

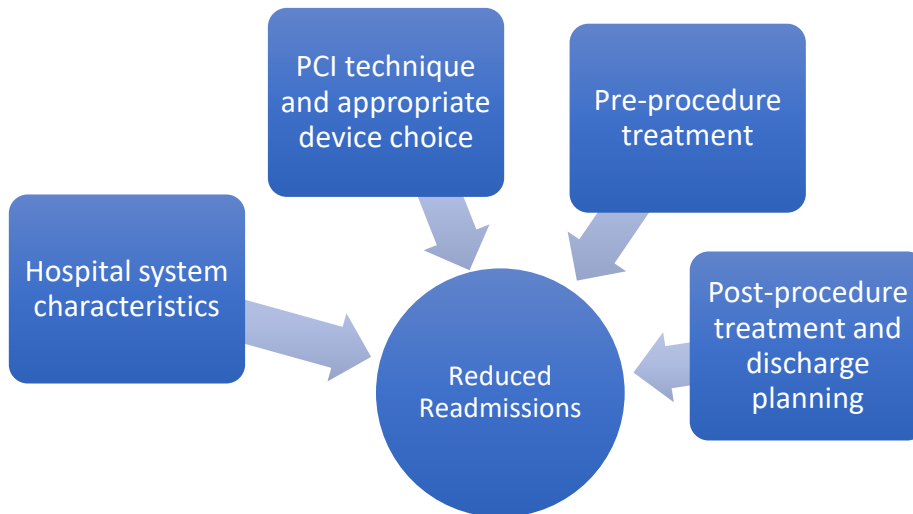
CBE #0695 Hospital 30-Day Risk-Standardized Readmission Rates following Percutaneous Coronary Intervention (PCI)

Logic Model

The goal of this measure is to improve patient outcomes by providing patients, physicians, and hospitals with information about hospital-level RSRRS following hospitalization for PCI. Measurement of patient outcomes allows for a broad view of quality of care that encompasses more than what can be captured by individual process-of-care measures. Complex and critical aspects of care, such as communication between providers, prevention of and response to complications, patient safety, and coordinated transitions to the outpatient environment, all contribute to patient outcomes but are difficult to measure by individual process measures. The goal of outcomes measurement is to risk-adjust for patients' conditions at the time of hospital admission and then evaluate patient outcomes. This measure was developed to identify institutions' whose performance is better or worse than would be expected based on their patient case mix, and therefore promote hospital quality improvement and better inform consumers about care quality.

This measure describes hospital-level readmission rates following PCI, with the overriding goal to reduce preventable readmissions to best-in-class and reduce readmissions following hospitalization for relevant conditions to best-in-class. The expectation is that providing this information to hospitals, coupled with public reporting of hospitals' results, will drive internal hospital quality improvement efforts to focus efforts on reducing readmissions following hospitalization for PCI. This perspective may motivate hospitals to look for opportunities not only within the organization, but also to better coordinate the transition of care from the inpatient to the outpatient arena.

Figure 1. Logic Model



Reliability Testing Results

Table 1. 30-Day Readmission Model (GLM) Risk Factor Frequency by Year of Discharge (%)

Description	2006 (Validation) N=117,375 in 618 Hospitals	2007 (Development) N=128,745 in 766 Hospitals	2010-2011 N=277,512 in 1,197 Hospitals
Age/10 (SD)	74.7 (6.5)	74.7 (6.6)	75.12 (6.9)
Female	41.8	41.2	39.9
BMI/5			
Unknown	0.1	0.1	0.2
Mean (SD)	28.5 (5.7)	28.6 (5.8)	(5.4)
Heart failure - previous history	13.8	13.8	16.6
Previous valvular surgery	1.6	1.7	2.2
Cerebrovascular Disease	16.0	16.0	17.8
Peripheral Vascular Disease	15.6	15.6	16.8
Chronic Lung Disease	18.6	18.6	18.9

CBE #0695 Hospital 30-Day Risk-Standardized Readmission Rates following Percutaneous Coronary Intervention (PCI)

Description	2006 (Validation) N=117,375 in 618 Hospitals	2007 (Development) N=128,745 in 766 Hospitals	2010-2011 N=277,512 in 1,197 Hospitals
Diabetes			
Non-Insulin diabetes	22.4	22.6	22.9
Insulin diabetes	9.8	10.1	13.1
Glomerular Filtration Rate (GFR)			
GFR: 0=Not measured	4.0	3.7	5.7
GFR: 1="0<=GFR<30"	4.0	4.3	5.1
GFR: 2="30<=GFR<60"	36.6	37.2	32.8
GFR: 4="GFR>=90"	8.3	8.3	11.8
Renal Failure - Dialysis	1.6	1.9	2.7
Hypertension	81.8	82.9	86.9
History of Tobacco Use	11.8	11.9	13.6
Previous PCI	35.9	37.2	40.7
Heart failure - current status	12.0	11.9	13.4
Symptoms present on admission			
No MI on admission	75.4	73.5	64.6
MI after 24 hours on admission	5.7	6.0	2.5
Ejection Fraction (EF) Percentage			
EFP: 1=Not measured	28.3	28.5	29.7
EFP: 2="0<=EFP<30"	3.9	3.9	4.6
EFP: 3="30<=EFP<45"	11.9	11.9	12.1
PCI status			
PCI status: 2=Urgent	36.0	36.4	44.4
PCI status: 3=Emergency	11.1	12.2	14.9
PCI status: 4=Salvage	0.1	0.1	0.1
Highest Risk Lesion – location			
pRCA/mLAD/pCIRC	38.2	37.9	37.9
pLAD	17.6	17.3	16.9
Left main	2.4	2.4	3.2
Highest Pre-Procedure TIMI Flow: None	7.8	8.7	11.3

Method of Validity Testing

Table 2. 30-Day Readmission Model Performance: Results Based on the GLM

Indices	Development Sample	Validation Sample
Year	2007	2006
N	128745	117375
RR Calibration (γ_0, γ_1) ¹	11.1% (0.00, 1.00)	10.7% (-0.06, 0.99)
Discrimination- Adjusted R-Square ²	0.07	0.06
Discrimination -Predictive Ability ³ (lowest decile %, highest decile)	(4.05, 25.08)	(3.80, 23.80)
Discrimination – ROC	0.665	0.663
Residuals Lack of Fit (Pearson Residual Fall %)		
<-2	0.00	0.00
[-2, 0)	88.86	89.33
[0, 2)	2.21	1.85
[2+	8.93	8.82
Model χ^2 [Number of Covariates] ⁴	4448.36 [31]	3812.62 [31]

CBE #0695 Hospital 30-Day Risk-Standardized Readmission Rates following Percutaneous Coronary Intervention (PCI)

Conceptual Model

Table 3. PCI Readmission Candidate Model Variables

Variable	Odds Ratio (95% CI)
Sex	
Male	Reference
Female	1.101 (0.966 - 1.218)
Reason for admission	
Admitted for procedure	Reference
Cardiac heart failure	1.733 (1.485 - 2.023)
Other	1.211 (1.988 - 1.459)
NYHA class	
I/II	Reference
III	1.388 (1.254 - 1.536)
IV	2.286 (1.866 - 2.802)
Prior CABG	0.797 (0.712 - 0.892)
Abnormal conduction	
No	Reference
Yes-left bundle	1.334 (1.183 - 1.504)
Yes-other	1.181 (1.049 - 1.329)
ICD type	
Single chamber or S-ICD	Reference
Dual chamber	1.372 (1.206 - 1.560)
CRT-D	1.304 (1.136 - 1.497)
Sodium	
<135	1.182 (1.025 - 1.363)
135-145	Reference
>145	1.174 (1.330 - 2.339)
Hemoglobin (5 g/dl)	0.617 (0.547 - 0.696)
BUN (10 mg/dl)	1.134 (1.102 - 1.167)

CBE #0695 Hospital 30-Day Risk-Standardized Readmission Rates following Percutaneous Coronary Intervention (PCI)

Table 4. PCI Readmission Final Model Variables

Description (n) Variable	Code
Demographic	
(1) Age	Age
(2) Female	FEMALE
History and Risk Factors	
(3) Body Mass Index	BMI
(4) Heart failure-previous history	PRCHF
(5) Previous valvular surgery	PRVALVE
(6) Cerebrovascular Disease	CVD
(7) Peripheral Vascular Disease	PVD
(8) Chronic Lung Disease	CLD
(9) Diabetes	
None	Reference
Non-insulin diabetes	NEWDIAB1
Insulin diabetes	NEWDIAB2
(10) Glomerular Filtration Rate (GFR)	
Not measured	GFRGRP0
GFR<30	GFRGRP1
30≤GFR<60	GFRGRP2
60≤GFR<90	Reference
GFR≥90	GFRGRP4
(11) Renal failure - dialysis	DIALYSIS
(12) Hypertension	HYPERTN
(13) History of tobacco use	TOBACCO
(14) Previous PCI	PrPCI
Cardiac Status	
(15) Heart failure – current status	CHF
(16) Symptoms present on admission	
No MI	ADMSX1
MI within 24 hours	Reference
MI after 24 hours	ADMSX3
Cath Lab Visit	
(17) Ejection Fraction (EF) Percentage	
Not measured	HDEFGRP1
EF<30	HDEFGRP2
30≤EF<45	HDEFGRP3
EF≥45	Reference
PCI Procedure	
(18) PCI status	
Elective	Reference
Urgent	PCIS2
Emergency	PCIS3
Salvage	PCIS4
(19) Highest risk lesion – location	
pRCA/mLAD/pCIRC	NLESLOC1
pLAD	NLESLOC2
Left main	NLESLOC3
Other	Reference
(20) Highest pre-procedure TIMI flow: none	

CBE #0695 Hospital 30-Day Risk-Standardized Readmission Rates following Percutaneous Coronary Intervention (PCI)

Risk Factor Statistical Results

Table 5. 30-Day Readmission (2007 Development Sample – HGLM Results [ROC=0.677])

Description	Estimate	Standard Error	T-Value	Pr > T-Value	Odds Ratio (95% CI)
Intercept	-3.84	0.15	-26.38	0	
Age/10	0.23	0.01	15.67	0	1.26 (1.22, 1.29)
Female	0.25	0.02	13.42	0	1.29 (1.24, 1.33)
BMI/5	-0.13	0.01	-9.27	0	0.88 (0.86, 0.90)
Heart failure - previous history	0.27	0.03	10.68	0	1.32 (1.25, 1.38)
Previous valvular surgery	0.2	0.06	3.28	0	1.23 (1.09, 1.38)
Cerebrovascular Disease	0.19	0.02	8.37	0	1.21 (1.16, 1.27)
Peripheral Vascular Disease	0.2	0.02	8.38	0	1.22 (1.16, 1.28)
Chronic Lung Disease	0.33	0.02	15.11	0	1.40 (1.34, 1.46)
Non-Insulin diabetes	0.11	0.02	5.11	0	1.12 (1.07, 1.17)
Insulin diabetes	0.32	0.03	11.18	0	1.38 (1.30, 1.46)
GFR: 0=Not measured	0.03	0.05	0.58	0.56	1.03 (0.93, 1.14)
GFR: 1="0<=GFR<30"	0.57	0.04	12.72	0	1.76 (1.62, 1.92)
GFR: 2="30<=GFR<60"	0.16	0.02	7.75	0	1.17 (1.13, 1.22)
GFR: 4="GFR>=90"	0.15	0.04	4.2	0	1.16 (1.08, 1.24)
Renal failure - dialysis	0.38	0.06	6.29	0	1.46 (1.40, 1.65)
Hypertension	0.08	0.03	3.08	0	1.08 (1.03, 1.14)
History of tobacco use	-0.05	0.01	-3.38	0	0.95 (0.93, 0.98)
Previous PCI	-0.08	0.02	-4.26	0	0.92 (0.89, 0.96)
Heart failure - current status	0.3	0.03	11.27	0	1.35 (1.28, 1.42)
No MI on admission	-0.13	0.03	-4.7	0	0.88 (0.83, 0.93)
MI after 24 hours on admission	0.1	0.04	2.73	0.01	1.11 (1.03, 1.19)
EFP: 1=Not measured	0.19	0.02	8.76	0	1.21 (1.16, 1.26)
EFP: 2="0<=EFP<30"	0.36	0.04	8.74	0	1.43 (1.32, 1.55)
EFP: 3="30<=EFP<45"	0.21	0.03	7.66	0	1.24 (1.17, 1.31)
PCI status: 2=Urgent	0.36	0.02	16.4	0	1.43 (1.37, 1.50)
PCI status: 3=Emergency	0.4	0.04	11	0	1.49 (1.39, 1.60)
PCI status: 4=Salvage	0.59	0.2	3.01	0	1.81 (1.23, 2.65)

CBE #0695 Hospital 30-Day Risk-Standardized Readmission Rates following Percutaneous Coronary Intervention (PCI)

pRCA/mLAD/pCIRC	0.04	0.02	2.12	0.03	1.04 (1.00, 1.09)
pLAD	0.12	0.03	4.72	0	1.13 (1.07, 1.19)
Left main	0.15	0.06	2.77	0.01	1.17 (1.05, 1.30)
Highest pre-procedure TIMI flow: none	0.09	0.03	2.64	0.01	1.09 (1.02, 1.17)

Calibration and Discrimination

Figure 1. Risk decile plot, 2010-2011 study sample.

