ARTICLE IN PRESS

Healthcare xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Healthcare

journal homepage: www.elsevier.com/locate/healthcare

Original research

Impact of a hospital bounceback policy to reduce readmissions

Nathan H. Moore[a,*], Emily D. Fondahn[a], Jack D. Baty[b], Melvin S. Blanchard[a]

[a] Department of Medicine, Washington University School of Medicine, St. Louis, USA
[b] Division of Biostatistics, Washington University School of Medicine, St. Louis, USA

1. Introduction

Nearly one in five Medicare patients is readmitted within 30 days of discharge, costing $26 billion – of which $17 billion may be avoidable.[1,2] Focus on avoiding readmissions has increased as the Centers for Medicare and Medicaid Services (CMS) introduced a penalty program for hospitals with excess rates of readmissions for patients with the so-called "big 4″ diagnoses: congestive heart failure (CHF), acute myocardial infarction (MI), pneumonia, and chronic obstructive pulmonary disease (COPD), as well as hip and knee replacements. In 2014, CMS penalized 2610 hospitals for a total of $428 million in penalties[3]; large, safety-net, and teaching hospitals are more likely to be penalized than other types of hospitals.[4] A number of studies have found that physician workload, scheduling, supervision, coordination and many other factors can affect readmission rates as well as length of stay. The penalty program has led to many new efforts to reduce readmissions, including several that focus on resident physicians.[5–7]

Resident and hospitalist medical services across the country commonly use a bounceback policy to determine the admitting physician for readmitted patients.[8–12] Patients readmitted to the hospital are assigned to the physician or care team that discharged them, regardless of that physician or team's call or admission schedule. These policies promote continuity of care as the care team already knows the patient and his or her medical issues. Additionally, the team learns about circumstances precipitating the readmission and can incorporate mitigation strategies into future discharge planning. The bounceback policy provides an additional incentive for physicians to ensure that their patients are not readmitted because admissions outside of scheduled call require extra work. Bounceback policies vary widely by institution in duration (e.g., the policy only applies for 7 days after discharge) and application (e.g., the policy only applies if the senior resident is still on service). Despite their widespread use, to date there have been no published studies on these policies or their effects on patient outcomes.

This study was conducted at a large academic tertiary safety-net healthcare center in the Midwest. Historically, the bounceback policy for the teaching service only applied if the patient was readmitted within 2 days of discharge, but in 2011 the policy was extended to 28 days. We hypothesized that the extension of the bounceback policy on the resident service would strengthen residents' incentive to avoid readmissions, leading to a reduction in readmissions for patients discharged from the resident service as compared to patients discharged from the hospitalist service. Additionally, we hypothesized that residents may keep patients in the hospital longer as one strategy to avoid readmissions, leading to an increased length of stay. Because the bounceback policy only applies while the senior resident is still on service, the potential for a bounceback declines over the course of a rotation. For example, a patient discharged on the 2nd day of a 28 day rotation would be eligible to bounceback for 26 days, whereas a patient discharged on the 20th day of that same rotation is only eligible to bounceback for 8 days. Therefore, the residents' incentive to avoid readmissions decreases over the course of a rotation, which may lead to time-dependent variations in length of stay and readmission rates.

2. Methods

Roughly half of the general medicine beds are covered by the hospitalist service and the other half by resident teams. The resident teams rotate off service every 28 days, while hospitalists rotate weekly. Patients admitted for general medicine care can be admitted to either a resident or hospitalist service (see Appendix). The bounceback policy for the resident service is that readmitted patients are accepted by the on-call team and then transferred to their original care team the next morning, regardless of their position in the call schedule, as long as the senior resident who discharged the patient is still on service. The original care team is then responsible for that patient's hospital care and discharge.

We compared outcomes among patients admitted to the general medical resident service to outcomes among patients admitted by the hospitalist general medical service for two years preceding and two years following institution of the bounceback policy on the resident service. Outcomes were adjusted for age, severity of illness, risk of mortality, gender, and race.

We used the hospitalist service as a control group, because the two services care for similar patient populations, share facilities and non-physician staff, and the bounceback policy on the hospitalist service did not change during the study period. The strength of this quasi-experimental difference-in-differences design is that it controls for secular trends that are correlated with patient outcomes, impacting both

* Correspondence to: Department of Internal Medicine, Washington University School of Medicine, Campus Box 8121, 660 South Euclid Avenue, Saint Louis, Missouri 63110, USA.
E-mail address: Moore.nathan@wustl.edu (N.H. Moore).

http://dx.doi.org/10.1016/j.hjdsi.2017.10.003
Received 23 September 2016; Received in revised form 23 October 2017; Accepted 25 October 2017
2213-0764/

Please cite this article as: Moore, N.H., Healthcare (2017), http://dx.doi.org/10.1016/j.hjdsi.2017.10.003

Table 1
Baseline values.

Characteristics	Resident service, before bounceback (n = 20 414)	Hospitalist service, before bounceback (n = 13 742)	Resident service, after bounceback (n = 20 149)	Hospitalist service, after bounceback (n = 11 813)
Age, mean (SD), y	55.3 (17.8)	59.4 (17.4)	55.3 (17.7)	58.4 (17.1)
Women	9716 (52.1)	6762 (53.3)	9693 (51.6)	5652 (51.3)
Race				
African-American	11041 (59.2)	4278 (33.8)	9909 (52.7)	3735 (33.9)
White	7172 (38.4)	8106 (63.9)	8513 (45.3)	7107 (64.5)
Other	443 (2.4)	293 (2.3)	378 (2.0)	174 (1.6)
Severity of Illness				
Extreme	1960 (10.5)	1437 (11.3)	2781 (14.8)	1887 (17.1)
Major	7155 (38.4)	5306 (41.9)	8148 (43.3)	4889 (44.4)
Moderate	6502 (38.9)	4320 (34.1)	5786 (30.8)	3259 (29.6)
Minor	3039 (16.3)	1614 (12.7)	2085 (11.1)	981 (8.9)
30-Day Readmission Rate	18.3%	20.8%	20.1%	24.9%
Length of Stay (SD), days	3.9 (4.3)	5.6 (6.9)	4.4 (5.2)	6.4 (8.4)
LOS Index (SD)	0.9 (0.7)	1 (0.8)	0.8 (0.8)	1 (0.8)

Note: Totals may not equal 100% due to rounding.

residents and hospitalists similarly.[13]

We obtained administrative claims data for patients admitted to the general medicine service from 6/15/09 to 6/16/13. We excluded patients admitted to or later transferred to an ICU, patients transferred to or from another service (e.g., neurology), and patients with specific diagnoses who are preferentially admitted to a resident or hospitalist service by hospital policy (e.g., bone marrow transplant patients). Data sets were extracted from the hospital's clinical database (Trendstar; McKesson Corporation). Because the bounceback policy was implemented in phases over the course of the first month of the 2011 academic year, we removed the first month of the academic year (July/Aug) from each year in our data set. The total number of patient admissions analyzed was 66,118.

Patients were stratified into the resident or hospitalist cohorts and as pre- or post- bounceback policy change. The unit of analysis was hospitalization; patients admitted more than once could be included in more than 1 cohort. Independent variables included age, sex, race, ICD-9 diagnosis code, severity of disease during the index hospitalization (minor, moderate, major, or extreme), University HealthSystem Consortium (UHC) risk of mortality (minor, moderate, major, or extreme), and the number of days following the beginning of the relevant 28 day resident rotation on which the patient was admitted. Outcomes measured included length of stay (LOS), UHC LOS index (the ratio of the actual LOS divided by the patient-specific LOS that would be expected at the time of admission),[14] and 30 day readmission. UHC risk adjusted outcomes have been validated and are widely used for research and benchmarking.[30] All readmissions were further classified as single (1 hospital readmission within 30 days) or recurrent (2 or more hospital readmissions within 30 days). Patients were grouped into clusters based on the admitting service and rotation. Each 28-day rotation of the resident physicians defined a cluster and each seven-day rotation of the hospitalist service defined a different cluster. Multiple regression analyses were performed using the SAS procedure SURVEYREG. Clustered standard errors were generated in the analyses though the inclusion of the clusters previously described.

A linear regression model was used to model log-transformed LOS and UHC LOS index as a function of a four-level categorical variable, representing the four cohorts of interest (pre-bounceback resident, post-bounceback resident, pre-bounceback hospitalist and post-bounceback hospitalist services). Approximate *t*-tests were subsequently used to test the effect of the bounceback policy, medicine service (resident or hospitalist), and the combination of bounceback policy and medicine service.

Thirty-day readmission rate was modeled with a log-binomial relative risk regression model[15] as a function of the same four-level categorical variable. In contrast to the adjusted odds ratio estimated by logistic regression, the log-binomial model estimates an adjusted relative risk ratio. Contrasts were used to assess the change in the thirty-day readmission rate associated with the medicine service and the change in bounceback policy. The result of each contrast was a relative risk ratio and a Wald-test p-value.

For readmission rate and LOS, both unadjusted and adjusted models were run. The unadjusted models contained only the four-level categorical variable while the adjusted models also contained age, severity of illness, UHC risk of mortality, gender, and race, both singly and in combination. A final adjusted model was run that contained the full set of independent variables and all the two-way interactions. Only the unadjusted model was run for UHC LOS index.

The effect of the day within rotation on LOS was examined with multiple linear regression models on the natural-log transformed LOS values. Both unadjusted models and adjusted models were examined. The unadjusted models contained only day of rotation, resident service, and bounceback policy while the adjusted models contained these variables as well as age, sex, race, severity of illness, and risk of mortality. Interactions between day of rotation and the other variables in the model were evaluated. The effect of day of rotation was calculated by multiplying the regression coefficient by 28 days and exponentiation of the result to calculate a geometric mean.

The effect of day of rotation on the thirty-day readmission rate was evaluated with multiple logistic regressions. Adjusted and unadjusted models were computed as described with respect to LOS and interactions with day of rotation were tested.

Given the focus of CMS on readmissions specifically for patients with COPD, CHF, acute MI and pneumonia, we performed a pre-specified subgroup analysis on patients with those primary diagnoses (identified by ICD-9 code) only. The same statistical tests were used for this subgroup.

Statistical analyses were performed using SAS version 9.4 (SAS Institute, Inc, Cary, NC, USA). P-values < 0.05 were used to indicate statistical significance.

3. Results

Table 1 shows the characteristics of patients admitted to the resident and hospitalist services before and after the bounceback policy was changed. Compared to patients on the resident service, patients on the hospitalist service were significantly older, more likely to be white, and had greater severity of illness. The resident service had significantly lower LOS, LOS index and readmission rates than the hospitalist service both before and after the bounceback policy was changed. Severity of illness for patients in both groups increased over the course of the study; the proportion of patients classified as major or extreme