Meaningful Use of Electronic Health Record and Patient Utilization Outcomes within 30 Days of Hospital Discharge

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Abstract

The HITECH Act authorized financial incentives to providers for adopting and using EHR to improve patient care. Through the Meaningful Use (MU) Programs, hundreds of thousands of providers have received incentives for complying with requirements that aim to stimulate the integration of EHR into daily practice. However, to date, there is limited evidence supporting that patients admitted to MU versus non-MU hospitals have better utilization outcomes within 30 days of discharge. We examined the pattern of utilization outcomes—within 30 days of hospital discharge to home—and found no evidence that patients admitted to MU hospitals had higher odds of timely follow-up, lower odds of ED utilization or readmission, compared with peers at non-MU hospitals. Further, we found no evidence of a protective effect of a timely follow-up against 30-day readmission. Improving patient utilization outcomes, during care transitions, will likely require additional interventions—beyond timely follow-up and hospitals using EHR.

Introduction

The United States Congress appropriated $27 billion to modernize the nation's health information systems infrastructure—via the Health Information Technology for Economic and Clinical Health (HITECH) Act of 2009[1]. The legislation authorized financial incentives to eligible providers for adopting and using electronic health record (EHR) to improve patient care[2]. Through the Meaningful Use (MU) Programs, launched in 2011, hundreds of thousands of providers have received incentives for complying with requirements that aim to stimulate the integration of EHR into daily practice[3]. Specifically, MU policy priorities target, for instance, improvements in quality, safety, efficiency, and patient/caregiver education—while focusing on clinical information exchange and care coordination[3,4]. Hence, it is likely that hospitals with MU designation could markedly improve inpatient care, promote effective communication among providers across settings, and support continuity of care to enable safe transitions and avoid overuse. However, to date, there is limited evidence supporting that patients admitted to MU versus non-MU hospitals have better utilization outcomes, within 30 days of discharge to home.

We therefore aimed to fill this research gap by determining whether being admitted to MU versus non-MU hospitals could 1) raise patient odds of timely ambulatory follow-up; 2) reduce patient odds of emergency department (ED) utilization; and 3) further reduce patient odds of readmission—beyond a direct effect on readmission—via a timely ambulatory follow-up.

Improving the pattern of utilization outcomes after hospitalization is critically important for Medicare patients enrolled in the Fee-for-Service program. Nearly 20% of patients are readmitted, within 30 days of discharge, costing the program an estimated $17 billion annually[5]. And, just as it is important to monitor and curb unnecessary readmission, it is equally important to monitor and curb ED overuse. The ED is not the ideal setting for longitudinal care, and it is relatively costly, particularly for care that can be provided in ambulatory setting. This suggests there could be opportunities for reducing cost and for improving patient experience with care.

Materials and Methods

Study Design

We merged Medicare enrollment and claims files, for 2012, for roughly 180,000 patients with publicly available MU records for 160 hospitals (2011-2012), corresponding to MU Stage-1, other hospital and market data. We followed Medicare methodology for the construction of the hospital-wide all cause readmission measure to establish our patient cohorts. We used a posttest only quasi-experimental evaluation design, with nonequivalent groups[6], to study the effect of being admitted to MU hospitals on the pattern of patient utilization outcomes, including 1) timely ambulatory follow-up, defined as an evaluation and management service in ambulatory setting occurring within 14 days of discharge—*before* a readmission *or* ED visit occurs; 2) 30-day ED utilization; and 3) 30-day readmission. These responses are binary and coded '1' for event occurrence, and '0' otherwise.

In the absence of randomization of patients to MU and non-MU hospitals (or to receive a timely follow-up and not), there exist potential risks of confounding that could obscure the relationship between exposure and outcome[6,7]. We addressed these threats to internal validity by using propensity-score based methods[8]. Specifically, to evaluate the effect of exposure to MU hospitals on utilization, we combined inverse probability of treatment weighting (IPTW)—using the propensity scores (PSs)—with two-level, multivariable logistic regressions[9,10]. And, to test for mediation, we exploited weighted, two-level structural equation modeling combined with regression adjustment—using the logit of the PSs of timely follow-up to reduce potential confounding in the mediator-outcome relationship. The weights and logit of the PSs were applied for bias reduction by improving comparability between the two groups of patients.

Estimating Propensity Scores and Weights

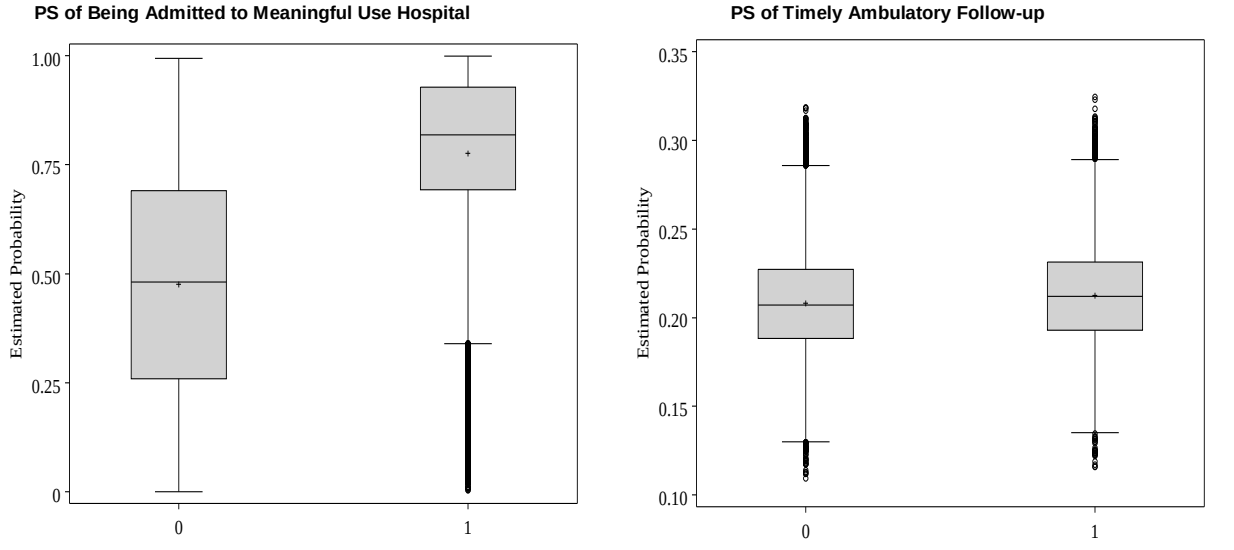
Using a single-level logistic regression, we estimated the selection mechanism predicting patient assignment to hospitals to obtain the PSs. Given there could be confounders at every level of the hierarchy because of the nested structure of the data, we adjusted for patient, market, and hospital characteristics—of known theoretical or empirical or policy relevance, measured at baseline—that could potentially influence the probability of receiving care at MU hospitals and the utilization outcomes[9,11]. Next, we computed the IPTW weights, using the inverse of the estimated PSs. And, to reduce the influence of patients with extreme weights, we calculated *stabilized-IPTW* weights by weighing the IPTW weights with a constant equal to the mean value of patients being in their respective groups. We used the same set of weights to fit the outcome models for each response. Similarly, we estimated the PSs of timely follow-up. However, we applied the logit of the PSs for covariate adjustment. (See Figure 1 for the distribution of estimated PSs for the two groups of patients.) We assessed statistical significance at the 5% threshold.

IPTW weights are analogous to survey sampling weights. Whereas the latter are used to increase external validity, IPTW weights are used to increase internal validity. IPTW is easy to implement, which explains its increasing popularity in applied work[9]. Alternatively, to reduce bias in the posttest only design, intervention effects can be estimated using PS matching or stratification on the PSs. We used SAS 9.4 version 14.1 and MPlus 7.4 (Muthen & Muthen) to estimate intervention effects using generalized linear mixed models (GLMM).

Results

68% of patients received care at MU hospitals (N = 180,000). Compared to otherwise identical peers, patients admitted to MU hospitals had similar odds of timely ambulatory follow-up (OR = 1.00, 95% CI: 0.95-1.07; p = .873); of 30-day ED utilization (OR = 1.07, 95% CI: 0.94-1.21; p = .294); and of 30-day readmission (OR = 1.00, 95% CI: 0.93-1.06; p = .919). (See Table 1 for select results.) Further, we found no evidence of an indirect effect of being admitted to MU hospitals on 30-day readmission via a timely ambulatory follow-up (results not reported).

Figure 1. Distribution of Propensity Scores Among Hospitalized Patients



PS: propensity score. 0 = admitted to non-MU hospital vs. 1 = admitted to MU hospital. 0 = without timely follow-up vs. 1 = with timely follow-up.

Table 1. Predictors of Patient Utilization Outcomes within 30 Days of Hospital Discharge to Home
(Odds Ratio, OR, and 95% Confidence Interval, CI)

Variable	*Timely Ambulatory Follow-up**	*p-value*	*30-Day ED Utilization*	*p-value*	*30-Day Readmission*	*p-value*
MU (Admitted to Meaningful Use hospital)	**1.00 (0.95-1.07)**	**.873**	**1.07(0.94-1.21)**	**.294**	**1.00 (0.93-1.06)**	**.919**
Patient Characteristics						
Prior Utilization	-	-	1.11 (1.10-1.12)	<.0001	1.24 (1.21-1.27)	<.0001
Dually Eligible for Medicare/Medicaid	1.06 (1.01-1.12)	.020	0.93 (0.87-0.99)	.015	1.18 (1.12-1.24)	<.0001
Female Gender	1.07 (1.04-1.11)	<.0001	0.99 (0.95-1.04)	.694	0.92 (0.88-0.96)	<.0001
Patient Cohort						
Medicine	*Reference*		*Reference*		*Reference*	
Cardiovascular	0.96 (0.89-1.04)	.317	1.37 (1.29-1.46)	<.0001	0.88 (0.80-0.96)	.007
Cardiorespiratory	0.93 (0.88-0.98)	.010	1.14 (1.07-1.21)	<.0001	1.05 (0.99-1.11)	.126
Neurology	1.07 (0.97-1.18)	.187	0.98 (0.91-1.06)	.684	0.82 (0.76-0.88)	<.0001
Surgery	0.86 (0.81-0.91)	<.0001	0.92 (0.86-0.98)	.007	0.63 (0.59-0.68)	<.0001
Patient MS-DRGs Weight						
Quartile 1 (lowest illness severity)	*Reference*		*Reference*		*Reference*	
Quartile 2	0.92 (0.88-0.97)	.004	0.93 (0.88-0.98)	.008	1.29 (1.19-1.39)	<.0001
Quartile 3	0.81 (0.77-0.86)	<.0001	0.82 (0.78-0.8)	<.0001	1.43 (1.28-1.59)	<.0001
Quartile 4	0.92 (0.86-0.98)	.007	0.81 (0.74-0.88)	<.0001	1.55 (1.40-1.71)	<.0001

Propensity score-weighted two-level logistic regressions fitted with SAS *PROC GLIMMIX*—using maximum likelihood estimation. * A timely follow-up is defined as an evaluation and management service occurring within 14 days of discharge before readmission or emergency department (ED) utilization occurs. MS-DRGs indicates Medicare Severity Diagnosis Related Groups.

Conversely, we found strong associations between patient characteristics and outcomes. For instance, patients with a history of prior utilization or higher illness severity—the most proximate determinants of utilization[12]—experienced higher odds of readmission, a finding in line with the literature on readmission[5] (Table 1). At the market level, we found that hospital supply was inversely related to outcomes. Interestingly, we found that physicians' adoption of EHR was associated with lower odds of 30-day ED utilization and readmission. Given that readmissions happen, by definition, once the patient has left the hospital walls, it is possible that this outcome is more heavily influenced by outpatient providers than by hospitals. Overall, hospital characteristics were weakly related to utilization outcomes (results not reported).

Discussion

We examined the pattern of utilization outcomes—within 30 days of discharge to home—for a sample of previously hospitalized Medicare patients in 2012. We found no evidence that patients admitted to MU hospitals had better utilization outcomes, including higher odds of timely ambulatory follow-up, lower odds of ED utilization or readmission, compared to otherwise identical peers at non-MU hospitals. Further, we found no evidence of a protective effect of a timely ambulatory follow-up against 30-day readmission.

It remains unclear why MU was not linked with superior post-discharge outcomes during care transitions. The MU designation implies that hospitals have been able to meet high standards of adoption and use of EHR systems, which provide tools that may help to a) improve the quality and safety of inpatient care, b) support patient/caregiver education, and c) facilitate communication and care coordination among providers to improve care transitions[4].

A possibility for why we did not find an association of MU with outcomes is that MU, in its early stages, does not address key patient-centered elements of care. Thus, our findings suggest the need to strengthen the Medicare EHR Incentive Program along the dimension of patient and family engagement—one of the MU objectives that providers had difficulty meeting in 2011-2012[4]. To improve post-discharge outcomes, it is imperative to educate and engage patients and caregivers, who are important partners for achieving desirable outcomes.

Limitations

Our study has limitations. First, we evaluated MU Stage-1. Thus, it is possible that increased requirements under future stages may produce significant improvements in transitional care. Second, we focused on elderly patients in some specific markets, suggesting that our findings may not generalize to a younger, technologically savvier population, or to other areas. Third, we analyzed patient follow-up using claims data. This implies that we were unable to analyze other methods of follow-up, including phone calls or electronic communications. Fourth, it is possible that other interventions, such as the Hospital Readmissions Reduction Program (HRRP), may have biased our results toward the null.

Regarding the methods, there are risks of model misspecifications, possibly associated with unmeasured confounders and/or omission of interactions or higher order terms, that can potentially bias our results. However, we adjusted for a comprehensive set of covariates and tested for the most plausible interactions. Finally, because our study is observational, we cannot establish a definitive claim of causality.

Conclusion

Compared to otherwise identical peers at non-MU hospitals, patients admitted to MU hospitals did not have better utilization outcomes within 30 days of discharge to home. It is possible that focusing the MU program on patient/caregiver health education, and engagement, may hold promise for improving the effectiveness of EHR-based interventions. However, improving utilization outcomes, and patient experience with care, will likely require additional interventions—beyond timely clinical follow-up and hospitals using EHR systems.

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