1-2 one-hour conference calls prior to starting the project. When coordinators had questions, they contacted the staff liaison to the CR3 working group directly by email or telephone. New questions and their corresponding answers were communicated weekly to all site coordinators. The entire project took approximately 20 weeks to complete (October 2011 through February 2012).

Definitions

The following definitions were developed for use in the study:

Eligible patients for CR/SP referral:

- Inpatient: a patient who survived the index hospitalization and who had a qualifying event/diagnosis for referral to CR/SP during the index hospitalization period under review.
- Outpatient: a patient who had a qualifying event/diagnosis for referral to CR/SP within the previous 12 months prior to the index outpatient visit.

Patients not eligible for CR/SP referral:

- Inpatient: a patient who had a cardiac event/diagnosis (atrial fibrillation, heart failure, or syncope for purposes of this study) during the index hospitalization period under review and no indication for CR/SP referral as specified in the performance measure.
- Outpatient: a patient who had a cardiac event/diagnosis (atypical chest pain, palpitations, or dyspnea for purposes of this study) during the 12 months prior to the index outpatient visit, and no indication for CR/SP referral as specified in the performance measure.

CR/SP referral:

- Inpatient: documentation in a patient's hospital medical records that the patient was referred to an outpatient CR/SP program.

- Outpatient: documentation in a patient's outpatient clinical medical records that the patient has been referred to an outpatient CR/SP program within 12 months after a qualifying event/diagnosis.

For purposes of this project, documentation in the medical record could include any of the following sources: hospital discharge summaries, office notes, clinical notes and medical records, orders (written/electronic), prescriptions (e.g. contact information for CR/SP specialist), or other parts of the clinical record that documents patient information.

Exceptions:

Because there are valid reasons why certain patients should not be referred to a CR/SP program, exceptions to the CR/SP measures are allowed. When a clinician is allowed to document exceptions he or she is given the flexibility to decide whether or not to institute a given intervention/process depending upon the overall benefits and risks to the patient. Exceptions allow clinicians this flexibility without the threat of being "penalized" for not referring a patient to CR/SP. Without the presence of exceptions, potential negative unintended consequences could arise such as forcing CR/SP on patients who are unstable. Furthermore, analysis of exception rates for quality improvement purposes allows providers and health systems to test the effects of process changes within their practices and communities that may facilitate CR/SP referral. Relatively few patients would be expected to qualify for an exception to CR/SP referral. Such

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4 exceptions would generally be limited to factors that may make CR/SP unsafe,
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6 ineffective, or lack of accessibility to a CR/SP program within a reasonable
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8 commuting distance.
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14 Such exceptions would generally be limited to factors that may make CR/SP
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16 unsafe or ineffective, or that otherwise prohibit access to a CR/SP program.
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18 ~~(e.g., long commuting distance from a CR/SP program).~~
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24 Examples of exceptions from referral to CR/SP include:

- 25
26 • Patient exceptions (e.g., patient resides in a long-term nursing care
27 facility)
28
- 29
30 • Medical exceptions (e.g., presence of an acute medical condition that
31 makes the patient unstable and unsafe for exercise training)
32
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- 34
35 • System exceptions (e.g., lack of an available CR/SP program within 60
36 minutes of travel time from the patient's home)
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43 Since the measures look only at whether patients were referred, not whether they
44 enrolled, patient refusal was not considered to be an exception. If a healthcare
45 provider recommended CR/SP referral to a patient, the patient refused the
46 referral, and the provider documented the patient refusal, then that encounter
47 was judged to have met the performance measure since the provider complied
48 with the expectation to recommend referral to CR/SP.
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Data analyses

Both Cohen's kappa (κ) statistic and percent agreement were used to measure the intra-abtractor and inter-abtractor reliability for the following qualitative ratings: (1) documented eligibility for CR/SP referral, (2) exception documented for CR/SP referral, and (3) documentation of CR/SP referral. The κ statistic is a chance-corrected index of agreement ranging from -1 to 1, with $\kappa < 0$ representing observed agreement worse than that due to chance alone. We interpreted a κ over 0.75 as excellent, 0.40 to 0.75 as fair to good, and below 0.40 as poor, following the guidelines of Fleiss et al[20]. Unlike the κ statistic, percent agreement does not take into account the agreement occurring by chance, but can be informative in situations for which the prevalence of a given response is very high or low and the interpretation based solely on the value of κ may be misleading. This phenomenon known as the kappa paradox[21, 22] occurs when the observed proportion of agreement is high but the value of the κ statistic is low.

For brevity, intra-abtractor reliability is reported for only one of the two abstractors (arbitrarily-designated "abtractor 1" at each site), and inter-abtractor reliability only for the initial set of ratings (i.e., "time 1"). Stratifying on inpatient vs. outpatient setting, reliability was analyzed 1) on the overall group with sites pooled together, and 2) within sites and summarizing the site-specific results across the overall group. All analyses were performed using the SAS statistical software package (version 9.2, SAS Institute Inc., Cary, NC).

Results

Descriptive Characteristics

Characteristics of the 234 inpatients and 211 outpatients (total 445) included in the CR3 Project are shown in Table 2. The majority of patients from both inpatient and outpatient sites were male, white and younger than 65 years of age. A total of 1746 chart reviews were performed for the CR3 Project (415 (93%) of the total 445 patient charts were reviewed as specified in the CR3 Project protocol, each one being reviewed 4 times (2 by each abstractor), while incomplete reporting of data resulted in 26 that were reviewed only 3 times each, and 4 that were each reviewed only twice).

Participating centers represented a variety of practice types and settings, including the following: Rural, suburban or urban area locations; teaching and non-teaching centers; and single specialty and multi-specialty centers. One hospital was from the Pacific Northwest, four from the Midwest, one from the Northeast, and one from the Southeast. Three inpatient centers used paper medical records, five used electronic medical records, and two used both.

Outpatient clinics in the CR3 Project were located throughout the Midwest and in the Southeastern part of the United States. Two outpatient clinics used paper medical records and four used electronic medical records, while none used both.

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4 Site abstractors involved in the CR3 Project had varying degrees of experience
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6 with chart abstraction prior to participating in the project, with 54% of abstractors
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8 having 2 years of experience or less and 23% having less than one month of
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10 experience. Among the 13 inpatient and outpatient sites, the pair of abstractors
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12 had similar levels of experience at 11 sites ~~(both abstractors had less than 2~~
13
14 ~~years of experience at 6 sites, and both had more than 2 years of experience at 5~~
15
16 ~~sites)~~. Excluding the 2 sites in which the pairs of abstractors had discordant
17
18 levels of experience, we found that ratings of CR/SP eligibility, exceptions, and
19
20 referral were not more reliable from abstractors having more than 2 years of
21
22 experience. Interestingly, some of these ratings reflected more favorable
23
24 reliability in abstractors having less than 2 years of experience (data not shown).
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31 In addition, we did not find a difference between the reliability of the first
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33 abstractions and the second abstractions, suggesting that there was no “learning
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35 effect” among abstractors.
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41 The mean \pm SD time per chart abstraction, reported by abstractors was 4.9 ± 3.2
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43 minutes for inpatient abstractions and 6.8 ± 4.7 minutes for outpatient
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45 abstractions.
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50 *Reliability Outcomes*

51 *Inpatient Sites (See Table 3)*

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53 Intra-abstractor reliability analysis of pooled inpatient data demonstrated
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55 excellent repeatability for ratings of CR/SP eligibility (100% agreement, $\kappa = 1.00$),
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CR/SP exceptions (96% agreement, $\kappa = 0.76$), and CR/SP referral (98% agreement, $\kappa = 0.95$). Based on site-specific inpatient data, each of the three CR/SP items showed high percent agreement ($\geq 90\%$) at all sites, and excellent repeatability ($\kappa \geq 0.75$) in the majority of sites (100% of sites for patient eligibility, 67% for patient exceptions, and 80% for patient referral).

Pooled analysis of inpatient sites demonstrated excellent inter-abtractor reliability analysis for ratings of CR/SP eligibility (94% agreement, $\kappa = 0.77$) and CR/SP exceptions (97% agreement, $\kappa = 0.79$), and modest agreement between abstractors for rating CR/SP referral (86% agreement, $\kappa = 0.70$). Consistent with the pooled results, site-specific analyses demonstrated excellent inter-abtractor reliability (as measured by $\kappa \geq 0.75$) in the majority of inpatient sites for ratings of eligibility (71% of sites) and exceptions (67% of sites), but in less than half (40%) of sites for the rating of CR/SP referral.

Outpatient Sites (See Table 3)

Pooled analyses of the six outpatient sites demonstrated excellent intra-abtractor reliability for the three ratings of CR/SP eligibility, exceptions, and referral (agreement $\geq 95\%$, $\kappa \geq 0.88$). From site-specific analysis of intra-abtractor reliability, percent agreement $\geq 90\%$ was observed in all six sites for ratings of CR/SP eligibility and exceptions, and in all but one site for rating of CR/SP referral. Likewise, excellent repeatability ($\kappa \geq 0.75$) was demonstrated in the

majority of outpatient sites (100% of sites for rating of eligibility, 67% for exceptions, and 67% for referral).

Regarding inter-abtractor reliability for outpatient sites, pooled analyses reflected excellent agreement between abstractors for ratings of both CR/SP eligibility ($\kappa = 0.78$) and CR/SP referral ($\kappa = 0.80$), and poor to fair agreement in rating patient exceptions for CR/SP referral ($\kappa = 0.43$). Similarly, according to site-specific results, excellent inter-abtractor reliability was observed in most (two-thirds) of the outpatient sites for rating CR/SP eligibility, and in none of the sites for rating CR/SP exceptions. Interestingly, despite excellent inter-abtractor agreement for rating CR/SP referral obtained from pooled analysis, site-specific results varied considerably (range of κ across six sites, -0.07 to 1.00), with excellent reliability seen in only one-third of outpatient sites (and percent agreement below 90% in half the sites).

Discussion

This study demonstrates high reliability for assessing CR/SP eligibility, referral, and exceptions using the CR/SP outpatient and inpatient performance measures. Data abstraction of patient records was performed by abstractors with varying amounts of abstraction experience at a variety of inpatient and outpatient centers, suggesting generalizability of our findings.

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4 Reliability testing is one of 3 important steps in developing high value PM's, as
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6 outlined by the ACCF/AHA Task Force on Performance Measures[19]. The 3
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8 steps include: (1) construction of the measurement set, (2) assessment of
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10 feasibility and reliability of data collection, and (3) measurement of clinicians'
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12 performance. Construction of the CR/SP PM set has previously been
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14 reported[12-17].
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24 Our testing generally found high reliability for comparisons between abstractors
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26 for the 3 key components of the CR/SP PM's: patient eligibility for CR/SP, patient
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28 exceptions to CR/SP referral, and patient referral to CR/SP. We included two
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30 measures of reliability, each shedding important light on the reliability of PM
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32 abstraction: percent agreement and the kappa statistic. "Percent agreement" is
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34 a helpful assessment of reliability, but given that over 80% of patients in the
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36 study sample were eligible for CR/SP, and more than 90% of patients were
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38 absent exceptions to CR/SP participation, the percent agreement may have been
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40 somewhat inflated, since by chance alone abstractors may have chosen the
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42 correct eligibility or exception status.
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51 Conversely, the kappa statistic performs best when there is nearly equal chance
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53 of study outcomes. When there is a high likelihood of one of the two outcomes,
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55 as in our study (high likelihood of CR/SP eligibility), the results of the kappa
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57 analyses can underestimate true reliability due to a phenomenon known as the
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“kappa score paradox” in which there is high percent agreement, yet a low kappa score[21, 22]. Indeed, we observed this paradox in some centers. The true reliability of abstracting our PM’s most likely lies between the results from the two methods of assessment we used. Since the “percent agreement” method generally suggests very high reliability of the CR/SP measures and the kappa statistic generally suggests moderate to high reliability, the true reliability of the CR/SP performance measure would appear overall to be high.

Data abstractors reported that data abstraction time was modest for the in-patient (4.9 minutes) and out-patient (6.8 minutes) CR/SP PM’s, and reported minimal barriers to their abstraction activities. If the CR/SP PM’s are included in sets of other PM’s, such as the PM set for CABG surgery, for example, it is likely that efficiencies of scale will result in less time being required for the CR/SP PM assessment.

Limitations

We selected participating centers to reflect variation in the location, size, and type of centers. However, our study is based on the experience of a relatively small number of centers from around the United States that volunteered to be in the project and may not be representative other centers from different regions.

Lessons Learned

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4 Outpatient abstraction of the CR/SP performance measure data was more time-
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6 consuming and somewhat less reliable than the abstraction of inpatient data.
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8 This is explained in large part by the fact that the review of inpatient data is
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10 limited to the time of the patient's index hospitalization (i.e., the time of the
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12 cardiac event that qualified them for CR/SP). Review of outpatient data is
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14 broader, including a review of records for up to 12 months previous to the
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16 outpatient visit and also a review of records for up to 12 month after the
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18 outpatient visit, due to the fact that patients are eligible for CR/SP for up to 12
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20 months following their qualifying cardiac event.
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28 *Future Directions*

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31 Healthcare provider education through effective communication channels is
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33 critically important to help providers understand and document appropriate
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35 exceptions to CR/SP referral, as well as the key components of CR/SP referral
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37 documentation: 1) that the patient has been referred to CR/SP, 2) that the patient
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39 has been given information and guidance to help them enroll in CR/SP, and 3)
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41 that the receiving CR/SP program has been sent patient information to expedite
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43 CR/SP enrollment).
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51 Current practices and existing ACCF and AHA registries only require
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53 documentation that the patient has been referred to a CR/SP program. Published
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55 evidence suggests that the use of additional communication components, as
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57 specified in the measures, may increase the predictive validity of the measures
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[23]. Going forward, with the advent of better data collection systems for CR/SP referral and the ability now to track CR/SP enrollment through the AACVPR Outpatient Cardiac Rehabilitation Registry we expect to be able to test the hypothesis that this more detailed definition of CR/SP referral will increase enrollment in CR/SP. Furthermore, computerized decision support, made more widely available through efforts to enhance the meaningful use of electronic health records, may also provide value by increasing the ability to track and improve the appropriate utilization of CR/SP.

Reliability of CR/SP performance measure abstraction is high. Data abstractors reported minimal barriers to the abstraction process and required a relatively small amount of time per patient to carry out the abstractions. These results contribute to published evidence regarding the soundness and generalizability of the CR/SP PM's. Further work will need to be carried out to assess the impact of the CR/SP PM's on patient referral rates and patient outcomes.

References

1. Goel, K., et al., *Impact of cardiac rehabilitation on mortality and cardiovascular events after percutaneous coronary intervention in the community*. *Circulation*. 2011;123: 2344-52.
2. Hammill, B.G., et al., *Relationship between cardiac rehabilitation and long-term risks of death and myocardial infarction among elderly Medicare beneficiaries*. *Circulation*. 2010;121: 63-70.
3. Oldridge, N.B., et al., *Cardiac rehabilitation after myocardial infarction. Combined experience of randomized clinical trials*. *JAMA - the journal of the American Medical Association*. 1988;260: 945-50.
4. Suaya, J.A., et al., *Cardiac rehabilitation and survival in older coronary patients*. *Journal of the American College of Cardiology*. 2009;54:25-33.
5. Taylor, R.S., et al., *Mortality reductions in patients receiving exercise-based cardiac rehabilitation: how much can be attributed to cardiovascular risk factor improvements?* *European Journal of Cardiovascular Prevention and Rehabilitation - official journal of the European Society of Cardiology, Working Groups on Epidemiology & Prevention and Cardiac Rehabilitation and Exercise Physiology*. 2006;13:369-74.
6. Williams, M.A., et al., *Clinical evidence for a health benefit from cardiac rehabilitation: an update*. *American Heart Journal*. 2006;152:835-41.
7. Witt, B.J., et al., *Cardiac rehabilitation after myocardial infarction in the community*. *JACC Journal of the American College of Cardiology*. 2004;44:988-96.
8. *Receipt of cardiac rehabilitation services among heart attack survivors--19 states and the District of Columbia, 2001*. *MMWR. Morbidity and mortality weekly report*. 2003;52:1072-5.
9. Suaya, J.A., et al., *Use of cardiac rehabilitation by Medicare beneficiaries after myocardial infarction or coronary bypass surgery*. *Circulation*. 2007;116:1653-62.
10. Thomas, R.J., et al., *National Survey on Gender Differences in Cardiac Rehabilitation Programs. Patient characteristics and enrollment patterns*. *Journal of Cardiopulmonary Rehabilitation*. 1996;16:402-12.
11. Fonarow, G.C., et al., *Association between performance measures and clinical outcomes for patients hospitalized with heart failure*. *JAMA - the journal of the American Medical Association*. 2007;297:61-70.
12. Thomas, R.J., et al., *AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services*. *Circulation*. 2007;116:1611-42.
13. Thomas, R.J., et al., *AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services*. *Journal of Cardiopulmonary Rehabilitation and Prevention*. 2007;27:260-90.
14. Thomas, R.J., et al., *AACVPR/ACCF/AHA 2010 Update: Performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services: A report of the American Association of Cardiovascular and*

- Pulmonary Rehabilitation and the American College of Cardiology Foundation/American Heart Association Task Force on Performance Measures (Writing Committee to Develop Clinical Performance Measures for Cardiac Rehabilitation). Journal of eCardiopulmonary rRehabilitation and pPrevention. 2010;30:279-88.*
15. Thomas, R.J., et al., AACVPR/ACCF/AHA 2010 update: performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services: a report of the American Association of Cardiovascular and Pulmonary Rehabilitation and the American College of Cardiology Foundation/American Heart Association Task Force on Performance Measures (Writing Committee to Develop Clinical Performance Measures for Cardiac Rehabilitation). *Circulation. 2010;122:1342-50.*
 16. Thomas, R.J., et al., AACVPR/ACCF/AHA 2010 Update: Performance Measures on Cardiac Rehabilitation for Referral to Cardiac Rehabilitation/Secondary Prevention Services Endorsed by the American College of Chest Physicians, the American College of Sports Medicine, the American Physical Therapy Association, the Canadian Association of Cardiac Rehabilitation, the Clinical Exercise Physiology Association, the European Association for Cardiovascular Prevention and Rehabilitation, the Inter-American Heart Foundation, the National Association of Clinical Nurse Specialists, the Preventive Cardiovascular Nurses Association, and the Society of Thoracic Surgeons. *JACC Journal of the American College of Cardiology. 2010;56:1159-67.*
 17. Thomas, R.J., et al., AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services endorsed by the American College of Chest Physicians, American College of Sports Medicine, American Physical Therapy Association, Canadian Association of Cardiac Rehabilitation, European Association for Cardiovascular Prevention and Rehabilitation, Inter-American Heart Foundation, National Association of Clinical Nurse Specialists, Preventive Cardiovascular Nurses Association, and the Society of Thoracic Surgeons. *JACC Journal of the American College of Cardiology. 2007;50:1400-33.*
 18. Spertus, J.A., et al., ACCF/AHA new insights into the methodology of performance measurement: a report of the American College of Cardiology Foundation/American Heart Association Task Force on performance measures. *Circulation. 2010;122:2091-106.*
 19. Spertus, J.A., et al., American College of Cardiology and American Heart Association methodology for the selection and creation of performance measures for quantifying the quality of cardiovascular care. *JACC Journal of the American College of Cardiology. 2005;45:1147-56.*
 20. Fleiss, J., ed. *Statistical Methods for Rates and Proportions, 2nd Edition.* 2nd ed. 1981, Wiley-Interscience: New York. 352.
 21. Feinstein, A.R. and D.V. Cicchetti, *High agreement but low kappa: I. The problems of two paradoxes. Journal of eClinical eEpidemiology. 1990;43:543-9.*
 22. Lantz, C.A. and E. Nebenzahl, *Behavior and interpretation of the kappa statistic: resolution of the two paradoxes. Journal of eClinical eEpidemiology. 1996;49:431-4.*

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4 23. Grace, SL, Russell KL, Reid RD, Oh P, Anand S, Rush J, Williamson K, Gupta
5 M, Alter DA, Stewart DE; Cardiac Rehabilitation Care Continuity Through
6 Automatic Referral Evaluation (CRCARE) Investigators. Effect of cardiac
7 rehabilitation referral strategies on utilization rates: a prospective, controlled
8 study. Arch Intern Med. 2011 Feb 14;171(3):235-41.
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~~Figure 1: Performance measures for referral to cardiac rehabilitation/secondary prevention programs from the in-patient (A) and out-patient (B) settings~~

Figure 21: Recruitment of participating centers in the CR3 Project

**Reliability of Abstracting Performance Measures:
Results of the Cardiac Rehabilitation Referral and Reliability (CR3) Project**

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Pulmonary Rehabilitation, American College of Cardiology Foundation, and American Heart
Association.

STRUCTURED ABSTRACT

BACKGROUND: Assessment of the reliability of performance measure (PM) abstraction is an important step in PM validation. Reliability has not been previously assessed for abstracting PMs for the referral of patients to cardiac rehabilitation and secondary prevention (CR/SP) programs. To help validate these PMs, we carried out a multicenter assessment of their reliability.

METHODS: Hospitals and clinical practices from around the U.S. were invited to participate in the CR3 Project. Twenty-nine hospitals and 23 outpatient centers expressed interest in participating. Seven hospitals and 6 outpatient centers met participation criteria and submitted completed data. Site coordinators identified 35 patients whose charts were reviewed by 2 site abstractors twice, 1 week apart. Percent agreement and Cohen's kappa statistic were used to describe intra- and inter-abtractor reliability for patient eligibility for CR/SP, patient exceptions for CR/SP referral, and documented referral to CR/SP.

RESULTS: Results were obtained from within-site data, as well as from pooled data of all inpatient and all outpatient sites. We found that intra-abtractor reliability reflected excellent repeatability ($\geq 90\%$ agreement, $\kappa \geq 0.75$) for ratings of CR/SP eligibility, exceptions, and referral, both from pooled and site-specific analyses of inpatient and outpatient data. Similarly, the inter-abtractor agreement from pooled analysis ranged from good to excellent for the 3 items, although with slightly lower measures of reliability.

CONCLUSIONS: Abstraction of PMs for CR/SP referral has high reliability, supporting the use of these PMs in quality improvement initiatives aimed at increasing CR/SP delivery to patients with cardiovascular disease.

CONDENSED ABSTRACT

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Cardiac rehabilitation and secondary prevention (CR/SP) services are significantly associated with positive health outcomes in a variety of patients with cardiac disorders¹⁻⁷ yet only a minority of eligible patients ever participate in CR/SP.⁸⁻¹⁰ The American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR), American College of Cardiology Foundation (ACCF), and American Heart Association (AHA)¹¹ have developed, and the National Quality Forum (NQF) has endorsed, performance measures (PM's) for CR/SP referral to increase the delivery of CR/SP to appropriate patients (see Table 1).¹²⁻¹⁷ In addition, the Centers for Medicare and Medicaid Services (CMS) has included these measures in the Physician Quality Reporting System, and will begin reporting audits of these PMs in the outpatient setting in 2015.

Comment [maw1]: Please use correct JCRP citation style. This paragraph has been corrected for you and should be used as example for remainder of the paper

Assessment of the reliability of data collection for performance measurement is an important step included in the ACCF/AHA methodology for the development and identification of high-value performance measures [18, 19]. However, to our knowledge, no studies have been published that have evaluated the reliability of collecting CR/SP performance measures. To address this need, and to respond to NQF requirements to provide such data as part of their endorsement process, we carried out a multi-site study, the Cardiac Rehabilitation Referral Reliability (CR3) Project, aimed at analyzing the reliability of abstracting the CR/SP PMs from inpatient and outpatient records.

METHODS

Hospitals and outpatient cardiology practices in the United States were identified from the ACCF, AHA, and AACVPR databases and were invited to participate. We sought a variety of hospitals and clinics, based on different geographical locations, community sizes, and

hospital/practice types/sizes (Figure 1). All 540 outpatient cardiology practices that were members of the ACCF outpatient quality and outcomes data registry (known as the PINNACLE network) as of October 1, 2011 were invited by email to participate in the CR3 Project as outpatient sites. The PINNACLE Network helps cardiovascular teams achieve practice success through quality measurement, performance improvement, and peer-to-peer learning through an interactive community that connects practices across the country. In addition, an invitation to participate in the CR3 Project as an inpatient and/or an outpatient site was sent by email to 2916 members of AACVPR, and targeted invitations were sent to 5 Board members, 6 Past Presidents, and 11 Committee Chairs of AACVPR, as well as to the CR/SP programs that were participating in the Wisconsin State Cardiac Rehabilitation Registry (70 centers) and the Montana State Cardiac Rehabilitation Registry (145 programs). Twenty-nine hospitals and 23 outpatient practices responded, expressing interest in participating in the project.

Based on available resources to carry out the CR3 Project, we initially planned to include a maximum of 12 sites in the project, with varied geographical locations and center characteristics. An additional site was added since it was able to participate without the need for CR3 Project resources, resulting in a total of 7 inpatient and 6 outpatient practices that participated in the project. Inclusion criteria included a willingness to participate, and ability to: (1) provide a study coordinator and 2 separate chart abstractors, (2) complete the project within the specified timeline, and (3) obtain local IRB clearance to carry out the project in their setting. Once each hospital and practice completed and submitted their required data, they were sent a small incentive as a token of appreciation for their participation and submission of complete project data from their site (\$200 gift card). Completed data were received from 7 hospitals and 6 outpatient cardiology practices.

Chart Abstraction

For inpatient facilities, charts of patients who had an index hospitalization (ie, a hospitalization for a cardiac event that is a qualifying diagnosis or procedure for CR/SP) between August 1, 2009 and August 1st 2010 were eligible for review and inclusion. For outpatient centers, charts of patients who had an outpatient visit between August 1, 2009 and August 1, 2010 were eligible for review and inclusion. However, since the performance measure allows as long as 12 months for a patient to complete CR/SP following a qualifying cardiac event, chart abstraction included a search for a qualifying cardiac event between August 1, 2009 and August 1, 2010, along with a search of records for up to 12 months after the cardiac event, to search for documentation of CR/SP referral during that time period.

Study sites designated 1 study coordinator and 2 chart abstractors. Each study coordinator identified 35 patients from a consecutive sample of patients: 30 patients with an eligible diagnosis for CR/SP referral, and 5 without an eligible diagnosis for CR/SP (see below for additional details). The 2 abstractors at each site reviewed the same 35 patient records that had been selected from their site twice (once at baseline, and again 1 week later). Abstractors had a range of experience reviewing charts, from less than 1 month to greater than 5 years.

Abstractors were blinded as to which patients in their sample had a qualifying diagnosis and which patients had exceptions for CR/SP. Only the site coordinator, who did not participate in the abstraction process, had access to this information. Patients considered to have qualifying events for CR/SP, as defined by CMS and therefore as specified in the performance measure, had 1 or more of the following: myocardial infarction, percutaneous coronary intervention, coronary artery bypass graft surgery, heart valve surgery, heart transplantation surgery, and chronic stable angina. Patients without a qualifying event, for the purpose of this abstraction project, were to

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10 have had documented 1 or more of the following diagnoses that are not currently considered by
11 CMS to be a covered indication for CR/SP:
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- 13 • *For inpatient centers:* atrial fibrillation, heart failure, or syncope during the index
14 hospitalization period under review (with no documented qualifying events for CR during
15 that same hospitalization)
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17 • *For outpatient centers:* atypical chest pain, palpitations, or dyspnea during the 12 months
18 prior to the index outpatient visit (with no documented qualifying events for CR referral
19 during that same time period).
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25 The CR3 Project workgroup created chart abstraction forms, site coordinator instructions,
26 abstractor instructions, a frequently asked questions document, and site tracking forms to allow
27 the study coordinator to track and report site specific results for intra-abstractor (1 abstractor
28 reviewing the chart 2 times) and inter-abstractor (2 abstractors reviewing 1 chart) reliability. The
29 workgroup held a kickoff call with each center's study coordinator to train them prior to the start
30 of the CR3 project. Thereafter, the workgroup communicated weekly with site coordinators to
31 address any questions or operational concerns that arose. The training of site coordinators was
32 carried out during 1-2 one-hour conference calls prior to starting the project. When coordinators
33 had questions, they contacted the staff liaison to the CR3 working group directly by email or
34 telephone. New questions and their corresponding answers were communicated weekly to all site
35 coordinators. The entire project took approximately 20 weeks to complete (October 2011
36 through February 2012).
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51 **Definitions**

52 The following definitions were developed for use in the study:
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Eligible patients for CR/SP referral:

- Inpatient: a patient who survived the index hospitalization and who had a qualifying event/diagnosis for referral to CR/SP during the index hospitalization period under review.
- Outpatient: a patient who had a qualifying event/diagnosis for referral to CR/SP within the previous 12 months prior to the index outpatient visit.

Patients not eligible for CR/SP referral:

- Inpatient: a patient who had a cardiac event/diagnosis (atrial fibrillation, heart failure, or syncope for purposes of this study) during the index hospitalization period under review and no indication for CR/SP referral as specified in the performance measure.
- Outpatient: a patient who had a cardiac event/diagnosis (atypical chest pain, palpitations, or dyspnea for purposes of this study) during the 12 months prior to the index outpatient visit, and no indication for CR/SP referral as specified in the performance measure.

CR/SP referral:

- Inpatient: documentation in a patient's hospital medical records that the patient was referred to an outpatient CR/SP program.
- Outpatient: documentation in a patient's outpatient clinical medical records that the patient has been referred to an outpatient CR/SP program within 12 months after a qualifying event/diagnosis.

For purposes of this project, documentation in the medical record could include any of the following sources: hospital discharge summaries, office notes, clinical notes and medical records, orders (written/electronic), prescriptions (e.g. contact information for CR/SP specialist), or other parts of the clinical record that documents patient information.

Exceptions

Because there are valid reasons why certain patients should not be referred to a CR/SP program, exceptions to the CR/SP measures are allowed. When a clinician is allowed to document exceptions he or she is given the flexibility to decide whether or not to institute a given intervention/process depending upon the overall benefits and risks to the patient. Exceptions allow clinicians this flexibility without the threat of being “penalized” for not referring a patient to CR/SP. Without the presence of exceptions, potential negative unintended consequences could arise such as forcing CR/SP on patients who are unstable. Furthermore, analysis of exception rates for quality improvement purposes allows providers and health systems to test the effects of process changes within their practices and communities that may facilitate CR/SP referral. Relatively few patients would be expected to qualify for an exception to CR/SP referral. Such exceptions would generally be limited to factors that may make CR/SP unsafe, ineffective, or lack of accessibility to a CR/SP program within a reasonable commuting distance.

Such exceptions would generally be limited to factors that may make CR/SP unsafe or ineffective, or that otherwise prohibit access to a CR/SP program. Examples of exceptions from referral to CR/SP include:

- Patient exceptions (eg, patient resides in a long-term nursing care facility)
- Medical exceptions (eg, presence of an acute medical condition that makes the patient unstable and unsafe for exercise training)
- System exceptions (eg, lack of an available CR/SP program within 60 minutes of travel time from the patient’s home)

Since the measures look only at whether patients were referred, not whether they enrolled, patient refusal was not considered to be an exception. If a healthcare provider recommended

CR/SP referral to a patient, the patient refused the referral, and the provider documented the patient refusal, then that encounter was judged to have met the performance measure since the provider complied with the expectation to recommend referral to CR/SP.

Data Analyses

Both Cohen's kappa (κ) statistic and percent agreement were used to measure the intra-abtractor and inter-abtractor reliability for the following qualitative ratings: (1) documented eligibility for CR/SP referral, (2) exception documented for CR/SP referral, and (3) documentation of CR/SP referral. The κ statistic is a chance-corrected index of agreement ranging from -1 to 1, with $\kappa < 0$ representing observed agreement worse than that due to chance alone. We interpreted a κ over 0.75 as excellent, 0.40 to 0.75 as fair to good, and below 0.40 as poor, following the guidelines of Fleiss et al.²⁰ Unlike the κ statistic, percent agreement does not take into account the agreement occurring by chance, but can be informative in situations for which the prevalence of a given response is very high or low and the interpretation based solely on the value of κ may be misleading. This phenomenon known as the kappa paradox[21, 22] occurs when the observed proportion of agreement is high but the value of the κ statistic is low.

For brevity, intra-abtractor reliability is reported for only 1 of the 2 abstractors (arbitrarily-designated "abstractor 1" at each site), and inter-abtractor reliability only for the initial set of ratings (ie, "time 1"). Stratifying on inpatient vs. outpatient setting, reliability was analyzed 1) on the overall group with sites pooled together, and 2) within sites and summarizing the site-specific results across the overall group. All analyses were performed using the SAS statistical software package (version 9.2, SAS Institute Inc., Cary, NC).

RESULTS

Characteristics of the 234 inpatients and 211 outpatients (total 445) included in the CR3 Project are shown in Table 2. The majority of patients from both inpatient and outpatient sites were male, white, and younger than 65 years of age. A total of 1746 chart reviews were performed for the CR3 Project (415 (93%) of the total 445 patient charts were reviewed as specified in the CR3 Project protocol, each 1 being reviewed 4 times (2 by each abstractor), while incomplete reporting of data resulted in 26 that were reviewed only 3 times each, and 4 that were each reviewed only twice).

Participating centers represented a variety of practice types and settings, including the following: Rural, suburban, or urban area locations; teaching and non-teaching centers; and single specialty and multispecialty centers. One hospital was from the Pacific Northwest, 4 from the Midwest, 1 from the Northeast, and 1 from the Southeast. Three inpatient centers used paper medical records, 5 used electronic medical records, and 2 used both. Outpatient clinics in the CR3 Project were located throughout the Midwest and in the Southeastern part of the United States. Two outpatient clinics used paper medical records and 4 used electronic medical records, while none used both.

Site abstractors involved in the CR3 Project had varying degrees of experience with chart abstraction prior to participating in the project, with 54% of abstractors having 2 years of experience or less and 23% having less than one month of experience. Among the 13 inpatient and outpatient sites, the pair of abstractors had similar levels of experience at 11 sites). Excluding the 2 sites in which the pairs of abstractors had discordant levels of experience, we found that ratings of CR/SP eligibility, exceptions, and referral were not more reliable from abstractors having more than 2 years of experience. Interestingly, some of these ratings reflected

more favorable reliability in abstractors having less than 2 years of experience (data not shown).

In addition, we did not find a difference between the reliability of the first abstractions and the second abstractions, suggesting that there was no “learning effect” among abstractors. The mean \pm SD time per chart abstraction, reported by abstractors was 4.9 \pm 3.2 minutes for inpatient abstractions and 6.8 \pm 4.7 minutes for outpatient abstractions.

Reliability Outcomes

Inpatient Sites (Table 3)

Intra-abstractor reliability analysis of pooled inpatient data demonstrated excellent repeatability for ratings of CR/SP eligibility (100% agreement, κ =1.00), CR/SP exceptions (96% agreement, κ =0.76), and CR/SP referral (98% agreement, κ =0.95). Based on site-specific inpatient data, each of the three CR/SP items showed high percent agreement (\geq 90%) at all sites, and excellent repeatability ($\kappa \geq$ 0.75) in the majority of sites (100% of sites for patient eligibility, 67% for patient exceptions, and 80% for patient referral).

Pooled analysis of inpatient sites demonstrated excellent inter-abstractor reliability analysis for ratings of CR/SP eligibility (94% agreement, κ =0.77) and CR/SP exceptions (97% agreement, κ =0.79), and modest agreement between abstractors for rating CR/SP referral (86% agreement, κ =0.70). Consistent with the pooled results, site-specific analyses demonstrated excellent inter-abstractor reliability (as measured by $\kappa \geq$ 0.75) in the majority of inpatient sites for ratings of eligibility (71% of sites) and exceptions (67% of sites), but in less than half (40%) of sites for the rating of CR/SP referral.

Outpatient Sites (Table 3)

Pooled analyses of the 6 outpatient sites demonstrated excellent intra-abstractor reliability for the 3 ratings of CR/SP eligibility, exceptions, and referral (agreement $\geq 95\%$, $\kappa \geq 0.88$). From site-specific analysis of intra-abstractor reliability, percent agreement $\geq 90\%$ was observed in all 6 sites for ratings of CR/SP eligibility and exceptions, and in all but 1 site for rating of CR/SP referral. Likewise, excellent repeatability ($\kappa \geq 0.75$) was demonstrated in the majority of outpatient sites (100% of sites for rating of eligibility, 67% for exceptions, and 67% for referral).

Regarding inter-abstractor reliability for outpatient sites, pooled analyses reflected excellent agreement between abstractors for ratings of both CR/SP eligibility ($\kappa = 0.78$) and CR/SP referral ($\kappa = 0.80$), and poor to fair agreement in rating patient exceptions for CR/SP referral ($\kappa = 0.43$). Similarly, according to site-specific results, excellent inter-abstractor reliability was observed in most (two-thirds) of the outpatient sites for rating CR/SP eligibility, and in none of the sites for rating CR/SP exceptions. Interestingly, despite excellent inter-abstractor agreement for rating CR/SP referral obtained from pooled analysis, site-specific results varied considerably (range of κ across six sites, -0.07 to 1.00), with excellent reliability seen in only one-third of outpatient sites (and percent agreement below 90% in half the sites).

DISCUSSION

This study demonstrates high reliability for assessing CR/SP eligibility, referral, and exceptions using the CR/SP outpatient and inpatient performance measures. Data abstraction of patient records was performed by abstractors with varying amounts of abstraction experience at a variety of inpatient and outpatient centers, suggesting generalizability of our findings.

Reliability testing is one of 3 important steps in developing high value PMs, as outlined by the ACCF/AHA Task Force on Performance Measures[19]. The 3 steps include: (1) construction of the measurement set, (2) assessment of feasibility and reliability of data collection, and (3) measurement of clinician performance. Construction of the CR/SP PM set has previously been reported[12-17].

Our testing generally found high reliability for comparisons between abstractors for the 3 key components of the CR/SP PM's: patient eligibility for CR/SP, patient exceptions to CR/SP referral, and patient referral to CR/SP. We included 2 measures of reliability, each shedding important light on the reliability of PM abstraction: percent agreement and the kappa statistic. "Percent agreement" is a helpful assessment of reliability, but given that over 80% of patients in the study sample were eligible for CR/SP, and more than 90% of patients were absent exceptions to CR/SP participation, the percent agreement may have been somewhat inflated, since by chance alone abstractors may have chosen the correct eligibility or exception status.

Conversely, the kappa statistic performs best when there is nearly equal chance of study outcomes. When there is a high likelihood of one of the 2 outcomes, as in our study (high likelihood of CR/SP eligibility), the results of the kappa analyses can underestimate true reliability due to a phenomenon known as the "kappa score paradox" in which there is high percent agreement, yet a low kappa score[21, 22]. Indeed, we observed this paradox in some centers. The true reliability of abstracting our PMs most likely lies between the results from the 2 methods of assessment we used. Since the "percent agreement" method generally suggests very high reliability of the CR/SP measures and the kappa statistic generally suggests moderate to high reliability, the true reliability of the CR/SP performance measure would appear overall to be high.

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10 Data abstractors reported that data abstraction time was modest for the inpatient (4.9
11 minutes) and outpatient (6.8 minutes) CR/SP PMs, and reported minimal barriers to their
12 abstraction activities. If the CR/SP PMs are included in sets of other PM's, such as the PM set
13 for CABG surgery, for example, it is likely that efficiencies of scale will result in less time being
14 required for the CR/SP PM assessment.
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21 **Limitations**

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23 We selected participating centers to reflect variation in the location, size, and type of centers.
24
25 However, our study is based on the experience of a relatively small number of centers from
26 around the United States that volunteered to be in the project and may not be representative other
27 centers from different regions.
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33 **Lessons Learned**

34
35 Outpatient abstraction of the CR/SP performance measure data was more time-consuming and
36 somewhat less reliable than the abstraction of inpatient data. This is explained in large part by
37 the fact that the review of inpatient data is limited to the time of the patient index hospitalization
38 (ie, the time of the cardiac event that qualified them for CR/SP). Review of outpatient data is
39 broader, including a review of records for up to 12 months previous to the outpatient visit and
40 also a review of records for up to 12 month after the outpatient visit, due to the fact that patients
41 are eligible for CR/SP for up to 12 months following their qualifying cardiac event.
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51 **Future Directions**

Healthcare provider education through effective communication channels is critically important to help providers understand and document appropriate exceptions to CR/SP referral, as well as the key components of CR/SP referral documentation: 1) that the patient has been referred to CR/SP, 2) that the patient has been given information and guidance to help them enroll in CR/SP, and 3) that the receiving CR/SP program has been sent patient information to expedite CR/SP enrollment).

Current practices and existing ACCF and AHA registries only require documentation that the patient has been referred to a CR/SP program. Published evidence suggests that the use of additional communication components, as specified in the measures, may increase the predictive validity of the measures.²³ Going forward, with the advent of better data collection systems for CR/SP referral and the ability now to track CR/SP enrollment through the AACVPR Outpatient Cardiac Rehabilitation Registry, we expect to be able to test the hypothesis that this more detailed definition of CR/SP referral will increase enrollment in CR/SP. Furthermore, computerized decision support, made more widely available through efforts to enhance the meaningful use of electronic health records, may also provide value by increasing the ability to track and improve the appropriate utilization of CR/SP.

Reliability of CR/SP performance measure abstraction is high. Data abstractors reported minimal barriers to the abstraction process and required a relatively small amount of time per patient to carry out the abstractions. These results contribute to published evidence regarding the soundness and generalizability of the CR/SP PMs. Further work will need to be carried out to assess the impact of the CR/SP PMs on patient referral rates and patient outcomes.

References

1. Goel, K., et al., *Impact of cardiac rehabilitation on mortality and cardiovascular events after percutaneous coronary intervention in the community*. Circulation. 2011;123: 2344-52.
2. Hammill, B.G., et al., *Relationship between cardiac rehabilitation and long-term risks of death and myocardial infarction among elderly Medicare beneficiaries*. Circulation. 2010;121: 63-70.
3. Oldridge, N.B., et al., *Cardiac rehabilitation after myocardial infarction. Combined experience of randomized clinical trials*. JAMA. 1988;260: 945-50.
4. Suaya, J.A., et al., *Cardiac rehabilitation and survival in older coronary patients*. JACC, 2009;54:25-33.
5. Taylor, R.S., et al., *Mortality reductions in patients receiving exercise-based cardiac rehabilitation: how much can be attributed to cardiovascular risk factor improvements?* European Journal of Cardiovascular Prevention and Rehabilitation. 2006;13:369-74.
6. Williams, M.A., et al., *Clinical evidence for a health benefit from cardiac rehabilitation: an update*. Am Heart J. 2006;152:835-41.
7. Witt, B.J., et al., *Cardiac rehabilitation after myocardial infarction in the community*. JACC. 2004;44:988-96.
8. *Receipt of cardiac rehabilitation services among heart attack survivors--19 states and the District of Columbia, 2001*. MMWR. Morbidity and mortality weekly report. 2003;52:1072-5.
9. Suaya, J.A., et al., *Use of cardiac rehabilitation by Medicare beneficiaries after myocardial infarction or coronary bypass surgery*. Circulation. 2007;116:1653-62.
10. Thomas, R.J., et al., *National Survey on Gender Differences in Cardiac Rehabilitation Programs. Patient characteristics and enrollment patterns*. J Cardiopulmon Rehabil. 1996;16:402-12.
11. Fonarow, G.C., et al., *Association between performance measures and clinical outcomes for patients hospitalized with heart failure*. JAMA. 2007;297:61-70.
12. Thomas, R.J., et al., *AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services*. Circulation. 2007;116:1611-42.
13. Thomas, R.J., et al., *AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services*. JCardiopulmon Rehabil Prev. 2007;27:260-90.
14. Thomas, R.J., et al., *AACVPR/ACCF/AHA 2010 Update: Performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services: A report of the American Association of Cardiovascular and Pulmonary Rehabilitation and the American College of Cardiology Foundation/American Heart Association Task Force on Performance Measures (Writing Committee to Develop Clinical Performance Measures for Cardiac Rehabilitation)*. JCardiopulmon Rehabil Prev. 2010;30:279-88.
15. Thomas, R.J., et al., *AACVPR/ACCF/AHA 2010 update: performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services: a report of the American Association of Cardiovascular and Pulmonary Rehabilitation and the American College of Cardiology Foundation/American Heart*

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Association Task Force on Performance Measures (Writing Committee to Develop Clinical Performance Measures for Cardiac Rehabilitation). *Circulation*. 2010;122:1342-50.

16. Thomas, R.J., et al., AACVPR/ACCF/AHA 2010 Update: Performance Measures on Cardiac Rehabilitation for Referral to Cardiac Rehabilitation/Secondary Prevention Services Endorsed by the American College of Chest Physicians, the American College of Sports Medicine, the American Physical Therapy Association, the Canadian Association of Cardiac Rehabilitation, the Clinical Exercise Physiology Association, the European Association for Cardiovascular Prevention and Rehabilitation, the Inter-American Heart Foundation, the National Association of Clinical Nurse Specialists, the Preventive Cardiovascular Nurses Association, and the Society of Thoracic Surgeons. *JACC*. 2010;56:1159-67.
17. Thomas, R.J., et al., AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services endorsed by the American College of Chest Physicians, American College of Sports Medicine, American Physical Therapy Association, Canadian Association of Cardiac Rehabilitation, European Association for Cardiovascular Prevention and Rehabilitation, Inter-American Heart Foundation, National Association of Clinical Nurse Specialists, Preventive Cardiovascular Nurses Association, and the Society of Thoracic Surgeons. *JACC*. 2007;50:1400-33.
18. Spertus, J.A., et al., ACCF/AHA new insights into the methodology of performance measurement: a report of the American College of Cardiology Foundation/American Heart Association Task Force on performance measures. *Circulation*. 2010;122:2091-106.
19. Spertus, J.A., et al., American College of Cardiology and American Heart Association methodology for the selection and creation of performance measures for quantifying the quality of cardiovascular care. *JACC*. 2005;45:1147-56.
20. Fleiss, J., ed. *Statistical Methods for Rates and Proportions, 2nd Edition*. 2nd ed. 1981, Wiley-Interscience: New York. 352.
21. Feinstein, A.R. and D.V. Cicchetti, *High agreement but low kappa: I. The problems of two paradoxes*. *J Clin Epidemiol*. 1990;43:543-9.
22. Lantz, C.A. and E. Nebenzahl, *Behavior and interpretation of the kappa statistic: resolution of the two paradoxes*. *J Clin Epidemiol*. 1996;49:431-4.
23. Grace, SL, Russell KL, Reid RD, et al^{Oh P, Anand S, Rush J, Williamson K, Gupta M, Alter DA, Stewart DE}; Cardiac Rehabilitation Care Continuity Through Automatic Referral Evaluation (CRCARE) Investigators. Effect of cardiac rehabilitation referral strategies on utilization rates: a prospective, controlled study. *Arch Intern Med*. 2011 Feb 14;171(3):235-241.

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AACVPR/ACCF/AHA Testing Project Data Collection Form Cohort-Outpatient

*Please track the amount of time taken to perform data abstraction and report at the end of the form. Provide information for 1st event/diagnosis. Referral must be noted within 365 calendar days (1 year) from diagnosis/event

Practice ID¹⁵²⁰:

Subject ID¹⁵⁰⁰:

Provider NPI¹⁵⁵⁰:

A. PATIENT DEMOGRAPHICS

Sex²⁰⁶⁰: ☐ Male ☐ Female

Age at start of measurement period²⁰⁵⁰: _____

Race: (Check all that apply)

- ☐ White²⁰⁷⁰ ☐ Black/African American²⁰⁷¹ ☐ Asian²⁰⁷²
☐ American Indian/Alaska Native²⁰⁷³ ☐ Native Hawaiian/Pacific Islander²⁰⁷⁴ ☐ Hispanic or Latino Ethnicity²⁰⁷⁶

B. QUALIFYING CARDIAC DIAGNOSES/EVENTS THAT QUALIFY PATIENT FOR CARDIAC REHAB ABSTRACTION: (If more than 1 event within 30 calendar days, check multiple events/diagnoses)

- ☐ Myocardial Infarction (within 12 months)⁵⁰⁰⁵ ☐ PCI - Stent (within 12 months)⁵⁰¹⁵
☐ Coronary Artery Bypass Graft (within 12 months)⁵⁰¹⁰ ☐ PCI - Other (non-stent) Intervention (within 12 months)⁵⁰³⁵
☐ Cardiac Valve Surgery (within 12 months)⁵⁰²⁰ ☐ No Qualifying Event/Diagnosis Identified (if checked, then form is complete)⁵⁰⁴⁰
☐ Heart Transplantation⁵⁰³⁰
☐ Stable Angina (within 12 months)⁴⁰⁵⁵ → If Yes, ☐ Current Diagnosis⁴⁰⁶⁰

C. CARDIAC REHAB REFERRAL STATUS FOR 1ST EVENT/DIAGNOSIS (IF MORE THAN 1 EVENT IS CHECKED IN ITEM B, USE THE EVENT WHICH OCCURRED FIRST DURING THE MEASUREMENT PERIOD)

Cardiac Rehabilitation Referral or Plan for Qualifying Event/Diagnosis during measurement period⁶⁵⁰⁵:

- ☐ Yes, documentation that patient was referred to CR from this provider/facility (if checked, please complete section D)
☐ Yes, documentation that patient was referred to CR from another provider/facility and/or was participating in CR prior to encounter with provider from this office/facility (if checked, please skip to section E)
☐ No, referral not documented, but medical exception documented for this qualifying event/diagnosis (if checked, please skip to section E)
☐ No, referral not documented, but patient exception documented for this qualifying event/diagnosis (if checked, please skip to section E)
☐ No, referral not documented, but health care system exception documented for this qualifying event/diagnosis (if checked, please skip to section E)
☐ No, referral not documented and no exceptions documented (if checked, please skip to section E)

Exception Reason

(Describe): _____

D. COMMUNICATION OF CARDIAC REHAB REFERRAL: (Check all that apply)

- ☐ Documentation (written/electronic) that the necessary CR referral was given to patient
☐ Documentation (written/electronic) that receiving CR site was given patient's referral information

E. DATA COLLECTION CHALLENGES/GENERAL FEEDBACK

What data collection challenges or other comments did you encounter/have (any feedback on the specifics of this record would be appreciated)?:

Total time taken: _____ mins

NQF application

CR: Cardiac Rehabilitation Patient Referral from an Outpatient Setting (PINNACLE)

[Type the author name]

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CR: Cardiac Rehabilitation Patient Referral from an Outpatient Setting (PINNACLE)

[Type the author name]

1. Performance measure name

CR: Cardiac Rehabilitation Patient Referral from an Outpatient Setting (PINNACLE)

2. Performance gap

2.1 Descriptive statistics of Performance rate (1b.2)

2011

# of providers	# of patients	Minimum	Lower Quartile	Mean	Upper Quartile	Maximum	Quartile Range	Std Dev
994	252331	0.00%	0.25%	8.27%	9.90%	97.0%	9.65%	13.8%

	Mean
Decile 3	0.1%
Decile 4	1.4%
Decile 5	2.7%
Decile 6	4.5%
Decile 7	6.9%
Decile 8	10.0%
Decile 9	15.5%
Decile 10	41.1%

2012

# of providers	# of patients	Minimum	Lower Quartile	Mean	Upper Quartile	Maximum	Quartile Range	Std Dev
1022	298206	0.00%	0.84%	9.18%	13.0%	100%	12.1%	12.3%

	Mean
Decile 2	0.0%
Decile 3	0.9%

NQF application

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	Mean
Decile 4	2.4%
Decile 5	4.1%
Decile 6	6.2%
Decile 7	8.9%
Decile 8	13.0%
Decile 9	19.0%
Decile 10	36.9%

2.2 Stratified descriptive statistics of Performance rate (1b.4)

2011

label	# of providers	# of patients	Minimum	Lower Quartile	Mean	Upper Quartile	Maximum	Quartile Range	Std Dev
Male	991	149190	0.00%	0.00%	8.99%	11.1%	100%	11.1%	14.4%
Female	992	102647	0.00%	0.00%	7.21%	8.07%	100%	8.07%	13.7%
Age: <60	989	70898	0.00%	0.00%	8.74%	10.3%	100%	10.3%	15.3%
Age: 60 -< 70	990	67641	0.00%	0.00%	9.15%	11.5%	100%	11.5%	15.8%
Age: 70 -< 80	985	65424	0.00%	0.00%	8.43%	10.5%	100%	10.5%	15.0%
Age: >= 80	975	47975	0.00%	0.00%	5.57%	5.30%	100%	5.30%	13.7%
Insurance: None	469	15075	0.00%	0.00%	7.20%	0.00%	100%	0.00%	20.5%
Insurance: Private	921	129482	0.00%	0.00%	8.85%	10.5%	100%	10.5%	14.9%
Insurance: Medicaid	916	61055	0.00%	0.00%	8.56%	10.1%	100%	10.1%	16.1%
Insurance: Medicare	588	3923	0.00%	0.00%	9.26%	2.81%	100%	2.81%	21.7%
Insurance: Other	364	2631	0.00%	0.00%	7.46%	0.00%	100%	0.00%	19.5%
Race: White	927	116020	0.00%	0.00%	7.96%	9.47%	100%	9.47%	14.7%
Race: Black	689	8663	0.00%	0.00%	7.46%	4.76%	100%	4.76%	18.3%
Race: Other	520	4404	0.00%	0.00%	5.31%	0.00%	100%	0.00%	19.0%

2012

NQF application

CR: Cardiac Rehabilitation Patient Referral from an Outpatient Setting (PINNACLE)

[Type the author name]

label	# of providers	# of patients	Minimum	Lower Quartile	Mean	Upper Quartile	Maximum	Quartile Range	Std Dev
Male	1022	175177	0.00%	0.79%	10.1%	14.3%	100%	13.5%	13.2%
Female	1022	122708	0.00%	0.00%	7.90%	10.3%	100%	10.3%	12.0%
Age: <60	1018	81177	0.00%	0.00%	9.53%	13.3%	100%	13.3%	13.7%
Age: 60 -< 70	1021	80530	0.00%	0.00%	10.6%	15.4%	100%	15.4%	13.9%
Age: 70 -< 80	1019	78353	0.00%	0.00%	9.32%	13.2%	100%	13.2%	13.5%
Age: >= 80	1012	57832	0.00%	0.00%	6.66%	9.09%	100%	9.09%	11.7%
Insurance: None	472	21792	0.00%	0.00%	9.65%	10.4%	100%	10.4%	21.2%
Insurance: Private	988	170243	0.00%	0.38%	10.0%	13.8%	100%	13.4%	13.7%
Insurance: Medicaid	960	71952	0.00%	0.00%	9.04%	12.9%	100%	12.9%	13.2%
Insurance: Medicare	642	5129	0.00%	0.00%	10.1%	14.3%	100%	14.3%	19.6%
Insurance: Other	376	2431	0.00%	0.00%	7.89%	1.28%	100%	1.28%	19.4%
Race: White	954	187806	0.00%	0.00%	8.49%	11.7%	100%	11.7%	12.5%
Race: Black	662	14842	0.00%	0.00%	8.34%	10.5%	100%	10.5%	16.4%
Race: Other	601	7512	0.00%	0.00%	7.22%	0.00%	100%	0.00%	21.2%

2.3 Dates of data (1.3)

2011 – Jan 1, 2011 through Dec 31 2011

2012 – Jan 1, 2012 through Dec 31 2012

2.4 Description of providers (measure entities 1.5).

2011

994 providers met the minimum number of eligible patients (10) for inclusion in the reliability analysis. The average number of eligible patients for providers included is 253.9 for a total of 252,331 patients. The range of number of patients for providers included is from 2396 to 10.

	Total n = 994
--	--------------------------------

NQF application

CR: Cardiac Rehabilitation Patient Referral from an Outpatient Setting (PINNACLE)

[Type the author name]

	Total
	n = 994
Provider gender	
(1) Male	797 (80.2%)
(2) Female	197 (19.8%)
Provider categories	
NP/PA	102 (10.4%)
MD/DO	855 (87.2%)
RN/nurses	23 (2.3%)
Missing (.)	14
Region	
(1) Northeast	194 (19.5%)
(2) Midwest	296 (29.8%)
(3) South	361 (36.3%)
(4) West	143 (14.4%)

2012

1022 providers met the minimum number of eligible patients (10) for inclusion in the reliability analysis. The average number of eligible patients for providers included is 291.8 for a total of 298,206 patients. The range of number of patients for providers included is from 2903 to 10.

	Total
	n = 1022
Provider gender	
(1) Male	804 (78.8%)
(2) Female	216 (21.2%)
Missing (.)	2
Provider categories	
NP/PA	114 (11.3%)
MD/DO	862 (85.7%)
RN/nurses	30 (3.0%)
Missing (.)	16

NQF application

CR: Cardiac Rehabilitation Patient Referral from an Outpatient Setting (PINNACLE)

[Type the author name]

Region	
(1) Northeast	189 (18.5%)
(2) Midwest	302 (29.5%)
(3) South	385 (37.7%)
(4) West	146 (14.3%)

2.5 Description of patients (1.6)

2011

	Total n = 252331
Race	
(1) White	117261 (89.9%)
(2) Black	8758 (6.7%)
(3) Other	4415 (3.4%)
Missing (.)	121897
Insurance	
(0) No insurance	14914 (7.0%)
(1) Private	129907 (61.1%)
(2) Medicare	61289 (28.8%)
(3) Medicaid	3956 (1.9%)
(4) Other	2629 (1.2%)
Missing (.)	39636
Age	
18 to <60	71020 (28.1%)
60 to <70	67696 (26.8%)
70 to <80	65497 (26.0%)
80 to 112	48118 (19.1%)
Sex	
(1) Male	149415 (59.2%)
(2) Female	102812 (40.8%)
Missing (.)	104
BMI	29.7 ± 6.4
Missing	91870
Diabetes	66294 (26.3%)
CAD	247440 (98.1%)

NQF application

CR: Cardiac Rehabilitation Patient Referral from an Outpatient Setting (PINNACLE)

[Type the author name]

	Total
	n = 252331
Hypertension	209013 (82.8%)
AFib	59525 (23.6%)
HF	76388 (30.3%)
PAD	89780 (35.6%)
Prior Stroke/TIA	79532 (31.5%)
MI history	125549 (49.8%)

2012

	Total
	n = 298206
Race	
(1) White	188393 (89.4%)
(2) Black	14885 (7.1%)
(3) Other	7531 (3.6%)
Missing (.)	87397
Insurance	
(0) No insurance	22049 (8.1%)
(1) Private	170472 (62.6%)
(2) Medicare	72131 (26.5%)
(3) Medicaid	5140 (1.9%)
(4) Other	2425 (0.9%)
Missing (.)	25989
Age	
18 to <60	81253 (27.2%)
60 to <70	80573 (27.0%)
70 to <80	78406 (26.3%)
80 to 112	57974 (19.4%)

NQF application

CR: Cardiac Rehabilitation Patient Referral from an Outpatient Setting (PINNACLE)

[Type the author name]

	Total
	n = 298206
Sex	
(1) Male	175387 (58.8%)
(2) Female	122812 (41.2%)
Missing (.)	7
BMI	29.7 ± 6.5
Missing	62153
Diabetes	83233 (27.9%)
CAD	292718 (98.2%)
Hypertension	258764 (86.8%)
AFib	76261 (25.6%)
HF	98438 (33.0%)
PAD	95404 (32.0%)
Prior Stroke/TIA	98036 (32.9%)
MI history	153948 (51.6%)

3. Reliability testing (2a2.1 - 2a2.4)

Reliability of the computed measure score was measured as the ratio of signal to noise. The signal in this case is the proportion of the variability in measured performance that can be explained by real differences in physician performance. Reliability at the level of the specific physician is given by:
$$\text{Reliability} = \text{Variance (physician-to-physician)} / [\text{Variance (physician-to-physician)} + \text{Variance (physician-specific-error)}]$$

Reliability is the ratio of the physician-to-physician variance divided by the sum of the physician-to-physician variance plus the error variance specific to a physician. A reliability of zero implies that all the variability in a measure is attributable to measurement error. A reliability of one implies that all the variability is attributable to real differences in physician performance.

Reliability testing was performed by using a beta-binomial model. The beta-binomial model assumes the physician performance score is a binomial random variable conditional on the physician's true value that comes from the beta distribution. The beta distribution is usually defined by two parameters, alpha and beta. Alpha and beta can be thought of as intermediate calculations to get to the needed variance estimates.

Reliability is estimated five different points: at the minimum number of quality reporting events for the measure; at the mean number of quality reporting events per physician; and at the 25th, 50th and 75th percentiles of the number of quality reporting events.

NQF application

CR: Cardiac Rehabilitation Patient Referral from an Outpatient Setting (PINNACLE)

[Type the author name]

Data shown below

2011

Description	Number of Patients	Signal-to-Noise Ratio
Minimum	10	0.987
25th percentile	71	0.995
50th percentile	164	0.997
75th percentile	312	0.998
Average	254	0.998

2012

Description	Number of Patients	Signal-to-Noise Ratio
Minimum	10	0.990
25th percentile	87	0.995
50th percentile	173	0.998
75th percentile	379	0.998
Average	292	0.998

This measure has excellent reliability when evaluated at the minimum level of quality reporting events and higher reliability at the median number of events (50th percentile), and at average and greater number of quality events.

4. Exclusion analysis(2b3.1 - 2b3.3)

Exclusion: Documented medical reason, patient reason, or system reason for not referring a patient to an outpatient CR program.

2011

95.0%(n=944) of the providers do not have exceptions. Among the providers who do have exceptions, the exclusion rate ranges from 0.4% to 100%, mean is 29.0%. Among the excluded patients, 7.4% were medical reason, 63.6 were patient reason, 29.0 were system reason.

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CR: Cardiac Rehabilitation Patient Referral from an Outpatient Setting (PINNACLE)

[Type the author name]

2012

96.8%(n=989) of the providers do not have exceptions. Among the providers who do have exceptions, the exclusion rate ranges from 0.1% to 85.7%, mean is 20.0%. Among the excluded patients, 10.5% were medical reason, 79.0 were patient reason, 10.5 were system reason.

5. Identification of differences in performance(2b5)

2011

# of providers	Minimum	Lower Quartile	Mean	Upper Quartile	Maximum	Quartile Range	Std Dev
994	0.00%	0.25%	8.27%	9.90%	97.0%	9.65%	13.8%

A large variability was noted among providers. The performance-met rate range was 0-97% with the inter-quartile range being 0.3% to 9.9%. This yielded a Median Rate Ratio of 4.07(3.78, 4.42). The Median Rate Ratio measures the variation between clusters by comparing 2 persons from two randomly chosen different clusters. A MRR of 4.07 indicates a moderate amount of variation among the clusters.

2012

# of providers	Minimum	Lower Quartile	Mean	Upper Quartile	Maximum	Quartile Range	Std Dev
1022	0.00%	0.84%	9.18%	13.0%	100%	12.1%	12.3%

A large variability was noted among providers. The performance-met rate range was 0-100% with the inter-quartile range being 0.8% to 13.0%. This yielded a Median Rate Ratio of 3.80(3.55, 4.09). The Median Rate Ratio measures the variation between clusters by comparing 2 persons from two randomly chosen different clusters. A MRR of 3.80 indicates a moderate amount of variation among the clusters.

6. Missing data(2b7)

In PINNACLE, missing values are interpreted as 'No' for most of the variables. For example, Thromboembolic Risk Factors Assessed: missing - not assessed; 1 - Yes (All risk factors assessed); 2 - No - Medical Reason; 3 - No - Patient Reason; 4 - No - System Reason. It's challenging to distinguish real missing vs 'No'. However, we do think it's reasonable to assume that data were not collected(missing) if all records from a practice are missing. For 2011 data, we identified 18 such

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[Type the author name]

practices for Cardiac Rehabilitation Referral. For 2012 data, we identified 13 such practices for Cardiac Rehabilitation Referral. These practices are excluded from the analysis.

Reliability of Abstracting Performance Measures

RESULTS OF THE CARDIAC REHABILITATION REFERRAL AND RELIABILITY (CR3) PROJECT

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■ **BACKGROUND:** Assessment of the reliability of performance measure (PM) abstraction is an important step in PM validation. Reliability has not been previously assessed for abstracting PMs for the referral of patients to cardiac rehabilitation (CR) and secondary prevention (SP) programs. To help validate these PMs, we carried out a multicenter assessment of their reliability.

■ **METHODS:** Hospitals and clinical practices from around the United States were invited to participate in the Cardiac Rehabilitation Referral Reliability (CR3) Project. Twenty-nine hospitals and 23 outpatient centers expressed interest in participating. Seven hospitals and 6 outpatient centers met participation criteria and submitted completed data. Site coordinators identified 35 patients whose charts were reviewed by 2 site abstractors twice, 1 week apart. Percent agreement and the Cohen κ statistic were used to describe intra- and interabstractor reliability for patient eligibility for CR/SP, patient exceptions for CR/SP referral, and documented referral to CR/SP.

■ **RESULTS:** Results were obtained from within-site data, as well as from pooled data of all inpatient and all outpatient sites. We found that intra-abstractor reliability reflected excellent repeatability ($\geq 90\%$ agreement; $\kappa \geq 0.75$) for ratings of CR/SP eligibility, exceptions, and referral, both from pooled and site-specific analyses of inpatient and outpatient data. Similarly, the interabstractor agreement from pooled analysis ranged from good to excellent for the 3 items, although with slightly lower measures of reliability.

■ **CONCLUSIONS:** Abstraction of PMs for CR/SP referral has high reliability, supporting the use of these PMs in quality improvement initiatives aimed at increasing CR/SP delivery to patients with cardiovascular disease.

KEY WORDS

cardiac rehabilitation

quality improvement

referral

reliability testing

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Cardiac rehabilitation (CR) and secondary prevention (SP) services are significantly associated with positive health outcomes in patients with cardiac disorders,¹⁻⁷ yet only a minority of eligible patients ever participate in CR/SP.⁸⁻¹⁰ The American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR), the American College of Cardiology Foundation (ACCF), and the American Heart Association (AHA)¹¹ have developed, and the National Quality Forum has endorsed, performance measures (PMs) for CR/SP referral to increase the delivery of CR/SP to appropriate patients (see Table 1).¹²⁻¹⁷ In addition, the Centers for Medicare & Medicaid Services has included these measures in the Physician Quality Reporting System and will begin reporting audits of these PMs in the outpatient setting in 2015.

Assessment of the reliability of data collection for performance measurement is an important step included in the ACCF/AHA methodology for the

development and identification of high-value PMs.^{18,19} However, to our knowledge, no studies have been published that have evaluated the reliability of collecting CR/SP PMs. To address this need, and to respond to the National Quality Forum requirements to provide such data as part of their endorsement process, we carried out a multisite study, the Cardiac Rehabilitation Referral Reliability (CR3) Project, aimed at analyzing the reliability of abstracting the CR/SP PMs from inpatient and outpatient records.

METHODS

Hospitals and outpatient cardiology practices in the United States were identified from the ACCF, AHA, and AACVPR databases and were invited to participate. We sought various hospitals and clinics, on the basis of

Table 1 • AACVPR/ACCF/AHA Performance Measures for Referral to a Cardiac Rehabilitation Program From an Inpatient and Outpatient Setting^{12,15}

Component	Details
Inpatient setting	
Performance measure	All patients hospitalized with a primary diagnosis of an acute myocardial infarction or chronic stable angina, or who during hospitalization have undergone coronary artery bypass graft surgery, a percutaneous coronary intervention, cardiac valve surgery, or cardiac transplantation are to be referred to an early outpatient cardiac rehabilitation/secondary prevention program
Numerator	The number of eligible patients with a qualifying event/diagnosis who have been referred to an outpatient cardiac rehabilitation program before hospital discharge or have a documented medical or patient-centered reason why such a referral was not made
Denominator	The number of hospitalized patients in the reporting period hospitalized with a qualifying event/diagnosis who do not meet any of the exception criteria
Exceptions	Patient-oriented factors (eg, patient discharged to a nursing care facility for long-term care) Medical factors (eg, patient deemed to have a medically unstable, life-threatening condition) Health care system factors (eg, lack of cardiac rehabilitation program near a patient home)
Outpatient setting	
Performance measure	All patients evaluated in an outpatient setting who within the past 12 months have experienced an acute myocardial infarction, coronary artery bypass graft surgery, a percutaneous coronary intervention, cardiac valve surgery, or cardiac transplantation, or who have chronic stable angina and have not already participated in an early outpatient cardiac rehabilitation/secondary prevention program for the qualifying event/diagnosis are to be referred to such a program
Numerator	The number of patients in an outpatient clinical practice who have had a qualifying event/diagnosis during the previous 12 months, who have been referred to an outpatient cardiac rehabilitation program
Denominator	The number of patients in an outpatient clinical practice who have had a qualifying event/diagnosis during the previous 12 months and who do not meet any of the exception criteria, and who have not already participated in an outpatient cardiac rehabilitation program since the qualifying event.
Exceptions	Patient oriented factors (eg, patient discharged to a nursing care facility for long-term care) Medical factors (eg, patient deemed to have a medically unstable, life-threatening condition) Health care system factors (eg, lack of cardiac rehabilitation program near a patient home)
Abbreviations: AACVPR, American Association of Cardiovascular and Pulmonary Rehabilitation; ACCF, American College of Cardiology Foundation; AHA, American Heart Association.	

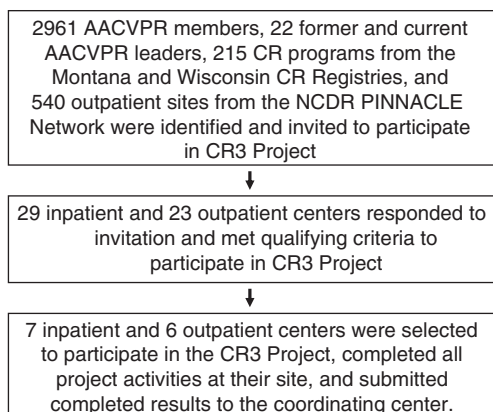


Figure 1. Recruitment of participating centers in the CR3 Project. AACVPR indicates American Association of Cardiovascular and Pulmonary Rehabilitation; CR, cardiac rehabilitation; CR3, Cardiac Rehabilitation Referral Reliability; NCDR, National Cardiovascular Data Registry.

different geographical locations, community sizes, and hospital/practice types/sizes (Figure 1). All 540 outpatient cardiology practices that were members of the ACCF outpatient quality and outcomes data registry (known as the PINNACLE network) as of October 1, 2011, were invited by e-mail to participate in the CR3 Project as outpatient sites. The PINNACLE Network helps cardiovascular teams achieve practice success through quality measurement, performance improvement, and peer-to-peer learning through an interactive community that connects practices across the country. In addition, an invitation to participate in the CR3 Project as an inpatient and/or an outpatient site was sent by e-mail to 2916 members of AACVPR, and targeted invitations were sent to 5 board members, 6 past presidents, and 11 committee chairs of the AACVPR, as well as to the CR/SP programs that were participating in the Wisconsin State Cardiac Rehabilitation Registry (70 centers) and the Montana State Cardiac Rehabilitation Registry (145 programs). Twenty-nine hospitals and 23 outpatient practices responded, expressing interest in participating in the project.

On the basis of available resources to carry out the CR3 Project, we initially planned to include a maximum of 12 sites in the project, with varied geographical locations and center characteristics. An additional site was added, since it was able to participate without the need for CR3 Project resources, resulting in a total of 7 inpatient and 6 outpatient practices that participated in the project. Inclusion criteria included a willingness to participate and ability to (1) provide a study coordinator and 2 separate chart abstractors, (2) complete the project within the specified timeline, and (3) obtain local institutional review board clearance to carry out the project in their setting. Once each hospital and practice completed and submitted their required data, they were sent a small incentive

as a token of appreciation for their participation and submission of complete project data from their site (\$200 gift card). Completed data were received from 7 hospitals and 6 outpatient cardiology practices.

Chart Abstraction

For inpatient facilities, charts of patients who had an index hospitalization (ie, a hospitalization for a cardiac event that is a qualifying diagnosis or procedure for CR/SP) between August 1, 2009, and August 1, 2010, were eligible for review and inclusion. For outpatient centers, charts of patients who had an outpatient visit between August 1, 2009, and August 1, 2010, were eligible for review and inclusion. However, since the PM allows as long as 12 months for a patient to complete CR/SP following a qualifying cardiac event, chart abstraction included a search for a qualifying cardiac event between August 1, 2009, and August 1, 2010, along with a search of records for up to 12 months after the cardiac event, to search for documentation of CR/SP referral during that time period.

Study sites designated 1 study coordinator and 2 chart abstractors. Each study coordinator identified 35 patients from a consecutive sample of patients: 30 patients with an eligible diagnosis for CR/SP referral, and 5 without an eligible diagnosis for CR/SP (see later for additional details). The 2 abstractors at each site reviewed the same 35 patient records that had been selected from their site twice (once at baseline and again 1 week later). Abstractors had a range of experience reviewing charts, from less than 1 month to greater than 5 years.

Abstractors were blinded as to which patients in their sample had a qualifying diagnosis and which patients had exceptions for CR/SP. Only the site coordinator, who did not participate in the abstraction process, had access to this information. Patients considered to have qualifying events for CR/SP, as defined by the Centers for Medicare & Medicaid Services and therefore as specified in the PM, had 1 or more of the following: myocardial infarction, percutaneous coronary intervention, coronary artery bypass graft surgery, heart valve surgery, heart transplantation surgery, and chronic stable angina. Patients without a qualifying event, for the purpose of this abstraction project, were to have had documented 1 or more of the following diagnoses that are not currently considered by the Centers for Medicare & Medicaid Services to be a covered indication for CR/SP:

- *For inpatient centers:* atrial fibrillation, heart failure, or syncope during the index hospitalization period under review (with no documented qualifying events for CR during that same hospitalization).
- *For outpatient centers:* atypical chest pain, palpitations, or dyspnea during the 12 months before the

index outpatient visit (with no documented qualifying events for CR referral during that same time period).

The CR3 Project workgroup created chart abstraction forms, site coordinator instructions, abstractor instructions, a frequently asked questions document, and site tracking forms to allow the study coordinator to track and report site-specific results for intra-abstractor (1 abstractor reviewing the chart 2 times) and interabstractor (2 abstractors reviewing 1 chart) reliability. The workgroup held a kickoff call with each center's study coordinator to train them before the start of the CR3 Project. Thereafter, the workgroup communicated weekly with site coordinators to address any questions or operational concerns that arose. The training of site coordinators was carried out during one or two 1-hour conference calls before starting the project. When coordinators had questions, they contacted the staff liaison to the CR3 working group directly by e-mail or telephone. New questions and their corresponding answers were communicated weekly to all site coordinators. The entire project took approximately 20 weeks to complete (October 2011 through February 2012).

Definitions

The following definitions were developed for use in the study.

Eligible patients for CR/SP referral:

- Inpatient: a patient who survived the index hospitalization and who had a qualifying event/diagnosis for referral to CR/SP during the index hospitalization period under review.
- Outpatient: a patient who had a qualifying event/diagnosis for referral to CR/SP within the previous 12 months before the index outpatient visit.

Patients not eligible for CR/SP referral:

- Inpatient: a patient who had a cardiac event/diagnosis (atrial fibrillation, heart failure, or syncope for purposes of this study) during the index hospitalization period under review and no indication for CR/SP referral as specified in the PM.
- Outpatient: a patient who had a cardiac event/diagnosis (atypical chest pain, palpitations, or dyspnea for purposes of this study) during the 12 months before the index outpatient visit and no indication for CR/SP referral as specified in the PM.

CR/SP referral:

- Inpatient: documentation in patient hospital medical records that the patient was referred to an outpatient CR/SP program.

- Outpatient: documentation in patient outpatient clinical medical records that the patient has been referred to an outpatient CR/SP program within 12 months after a qualifying event/diagnosis.

For purposes of this project, documentation in the medical record could include any of the following sources: hospital discharge summaries, office notes, clinical notes and medical records, orders (written/electronic), prescriptions (eg, contact information for CR/SP specialist), or other parts of the clinical record that documents patient information.

Exceptions

Because there are valid reasons why certain patients should not be referred to a CR/SP program, exceptions to the CR/SP measures are allowed. When a clinician is allowed to document exceptions, he or she is given the flexibility to decide whether or not to institute a given intervention/process depending upon the overall benefits and risks to the patient. Exceptions allow clinicians this flexibility without the threat of being "penalized" for not referring a patient to CR/SP. Without the presence of exceptions, potential negative unintended consequences could arise, such as forcing CR/SP on patients who are unstable. Furthermore, analysis of exception rates for quality improvement purposes allows providers and health systems to test the effects of process changes within their practices and communities that may facilitate CR/SP referral. Relatively few patients would be expected to qualify for an exception to CR/SP referral. Such exceptions would generally be limited to factors that may make CR/SP unsafe or ineffective, or lack of accessibility to a CR/SP program within a reasonable commuting distance.

Such exceptions would generally be limited to factors that may make CR/SP unsafe or ineffective, or that otherwise prohibit access to a CR/SP program. Examples of exceptions from referral to CR/SP include:

- Patient exceptions (eg, patient resides in a long-term nursing care facility)
- Medical exceptions (eg, presence of an acute medical condition that makes the patient unstable and unsafe for exercise training)
- System exceptions (eg, lack of an available CR/SP program within 60 minutes of travel time from the patient home)

Since the measures look only at whether patients were referred, not whether they enrolled, patient refusal was not considered to be an exception. If a health care provider recommended CR/SP referral to a patient, the patient refused the referral, and the provider documented the patient refusal, then that encounter was judged to have met the PM since the

provider complied with the expectation to recommend referral to CR/SP.

Data Analyses

Both the Cohen κ statistic and percent agreement were used to measure the intra- and interabstractor reliability for the following qualitative ratings: (1) documented eligibility for CR/SP referral, (2) exception documented for CR/SP referral, and (3) documentation of CR/SP referral. The κ statistic is a chance-corrected index of agreement ranging from -1 to 1 , with $\kappa < 0$ representing observed agreement worse than that due to chance alone. We interpreted a κ greater than 0.75 as excellent, 0.40 to 0.75 as fair to good, and less than 0.40 as poor, following the guidelines of Fleiss et al.²⁰ Unlike the κ statistic, percent agreement does not take into account the agreement occurring by chance but can be informative in situations for which the prevalence of a given response is very high or low and the interpretation based solely on the value of κ may be misleading. This phenomenon, known as the κ paradox,^{21,22} occurs when the observed proportion of agreement is high but the value of the κ statistic is low.

For brevity, intra-abstractor reliability is reported for only 1 of the 2 abstractors (arbitrarily designated “abstractor 1” at each site), and interabstractor reliability only for the initial set of ratings (ie, “time 1”). Stratifying on inpatient versus outpatient setting, reliability was analyzed (1) on the overall group with sites pooled together and (2) within sites and summarizing the site-specific results across the overall group. All analyses were performed using the SAS statistical software package (version 9.2, SAS Institute Inc, Cary, NC).

RESULTS

Characteristics of the 234 inpatients and 211 outpatients (total 445) included in the CR3 Project are shown in Table 2. Most patients from both inpatient and outpatient sites were male, white, and younger than 65 years. A total of 1746 chart reviews were performed for the CR3 Project (415 of the total 445 patient charts [93%] were reviewed as specified in the CR3 Project protocol, each 1 being reviewed 4 times [twice by each abstractor], while incomplete reporting of data resulted in 26 that were reviewed only 3 times each and 4 that were each reviewed only twice).

Participating centers represented various practice types and settings, including the following: rural, suburban, or urban area locations; teaching and non-teaching centers; and single specialty and multispecialty centers. One hospital was from the Pacific Northwest, 4 from the Midwest, 1 from the Northeast,

Table 2 • Sociodemographic Characteristics of Patients in the Cardiac Rehabilitation Referral Reliability Project

Characteristics	Patients From Inpatient Sites (n = 234), %	Patients From Outpatient Sites (n = 211), %
Age, y		
18-39	3	5
40-64	40	50
65-79	45	33
≥ 80	12	12
Sex		
Female	35	36
Race and ethnicity		
White	84	84
Black	8	8
Asian	0.5	0.5
American Indian	1	0.5
Native Hawaiian/ Pacific Islander	0.5	0.5
Other	5.5	5.5
Hispanic ethnicity	0.5	1

and 1 from the Southeast. Three inpatient centers used paper medical records, 5 used electronic medical records, and 2 used both. Outpatient clinics in the CR3 Project were located throughout the Midwest and in the Southeastern part of the United States. Two outpatient clinics used paper medical records and 4 used electronic medical records, while none used both.

Site abstractors involved in the CR3 Project had varying degrees of experience with chart abstraction before participating in the project, with 54% of abstractors having 2 years of experience or less and 23% having less than 1 month of experience. Among the 13 inpatient and outpatient sites, the pair of abstractors had similar levels of experience at 11 sites. Excluding the 2 sites in which the pairs of abstractors had discordant levels of experience, we found that ratings of CR/SP eligibility, exceptions, and referral were not more reliable from abstractors having more than 2 years of experience. Interestingly, some of these ratings reflected more favorable reliability in abstractors having less than 2 years of experience (data not shown). In addition, we did not find a difference between the reliability of the first abstractions and the second abstractions, suggesting that there was no “learning effect” among abstractors. The mean \pm SD

time per chart abstraction, reported by abstractors, was 4.9 ± 3.2 minutes for inpatient abstractions and 6.8 ± 4.7 minutes for outpatient abstractions.

Reliability Outcomes

Inpatient sites (Table 3)

Intra-abtractor reliability analysis of pooled inpatient data demonstrated excellent repeatability for ratings of CR/SP eligibility (100% agreement; $\kappa = 1.00$), CR/SP exceptions (96% agreement; $\kappa = 0.76$), and CR/SP referral (98% agreement; $\kappa = 0.95$). On the basis of site-specific inpatient data, each of the three CR/SP items showed high percent agreement ($\geq 90\%$) at all sites and excellent repeatability ($\kappa \geq 0.75$) in most sites (100% of sites for patient eligibility, 67% for patient exceptions, and 80% for patient referral).

Pooled analysis of inpatient sites demonstrated excellent interabtractor reliability analysis for ratings of CR/SP eligibility (94% agreement; $\kappa = 0.77$) and CR/SP exceptions (97% agreement; $\kappa = 0.79$), and modest agreement between abstractors for rating CR/SP referral (86% agreement; $\kappa = 0.70$). Consistent with the pooled results, site-specific analyses demonstrated excellent interabtractor reliability (as measured by $\kappa \geq 0.75$) in most inpatient sites for ratings of eligibility (71% of sites) and exceptions (67% of sites) but in less than half (40%) of sites for the rating of CR/SP referral.

Outpatient sites (Table 3)

Pooled analyses of the 6 outpatient sites demonstrated excellent intra-abtractor reliability for the 3 ratings of CR/SP eligibility, exceptions, and referral (agreement $\geq 95\%$; $\kappa \geq 0.88$). From site-specific analysis of intra-abtractor reliability, percent agreement $\geq 90\%$ was observed in all 6 sites for ratings of CR/SP eligibility and exceptions, and in all but 1 site for rating of CR/SP referral. Likewise, excellent repeatability ($\kappa \geq 0.75$) was demonstrated in most outpatient sites (100% of sites for rating of eligibility, 67% for exceptions, and 67% for referral).

Regarding interabtractor reliability for outpatient sites, pooled analyses reflected excellent agreement between abstractors for ratings of both CR/SP eligibility ($\kappa = 0.78$) and CR/SP referral ($\kappa = 0.80$), and poor to fair agreement in rating patient exceptions for CR/SP referral ($\kappa = 0.43$). Similarly, according to site-specific results, excellent interabtractor reliability was observed in most (two-thirds) of the outpatient sites for rating CR/SP eligibility and in none of the sites for rating CR/SP exceptions. Interestingly, despite excellent interabtractor agreement for rating CR/SP referral obtained from pooled analysis, site-specific results varied considerably (range of κ across 6 sites, -0.07 to 1.00), with excellent reliability seen in only one-third of outpatient sites (and percent agreement less than 90% in half the sites).

Table 3 • Reliability Testing Results From Pooled and Site-Specific Data Analyses From the Cardiac Rehabilitation Referral Reliability Project for Inpatient and Outpatient Sites

Setting	Reliability	Item	Percent Agreement			
			Pooled Data (No. of Abstractions in Agreement/Total No. of Abstractions)		κ	
			Range Across Study Sites		Pooled Data (95% CI)	Range Across Study Sites
Inpatient	Intrarater	Eligibility	100 (232/232)		1.00	1.00 to 1.00
		Exception	96 (189/196)		0.76 (0.60-0.93)	0.67 to 1.00
		Referral	98 (172/176)		0.95 (0.90-0.99)	0.62 to 1.00
	Interrater	Eligibility	94 (218/231)		0.77 (0.65-0.89)	0.31 to 1.00
		Exception	97 (185/191)		0.79 (0.63-0.95)	0.66 to 0.91
		Referral	86 (148/172)		0.70 (0.59-0.81)	0.23 to 1.00
Outpatient	Intrarater	Eligibility	98 (191/194)		0.94 (0.87-1.00)	0.88 to 1.00
		Exception	99 (146/148)		0.89 (0.74-1.00)	0.70 to 1.00
		Referral	95 (130/137)		0.88 (0.79-0.96)	0.39 to 1.00
	Interrater	Eligibility	94 (190/203)		0.78 (0.66-0.89)	0.46 to 1.00
		Exception	95 (139/146)		0.43 (0.09-0.78)	0.40 to 0.46
		Referral	91 (124/136)		0.80 (0.70-0.91)	-0.07 to 1.00

Abbreviation: CI, confidence interval.

This study demonstrates high reliability for assessing CR/SP eligibility, referral, and exceptions by using the CR/SP outpatient and inpatient PMs. Data abstraction of patient records was performed by abstractors with varying amounts of abstraction experience at various inpatient and outpatient centers, suggesting generalizability of our findings.

Reliability testing is 1 of 3 important steps in developing high value PMs, as outlined by the ACCF/AHA Task Force on PMs.¹⁹ The 3 steps include (1) construction of the measurement set, (2) assessment of feasibility and reliability of data collection, and (3) measurement of clinician performance. Construction of the CR/SP PM set has previously been reported.¹²⁻¹⁷

Our testing generally found high reliability for comparisons between abstractors for the 3 key components of the CR/SP PMs: patient eligibility for CR/SP, patient exceptions to CR/SP referral, and patient referral to CR/SP. We included 2 measures of reliability, each shedding important light on the reliability of PM abstraction: percent agreement and the κ statistic. "Percent agreement" is a helpful assessment of reliability, but given that more than 80% of patients in the study sample were eligible for CR/SP and more than 90% of patients were absent exceptions to CR/SP participation, the percent agreement may have been somewhat inflated, since by chance alone abstractors may have chosen the correct eligibility or exception status.

Conversely, the κ statistic performs best when there is nearly equal chance of study outcomes. When there is a high likelihood of 1 of the 2 outcomes, as in our study (high likelihood of CR/SP eligibility), the results of the κ analyses can underestimate true reliability because of a phenomenon known as the "kappa score paradox" in which there is high percent agreement, yet a low κ score.^{21,22} Indeed, we observed this paradox in some centers. The true reliability of abstracting our PMs most likely lies between the results from the 2 methods of assessment we used. Since the "percent agreement" method generally suggests very high reliability of the CR/SP measures and the κ statistic generally suggests moderate to high reliability, the true reliability of the CR/SP PM would appear overall to be high.

Data abstractors reported that data abstraction time was modest for the inpatient (4.9 minutes) and outpatient (6.8 minutes) CR/SP PMs, and minimal barriers to their abstraction activities. If the CR/SP PMs are included in sets of other PMs, such as the PM set for coronary artery bypass graft surgery, for example, it is likely that efficiencies of scale will result in less time being required for the CR/SP PM assessment.

Limitations

We selected participating centers to reflect variation in the location, size, and type of centers. However, our study is based on the experience of a relatively small number of centers from around the United States that volunteered to be in the project and may not be representative of other centers from different regions.

Lessons Learned

Outpatient abstraction of the CR/SP PM data was more time-consuming and somewhat less reliable than the abstraction of inpatient data. This is explained in large part by the fact that the review of inpatient data is limited to the time of the patient index hospitalization (ie, the time of the cardiac event that qualified them for CR/SP). Review of outpatient data is broader, including a review of records for up to 12 months previous to the outpatient visit and also a review of records for up to 12 month after the outpatient visit, because of the fact that patients are eligible for CR/SP for up to 12 months following their qualifying cardiac event.

Future Directions

Health care provider education through effective communication channels is critically important to help providers understand and document appropriate exceptions to CR/SP referral, as well as the key components of CR/SP referral documentation: (1) that the patient has been referred to CR/SP, (2) that the patient has been given information and guidance to help them enroll in CR/SP, and (3) that the receiving CR/SP program has been sent patient information to expedite CR/SP enrollment).

Current practices and existing ACCF and AHA registries only require documentation that the patient has been referred to a CR/SP program. Published evidence suggests that the use of additional communication components, as specified in the measures, may increase the predictive validity of the measures.²³ Going forward, with the advent of better data collection systems for CR/SP referral and the ability now to track CR/SP enrollment through the AACVPR Outpatient Cardiac Rehabilitation Registry, we expect to be able to test the hypothesis that this more detailed definition of CR/SP referral will increase enrollment in CR/SP. Furthermore, computerized decision support, made more widely available through efforts to enhance the meaningful use of electronic health records, may also provide value by increasing the ability to track and improve the appropriate utilization of CR/SP.

Reliability of CR/SP PM abstraction is high. Data abstractors reported minimal barriers to the abstraction

process and required a relatively small amount of time per patient to carry out the abstractions. These results contribute to published evidence regarding the soundness and generalizability of the CR/SP PMs. Further work will need to be carried out to assess the impact of the CR/SP PMs on patient referral rates and patient outcomes.

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References

- Goel K, Lennon RJ, Tilbury RT, Squires RW, Thomas RJ. Impact of cardiac rehabilitation on mortality and cardiovascular events after percutaneous coronary intervention in the community. *Circulation*. 2011;123:2344-2352.
- Hammill BG, Curtis LH, Schulman KA, Whellan DJ. Relationship between cardiac rehabilitation and long-term risks of death and myocardial infarction among elderly Medicare beneficiaries. *Circulation*. 2010;121:63-70.
- Oldridge NB, Guyatt GH, Fischer ME, Rimm AA. Cardiac rehabilitation after myocardial infarction. Combined experience of randomized clinical trials. *JAMA*. 1988;260:945-950.
- Suaya JA, Stason WB, Ades PA, Normand SL, Shepard DS. Cardiac rehabilitation and survival in older coronary patients. *J Am Coll Cardiol*. 2009;54:25-33.
- Taylor RS, Unal B, Critchley JA, Capewell S. Mortality reductions in patients receiving exercise-based cardiac rehabilitation: how much can be attributed to cardiovascular risk factor improvements? *Eur J Cardiovasc Prev Rehabil*. 2006;13:369-374.
- Williams MA, Ades PA, Hamm LF, et al. Clinical evidence for a health benefit from cardiac rehabilitation: an update. *Am Heart J*. 2006;152:835-841.
- Witt BJ, Jacobsen SJ, Weston SA, et al. Cardiac rehabilitation after myocardial infarction in the community. *J Am Coll Cardiol*. 2004;44:988-996.
- Centers for Disease Control and Prevention. Receipt of cardiac rehabilitation services among heart attack survivors—19 states and the District of Columbia, 2001. *MMWR Morb Mortal Wkly Rep*. 2003;52:1072-1075.
- Suaya JA, Shepard DS, Normand SL, Ades PA, Prottas J, Stason WB. Use of cardiac rehabilitation by Medicare beneficiaries after myocardial infarction or coronary bypass surgery. *Circulation*. 2007;116:1653-1662.
- Thomas RJ, Miller NH, Lamendola C, et al. National survey on gender differences in cardiac rehabilitation programs. Patient characteristics and enrollment patterns. *J Cardiopulm Rehabil*. 1996;16:402-412.
- Fonarow GC, Abraham WT, Albert NM, et al. Association between performance measures and clinical outcomes for patients hospitalized with heart failure. *JAMA*. 2007;297:61-70.
- Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J. AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services. *J Cardiopulm Rehabil Prev*. 2007;27:260-290.
- Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J. AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services. *Circulation*. 2007;116:1611-1642.
- Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J. AACVPR/ACCF/AHA 2010 update: performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services. *J Am Coll Cardiol*. 2010;56:1159-1167.
- Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J. AACVPR/ACCF/AHA 2010 update: performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services. *J Cardiopulm Rehabil Prev*. 2010;30:279-288.
- Thomas RJ, King M, Lui K, Oldridge N, Pina IL, Spertus J. AACVPR/ACCF/AHA 2010 update: performance measures on cardiac rehabilitation for referral to cardiac rehabilitation/secondary prevention services. *Circulation*. 2010;122:1342-1350.
- Thomas RJ, King M, Lui K, et al. AACVPR/ACC/AHA 2007 performance measures on cardiac rehabilitation for referral to and delivery of cardiac rehabilitation/secondary prevention services. *J Am Coll Cardiol*. 2007;50:1400-1433.
- Spertus JA, Bonow RO, Chan P, et al. ACCF/AHA new insights into the methodology of performance measurement. *Circulation*. 2010;122:2091-2106.
- Spertus JA, Eagle KA, Krumholz HM, Mitchell KR, Normand SL. American College of Cardiology and American Heart Association methodology for the selection and creation of performance measures for quantifying the quality of cardiovascular care. *J Am Coll Cardiol*. 2005;45:1147-1156.
- Fleiss JL, Levin B, Cho Park M. *Statistical Methods for Rates and Proportions*. Hoboken, NJ: Wiley Interscience; 1981:352.
- Feinstein AR, Cicchetti DV. High agreement but low kappa: I. The problems of two paradoxes. *J Clin Epidemiol*. 1990;43:543-549.
- Lantz CA, Nebenzahl E. Behavior and interpretation of the kappa statistic: resolution of the two paradoxes. *J Clin Epidemiol*. 1996;49:431-434.
- Grace SL, Russell KL, Reid RD, et al. Effect of cardiac rehabilitation referral strategies on utilization rates: a prospective, controlled study. *Arch Intern Med*. 2011;171:235-241.