The durability of operational improvements with rotational patient assignment☆

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ABSTRACT

Introduction: Previous work has suggested that Emergency Department rotational patient assignment (a system in which patients are algorithmically assigned to physicians) is associated with immediate (first-year) improvements in operational metrics. We sought to determine if these improvements persisted over a longer follow-up period.
Methods: Single-site, retrospective analysis focused on years 2–4 post-implementation (follow-up) of a rotational patient assignment system. We compared operational data for these years with previously published data from the last year of physician self-assignment and the first year of rotational patient assignment. We report data for patient characteristics, departmental characteristics and facility characteristics, as well as outcomes of length of stay (LOS), arrival to provider time (APT), and rate of patients who left before being seen (LBBS).
Results: There were 140,673 patient visits during the five year period; 138,501 (98.7%) were eligible for analysis. LOS, APT, and LBBS during follow-up remained improved vs. physician self-assignment, with improvements similar to those noted in the first year of implementation. Compared with the last year of physician self-assignment, approximate yearly average improvements during follow-up were a decrease in median LOS of 18 min (8% improvement), a decrease in median APT of 21 min (54% improvement), and a decrease in LBBS of 0.69% (72% improvement).
Conclusion: In a single facility study, rotational patient assignment was associated with sustained operational improvements several years after implementation. These findings provide further evidence that rotational patient assignment is a viable strategy in front-end process redesign.

1. Introduction

The Emergency Department (ED) front-end (that portion of the visit between patient arrival and the time a provider assumes definitive care of a patient [1]) is an area in which ED administration and personnel generally have a great deal of operational control. As such, it is often an area for innovation and redesign to improve patient flow. Examples of front-end interventions include the use of a fast-track [2], physician in triage [3,4], telemedical triage [5,6], bedside registration [7], virtual patient streaming [8], and split-flow models [9].

Rotational patient assignment is another ED front-end process redesign, in which patients are algorithmically assigned to physicians. This workflow inverts a typical approach of relying on physicians to acquire (or "pick up") new patients at their discretion. Previous work has shown that rotational patient assignment is associated with short-term operational gains [10-15], but the long-term effects of rotational patient assignment on operational metrics are unclear.

Improving clinical operations is an overarching goal of virtually every ED. Operational improvements have the potential to improve clinical care, increase patient satisfaction, and improve financial performance. Such improvements can also help to decrease ED crowding, a condition associated with a number of negative patient outcomes [16]. Knowing if an intervention was likely to produce long-term gains

might help ED administrators and personnel decide if such an intervention was a worthwhile investment at their facility.

We report long-term operational metrics (years 2–4) in a rotational patient assignment system, with the goal of understanding the durability of improvements over time.

2. Methods

2.1. Institutional review board

This work was part of a quality improvement initiative, and was identified as exempt by our Institutional Review Board process, with a waiver of the requirement for informed consent.

2.2. Study design and setting

This was a retrospective, single-site analysis of routinely gathered operational data.

The XXX ED is located in tertiary care teaching hospital in City, State. The average yearly census during the 5 year period was 28,135 (range: 25,651–32,224), and the average admission rate was 31%. The ED has 24 rooms, and 9 hallway bays. The ED is staffed 24 h per day with board-certified Emergency Physicians. There are no advanced practice providers (nurse practitioners or physician assistants), and there is no fast-track. There is no Emergency Medicine training program, although residents from multiple services rotate through the department as learners and are involved in the evaluation of approximately 5% of visits. Residents acquire patients ad libitum, without having patients assigned to them, and may see patients assigned to any attending physician.

2.3. Selection of participants

We electronically reviewed all patient visits identified by our electronic medical record (EMR; Cerner®; Kansas City) within a five-year period (June 12, 2011–June 11, 2016) that included our last year of physician self-assignment and the first four years of rotational patient assignment.

We have previously reported a comparison of operational metrics for our last year of physician self-assignment (June 12, 2011 to June 11, 2012) and our first year of rotational patient assignment (June 12, 2012 to June 11, 2013) [14]. We include data from our original publication herein for reference and as a part of a regression analysis, but note that these are not novel data.

2.4. Interventions

For the entirety of the five year period, virtually all ambulance patients were roomed immediately and registered at bedside. Ambulatory patients underwent quick registration and nursing triage, in a dedicated triage area or at bedside.

In the last year of physician self-assignment, there was one queue ("rack") into which the charge nurse placed all charts, in the order that she or he thought they should be evaluated. Physicians then picked up patients at their discretion.

After implementation of rotational patient assignment, a computer algorithm electronically assigned patients to physicians 60 s after registration. In the first iteration of this system, physicians were assigned 3 consecutive patients at the beginning of their shift, were not assigned any patients in the last 90 min of their shift, and were not assigned more than 16 patients per shift. In its current iteration, physicians are assigned 4 consecutive patients at the beginning of their shift, are not assigned any patients in the last 120 min of their shift, and are not assigned more than 18 patients per shift.

In all iterations, after the initial allocation of patients physicians are placed into a strict rotation with other on-duty physicians. Assignments are made based solely on arrival time, without consideration of patient demographics, chief complaint, Emergency Severity Index score,

provider patient load, or acuity of patients recently assigned to the provider.

The typical shift length is 9 h. A more detailed discussion of the first iteration of this system has been reported previously [14].

2.5. Methods and measurements

We defined LOS as the time interval (in minutes) between registration and the end of the ED visit. The end of the ED visit was defined as leaving the department or being placed into holding status, which generally occurred if a bed had not been assigned to an admitted patient 4 h after a bed request was placed. We defined APT as the time from registration until the time that a physician electronically "claimed" the patient (an event that occurred after, and independent of, the patient being assigned to a certain physician). LBBS was defined as leaving before evaluation by a physician. None of these working definitions or parameters changed during the five year period.

Total nurse staffing hours was defined as the number of hours worked by clinical nurse staff (excluding nurse administrators, nursing aides, and technicians) starting with the 7 AM shift, which was the first shift of the day. Nursing workload was defined as daily ED census/total nurse staffing hours. Total physician staffing hours was defined as the number of scheduled physician hours, beginning with the 6 AM shift, which was the first shift of the day. Physician workload was defined as daily ED census/total physician staffing hours. ED holding is expressed as number of days in which any ED holding occurred. Effective hospital occupancy was defined as the hospital census divided by the number of staffed beds (expressed as a proportion) at 6 AM.

Data for LOS, APT, LBBS and daily ED census were retrieved from the EMR. Data for nurse staffing were retrieved from handwritten logs and ANSOS One Staff® (McKesson, San Francisco, CA). Data for physician staffing were retrieved from Tangier® (Peake Software Labs, Sparks, MD). Data for effective hospital occupancy and ED holding were retrieved from a customized hospital operations report.

Non-parametric 95% bootstrap confidence intervals were produced to evaluate the differences between the means and medians for LOS and APT and the differences in percentage for LBBS. In each case we performed 1000 replications and calculated the 2.5th percentile and the 97.5th percentile to provide the lower and upper limits (respectively) of the 95% confidence intervals. Statistical significance was defined as a bootstrap confidence interval that did not include zero.

We performed a multiple linear regression to determine the change in LOS in the 4 years of rotational patient assignment vs. the last year of physician self-assignment after accounting for confounders. We used a simplified model incorporating those variables (ED holding, effective hospital occupancy) that changed in a direction that might independently decrease LOS, and did not incorporate potential confounders that showed little or no change (such as physician and nurse staffing) or changed in a manner that would tend to increase LOS (such as ED volume).

Statistical analysis was performed with SAS version 9.3 (SAS Institute Inc., Cary NC).

3. Results

3.1. Patient and site characteristics

There were 140,673 visits over the 5 year period. We eliminated 1772 visits (1.3%) with APT or LOS values that were missing or illogical (such as APT or LOS of less than zero). This left 138,901 visits eligible for analysis.

Yearly ED volumes and yearly study subject characteristics are presented in Table 1. There was little change in age or gender over the 5 year period, and a slight increase in acuity (manifesting primarily as an increase in ESI level 2 patients and a decrease in ESI level 4 patients) in all four years of rotational patient assignment vs. the last year of physician self-assignment.