American Journal of Emergency Medicine xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Are testers also admitters? Comparing emergency physician resource utilization and admitting practices

Nicole R. Hodgson, MD [a,b,*], Souroush Saghafian, PhD [c], Lanyu Mi, MS [a], Matthew R. Buras, MS [a], Eric D. Katz, MD [b], Jesse M. Pines, MD MBA [d], Leon Sanchez, MD [e], Scott Silvers, MD [f], Steven A. Maher, MD [a], Stephen J. Traub, MD [a]

[a] Department of Emergency Medicine, Mayo Clinic Arizona, Phoenix, AZ, USA
[b] Department of Emergency Medicine, District Medical Group-Maricopa Integrated Health Systems, Phoenix, AZ, USA
[c] Harvard Kennedy School, Harvard University, Cambridge, MA, USA
[d] Department of Emergency Medicine and Health Policy & Management, George Washington University, Washington, DC, USA
[e] Department of Emergency Medicine, Beth Israel Deaconess Medical Center, Boston, MA, USA
[f] Department of Emergency Medicine, Mayo Clinic Florida, Jacksonville, FL, USA

ARTICLE INFO

Article history:
Received 1 May 2018
Received in revised form 30 June 2018
Accepted 20 July 2018
Available online xxxx

Keywords:
Resource utilization
Provider variability
Emergency medicine

ABSTRACT

Objective: To describe the relationship between emergency department resource utilization and admission rate at the level of the individual physician.
Methods: Retrospective observational study of physician resource utilization and admitting data at two emergency departments. We calculated observed to expected (O/E) ratios for four measures of resource utilization (intravenous medications and fluids, laboratory testing, plain radiographs, and advanced imaging studies) as well as for admission rate. Expected values reflect adjustment for patient- and time-based variables. We compared O/E ratios for each type of resource utilization to the O/E ratio for admission for each provider. We report degree of correlation (slope of the trendline) and strength of correlation (adjusted R^2 value) for each association, as well as categorical results after clustering physicians based on the relationship of resource utilization to admission rate.
Results: There were statistically significant positive correlations between resource utilization and physician admission rate. Physicians with lower resource utilization rates were more likely to have lower admission rates, and those with higher resource utilization rates were more likely to have higher admission rates.
Conclusions: In a two-facility study, emergency physician resource utilization and admission rate were positively correlated: those who used more ED resources also tended to admit more patients. These results add to a growing understanding of emergency physician variability.

1. Introduction

Emergency physicians (EPs) differ with regard to resource utilization [1, 2] and admission rate [3, 4]. We sought to determine the relationship, if any, between the rate of utilization of specific resources (intravenous medications and fluids, laboratory tests, plain radiographs, and advanced imaging studies) and admission rate.

2. Methods

2.1. Study design and setting

This retrospective analysis of routinely gathered emergency department (ED) operational data was a two-site quality improvement study and identified as exempt from our institutional review board process.

Neither site has an Emergency Medicine training program or a Fast Track. Both sites are staffed by residency-trained EPs, utilize a rotational patient assignment system [5], and have resident physicians from other services working in the department who assist in evaluating ~5% of patients. Additional site characteristics are noted in Table 1.

* Corresponding author at: Department of Emergency Medicine, Mayo Clinic Arizona, Phoenix, AZ, USA.
E-mail address: Hodgson.Nicole@Mayo.edu (N.R. Hodgson).

https://doi.org/10.1016/j.ajem.2018.07.041
0735-6757/

Table 1
Site characteristics.

Site	City	State	Census[a]	Rooms	Hallway Bays	NP/PA used	ED observation
1	Phoenix	AZ	34,000	24	9	None	No
2	Jacksonville	FL	24,500	22	12	One	Yes[b]

[a] Annual census rounded to nearest 500 visits.
[b] At Site 2, ~4% of patients were placed into ED observation status.

2.2. Measurements

We analyzed visits between October 1, 2015 and September 30, 2017, eliminating those who left without being seen (LWBS), those for whom no physician was assigned in the electronic medical record (EMR), and those seen by low-volume providers (<500 patient visits during the study period, which has been used as a threshold for exclusion in similar papers [6]).

We measured patient age in years, assigned sex based on patient declaration, and categorized race as white versus other. Nurses assigned Emergency Severity Index (ESI) scores in standard (1–5) fashion. Time of day was categorized by shift: day (07:00–14:59), evening (15:00–22:59), or night (23:00–06:59). Days of the week were aggregated as weekday vs. weekend. Season was categorized as Winter (January–March), Spring (April–June), Summer (July–September) and Fall (October–December). Study year 1 was October 1, 2015 to September 30, 2016; year 2 was October 1, 2016 to September 30, 2017.

Both sites utilized a common EMR and provider order entry system (Cerner®; Kansas City, MO).

Definitions of intravenous medications and fluids, laboratory testing, plain radiography, and advanced imaging were identical at both sites. We defined intravenous medications and fluids as the number of unique orders for these items that were placed per visit. We defined laboratory testing as the number of tests resulted, not number of orders placed. For example, the order for a basic metabolic panel generates results for 8 items; the laboratory testing value for a basic metabolic panel was therefore 8. We defined plain radiography as the number of x-ray studies ordered per visit, not number of specific films obtained; the plain radiography value of a 3-view plain radiograph of the wrist was therefore 1. We defined advanced imaging studies as formal computerized tomography (CT), ultrasound and magnetic resonance imaging studies; bedside ultrasound tests performed by EPs were not included. We defined admission as being hospitalized (either as a full admission or in observation status) or placed into ED observation status.

2.3. Statistics

We calculated the observed per-visit rate of each type of resource utilization for each physician. We also calculated an observed admission rate for each physician, which we defined as number of admissions/number of visits seen. Adjusted by patient (age, sex, race, and ESI score) and time (shift, day of week, season, and study year) characteristics, we determined an expected value for each visit for resource utilization using general Poisson regression and separately for admission using logistic regression. We calculated the mean of individual expected values for all visits seen by a given physician to determine that physician's expected rates. We then derived the observed/expected ratio (O/E) for each physician.

We report mean, standard deviation (SD), median, interquartile range (IQR) and range for O/E resource utilization and admission rates. We created scatter plots with fitted linear regression lines to examine the correlation between each of the four categories of resource utilization and admission rate. For each regression analysis, we determined slope (degree of association) and adjusted R^2 (strength of association) of the line of best fit.

For categorical associations, we classified physicians as "low" (O/E < 1), or "high" (O/E > 1). We then divided physicians into four groups based on their resource utilization rate/admission rate (low/low, high/low, low/high, high/high). We calculated the odds ratio for low resource utilization O/E between low versus high admission O/E. Weighted Kappa coefficients of pairwise association groups based on resource utilization/admission were calculated and tested.

3. Results

We report patient inclusion and elimination profiles in Table 2 and patient characteristics in Table 3. We report raw data for resource utilization and admission in Table 4. We report O/E ratios for resource utilization and admission in Table 5.

We present graphical relationships of per-physician resource utilization O/E ratios vs. admission O/E ratios in Fig. 1. Regression lines are shown for each of the measurements versus admission rate, surrounded by the 95% confidence interval of that line. Statistics for the line of best fit are provided above each graph. Average decile values (grouped by admission rate)—and not physician-specific data—are overlaid on each graph for context. All per-physician resource utilization measures had statistically significant positive correlations with admission.

Categorical results are reported in Table 6. EPs with low resource utilization were statistically more likely to have low admission rates and those with high resource utilization were more likely to have high admission rates in all categories except plain radiography.

4. Discussion

4.1. Main discussion

There were three plausible a priori hypotheses regarding the relationship between resource utilization and admission rate: they are independent (the null hypothesis), negatively correlated (perhaps because increased resource utilization gives EPs sufficient reassurance to discharge), or positively correlated (perhaps because EP tendencies that increase resource utilization drive the decision to admit). Our findings support the latter.

We found a significant relationship at the level of the individual physician between each of four ED resource utilization rates and admission rate (Fig. 1). We also found that physicians were more likely to have a consistent resource utilization and admission pattern (below average for both or above average for both) for all resources other than plain radiography (Table 6).

Taken in the aggregate, we believe our results suggest that, for a given patient encounter, resource utilization and admission decisions may reflect provider approach in addition to patient presentation.

Our findings are consistent with those of others. A preliminary communication found a positive correlation between CT utilization and admission rate [7]. Another study found a positive correlation between acute gastroenteritis-related testing and admission, concluding that pediatric EPs displayed a consistent high-resource or low-resource utilization tendency [1]. Previous studies have examined EP variation with regard to specific orders (such as CT scans [2] or admission [4]), but our study attempts to determine whether the physicians who are higher utilizers of ED resources are the same physicians who admit more patients. While our results collectively suggest that the propensity to utilize resources and admit patients may be an inherent physician practice characteristic, our data offer no insight into how such a propensity might develop. Previous studies suggested that both risk-aversion [8] and malpractice fears [9] may increase ordering behavior in specific clinical situations for EPs; if so, it is logical that resource utilization and admitting behavior may track together at the level of individual physician.

If risk-aversion and malpractice fears drive higher utilization, one mitigation strategy may be to integrate decision support into the EMR,

Please cite this article as: Hodgson NR, et al, Are testers also admitters? Comparing emergency physician resource utilization and admitting practices, American Journal of Emergency Medicine (2018), https://doi.org/10.1016/j.ajem.2018.07.041