

Supplementary Online Content

Gupta A, Allen LA, Bhatt DL, et al. Association of the hospital readmissions reduction program implementation with readmission and mortality outcomes in heart failure. *JAMA Cardiol*. Published online November 12, 2017. 10.1001/jamacardio.2017.4265

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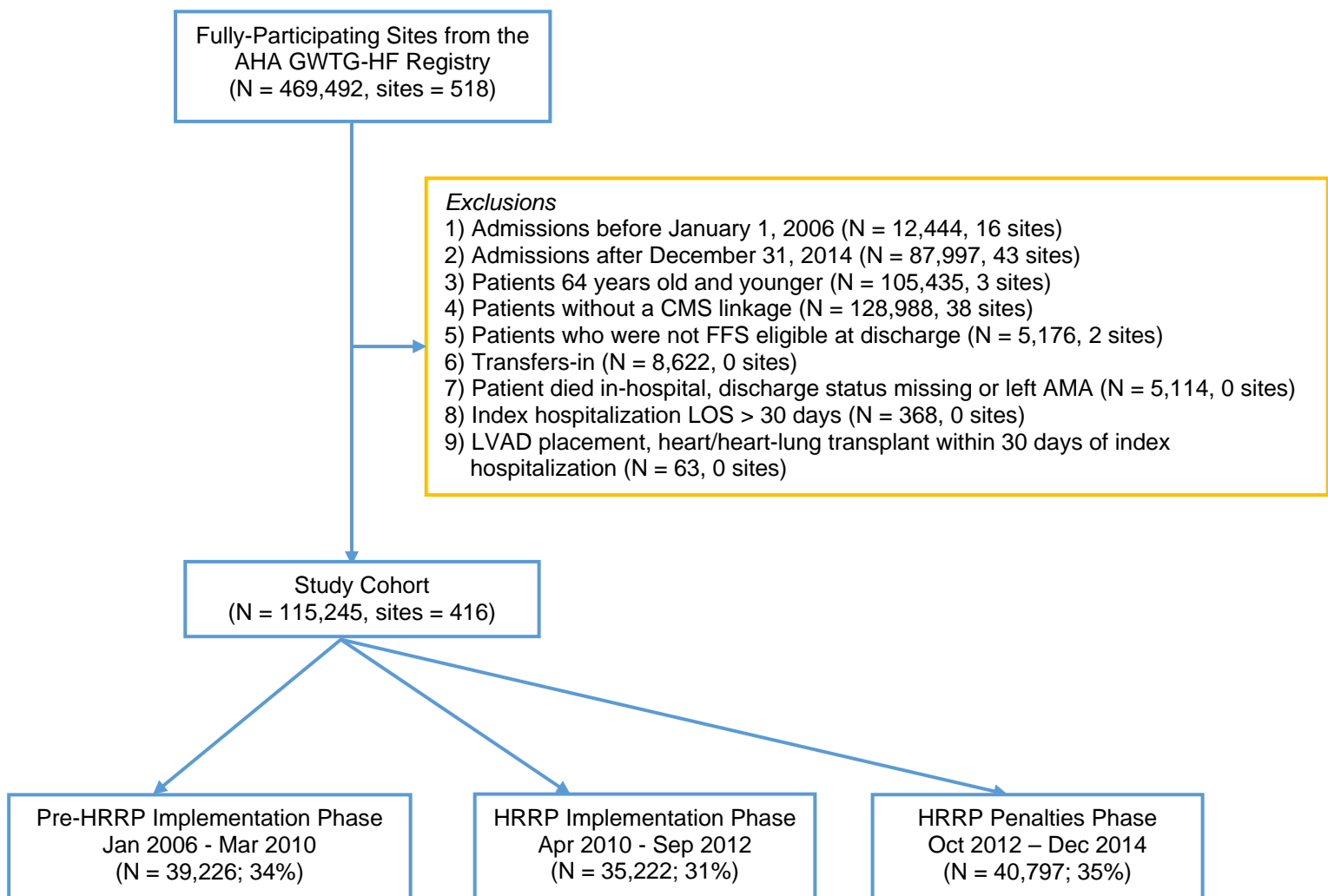
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This supplementary material has been provided by the authors to give readers additional information about their work.

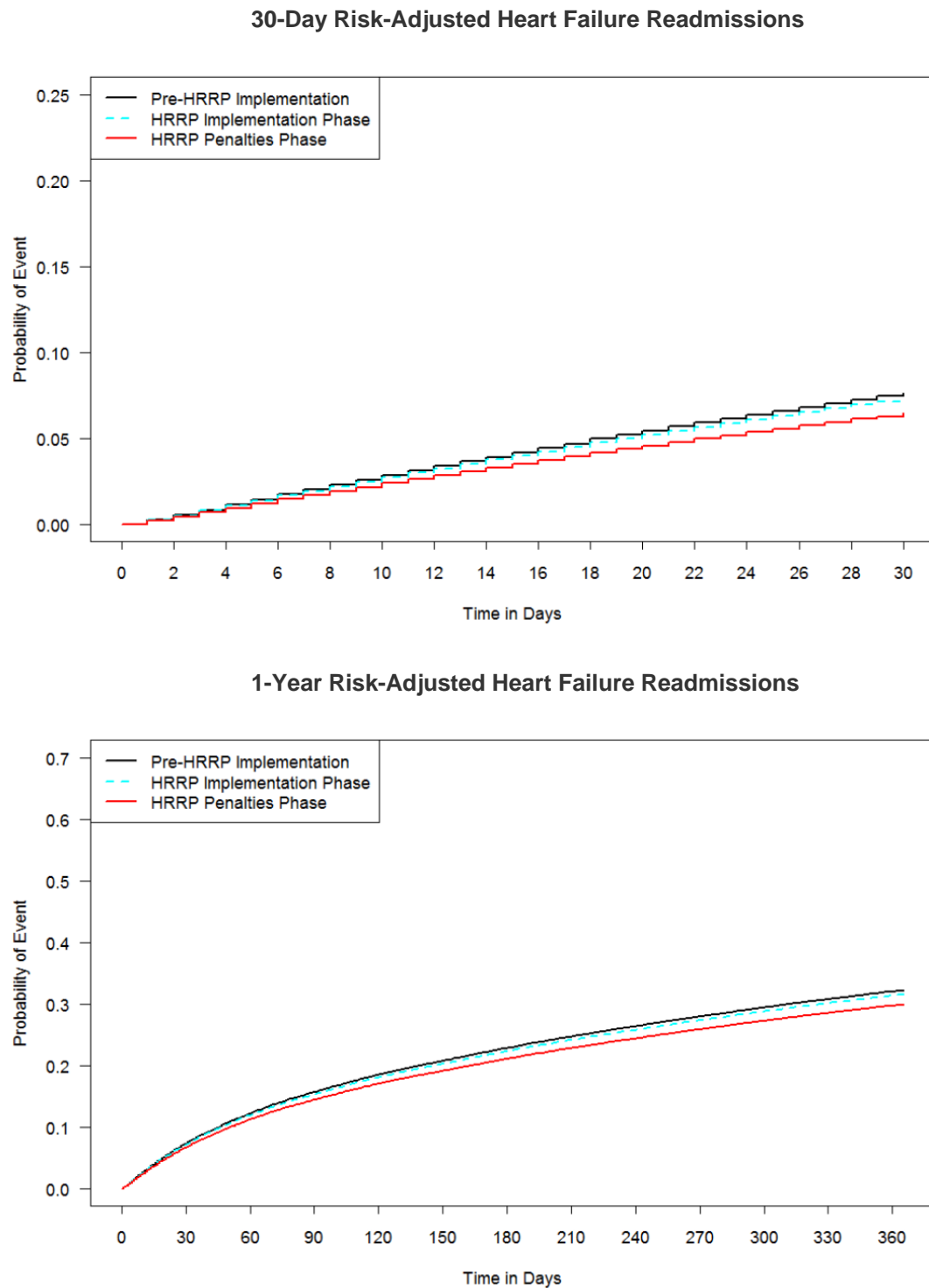
eFigure 1. Flow Diagram of Patient Selection for the Study Cohort



There were 226 (0.57%), 87 (0.25%), and 55 (0.13%) exclusions from the study cohort due to LOS > 30 days in the pre-HRRP implementation phase, HRRP implementation phase, and HRRP penalties phase, respectively. There were 1,218 (3.01%), 1,119 (3.08%), 1,401 (3.32%) exclusions from the study cohort due to in-hospital mortality in the pre-HRRP implementation phase, HRRP implementation phase, and HRRP penalties phase, respectively.

Abbreviations: AHA, American Heart Association; AMA, Against Medical Advice; CMS, Centers for Medicare and Medicaid; FFS, Fee-For-Service; GWTG-HF, Get With The Guidelines-Heart Failure; HRRP, Hospital Readmissions Reduction Program; LOS, Length of Stay; LVAD, Left Ventricular Assist Device

eFigure 2. Event Curves for Risk-Adjusted Heart Failure-Specific Readmissions by the HRRP Time Periods



eFigure 2 shows that the event probability of the 30-day and 1-year risk-adjusted heart failure-specific readmissions decreased in the HRRP penalties phase (red line) compared with the pre-HRRP implementation phase (black line). Abbreviation: HRRP, Hospital Readmissions Reduction Program

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eTable 1. Heart Failure-Specific Risk-Adjusted Readmission Hazards

	Pre-HRRP Implementation Phase	HRRP Implementation Phase	p- value ^a	HRRP Penalties Phase	p-value ^b
30-Day Heart Failure-Specific Readmissions, HR (95% CI)	Reference	0.96 (0.88 to 1.04)	.32	0.84 (0.78 to 0.92)	.0001
1-year Heart Failure-Specific Readmissions, HR (95% CI)	Reference	0.98 (0.93 to 1.03)	.35	0.91 (0.86 to 0.97)	.002

^ap-value for comparison of the HRRP implementation phase with the pre-HRRP implementation phase

^bp-value for comparison of the HRRP penalty phase with the pre-HRRP implementation phase

Abbreviation: HRRP, Hospital Readmissions Reduction Program

eTable 2. Risk-Adjusted All-Cause Readmissions and Mortality After Including Transferred Patients

eTable 2a. Time Trends After Including Transferred Patients		
	Readmissions	Mortality
Pre-HRRP Implementation Phase		
Slope (95% CI)	0.009 (-0.005, 0.023)	-0.018 (-0.025, -0.011)
HRRP Implementation Phase		
Slope (95% CI)	-0.007 (-0.029, 0.014)	0.007 (-0.002, 0.017)
Change in Slope from Pre-HRRP Phase (95% CI)	-0.016 (-0.042, 0.010)	0.025 (0.013, 0.037)
HRRP Penalties Phase		
Slope (95% CI)	-0.038 (-0.073, -0.003)	0.021 (0.009, 0.034)
Change in Slope from Pre-HRRP Phase (95% CI)	-0.046 (-0.084, -0.009)	0.039 (0.025, 0.053)
Change in Slope from Implementation Phase (95% CI)	-0.030 (-0.071, 0.011)	0.014 (-0.001, 0.029)

eTable 2b. Hazards of Risk-Adjusted Readmissions and Mortality After Including Transferred Patients					
	Pre-HRRP Implementation Phase	HRRP Implementation Phase	p-value^a	HRRP Penalties Phase	p-value^b
30-Day Outcomes					
Readmissions, HR (95% CI)	Reference	1.01 (0.96 to 1.06)	.79	0.91 (0.87 to 0.96)	.0001
Mortality, HR (95% CI)	Reference	1.15 (1.08 to 1.24)	<.0001	1.22 (1.13 to 1.31)	<.0001
1-year Outcomes					
Readmissions, HR (95% CI)	Reference	1.01 (0.98 to 1.05)	.45	0.92 (0.89 to 0.96)	<.0001
Mortality, HR (95% CI)	Reference	1.11 (1.08 to 1.15)	<.0001	1.11 (1.07 to 1.16)	<.0001

Slopes are scaled to represent yearly change in rate.

^ap-value for comparison of the HRRP implementation phase with the pre-HRRP implementation phase

^bp-value for comparison of the HRRP penalty phase with the pre-HRRP implementation phase

Abbreviations: CI, Confidence Interval; HR, Hazard Ratio; HRRP, Hospital Readmissions Reduction Program

eTable 3. Risk-Adjusted All-Cause Readmissions and Mortality in Patients From Hospital Sites Continuously Participating in GWTG-HF Registry

eTable 3a. Time Trends After Including Patients from Continuously Participating Hospitals		
	Readmissions	Mortality
Pre-HRRP Implementation Phase		
Slope (95% CI)	0.012 (-0.005, 0.029)	-0.029 (-0.041, -0.017)
HRRP Implementation Phase		
Slope (95% CI)	0.007 (-0.014, 0.027)	0.008 (-0.004, 0.021)
Change in Slope from Pre-HRRP Phase (95% CI)	-0.005 (-0.032, 0.022)	0.037 (0.020, 0.055)
HRRP Penalties Phase		
Slope (95% CI)	-0.076 (-0.120, -0.031)	0.033 (0.015, 0.051)
Change in Slope from Pre-HRRP Phase (95% CI)	-0.087 (-0.135, -0.040)	0.062 (0.041, 0.083)
Change in Slope from Implementation Phase (95% CI)	-0.082 (-0.131, -0.033)	0.024 (0.003, 0.046)

eTable 3b. Hazards of Risk-Adjusted Readmissions and Mortality After Including Patients from Continuously Participating Hospitals					
	Pre-HRRP Implementation Phase	HRRP Implementation Phase	p-value^a	HRRP Penalties Phase	p-value^b
30-Day Outcomes					
Readmissions, HR (95% CI)	Reference	1.01 (0.96 to 1.07)	.62	0.91 (0.87 to 0.96)	.0005
Mortality, HR (95% CI)	Reference	1.17 (1.08 to 1.27)	0.0002	1.23 (1.13 to 1.35)	<.0001
1-year Outcomes					
Readmissions, HR (95% CI)	Reference	1.03 (0.99 to 1.06)	.15	0.93 (0.89 to 0.97)	.0005
Mortality, HR (95% CI)	Reference	1.10 (1.06 to 1.14)	<.0001	1.10 (1.06 to 1.15)	<.0001

Slopes are scaled to represent yearly change in rate.

^ap-value for comparison of the HRRP implementation phase with the pre-HRRP implementation phase

^bp-value for comparison of the HRRP penalty phase with the pre-HRRP implementation phase

Abbreviations: CI, Confidence Interval; HR, Hazard Ratio; HRRP, Hospital Readmissions Reduction Program

eTable 4. Risk-Adjusted All-Cause Readmissions and Mortality After Excluding Patients Discharged to Hospice

	Pre-HRRP Implementation Phase	HRRP Implementation Phase	p- value ^a	HRRP Penalties Phase	p- value ^b
30-Day Outcomes					
Readmissions, HR (95% CI)	Reference	1.01 (0.96 to 1.06)	.79	0.92 (0.88 to 0.96)	.0002
Mortality, HR (95% CI)	Reference	1.07 (0.99 to 1.16)	.07	1.03 (0.94 to 1.13)	.54
1-year Outcomes					
Readmissions, HR (95% CI)	Reference	1.02 (0.98 to 1.05)	.39	0.93 (0.90 to 0.96)	<.0001
Mortality, HR (95% CI)	Reference	1.08 (1.04 to 1.12)	<.0001	1.05 (1.01 to 1.09)	.01

^ap-value for comparison of the HRRP implementation phase with the pre-HRRP implementation phase

^bp-value for comparison of the HRRP penalty phase with the pre-HRRP implementation phase

Abbreviation: HRRP, Hospital Readmissions Reduction Program

eTable 5. Time Interactions by Race, Teaching Hospital Status, and Rural or Urban Hospital Location for 30-day Risk-Adjusted Readmissions and Mortality

eTable 5a. Race*Time Interactions (Reference: Pre-HRRP Phase)			
Outcome	OR	95% CI	P-value
30-Day All-cause Readmissions	No Significant Interaction		0.3255
30-Day Heart Failure Readmissions	No Significant Interaction		0.0586
30-Day Mortality			0.0344
Implementation of HRRP - White	1.17	(1.08 to 1.27)	0.0001
Implementation of HRRP - Black	1.05	(0.85 to 1.29)	0.6452
Implementation of HRRP - Hispanic	1.42	(1.07 to 1.89)	0.0160
Implementation of HRRP - Asian	0.55	(0.33 to 0.91)	0.0205
Implementation of HRRP - Other	1.01	(0.62 to 1.66)	0.9619
Penalty Phase of HRRP - White	1.18	(1.09 to 1.27)	<.0001
Penalty Phase of HRRP - Black	1.13	(0.89 to 1.44)	0.3203
Penalty Phase of HRRP - Hispanic	1.49	(1.05 to 2.11)	0.0241
Penalty Phase of HRRP - Asian	0.91	(0.61 to 1.37)	0.6572
Penalty Phase of HRRP - Other	1.33	(0.89 to 1.99)	0.1623

eTable 5b. Teaching*Time Interactions (Reference: Pre-HRRP Phase)			
Outcome	OR	95% CI	P-value
30-Day All-cause Readmissions	No Significant Interaction		0.0651
30-Day Heart Failure Readmissions	No Significant Interaction		0.3012
30-Day Mortality	No Significant Interaction		0.0830

eTable 5c. Rural*Time Interactions (Reference: Pre-HRRP Phase)			
Outcome	OR	95% CI	P-value
30-Day All-cause Readmissions	No Significant Interaction		0.9683
30-Day Heart Failure Readmissions	No Significant Interaction		0.6203
30-Day Mortality			0.0166
Implementation of HRRP - Rural	1.17	(0.93 to 1.46)	0.1883
Implementation of HRRP - Urban	1.15	(1.07 to 1.24)	0.0001
Penalty Phase of HRRP - Rural	0.96	(0.81 to 1.15)	0.6775
Penalty Phase of HRRP - Urban	1.20	(1.12 to 1.30)	<.0001

Abbreviation: HRRP, Hospital Readmissions Reduction Program

eTable 6. Time Interactions by Race, Teaching Hospital Status, and Rural or Urban Hospital Location for 1-year Risk-Adjusted Readmissions and Mortality

eTable 6a. Race*Time Interactions (Reference: Pre-HRRP Phase)			
Outcome	OR	95% CI	P-value
1-Year All-cause Readmissions	No Significant Interaction		0.5897
1-Year Heart Failure Readmissions	No Significant Interaction		0.1474
1-Year Mortality	No Significant Interaction		0.1951

eTable 6b. Teaching*Time Interactions (Reference: Pre-HRRP Phase)			
Outcome	OR	95% CI	P-value
1-Year All-cause Readmissions			0.0354
Implementation of HRRP - Teaching	1.00	(0.95 to 1.05)	0.9990
Implementation of HRRP - Non-Teaching	1.03	(0.98 to 1.09)	0.2494
Penalty Phase of HRRP - Teaching	0.95	(0.90 to 0.99)	0.0199
Penalty Phase of HRRP - Non-Teaching	0.89	(0.85 to 0.94)	0.0001
1-Year Heart Failure Readmissions			0.0302
Implementation of HRRP - Teaching	0.95	(0.89 to 1.02)	0.1714
Implementation of HRRP - Non-Teaching	1.01	(0.94 to 1.09)	0.7851
Penalty Phase of HRRP - Teaching	0.94	(0.88 to 1.01)	0.1046
Penalty Phase of HRRP - Non-Teaching	0.88	(0.80 to 0.95)	0.0027
1-Year Mortality	No Significant Interaction		0.3761

eTable 6c. Rural*Time Interactions (Reference: Pre-HRRP Phase)			
Outcome	OR	95% CI	P-value
1-Year All-cause Readmissions	No Significant Interaction		0.5577
1-Year Heart Failure Readmissions	No Significant Interaction		0.4241
1-Year Mortality	No Significant Interaction		0.5690

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