Length of stay and hospital costs among patients admitted to hospital by family physicians

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Abstract

Objective To compare length of stay and total hospital costs among patients admitted to hospital under the care of family physicians who were their usual health care providers in the community (group A) and patients admitted to the same inpatient service under the care of family physicians who were not their usual health care providers (group B).

Design Retrospective observational study.

Setting A large urban hospital in Vancouver, BC.

Participants All adult admissions to the family practice inpatient service between April 1, 2006, and June 30, 2008.

Main outcome measures Ratio of length of stay to expected length of stay and total hospital costs per resource intensity weight unit. Multivariate linear regression was performed to determine the effect of admitting group (group A vs group B) on the natural logarithm transformations of the outcomes.

Results The median acute length of stay was 8.0 days (interquartile range [IQR] 4.0 to 13.0 days) for group A admissions and 8.0 days (IQR 4.0 to 15.0 days) for group B admissions. The median (IQR) total hospital costs were $6498 ($4035 to $11 313) for group A admissions and $6798 ($4040 to $12 713) for group B admissions. After adjustment for patient characteristics, patients admitted to hospital under the care of their own family physicians did not significantly differ in terms of acute length of stay to expected length of stay ratio (percent change 0.6%, P=.942) or total hospital costs per resource intensity weight unit (percent change -2.0%, P=.722) compared with patients admitted under the care of other family physicians.

Conclusion These findings suggest that having networks of family physicians involved in hospital care for patients is not less efficient than having family physicians provide care for their own patients.

EDITOR'S KEY POINTS

- It is unclear if admission of patients to hospital under the care of their usual family physicians has the potential to increase efficiency owing to greater continuity of care. It has been suggested that lack of continuity might lead to ordering redundant or unnecessary medical tests or to poorer quality of follow-up care.
- Hospital admission under the care of a family physician who was not the patient's usual health care provider was not associated with increased length of stay or hospital costs.
- These findings support the development and expansion of comprehensive and coordinated networks of family physicians providing hospital care as a substitute for family physicians who no longer provide inpatient care.

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Durée et coûts de l'hopitalisation de patients par des médecins de famille

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Résumé

Objectif Comparer la durée de l'hospitalisation et les coûts hospitaliers totaux pour les patients hospitalisés sous les soins du médecin de famille qui les soignait habituellement dans la communauté (groupe A) et pour ceux admis dans le même service hospitalier mais par des médecins de famille qui n'étaient pas leur médecin habituel (groupe B).

Type d'étude Étude d'observation rétrospective.

Contexte Un grand hôpital de la ville de Vancouver, C.-B.

Participants Tous les patients adultes admis au département hospitalier de médecine familiale entre le 1er avril 2006 et le 30 juin 2008.

Principaux paramètres à l'étude Rapport entre la durée de séjour et la durée prévue, et coûts hospitaliers totaux par unité d'effort exigé des ressources. Une analyse de régression multivariable linéaire a servi à déterminer l'effet de l'admission d'un groupe (groupe A vs groupe B) sur les transformations en logarithmes naturels des issues.

Résultats La durée médiane du séjour était de 8,0 jours (écart interquantile [ÉIQ] 4,0 à 13,0 jours) pour les admissions du groupe A et de 8,0 jours [ÉIQ 4,0 à 15 jours] pour celles du groupe B. Les coûts hospitaliers totaux médians étaient de 6 498 $ (4 035 $ à 11 313 $) pour les admissions du groupe A et de 6 798 $ (4 040 $ à 12 713 $) pour celles du groupe B. Après ajustement pour les caractéristiques des patients, il n'y avait pas de différence significative entre ceux admis sous les soins de leur propre médecin de famille et ceux admis sous les soins d'un autre médecin de famille pour ce qui est du rapport entre la durée réelle du séjour et celle prévue (0,6% de différence, P=,942) ni pour les coûts hospitaliers totaux par unité d'effort exigé des ressources (-2,0% de différence, P=,722).

Conclusion Ces résultats donnent à croire que le fait d'avoir des réseaux de médecins de famille qui contribuent aux soins hospitaliers des patients n'est pas moins efficace que celui d'avoir des médecins de famille qui soignent leurs propres patients.

POINTS DE REPÈRE DU RÉDACTEUR

- Il n'est pas évident que le fait d'hospitaliser des patients aux soins de leur médecin de famille habituel augmente l'efficacité en raison d'une meilleure continuité des soins. On a suggéré que l'absence de continuité pourrait résulter en des examens médicaux redondants ou inutiles, ou en un suivi de moins bonne qualité.
- L'hospitalisation sous les soins d'un médecin de famille qui n'était pas le médecin habituel du patient n'augmentait pas la durée du séjour ni les coûts hospitaliers.
- Ces résultats sont en faveur du développement et de de l'accroissement de réseaux complets et coordonnés de médecins de famille chargés de soigner des patients hospitalisés dont les médecins ne font plus de service hospitalier.

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As fewer family physicians maintain their hospital admitting privileges, it is increasingly common for patients to be admitted under the care of physicians who are not involved in their primary care before or after the hospital stays. This practice has raised concerns about continuity of care when patients are admitted to hospital. It has been suggested that this discontinuity might lead to ordering redundant or unnecessary medical tests or to poorer quality of follow-up care after discharge.[1-3] Particularly for patients with higher-level needs, the level of attachment to a primary care provider has been shown to be inversely associated with costs, such that discontinuity of care results in higher costs to the health care system.[4] The present study examined length of stay (LOS) and hospital cost outcomes among patients hospitalized under family physicians at a large urban hospital in Vancouver, BC.

METHODS

Study setting and population

St Paul's Hospital is an acute care, teaching, and research hospital that serves an urban population in downtown Vancouver. This study identified all adult admissions to the family practice inpatient service between April 1, 2006, and June 30, 2008. Data were obtained from Health Record Services at Providence Health Care, which maintains records of all admissions and discharges for St Paul's Hospital. Ethics approval was obtained from the research ethics boards of the University of British Columbia and Providence Health Care.

Patients presenting to the emergency department who require admission for medical conditions are referred to the family practice inpatient service if they have family physicians in the community with admitting privileges and do not require specialist care. Other clinically suitable patients are referred to this service, even if they do not have family physicians in the community with admitting privileges, if beds are available and the physicians attending the family practice inpatient service for 1-week rotations accept the referrals. Most of these attending physicians maintain community-based practices outside of the hospital, and none exclusively provide hospital-based care. In 2009, 22 different physicians (19 men, 3 women) covered 52 scheduled weeks of inpatient service. Family medicine residents provided an important care component to patients using this service. Two family practice medical residents attended during the day and 1 provided home-call coverage overnight and on weekends. Under the supervision of family practice physician staff, residents performed daily rounds on admitted patients and reviewed daily patient progress. On average, there were 13 to 15 patients on the family practice inpatient service at any given time.

Inpatient admissions to the family practice service were classified into 2 groups on the basis of the patients' admitting physicians or most responsible physicians. Group A consisted of patients admitted under the care of the family physicians who were the patients' usual health care providers in the community. Group B consisted of patients admitted under the care of family physicians who were not the patients' usual health care providers but who were attending the inpatient service for 1-week rotations. Group B included patients who did not have primary care physicians in the community and patients whose primary care physicians did not have admitting privileges at the hospital.

Admissions were excluded if they were patient transfers from or to another acute care inpatient institution, had specialists listed as the most responsible physicians, or had missing or incomplete data for outcome variables. A sensitivity analysis was also performed to exclude admissions for patients who died while in hospital or who left against medical advice, as these variables could directly affect the outcomes of interest.

Data sources

Demographic data, most responsible diagnoses, date of discharge, expected LOS (ELOS), and resource intensity weight (RIW) were ascertained from the hospital's electronic health records. Most responsible diagnosis was based on International Statistical Classification of Diseases and Related Health Problems, 10th revision, Canadian edition codes and represents the diagnosis that most contributed to the patients' LOS. Using standardized methods, each admission was assigned an ELOS and RIW based on the patient's age, most responsible diagnosis, and comorbidities.[5,6]

Whether the patient had a family physician in the community was determined by self-report at admission. Patients' residential postal codes were linked to neighbourhood-level mean household income quintiles using previously described methods.[7-10] Patients with no fixed address were assigned to the lowest income quintile. Admissions with postal codes that could not be converted (eg, low census income response rate or postal codes associated with an institution) were excluded from analyses that included neighbourhood-level incomes.

Outcome measures

The primary outcomes for this analysis were adjusted LOS and adjusted total hospital costs. Length of stay was defined as the number of acute days in hospital and represented the length of time the patient was being actively treated from date of admission to date of discharge. Adjustment of LOS was accomplished by either subtracting (difference between LOS and ELOS [LOS - ELOS]) or dividing by (acute LOS to ELOS ratio [LOS:ELOS]) ELOS.

Hospital-level costs were ascertained for each admission by tracking actual resource use. Hospital departments give standard unit cost information for resources and services. The sum of the actual resources used multiplied by their respective unit cost estimates the total cost of any admission. Adjusted hospital costs were expressed as hospital costs per RIW unit. These values are commonly used to facilitate comparisons of economic efficiency among health care entities.[6]

Data analysis

The patient characteristics of the 2 groups were compared using *t* tests or Mann-Whitney nonparametric tests (where appropriate) for continuous variables and χ^2 tests for categorical variables. Most responsible diagnoses for hospitalization were compared using Fisher exact tests to account for the small (<5) expected cell counts. All outcome measures (LOS, LOS-ELOS, LOS:ELOS, total hospital costs, and total hospital costs per RIW unit) were compared using Mann-Whitney nonparametric tests, as these data were not normally distributed. A *P* value of .05 was considered statistically significant.

Multivariate linear regression models were constructed separately for each outcome of interest. The independent variable was admission group. Variables for patient age, sex, admission from a nursing home, and neighbourhood-level income were entered into the models to adjust for demographic characteristics. In the primary analysis, models were also adjusted for whether the patient died during hospitalization or left against medical advice. Having a primary care physician in the community was not included because of its obvious correlation with admission group.

Initial diagnostic tests suggested that assumptions of normality and constant variance (homoscedasticity) were being violated. For this reason, the regression models were reconstructed using a natural logarithm transformation of the outcome variables. Regression coefficients from the models including the transformed outcomes were converted into the percentage increase in the average value of the outcome per unit increase in the predictor using the following formula: $100(e^{\beta}-1)$.[11] All analyses were performed using SPSS, version 16.0.

RESULTS

There were 659 admissions to the family practice inpatient service during the study period. Of these admissions, 46 (7.0%) were excluded: 14 (2.1%) admissions were transfers from other acute care inpatient institutions, 10 (1.5%) were transfers to other acute care inpatient institutions, 25 (3.8%) had specialists listed as the most responsible physicians for that admission, and 2 (0.3%) had missing or incomplete data for the outcome variables (1 had missing RIW data, 1 had invalid cost data); some patients met multiple exclusion criteria. Of the remaining 613 admissions, 424 (69.2%) were in group A and 189 (30.8%) were in group B.

Group A admissions did not significantly differ from group B admissions in terms of patient age (*P*=.385), sex (*P*=.389), neighbourhood-level income quintile (*P*=.199), whether patients were residents of nursing homes (*P*=.213), whether patients died during hospitalization (*P*=.738), whether patients left against medical advice (*P*=.072), ELOS (*P*=.495), or RIW (*P*=.279) (**Table 1**). The most common diagnoses that were

Table 1. Patient characteristics by group

CHARACTERISTIC	OVERALL (N=613)	GROUP A (N=424)	GROUP B (N=189)	*P* VALUE
Mean (SD) age, y	73.4 (16.8)	73.8 (16.9)	72.5 (16.7)	.385
Sex, n (%)				.389
• Female	337 (55.0)	238 (56.1)	99 (52.4)	
• Male	276 (45.0)	186 (43.9)	90 (47.6)	
Neighbourhood-level income,* n (%)				.199
• Lowest quintile	259 (46.4)	171 (45.4)	88 (48.6)	
• 2nd quintile	92 (16.5)	63 (16.7)	29 (16.0)	
• 3rd quintile	85 (15.2)	51 (13.5)	34 (18.8)	
• 4th quintile	71 (12.7)	53 (14.1)	18 (9.9)	
• Highest quintile	51 (9.1)	39 (10.3)	12 (6.6)	
Resident of nursing home, n (%)	98 (16.0)	73 (17.2)	25 (13.2)	.213
Had a family physician in the community, n (%)	600 (97.9)	424 (100.0)	176 (93.1)	<.001
Died during hospitalization, n (%)	58 (9.5)	39 (9.2)	19 (10.1)	.738
Left against medical advice, n (%)	23 (3.8)	12 (2.8)	11 (5.8)	.072
Median (IQR) ELOS, d	6.5 (5.1 to 9.7)	6.5 (5.0 to 9.7)	6.8 (5.2 to 9.8)	.495
RIW, median (IQR)	1.1 (0.8 to 2.0)	1.1 (0.8 to 1.9)	1.2 (0.8 to 2.2)	.279

ELOS—expected length of stay, IQR—interquartile range, RIW—resource intensity weight.
*Neighbourhood-level income data missing for 55 admissions.

most responsible for hospitalizations are shown in **Table 2**. Group A admissions did not significantly differ from group B admissions in terms of median LOS ($P = .687$) or median total hospital costs ($P = .673$) (**Table 3**). The differences between groups were also not significant after adjustment for ELOS and RIW, respectively ($P > .05$).

In the multivariate linear regression models, the relationship between outcomes and groups remained consistent after adjustment for patient characteristics. Relative to group A admissions, group B admissions had 0.6% higher LOS:ELOS ratios (95% CI -13.4% to 16.8%, $P = .942$) and 2.0% lower total hospital costs per RIW unit (95% CI -12.4% to 9.6%, $P = .722$), but these differences in percent changes were not statistically significant. Admissions had significantly lower LOS:ELOS ratios if patients were residents of nursing homes or if patients died during hospitalization ($P \leq .05$). Results were similar for the sensitivity analysis in which admissions for patients who died during hospitalization or who left against medical advice were excluded (data not shown).

Table 2. MRD for hospitalization classifications

MRD CLASSIFICATION (ICD-10-CA CODE)	OVERALL N = 613), N (%)	GROUP A (N = 424), N (%)	GROUP B (N = 189), N (%)	*P* VALUE*
Chronic obstructive pulmonary disease (J44)	60 (9.8)	44 (10.4)	16 (8.5)	.556
Pneumonia (J18)	42 (6.9)	28 (6.6)	14 (7.4)	.731
Heart failure (I50)	28 (4.6)	20 (4.7)	8 (4.2)	1.00
Palliative care (Z51.5)	23 (3.8)	17 (4.0)	6 (3.2)	.818
Urinary tract infection (N39.0)	21 (3.4)	13 (3.1)	8 (4.2)	.476
Cellulitis (L03)	20 (3.3)	11 (2.6)	9 (4.8)	.216
Dementia (F01-F03)	16 (2.6)	9 (2.1)	7 (3.7)	.278
Delirium, not induced by alcohol or other psychoactive substances (F05)	16 (2.6)	14 (3.3)	2 (1.1)	.168
Stroke, including intracerebral hemorrhage and cerebral infarction (I62-I64)	12 (2.0)	8 (1.9)	4 (2.1)	1.00
Tendency to fall, not elsewhere classified (R29)	12 (2.0)	9 (2.1)	3 (1.6)	.763
Volume depletion and other disorders of fluid, electrolyte, and acid-base balance (E86-E87)	11 (1.8)	9 (2.1)	2 (1.1)	.517
Dorsalgia (back pain) (M54)	11 (1.8)	5 (1.2)	6 (3.2)	.103
Care involving use of rehabilitation procedures (Z50)	11 (1.8)	4 (0.9)	7 (3.7)	.041
Abdominal and pelvic pain (R10)	10 (1.6)	8 (1.9)	2 (1.1)	.731
Septicemia due to bacterial infection (A40-A41)	9 (1.5)	7 (1.7)	2 (1.1)	.728
Diabetes mellitus (type 1 or type 2) (E10-E11)	9 (1.5)	8 (1.9)	1 (0.5)	.287
Fracture of shoulder and upper arm (S42)	8 (1.3)	4 (0.9)	4 (2.1)	.259
HIV disease (B24)	7 (1.1)	7 (1.7)	0 (0.0)	.106
Secondary malignant neoplasm of respiratory and digestive organs (C78)	7 (1.1)	6 (1.4)	1 (0.5)	.682
Renal failure, acute or chronic (N17-N18)	7 (1.1)	7 (1.7)	0 (0.0)	.106
Enterocolitis due to *Clostridium difficile* (A04.7)	6 (1.0)	1 (0.2)	5 (2.6)	.012
Pneumonitis due to solids and liquids (J69)	6 (1.0)	5 (1.2)	1 (0.5)	.672
Noninfectious enteritis and colitis (K52)	6 (1.0)	5 (1.2)	1 (0.5)	.672
Pain in joint (M25.5)	6 (1.0)	3 (0.7)	3 (1.6)	.379
Malaise and fatigue (R53)	6 (1.0)	3 (0.7)	3 (1.6)	.379
Fracture of lumbar spine and pelvis (S32)	6 (1.0)	3 (0.7)	3 (1.6)	.379
Mental and behavioural disorders due to use of alcohol (F10)	5 (0.8)	1 (0.2)	4 (2.1)	.033
Diverticular disease of intestine (K57)	5 (0.8)	4 (0.9)	1 (0.5)	1.000
Constipation (K59.0)	5 (0.8)	3 (0.7)	2 (1.1)	.646
Cachexia (R64)	5 (0.8)	3 (0.7)	2 (1.1)	.646
Fracture of ribs, sternum, and thoracic spine (S22)	5 (0.8)	4 (0.9)	1 (0.5)	1.000
Other conditions	212 (34.6)	151 (35.6)	61 (32.3)	.462

ICD-10-CA—International Statistical Classification of Diseases and Related Health Problems, 10th revision, Canadian edition; MRD—most responsible diagnosis.
*Fisher exact test (2-sided).

Table 3. Median values and IQRs for outcomes by group

OUTCOME	GROUP A (N = 424), MEDIAN (IQR)	GROUP B (N = 189), MEDIAN (IQR)	*P* VALUE
LOS, d	8.0 (4.0 to 13.0)	8.0 (4.0 to 15.0)	.687
LOS - ELOS, d	0.6 (-2.7 to 4.7)	0.2 (-3.2 to 5.5)	.657
LOS:ELOS	1.1 (0.6 to 1.7)	1.0 (0.5 to 1.8)	.826
Total hospital costs,* $	6498 (4035 to 11 313)	6798 (4040 to 12 713)	.673
Total hospital costs per RIW unit,* $	5952 (3985 to 8167)	5428 (3955 to 8356)	.406

ELOS—expected length of stay, IQR—interquartile range, LOS—length of stay, LOS - ELOS—difference between LOS and ELOS, LOS:ELOS—acute LOS to ELOS ratio, RIW—resource intensity weight.
*Total hospital costs missing for 66 admissions.

DISCUSSION

In this observational study conducted at an urban hospital in Canada, patients admitted to a family medicine service under the care of their own family physicians did not significantly differ in terms of acute LOS (*P* = .687) or total hospital costs (*P* = .673) compared with patients admitted under the care of other family physicians. Contrary to our original hypothesis, after adjustment for expected values of LOS and resource use, admissions in group A actually had slightly higher values for adjusted LOS and total hospital costs. However, because these differences between groups were not statistically significant, our study does not support the hypothesis that being admitted by one's own family physician increases LOS or costs while in hospital. These outcomes also did not significantly differ between groups when relevant patient characteristics were taken into account. Percent changes in adjusted LOS values were inversely associated with indicators for whether patients were residents of nursing homes or died during hospitalization, likely resulting from shorter-than-expected hospital stays for these admissions.

Unfortunately, there are limited data available with which to compare our findings. Previous research has been chiefly informed by studies conducted in the United States[12-16] and might not be generalizable to the Canadian setting. Furthermore, these studies have generally examined patients admitted under the care of hospital-based physicians, or hospitalists, and might not be applicable to our study setting where admitting physicians were primarily community-based family doctors. The main factor varying between our 2 study groups was whether the admitting physician was the patient's primary health care provider. In this sense, our study design inherently controlled for differences resulting from the type of inpatient service or physician specialization in hospital-based care.

It is important to note that any effect of continuity of care on our outcomes of interest might have been minimized through substantial efforts by the family practice inpatient service to ensure that family physicians in the hospital provided service comparable with that provided by the patients' usual family physicians in the community. The effects of discontinuity of care might have been further reduced through explicit efforts to promote coordination of care between the patients' attending physicians and their usual physicians in the community in accordance with College of Family Physicians of Canada recommendations.[17] Moreover, largely through care provided by medical residents and the interdisciplinary health care staff, continuity of care while in hospital was maintained for patients admitted under the care of physicians who were not their usual physicians in the community when the attending physicians' 1-week rotations on the ward were complete and the patients were transferred to the care of other attending physicians.

Limitations

This study has certain limitations. These data were obtained at a single urban teaching hospital, and the results might not be generalizable to other institutions. Our study might have been underpowered to detect clinically meaningful differences in LOS or costs between the 2 groups. The socioeconomic status of each patient was determined at a neighbourhood level based on postal code of residence, and might not necessarily correspond to socioeconomic status at the individual level. As we relied on administrative data, only limited variables were available for secondary analysis, and models might not have been adequately adjusted for potential confounders (eg, patient comorbidities, medications, or previous hospitalizations). Additionally, our analysis was unable to consider more subjective measures of care that could affect patient outcomes (eg, perceived quality of care and follow-up). Re-admissions of the same patients within a certain time frame were not excluded; as such, events were not independent. The assignment of patients on the basis of their admitting physicians was non-random.

Conclusion

The family practice inpatient service at St Paul's Hospital represents a unique setting to study continuity of care among a network of community-based family physicians who complete 1-week rotations on inpatient service. This study did not affirm notions that continuity of care is associated with more efficient and less expensive care. This study has important implications for family practice inpatient models in Canada. Policy makers and health care providers should consider the expansion of explicit family practice models that include hospital care

as 1 piece of a comprehensive, coordinated network of family physicians and associated health care professionals. More studies are needed to determine the effect of these models on additional patient outcomes, including perceived quality of care.

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Contributors

All authors made substantial contributions to conception and design of the study, acquisition of data, or analysis and interpretation of data; drafted the article or revised it critically for important intellectual content; and approved the final version to be published.

Competing interests

None declared

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