A "Reverse July Effect": Association Between Timing of Admission, Medical Team Workload, and 30-Day Readmission Rate

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Abstract

Background High teaching team workload has been associated with poor supervision and worse patient outcomes, yet it is unclear whether this association is more pronounced during the early months of the academic year when the residents are less experienced.

Objective We examined the associations between teaching team workload, timing of admission, and the 30-day readmission rate.

Methods In this retrospective observational study, all admissions to an urban internal medicine teaching service over a 16-month period were divided into 2 groups based on admission date: early in the academic year (July–September) or late (October–June) and further defined as being admitted to "busy" versus "less busy" teams based on number of monthly admissions. The primary outcome was 30-day readmission rate. Multivariate logistic regression was used to determine the independent association between teaching team workload and readmission rates, stratified by time of year of admission after adjustment for demographic and clinical characteristics.

Results Of 12 118 admissions examined, 2352 (19.4%) were admitted early in the year, and 9766 (80.6%) were admitted later. After multivariate adjustment, we found that patients admitted to busy versus less busy teams in the first quarter had similar 30-day readmission rate (odds ratio $[OR]_{adj} = 1.03$ [0.82–1.30]). Later year admission to a busy team was associated with increased risk of readmission after adjustment ($OR_{adj} = 1.16$ [1.03–1.30]).

Conclusions Admission to busy teams early in the year was not associated with increased odds of 30-day readmission, whereas admission later in the year to busy teams was associated with 16% increased odds of readmission.

Introduction

Of the 19.4 million hospitalizations that occur each year, 4 million patients are admitted to teaching hospitals.[1] High teaching team workload has been associated with poor supervision and worse patient outcomes,[2–6] including increased readmission rate,[7] but it is not clear whether this effect occurs uniformly throughout the academic year.

The *July phenomenon* refers to a presumed drop in the quality of care in the early months of the academic year at teaching institutions, thought to be related to inexperienced residents taking on new responsibilities in July. Care by new residents on a teaching service at the beginning of the academic year has been associated with increase in medical errors,[8,9] mortality,[10] and inefficient care.[11] In a review of the July phenomenon, Barack et al[12] suggested that reducing teaching team workload in the beginning of the academic year should be considered as a measure to compensate for the July effect.[12]

It is not clear whether the association between high workload and poor outcomes during the early months of the academic year, when residents are new, is the same as that in the later months of the academic year, when residents are more experienced. To address this, we sought to examine the association between teaching team workload and readmission rate in the beginning of the academic year versus that in the later months of the academic year.

To determine whether high resident workload may be a factor in the July phenomenon, we examined the association between teaching team workload and readmission rate[13] in the first 3 months of the academic year versus that

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in the remainder of the academic year. We hypothesized that the association between high team workload and increased readmissions would be strongest in the first 3 months of the academic year and less strong during the rest of the year.

What was known

High team workload has been associated with inferior patient outcomes. Studies have not assessed whether this relationship is more pronounced in the early months of the academic year.

What is new

Admission early in the academic year was not associated with increased odds of readmission, whereas admission later in the academic year was associated with increased odds.

Limitations

Single-institution study may limit generalizability; 30-day readmission rates are influenced by factors beyond the control of the inpatient setting.

Bottom line

Added supervision and resident diligence early in the year may compensate for negative effects of high team workload.

Methods

Study Setting and Patients

Montefiore Medical Center is an urban academic medical center in Bronx, New York, consisting of Weiler (381 beds) and Moses hospitals (706 beds), and is affiliated with Albert Einstein College of Medicine. We examined clinical and administrative data for all patients who were admitted to the medicine teaching service from March 1, 2009, to June 30, 2010. This represented a time period during which we had full data for teaching team structure and when there was significant variation in team workload.

Teaching Teams

Each month, 18 teaching teams provide care at the 2 hospitals within the medical center. Each teaching team consists of a supervising attending, a second-year or third-year resident, and 1 or 2 interns plus no or 1 subintern. The maximum number of daily admissions was 5 for an intern and 2 for a subintern. Patient census was capped at 5 for the subintern, at 10 for the intern, and at 20 for the supervising resident. Admissions were assigned to the teams 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 among timing of admissions throughout the academic year, teaching team workload, and patient readmission rates. Clinical data were extracted from a replicate of Montefiore's Clinical Information System, using Clinical Looking Glass quality improvement health care surveillance software.[14]

Montefiore's Institutional Review Board approved this study.

Outcomes

The primary outcome of the study was 30-day readmission rate. Thirty-day readmission was defined as any admission for any reason within 30 days after discharge to either hospital and was analyzed both as a dichotomous and time-to-event variable.

Independent Variables

Teaching team workload was 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 a low-workload team (total admissions ≤ 49, the median for all teams) or a high-workload team (total admissions > 49).

Each admission was defined as early in the academic year (July–September) or later in the academic year (October–June).

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[15] as our comorbidity index. The index was determined by using *International Classification of Diseases,* 9th revision, 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 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. Medical team characteristics were examined with respect to the presence of junior versus senior resident and subintern on the team.

Statistical Analysis

Patients admitted early in the academic year versus later in the year were compared with respect to demographic characteristics, comorbidities, severity of illness, and length of stay by using *t* tests and χ^2 and rank sum tests, as appropriate. To assess univariate associations among

TABLE 1 **Characteristics of Patients**

Characteristic	All Patients	Q1 Patients	Q2–Q4 Patients	
	(n = 12 118; 100%)	(n = 2352; 19.4%)	(n = 9766; 80.6%)	*P* Value
Age	58.9 ± 18.2	58.6 ± 18.2	58.9 ± 18.2	.49
No. of male patients (%)	5269 (43.5)	1021 (43.4)	4248.0 (43.5)	.94
Race				.06
White (%)	1795 (14.8)	383 (16.3)	1412 (14.5)	
Black (%)	4070 (33.6)	750 (31.9)	3322 (34.0)	
Latino (%)	5547 (45.8)	1073 (45.6)	4470 (45.8)	
Other/unknown (%)	706 (5.8)	146 (6.2)	560 (5.7)	
Insurance				.44
Medicare (%)	5420 (44.7)	1036 (44.0)	4384 (44.9)	
Medicaid (%)	4511 (37.2)	896 (38.1)	3615 (37.0)	
Commercial (%)	2042 (16.9)	389 (16.5)	1653 (16.9)	
Self-insured (%)	130 (1.1)	30 (1.3)	100 (1.0)	
Charlson comorbidity score[a]	2.50 ± 2.60	2.44 ± 2.63	2.51 ± 2.60	.86
LAPS	20.83 ± 17.1	20.25 ± 17.0	21.0 ± 17.1	.42
Length of stay (days)	5.23 ± 8.1	5.32 ± 9.5	5.21 ± 7.7	.86
90-day prior admission (days)	0.23 ± 0.6	0.19 ± 0.6	0.24 ± 0.6	< .001

Abbreviations: ICD-9, *International Classification of Diseases*—9th rev; LAPS, laboratory-based acute physiology score; Q, quarter.

[a] Charlson comorbidity score was calculated using ICD-9 diagnosis codes.
[b] LAPS was calculated using 14 laboratory results.

timing of admission, team workload, and 30-day readmission, we compared rates of these outcomes among groups by using χ^2 tests. Logistic regression models were constructed to determine the independent association between assignment to a less busy team and readmission versus assignment to a more busy team and readmission, stratified by time of year, after adjustment for demographic and clinical characteristics. Finally, we constructed survival curves to examine the time to readmission for admissions early versus later in the academic year, using the Kaplan-Meier method. Survival curves for admissions assigned to low-workload teams versus those assigned to high-workload teams were compared using log-rank tests. STATA/IC version 10.0 software (Stata Corp, College Station, TX) was used for all statistical analysis and data management.

Results

Patient Populations

Of 12 118 admissions examined, 2352 (19%) were admitted early in the academic year (July–September), and

TABLE 2 **Characteristics of Teaching Teams**

Characteristic	Total No. Participating (%)	No. of Q1 Members/Total (%)	No. of Q2–Q4 Members/Total (%)	*P* Value
No. of junior (not senior) residents on a team (%)[a]	100 (36.6%)	20/52 (38.5%)	80/221 (36.2%)	.76
No. of subinterns on a team (%)[b]	189 (69.2%)	32/52 (61.5%)	157/221 (71%)	.18

[a] Each team had a junior (postgraduate year [PGY]-2) or senior (PGY-3) resident.
[b] Some teams included a fourth-year student subintern.

TABLE 3 **Primary Outcomes Univariate Analysis: 30-day Readmission Rate in Less-Busy Teams Versus That in More-Busy Teams**

Outcome	Less Busy	More Busy	*P* Value
First quarter	14.93	15.26	.82
Second–fourth quarters	14.45	17.63	< .001

9766 (81%) were admitted later in the academic year (October–June). Patients admitted during the first quarter were similar to those patients admitted during the rest of the year with respect to age, sex, race/ethnicity, insurance, clinical characteristics (LAPS and Charlson score), and mean length of stay. Patients admitted later in the year had a slightly higher 90-day prior admissions rate (19% versus 24%, respectively, $P < .001$; TABLE 1).

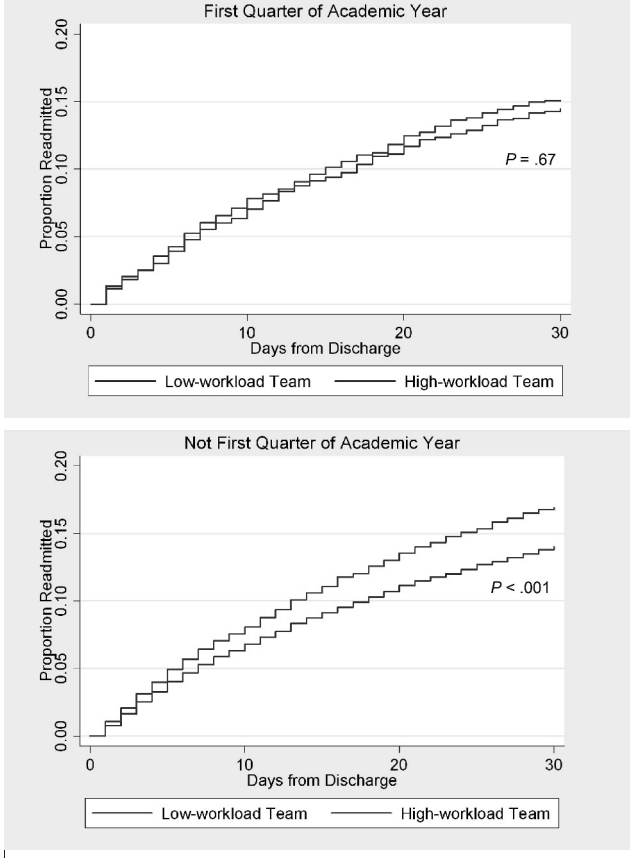

FIGURE **Readmission Rates During First Academic Year Quartile Versus Rest of Academic Year to Low-Workload Versus High-Workload Teams**

Medical Teams Characteristics

During the study period, 273 medical teams were providing care. Medical teams had similar characteristics at the beginning versus later in the academic year regarding the presence of junior residents (38% versus 36%, respectively, $P = .76$) and subinterns (62% versus 71%, respectively, $P = .18$; TABLE 2).

Readmission Rates

Early in the academic year, high-workload teams and lower-workload teams had similar readmission rates (15.3% versus 14.9%, respectively, $P = .82$). However, later in the academic year, high-workload teams had a significantly higher readmission rate than lower-workload teams (17% versus 14%, respectively, $P = .04$; FIGURE, TABLE 3). After multivariate adjustment for age, LAPS, Charlson score, and 90-day prior admissions, the odds of 30-day readmission early in the academic year for high-workload teams were similar to those for lower-workload teams (odds ratio [OR] = 1.03, 95% confidence interval [CI] 0.82–1.30). However, high team workload later in the academic year was associated with increased risk of 30-day readmission (OR = 1.16, 95% CI 1.03–1.30) after adjustment for age, LAPS, Charlson score, and prior admissions (TABLE 4).

Discussion

Our study showed that high teaching team workload was associated with increased risk of 30-day readmission later in the academic year but not early in the academic year. Contrary to our hypothesis that inexperienced residents would be particularly susceptible to high workload in the early months of the academic year, we found the opposite effect. Our findings do not support the notion that teaching team workload should be adjusted down during the early months of the academic year to decrease readmission rates.

In a recent comprehensive review of 38 studies of the July phenomenon, Young et al[18] found that care in July was associated with increased mortality in 22% of the studies,[11,19] increased morbidity in 17% of studies,[20–23] and decreased efficiency in 37% of studies,[24,25] whereas most studies did not find evidence of the July effect. In addition, there is no consensus on the mechanisms causing the July effect. Our study found a "reverse July effect," with teaching apparently more susceptible to high workload later in the academic year.

The heterogeneity of results of studies of the July phenomenon and our evidence of a "reverse July effect" suggests that there may be processes in place that tend to offset the relative inexperience of trainees on teaching teams in July. In a study by Carnahan,[26] teaching teams were compared to hospitalist teams during 4 academic year

TABLE 4 **Odds of 30-day Readmission if Admitted to More-Busy Versus Less-Busy Team Stratified by Time of Year**

Time of Year	Univariate Analysis	Multivariate Analysis[a]
First quarter (July–September)	1.03 (0.82–1.29)	1.03 (0.82–1.31)
Second to fourth quarters (October–June)	1.27 (1.14–1.41)	1.16 (1.04–1.30)

[a] Adjusted for age, laboratory-based acute physiology score, Charlson score, and 90-day prior admissions.

quarters, and it was found that during the fourth academic year quarter, teaching teams had more patient-related adverse outcomes that were not seen in the other quarters. The authors concluded that the notion of a July phenomenon was not supported by their study and that a relative increase in adverse effects at the end of the academic year might be explained by either resident burnout or decrease in supervision. Other possible explanations of the apparent "reverse July effect" include the fact (1) that stronger or more senior residents and/or attending physicians might be assigned to duty at the beginning of academic year; (2) that new residents might compensate for the lack of systems knowledge early in the academic year by being more diligent and thorough than later in a year; and (3) that supervising attending physicians might become less vigilant as the year progressed, as interns attained greater confidence and autonomy in handling medical cases.

Our study has limitations. First, it was conducted at 1 academic institution, and results may not be generalizable to other training programs. Second, we were able to collect meaningful data for a 16-month period, and the trend we observed may not be generalizable to other years. Also, we were not able to directly measure the quality of resident supervision or the quality of care. Although a 30-day readmission rate is a reasonable global measure of quality,[13] it reflects patient factors outside of residents' control, including comorbidities,[27] postdischarge environment,[28] health literacy,[29] and socioeconomic status.[30] Finally, the study was observational, and the results may be confounded if there were differences in the patient groups being compared. We tried to minimize the threat of confounding by adjusting for covariates in a broad range of domains, including patient demographics, comorbidities, severity of illness, and previous admissions.

Conclusion

During the first quarter of the academic year, admission to a busier team is not associated with increased odds of 30-day readmission, suggesting there is a July effect, at least for patient readmissions. In contrast, during the rest of the academic year, admission to busier teams is associated with slightly increased risk for 30-day readmission.

References

1 Wier L. *HCUP Facts and Figures: Statistics on Hospital-based Care in the United States, 2009*. Rockville, MD: Agency for Healthcare Research and Quality; 2009.
2 Singh H, Thomas EJ, Petersen LA, Studdert DM. Medical errors involving trainees: a study of closed malpractice claims from 5 insurers. *Arch Intern Med*. 2007;167(19):2030–2036.
3 Sexton JB, Thomas EJ, Helmreich RL. Error, stress, and teamwork in medicine and aviation: cross sectional surveys. *BMJ*. 2000;320(7237):745–749.
4 Ong M, Bostrom A, Vidyarthi A, McCulloch C, Auerbach A. House staff team workload and organization effects on patient outcomes in an academic general internal medicine inpatient service. *Arch Intern Med*. 2007;167(1):47–52.
5 McMahon GT, Katz JT, Thorndike ME, Levy BD, Loscalzo J. Evaluation of a redesign initiative in an internal-medicine residency. *N Engl J Med*. 2010;362(14):1304–1311.
6 Coit MH, Katz JT, McMahon GT. The effect of workload reduction on the quality of residents' discharge summaries. *J Gen Intern Med*. 2011;26(1):28–32.
7 Averbukh Y, Southern W. The impact of the number of admissions to the inpatient medical teaching team on patient safety outcomes. *J Grad Med Educ*. 2012;4(3):307–311.
8 Walling HW, Veremakis C. Ordering errors by first-year residents: evidence of learning from mistakes. *Mo Med*. 2004;101(2):128–131.
9 Garcia S, Canoniero M, Young L. The effect of July admission in the process of care of patients with acute cardiovascular conditions. *South Med J*. 2009;102(6):602–607.
10 Phillips DP, Barker GE. A July spike in fatal medication errors: a possible effect of new medical residents. *J Gen Intern Med*. 2010;25(8):774–779.
11 Huckman R, Barro J. Cohort turnover and productivity. The July phenomenon in teaching hospitals 2005. Located at: National Bureau of Economic Research, Cambridge, MA.
12 Barach P, Philibert I. The July effect: fertile ground for systems improvement. *Ann Intern Med*. 2011;155(5):331–332.
13 Benbassat J, Taragin M. Hospital readmissions as a measure of quality of health care: advantages and limitations. *Arch Intern Med*. 2000;160(8):1074–1081.
14 Emerging Health Information Technology, 2012. http://www.emerginghealthit.com. Accessed December 23, 2013.
15 Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40(5):373–383.
16 Escobar GJ, Greene JD, Scheirer P, Gardner MN, Draper D, Kipnis P. Risk-adjusting hospital inpatient mortality using automated inpatient, outpatient, and laboratory databases. *Med Care*. 2008;46(3):232–239.
17 Tabak YP, Johannes RS, Silber JH. Using automated clinical data for risk adjustment: development and validation of six disease-specific mortality predictive models for pay-for-performance. *Med Care*. 2007;45(8):789–805.
18 Young JQ, Ranji SR, Wachter RM, Lee CM, Niehaus B, Auerbach AD. "July effect": impact of the academic year-end changeover on patient outcomes: a systematic review. *Ann Intern Med*. 2011;155(5):309–315.
19 Anderson KL, Koval KJ, Spratt KF. Hip fracture outcome: is there a "July effect"? *Am J Orthop* (*Belle Mead NJ*). 2009;38(12):606–611.
20 Haller G, Myles PS, Taffe P, Perneger TV, Wu CL. Rate of undesirable events at beginning of academic year: retrospective cohort study. *BMJ*. 2009;339:b3974.
21 Kestle JR, Cochrane DD, Drake JM. Shunt insertion in the summer: is it safe? *J Neurosurg*. 2006;105(suppl 3):165–168.
22 Englesbe MJ, Pelletier SJ, Magee JC, Gauger P, Schifftner T, Henderson WG, et al. Seasonal variation in surgical outcomes as measured by the American College of Surgeons-National Surgical Quality Improvement Program (ACS-NSQIP). *Ann Surg*. 2007;246(3):456–462; discussion 463–455.

23 Inaba K, Recinos G, Teixeira PG, Barmparas G, Talving P, Salim A, et al. Complications and death at the start of the new academic year: is there a July phenomenon? *J Trauma*. 2010;68(1):19–22.

24 Barry WA, Rosenthal GE. Is there a July phenomenon? The effect of July admission on intensive care mortality and length of stay in teaching hospitals. *J Gen Intern Med*. 2003;18(8):639–645.

25 Rich EC, Hillson SD, Dowd B, Morris N. Specialty differences in the "July Phenomenon" for Twin Cities teaching hospitals. *Med Care*. 1993;31(1):73–83.

26 Carnahan J, Visotcky AM, Fletcher KE. The Relationship Between Experience and Outcomes: Another Look at the July Effect. http://www.sgim.org/File%20Library/SGIM/Resource%20Library/Meeting%20Handouts/SGIM/2012/ASE3AM12.pdf. Accessed December 23, 2013.

27 Franchi C, Nobili A, Mari D, Tettamanti M, Djade CD, Pasina L, et al. Risk factors for hospital readmission of elderly patients. *Eur J Intern Med*. 2013;24(1):45–51.

28 Chaudhry S, Jin L, Meltzer D. Use of a self-report-generated Charlson comorbidity index for predicting mortality. *Med Care*. 2005;43(6):607–615.

29 Schmeida M, Savrin RA. Heart failure rehospitalization of the Medicare FFS patient: a state-level analysis exploring 30-day readmission factors. *Prof Case Manag*. 2012;17(4):155–161; quiz 162–163.

30 Calvillo-King L, Arnold D, Eubank KJ, Lo M, Yunyongying P, Stieglitz H, et al. Impact of social factors on risk of readmission or mortality in pneumonia and heart failure: systematic review. *J Gen Intern Med*. 2013;28(2):269–282.