Natural History of Late Discharges from a General Medical Ward

Lena M. Chen, MD, MS[1]
Michael H. Freitag, MD, MPH[2]
Manuel Franco, MD, PHD[3]
Christopher D. Sullivan, MD, MPH[4]
Conan Dickson, PhD, MPH[5]
Frederick L. Brancati, MD, MHS[3,6]

[1] Massachusetts Veterans Epidemiology Research and Information Center (MAVERIC), VA Boston Healthcare System, Boston, Massachusetts.

[2] Institut für Medizinmanagement und Gesundheitswissenschaften, Universität Bayreuth, Bayreuth, Germany.

[3] Department of Epidemiology, Johns Hopkins Bloomberg School of Public Health, Baltimore, Maryland.

[4] Excela Health, Greensburg, Pennsylvania.

[5] Operations Support, Johns Hopkins Health System, Baltimore, Maryland.

[6] Division of General Internal Medicine, Johns Hopkins School of Medicine, Baltimore, Maryland.

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BACKGROUND: Slow hospital discharges reduce efficiency and compromise care for patients awaiting a bed. Although efficient discharge is a widely held goal, the natural history of the discharge process has not been well studied.
OBJECTIVE: To describe the discharge process and identify factors associated with longer and later discharges.
DESIGN: Prospective cohort study.
SETTING: A general medicine ward without house-staff coverage, in a tertiary care hospital (The Johns Hopkins Hospital) in Baltimore, Maryland, from January 1, 2005 to April 30, 2005.
PATIENTS: Two hundred and nine consecutively discharged adult inpatients.
MEASUREMENTS: Discharge time (primary outcome) and discharge duration (secondary outcome).
RESULTS: Median discharge time was 3:09 PM (25th% to 75th%: 1:08 to 5:00 PM). In adjusted analysis, discharge time was associated with ambulance used on discharge (1.5 hours), prescriptions filled prior to discharge (1.4 hours), subspecialty consult prior to discharge (1.2 hours), and procedure prior to discharge (1.1 hours). Median duration of the discharge process was 7 hours 34 minutes (25th% to 75th%: 4.0 to 22.0 hours). Discharge duration was associated with discharge to a location other than home (28.9 hours), and with need for consultation (14.8 hours) or a procedure (13.4 hours) prior to discharge (all P values <0.05).
CONCLUSIONS: Discharge time and duration have wide variability. Longer and later discharges were associated with procedures and consults. Successful efforts to decrease time of discharge will require broad institutional effort to improve delivery of interdepartmental services. **Journal of Hospital Medicine** 2009;4:226–233. © 2009 Society of Hospital Medicine.

KEYWORDS: discharge, efficiency, length of stay, patient flow.

Additional Supporting Information may be found in the online version of this article.

In the past 2 decades, emergency department (ED) overcrowding has become an issue large enough to receive coverage in the popular press, and to spawn research around its causes and effects.[1–16] At the same time, nurses and physicians on the inpatient wards have been urged to shorten the length of stay for patients as health system leaders face an aging population but limited capital to build new beds or hire additional clinical staff. Capacity management—encompassing the flow of patients from ED triage to inpatient discharge—has become a shared concern of clinicians and hospital administrators alike.

How to achieve the goals of diagnosing and healing while ushering patients ever more quickly through the modern hospital is not yet entirely clear. Past research and work by business groups suggests that demand for inpatient beds starts early in the day, but discharges typically occur in the late afternoon.[17] This creates a potential bottleneck in patient flow. Many hospitals have implemented measures to improve patient throughput.[18–21] However, formal research has focused on factors leading to an additional inpatient day.[22–26] We have found no peer-reviewed publications that address the problem of same-day delays by describing hour of day for each step in the discharge process and variables associated with late-day discharges. To fill this gap, we conducted a prospective cohort study of 209 consecutive discharges from a general medical ward to: (1) describe the natural history of hospital discharge, (2) measure time of day and duration for each step, and (3) identify factors associated with discharges that occur later in the day. We hypothesized that time and duration of discharge would be associated with 5 factors: patient demographics and clinical characteristics, departmental occupancy, type of inpatient

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testing done immediately prior to discharge, and discharge characteristics such as discharge to a location other than home.

Patients and Methods

Setting

The setting was the Hospitalist Unit of a single teaching hospital in Baltimore (The Johns Hopkins Hospital) from January 1, 2005 to April 30, 2005. Patients entered the cohort upon initiation of the discharge process by the hospitalist team on the Hospitalist Unit, and were followed until they were discharged alive from the hospital.

There were no published data on which to base firm a priori sample size calculations. Based on pilot data, we estimated that a sample size of about 170 would yield precise estimates for means and standard deviations, giving us 80% to 90% power to determine differences in time intervals across categories, with alpha set to 0.05. We estimated that we would need 4 months of data collection to achieve this sample size.

During the period of study, the 16-bed unit was staffed with in-house hospitalist attending physicians without house-staff, from 7 AM (weekdays) or 8 AM (weekends) to 10 PM (Monday to Thursday) or 8 PM (Friday to Sunday). The hospitalist unit had 24-hour physician coverage, but attending physicians provided overnight coverage from home (backed up by in-house residents for patient care emergencies). Handoffs of patient care from one attending physician to another typically occurred on Friday afternoon or Monday morning. The unit had 1 dedicated social worker and a nurse clinician who provided part-time assistance with discharge planning.

Outcome Measurements

We defined the start of the discharge process as the time the patient's last medically necessary test was needed by his or her attending physician. Specifically, physicians were asked when the results of this test first would have been useful in clearing the patient for discharge. In the remainder of this work, we will refer to the start of the discharge process as "time decisive test needed."

The end of the discharge process was called the discharge time, and defined as the time the unit clerk saw the patient leave the unit. We defined early discharges as those occurring before the median hour of discharge (3:00 PM), and late discharges as those occurring at or after this hour.

A focus group composed of nurses, physicians, social worker, unit clerks, and support associates (group responsible for cleaning patient rooms) volunteered to map out the discharge process. Based on these discussions, durations in the discharge process were defined as follows: (1) duration 1: time decisive test needed, until time the attending physician was aware of test results; (2) duration 2: time the physician was aware of test results until discharge paperwork was complete; (3) duration 3: time discharge paperwork complete until patient leaves unit; and (4) total discharge duration: time decisive test needed until patient leaves unit.

Exposure Measurements

We categorized exposures into 5 groups: (1) demographics (age, gender, race, source of patient such as outside hospital versus emergency department versus other, and payer on discharge); (2) clinical characteristics (length of stay, any psychiatric diagnosis, any substance abuse diagnosis, and severity of illness); (3) system characteristics (departmental occupancy defined as proportion of hospital beds designated for Department of Medicine patients that were occupied on the day of discharge); (4) last test characteristics (physical exam, laboratory test, procedure, and consult); and (5) discharge characteristics (discharged to home versus not discharged to home, prescriptions filled in hospital pharmacy prior to discharge, and ambulance required for transport).

Psychiatric diagnosis was defined as the presence of any of the following International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) codes: 290–319 (any fourth or fifth digits).[27] Substance abuse diagnosis was defined as the presence of any of the following ICD-9-CM codes: 303–305 (any fourth or fifth digits). Substance abuse codes encompassed drug dependence and abuse, including alcohol dependence and abuse.

The "all patient refined diagnosis related group relative weight" (APRDRGwt) is a unitless number that estimates the total cost of care for inpatients, based on clinical and demographic characteristics.[28] A patient with a relative APRDRGwt of 1 is predicted to have the same cost of care as the national average for inpatients. A patient with a score of 2 is predicted to be twice as costly as the average. In this study, we used APRDRGwt as a gross proxy for severity of illness.

Adjusted length of stay was measured as length of stay minus discharge duration. This adjustment was made to avoid including the exposure (length of stay) in the outcome (discharge duration). Unadjusted length of stay was used when the outcome was discharge time.

Data Sources

We created a separate 4-item to 9-item paper questionnaire (included in the Appendix) for each of 4 functional groups participating directly in the discharge process: nurses, physicians, social worker, and unit clerks. Questions were based on staff feedback about the sequence of steps in the discharge process, and potential reasons for delay. The surveys were piloted for several weeks to further refine the wording of questions, and to ensure that the length and location of the surveys minimized workflow interruptions. The questionnaires captured information about the timing of routine events not recorded in existing databases.

Physicians were asked to identify the "last test/procedure/consult needed prior to the patient being medically ready for discharge." They were asked when the test results

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first could have cleared the patient for discharge ("time decisive test needed"), and when they actually received the test results ("time test results back"). Nursing and social work surveys provided information on whether or not prescriptions were filled prior to discharge, and the type of transportation used on discharge. Unit clerks documented when the patient left the unit.

Response rates were: nurses (97%), physicians (97%), social worker (99%), and unit clerks (94%). All 4 surveys were completed for 88% of the 209 included patients (prior to 8 exclusions for missing data or extreme outlier observations). Group response rates were tallied at the end of each month and posted on the unit. We did not track how soon after discharge the surveys were completed. However, we reviewed survey responses frequently (often daily, at most every 4 days) and if surveys were incomplete we personally approached staff members to complete the survey.

We supplemented and cross-checked data from the questionnaire with information from existing hospital databases. These databases were: (1) the patient's medical record for time patient arrived on the floor, and completion time for consults/procedures; (2) the Electronic Bedboard (EBB) for time patient left the unit (as recorded by unit clerk); (3) the Patient Order Entry System for time discharge papers were completed by the physician, and ordering time for select tests; (4) the Electronic Patient Record for demographic information and completion time for select tests; and (5) Datamart, the hospital's administrative/billing database, for information such as length of stay, diagnosis, patient demographics, and insurance status.

Cross-checking of data and calculation of durations 1, 2, and 3 identified areas of disagreement that were addressed in the following way. Discharge time was provided by 3 sources: social worker and nurses as an ad hoc addition to each of their surveys, unit clerks as a mandatory question on their survey, and unit clerks as entered in the EBB. We used EBB data for discharge time, as this was the most complete and accurate single source of data. However, survey results and knowledge about the sequential process for discharge, suggested that in 20 cases EBB data did not provide the most accurate time. In these cases, discharge time was provided by the unit clerk survey (16 cases), the social work survey (3 cases), and the nursing survey (1 case).

In 28 cases (14%), discharge paperwork was completed before decisive test results were back. And in 8 cases (4%) test results were received earlier than needed. As these were a minority of cases, these negative durations were converted to zero for analysis.

Statistical Analysis

The unit of analysis was the unique hospital discharge. For patients who were discharged from the Hospitalist Unit more than once during the 4-month study period, each discharge was treated as a separate unit of analysis.

We defined patients discharged before the median discharge time as early discharges, and all others as late discharges. We then categorized patients with discharge durations less than 24 hours as short discharges, and all others as long discharges.

We described the characteristics of 2 groups of patients: early and short discharges versus all others. We used the chi square statistic and Fisher's exact test (when frequency ≤ 5 in 1 or both groups) to test the null hypothesis that there was no association between the 2 groups and select patient characteristics. When comparing medians, we used the nonparametric equality of medians test.

For each step in the discharge process, we identified a median time of occurrence. For the first point in the process—time decisive test needed—we also used 1-way analysis of variance and the F-test to assess whether or not timing varied significantly *by physician*.

Because our primary goal was to quantify in hours the association between various factors and discharge time or duration, we used bivariate linear regression models to identify factors associated with time of discharge (primary analysis) and total duration of the discharge process (secondary analysis). We then used multivariate linear regression to identify factors associated with both outcomes. We used forward and backward selection methods to choose the final models for the multivariate analyses, after forcing in the variables for race, sex, and age. Both methods of selection produced identical results. We assessed for colinearity using variance inflation factors.[29]

Sensitivity Analyses

For both discharge time and discharge duration, we performed regression diagnostics including leverage, Studentized residuals, and influence. Excluding outliers for influence slightly altered the results of our multivariate analyses. However, all variables that were significant at the $P < 0.05$ level remained significant in the models without outliers.

We chose to include outliers for influence in our final data set after verifying the data as accurate. For discharge time, the number of outliers (3; 1.5%) for influence was in the range expected for a normally distributed data set.

We also tested for normality of the 2 outcome variables. Discharge time was normally distributed, but discharge duration was not. Because of this, we used 2 additional methods to assess the robustness of our results for discharge duration.

First, we log-transformed the outcome and repeated the analysis. Variables significant in the non-log-transformed model remained significant after log-transformation. Second, we applied bootstrapping[30] with 1,000 repetitions for the bivariate and multivariate analyses. The 95% confidence intervals (CIs) (using the bias-corrected confidence intervals) were modestly altered (some narrowed, some widened), but our conclusions remained the same except for a single variable with borderline significance (payer on discharge) in

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bivariate analysis. The final reported confidence intervals for discharge duration are based on our analysis without bootstrapping.

Results

Data were collected on 216 patients. Seven patients were excluded from the study, because they were discharged against medical advice. Since these patients left before their decisive test was completed, there was no way to assess duration of the discharge process. Of the remaining 209 patients, 6 patients lacked necessary data to complete analysis (5 without survey data; 1 without administrative data). Two additional patients were eliminated from the final analysis because they bypassed the normal discharge process and were extreme outliers in either discharge time (1 discharged at 1 AM), or discharge duration (1 with discharge duration of 400+ hours). A total of 201 patients were included in the final analyses.

The hospitalist program primarily serves an indigent, local adult population with general medical problems, and this is reflected in the patient characteristics (Table 1). We compared the characteristics of patients discharged early and quickly (discharged prior to median hour of 3:00 PM, and discharge process lasting less than 24 hours) to all other discharges, to identify factors associated with later and longer discharges.

Overall, 81% of patients were admitted from the ED, and 40% of all patients were insured by Medicaid or were self-pay at time of discharge. Median expected charges were similar to the national average, as demonstrated by the median APRDRGwt of 1.0. Patients stayed an average of 6 days (median = 3 days). Patients with the longest adjusted lengths of stay (>20 days) were never early and short discharges. The most common discharge diagnoses were: congestive heart failure, chest pain or myocardial infarction, pneumonia, asthma/chronic obstructive pulmonary disease, and sickle-cell disease. Thirty-nine percent of all patients carried the diagnosis of alcohol or drug dependence or abuse, although for most this was not their discharge diagnosis. None of these demographic or clinical factors were associated with a late or long discharge.

The types of tests patients required on discharge were categorized into 4 groups: consults (18.4%), laboratory tests (22.9%), procedures (26.4%), and physical exam (32.3%). Distribution differed significantly between early and short discharges, and all other discharges ($P < 0.001$). Procedures and consults were less frequent among early and short discharges (procedures: 10.7% versus 35.7%; consults: 8.0% versus 24.6%).

For all patients, there was fragmentation within the consult and procedure categories. Within the consult group, there were 12 different types of consults ordered, with the dominant category (35.1%) being "other." The next highest volume consult was physical/occupational therapy (27.0%). Within the procedure group, there were 11 different types of procedures, with the most common being stress echocardiograms (28.3%). Non-MRI radiology procedures made up the next largest category (20.8%) and the third was "other" (18.9%).

TABLE 1. Patient Characteristics for Early and Short Discharges Versus All Other Discharges

	Early and Short Discharges (n = 75)*	All Other Discharges (n = 126)	*P* Value†
Demographics			
Age (years)			
Median	55	55	0.73
Range	(19, 94)	(20, 90)	
Gender (%)			
Female	61.3	61.1	0.98
Race (%)			0.08
African American	76.0	60.3	
Caucasian	21.3	34.9	
Other	2.7	4.8	
Payor on discharge (%)			0.29
Medicaid	32.0	20.6	
Medicare	32.0	38.9	
Self-pay	12.0	16.7	
Other	24.0	23.8	
Clinical characteristics			
Adjusted length of stay (days)‡			
Median	3	3	0.19
Range	(<1, 20)	(<1, 138)	
Substance abuse (%)	41.3	37.3	0.57
Psychiatric diagnosis (%)	20.0	25.4	0.38
Last test characteristics			
Test type (%)			<0.001
Exam	42.7	26.2	
Laboratory test	38.7	13.5	
Procedure	10.7	35.7	
Consult	8.0	24.6	
Discharge characteristics			
Discharged to home (%)	93.3	71.4	<0.001
Prescriptions filled prior to discharge (%)	10.7	19.8	0.09
Ambulance required for transport (%)	8.0	21.4	0.01

*Early and short discharges are discharges prior to the median hour of discharge (3:00 PM), and with a duration <24 hours.
†Early and short discharges versus all others.
‡Adjusted length of stay = (length of stay) − (number of days patient discharged after start of discharge process).

Many patients had immediate postdischarge needs, as demonstrated by the 20% of patients not discharged home. The majority (66%) of those who were discharged to a facility required an ambulance. Early and short discharges were less likely to use an ambulance to leave the hospital (8.0% versus 21.4%; $P = 0.01$), and more likely to be discharged directly to home (99.3% versus 71.4%; $P < 0.001$).

Based on process mapping, we defined a 4-step sequential discharge process for all patients (Figure 1). The first step was: decisive test needed by physician to discharge patient. Subgroup analysis demonstrated no significant difference in the timing of this step by individual physician (*P*

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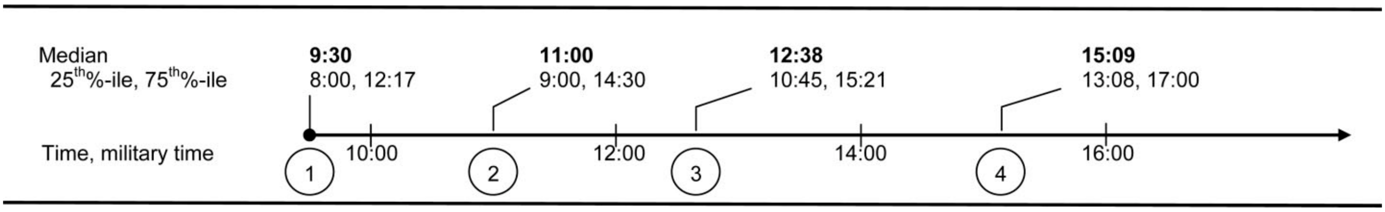

FIGURE 1. Hour of day for steps in the discharge process. Point 1 represents when physicians needed the results of a patient's last medically necessary test to clear a patient for discharge (decisive test needed). Point 2 represents when physicians learned the results of a patient's last medically necessary test (test results back). Point 3 illustrates when discharge paperwork was complete. Point 4 shows when patients left the unit.

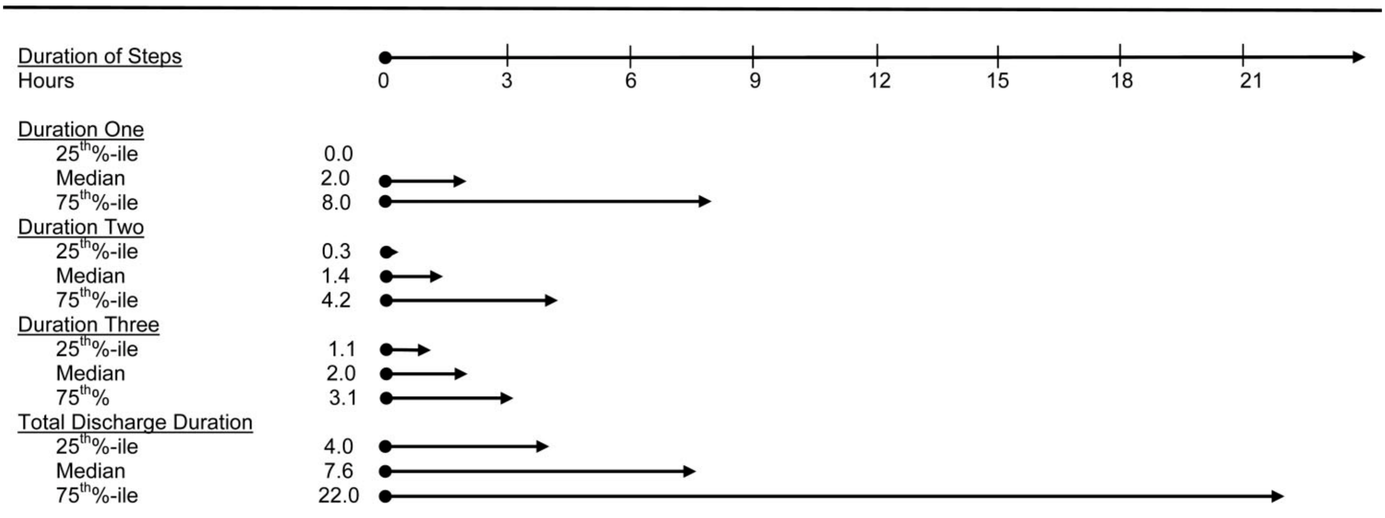

FIGURE 2. Duration of steps in the discharge process. The top line serves as a measuring stick, with hours as the unit of measurement. Duration 1 represents the time between 2 points: time the physician needed results of the patient's last medically necessary test to clear the patient for discharge, to time the physician learned the results of this test. Duration 2 represents the next step in the discharge process: time between physician learning test results, and discharge paperwork being complete. Duration 3 represents the final step in the discharge process: time between completing the discharge paperwork and patient leaving the unit. Total discharge duration represents the time from the start of the discharge process (decisive test needed), until the end of the process (patient leaves unit).

= 0.44). The remaining 3 steps were as follows: physician aware of test results, discharge paperwork complete by physician, and patient leaves the unit. Each of the 4 steps showed wide variability in hour of occurrence.

Total discharge duration showed even more variability than the time of day when steps were likely to occur (Figure 2). Median duration of the discharge process was 7.6 hours (25th% to 75th%: 4 to 22 hours). Median duration from decisive test needed until resulted (duration 1) was 2 hours (25th% to 75th%: 0 to 8 hours); between test resulted until discharge paperwork complete (duration 2) was 1.4 hours (25th% to 75th%: 0.3 to 4.2 hours); and between discharge paperwork complete and patient leaving the unit (duration 3) was 2.0 hours (25th% to 75th%: 1.1 to 3.1 hours). All durations were skewed to the right, with durations 1 and 2 each taking at least 24 hours to occur in 10% of patients.

The final multivariate model for time of discharge contained 6 covariates: age, sex, race, test type, prescriptions filled prior to discharge, and need for an ambulance on discharge (Table 2). Special discharge needs continued to be associated with later discharges. Those patients who required an ambulance for transport had mean discharge times that were later by 1.5 hours (95% CI, 0.4–2.5). If staff obtained discharge medications for patients, these patients left 1.4 hours later than those patients who filled their prescriptions on their own (95% CI, 0.3–2.4). Patients requiring a consult or procedure also had significantly later discharges (1.2 hours for consults, 95% CI, 0.1–2.4; 1.1 hours for

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TABLE 2. Factors Associated with Discharge Time and Discharge Duration, in Adjusted Analyses

	Adjusted Coefficient, Discharge Time as Outcome in Hours (95% CI)*	*P* Value	Adjusted Coefficient, Discharge Duration as Outcome in Hours (95% CI)†	*P* Value
Demographics				
Age in quartiles (years)				
72–94	0.5 (−0.5, 1.6)	0.33	−0.6 (−8.3, 7.2)	0.88
56–71	0.5 (−0.6, 1.6)	0.41	−1.3 (−9.2, 6.6)	0.75
44–55	0.2 (−0.9, 1.3)	0.74	−1.2 (−9.0, 6.5)	0.76
Male gender	0.0 (−0.8, 0.8)	0.97	−1.2 (−6.8, 4.5)	0.69
African American race	0.1 (−0.7, 0.9)	0.80	0.3 (−5.6, 6.1)	0.93
Last test characteristics				
Test type				
Consult	1.2 (0.1, 2.4)	0.04	14.8 (6.5, 23.1)	0.001
Procedure	1.1 (0.1, 2.1)	0.03	13.4 (6.0, 20.7)	<0.001
Laboratory test	−0.8 (−1.8, 0.3)	0.14	−0.9 (−8.4, 6.6)	0.82
Exam (reference)				
Discharge needs				
Prescriptions filled prior to discharge	1.4 (0.3, 2.4)	0.02		
Not discharged to home			28.9 (21.9, 35.9)	<0.001
Ambulance required for transport	1.5 (0.4, 2.5)	0.007		

*Adjusted for age, gender, race, test type, prescription needs, and ambulance required for transport.
†Adjusted for age, gender, race, test type, and discharge to a location other than home.

procedures, 95% CI, 0.1–2.1) than those needing a bedside exam. Age, sex, and race remained insignificant at the $P \geq 0.05$ level in the final multivariate model. Length of stay was significantly associated with discharge time in crude analysis, but this variable dropped out of the final multivariate model.

We used duration of discharge as a secondary outcome measure. The final multivariate model for discharge duration included: age, sex, race, test type, and discharge to a facility (Table 2). Those who went to a facility on average left 28.9 hours (95% CI, 21.9–35.9) later than those who went home. Test type continued to show a significant association with discharge duration, although the estimates were slightly lower in the adjusted model. Need for a consult was associated with a discharge that was on average 14.8 hours (95% CI, 6.5–23.1) longer than discharges contingent on a physical exam. Similarly, those patients who had procedures had discharges that were on average 13.4 hours (95% CI, 6.0–20.7) longer than those whose last test was an exam. Several factors that were significantly associated with discharge duration in unadjusted analyses dropped out of the final multivariate model. These included: need for an ambulance, length of stay, insurance status, and medical complexity as estimated by APRDRGwt.

Conclusions

We found that discharge time and duration had wide variability and that certain factors were associated with only one outcome variable—discharge time or duration. Two factors—need for an ambulance and filling of prescriptions prior to discharge—were associated with later hour of discharge. Discharge to a location other than home was associated with prolonged discharge duration. Test characteristics—in particular need for a procedure and consult—were significantly associated with both longer and later discharges.

In bivariate analysis, several factors were not associated with discharge time or duration. These were: African-American race, sex, age, Department of Medicine occupancy on day of discharge, source of admission, psychiatric comorbidity, and substance abuse comorbidity. We had expected higher occupancy to delay discharge as demand exceeded capacity for tests, consults, etc. Our findings suggest that even though our study was conducted during the winter months when hospital occupancy is typically at its peak, supply of staff was still adequate enough to meet high demand. We had also expected that psychiatric and substance abuse comorbidities would prolong discharge as prior studies have found some of these diagnoses to be associated with longer lengths of stay.[31–34] However, our results do not support such an association, and may reflect our decision to group all psychiatric diagnoses together due to limited sample size.

The main strength of our study is the use of 2 outcome variables—time and duration—to define delayed discharges. Our findings demonstrate that few factors are associated with both later and longer discharges. In an era when avoiding emergency room walkouts through early morning hospital discharges can be as important as managing overall length of stay, identifying factors associated with both

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duration and timing of discharges addresses actual challenges faced by hospitals with limited resources. Prior studies have rarely addressed both outcomes. An additional strength of our study is our use of an interdisciplinary survey. The discharge process is a key component of the inpatient stay, but it is also one for which no group is entirely responsible. Through the development and administration of an interdisciplinary survey, our study adds detail to existing descriptions of this fragmented process, and identifies potential areas for improvement.

Several limitations of our study deserve comment. First, we examined patients discharged from a hospitalist unit without house-staff at an urban tertiary care hospital. Our findings may need additional interpretation prior to their application in dissimilar settings such as: (1) resident-covered units in which workflow is shaped by teaching rounds, and (2) nonacademic hospitals in which incentives to provide rapid consults and procedures may be different. Second, we relied on self-reporting for certain variables such as time decisive test needed. This may be subject to recall bias, as we did not have staff to independently verify recalled times. However, since the discharge process is generally a linear one, we were able to verify the general scope of recalled times with times date-stamped by the computer during the discharge process (eg, checking that "time decisive test needed" did not occur after the discharge worksheet had been finalized in the electronic order-entry system). Third, our sample size was not large enough to control for disease-specific quality measures. Of note, prior studies have not identified a consistently positive or negative relationship between quality of care and efficiency.[35–38]

Past work has used administrative and survey data to analyze the effect of discharge planning interventions on financial or quality outcomes. Outcomes have included readmissions, mortality, patient satisfaction, length of stay, and inappropriate bed days.[22,38–45] However, as capacity management has become a more pressing issue for hospitals, greater focus is being placed on the mismatch between supply and demand of patients at each hour of the day. The relevant unit of measure for efficient discharges has become hour of day, in addition to total length of stay. Some hospital improvement projects have already addressed this shift in thinking.[20,21] Our study adds to this work by formally describing the precise timing and duration of steps in the discharge process, and identifying factors associated with both time and duration.

We believe the results of our study have several implications for hospital administrators and patients interested in more timely care. First, the methods used provide a tangible framework for addressing problems that cross disciplines (eg, nursing, physician, social work) and departments (eg, medicine and radiology), and have a multitude of potential causes and confounders. The survey results offer guidance on where to focus resources, provide a shared baseline metric for improvement, and suggest the cross-functional team that should be involved in change efforts. Such an approach may be useful for addressing common system-based challenges in inpatient quality and safety.

Second, with specific regard to discharge planning, our study supports the notion that modifiable factors are associated with discharge time and duration. However, we also describe a fragmented discharge process, with no single bottleneck or department responsible for the majority of late and long discharges. Although procedures and consults were both associated with longer and later discharges, only 26% of patients required a procedure prior to discharge, and 18% required a consult. Moreover, among procedures, different people and events are needed to carry out the 2 most popular procedures: stress echocardiograms, and non-MRI radiology procedures. Hospital leadership at the highest levels will be required to improve efficiency based on local usage patterns, and to increase coordination among the multiple interdepartmental processes that make up the more general categories of procedure and consult.

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Address for correspondence and reprint requests:
Dr. Lena M. Chen, VA Boston Healthcare System, 150 S. Huntington Ave. (151 MAV), Boston, MA 02130; Telephone: 857-364-4201; Fax: 857-364-4424; E-mail: lmchen@partners.org
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