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Readmission Rates After Passage of the Hospital Readmissions Reduction Program:

A Pre–Post Analysis

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Abstract

Background—Whether hospitals with the highest risk-standardized readmission rates (RSRRs) subsequently experienced the greatest improvement after passage of the Medicare Hospital Readmissions Reduction Program (HRRP) is unknown.

Objective—To evaluate whether passage of the HRRP was followed by acceleration in improvement in 30-day RSRRs after hospitalizations for acute myocardial infarction (AMI), congestive heart failure (CHF), or pneumonia and whether the lowest-performing hospitals had faster acceleration in improvement after passage of the law than hospitals that were already performing well.

Design—Pre–post analysis stratified by hospital performance groups.

Setting—U.S. acute care hospitals.

Patients—15 170 008 Medicare patients discharged alive from 2000 to 2013.

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Reproducible Research Statement: *Study protocol, statistical code, and data set:* See the Appendix (available at www.annals.org). Further requests can be sent to the authors (jwasfy@mgh.harvard.edu).

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Intervention—Passage of the HRRP.

Measurements—30-day readmission rates after hospitalization for AMI, CHF, or pneumonia for hospitals in the highest-performance (0% penalty), average-performance (>0% and <0.50% penalty), low-performance (0.50% and <0.99% penalty), and lowest-performance (>0.99% penalty) groups.

Results—Of 2868 hospitals serving 1 109 530 Medicare discharges annually, 30.1% were highest performers, 44.0% were average performers, 16.8% were low performers, and 9.0% were lowest performers. After controlling for prelaw trends, an additional 67.6 (95% CI, 66.6 to 68.4), 74.8 (CI, 74.0 to 75.4), 85.4 (CI, 84.0 to 86.8), and 95.1 (CI, 92.6 to 97.5) readmissions per 10 000 discharges were found to have been averted per year in the highest-, average-, low-, and lowest-performance groups, respectively, after passage of the law.

Limitation—Inability to distinguish between improvement caused by the magnitude of the penalty or by different levels of health improvement in different patient populations.

Conclusion—After passage of the HRRP, 30-day RSRRs for myocardial infarction, heart failure, and pneumonia decreased more rapidly than before the law's passage. Improvement was most marked for hospitals with the lowest prelaw performance.

Passage of the Patient Protection and Affordable Care Act (ACA) in March 2010 created the Medicare Hospital Readmissions Reduction Program (HRRP), which introduced the prospect of financially penalizing hospitals (1, 2) based on their previous performance. Performance was assessed on the basis of readmission rates within 30 days after hospitalizations for acute myocardial infarction (AMI), congestive heart failure (CHF), and pneumonia. These metrics were publicly reported on Medicare's Hospital Compare Web site starting on 9 July 2009 (3) and applied to reimbursements starting on 1 October 2012 (2). Performance during a period starting in 2009 and extending after passage of the law was the basis for the penalties administered in 2012 (Figure 1).

This program represents one of several efforts to encourage provider organizations to enhance safety and value. Medicare has reported lower readmission rates since passage of the law (4, 5), but whether the lowest-performing hospitals might experience less rapid improvement than hospitals that are already performing well, due to being underresourced or serving vulnerable populations, has been questioned (6).

In the context of this uncertainty, we analyzed time-series data on all-cause and condition-specific 30-day risk-standardized readmission rates (RSRRs) for Medicare fee-for-service enrollees from 2000 to 2013 to answer 2 questions. First, we sought to confirm that hospital RSRRs for AMI, CHF, and pneumonia decreased after passage of the ACA compared with any preexisting trends in improvement before passage of the law. Second, we determined whether the acceleration of improvement in readmission rates after passage of the law was greater in the lowest-performing hospitals than in higher-performing hospitals.

Methods

Study Population

We queried the Medicare Provider Analysis and Review files to identify all Medicare fee-for-service beneficiaries aged 65 years or older who were discharged alive from an acute care hospital in the United States after hospitalization for AMI, CHF, or pneumonia from 1 January 2000 through 30 November 2013. Hospitalizations for AMI, CHF, or pneumonia were defined as a principal discharge diagnosis of an International Classification of Diseases, Ninth Revision, Clinical Modification code for those conditions. These codes are used for public reporting and financial penalties (7, 8). We restricted the sample to patients who were enrolled in the fee-for-service plan for at least 12 months before an index hospitalization and continued enrollment in the plan for at least 1 month after the index discharge.

Patient Characteristics and Comorbidities

Patient demographic information included age; sex; and major comorbidities, including 7 cardiovascular history variables and 14 variables representing other comorbidities. Clinical variables were obtained from secondary diagnosis codes in the index condition-specific hospitalization as well as from principal and secondary diagnosis codes from all hospitalizations for 12 months before the index hospitalization. These comorbidities were classified using the Hierarchical Condition Categories method (9). Inpatient claims from 1999 were used to obtain comorbidities for patients hospitalized in 2000.

Hospital Characteristics and Penalty Information

Hospital characteristics included teaching status (teaching vs. nonteaching); Joint Commission certification (yes/no); hospital geographic location (urban vs. rural); ownership (public or private not-for-profit); number of beds; mean age of Medicare fee-for-service admitted patients; percentage of admitted patients who were white, black, and female; median hospital volume; 30-day mortality and readmission rates; and percentage of admissions for dual-eligible patients (those eligible for both Medicare and Medicaid).

We obtained publicly available hospital penalty information (2). The Centers for Medicare & Medicaid Services (CMS) combined the hospital-specific diagnosis-related group payments and hospital-specific excess readmission ratios for AMI, CHF, and pneumonia to determine penalties (2). In fiscal year 2013, the maximum penalty was 1% of total Medicare payments. We used penalties for fiscal year 2013, the first year of the penalties. For this analysis, we divided hospitals into 4 groups based on the size of the penalty: highest-performing (0% penalty), average-performing ($>0\%$ and $<0.50\%$), low-performing (0.50% and $<0.99\%$), and lowest-performing (0.99%). We excluded hospitals not in the CMS HRRP penalty list; many of these hospitals were small and were acquired by other hospitals during our study period (10). Only hospitals that existed during the entire period were included in this analysis.

Outcomes

The primary outcomes were hospital-specific, 30-day, all-cause RSRRs for patients discharged with AMI, CHF, or pneumonia. All-cause readmissions were defined as 1 or more hospitalizations in any acute care hospital in the United States for any cause within 30 days of discharge from an index hospitalization. For the index hospitalization, patients transferred from 1 acute care hospital to another were considered to have 1 episode of care, attributed to the last hospital in the transfer chain. To permit complete 30-day follow-up, we used December 2013 inpatient data to obtain readmission information for patients discharged in November 2013.

Using the CMS risk-standardized method for profiling hospitals (7, 8, 11), for each hospital in each quarter, we estimated 30-day all-cause RSRRs after hospitalizations for AMI, CHF, or pneumonia. Briefly, we fitted a hierarchical generalized linear model with a logit link function and hospital-specific random intercepts to model 30-day all-cause readmissions as a function of patients' age, sex, and comorbidities described previously. This model accounts for patient case mix and permits hospital-level random intercepts. We also calculated a combined RSRR that reflected readmissions after hospitalizations for any of the 3 conditions.

Definition of the Intervention Point

The ACA was signed into law on 23 March 2010, but because readmissions are categorized by quarter, we considered the end of the first quarter of 2010 (31 March) as the time point of intervention. We chose the actual enactment of the ACA—a law that included the HRRP—as the time point of intervention rather than the start of financial penalties for 2 reasons. First, at the time the law was passed, hospitals became aware of impending penalties and began implementing administrative changes, including redesigns of care processes, in anticipation of the penalties. Second, because readmission rates at the time of passage of the law would influence future penalties, hospitals were incentivized to reduce readmissions starting in 2010 (Figure 1). Although we made our decision before we examined the data, visual inspection of the data confirmed an inflection point in readmission rates occurring at the time the law was passed. To assess the effect of the law's passage, we defined a prelaw period of 40 quarters before passage of the law (1 January 2000 to 31 March 2010) and a postlaw period of 15 quarters after passage of the law (1 April 2010 to 31 December 2013). The span of the prelaw period was also varied in a sensitivity analysis (see Sensitivity Analysis section).

Statistical Analysis

In the main analysis, we used a 2-stage approach to test the following 2 hypotheses: 1) hospital-specific RSRRs have improved over time in the postlaw period, after control for any prelaw preexisting secular trends in each of the 4 performance groups; and 2) any increase in the rate of reduction in hospital RSRRs (postlaw vs. prelaw period) was greater for hospitals with lower performance than for those with higher performance.

Specifically, at the first stage of the hierarchical model, we specified and fitted a logistic regression to patient-level data to estimate the RSRRs for each quarter. At the second stage,

we specified and fitted a piecewise linear model with a change point placed at the time of passage of the ACA (the intervention point, between the prelaw and postlaw periods), with the estimated RSRRs from the first stage as the dependent variable (“trend model”). The equation is defined mathematically and represented visually in the Supplement (available at www.annals.org). For the trend models, we used generalized estimating equations with robust SEs and an autoregressive correlation structure. Unless otherwise specified, we report both the absolute proportion of readmitted patients and the rate of change in the RSRRs over time as the number of readmissions per 10 000 discharges per year.

Sensitivity Analysis

The piecewise model described earlier was fitted to the estimated RSRRs, ignoring that RSRRs may be more or less precise depending on hospital volume. Therefore, in a sensitivity analysis, we refitted our piecewise model weighted by hospital volume for each disease condition. We also adjusted for hospital characteristics in the piecewise linear models to control for hospital differences among performance categories. In a third sensitivity analysis, we performed the original statistical analysis using 15 quarters as the prelaw period, as opposed to the 40-quarter prelaw period used in the primary analysis. To assess whether our findings were sensitive to the performance group definitions, we repeated the analyses after recategorizing the performance categories into equally sized quartiles. We repeated the piecewise models using hospital-unadjusted readmission rates instead of the RSRRs as the dependent variable to detect any effect of the risk-adjustment methods on our main findings. Finally, we repeated the analysis using a full hierarchical model, with a logistic regression for patient-level data at the first stage and linear spline terms for the pre-post change at the second level. This full hierarchical model accounted for uncertainty in the estimation of the RSRR, clustering of the observations within hospitals and over time, and individual-level risk adjusters automatically. The drawback was that it was substantially more computationally intensive than fitting the stage 1 and 2 models as 2 separate regression models.

The RSRRs were estimated with SAS, version 9.3, 64-bit (SAS Institute). The fitting of the piecewise model and statistical tests were conducted with R, version 3.3.0, for Mac OS X 10.9 and higher (R Foundation for Statistical Computing) and can be made available for replication. Statistical testing was 2-sided, with a significance level of 0.05.

Role of the Funding Source

The National Institutes of Health and the Hassenfeld Scholars Program of the Cardiology Division at Massachusetts General Hospital had no role in the design, conduct, or analysis of this study or the decision to submit the manuscript for publication.

Results

In this analysis, 2868 hospitals met inclusion criteria (Figure 2, *top*). In the first year of HRRP penalties (fiscal year 2013 [1 October 2012 to 30 September 2013]), 866 of the 2868 hospitals (30.1%) were assigned to the highest-performance group, 1261 (44.0%) were assigned to the average-performance group, 483 (16.8%) were assigned to the low-

performance group, and 258 (9.0%) were assigned to the lowest-performance group. Characteristics of the hospitals are shown in Table 1, and the distribution of hospitals nationally by performance group is shown in the Supplement. Among the included hospitals, 15 170 008 patients were discharged alive, of whom 3 380 151 (22.9%) were readmitted within 30 days (Figure 2, *bottom*).

Compared with the highest-performing hospitals, those with the lowest performance served a greater percentage of black patients (13.1% vs. 7.3%; $P < 0.001$), female patients (56.7% vs. 53.1%; $P < 0.001$), and dual-eligible patients (26.1% vs. 17.0%; $P < 0.001$). They also had higher all-cause readmission rates after hospitalization for any condition (17.2% vs. 13.3%; $P < 0.001$); were more likely to be a major teaching hospital (11.2% vs. 6.1%; $P < 0.001$); were less likely to be a private, not-for-profit hospital (61.6% vs. 70.6%; $P < 0.001$); and were less likely to be in a rural setting (22.9% vs. 29.9%; $P < 0.001$).

Readmission Trends

Overall, risk-standardized readmissions increased by an estimated 0.5 (95% CI, 0.3 to 0.7) per 10 000 discharges per year before passage of the law and decreased by 76.6 (CI, 76.1 to 77.1) per 10 000 discharges per year after passage of the law. These trends differed for hospitals in different performance groups (Figure 3). During the prelaw period, we found that risk-standardized readmissions for combined conditions decreased by 1.4 (CI, 1.1 to 1.7) per 10 000 discharges per year in the highest-performance group, remained stable in the average-performance group (increase of 0.2 [CI, -0.02 to 0.5] per 10 000 discharges per year), increased by 2.3 (CI, 1.8 to 2.8) per 10 000 discharges per year in the low-performance group, and increased by 2.6 (CI, 1.8 to 3.5) per 10 000 discharges per year in the lowest-performance group (Table 2). During the postlaw period, risk-standardized readmissions decreased by 69.0 (CI, 68.2 to 69.7), 74.5 (CI, 73.9 to 75.1), 83.2 (CI, 82.0 to 84.3), and 92.4 (CI, 90.4 to 94.4) per 10 000 discharges per year, respectively (Table 2). After controlling for prelaw trends, we found that an additional 67.6 (CI, 66.6 to 68.4), 74.8 (CI, 74.0 to 75.4), 85.4 (CI, 84.0 to 86.8), and 95.1 (CI, 92.6 to 97.5) readmissions per 10 000 discharges were averted per year, respectively (Table 2). The number of readmissions averted was larger among lower-performance groups than higher-performance groups (Table 2).

For AMI, risk-standardized readmissions decreased by 23.7 (CI, 23.5 to 24.0) per 10 000 discharges per year before passage of the law and by 99.3 (CI, 98.6 to 100.1) per 10 000 discharges per year after passage of the law. For CHF, risk-standardized readmissions increased by 5.1 (CI, 4.8 to 5.3) per 10 000 discharges per year before passage of the law and decreased by 84.7 (CI, 83.9 to 85.4) per 10 000 discharges per year after passage of the law. For pneumonia, risk-standardized readmissions increased by 3.1 (CI, 2.9 to 3.4) per 10 000 discharges per year before passage of the law and decreased by 48.2 (CI, 47.7 to 48.8) per 10 000 discharges per year after passage of the law (Supplement).

For all 3 conditions, the number of averted readmissions was larger among lower-performance groups than higher-performance groups (Table 2). For AMI, after controlling for prelaw trends, we found that an additional 65.6 (CI, 63.6 to 67.2), 74.1 (CI, 72.8 to 75.2), 83.2 (CI, 80.8 to 85.2), and 93.3 (CI, 89.6 to 97.2) readmissions per 10 000 discharges were

averted per year in the highest-, average-, low-, and lowest-performance groups, respectively. For CHF, the corresponding numbers were 77.6 (CI, 76.4 to 79.2), 86.8 (CI, 85.6 to 88.0), 100.8 (CI, 98.4 to 102.8), and 112.0 (CI, 108.0 to 115.6) readmissions per 10 000 discharges, respectively. For pneumonia, the corresponding numbers were 46.0 (CI, 44.8 to 47.2), 50.4 (CI, 49.6 to 51.2), 56.4 (CI, 54.4 to 58.0), and 62.8 (CI, 60.0 to 66.0) readmissions per 10 000 discharges, respectively (Supplement).

Sensitivity Analysis

Our results were robust when we accounted for hospital volume, other hospital characteristics, the categorization of performance for hospitals, substitution of observed readmissions for risk-standardized readmissions, and the selection of the prelaw period (15 vs. 40 quarters before passage of the law). Our results were also similar in the full hierarchical model. Results of all sensitivity analyses are presented in the Supplement.

Discussion

In this analysis, we confirmed that readmission rates after hospitalizations for AMI, CHF, and pneumonia and for all 3 conditions combined improved nationally with the passage of the HRRP as part of the ACA in March 2010. Furthermore, we showed that low-performing hospitals had more accelerated improvement than hospitals with better performance, suggesting that the law led to a reduction in discrepancies in performance on this metric. Readmission rates for the lowest-performing hospitals were increasing before the law. Nevertheless, after passage of the law, the rate of decrease in RSRRs for penalized conditions was one-third greater than that of the highest-performing hospitals. Taken together, our main findings suggest that passage of the law was followed by widespread reductions in readmission rates, even with control for prelaw trends, and that this effect was most concentrated among the lowest-performing hospitals.

These findings are important because they suggest that implementation of the HRRP achieved its goal of accelerating reductions in hospital readmissions, particularly for the lowest-performing institutions. Because the financial penalties are applied to up to 3% of all inpatient revenue for each hospital, the magnitude of the reductions in readmissions shown here is likely to have had substantial financial implications for individual hospitals. For patients with heart failure at the lowest-performing hospitals, the readmission rate decreased from 26.5% in 2010 to 23.3% in 2013, a relative decrease of nearly one sixth over just 3 years.

These findings also contribute to a general understanding of how policies motivate health care providers to improve performance. Evidence that financial incentives improve the quality of care is mixed (12–15). In this case, Medicare began publicly reporting readmission metrics in 2009 on the Hospital Compare Web site (16), and providers would not have known that financial penalties would be tied to these metrics until passage of the bill. When passage of the law confirmed that these penalties would be forthcoming, provider organizations improved readmission rates over and above the preexisting trend. These findings suggest that coupling performance metrics to financial incentives may have more substantial effects on performance than public reporting alone.

Furthermore, a concerning potential outcome of the new policy was that low-performing hospitals might not be able to improve due to poor financial circumstances or insufficient infrastructure. At least in the initial phase, the magnitude of improvement in the lowest-performing hospitals was actually greater than in the higher-performing hospitals. Others have shown that HRRP penalties were applied disproportionately to hospitals that serve black patients and patients with lower levels of education and household income (17–20). Our results are consistent with those findings, although here we also tested for differences in longitudinal trends in readmission rates and acceleration of improvement across different performance groups.

The fact that lower-performing hospitals accelerated improvement more than higher-performing hospitals is likely multifactorial. First, lower-performing hospitals have more room for improvement. As such, our results may have been a form of “regression to the mean.” Even so, our results present strong evidence that passage of the law caused this change in hospital performance patterns. Second, because lower-performing hospitals are more likely to serve socially and economically disadvantaged patients, we could not distinguish between general improvement in lower-performing hospitals and improvement in the care of these specific patient groups in all hospitals. Distinguishing among the reasons that lower-performing hospitals achieved more accelerated improvement will be essential to sustaining improvement and reducing disparities in care between hospitals.

A key strength of our analysis is that our statistical approach minimized potential threats to validity that are common in the analysis of policy interventions, particularly confounding bias (history bias). This can occur when events that take place before or during the intervention have a greater effect than the intervention itself. To control for this source of potential bias, our statistical approach implemented a pre–post analysis, with the prelaw period serving as a control for the post-law period. Although this approach is useful for longitudinal analysis of the health effects of policy changes, it should be recognized that there is no natural control group that was unaffected by the policy intervention (21–24).

Our analysis should be interpreted in the context of important limitations. First, because this was an analysis of claims data, our results are subject to discrepancies due to inaccuracies of billing codes. Nevertheless, our methods to detect specific diagnoses are identical to the methods used by CMS to assess financial penalties. In addition, accuracy in the claims data is unlikely to have varied dramatically before and after passage of the law in a way that would explain our findings. Second, we cannot be certain that decreases in readmission rates were due to genuine improvements in quality, particularly in other domains. Third, we do not know whether these improved quality metrics will continue. These questions will be essential to examine in the future. Fourth, as a study of inpatient readmissions, this analysis could not detect the extent to which hospitals may have decreased inpatient readmissions by increasing observation readmissions (25). Fifth, we did not model comorbidities as having potential time dependence in their effect on readmissions, which may have affected our results. Finally, although we demonstrated that lower-performing hospitals showed the most accelerated improvement in readmission rates, our analysis cannot distinguish between improvement caused by the magnitude of the penalty and improvement caused by changes in

health status in different patient populations. Nevertheless, a sensitivity analysis that adjusted for patient and hospital characteristics did not alter our main findings.

In conclusion, improvement in RSRRs after AMI, CHF, and pneumonia accelerated after passage of the law. Compared with hospitals with the highest initial performance, those with the lowest performance had greater acceleration in the rate of improvement for all 3 conditions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Appendix: Requests for Data and Code Sharing

The SAS codes that were used to generate the analytic data sets and the R codes that were used to compute descriptive statistics, estimate statistical models, and generate graphs and maps will be made available for public use. The permanent URL of the replication material is <https://osf.io/5thx5>. Analytic data sets were created from Medicare data that cannot be shared, although they can be obtained from CMS (www.cms.gov) for purchase. However, the list of Medicare files that can be purchased from CMS and the SAS codes that were used to generate the analytic data sets are provided. These analytic data sets will be made

available, together with the associated R codes that were used to compute descriptive statistics, estimate statistical models, and generate graphs and maps.

The following 2-stage sharing process will be implemented:

1. We will give restricted access to the analytic data sets and R codes (with written permission from Dr. Wasfy), with the understanding that use of our material implies shared authorship.
2. Once the companion articles have been accepted for publication, we will give open access to the list of Medicare files, the analytic data sets, and the R codes, with the request that our material be properly cited.

Access to the SAS codes used to process Medicare files will remain restricted except for audits and other quality-control purposes.

Figure 1.
Timeline of Medicare public reporting, passage of health reform, and financial penalties.
CMS = Centers for Medicare & Medicaid Services; HRRP = Hospital Readmissions
Reduction Program.

Figure 2.

Included and excluded hospitals (*top*) and patients (*bottom*).

Hospitals not on the penalty list and those that did not exist during the entire study period were excluded.

Figure 3.

Estimated RSRRs, by quarter and by performance group, for all 3 conditions combined. Lines represent smoothed trends over time. The vertical dashed line is placed at the intervention point (31 March 2010). Q1 = first quarter; RSRR = risk-standardized readmission rate.

Table 1

Characteristics of Patients and Hospitals, by Initial Hospital Performance Group *

Characteristic	Performance Group				
	Highest	Average	Low	Lowest	Overall
Study population, <i>n</i>					
Total hospitals	866	1261	483	258	2868
Total annual discharges	311 920	467 000	217 350	113 270	1 109 530
Condition-specific discharges in the whole population, %					
Acute myocardial infarction	20.8	18.7	18.5	16.4	19.0
Congestive heart failure	42.8	44.9	47.1	47.7	45.0
Pneumonia	36.5	36.3	34.4	35.9	35.9
Patients					
Demographic characteristics					
Mean age (SD), <i>y</i>	79.5 (8.4)	79.5 (8.5)	79.5 (8.5)	79.8 (8.6)	79.5 (8.5)
Female, %	53.1	54.6	55.0	56.7	54.5
White, %	87.9	85.8	81.9	81.6	85.2
Black, %	7.3	9.6	13.4	13.1	10.1
Other race, %	4.8	4.5	4.7	5.3	4.7
Comorbidities, %					
History of congestive heart failure	33.2	36.1	39.1	41.8	36.5
History of acute myocardial infarction	6.9	7.3	7.9	8.3	7.4
Unstable angina	4.5	4.6	5.2	5.4	4.8
Chronic atherosclerosis	54.5	55.5	58.0	58.6	56.0

Characteristic	Performance Group				
	Highest	Average	Low	Lowest	Overall
Hypertension	61.5	63.7	65.6	67.5	63.8
Stroke	2.3	2.5	2.7	2.9	2.5
Cerebrovascular disease other than stroke	5.6	6.2	6.4	6.8	6.1
Renal failure	17.1	18.7	20.7	21.0	18.9
Chronic obstructive pulmonary disease	38.2	40.3	41.2	43.0	40.2
Pneumonia	20.9	22.6	23.5	26.0	22.7
Protein–calorie malnutrition	6.1	6.4	6.5	6.4	6.3
Dementia	12.3	13.7	14.3	16.2	13.7
Functional disability	3.4	3.9	4.3	4.7	3.9
Peripheral vascular disease	9.7	10.5	11.5	12.0	10.6
Metastatic cancer	9.5	9.8	10.2	10.4	9.9
Major psychiatric disorder	3.0	3.5	3.7	4.1	3.5
Chronic liver disease	1.1	1.2	1.3	1.4	1.2
Depression	8.7	9.2	9.2	9.7	9.1
Diabetes	34.8	36.1	37.9	39.1	36.4
Anemia	31.3	32.7	33.8	34.5	32.7
Asthma	3.7	3.7	3.9	4.3	3.8
Major discharge disposition and outcomes					
Discharged to home, %	56.2	52.2	50.1	47.0	52.4
Discharged to home with care, %	15.6	17.8	19.5	21.1	17.9

Characteristic	Performance Group				
	Highest	Average	Low	Lowest	Overall
Discharged to nursing home, %	21.7	23.3	23.4	25.2	23.0
Mean length of stay (SD), <i>d</i>	6 (4.8)	6 (5.0)	6 (5.5)	6 (5.7)	6 (5.1)
Observed readmission rate, %	19.9	22.0	24.2	26.3	22.3
Hospitals, %					
Located in a rural area	29.9	23.7	21.9	22.9	25.2
Private, not-for-profit hospital	70.6	62.4	66.2	61.6	65.4
Major teaching hospital	6.1	9.6	12.7	11.2	9.2
All admitted Medicare fee-for-service patients					
Median annual volume, <i>n</i>	2 539 620	3 783 810	1 694 920	825 410	8 843 770
Mean age (SD), <i>y</i>	78.0 (8.0)	78.1 (8.1)	78.2 (8.1)	78.6 (8.2)	78.1 (8.1)
Female, %	56.7	57.8	57.8	59.3	57.6
White, %	88.6	86.5	82.3	81.1	85.8
Black, %	7.0	9.1	13.0	13.2	9.6
Other race, %	4.4	4.4	4.7	5.7	4.6
Dual-eligible, % [†]	17.0	20.6	22.0	26.1	20.3
Outcomes, %					
30-d all-cause mortality rate	8.8	8.8	8.6	8.7	8.8
30-d all-cause readmission rate	13.3	14.4	15.8	17.2	14.6

* Percentages may not sum to 100 due to rounding.

All *P* values <0.001 for linear trends.

[†] Eligible for Medicaid and Medicare.

Table 2

Readmission Trends, Improvement in Readmission Trends Before and After Passage of the Law Within Each Performance Group, and Testing Differences in Pre-Post Changes Across All Performance Groups for Combined Conditions*

Performance Group	Risk-Standardized Readmission Rate per 10 000 Discharges			Readmissions per 10 000 Discharges per Year (95% CI), <i>n</i> [†]		
	2001	2010	2013	Prelaw	Postlaw	Difference
Highest	2253.1	2216.4	1983.1	-1.4 (-1.7 to -1.1)	-69.0 (-69.7 to -68.2)	-67.6 (-68.4 to -66.6)
Average	2269.6	2247.2	1996.7	0.2 (-0.02 to 0.5)	-74.5 (-75.1 to -73.9)	-74.8 (-75.4 to -74.0)
Low	2294.0	2285.1	2008.7	2.3 (1.8 to 2.8)	-83.2 (-84.3 to -82.0)	-85.4 (-86.8 to -84.0)
Lowest	2328.3	2322.1	2019.7	2.6 (1.8 to 3.5)	-92.4 (-94.4 to 90.4)	-95.1 (-97.5 to 92.6)
Performance Group Comparison	Difference in Risk-Standardized Readmission Rate per 10 000 Discharges			Difference in Readmissions per 10 000 Discharges per Year (95% CI), <i>n</i>		
	2001	2010	2013	Prelaw	Postlaw	Difference
Average vs. highest	-16.5	-30.8	-13.6	-1.7 (-2.0 to -1.3)	5.5 (4.6 to 6.5)	7.2 (6.0 to 8.3)
Low vs. highest	-40.9	-68.7	-25.7	-3.7 (-4.3 to -3.1)	14.2 (12.8 to 15.6)	17.9 (16.2 to 19.6)
Lowest vs. highest	-75.2	-105.6	-36.6	-4.1 (-4.9 to -3.2)	23.4 (21.3 to 25.6)	27.5 (24.9 to 30.1)

* Interpretation of the regression parameters is provided in the Supplement (available at www.annals.org).

[†] Negative values indicate averted readmissions; positive values indicate additional readmissions.