Supplementary Online Content

Liu M, Sandhu S, Joynt Maddox KE, Wadhera RK. Health Equity Adjustment and Hospital Performance in the Medicare Value-Based Purchasing Program. *JAMA*. Published online March 27, 2024. doi:10.1001/jama.2024.2440

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

eMethods 1. Methodology for Estimating HVBP Payment Adjustments

The HVBP determines payment adjustments by withholding 2% of base operating Diagnosis-Related Group (DRG) payments from all participating hospitals and then redistributing this pool back to hospitals based on their TPS. An HVBP slope is calculated every fiscal year to ensure budget neutrality and applied to the TPS to determine a payment adjustment factor for each hospital. A hospital receives a bonus (positive payment adjustment) or penalty (negative payment adjustment) if its HVBP payment adjustment factor is greater or smaller than the 2% withheld by the program, respectively. The HVBP payment adjustment in dollar amounts for each hospital is calculated by multiplying its payment adjustment factor by its total Medicare base operating payment.

The Medicare base operating payment rate includes a labor-related and non-labor-related share. The labor-related share is adjusted by an area-specific wage index to reflect variations in area-specific labor costs. The sum of the adjusted labor-related share and the non-labor-related share is equal to a wage-adjusted standardized amount. For fiscal year 2021, hospitals in areas with wage indices greater than 1, the labor-related share was equal to $4,071.57 and the non-labor-related share was $1,889.74. The corresponding numbers for hospitals in areas with wage indices less than or equal to 1 were $3,696.01 and $2,265.30, respectively. The wage-adjusted standardized amount is then multiplied by the total relative DRG weights for each hospital to estimate the total Medicare base operating payment in fiscal year 2021.

eMethods 2. Logistic Exchange Function to Calculate Underserved Multiplier

The underserved multiplier is calculated by applying the below logistic function to the ranked proportion of the number of inpatient stays for patients with dual-eligible status. This proportion was calculated as the proportion of all Medicare Fee-For-Service and Medicare Advantage inpatient stays in which a patient was dually eligible for both Medicare and full Medicaid benefits. Inpatient stays were evaluated during the calendar year two years before the applicable program year (e.g., January 1, 2019, to December 31, 2019, for fiscal year 2021).

$$Underserved\ Multiplier = \frac{1}{1 + e^{-(-5+10*\frac{DES\ Rank}{Max\ DES\ Rank})}}$$

eMethods 3. Detailed Description of Study Covariates

Patient mix characteristics included top (most medically complex) versus other quintiles of CMI, safety-net status, and high-proportion Black status. Safety-net status was defined as hospitals in the top quartile of the Disproportionate Share Hospital index and high-proportion Black status was defined as hospitals in the top quintile of Medicare hospitalizations for Black patients. Structural characteristics included size (small [<100 beds], medium [100-399 beds], or large [400 beds]), ownership (for-profit, non-profit, or public), and teaching status. Geographical characteristics included US Census Bureau region (Northeast, Midwest, South, or West), rurality (urban or rural), and state-level Medicaid expansion status.

eTable 1. Fiscal Year 2021 Performance Period of HVBP Performance Domain Measures

Measure Description	Baseline Period	Performance Period
Clinical Outcomes Domain		
Acute Myocardial Infarction (AMI) 30-Day Mortality Rate	July 1, 2011 - June 30, 2014	July 1, 2016 - June 30, 2019
Heart Failure (HF) 30-Day Mortality Rate	July 1, 2011 - June 30, 2014	July 1, 2016 - June 30, 2019
Pneumonia (PN) 30-Day Mortality Rate	July 1, 2012 - June 30, 2015	Sep. 1, 2017 - June 30, 2019
Total Hip Arthroplasty (THA)/Total Knee Arthroplasty Complication Rate (TKA)	April 1, 2011 - March 31, 2014	April 1, 2016 - March 31, 2019
Chronic Obstructive Pulmonary Disease (COPD) 30-Day Mortality Rate	July 1, 2011 - June 30, 2014	July 1, 2016 - June 30, 2019
Person and Community Engagement Domain		
Communication with Nurses	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Communication with Doctors	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Responsiveness of Hospital Staff	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Communication about Medicines	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Cleanliness and Quietness of Hospital Environment	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Discharge Information	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Overall Rating of Hospital	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Care Transition	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Safety Domain		
Catheter-Associated Urinary Tract Infection	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Central Line-Associated Blood Stream Infection	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Clostridium Difficile Infection	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Methicillin-Resistant Staphylococcus Aureus Bacteremia	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Surgical Site Infection - Colon Surgery	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Surgical Site Infection - Abdominal Hysterectomy	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019
Efficiency and Cost Reduction Domain		
Medicare Spending Per Beneficiary	Jan. 1, 2017 - Dec. 31, 2017	Jan. 1, 2019 - Dec. 31, 2019

eTable 2. Proportion of Dual-Eligible Inpatient Stays by Hospital Characteristics

Characteristic	Dual-Eligible Inpatient Stays, Mean % (SD)
Overall	27.7 (13.7)
Patient Mix Characteristics	
Case Mix Index	
Quintile 2-5	28.4 (14.2)
Quintile 1 (Most Complex)	24.5 (11.1)
Safety-Net Status	
Non-Safety-Net Hospital	22.9 (8.9)
Safety-Net Hospital	41.9 (15.4)
Proportion Minority	
Non-High-Proportion Black	25.4 (12.6)
High-Proportion Black	37.2 (14.0)
Structural Characteristics	
Size	
Small (<100 beds)	26.7 (12.4)
Medium (100-399 beds)	28.5 (14.8)
Large (≥ 400 beds)	26.8 (11.3)
Ownership	
Private, For-Profit	31.4 (16.8)
Private, Non-Profit	25.4 (12.0)
Public	34.9 (14.2)
Teaching Status	
Non-Teaching	28.2 (14.0)
Teaching	27.3 (13.4)
Geographical Characteristics	
Region	
Northeast	25.7 (11.6)
Midwest	22.6 (10.2)
South	29.5 (12.5)
West	32.1 (18.3)
Rurality	
Urban	27.0 (14.3)
Rural	30.3 (11.4)
Medicaid Expansion Status	
Non-Expansion State	26.7 (12.6)
Expansion State	28.3 (14.4)

eTable 3. Total Change in HVBP Payment Adjustments After Health Equity Adjustment by Hospital Characteristics without 10-Point Cap

Characteristic	Total Change in HVBP Payment Adjustments, $
Overall (n = 2,676)	-9,846,349
Patient Mix Characteristics	
Case Mix Index	
Quintile 2-5 (n = 2,190)	-3,500,148
Quintile 1 (Most Complex) (n = 486)	-6,346,201
Safety-Net Status	
Non-Safety-Net Hospital (n = 1,993)	-39,979,007
Safety-Net Hospital (n = 683)	30,132,659
Proportion Minority	
Non-High-Proportion Black (n = 2,153)	-26,030,585
High-Proportion Black (n = 523)	16,184,237
Structural Characteristics	
Size	
Small (<100 beds) (n = 783)	-2,087,553
Medium (100-399 beds) (n = 1,538)	-4,736,318
Large (≥ 400 beds) (n = 355)	-3,022,477
Ownership	
Private, For-Profit (n = 492)	3,213,163
Private, Non-Profit (n = 1,829)	-18,454,052
Public (n = 331)	5,403,763
Teaching Status	
Non-Teaching (n = 1,322)	-180,280
Teaching (n = 1,354)	-9,666,069
Geographical Characteristics	
Region	
Northeast (n = 439)	-5,121,958
Midwest (n = 648)	-16,505,679
South (n = 1,040)	5,633,899
West (n = 549)	6,147,388
Rurality	
Urban (n = 2,064)	-14,556,520
Rural (n = 612)	4,710,171
Medicaid Expansion Status	
Non-Expansion State (n = 1,025)	-3,541,511
Expansion State (n = 1,651)	-6,304,837

eTable 4. Total Change in HVBP Payment Adjustments After Health Equity Adjustment by Hospital Characteristics with (0,0,4) Performance Scaler

| Characteristic	Total Change in HVBP Payment Adjustments, $
Overall (n = 2,676)	-77,843,937
Patient Mix Characteristics	
Case Mix Index	
Quintile 2-5 (n = 2,190)	-44,193,212
Quintile 1 (Most Complex) (n = 486)	-33,650,725
Safety-Net Status	
Non-Safety-Net Hospital (n = 1,993)	-80,054,441
Safety-Net Hospital (n = 683)	2,210,504
Proportion Minority	
Non-High-Proportion Black (n = 2,153)	-72,586,985
High-Proportion Black (n = 523)	-5,256,952
Structural Characteristics	
Size	
Small (<100 beds) (n = 783)	-5,580,395
Medium (100-399 beds) (n = 1,538)	-42,233,975
Large (≥ 400 beds) (n = 355)	-30,029,568
Ownership	
Private, For-Profit (n = 492)	-8,524,168
Private, Non-Profit (n = 1,829)	-64,995,027
Public (n = 331)	-4,031,959
Teaching Status	
Non-Teaching (n = 1,322)	-18,818,131
Teaching (n = 1,354)	-59,025,807
Geographical Characteristics	
Region	
Northeast (n = 439)	-15,196,792
Midwest (n = 648)	-27,855,168
South (n = 1,040)	-27,248,959
West (n = 549)	-7,543,019
Rurality	
Urban (n = 2,064)	-76,567,706
Rural (n = 612)	-1,276,231
Medicaid Expansion Status	
Non-Expansion State (n = 1,025)	-31,813,232
Expansion State (n = 1,651)	-46,030,705

eTable 5. Total Change in HVBP Payment Adjustments After Health Equity Adjustment by Hospital Characteristics with Linear Scoring to Calculate the Underserved Multiplier

| Characteristic	Total Change in HVBP Payment Adjustments, $
Overall (n = 2,676)	-1,562,635
Patient Mix Characteristics	
Case Mix Index	
Quintile 2-5 (n = 2,190)	628,723
Quintile 1 (Most Complex) (n = 486)	-2,191,358
Safety-Net Status	
Non-Safety-Net Hospital (n = 1,993)	-24,228,991
Safety-Net Hospital (n = 683)	22,666,357
Proportion Minority	
Non-High-Proportion Black (n = 2,153)	-14,496,661
High-Proportion Black (n = 523)	12,934,027
Structural Characteristics	
Size	
Small (<100 beds) (n = 783)	-1,685,497
Medium (100-399 beds) (n = 1,538)	-449,671
Large (≥ 400 beds) (n = 355)	572,534
Ownership	
Private, For-Profit (n = 492)	2,743,909
Private, Non-Profit (n = 1,829)	-8,934,743
Public (n = 331)	4,525,612
Teaching Status	
Non-Teaching (n = 1,322)	1,423,913
Teaching (n = 1,354)	-2,986,547
Geographical Characteristics	
Region	
Northeast (n = 439)	-3,405,476
Midwest (n = 648)	-10,074,707
South (n = 1,040)	5,655,325
West (n = 549)	6,262,223
Rurality	
Urban (n = 2,064)	-5,254,947
Rural (n = 612)	3,692,312
Medicaid Expansion Status	
Non-Expansion State (n = 1,025)	842,119
Expansion State (n = 1,651)	-720,516

eTable 6. Total Change in HVBP Payment Adjustments After Health Equity Adjustment by Hospital Characteristics with Actual Scoring to Calculate the Underserved Multiplier

| Characteristic	Total Change in HVBP Payment Adjustments, $
Overall (n = 2,676)	-76,704,346
Patient Mix Characteristics	
Case Mix Index	
Quintile 2-5 (n = 2,190)	-45,276,087
Quintile 1 (Most Complex) (n = 486)	-31,428,259
Safety-Net Status	
Non-Safety-Net Hospital (n = 1,993)	-69,540,111
Safety-Net Hospital (n = 683)	-7,164,235
Proportion Minority	
Non-High-Proportion Black (n = 2,153)	-66,040,016
High-Proportion Black (n = 523)	-10,664,330
Structural Characteristics	
Size	
Small (<100 beds) (n = 783)	-7,603,320
Medium (100-399 beds) (n = 1,538)	-40,375,447
Large (≥ 400 beds) (n = 355)	-28,725,579
Ownership	
Private, For-Profit (n = 492)	-8,890,911
Private, Non-Profit (n = 1,829)	-62,230,099
Public (n = 331)	-5,370,582
Teaching Status	
Non-Teaching (n = 1,322)	-20,826,027
Teaching (n = 1,354)	-55,878,319
Geographical Characteristics	
Region	
Northeast (n = 439)	-15,097,906
Midwest (n = 648)	-23,149,908
South (n = 1,040)	-27,524,494
West (n = 549)	-10,932,038
Rurality	
Urban (n = 2,064)	-71,317,127
Rural (n = 612)	-5,387,219
Medicaid Expansion Status	
Non-Expansion State (n = 1,025)	-28,691,239
Expansion State (n = 1,651)	-48,013,107

eFigure 1. Relationship Between Dual-Eligible Inpatient Stay Proportion and the Underserved Multiplier
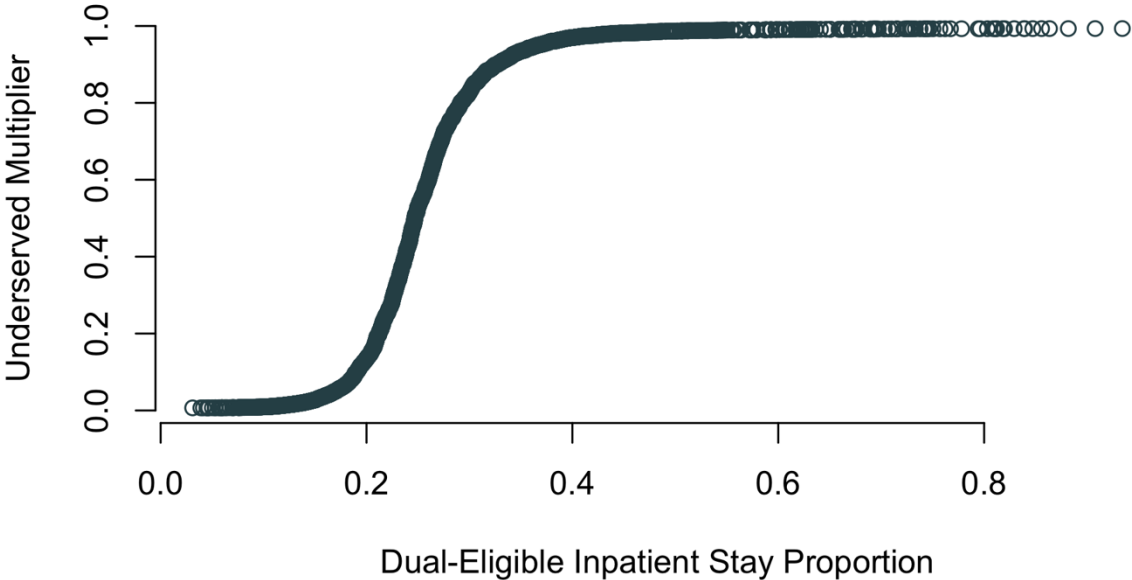
eFigure 2. Relationship Between Rank of Dual-Eligible Inpatient Stay Proportion and the Underserved Multiplier
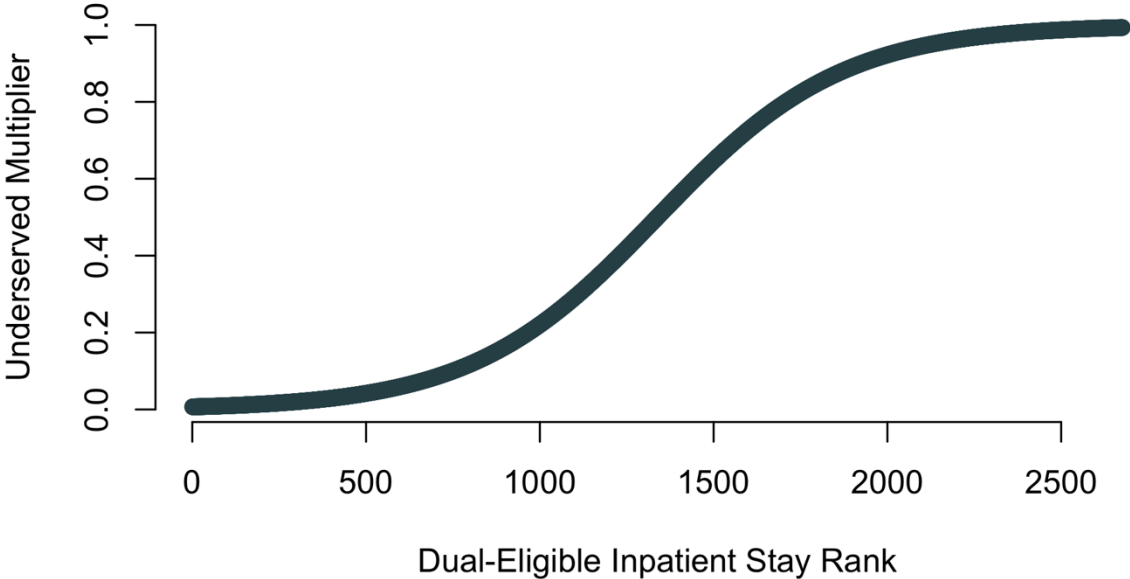
eFigure 3. Distribution of Dual-Eligible Inpatient Stay Proportion Across Hospitals
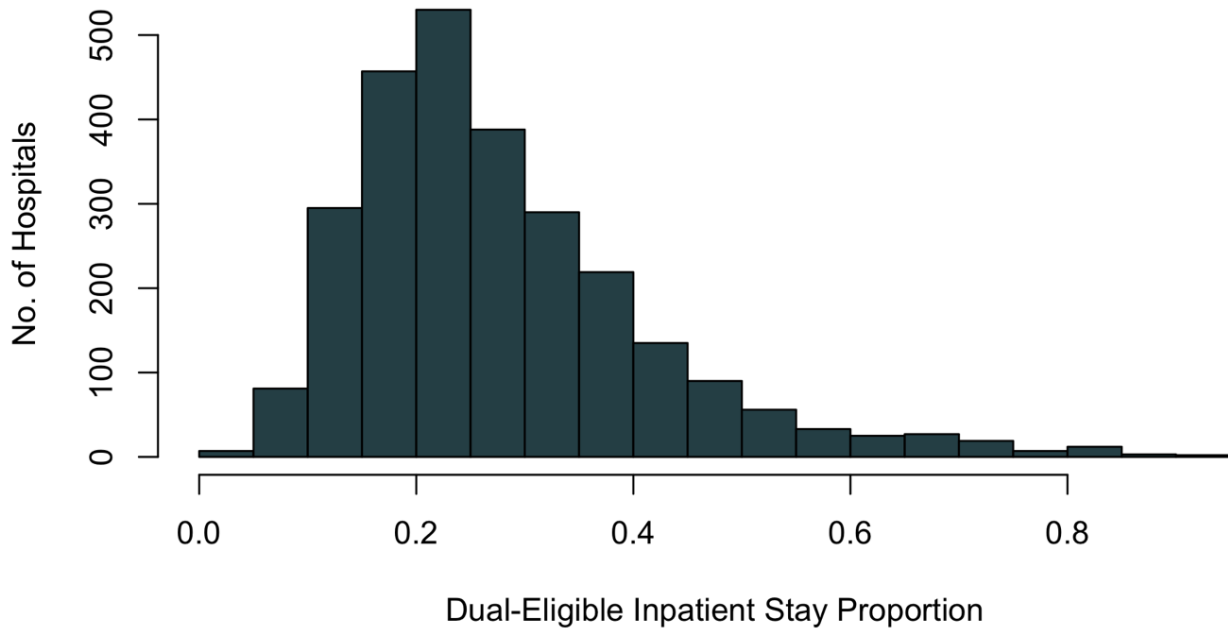
eFigure 4. Reclassification of Hospital Bonus/Penalty Status in the HVBP After Health Equity Adjustment

HVBP Bonus/Penalty Status

	After Health Equity Adjustment		
Status	**Bonus**	**Penalty**	**Total**
Bonus	1,368 (93.1)	102 (6.9)	1,470
Penalty	119 (9.9)	1,087 (90.1)	1,206
Total	1,487	1,189	2,676

(Rows labeled "Before Health Equity Adjustment")

HVBP: Hospital Value-Based Purchasing
Cells shaded green represent hospitals that were penalized before health equity adjustment and received bonuses after. Cells shaded red represent hospitals that received bonuses before health equity adjustment and were penalized after.

eFigure 5. Reclassification of Hospital Performance in the HVBP After Health Equity Adjustment

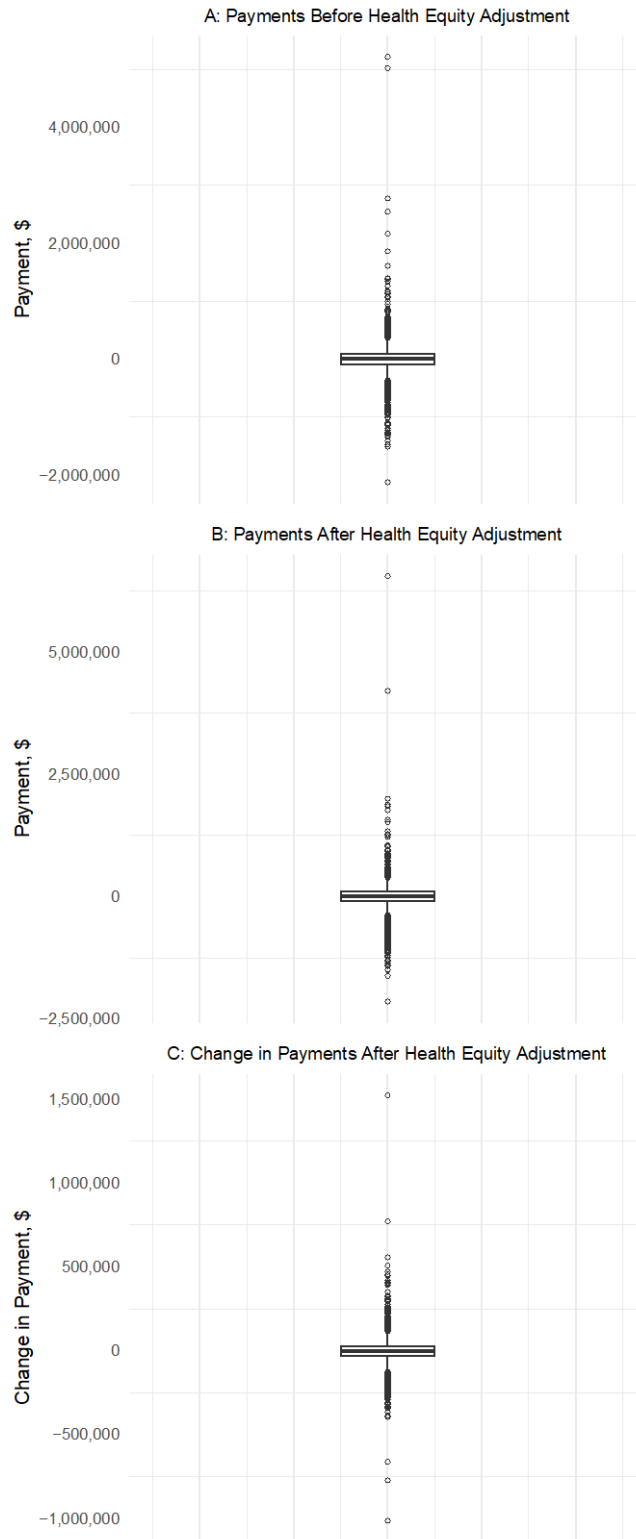**HVBP Total Performance Score Quintile**

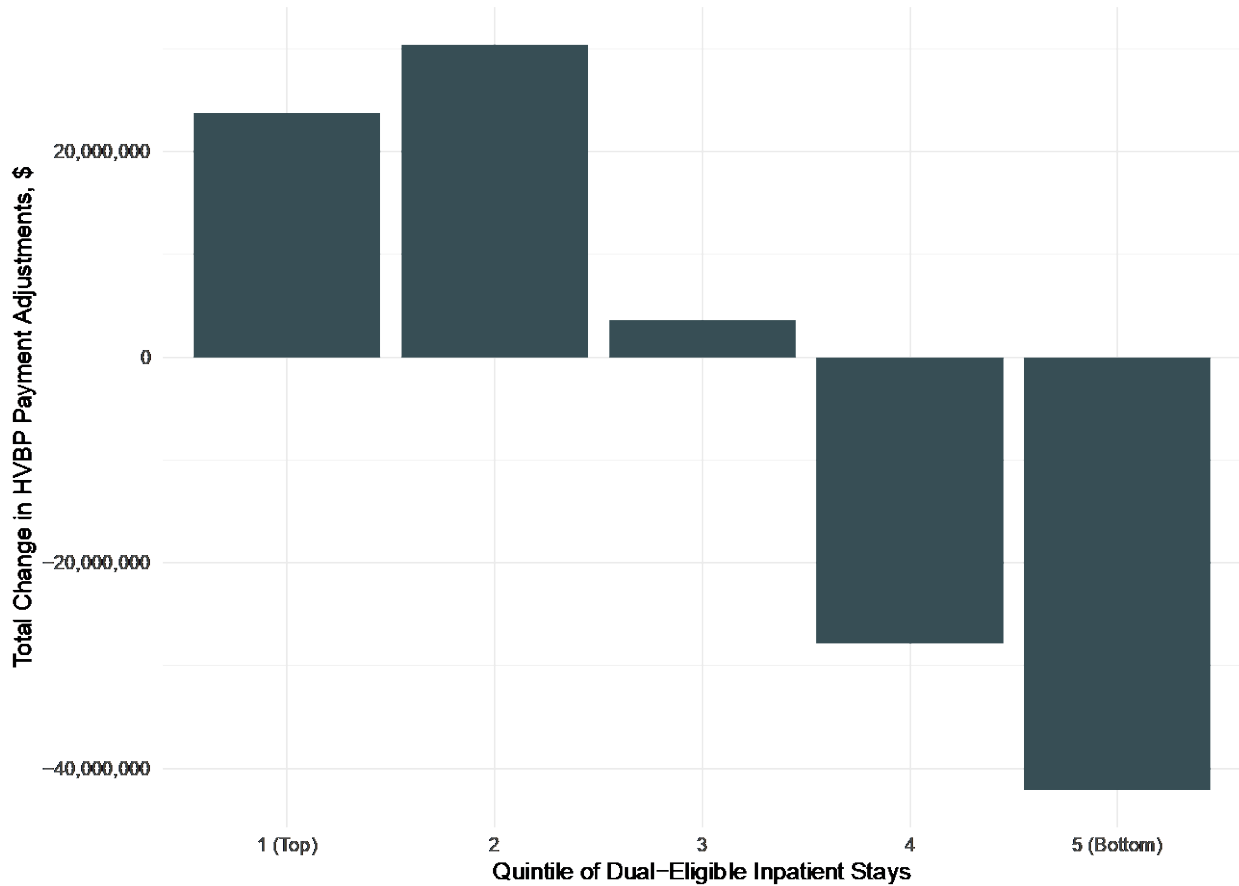|			After Health Equity Adjustment				
	Quintile	**1 (Highest)**	**2**	**3**	**4**	**5 (Lowest)**	**Total**
Before Health Equity Adjustment	**1 (Highest)**	434 (80.8)	102 (19.0)	0 (0)	0 (0)	0 (0)	537
	2	103 (19.2)	312 (58.2)	119 (22.1)	0 (0)	0 (0)	536
	3	0 (0)	122 (22.8)	309 (57.4)	105 (19.4)	0 (0)	538
	4	0 (0)	0 (0)	110 (20.4)	365 (67.6)	60 (11.4)	540
	5 (Lowest)	0 (0)	0 (0)	0 (0)	70 (13.0)	465 (88.6)	525
	Total	536	534	536	535	535	2,676

HVBP: Hospital Value-Based Purchasing
Hospitals were classified into performance quintiles based on Total Performance Scores. Quintile 1 represents "best-performing" and quintile 5 represents "worst-performing" hospitals. Cells shaded green represent hospitals that were reclassified into better-performing quintiles after health equity adjustment, whereas cells shared red represent those that were reclassified into worse-performing quintiles.

eFigure 6. Distribution of Hospital-Level HVBP Payment Adjustments Before and After Health Equity Adjustment
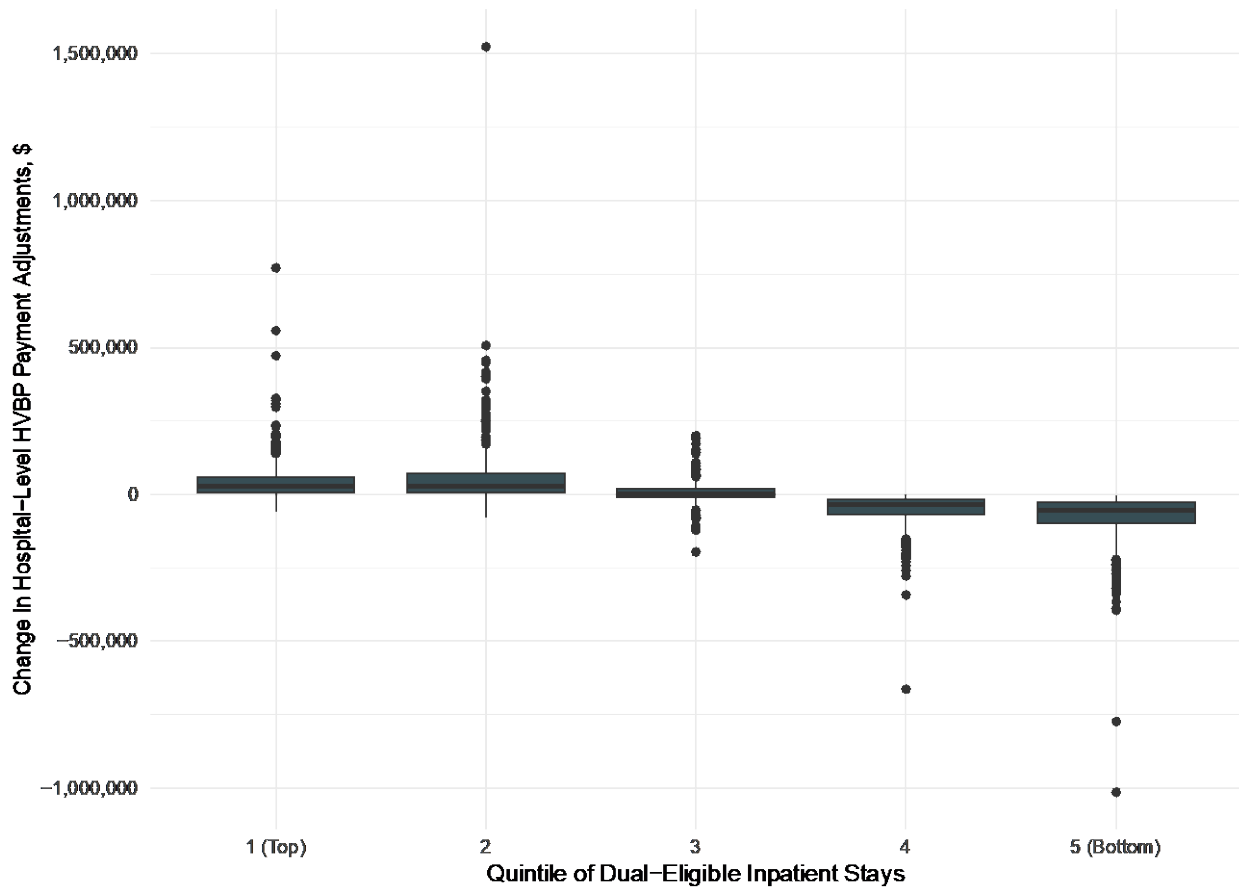

A: Payments Before Health Equity Adjustment

B: Payments After Health Equity Adjustment

C: Change in Payments After Health Equity Adjustment

HVBP: Hospital Value-Based Purchasing.
 Positive values represent increased payment adjustments and negative values represent decreased payment adjustments. Hospitals in the top quintile (1) of dual-eligible inpatient stays have the highest proportion of dual-eligible inpatient stays, whereas those in the bottom quintile (5) have the lowest.

HVBP: Hospital Value-Based Purchasing

Positive values represent increased payment adjustments and negative values represent decreased payment adjustments. Hospitals in the top quintile (1) of dual-eligible inpatient stays have the highest proportion of dual-eligible inpatient stays, whereas those in the bottom quintile (5) have the lowest. The horizontal lines in the middle of each box indicate median values; the top and bottom borders of the boxes indicate the 75th and 25th percentiles; the whiskers represent the maximum and minimum values within 1.5 times the interquartile range above and below the 75th and 25th percentiles; and the points represent outlier values beyond the whiskers.

eFigure 9. Geographical Distribution of Proportion of Hospitals Receiving Increased Payment Adjustments After Health Equity Adjustment

Hospitals with Increased Payment Adjustments (%)

- 0 to 25
- 26 to 40
- 41 to 55
- 56 to 70
- 71 to 100
- MD Hospitals Exempt from HVBP
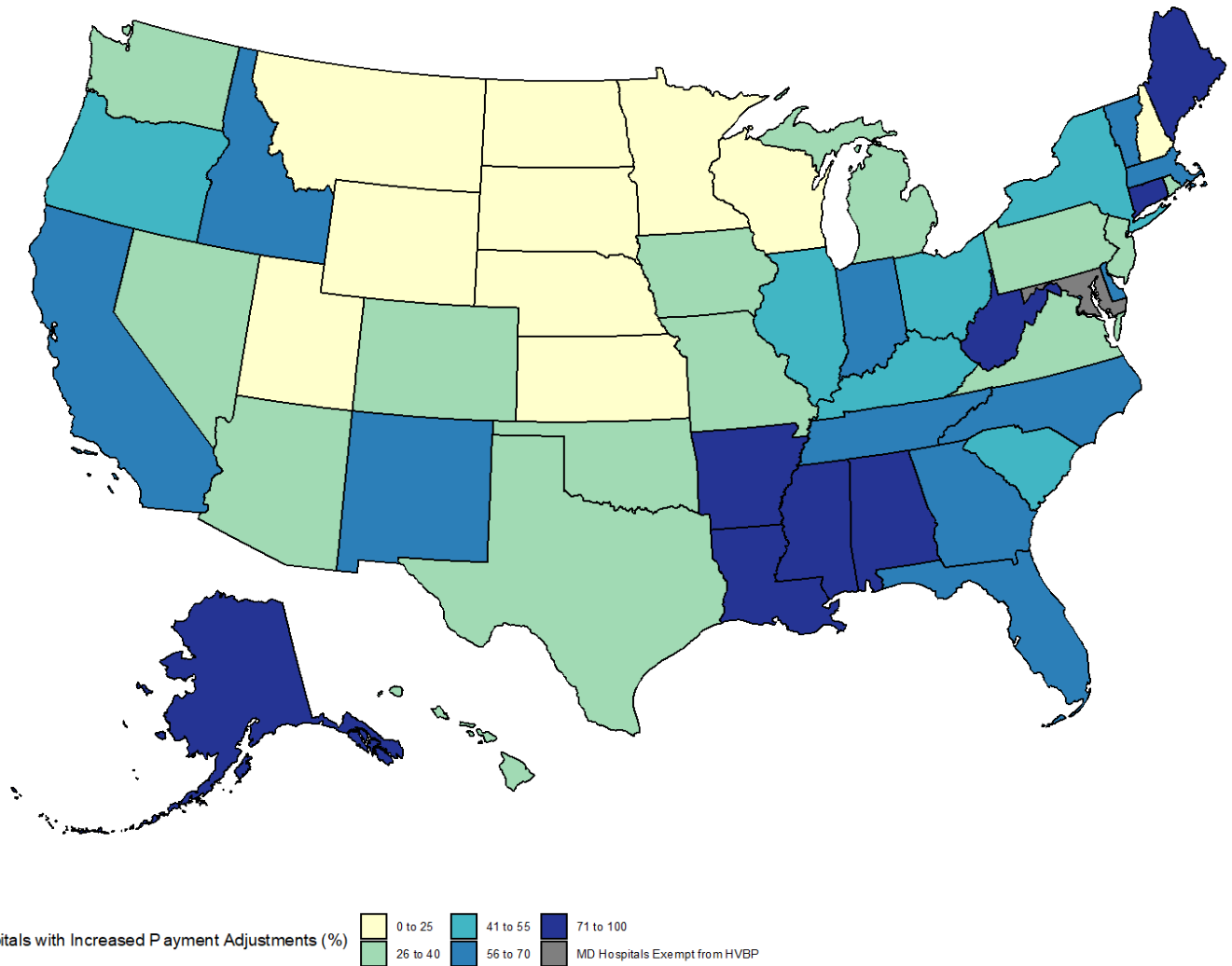
No hospitals in North Dakota, New Hampshire, South Dakota, or Utah experienced increases in payment adjustments, whereas all hospitals in Alaska experienced increases in HVBP payment adjustments.

eFigure 10. Reclassification of Hospital Bonus/Penalty Status After Health Equity Adjustment without 10-Point Cap

HVBP Bonus/Penalty Status

		After Health Equity Adjustment		
	Status	Bonus	Penalty	Total
Before Health Equity Adjustment	Bonus	1,368 (93.1)	102 (6.9)	1,470
	Penalty	119 (9.9)	1,087 (90.1)	1,206
	Total	1,487	1,189	2,676

eFigure 11. Reclassification of Hospital Bonus/Penalty Status After Health Equity Adjustment with (0,0,4) Performance Scaler

HVBP Bonus/Penalty Status

		After Health Equity Adjustment		
	Status	**Bonus**	**Penalty**	**Total**
Before Health Equity Adjustment	**Bonus**	1,349 (91.8)	121 (8.2)	1,470
	Penalty	37 (3.1)	1,169 (96.9)	1,206
	Total	1,386	1,290	2,676

eFigure 12. Reclassification of Hospital Bonus/Penalty Status After Health Equity Adjustment with Linear Scoring to Calculate the Underserved Multiplier

HVBP Bonus/Penalty Status

		After Health Equity Adjustment		
	Status	**Bonus**	**Penalty**	**Total**
Before Health Equity Adjustment	**Bonus**	1,413 (96.1)	57 (3.9)	1,470
	Penalty	89 (7.4)	1,117 (92.6)	1,206
	Total	1,502	1,174	2,676

eFigure 13. Reclassification of Hospital Bonus/Penalty Status After Health Equity Adjustment with Actual Scoring to Calculate the Underserved Multiplier

HVBP Bonus/Penalty Status

		After Health Equity Adjustment		
	Status	Bonus	Penalty	Total
Before Health Equity Adjustment	Bonus	1,360 (92.5)	110 (7.5)	1,470
	Penalty	8 (0.66)	1,198 (99.3)	1,206
	Total	1,368	1,308	2,676