The Impact of the Number of Admissions to the Inpatient Medical Teaching Team on Patient Safety Outcomes

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Abstract

Introduction The clinical work in academic internal medicine inpatient units is done by teaching teams. To date, few studies have investigated how team workload affects patient safety outcomes.

Objective We examined the association between the number of patients seen by a teaching team, 30-day readmission, and 60-day mortality.

Methods In this retrospective observational study we defined each team as "less busy" (total monthly admissions ≤49, the median for all teams) or "more busy" (total monthly admissions >49). We compared patients in both groups' demographic characteristics, comorbidities (Charlson score), severity of illness (the Laboratory-based Acute Physiology Score [LAPS]), and length of stay using *t* tests, χ^2 tests, and rank sum tests, as appropriate. Logistic regression models were constructed to determine whether there was an association between assignment to a busy team and readmission and mortality.

Results Of 12 119 admissions examined, 6398 (52.8%) were assigned to the less busy teams and 5721 (47.2%) were assigned to busy teams. Mean length of stay was not statistically different between the groups (5.2 vs 5.3 days; $P = .08$). After adjustment for demographic and clinical characteristics (LAPS and Charlson score), care by a busy team was associated with greater 30-day readmission rate (odds ratio, 1.21; 95% confidence interval [CI], 1.10–1.34) but not with increased risk of mortality (odds ratio, 1.05; 95% CI, 0.88–1.27). There was a significant linear association between the number of monthly admissions to teams and the readmission rate.

Conclusions Admission to a busier teaching team is associated with a 21% increase in the odds of 30-day readmission. Sixty-day mortality was not affected by the number of monthly admissions to the teaching team.

Introduction

Avoidable hospital readmissions, which affect 1 in 5 patients and account for $17.4 billion of the current $102.6 billion Medicare budget, are the focus of many quality-improvement initiatives.[1] Trainees have been implicated in many cases of medical error[2,3] and may also contribute to higher rates of readmission.

In training institutions medical care is rendered by a team of health care professionals, and each patient is cared for by several members of the team.[4] Thus, quality of health care delivery is affected not only by individual performance, but also by a medical team's performance as a whole. Evidence suggests that team malfunction (ie, systemic failures) causes far more errors than the poor performance of individuals.[5–7] This suggests that in addition to evaluating individual providers' quality performance, we should be evaluating the performance of care teams. In addition, determining the mechanism whereby busy teams have worse outcomes should be the object of future study. Evaluating medical teaching team performance outcomes separately from the care outcomes of individual providers may provide an interesting insight into interplay between the cumulative effect of individual workloads and the amount of oversight provided.

Although a substantial body of research has found an association between poor resident supervision and worse patient outcomes,[8–10] less consistency was seen on the link between resident workload and outcomes.[11–14] Even less is known about the association between the workload of a teaching team as a whole and patient outcomes. To determine whether the team's workload affects patient

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outcomes we examined the association between a total number of teaching team's monthly admissions, and 30-day readmission and 60-day mortality rates. We hypothesized that increased teaching team workload is associated with higher readmission rate.

What was known

The clinical work in academic internal medicine inpatient units is done by teaching teams, yet few studies have explored how team workload affects patient safety.

What is new

A retrospective observation study with risk adjustment found that care by a busy team was associated with a 21% increase in the 30-day readmission rate, but not with increased risk of mortality.

Limitations

Single-institution, single-specialty study may limit generalizability; findings may have been affected by unmeasured differences between patients or attributes of care after discharge.

Bottom line

Admission to a busier team conferred an increase in the odds for readmission to the hospital that could translate into significant added, avoidable health care expenditures.

Methods

Study Setting and Patients

Montefiore Medical Center is an urban academic medical center in the Bronx, New York, consisting of Weiler (381 beds) and Moses (706 beds) Hospitals, and affiliated with the Albert Einstein College of Medicine. We extracted data on all patients who were admitted to the internal medicine teaching service from March 1, 2009, to June 30, 2010.

Teaching Teams

Each month, approximately 18 teaching teams provide care at the two hospitals within the medical center. Each team had one or two first-year residents, and some teams had one subintern. A second- or third-year resident and a supervising attending were assigned to each team. Interns and residents admitted on a 4-day call cycle, which allowed for variations in the team census over time. The maximum number of daily admissions was 5 for an intern and 20 for the supervising resident. Patient census was capped at 10 for the intern and at 20 for the supervising resident. Admissions were assigned to all of the teams similarly and on a daily basis without any known bias according to an on-call schedule. Social workers and discharge planners were assigned to specific floors, whereas teaching teams covered patients throughout the hospital.

Study Design

We conducted a retrospective observational cohort study to examine the associations between teaching team workload and patient outcomes.

The independent variable was defined as medical team workload based on the number of monthly admissions to a team. First, we examined the total number of admissions seen by each team each month. Next, we defined each team as "less busy" (total admissions ≤49, the median for all teams) or "more busy" (total admissions >49). Clinical data were extracted from a replicate of Montefiore's Clinical Information System using Clinical Looking Glass, quality-improvement health care surveillance software.[15] Montefiore's Institutional Review Board approved this study.

Outcomes

The primary outcomes of the study were 30-day readmission and 60-day mortality. Thirty-day readmission was defined as any admission to either hospital for any reason within 30 days of discharge, and was analyzed as a dichotomous variable. Sixty-day mortality data were extracted from the social security death index, calculated from the date of admission, and analyzed as a dichotomous variable.

Main Independent Variable

Because we are unable to measure teaching team workload directly, we used each team's total number of admissions as a surrogate measure of workload. Each team was defined as "less busy" or "more busy" based on the number of monthly admissions to the team. "Less busy" (≤49 admissions) or "more busy" (>49 admissions) was defined by the median number of admissions for all teams (49).

Covariates

To address the threat of confounding we examined patient characteristics, including demographic characteristics, comorbidities, and severity of illness indices. Patient characteristics included age, sex, race/ethnicity, and insurance (categorized as Medicare, Medicaid, Commercial, or Self-pay), and were analyzed as continuous or dichotomous variables. We used the Charlson comorbidity score as our comorbidity index. It was determined using *International Classification of Disease* 9th edition diagnosis codes and was analyzed as a continuous variable. We calculated the Laboratory-based Acute Physiology Score (LAPS) to measure severity of illness. When combined with measures of comorbidity, the LAPS score accounts for significant variance in inpatient mortality (C statistic, 0.88–0.91).[16,17] LAPS was calculated using 14 commonly used laboratory values and was analyzed as a continuous variable.

Statistical Analysis

Patients admitted to the "less busy" vs "more busy" teams were compared for demographic characteristics, comor-

TABLE 1 **Characteristics of Patients in Study**

	All (n = 12 119)	Less Busy Team (n = 6398)	Busy Team (n = 5721)	*P*
Age, y	58.9 ± 18.2	57.6 ± 17.8	60.3 ± 18.4	<.001
No. of men (%)	5269 (43.5)	2821 (44.1)	2448 (42.8)	.03
Race/ethnicity				
Non-Hispanic white	1796 (14.8)	785 (12.3)	1011 (17.7)	<.001
African American	4070 (33.6)	2190 (34.2)	1880 (32.9)	.11
Latino	5547 (45.8)	3021 (47.2)	2526 (44.2)	.001
Other/unknown	706 (5.8)	402 (6.3)	304 (5.3)	.02
Insurance				
Medicare	5421 (44.7)	2679 (41.9)	2742 (47.9)	<.001
Medicaid	4511 (37.2)	2584 (40.3)	1927 (33.7)	<.001
Commercial	2042 (16.8)	1064 (16.6)	978 (17.1)	.50
Self-insured	130 (1.1)	62 (1.0)	68 (1.2)	.24
Charlson[a]	2.50 ± 2.60	2.51 ± 2.65	2.48 ± 2.54	.57
LAPS[b]	20.8 ± 17.1	20.0 ± 16.8	21.7 ± 17.3	<.001
Length of stay	5.2 ± 8.1	5.3 ± 8.2	5.2 ± 8.0	.08

Abbreviation: LAPS, Laboratory-based Acute Physiology Score.

[a] Charlson comorbidity score was calculated using *International Classification of Disease* 9th edition diagnosis codes.
[b] LAPS was calculated using 14 laboratory results.

bidities, severity of illness, and length of stay using *t* tests, χ^2, and rank sum tests, as appropriate. To assess univariate associations between team workload and both 60-day mortality and 30-day readmission, we compared rates of these outcomes between groups using χ^2 tests. Logistic regression models were constructed to determine the independent association between assignment to a "less busy" vs "more busy" team and readmission and mortality, after adjustment for demographic and clinical characteristics. In additional analyses, teams were placed into quintiles of number of admissions, and the readmission rate for each quintile was determined. STATA/IC software, version 10.0 (StataCorp, College Station, TX) was used for all statistical analysis and data management.

Results

Of 12 119 admissions examined, 6398 (52.8%) were assigned to the less busy teams, and 5721 (47.2%) were assigned to the busy teams. Patients assigned to busy teams were older, more likely to be women, more likely to be non-Hispanic white, less likely to be black or Latino, more likely to have Medicare, less likely to have Medicaid, and had higher LAPS scores. Mean length of stay was not significantly different between the groups (5.2 vs 5.3 days; $P = .08$; TABLE 1).

After adjustment for demographics (age, race, sex, ethnicity, insurance type) and clinical characteristics (LAPS and Charlson score), care by a busy team was associated with a greater 30-day readmission rate (odds ratio, 1.21; 95% confidence interval, 1.10–1.34). After adjustment for demographic and clinical characteristics, care on a busy team was not associated with increased risk of mortality (odds ratio, 1.05; 95% confidence interval, 0.88–1.27; TABLE 2).

TABLE 2 **Primary Outcomes[a]**

	Univariate	Multivariate
30-Day readmission	1.22	1.21[b]
	1.10–1.34	1.10–1.34
60-Day mortality	1.28	1.05[c]
	1.08–1.51	0.88–1.27

[a] Logistic regression model built in backward stepwise fashion including variables with Wald statistics ≤0.20.
[b] Adjusted for race/ethnicity, Laboratory-based Acute Physiology Score (LAPS), Charlson score, sex, insurance type.
[c] Adjusted for age, race/ethnicity, LAPS, Charlson score.

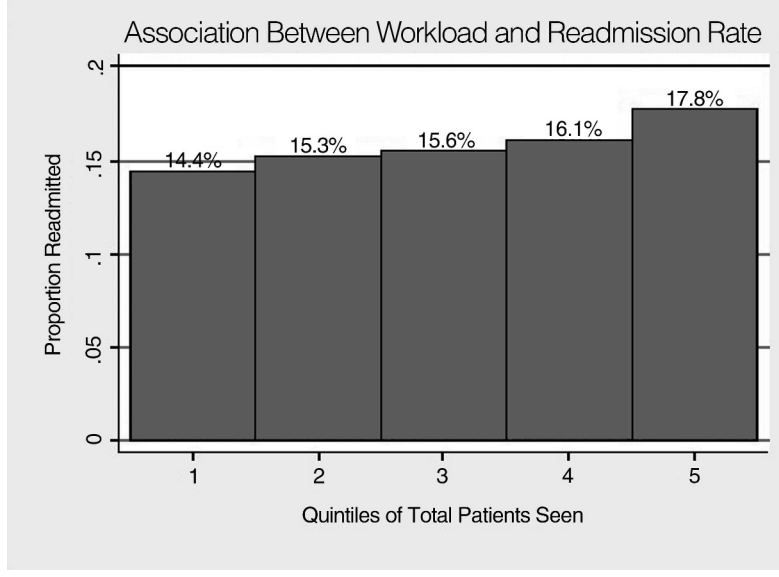

FIGURE **Medical Teams Divided into Quintiles Based on the Number of Monthly Admissions Seen**

Workload key: quintile 1: 17–37 admissions, 1509 patients; quintile 2: 38–44 admissions, 1977 patients; quintile 3: 45–52 admissions, 2329 patients; quintile 4: 53–62 admissions, 2749 patients; quintile 5: 63–91 admissions, 3555 patients.

There was a significant linear association between the number of monthly admissions to teams and patients' readmission rate (FIGURE). As teams were placed into quintiles based on the number of monthly admissions, there was a roughly 4% increase in odds of readmission for patients admitted from one quintile to the next.

Discussion

In this carefully controlled study we found that care by a busy teaching team is associated with increased risk of readmission. Further, we found a significant linear trend linking the number of admissions a team sees with incremental increases in risk for readmission. After adjustment, we found no association between number of admissions to a teaching team and 60-day mortality. Our data highlight the need to establish acceptable goals for teaching team workload to minimize unnecessary readmissions.

Patient safety outcome measures have traditionally focused on adverse event rates and mortality. Recently, as the length of stay in the hospitals shortened, the readmission rate became another indicator of adverse outcomes.[18,19] The Patient Protection and Affordable Care Act will reduce Medicare payments to hospitals with excess hospital readmissions, so this potential loss of revenue might spur more hospitals to look harder at the factors influencing readmission rates.[20] Although we have found an association between greater teaching team workload and increased readmissions, further research is needed to determine whether reducing team workload improves readmission rates.

We used a single simple measure of team workload, which was the total number of admissions seen by the team over the course of a month. Another commonly used measure of workload, the intern's daily census, may not accurately reflect the full amount of work an intern is doing. It has been suggested that as length of stay has shortened, number of admissions became more of a factor when defining medical team workload.[21]

Our study has several limitations. First, it is possible that patients admitted to busy teams were different from patients admitted to less busy teams in ways that we did not measure, confounding our analysis. We applied validated measures of comorbidity and severity of illness in risk-adjustment models in an attempt to minimize confounding. Second, it is possible that patients discharged from the busier teams had less consistent outpatient followup arranged upon discharge that had contributed to the increased readmission rate. In addition, our study is from a single institution and the results may not be generalizable to other teaching services.

Conclusions

In our study, admission to the busier team conferred a 21% increased odds of readmission to the hospital that could translate into billions of dollars of avoidable health care expenditures. Further research is needed to determine whether reducing a teaching team's monthly workload reduces readmissions.

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