The Impact of Hospitalist Discontinuity on Hospital Cost, Readmissions, and Patient Satisfaction

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BACKGROUND: Achieving patient–physician continuity is difficult in the inpatient setting, where care must be provided continuously. Little is known about the impact of hospital physician discontinuity on outcomes.

OBJECTIVE: To determine the association between hospital physician continuity and percentage change in median cost of hospitalization, 30-day readmission, and patient satisfaction with physician communication.

DESIGN: Retrospective observational study using various multivariable models to adjust for patient characteristics.

PARTICIPANTS: Patients admitted to a non-teaching hospitalist service in a large, academic, urban hospital between 6 July 2008 and 31 December 2011.

MAIN MEASURES: We used two measures of continuity: the Number of Physicians Index (NPI), and the Usual Provider of Continuity (UPC) index. The NPI is the total number of unique physicians caring for a patient, while the UPC is calculated as the largest number of patient encounters with a single physician, divided by the total number of encounters. Outcome measures were percentage change in median cost of hospitalization, 30-day readmissions, and top box responses to satisfaction with physician communication.

KEY RESULTS: Our analyses included data from 18,375 hospitalizations. Lower continuity was associated with modest increases in costs (range 0.9–12.6 % of median), with three of the four models used achieving statistical significance. Lower continuity was associated with lower odds of readmission (OR=0.95–0.98 across models), although only one of the models achieved statistical significance. Satisfaction with physician communication was lower, with less continuity across all models, but results were not statistically significant.

CONCLUSIONS: Hospital physician discontinuity appears to be associated with modestly increased hospital costs. Hospital physicians may revise plans as they take over patient care responsibility from their colleagues.

KEY WORDS: continuity of care; health care costs; health services research; hospital medicine.

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INTRODUCTION

Continuity of care occurs when healthcare is provided by the same professional over time. In the outpatient setting, greater continuity has been associated with better hypertensive control, lower risk of hospitalization, fewer emergency department visits, higher patient satisfaction, and higher physician satisfaction.^{1–4} Achieving continuity is difficult in the inpatient setting, where care must be provided continuously. Fletcher et al. showed that between 1996 and 2006, Medicare patients experienced declining levels of physician continuity during their hospitalizations.⁵ Interestingly, the decline was independent of whether hospitalists or primary care physicians cared for patients in the study.

Little is known about the association between physician continuity and outcomes in the hospital setting. Epstein et al. also reported that decreased continuity of care was associated with longer hospital length of stay.⁶ Though provocative, the study is limited in that continuity and length of stay are interrelated. As a patient's length of stay increases, so does the likelihood of discontinuity. Discontinuity, in turn, may result in inefficiencies that lengthen the patient's hospitalization.

Physician continuity during hospitalization may be associated with important outcomes other than length of stay. Transfers of patient care responsibility from one hospital physician to another may result in loss of important clinical information, potentially resulting in unnecessary tests and/or treatments. Additionally, transfers of patient care challenge physicians' ability to establish rapport with their patients, potentially affecting patient satisfaction.

We sought to examine the relationship between the continuity inpatients experience exclusively from hospitalists and three important outcomes: percentage change in median cost of hospitalization, 30-day readmission rates, and patient satisfaction with physician communication.

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METHODS

Setting and Study Design

This study was conducted at Northwestern Memorial Hospital (NMH), an 897-bed tertiary care teaching hospital in Chicago, Illinois, and was approved by the Institutional Review Board of Northwestern University. This observational study involved patients admitted to an adult non-teaching hospitalist service between 6 July 2008 and 31 December 2011. Hospitalists cared for patients independently without the assistance of resident physicians. Hospitalists worked for seven consecutive days, with clinical rotations typically beginning on Mondays and ending on Sundays. Nighttime admissions and coverage for urgent issues was provided by night hospitalists working from 7PM to 7AM.

Acquisition of Study Population Data

Patient data was obtained from the Northwestern Medicine Enterprise Data Warehouse (EDW), an integrated database including information from the hospital's electronic health record (PowerChart Millennium® from Cerner Corporation), hospital and physician billing systems, and admission/discharge/transfer system. We identified all patients admitted to the nonteaching hospitalist service using the EDW. We excluded patients admitted under observation status, those initially admitted to other services (e.g., intensive care, general surgery), those discharged from other services, and those cared for by non-physician providers.

Predictor Variables

For measuring physician continuity throughout a hospitalization, we identified physician authors of the history and physicals (H&P) and progress notes throughout patients' hospitalizations. In the event that multiple progress notes were written on a given day, we selected the one used for billing. We used two measures of continuity: the Number of Physicians Index (NPI), and the Usual Provider of Continuity (UPC) index.^{7,8} The NPI, in this context, is the total number of unique authors of H&Ps and/or progress notes for a patient. The UPC is calculated as the largest number of notes written by a single physician divided by the total number of notes written for a patient. For example, if physician A wrote notes on the first 3 days of a patient's hospital stay and physician B wrote notes on the subsequent 2 days (total stay=5 days), the NPI would be 2 and the UPC would be 0.6. A reduction in continuity occurs with higher NPI and lower UPC values.

Outcome Variables

Cost of hospitalization refers to hospital costs and excludes physician charges. Costs were obtained from an administrative database and reflect hospital costs rather than hospital charges. Because costs spanned a 3-year period, we adjusted for inflation using the Bureau of Labor Statistics producer price indices for medical care services.⁹ We calculated the percentage increase in cost by dividing the estimate of the increase by the median cost of hospitalization. For readmissions, our data indicate whether the patient returned to the same hospital within 30 days. We assessed satisfaction with physician communication using questions from the Hospital Consumer Assessment of Healthcare Providers and Systems (HCAHPS) survey.¹⁰ During the study period, NMH used a third party vendor, Press Ganey Associates, Inc., to administer the HCAHPS survey to a random sample of 40 % of hospitalized patients between 48 h and 6 weeks after discharge. Patients indicated how often doctors: 1) treated them with courtesy and respect, 2) listened carefully, and 3) explained things in a way they could understand. Questions included ordinal response options of never, sometimes, usually, and always.

Statistical Analyses

We calculated descriptive statistics for patient characteristics. Primary discharge diagnosis *ICD-9* codes were grouped into diagnosis clusters using the Clinical Classification Software developed by the Healthcare Cost and Utilization Project.¹¹ We constructed regression models to determine whether three operational outcomes could be predicted by continuity of care metrics, while incorporating patient covariates. Statistical analyses were performed using SAS for Windows® (Version 9.29.3). The outcome variables were total cost of hospitalization, 30-day readmissions, and patient responses to the three HCAHPS physician domain questions. We used median regression (a special case of quantile regression) to predict the cost of hospitalization. This is appropriate when an outcome variable's distribution is highly skewed. We used logistic regression to predict likelihoods of 30-day readmission and patient rating of HCAHPS physician domain questions in the highest category (also known as "percent top box").¹² For a given hospitalization, we created two patient satisfaction variables. The first defined a positive outcome if the patient gave a top box response to all three questions in the physician communication domain. The second defined a positive outcome if the patient gave a top box response to any of the three questions. Results for models using each were similar, so we report satisfaction as the percentage of patients indicating top box response for all three questions.

Covariates included patient age, sex, race, payor, case mix, Elixhauser comorbidity index,¹³ admission source, discharge disposition, admission time, admission weekday, Diagnosis Related Group (DRG) weight, and length of stay (LOS). The treatment of the admission weekday, DRG, and LOS variables merited special attention. Because the hospitalists' regular switch day during the study period was Monday, the weekday of admission predicts the likelihood of a handoff. Because of this, we dichotomized admission weekday three different ways: Mon vs. Tue–Sun, Mon–Wed vs. Thu–Sun, and Mon–Fri vs. Sat–Sun. Results for models using each alternative were similar, so we reported admission weekday dichotomized as Mon–Fri vs. Sat–Sun. Due to concerns of multicollinearity between DRG and LOS, we also fit an alternative model in which these two covariates were categorized into quartiles. Data were complete except for the following variables, each of which had < 2 % missing data: race, diagnosis, admission source, and discharge disposition. Missing values for these variables were categorized as “other”.

RESULTS

Patient Characteristics

Our analyses included data from 18,375 hospitalizations. Characteristics of these patients and their hospitalizations are shown in Table 1. Patients were a mean 58.4 ± 18.2 years of age, hospitalized for a median 2.9 (IQR=1.8–4.8) days, and included 9,921 (54 %) women, and 8,784 (48 %) persons of non-white race. The mean and standard deviation of NPI and UPC were 1.90 ± 0.79 (meaning that patients were cared for by an average 1.90 physicians during hospitalization) and 0.75 ± 0.21 , respectively. Median (interquartile range) hospital cost was \$6,306 (\$4,276–\$9,963). The number (percent) of patients readmitted within 30 days was 4,081 (22.2 %). The number (percent) of patients who answered all three physician communication HCAHPS questions was 1,519 (8.5 %). Of these, 963 (63.4 %) provided top box responses.

Association Between Continuity and Hospitalization Outcomes

Table 2 shows the cost, 30-day readmission, and patient satisfaction results for a one-unit increase in the NPI metric and a 0.1-unit decrease in the UPC metric. These results are adjusted for other covariates. These changes in NPI or UPC represent lower continuity (or, alternatively, higher ‘fragmentation’).

Each one-unit increase in the NPI (i.e., less continuity) was significantly associated with 0.9 % higher median

Table 1. Patient and Hospitalization Characteristics (N=18,375)

Characteristic	
Mean age (SD)	58.4 (18.2)
Median length of stay in days (IQR)	2.9 (1.8–4.8)
Women	9,921 (54)
Race/ ethnicity	
White	9,591 (52)
Black	6,515 (35)
Hispanic	1,488 (8)
Asian	369 (2)
Other	412 (2)
Payor	
Medicare	8,747 (48)
Private	5,981 (33)
Medicaid	2,218 (12)
Self-pay	682 (4)
Other	747 (4)
Admission source	
Emergency Department	14,587 (79)
Direct/ scheduled	3,331 (18)
Other	457 (2)
Night admission	8,103 (44)
Admission weekday	
Monday–Friday	14,558 (79)
Saturday–Sunday	3,817 (21)
Diagnosis	
Diseases of the circulatory system	4,263 (23)
Diseases of the digestive system	2,111 (11)
Diseases of the respiratory system	1,838 (10)
Neoplasms	1,678 (10)
Diseases of the genitourinary system	1,089 (6)
Injury and poisoning	1,083 (6)
Symptoms, signs, and ill-defined conditions and factors influencing health status	1,078 (6)
Endocrine; nutritional; and metabolic diseases and immunity disorders	1,047 (6)
Diseases of the musculoskeletal system and connective tissue	820 (4)
Diseases of the blood and blood forming organs	788 (4)
Other	2,560 (14)
Discharge disposition	
Home	16,495 (90)
Skilled nursing or rehabilitation facility	1,305 (7)
Transfer to another inpatient facility	307 (2)
Other	268 (1)

Data are presented as number (percentage) of study participants unless otherwise indicated

hospitalization costs. Each 0.1-unit decrease in the UPC (i.e., less continuity) was associated with 1.7 % higher median costs, although the result was not statistically significant (p value=0.09). Readmission was 5 % less likely with each one unit increase in the NPI and 3 % less likely with each 0.1 unit decrease in the UPC, although the readmission result for NPI was of borderline statistical significance. Patient satisfaction with physician communication was lower with less continuity, but results were not statistically significant.

Addressing multicollinearity, we also categorized the LOS and DRG covariate values into quartiles. Table 3 summarizes these results. In these models, we found statistically significant cost increases with lower continuity. Readmissions were again less likely with lower continuity,

Table 2. Adjusted Effect of Decreased Continuity on Cost, 30-Day Readmission, and Top Box Patient Satisfaction Scores with LOS and DRG Treated as Continuous Values

Effect	Cost increase (<i>p</i> value**)	Odds ratio of 30-day readmission (95 % CI of OR)	Odds ratio of top box patient satisfaction scores (95 % CI of OR)
NPI (+1)	0.9 % (<i>< 0.001</i>)	0.95 (0.89–1.00)	0.86 (0.72–1.02)
UPC (-0.1)	1.7 % (0.09)	0.97 (0.95–0.99)	0.96 (0.91–1.02)

n 18,368 for cost, *n* = 18,375 for readmission, and *n* = 1,519 for patient satisfaction. The NPI is the total number of unique hospitalist physicians. The UPC is the largest number of encounters by a single hospitalist physician divided by the total number of hospitalist physician encounters for a patient

LOS length of stay, DRG diagnosis related group, NPI number of physicians index, UPC usual provider of continuity

***p* value tests the significance of NPI or UPC effects

but the association using NPI was not statistically significant and the result using UPC was of borderline significance. Patient satisfaction was also reduced with lower continuity, but results were not statistically significant.

DISCUSSION

We found that lower inpatient physician continuity was significantly associated with modest increases in hospital costs. Some of our models also suggested a slightly reduced risk of readmission with lower continuity (the direction of the effect was consistent, while achievement of statistical significance was not). Higher costs might be explained by additional testing and/or treatments ordered by hospital physicians when taking over patient care from their colleagues.¹⁴ Additional testing and treatment may increase costs unnecessarily if duplicative. Alternately, a physician newly taking over a patient's care may identify clinical

issues and opportunities missed by the initial hospital physician. We speculate that hospital physicians may become anchored to initial diagnostic impressions and therapeutic plans. The reassessment of the plan of care by another physician at the transfer of care may, as Wachter has proposed, “provide an opportunity for a beneficial second look.”¹⁵ The same dynamics could also explain a lower readmission rate with lower continuity, if readmission rates are truly influenced by continuity. A physician newly taking over the care of a patient planned for discharge may identify opportunities to enhance the post-discharge plan thought to be sufficient by the initial physician. Overall, the effect of discontinuity appears minimal, and our study provides some reassurance to hospital medicine group leaders attempting to balance competing priorities when creating staffing and scheduling models.

Although we found that lower continuity was associated with reduced patient satisfaction with physician communication, our results were not statistically significant. It seems intuitive that discontinuity would impede the establishment of rapport between patients and hospital physicians. We may have been underpowered to detect a significant association, given the lower number of patients for which we had satisfaction data.

Our findings are important because an increasing number of patients are cared for by hospitalists.¹⁶ Staffing and scheduling models for hospital medicine groups vary with respect to rotation length (i.e., consecutive days worked) and night coverage.¹⁷ These models affect continuity, yet little prior research has assessed the impact of these models on continuity and downstream patient outcomes. Chandra and colleagues recently reported the effect of the Creating Incentives and Continuity Leading to Efficiency (CICLE) staffing model designed to improve continuity of inpatient care.¹⁸ The model was associated with reductions in hospital costs, but had no effect on readmission rates.

Our study has several limitations. First, the culture and practices of the particular study site may yield unique findings. We did not study the quality or methods of the service-to-service handoffs practiced. It is possible that the quality of communication that occurs as one hospitalist takes over patients from another may influence the association between continuity and the outcomes we assessed. Second, this study may be limited by the continuity metrics used. We used two different metrics, each with their own characteristics, but a metric sensitive to the *timing* of the handoff within the hospitalization may have better predictive capabilities in this context. Furthermore, our study was designed to assess the impact of discontinuity among day hospital physicians. All patients in our study received nighttime coverage by hospitalists working in shifts from 7PM to 7AM. Therefore, all patients were subject to discontinuity occurring as a result of nighttime coverage, and we did not assess the quality of handoffs between day and night physicians or their effect on outcomes. Similarly, discontinuities introduced by the use of

Table 3. Adjusted Effect of Decreased Continuity on Cost, 30-Day Readmission, and Top Box Patient Satisfaction Scores with LOS and DRG Treated as Continuous Values Categorized into Quartile Values

Effect	Cost increase (<i>p</i> value)	Odds ratio of 30-day readmission (95 % CI of OR)	Odds ratio of top box patient satisfaction scores (95 % CI of OR)
NPI (+1)	8.0 % (<i>< 0.001</i>)	0.97 (0.92–1.02)	0.88 (0.74–1.04)
UPC (-0.1)	12.6 % (<i>< 0.001</i>)	0.98 (0.96–1.00)	0.96 (0.91–1.02)

n = 18,368 for cost, *n* = 18,375 for readmission, and *n* = 1,519 for patient satisfaction. The UPC is the largest number of encounters by a single hospitalist physician divided by the total number of hospitalist physician encounters for a patient

LOS length of stay, DRG diagnosis related group, NPI number of physicians index, UPC usual provider of continuity

***p* value tests the significance of NPI or UPC effects

consultants were not been measured in this study. Third, this study excluded patients who experienced care transitions from other hospitals or other units within the hospital. As a result, some of the most costly hospitalizations were excluded from this study. Including these hospitalizations would unfortunately require even more complex modeling and yet untested continuity metrics. Fourth, as is common in contemporary single site studies predicting readmission, patients in this study could have been readmitted to another care facility without our knowledge. While it may be conjectured that discontinuity lowers satisfaction, which in turn influences the patient's selection of a hospital when seeking care the second time, we were unable to detect a significant relationship between continuity and satisfaction. As previously mentioned, we may have been underpowered to detect a significant association between continuity and patient satisfaction with physician communication.

CONCLUSION

In conclusion, we found that hospital physician discontinuity appears to be associated with modestly increased hospital costs and possibly slightly lower odds for readmission. We speculate that transfers of patient care may introduce an opportunity for a beneficial second look by a physician not anchored to initial diagnostic impressions and therapeutic plans. Future research should test this hypothesis, as well as explore cognitive processes at the time of patient care transfer, and attempt to create models that optimize decision making, yet enhance rapport between hospitalized patients and their physicians.

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