Hospitals' Behavioral Adaptation under the Hospital Readmissions Reduction Program (HRRP)

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1 Introduction and Overview

The **Hospital Readmissions Reduction Program (HRRP)**, launched by the Centers for Medicare and Medicaid Services (CMS) in 2013, penalizes hospitals with excess 30-day readmissions for conditions such as heart failure, pneumonia, and myocardial infarction. The policy's goal was to encourage hospitals to improve discharge planning and care coordination. However, recent studies suggest that hospitals may have responded administratively rather than clinically—through changes in coding, classification, or timing of readmissions—raising concerns about whether HRRP improved patient outcomes or simply altered reporting behavior (Gupta and Fonarow, 2018; Joynt and Jha, 2013; Zuckerman et al., 2016).

This proposal outlines datasets and preliminary regression ideas to study hospital behavior under HRRP. The main objective is to test whether differences in penalties reflect real quality improvements or structural disparities across hospitals. Using CMS data, I propose a set of feasible regressions linking socioeconomic composition, case-mix complexity, and readmission performance, while sketching a Difference-in-Differences (DiD) framework for future analysis once additional data become available.

2 Data Overview

The project draws primarily from two publicly available CMS datasets:

(1) FY2019 HRRP Proposed Rule Supplemental Data File — provides hospital-level Excess Readmission Ratios (ERRs) for each targeted condition, Dual-Eligible propor-

tions, peer group categories, and the final Payment Adjustment Factor that determines each hospital's Medicare penalty.

(2) FY2019 DRG Weight Supplemental Data File — reports the Sum of Transfer-Adjusted Diagnosis-Related Group (DRG) Weights and the Number of Transfer-Adjusted Cases for fiscal years 2013–2016, which form the historical basis for calculating the 2019 penalty.

Together, these files make it possible to examine how patient complexity, measured through DRG weights, relates to performance metrics and financial penalties.

2.1 HRRP Penalty Calculation and Role of DRG Weights

Under HRRP, CMS penalizes hospitals with higher-than-expected 30-day readmission rates for six monitored conditions, including heart failure, pneumonia, and acute myocardial infarction (AMI). For each condition c at hospital h, CMS calculates an *Excess Readmission Ratio (ERR)*:

$$ERR_{hc} = \frac{\text{Observed Readmissions}_{hc}}{\text{Expected Readmissions}_{hc}},$$

where $ERR_{hc} > 1$ indicates excess readmissions relative to the national average.

To combine performance across conditions, each hospital's penalty is weighted by the share of Medicare payments associated with that condition, derived from its *Diagnosis-Related Group (DRG)* reimbursements. DRGs classify cases by diagnosis and expected resource use; higher DRG weights correspond to more complex or costly patients.

The total penalty equals the weighted sum of excess readmission shares:

$$TotalPenalty_h = \sum_c w_{hc} \times \max(0, ERR_{hc} - 1),$$

and is capped at 3% of Medicare reimbursements. The resulting *Payment Adjustment Factor* is

$$A_h = 1 - \min(0.03, TotalPenalty_h),$$

where lower values indicate higher penalties.

From the DRG Weight dataset, each hospital's *Case-Mix Index (CMI)* can be calculated as

$$CMI_h = \frac{\text{Sum of Transfer-Adjusted DRG Weights}}{\text{Number of Transfer-Adjusted Cases}},$$

summarizing the average clinical complexity of its patients. Linking CMI_h, ERR_h, and A_h allows tests of whether hospitals with more complex or disadvantaged populations systematically face higher penalties.

3 Econometric Framework

The empirical analysis begins with two simple cross-sectional regressions that can be run using the HRRP and DRG data alone. These provide initial evidence on how socioeconomic composition and patient complexity relate to penalty magnitude and performance.

3.1 Regression 1: Socioeconomic Composition and Penalty Exposure

$$A_h = \beta_0 + \beta_1 DualProp_h + \beta_2 PeerGroup_h + \sum_c \beta_{3c} ERR_{hc} + \epsilon_h$$

where A_h is the Payment Adjustment Factor and $DualProp_h$ is the proportion of dual-eligible patients. A negative β_1 would indicate that hospitals serving more low-income patients are penalized more heavily, even after controlling for performance.

3.2 Regression 2: Case-Mix Complexity and Readmission Performance

$$ERR_h = \alpha_0 + \alpha_1 CMI_h + \alpha_2 DualProp_h + \alpha_3 PeerGroup_h + \epsilon_h$$

where ERR_h is the average Excess Readmission Ratio across conditions. A positive α_1 suggests that hospitals treating more complex patients face higher readmission ratios, pointing to limitations in HRRP's severity adjustment.

3.3 Potential Difference-in-Differences (DiD)

The eventual goal is to study how hospitals' behavior changed after HRRP's introduction, distinguishing genuine quality improvements from administrative adaptation. A Difference-in-Differences (DiD) model offers a natural design for this:

$$Y_{ht} = \gamma_0 + \gamma_1 (Post_t \times Penalized_h) + \mu_h + \lambda_t + \varepsilon_{ht},$$

where Y_{ht} is an outcome such as readmission rate, discharge volume, or another performance measure; $Post_t$ indicates post-HRRP years; and $Penalized_h$ equals 1 for hospitals that received penalties in the first HRRP cycle. The coefficient γ_1 measures how penalized hospitals changed relative to unpenalized hospitals.

Because national data on observation stays are limited, early analysis would use proxies such as inpatient discharges or DRG-weighted case volumes. The proposed *Observation Substitution Index (OSI)*:

$$OSI_h = \frac{\Delta ObsRate_h}{|\Delta ReadmRate_h|},$$

remains conceptual until outpatient or Part B claims data become available.

4 Next Steps and Exploratory Analysis

4.1 Data Expansion

The next phase will focus on expanding data coverage to make the DiD feasible. Specific priorities include:

- **Merging additional CMS datasets:** combining HRRP with Hospital Compare, Provider Utilization, or MedPAR files to obtain annual data on readmissions and discharges.
- **Adding outpatient information:** acquiring Part B or Outpatient Limited Data Set claims to measure observation-stay rates and compute the OSI empirically.
- **Including hospital characteristics:** linking American Hospital Association (AHA) Annual Survey data for ownership, teaching status, and bed size.

These linkages would enable dynamic analysis and could later support a Triple-Differences (DDD) design comparing targeted and untargeted conditions.

4.2 Exploratory Data Visualization

Before running regressions, exploratory plots will summarize existing HRRP data and guide model design. Planned visuals include:

- Histograms of payment adjustment factors (A_h) to show the distribution of penalties.
- Scatterplots of A_h vs. $DualProp_h$ and ERR_h vs. CMI_h to examine equity and complexity patterns.
- Boxplots of ERR by condition to highlight variation in performance.
- Regional comparisons of penalty exposure, if location data are available.

These descriptive figures will help identify outliers, trends, and potential biases, forming the basis for future causal analysis.

5 Conclusion

This proposal outlines feasible datasets and regression designs to explore how hospitals have responded to HRRP incentives. By linking penalties, readmission performance, and case-mix complexity, the analysis aims to determine whether HRRP improved care or merely reshaped reporting. Future work will focus on integrating longitudinal and outpatient data to estimate causal effects more precisely.

References

Gupta, A. and Fonarow, G. C. (2018). The hospital readmissions reduction program—learning from failure of a healthcare policy. *JAMA*.

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