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A targeted initiative to discharge surgical patients earlier in the day is associated with decreased length of stay and improved hospital throughput

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ABSTRACT

Background: The timing of inpatient discharges can impact hospital throughput with later discharges leading to decreased patient satisfaction, increased length of stay (LOS), and longer boarding times.
Methods: A 12-month targeted intervention that included both pre-operative and inpatient components was implemented across all surgical inpatient services to increase the proportion of patients discharged by noon.
Results: Discharge by noon rates increased from 14.3% to 21.5% during the 12-month initiative ($p < 0.01$). The case mix index adjusted LOS (aLOS) decreased from 2.17 to 2.02 days ($p < 0.01$). ED, PACU, and ICU boarding times were all significantly lower during the initiative ($p < 0.01$, $p < 0.01$, $p = 0.03$ respectively).
Conclusions: A targeted initiative to discharge surgical patients earlier resulted in a 50% increase in the proportion of patients discharged by noon. Associated with this finding were improvements in hospital throughput as measured by aLOS and boarding times in the ED, ICUs, and PACU.

Introduction

Hospital congestion is an identified concern for major academic medical centers and can lead to high boarding times in various hospital units.[1] This has largely been studied in the emergency department with higher boarding times even being associated with higher mortality rates.[2,3] Shortening patient boarding times, not only in the emergency department, but also on other inpatient units has therefore been identified as a hospital quality improvement goal by hospital accreditation agencies.[4]

One aspect of inpatient care that greatly affects hospital throughput and boarding times is the timing of a patient's discharge.[5] There are many barriers hindering patients from being discharged earlier in the day. However, overcoming these barriers and discharging patients earlier can lead to increased overall hospital throughput and potentially improve patient safety and satisfaction.[6] While attaining earlier discharges has been shown to be possible at an institutional level and with medical services, this study was designed to investigate if improvements can be made on surgical services specifically.[7,8] Surgical services are unique in that the patient flow is largely dictated by patients undergoing elective operations being admitted from the operating room. Lastly, the relationship between discharge timing and various hospital throughput metrics was also studied.

Material and methods

Setting

University Hospitals Cleveland Medical Center is an urban 1032 bed tertiary care academic medical center. The initiative was implemented across all surgical specialties including colorectal surgery, cardiac surgery, obstetrics and gynecology, general surgery, neurosurgery, oral and maxillofacial surgery, orthopedic surgery, otolaryngology, plastic surgery, surgical oncology, transplant surgery, trauma surgery, urology, and vascular surgery. Each service was a combination of medical students, advanced practice providers, residents, and attendings performing both elective and

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emergency operations. No individual patient data were collected and an IRB exemption was obtained.

Intervention

Prior to the initiation of this intervention, there was no standardized discharge process or workflow across the various surgical services. Based on previous literature and our pilot intervention on the otolaryngology service, noon was identified as the target discharge time. The discharge time was defined as when the unit secretary recorded the patient leaving the floor. If the patient was undergoing an elective procedure, the initiative was first communicated to the patient at the preoperative visit including expected length of stay and anticipated day of discharge (ADOD). While an inpatient, the plan of care and ADOD were continually updated and communicated to the patients and their families on a daily basis by their surgical team. This was reinforced using signage in the room, in the hallway, and as a scrolling message on the TV screen which consistently reminded patient of their ADOD. Residents, advanced practice providers, and attendings were instructed to have all discharge paperwork completed in the electronic medical record the day prior to the ADOD with labs only being ordered on the ADOD if deemed medically necessary.

Nursing managers were also included in the initiative and nursing specific changes were implemented on the surgical floors. Nurses reinforced the ADOD throughout the hospital stay, ensured patient education was completed the day prior to the ADOD, and completed all the necessary paperwork in the medical record in a timely fashion in order for discharges to be expedited. To shorten the discharge process completed by the nursing staff, nurses were told which patients were expected to be discharged that day during morning report, and nurses were not assigned to multiple patients who were being discharged that morning. A nurse driven discharge appointment was scheduled at 9:30AM on the day of discharge to review final discharge paperwork with the patient and their families.

The patient transport department increased the pool of available transporters during the morning hours to alleviate any potential bottlenecks in patient transport. Environmental services also increased their pool of available staff to efficiently clean and prepare the rooms of discharged patients for new admissions.

Throughout the intervention period, there were no incentives or penalties created to encourage adoption of the intervention.

Data and analysis

The intervention period was January 1, 2017 to December 31, 2017 and the year prior, January 1, 2016 to December 31, 2016, was used as a comparison. The primary outcome was the proportion of patients discharged by noon, and secondary outcomes included measures of hospital throughput such as length of stay (LOS) and boarding times in various hospital units including the emergency department (ED), surgical and cardiac intensive care units (SICU and CICU), and the post-anesthesia care unit (PACU). Case mix index (CMI) and 30-day readmission rates were also collected. Length of stay was collected due to the concern that providers might not discharge patients who meet discharge criteria later in the day to improve the primary outcome of the study by discharging them the following day before noon. Adjusted length of stay (aLOS), calculated by dividing the LOS by the CMI, was also collected as it reduces the biases introduced when patient populations have large fluctuations in CMI. Boarding time in the ED, ICUs, and PACU were defined as the time from when the medical provider placed a bed request order to when a bed was assigned. Data were collected from the electronic medical record and the hospital's bed management system. Statistical analyses were performed with JMP Pro 13 (SAS Institute Inc, Cary, NC) and included the 2-tailed *z* test, 2-tailed unpaired Student's *t*-test, and Pearson's chi-squared test with a p-value of <0.05 being considered significant.

Results

Over the 12-month intervention period there were 12,055 discharges across the fourteen surgical services which was not significantly different than the year prior. There were 803 discharges on colorectal surgery, 912 on cardiac surgery, 829 on obstetrics and gynecology, 686 on general surgery, 1615 on neurosurgery, 111 on oral and maxillofacial surgery, 2000 on orthopedic surgery, 733 on otolaryngology, 103 on plastic surgery, 414 on surgical oncology, 456 on transplant surgery, 1408 on trauma surgery, 924 on urology, and 512 on vascular surgery.

The proportion of patients discharged by noon increased from 14.3% during 2016 to 21.5% during 2017, a 50.5% increase ($p < 0.01$) (Fig. 1).

Overall length of stay decreased from 6.1 to 5.9 days, but this did not achieve statistical significance ($p = 0.07$). Adjusted length of stay (aLOS) decreased from 2.17 to 2.02 days, which was a 6.6% decrease and was statistically significant ($p < 0.01$).

Boarding times across all units studied were significantly reduced (Fig. 2). In the ED, the average boarding time decreased from 220 min to 119 min ($p < 0.01$). In the PACU, the average boarding time decreased from 181 min to 125 min ($p < 0.01$). In the SICU and CICU, the average boarding time decreased from 387 min to 316 min ($p = 0.03$).

CMI and 30-day readmission rates did not significantly change during the intervention period when compared to the year prior (2.82 vs 2.93 $p = 0.10$, 10.6% vs 10.8% $p = 0.8$ respectively).

Discussion

This initiative's primary objective was to increase the proportion of patients discharged earlier in the day in an attempt to improve hospital throughput. While this has been shown to be possible on medical services, surgical services have unique bottlenecks to throughput that become quite evident in the afternoon as elective surgical patients in the PACU begin to need either floor or ICU beds. If no beds are available, boarding times in the PACU increase and delayed admission to the ICU from PACU has been associated with higher ICU mortality rates. Therefore, efforts should be made to minimize PACU boarding times.[9] In addition, congestion in the PACU may impact throughput by delaying the start of afternoon operations.

The increased bed availability earlier in the day can also explain the decrease in ICU boarding times as the ICU teams begin to transfer patients to the floor after morning rounds. Being able to more quickly transfer patients out of the ICU can also decrease delayed admissions to the ICU from the floor and ED. Such delayed admissions are associated with higher overall patient mortality.[10]

Increasing ED throughput is becoming a national objective as ED overcrowding has been shown to be associated with higher early mortality in admitted patients.[3,11] While increasing the proportion of available inpatient beds can be expected to lower ED boarding times, this study showed a significantly higher than anticipated decrease in ED boarding times for an intervention that was limited to the surgical services. However, beds made available by discharging surgical patients earlier in the day can then be filled by either medical or surgical patients from the ED and therefore could also impact throughput for medical patients boarding in the ED as

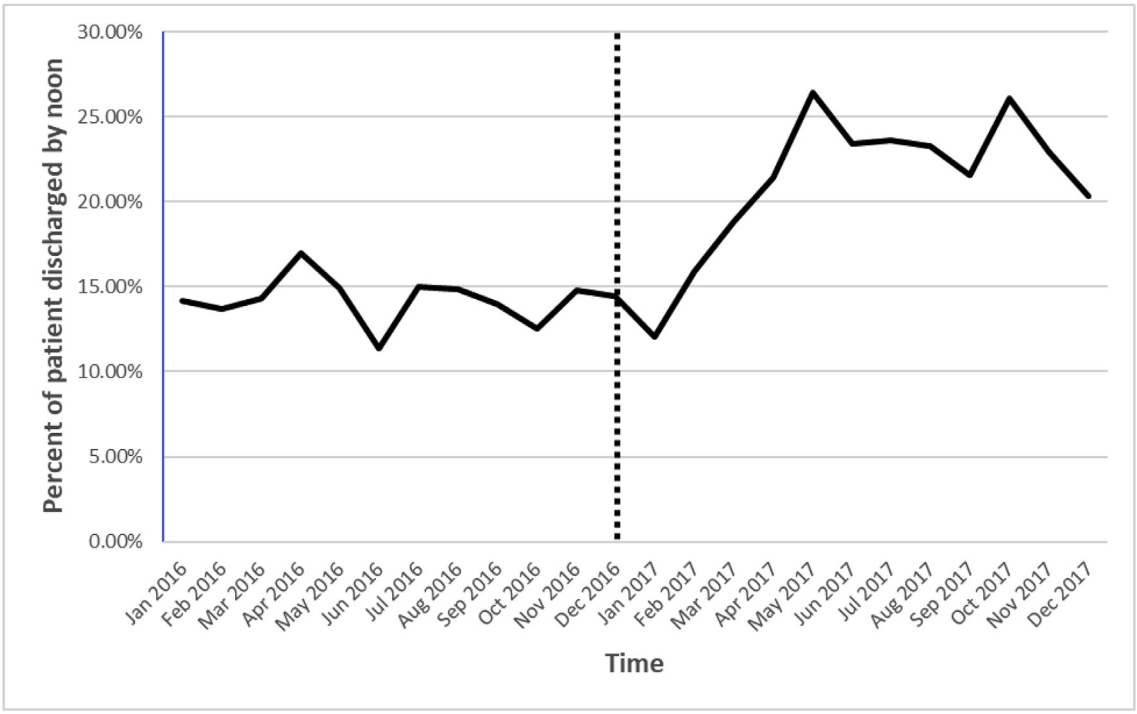

Fig. 1. Percentage of patients discharged by noon versus time for the 12 months prior to the initiative and the 12 months during the initiative. Dashed line represents the beginning of the initiative.

well. In addition, previous studies on medical services have also shown that earlier inpatient discharges can lead to shorter ED boarding times.[12]

The strengths of this study include its high number of patient encounters, its potential reproducibility with other services or hospital systems, and its potential to affect hospital throughput. The study's main limitation is that the intervention and subsequent results are not necessarily cause and effect but instead are correlative which has the potential to introduce bias. No known initiatives were undertaken in other departments that would affect discharge timing, however unknown initiatives may have had an additive effect on the metrics studied leading to potential confounding bias.

As with many quality improvement initiatives, sustainability can be difficult and data will continue to be collected and analyzed to ensure the above results of the initiative persist. Financial impact, patient satisfaction, and throughput in the operating rooms are potential future areas of study.

Conclusions

A targeted initiative to discharge surgical patients earlier resulted in a 50% increase in the proportion of patients discharged by noon. Associated with this finding were improvements in

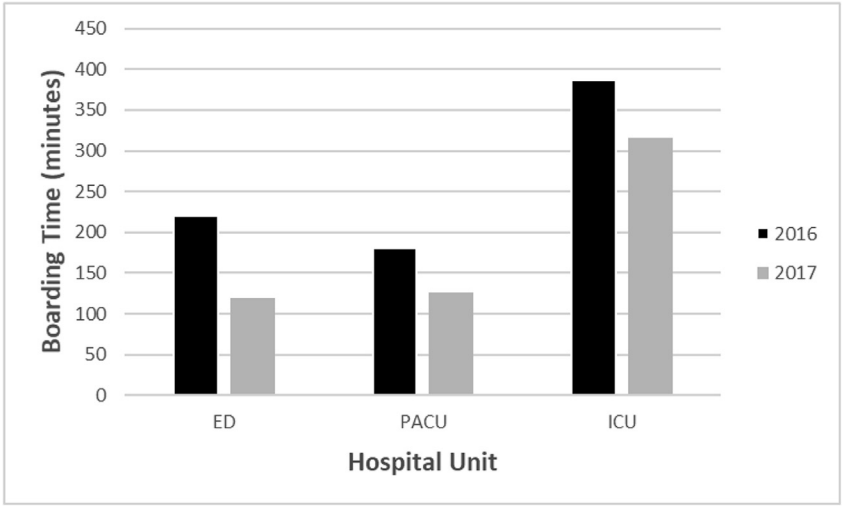

Fig. 2. Comparing the boarding times for various hospital units between the 12 months prior to the initiative and the 12 months during the initiative.

hospital throughput as measured by aLOS and boarding times in the ED, ICUs, and PACU.

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Appendix A. Supplementary data

Supplementary data related to this article can be found at https://doi.org/10.1016/j.amjsurg.2018.08.017.

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