Supplementary Online Content

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This supplementary material has been provided by the authors to give readers additional information about their work.
eMethods 1. Details on the Publicly Reported Hospital Consumer Assessment of Healthcare Providers and Systems Survey

We used publicly reported data from the CMS Hospital Compare datafiles and used the 2008-2019 years of data. CMS Hospital Compare includes national hospital-level data, with files reporting the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey data for patient satisfaction ratings. The HCAHPS draws a random sample of eligible discharges throughout each month and then aggregates these data quarterly to create a rolling four-quarter data file for each hospital such that the most recent four quarters—comprising 12 months of data—are used in public reporting. As we sought to evaluate the impact of the CMS VBP's implementation of financial incentives tied to HCAHPS ratings instituted on July 1, 2011, we used the July 1st to June 30th four-quarter data files for each year.

HCAHPS results are publicly reported on Hospital Compare as “top-box,” “bottom-box” and “middle-box” scores. The “top-box” represents the most positive response to HCAHPS Survey items, the “middle-box” represents intermediate responses to Survey items, and the “bottom-box” is the least positive response category for HCAHPS Survey items. Hospital VBP Performance Standards are based on hospital "Top-box" scores, which represents the percentage of patients who chose the most positive response to HCAHPS survey items.

Notably, CMS removed the pain management dimension of the HCAHPS Survey in 2017 in an effort to eliminate financial pressure to overprescribe medications. In addition, the care transition dimension of HCAHPS was introduced in 2013. As our analysis spans 2008-2019, we do not examine these two scales in our analysis.
eMethods 2. Methodological Approach for Difference-in-Differences in Analysis

The goal of this study was to estimate annual trends in patient experience outcomes for safety-net and non-safety net hospitals, and to estimate differential changes in trends between safety- and non-safety-net hospitals after implementation of the VBP. We used the following linear mixed regression model with a random intercept for each hospital to calculate our estimates for each outcome and compare differential trends across periods:

$$Y_{ij} = \beta_0 + \beta_1 SafetyNet Status_{ij} + \beta_2 Year_{ij} + \beta_3 PostVBP_{ij} + \beta_4 SafetyNet Status_{ij} \times Year_{ij} + \beta_5 SafetyNet Status_{ij} \times PostVBP_{ij} + \text{adjusted covariates} + \alpha_i + \varepsilon_{ij}$$

$Y_{ij}$ denotes the outcome at hospital $i$ and year $j$, $\alpha_i$ represents the random intercept for each hospital $i$.

‘Safety-Net Status’ was coded as 1 for safety-net-hospitals and 0 for non-safety-net hospital; ‘Year’ with baseline year 2008 (July 1, 2007 to June 30, 2008) and last year 2019 (July 1, 2018 to June 30, 2019) and was coded from 0 to 11 for 2008-2019; ‘PostVBP’ was a continuous variable that equaled 0 if years were before July 1, 2011 (2008-2011) and ranged from 1 to 8 for the first year 2012 (July 1, 2011 to June 30, 2012) after the VBP implementation up to the last year 2019 (July 1, 2018 to June 30, 2019); fixed effects include the following time-invariant covariates: size of hospital, ownership status, teaching-status, urban vs. rural status, region; and $\alpha_i$ represents the random intercept for each hospital $i$ to account for within hospital correlations.

This resulted in the following interpretation for estimates of trends in patient experience ratings by year:

$\beta_2$: Annual percentage change in patient experience ratings for non-safety-net hospitals in the pre-VBP period

$\beta_2 + \beta_4$: Annual percentage change in patient experience ratings for safety-net hospitals in the pre-VBP period

$\beta_4$: The difference in annual percentage change between safety-net hospitals and non-safety net hospitals in the pre-VBP period

$\beta_2 + \beta_3$: Annual percentage change in patient experience scores for non-safety-net hospitals in the post-VBP period

$\beta_2 + \beta_3 + \beta_4 + \beta_5$: Annual percentage change in patient experience scores for safety-net-hospitals in the post-VBP period

$\beta_4 + \beta_5$: The difference in annual percentage change between safety-net hospitals and non-safety-net hospitals in the post-VBP period.

$\beta_5$: The differential change in patient experience scores at safety-net vs. non-safety-net hospitals in the post- vs. pre-VBP periods.

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| HCHAPS Domain        | Pre-VBP Annual Change (%) | Post-VBP Annual Change (%) | Adjusted differential change (%) | \( P \)-value |
|----------------------|--------------------------|---------------------------|----------------------------------|---------------|
| HCHAPS Measure       |                          |                           |                                  |               |
| Safety-Net Hospitals | \((\beta_2 + \beta_4)\) | \((\beta_2 + \beta_3 + \beta_4 + \beta_5)\) | \((\beta_5)\)                      |               |
| Non-Safety-Net Hospitals | \((\beta_2)\)          | \((\beta_2 + \beta_3)\)  | \((\beta_5)\)                      |               |

\( ^a \) Adjusted annual percentage change in patient experience ratings during the pre-VBP period (July 1, 2007 to June 30, 2011)

\( ^b \) Adjusted annual percentage change in patient experience ratings during the post-VBP period (July, 2011 to June 30, 2019)

**Statistical Testing for Linear Trends**

To assess linearity in trends, we tested fit statistics of a model incorporating squared time terms:

\[
Y_{ij} = \beta_0 + \beta_1 SafetyNet Status_{ij} + \beta_2 Year_{ij} + \beta_3 PostVBP_{ij} + \beta_4 Year_{ij}^2 \\
+ \beta_5 PostVBP_{ij}^2 + \beta_6 \times Year_{ij} + \beta_7 SafetyNet Status_{ij} \times Year_{ij}^2 \\
+ \beta_8 SafetyNet Status_{ij} \times PostVBP_{ij} \\
+ \beta_9 SafetyNet Status_{ij} \times PostVBP_{ij}^2 + adjusted covariates + \alpha_i + \varepsilon_{ij}
\]

We compared the fit statistics with the squared terms in the new model incorporating squared time terms versus the fit statistics without the squared terms in our original model above. These are displayed below:

- Fit Statistics with Square Term (-2 Res Log Likelihood) = 156606
- Fit Statistics without Square Term (-2 Res Log Likelihood) = 156884

Given that fit statistics are comparable between the model that assumes linear trends and the model that tests curvilinear trends, we report the main analysis using the model without the square terms for ease of interpretation.
eMethods 3. Statistical Testing for Parallel (Pre-VBP) Trends

In addition to visual inspection of plotted unadjusted annual trends in performance measures for each scale, we formally tested whether trends in performance were similar at safety-net and non-safety-net hospitals during the pre-VBP period.

**Statistical test for parallel trends assumption**
The following model was used to test for parallel trends by testing the significance of the p-value of interaction for $\beta_3$ below:

$$Y = \beta_0 + \beta_1 \text{SafetyNet Status} + \beta_2 \text{Year} + \beta_3 \text{SafetyNet Status} \times \text{PreVBP Year} + \text{adjusted covariates}$$

| HCAHPS Measure               | P-Value for Interaction |
|------------------------------|-------------------------|
| Rating of 9 or Higher        | 0.63                    |
| Would Definitely Recommend   | 0.51                    |
| Doctor Communication         | 0.45                    |
| Nurse Communication          | 0.27                    |
| Medication Communication     | 0.58                    |
| Staff Responsiveness         | 0.43                    |
| Discharge Instructions       | 0.58                    |
| Quietness                    | 0.87                    |
| Cleanliness                  | 0.84                    |

**Legend:** The interaction term between safety-net status and pre-VBP calendar years was tested for each HCAHPS measure in the years 2008-2011 (prior to the VBP implementation). The P-values for the interaction terms were not significant across all measures, indicating that the trends for each outcome did not significantly differ at safety-net compared with non-safety-net hospitals during the pre-VBP period.
**eTable 1.** Characteristics of Hospitals Included vs. Not Included in the Analysis

|                          | Included Hospitals (n=2226) | Excluded Hospitals (n=3894) |
|--------------------------|-----------------------------|-----------------------------|
| **Bed size**             |                             |                             |
| Large Hospital (≥400 beds)| 18.2%                       | 2.5%                        |
| Medium Hospital (100-399 beds) | 59.3%                     | 22.6%                       |
| Small Hospital (<100 beds) | 22.5%                       | 74.9%                       |
| **Ownership Status**     |                             |                             |
| For Profit               | 18.6%                       | 30.4%                       |
| Government               | 11.8%                       | 30.0%                       |
| Nonprofit                | 69.6%                       | 39.6%                       |
| **Teaching Hospital**    |                             |                             |
| Yes                      | 56.6%                       | 23.6%                       |
| No                       | 43.4%                       | 76.4%                       |
| **Urban vs. Rural Hospital** |                         |                             |
| Rural Hospital           | 21.4%                       | 37.7%                       |
| Urban Hospital           | 78.6%                       | 62.3%                       |
**eTable 2. Primary Outcome Sensitivity Analysis: Defining Safety-Net Hospitals Using Top Quintile DSH Scores**

| Rating of 9 or Higher |   |   |   |   |
|-----------------------|---|---|---|---|
|                       |   |   |   |   |
| Safety-Net Hospitals  | 1.92 | 0.49 | -0.03 | 0.73 |
|                       | (1.78, 2.08) | (0.44, 0.54) | (-0.23, 0.16) |
| Non-Safety-Net Hospitals | 1.84 | 0.43 | -0.03 | 0.73 |
|                       | (1.78, 1.90) | (0.41, 0.45) | (-0.23, 0.16) |
| Would Definitely Recommend |   |   |   |   |
| Safety-Net Hospitals  | 1.31 | 0.14 | -0.09 | 0.35 |
|                       | (1.16, 1.46) | (0.09, 0.19) | (-0.29, 0.10) |
| Non-Safety-Net Hospitals | 1.13 | 0.05 | -0.09 | 0.35 |
|                       | (1.07, 1.19) | (0.03, 0.07) | (-0.29, 0.10) |

All values represent percentages with 95% confidence intervals, unless otherwise indicated.

- Adjusted annual percentage change in patient satisfaction ratings during the pre-VBP period (July 1, 2007 to June 30, 2011) (a)
- Adjusted annual percentage change in patient satisfaction ratings during the post-VBP period (July, 2011 to June 30, 2019) (b)
- Estimated percentage point difference in outcomes at safety-net vs. non-safety-net hospitals since the implementation of the VBP (c)
**eTable 3. Secondary Outcome Sensitivity Analysis: Defining Safety-Net Hospitals Using Top Quintile DSH Scores**

All values represent percentages with 95% confidence intervals, unless otherwise indicated.

|                              | Pre-VBP Annual Change (%) a | Post-VBP Annual Change (%) b | Adjusted differential change (%) c | *P*-value |
|------------------------------|-------------------------------|------------------------------|-----------------------------------|-----------|
| **Communication**            |                               |                              |                                   |           |
| **Doctor Communication**     |                               |                              |                                   |           |
| Safety-Net Hospitals         | 0.61 (0.52, 0.70)             | 0.03 (0.01, 0.07)            | -0.06 (-0.17, 0.06)              | 0.34      |
| Non-Safety-Net Hospitals     | 0.52 (0.49, 0.56)             | 0.01 (-0.01, 0.02)          |                                   |           |
| **Nurse Communication**      |                               |                              |                                   |           |
| Safety-Net Hospitals         | 1.56 (1.45, 1.66)             | 0.48 (0.45, 0.52)           | -0.04 (-0.18, 0.10)              | 0.57      |
| Non-Safety-Net Hospitals     | 1.41 (1.37, 1.45)             | 0.38 (0.37, 0.39)           |                                   |           |
| **Medication Communication** |                               |                              |                                   |           |
| Safety-Net Hospitals         | 1.44 (1.31, 1.57)             | 0.48 (0.43, 0.52)           | 0.05 (-0.12, 0.22)               | 0.56      |
| Non-Safety-Net Hospitals     | 1.41 (1.36, 1.46)             | 0.39 (0.38, 0.41)           |                                   |           |
| **Clinical Processes**       |                               |                              |                                   |           |
| **Staff Responsiveness**     |                               |                              |                                   |           |
| Safety-Net Hospitals         | 1.31 (1.16, 1.46)             | 0.56 (0.50, 0.61)           | 0.11 (-0.09, 0.30)               | 0.29      |
| Non-Safety-Net Hospitals     | 1.25 (1.19, 1.31)             | 0.38 (0.36, 0.40)           |                                   |           |
| **Discharge Instructions**   |                               |                              |                                   |           |
| Safety-Net Hospitals         | 1.52 (1.43, 1.61)             | 0.57 (0.53, 0.60)           | -0.09 (-0.21, 0.03)              | 0.14      |
| Non-Safety-Net Hospitals     | 1.38 (1.35, 1.43)             | 0.51 (0.50, 0.53)           |                                   |           |
| **Hospital Environment**     |                               |                              |                                   |           |
| **Quietness**                |                               |                              |                                   |           |
| Safety-Net Hospitals         | 1.30 (1.14, 1.45)             | 0.17 (0.12, 0.22)           | 0.08 (-0.13, 0.28)               | 0.47      |
| Non-Safety-Net Hospitals     | 1.42 (1.35, 1.48)             | 0.21 (0.19, 0.23)           |                                   |           |
| **Cleanliness**              |                               |                              |                                   |           |
| Safety-Net Hospitals         | 1.16 (1.01, 1.31)             | 0.40 (0.35, 0.45)           | 0.18 (-0.02, 0.37)               | 0.08      |
| Non-Safety-Net Hospitals     | 1.20 (1.15, 1.28)             | 0.26 (0.25, 0.29)           |                                   |           |

a Adjusted annual percentage change in patient satisfaction ratings during the pre-VBP period (July 1, 2007 to June 30, 2011)

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b Adjusted annual percentage change in patient satisfaction ratings during the post-VBP period (July, 2011 to June 30, 2019)
c Estimated percentage point difference in outcomes at safety-net vs. non-safety-net hospitals since the implementation of the VBP
**eTable 4. Annual Response Rates in the HCAHPS Survey**

| Year | Mean HCAHPS Response Rate Percentage Per Hospital | Range (%) |
|------|--------------------------------------------------|------------|
| 2008 | 34%                                              | 4-100%     |
| 2009 | 33%                                              | 6-82%      |
| 2010 | 33%                                              | 3-82%      |
| 2011 | 32%                                              | 3-80%      |
| 2012 | 33%                                              | 5-87%      |
| 2013 | 33%                                              | 6-86%      |
| 2014 | 31%                                              | 6-88%      |
| 2015 | 30%                                              | 3-92%      |
| 2016 | 29%                                              | 6-86%      |
| 2017 | 27%                                              | 6-77%      |
| 2018 | 26%                                              | 3-82%      |
| 2019 | 26%                                              | 4-75%      |

**Legend:** The table above displays the mean HCAHPS survey response rates reported by each hospital per year in percentages as well as the range of response rates per year.
**Legend:** Flow diagram of exclusions that resulted in the final population of hospitals that participated in the VBP and also reporting HCAHPS scores each year from 2008-2019. Omitted hospitals included those not eligible to participate in the VBP and/or not reporting HCAHPS scores every year of the study period.
eFigure 2. Trends in Hospital Performance on Communication Measures From 2008 to 2019

Legend: The figure shows unadjusted annual trends in performance on the doctor communication (Panel A), nurse communication (Panel B), and medication communication (Panel C) measures at safety-net hospitals (red) and non-safety-net hospitals (green) from 2008 to 2019. The dashed line represents implementation of the Value-Based Purchasing program in 2011. Safety-net hospitals were classified as those in the highest quartile of the disproportionate share hospital index. Hospital-level performance on patient experience measures were obtained from the publicly-reported Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey.

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eFigure 3. Trends in Hospital Performance on Clinical Processes Measures From 2008 to 2019

Legend: The figure shows unadjusted annual trends in performance on the staff responsiveness measure (Panel A) and discharge instructions measure (Panel B) at safety-net hospitals (red) and non-safety-net hospitals (green) from 2008 to 2019. The dashed line represents implementation of the Value-Based Purchasing program in 2011. Safety-net hospitals were classified as those in the highest quartile of the disproportionate share hospital index. Hospital-level performance on patient experience measures were obtained from the publicly-reported Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey.
eFigure 4. Trends in Hospital Performance on Hospital Environment Measures From 2008 to 2019

Legend: The figure shows unadjusted annual trends in performance on the quietness measure (Panel A), and cleanliness measure (Panel B) at safety-net hospitals (red) and non-safety-net hospitals (green) from 2008 to 2019. The dashed line represents implementation of the Value-Based Purchasing program in 2011. Safety-net hospitals were classified as those in the highest quartile of the disproportionate share hospital index. Hospital-level performance on patient experience measures were obtained from the publicly-reported Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey.