Effect of Standardized Electronic Discharge Instructions on Post-Discharge Hospital Utilization

John W. Showalter, MD[1,2], Colleen M. Rafferty, MD, MPH[3], Nicole A. Swallow, MD[3], Kolapo O. DaSilva, MD[4], and Cynthia H. Chuang, MD, MSc[3,5]

[1]Department of Medicine, Penn State College of Medicine, Hershey, PA, USA; [2]Department of Information Technology, Penn State College of Medicine, Hershey, PA, USA; [3]Division of General Internal Medicine Penn State College of Medicine, Hershey, PA, USA; [4] Penn State College of Medicine, Hershey, PA, USA; [5]Department of Public Health Sciences, Penn State College of Medicine, Hershey, PA, USA.

BACKGROUND: Several physician organizations and the Centers for Medicare and Medicaid Services (CMS) support compliance measures for written discharge instructions. CMS has identified clear discharge instructions with specific attention to medication management as a necessary intervention.

OBJECTIVE: We tested the hypothesis that implementing a standardized electronic discharge instructions document with embedded computerized medication reconciliation would decrease post-discharge hospital utilization.

DESIGN: Retrospective pre- and post-implementation comparison cohort study.

PATIENTS: Subjects were hospitalized patients age 18 and older discharged between November 1, 2005 and October 31, 2006 (n=16,572) and between March 1, 2007 and February 28, 2008 (n=17,516).

INTERVENTION: Implementation of a standardized, templated electronic discharge instructions document with embedded computerized medication reconciliation on December 18, 2006.

MAIN MEASURES: The primary outcome was a composite variable of readmission or Emergency Department (ED) visit within 30 days of discharge. Secondary outcomes were the individual variables of readmissions and ED visits within 30 days.

KEY RESULTS: The implementation of standardized electronic discharge instructions with embedded computerized medication reconciliation was not associated with a change in the primary composite outcome (adjusted OR 1.04, 95% CI 0.98–1.10) or the secondary outcome of 30-day ED visits (adjusted OR 0.98, 95% CI 0.98–1.10). There was an unexpected small but statistically significant increase in 30-day readmissions (adjusted OR 1.08, 95% CI 1.01–1.16).

CONCLUSIONS: Implementation of standardized electronic discharge instructions was not associated with reduction in post-discharge hospital utilization. More studies are needed to determine the reasons for post-discharge hospital utilization and to examine outcomes associated with proposed process-related recommendations.

KEY WORDS: medical informatics; hospital medicine; performance measurement; readmission; health care utilization.
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INTRODUCTION

Hospital readmissions are frequent and costly. Jencks and colleagues estimated that in 2004 nearly one-fifth of hospitalized elderly patients were readmitted within 30 days, leading to an estimated cost of $17.4 billion.[1] Patients often have a poor understanding of their diagnoses and medications at time of discharge,[2] suggesting that some readmissions may be preventable by improving care transitions at the time of discharge. Other studies have shown that 14% of elderly patients have medication discrepancies at the time of discharge, and such discrepancies predispose to rehospitalization.[3,4] The Centers for Medicare and Medicaid (CMS) estimate that more than 13% of readmissions are potentially avoidable and have thus proposed strategies to motivate hospitals to avoid readmissions. Such strategies include reducing hospital reimbursement for readmissions and mandating public reporting of hospital-specific risk-adjusted readmission rates.[5]

CMS has proposed clear discharge instruction documents with specific attention to medication reconciliation as a strategy to improve transitions of care and thus reduce readmissions. In 2009, a multidisciplinary collaboration of professional medical organizations developed the Transition of Care Consensus Policy (TCCP) Statement that also proposed standardized discharge communication forms. Such forms were recommended to document principal diagnosis, problem list, a reconciled medication list, names of coordinating physicians, a description of the patient's cognitive status, and pending tests at the time of discharge.[6] However, whether standardizing discharge instruction in such a way actually reduces readmissions is unclear.

Studies investigating whether standardizing discharge instructions alone reduces readmissions have shown conflicting results. In patients with heart failure, one study has shown that documentation of discharge instructions was correlated with lower risk of hospital readmission.[7] However, another recent study showed no association between the provision of discharge instructions and 30-day readmission rate among heart failure patients.[8] In contrast, more comprehensive discharge interventions have successfully decreased post-hospital utilization—those programs have typically included not only standardized discharge instructions, but also planning by nurse discharge advocates and telephone medication follow-up by pharmacists.[9–12]

Limited resource availability at many hospitals make such complex discharge interventions difficult, so some hospitals are leveraging health IT resources in an attempt to improve discharge communications. At our institution, we sought to investigate whether hospital-wide implementation of a standardized electronic discharge instructions form that met criteria suggested by CMS and TCCP guidelines was associated with a reduction in 30-day hospital readmissions or ED visits.

METHODS

Setting and Intervention

This study was conducted at the Penn State Hershey Medical Center, a 501-bed academic medical center located in central Pennsylvania, which uses an electronic health record with computerized provider order entry. Prior to December 2006, the discharge instructions were generated from a word processing template completed by physicians or physician extenders. The document template contained fields for patient administrative information, diagnostic testing results, discharge medications, patient care instructions and follow-up appointments. The template was all free-text and no portion of the template was required to be completed. Medication reconciliation was a manual process of comparing admission medications with discharge medications to produce the discharge medication list. The physician or physician extender filled in the free-text areas they deemed necessary for each patient and then designated the document as complete. The document could be designated as complete regardless of how many sections of the template had been filled in. An internal chart review of discharge documentation from November 2005 to October 2006 revealed that less than 30% of discharge instructions documents had all fields completed, and only 50% had a discharge medication list documented.

In order to address these deficiencies and comply with the Joint Commission requirement to document medication reconciliation,[5] the hospital implemented a redesigned electronic discharge instructions document in December 2006. The redesigned discharge instructions included an electronic medication reconciliation process that auto-populated the home medication list, performed automated medication interaction and allergy checking, and converted medical terminology into patient-friendly dosing instructions. This redesigned document also included automated input of the admission date, discharge date, and the name of the physician of record. The document required the discharging physician or physician extender to complete the principal diagnosis, prescribed diet, activity guidelines, and follow-up appointments written in patient-friendly language. The document could not be finalized until all of these elements were completed.

Participants

All patients aged 18 and older discharged between November 1, 2005 and October 31, 2006 (pre-implementation cohort) and between March 1, 2007 and February 28, 2008 (post-implementation cohort) were eligible. The inclusion dates for the post-implementation cohort began 3 months after the implementation of the electronic discharge instruction process to allow for uptake of the new system. We excluded patients discharged from the Hematology/Oncology services because of high rates of planned and expected readmissions in this population.[1] The Transplant Surgery service was also excluded because our institution began performing a higher volume of liver transplants in late 2006, which we expected could affect the likelihood of readmission in the post-implementation period. We also excluded patients that were discharged from low volume services (less than 100 patients per year). This study was approved by the Penn State College of Medicine's Institutional Review Board.

Outcome Variables

The primary outcome was a composite variable indicating readmission or ED visit within 30-days of discharge. Readmission was defined as any patient readmitted to our hospital at least once within 30 days of discharge. Any ED visit resulting in admission to the hospital was considered a readmission. The unit of analysis was the index discharge, therefore multiple readmissions or ED visits within 30 days were only counted once. Secondary outcomes were the individual variables of the composite outcome: readmission within 30 days or ED visit within 30 days.

Covariates

Variables known to influence readmission were investigated as covariates. These include sociodemographics (age at index admission, sex, race), severity of illness, discharge disposition and diagnoses associated with high readmission.[1] Severity of illness has been well documented to affect the likelihood of hospital readmission.[13,14] In this study, we used the All Patient Refined Diagnostic Related Groups (APR-DRG) weight that has been used in previous studies as a measure of severity of illness and predicts readmission risk.[15] For the purpose of our analyses the APR-DRG weight was categorized in deciles. Discharge destination has been shown to affect the likelihood of hospital utilization,[16] so a variable indicating whether patients were discharged to home, an acute rehabilitation facility, a skilled nursing facility (SNF) or other location was included. Discharge diagnoses known to be associated with increased likelihood for readmission [chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF) and pneumonia] were included as covariates.[1] We included a variable of end-stage renal disease (ESRD), since use of dialysis has also been shown to be an independent predictor of readmissions.[1] Finally, we categorized index discharges according to the primary service line (Medicine, General Surgery, Heart and Vascular, Neurology/Neurosurgery, Obstetrics/Gynecology, Orthopaedics/Trauma, and Surgical Subspecialties).

Data Management and Statistical Analysis

Study variables were collected electronically from our institution's electronic medical record. We compared patient characteristics of the pre-implementation and post-implementation cohorts using chi-square tests. Unadjusted analysis using chi-square tests compared the rates of 30-day readmission and ED visits in the pre- vs. post-implementation cohorts. Multivariable logistic regressions were used to compare the likelihood of the primary and secondary outcomes in the pre-implementation and post-implementation cohorts, adjusting for age, sex, race, severity weighting (APR-DRG deciles), discharge destination, discharge diagnoses of COPD, CHF, and pneumonia, and the presence of ESRD. Although we initially tested the effect of the primary service line, there was no association with likelihood of readmission or ED visit in bivariate analysis, so this variable was not included in the final model. The study was powered to detect a difference in readmission or ED visits of greater than one percent between the pre- and post-implementation cohorts. All statistical analyses were performed using SAS, Version 9.1 (SAS Institute, Cary, NC).

Table 1. Characteristics of Patients Discharged Before and After Implementation of a Standardized Electronic Discharge Instruction Process (N=34,088)

Characteristic	Pre-implementation cohort n=16,572	Post-implementation cohort n=17,516	p-value
Age—n (%)			
<30	2,279 (13.8)	2,438 (13.9)	0.24
30–39	2,087 (12.6)	2,158 (12.3)	
40–49	2,333 (14.1)	2,521 (14.4)	
50–59	2,721 (16.4)	2,901 (16.6)	
60–69	2,526 (15.2)	2,797 (16.0)	
70–79	2,521 (15.2)	2,548 (14.6)	
80+	2,105 (12.7)	2,153 (12.3)	
Male sex—n (%)	7,363 (44.4)	7,804 (44.6)	0.82
Race—n (%)			
White	15,089 (91.1)	15,793 (90.2)	0.03
Black	684 (4.1)	808 (4.6)	
Hispanic/Latino	450 (2.7)	532 (3.0)	
Other	348 (2.1)	383 (2.2)	
Discharge destination—n (%)			
Home	14,126 (85.2)	14,863 (84.9)	<0.01
Acute rehab hospital	627 (3.8)	521 (3.00)	
Skilled nursing facility	1,057 (6.4)	1,209 (6.9)	
Other	762 (4.6)	923 (5.3)	
Severity weighting—n (%)			
1st Decile (lowest severity)	1,579 (9.5)	1,786 (10.2)	<0.01
2nd Decile	1,725 (10.4)	1,815 (10.4)	
3rd Decile	1,757 (10.6)	1,781 (10.2)	
4th Decile	1,691 (10.2)	1,721 (9.8)	
5th Decile	1,630 (9.8)	1,714 (9.8)	
6th Decile	1,660 (10.0)	1,743 (10.0)	
7th Decile	1,763 (10.6)	1,794 (10.2)	
8th Decile	1,674 (10.1)	1,642 (9.4)	
9th Decile	1,507 (9.1)	1,786 (10.2)	
10th Decile (highest severity)	1,580 (9.5)	1,730 (9.9)	
COPD—n (%)	124 (0.8)	154 (0.9)	0.18
CHF—n (%)	371 (2.2)	360 (2.1)	0.24
Pneumonia—n (%)	368 (2.2)	396 (2.3)	0.80
ESRD—n (%)	173 (1.0)	216 (1.2)	0.10

RESULTS

The total study population consisted of 34,088 patients, with 16,572 patients in the pre-implementation group and 17,516 patients in the post-implementation group (Table 1). Small but statistically significant differences existed between the groups with regard to race, discharge destination, and APR-DRG severity weight. The patients in the pre-implementation group were more likely to be white and discharged to home or an acute rehabilitation facility. The post-implementation group had more patients in the lowest and the highest two deciles of severity weighting.

In unadjusted analysis, there was no difference in the rate of the primary composite outcome (30-day readmission and ED visits) comparing the pre- and post-implementation cohorts (15.71% vs. 16.25%, p=0.17) (Table 2). With regard to the secondary outcome variables, we observed no difference in 30-day ED visits and a small but statistically significant increase in 30-day readmissions in the post-implementation cohort (10.21% vs. 11.00%, p=0.02). Compared with patients who were not readmitted, readmitted patients were more likely to be older, male, Black, discharged to SNF, have higher severity of illness, have a discharge diagnosis of COPD, CHF, or pneumonia, and have ESRD. ED visits were more likely in patients in the youngest and oldest age group, with the lowest rates of ED visits among patients in their 60s. Black and Hispanic patients, patients discharged to SNF, patients in the 2nd through 5th decile of severity of illness, and patients with a discharge diagnosis of CHF also had higher rates of ED visits.

After adjusting for covariates, multivariable logistic regression analysis (Table 3) revealed no significant differences in the likelihood of the primary composite outcome comparing the post-implementation to the pre-implementation cohorts (adjusted OR 1.04, 95% CI 0.98–1.10). Black race, Hispanic ethnicity, higher severity weighting, discharge diagnoses of COPD, CHF, and pneumonia, and presence of ESRD were significantly associated with the primary composite outcome.

There was an increased likelihood of the secondary outcome of 30-day readmission in the post-implementation cohort (adjusted OR 1.08, 95% CI 1.01–1.16). Age, increasing severity weighting, discharge diagnoses of COPD, CHF, and pneumonia, and presence of ESRD were significantly associated with higher odds of readmission. There was no difference in the secondary outcome of ED visits comparing the post-implementation to the pre-implementation cohort (adjusted OR 0.98, 95% CI 0.90–1.07). Age groups over 40 were less likely to have ED visits, whereas black and Hispanic patients were more likely to have ED visits. Patients with severity weighting in the 2nd–10th deciles were more likely to have ED visits than patients in the 1st decile, but there was no increasing trend with greater severity.

Table 2. Characteristics of Readmissions and ED Visits Within 30 Days of Index Discharge

Patient characteristics	30-Day Readmission or ED visits (composite outcome, N=5,451)		30-Day readmission N=3,618		30-Day ED visits, N=2,265	
	N (%)	p-value	N (%)	p-value	N (%)	p-value
Study cohort—n (%)		0.17		0.02		0.55
Pre-implementation	2,604 (47.8)		1,692 (46.8)		1,115 (49.2)	
Post-implementation	2,847 (52.2)		1,926 (53.2)		1,150 (50.8)	
Age—n (%)		<0.01		<0.01		<0.01
<30	688 (12.6)		345 (9.5)		397 (17.5)	
30–39	641 (11.8)		375 (10.4)		324 (14.3)	
40–49	753 (13.8)		478 (13.2)		338 (14.9)	
50–59	939 (17.2)		660 (18.2)		349 (15.4)	
60–69	802 (14.7)		610 (16.9)		254 (11.2)	
70–79	830 (15.2)		588 (16.3)		308 (13.6)	
80+	798 (14.6)		562 (15.5)		295 (13.0)	
Sex—n (%)		0.01		<0.01		0.06
Male	2,511 (46.1)		1,745 (48.2)		965 (42.6)	
Female	2,940 (53.9)		1,873 (51.8)		1,300 (57.4)	
Race—n (%)		<0.01		0.01		<0.01
White	4,891 (89.7)		3,291 (91.0)		1,976 (87.2)	
Black	296 (5.4)		174 (4.8)		164 (7.2)	
Hispanic/Latino	179 (3.3)		100 (2.8)		89 (3.9)	
Other	85 (1.6)		53 (1.5)		36 (1.6)	
Discharge destination—n (%)		<0.01		<0.01		<0.01
Home	4,561 (83.7)		2,935 (81.1)		1,984 (87.6)	
Acute rehab hospital	161 (3.0)		121 (3.3)		50 (2.2)	
Skilled nursing facility	506 (9.3)		382 (10.6)		173 (7.6)	
Other	223 (4.1)		180 (5.0)		58 (2.6)	
Severity weighting—n (%)		<0.01		<0.01		<0.01
1st Decile (lowest severity)	348 (6.4)		207 (5.7)		163 (7.2)	
2nd Decile	515 (9.5)		279 (7.7)		277 (12.2)	
3rd Decile	511 (9.4)		276 (7.6)		281 (12.4)	
4th Decile	583 (10.7)		378 (10.5)		260 (11.5)	
5th Decile	627 (11.5)		427 (11.8)		257 (11.4)	
6th Decile	594 (10.9)		411 (11.4)		224 (9.9)	
7th Decile	589 (10.8)		402 (11.1)		233 (10.3)	
8th Decile	458 (8.4)		308 (8.5)		183 (8.1)	
9th Decile	573 (10.5)		429 (11.9)		192 (8.5)	
10th Decile (highest severity)	651 (12.0)		500 (13.8)		194 (8.6)	
COPD—n (%)	66 (1.2)	<0.01	49 (1.4)	<0.01	19 (0.8)	0.90
CHF—n (%)	200 (3.7)	<0.01	157 (4.3)	<0.01	63 (2.8)	0.03
Pneumonia—n (%)	165 (3.0)	<0.01	123 (3.4)	<0.01	55 (2.4)	0.53
ESRD—n (%)	96 (1.8)	<0.01	76 (2.1)	<0.01	26 (1.1)	0.98

DISCUSSION

At our institution, the implementation of electronic standardized discharge instructions including automated medication reconciliation was not associated with decreased rates of 30-day readmissions and ED visits or ED visits alone. Our null findings support other studies that have also shown that improving the discharge instructions and medication reconciliation process alone has not been associated with decreases in 30-day readmissions. Graumlich and colleagues found no difference in readmission rates in a small randomized trial comparing a handwritten discharge document to an electronic discharge instruction form with medication reconciliation and automated communication to outpatient providers.[17] More recently, Jha et al. reported no differences in 30-day readmission rates in CHF patients with and without disease-specific discharge instructions.[8] Grafft and colleagues showed no differences in readmission rates in general medicine patients with and without follow-up appointments documented on discharge instructions.[15]

Instead of the hypothesized decrease in readmissions in response to the new discharge instructions, we observed a small but statistically significant increase in one of the secondary outcome variables—30-day readmissions. One possible explanation for this observed increase is chance. It is also possible that improving the discharge instructions to inform patients of worrisome symptoms that should prompt a return to the ED may have led to increased return visits to the ED and subsequent readmissions.

While the implementation of the standardized electronic discharge instructions did not result in decreased post-discharge hospital utilization, we conducted post-hoc subgroup analyses to determine whether particular groups of patients (age groups, sex, race, discharge destination, severity weighting, discharge diagnoses/comorbidities) benefited from the new standardized discharge instruction process. The implementation of the discharge instructions was associated with a decline in 30-day ED visits (adjusted OR 0.78, 95% CI 0.62–0.98) among 30–39 year olds, but there was no association with the primary or secondary outcomes for any other subgroup investigated.

Table 3. Logistic Regression Modeling Association of Standardized Discharge Instruction Implementation and Study Outcomes (N=34,077)

Patient characteristics	30-Day readmission or ED visits (composite outcome)	30-Day readmission	30-Day ED visits
	Adjusted OR (95% CI)	Adjusted OR (95% CI)	Adjusted OR (95% CI)
Study cohort			
Pre-implementation	Reference	Reference	Reference
Post-implementation	1.04 (0.98–1.10)	1.08 (1.01–1.16)	0.98 (0.90–1.07)
Age			
<30	Reference	Reference	Reference
30–39	1.00 (0.89–1.12)	1.18 (1.01–1.38)	0.86 (0.74–1.00)
40–49	0.94 (0.83–1.05)	1.20 (1.03–1.39)	0.74 (0.63–0.86)
50–59	0.98 (0.88–1.10)	1.35 (1.17–1.56)	0.66 (0.56–0.77)
60–69	0.85 (0.75–0.95)	1.26 (1.09–1.46)	0.51 (0.43–0.60)
70–79	0.91 (0.81–1.03)	1.23 (1.06–1.43)	0.66 (0.56–0.77)
80+	0.99 (0.87–1.13)	1.30 (1.11–1.52)	0.71(0.59–0.85)
Sex			
Male	Reference	Reference	Reference
Female	0.99 (0.93–1.05)	0.95 (0.88–1.02)	1.04 (0.95–1.14)
Race			
White	Reference	Reference	Reference
Black	1.34 (1.17–1.53)	1.18 (1.00–1.39)	1.70 (1.44–2.02)
Hispanic/Latino	1.24 (1.04–1.46)	1.07 (0.86–1.32)	1.35 (1.08–1.69)
Other	0.78 (0.62–0.99)	0.88 (0.60–1.06)	0.74 (0.52–1.04)
Discharge destination			
Home	Reference	Reference	Reference
Acute rehab hospital	0.82 (0.69–0.98)	0.91 (0.74–1.11)	0.69 (0.51–0.92)
Skilled nursing facility	1.35 (1.20–1.51)	1.47 (1.29–1.67)	1.17 (0.97–1.40)
Other	0.72 (0.62–0.83)	0.86 (0.73–1.01)	0.51 (0.39–0.67)
Severity weighting			
1st Decile (lowest severity)	Reference	Reference	Reference
2nd Decile	1.48 (1.27–1.71)	1.17 (0.96–1.41)	1.93 (1.57–2.36)
3rd Decile	1.47 (1.26–1.70)	1.14 (0.94–1.38)	2.00 (1.63–2.45)
4th Decile	1.65 (1.41–1.92)	1.43 (1.19–1.73)	2.00 (1.61–2.47)
5th Decile	1.95 (1.68–2.26)	1.79 (1.49–2.15)	2.11 (1.70–2.61)
6th Decile	1.76 (1.51–2.04)	1.63 (1.36–1.97)	1.77 (1.42–2.20)
7th Decile	1.76 (1.51–2.04)	1.65 (1.37–1.98)	1.81 (1.46–2.25)
8th Decile	1.47 (1.26–1.72)	1.36 (1.12–1.65)	1.58 (1.26–1.99)
9th Decile	1.86 (1.60–2.17)	1.89 (1.58–2.28)	1.66 (1.32–2.08)
10th Decile (highest severity)	2.28 (1.96–2.66)	2.32 (1.93–2.79)	1.80 (1.43–2.27)
COPD	1.59 (1.20–2.11)	1.75 (1.27–2.41)	0.99 (0.61–1.59)
CHF	1.94 (1.62–2.32)	2.26 (1.86–2.75)	1.30 (0.98–1.72)
Pneumonia	1.35 (1.12–1.61)	1.53 (1.25–1.87)	0.99 (0.75–1.32)
End-stage renal disease	1.44 (1.13–1.82)	1.59 (1.23–2.06)	0.97 (0.65–1.45)

The covariates that influenced the likelihood of post-hospital utilization in our analyses were age, race, illness severity, and presence of comorbidities (CHF, COPD, pneumonia, and ESRD). These findings are similar to those reported by Jencks and colleagues who also identified these risk factors as associated with readmissions in their study.[1] It is likely that these patient-specific and disease-specific risk factors will be unaffected by standardized communication interventions, such as improved discharge instructions that are not targeted to disease-specific individualized risks. However, these factors may be useful in identifying certain patient populations at particularly high risk for readmission, and as such help to focus efforts on developing successful strategies to decrease the rates of readmission in these high-risk groups.

Strengths of this study are the large sample size, inclusion of patients of all insurance types, all discharge dispositions, and hospital-wide inpatient clinical services. Previous studies examining readmissions have generally been limited to patients on general medical services or Medicare patients alone. The large sample size allowed us to develop a robust logistic regression model that included multiple covariates and was sufficiently powered to detect even small differences in the outcome variables.

Our study has several limitations. We did not have data on readmissions or ED visits to other hospitals, leading to a potential underestimation of post-discharge hospital utilization. However, we expect that the likelihood that a patient would seek post-hospital care at our institution versus another would not have changed between the pre- and post-implementation periods and therefore would not result in biasing the main effect of the intervention. Our study did not evaluate patient understanding of the discharge instructions—although health literacy is likely an important variable for assessing readmission risk, we do not anticipate that there would have been a difference in health literacy between the pre-implementation and post-implementation patient cohorts. Additionally, we did not assess the availability, timeliness, or quality of outpatient follow-up services, but we are unaware of any major fluctuations in the availability of outpatient services in the geographic area over the time period of our study. Finally, our pre- and post-implementation cohorts did differ significantly on several key variables, namely race, discharge disposition, and disease severity. While these variables were adjusted for, residual confounding is a possibility.

While we believe that having a standardized discharge instructions process is necessary, our findings suggest that this change alone will not sufficiently address the complex issues around post-discharge hospital utilization. Multi-faceted interventions that comprehensively address numerous aspects of the discharge process will be more likely to have a meaningful impact on post-hospital utilization, such as discharge conversations between health care providers and patients/caregivers, patient health literacy, appropriate post-hospital follow-up, and communication with outpatient providers.[9–11] Although health IT initiatives are likely a necessary building block for achieving national health care quality goals, whether they result in intended outcomes needs to be evaluated closely. Additional work is needed to further understand the reasons for preventable hospital readmissions and post-discharge ED visits, to examine the outcomes associated with current reporting mandates, and to determine the most cost-effective discharge processes that minimize preventable post-discharge hospital utilization.

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Corresponding Author: *John W. Showalter, MD; Department of Medicine, Penn State College of Medicine, 500 University Drive, Mail Code HS04, Hershey, PA 17033, USA (e-mail: jshowalter@hmc.psu.edu).*

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