Predictors of Admission Following Emergency Department Discharge in Older Adults

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Abstract

Objectives—To identify predictors of hospital inpatient admission of older Medicare patients following discharge from the emergency department.

Design—Retrospective cohort study

Setting—284 non-federal California hospitals

Participants—505,315 visits of patients age >65 years (yrs) with Medicare insurance discharged from California EDs in 2007.

Measurement—Using the California Office of Statewide Health Planning and Development files, predictors of a hospital inpatient admission within 7 days of ED discharge in older adults (age > 65 yrs) with Medicare were evaluated.

Results—Hospital inpatient admissions within 7-days of ED discharge occurred in 23,340 (4.6%) visits and were associated with older age (Age 70–74 Adjusted Odds Ration=AOR 1.12, 95% Confidence Interval=CI 1.07–1.17; Age 75–79 AOR 1.18, 95% CI 1.13–1.23; Age 80+ AOR 1.4, 95% CI 1.35–1.46), skilled nursing facility use (AOR 1.82, 95% CI 1.72–1.94), leaving the ED against medical advice (AOR 1.82, 95% CI 1.67–1.98), and the following diagnoses with the highest odds of admission: End Stage Renal Disease (AOR 3.83, 95% CI 2.42–6.08), chronic renal disease (AOR 3.19, 95% CI 2.26–4.49), and congestive heart failure (AOR 3.01, 95% CI 2.59–3.50).

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Conclusion—A total of 4.6% of older adults with Medicare insurance have a hospital inpatient admission after discharge. Chronic conditions such as renal disease and heart failure were associated with the greatest odds of admission.

Keywords

Emergency department; Medicare; outcomes

INTRODUCTION

An emergency department (ED) visit for episodic illness may lead to fragmented care management for older adults.[1,2] Contributing factors may include pressure to rapidly discharge patients who do not require hospitalization, incomplete knowledge about a specific patient's complex medical needs, and limited resources to coordinate post-ED care with primary care physicians, specialists, home health services, and other health care providers. Unscheduled hospital admissions shortly after an ED evaluation and discharge may signal opportunities to improve care. Such events may signal a missed diagnosis of a serious illness, incomplete ED care, or insufficient coordination of outpatient care associated with the initial ED visit. Understanding the factors associated with short-term admissions after ED discharge in older adults should help ED practitioners, geriatricians, and policy makers better care for this population.

To our knowledge, there are no studies evaluating the factors associated with admission within 7 days of ED discharge in older Medicare patients. There is a concern that in older adults, age, rather than the diagnosis drives this outcome. The objective of this study was within older Medicare patient visits (age > 65 years), to identify the incidence and predictors of admissions within 7 days of ED discharge to non-federal California hospitals. The study hypothesis was that the predictors of admission in this cohort were driven by diagnosis rather than age.

METHODS

Design and Setting

A retrospective cohort study of ED visit discharges from general, acute, non-federal hospitals in California in 2007 was conducted. The study protocol was reviewed and approved by the California Committee for Protection of Human Subjects and the Institutional Review Board of the University of California at Los Angeles.

Data Sources

All non-federal healthcare facilities in California are required to provide ED and hospital discharge data to the Office of Statewide Hospital Planning and Development (OSHPD).[3] OSHPD non-public use files for all ED visits resulting in discharge (the ED file) and unscheduled hospital admissions (the Patient Discharge File) for general, acute-care hospitals were obtained. The ED file was linked to the Patient Discharge File based on date of birth, gender, and a unique identifier (Record Linkage Number) that is a masked Social Security number. The ED file also provided the following clinical variables: primary

diagnosis, other diagnoses at the time of the visit, principal procedure, and other procedures. Hospital-level financial and structural data were extracted from the year 2007 OSHPD public-use files. The non-public use files supplied the patient characteristic variables such as age, gender, race/ethnicity, and insurance status. The public use files provided the hospital characteristic variables such as ownership, teaching affiliation, and hospital beds. All variables had a less than 3% missing rate.

Participants

The analysis was of older adult (age 65 years) patient ED visits that resulted in emergency department discharge in 2007. Exclusion criteria included index visits to facilities that closed their hospital or ED in 2007, index visits to hospitals without basic or comprehensive emergency services, and index visits to children's hospitals. Index visits without a Record Linkage Number were also excluded because of the inability to match to subsequent hospital admissions. Visits with a disposition of death in the ED and transfer to an acute care facility or to hospice care were similarly excluded. Multiple ED visits by the same patient on the same day as well as ED visits with a hospital admission by the same patient on the same day were also excluded based on the team's prior work that suggested that these may reflect duplicate coding for a single visit.[4] Finally, ED visits occurring in the last week of 2007 were also excluded because of the lack of complete 7-day follow-up data.

Outcome Measures

The outcome was an unscheduled admission to an inpatient hospital bed within 7 days after ED discharge. The inpatient admission did not have to originate from a particular visit such as the emergency department. A 7-day time frame was selected based on prior studies of adverse events after ED discharge[5–8], local quality improvement efforts that often track 7-day admissions, and an assumption by the research team that longer time frames were likely to include an increasing proportion of events unrelated to the index ED visit. If there were more than one ED visits in the seven days prior to an admission, then the outcome was attributed to only the most recent ED visit.

Candidate Predictors

Hospital-level characteristics included in the model were ownership (not-for-profit, for-profit, and government), trauma center status, teaching affiliation, and size of hospital (based on the number of medical and surgical beds:<100 or>100). There was no missing data for hospital characteristics. All predictors were chosen based on prior literature and the team's conceptual model.

Visit-level information of the ED visit including age, sex, race/ethnicity and day of week (weekday or weekend) of the ED visit were assessed. A dichotomous variable was created to identify ED visits with a disposition of either having left the ED' Against Medical Advice (AMA)' and signing a document stating that they do not agree to the disposition plan of the physician or 'eloped', which describes patients who leave the ED without permission before a final management plan has been made. Patients coming to the ED from a skilled nursing facility or not were also identified.

Finally, information on the primary ED discharge diagnosis was collected. Primary International Statistical Classification of Disease (ICD) diagnosis codes were obtained from emergency department encounters and were then sorted into 36 categories. There were a total of thirty-seven diagnosis codes considered for each visit. Thirty-five of the diagnoses were based on a classification system previously described.[4] In creating this classification system, all possible ICD-9 codes were mapped to the Agency for Health Care Research and Quality Clinical Categorization Software (CCS)[9] multi-level diagnosis codes. A multi-specialty team of physicians further aggregated the codes into categories based on clinical coherence and relevance to the ED. Two codes did not map out solely to CCS codes: End stage renal disease (ESRD) was identified with ICD-9 codes and chronic renal disease (CRD) was identified by subtracting the ESRD ICD-9 codes from the CCS for renal disease.

Data Analysis

First, the cohort from the base population was selected. Then, the team assessed individual predictors using the hospital-level random-effects model for continuous variables and the Cochran-Mantel-Haenszel test stratified by hospital for categorical variables. The outcome was modeled using hierarchical logistic regression with ED visits clustered within hospitals; all models included a hospital-level random effect. All other candidate predictors were included as fixed effects.

The adjusted odds ratios (AOR) and 95% confidence intervals (CI) estimates from the model were generated. The reference group used was age of 65–69 years, male, white, weekday, no AMA/elope, not a Skilled Nursing Facility (SNF) resident, ED diagnosis category= 'Hypertension'; not-for-profit, non-teaching, non-trauma center. The most common and 2nd most common subsequent inpatient diagnosis for a given emergency department discharge diagnosis was also reported. This included the percent of the time the most common inpatient diagnosis was the same as the ED discharge diagnosis. Data analyses were performed with SAS 9.2 (SAS Institute, Cary, NC).

RESULTS

Characteristics of Study Subjects

Figure 1 illustrates the construction of the study cohort. The cohort contained a total of 505,315 ED visits that were discharged from 284 facilities in 2007 by Medicare patients age > 65 years. There were 23,340 (4.6%) patient visits that resulted in an inpatient admission within 7 days of being discharged from the ED. Of the 23,340 in patient admissions, 21,920 (94%) were attributed to unique patients.

Table 1 describes the characteristics of the cohort. The mean age of patients who were admitted within 7 days was 78.6 years (Standard Deviation=SD 8.1) and that of the controls was 77.5 years (SD 8.1). Table 2 shows the primary discharge diagnoses of the cohort stratified by outcome. The two diagnoses that resulted in highest odds of an admission involved renal impairment and were End Stage Renal Disease and chronic renal disease. The most common discharge diagnosis was "other injuries", which includes burns, wounds and superficial injuries (13.9% of all discharge diagnoses in older adult cohort). However

patients with this diagnosis were rarely admitted within 7 days. In the subset of patients who experienced the outcome, the most common and 2nd most common subsequent primary inpatient diagnoses associated with each ED primary discharge diagnosis (Online Appendix A) are provided. Of the ED discharge diagnoses, 72% were the same as the most common primary inpatient diagnosis.

Predictors of 7-Day Hospital Inpatient Admission after Discharge

Table 3 describes the results of the multivariate model. For-profit hospital EDs, as compared to not-for-profit hospital EDs, were found to have an increased likelihood of inpatient admissions within 7 days following the ED visit (AOR 1.14 95% CI 1.03–1.26). Compared to a reference group of patients age 65–70, increasing age (age 70–74 AOR 1.12, 95% CI 1.07–1.17; age 75–79 AOR 1.18, 95% CI 1.13–1.23; age 80+ AOR 1.4, 95% CI 1.35–1.46) was associated with a greater likelihood of admission after discharge. Patients with the greatest odds of an admission after discharge were those that left against medical advice (AMA) or eloped (left prior to discharge) (AOR 1.82, 95% CI 1.67–1.98) and those with a skilled nursing facility residence(AOR 1.82, 95% CI 1.72–1.94). The three most common ED discharge diagnoses associated with admission were end stage renal disease (AOR 3.83, 95% CI 2.42–6.08), chronic renal disease (AOR 3.19, 95% CI 2.26–4.49), and congestive heart failure (CHF) (AOR 3.01, 95% CI 2.59–3.50).

DISCUSSION

Using the California Office of Statewide Health Planning and Development (OSHPD) files for 2007, the study team examined the relationship between certain patient and hospital characteristics and hospital inpatient admissions following ED discharge from California hospitals in Medicare patient visits age 65 and older. Increasing age, male gender, leaving the ED against medical advice or eloping prior to discharge, and nursing home residence were found to have a greater odds of a 7-day admission after ED discharge. The ED discharge diagnoses with the greatest odds of an admission were as a result of a chronic medical condition. Compared to non-Latino whites, the older cohort showed Hispanic and Asian subjects to have a lower likelihood of admission after discharge.

To our knowledge, this study is the first large scale evaluation of short-term hospital inpatient admissions after ED discharge in Medicare patients. Previous studies evaluating health service use following ED discharge focus on ED revisits[10–16] which may not indicate a related condition, have small sample sizes or occur at single institutions.[12,13,15,17–23]; are conducted in countries with different health system characteristics than the U.S[12–16,20,22,24–28], or assess follow-up periods of 30 to 90 days[15,17,19,21,22,26,29,30], which are more likely to include events unrelated to the initial ED visit.

Close to 1 of 25 or 4.6%of Medicare patients seen in EDs daily require an admission within 7 days of discharge. This rate is high possibly due to factors not identified through administrative analysis such as frailty,[30] functional capacity, and support situations.[20] The clinical variables available in this data set included the primary and other diagnosis as well as the principal and other diagnoses. This study evaluated the primary ED diagnosis. Previous studies have suggested that older patients with poor physical functioning that have

difficulty completing their activities of daily living (ADLs) or depend on support services, such as a nurse or caretaker, often recover poorly following an ED visit.[17,21,22,31].

Patients at highest risk for an admission after discharge were found to be patients who left the ED AMA or elope(leave without permission prlor to discharge). Similar to prior studies, these findings confirm that patients leaving AMA are not less ill as compared to other patients who wait to be evaluated in the ED.[32–35] Patients of skilled nursing facilities were also at increased risk suggesting that these patients may have more complex disease presentations when arriving in the ED. These findings suggest that providers managing ED patients from skilled nursing facilities consider obtaining histories from a number of contacts to the patient, including the skilled nursing facility staff and family. Providers evaluating patients who desire to leave prior to a complete evaluation should consider providing thorough discharge instructions regardless of their desire to leave and ensure that the patient has appropriate follow-up in a timely manner.

The study identified the discharge diagnoses associated with admission after discharge and found that the diagnoses with the greatest odds of an admission after discharge indicated chronic conditions (ESRD, CRD, and CHF). Although these diagnoses often require regular health care provider encounters, our findings suggest that when presenting to the ED, patients with these diagnoses may harbor disease processes not immediately apparent to the provider. Regardless of age, providers evaluating patients with these conditions in the ED, upon discharge should consider securing short-term follow-up, such as within 24 to 48 hours, with their primary care provider so as to prevent an inpatient admission.

This study also found that non-Latino whites were at greater risk of experiencing admissions after discharge when compared with other races. This may be due to differences in social or family support provided by different cultures that could prevent the need for an admission following an ED visit. It could also be due to different cultures having varied thresholds for visiting the ED.

This study has limitations. First, the analysis is based on data derived from ICD-9 codes which is limited in that it is retrospective and could reflect coding that is incomplete. Second, OSHPD does not provide information about federal hospitals, and our findings are not generalizable to these facilities. Third, although California represents 12% of the US population[36] and this study provides important information for policy makers and hospital administrators, the findings cannot be generalized to the entire US population. Fourth, although the study team did case-mix adjust using discharge diagnosis codes, the OSHPD ED files lack data of pre-existing comorbidities. Also, the analysis did not include information on previous hospital or emergency department visits as that would require the use of data from a prior year. In addition, although large, the files and the design of the study do not provide explanations of causation between the patient and hospital characteristics and outcomes. Also, the files lack clinical variables that evaluate functional impairment, social support, transitions in care, prior utilization, and health literacy. Finally, the data is several years old as a result of the time it took to acquire (2 years), link and clean the files (2 years). Despite these limitations, this study is an important first step in identifying factors that may predict the need for subsequent admission shortly following the ED visit.

Short-term hospital admission following discharge from the ED may be an indicator of incomplete ED or follow-up care. This study identified important patient and hospital characteristics associated with admissions within 7 days of ED discharge in an older age > 65 years cohort with Medicare insurance. Patients who left the ED AMA, residents of skilled nursing facilities, and patients with chronic diseases were especially at risk. These findings suggest that quality improvement efforts focus on these high-risk individuals by ensuring immediate outpatient follow-up.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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6,745,320 visits to 336 hospitals

Hospital Level Exclusions
No ED services
Partial Year Hospitals
Pediatric Hospitals

6,437,847 Visits to 288 hospitals

Visit Level Exclusions (n=visits)*
Age less than 18: (n=985,185)
No ED Disposition information (n= 49,372)
Died (n=11,732)
Transferred (n=142,595)
Hospice care (n=1,993)
Visit last week of 2007 (n=128,835)
Patients with multiple ED visits on day 0
(n=63,817)
Same day admission (23,588)

Age ≥ 65 Medicare Cohort
505,315 visits to 284 hospitals

23,340 (4.6%) visits resulting in
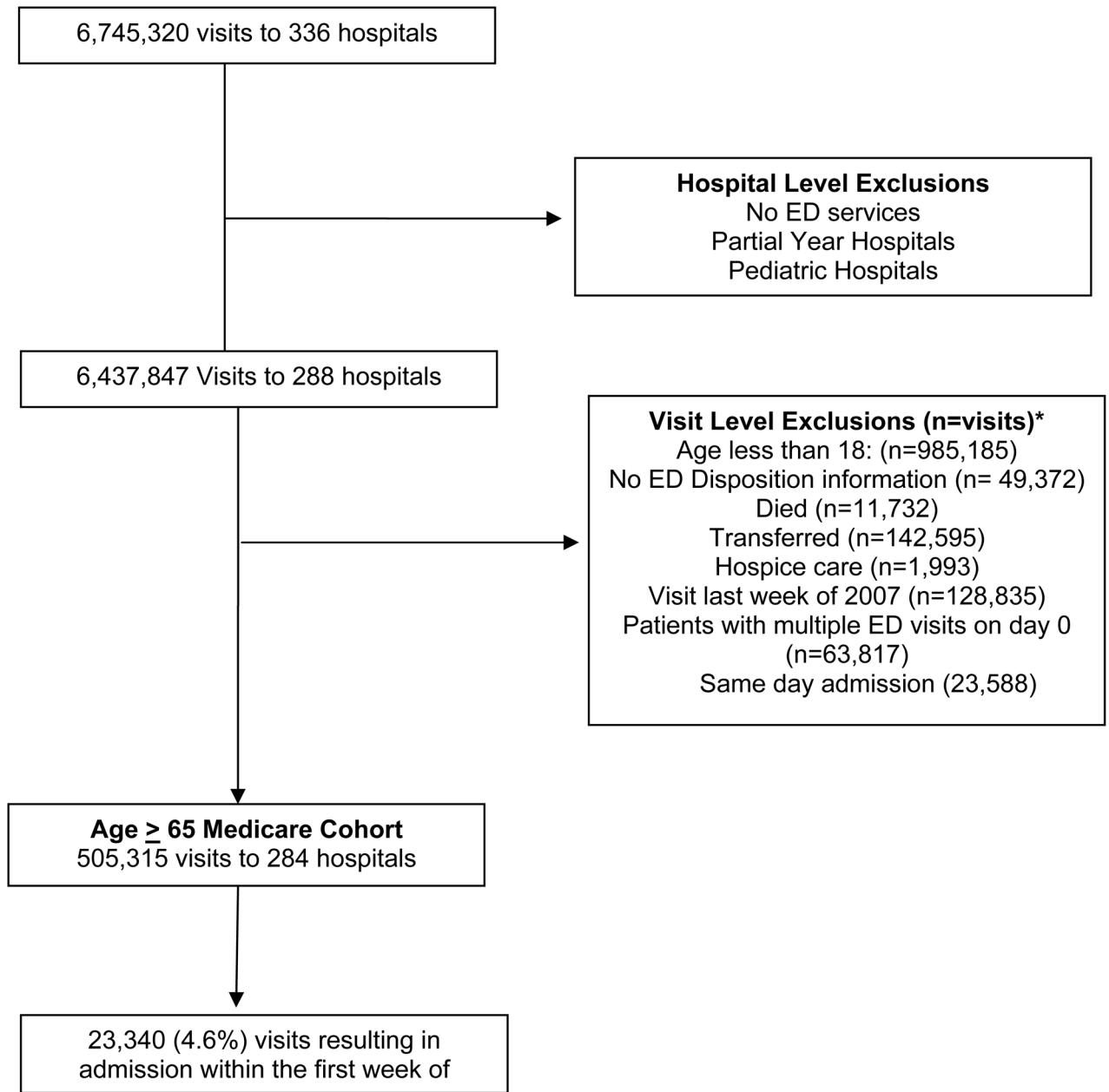admission within the first week of

Figure 1. Flow diagram of study cohort
*Multiple patients with more than 1 exclusion

Table 1

Characteristics of the Study Cohort

	Facilities (n=284)	Total Visits (%) (n=505,315)	Admitted within 7-days (n=23,340)	Not Admitted within 7-days (n=481,975)	P
Hospital Characteristics					
Ownership					0.0003
Not-For-Profit	204	400,194 (79)	18,463 (79)	381,731 (79)	
For-Profit	63	83,817 (17)	3,998 (17)	79,819 (17)	
County	17	21,304 (4)	879 (4)	20,425 (4)	
Trauma center	41	100,947 20)	4,835 (21)	96,112 (20)	0.0039
Teaching	22	41,377 (8)	2,004 (9)	39,373 (8)	0.0232
Med-Surg Hospital Beds					<.0001
(1) < 100	107	134,972 (27)	5,872 (25)	129,100 (27)	
(2) >100	177	370,343 (73)	17,468 (75)	352,875 (73)	
Patient Characteristics					
Age (Mean ± SD)		77.6 ± 8.09	78.58 ± 8.14	77.52 ± 8.08	<.0001
80+		208,290 (41)	10,888 (47)	197,402 (41)	
75 < 80		97,192 (19)	4,346 (19)	92,846 (19)	
70– <75		95,733 (19)	4,081 (17)	91,652 (19)	
65– <70		104,100 (21)	4,025 (17)	100,075 (21)	
Male		196,279 (39)	9,604 (41)	186,675 (39)	<.0001
Race/Ethnicity					<.0001
White		329,145 (65)	15,475 (66)	313,670 (65)	
Black		32,265 (6)	1,565 (7)	30,700 (6)	
Hispanic		83,367 (17)	3,803 (16)	79,564 (17)	
Asian		34,262 (7)	1,520 (7)	32,742 (7)	
American Indian		1,388 (0.3)	73 (0.3)	1,315	
Other		24,888 (5)	904 (4)	23,984 (5)	
Day of week of service					0.0008
Weekday (M–F)		357,722 (71)	16,748 (72)	340,974 (71)	
Weekend (Sat–Sun)		147,593 (29)	6,592 (28)	141,001 (29)	
AMA*/Eloped		8,425 (2)	650 (3)	7,775 (2)	<.0001

	Facilities (n=284)	Total Visits (%) (n=505,315)	Admitted within 7-days (n=23,340)	Not Admitted within 7-days (n=481,975)	P
Nursing Home Patient		14,080 (3)	1,269 (5)	12,811 (3)	<.0001

*
AMA= against medical advice

Table 2

Discharge Diagnoses of the Study Cohort

ED Discharge Diagnosis	Total Cohort (n=505,315)	Admitted within 7 days (n=23,340)(%)	% Cases with Diagnosis
End stage renal disease	193	22 (11.4)	0.038
Chronic renal disease	399	42 (10.5)	0.079
Congestive heart failure	5,019	483 (9.6)	0.99
Noninfectious lung disease	1,036	97 (9.4)	0.21
Neoplasm	1,593	142 (8.9)	0.32
Chronic obstructive pulmonary disease	11,855	893 (7.5)	2.3
Pneumonia	5,547	417 (7.5)	1.1
Endocrine; nutritional; immunity and metabolic disease	9,669	691 (7.2)	1.9
Mental Illness	10,660	751 (7.1)	2.1
Disease of the blood	2,569	174 (6.8)	0.51
Symptom: Abdominal pain	20,737	1281 (6.2)	4.1
Complications and adverse events	9,386	571 (6.1)	1.9
Other symptoms	23,085	1,400 (6.1)	4.6
Diabetes	8,388	501 (6.0)	1.7
Urinary tract infection	18,306	1,075 (6.0)	3.6
Cerebrovascular disease	4,212	246 (5.8)	0.83
Asthma	3,772	211 (5.6)	0.75
GI system disease	33,453	1,863 (5.6)	6.6
Skin and subcutaneous infection	9,824	489 (5.0)	1.9
Heart disease	2,045	95 (4.7)	0.4
Other renal and genitourinary disease	18,852	874 (4.6)	3.7
Other respiratory disease	20,962	955 (4.6)	4.1
Other infections	5,249	236 (4.5)	1
Disease of the musculoskeletal system, skin and tissue	42,444	1,857 (4.4)	8.4
Circulatory disorder	5,799	249 (4.3)	1.1
Other	20,167	840 (4.2)	4
Nervous system disorders	19,211	719 (3.7)	3.8
Dysrhythmias	10,637	390 (3.7)	2.1
Symptom: Headache	7,636	279 (3.7)	1.5
Major injuries	1,470	53 (3.6)	0.29
Minor injuries	35,360	1,272 (3.6)	7
Symptom: Chest pain	22,219	775 (3.5)	4.4
Upper respiratory infection	9,290	316 (3.4)	1.8
Hypertension	8,844	289 (3.3)	1.8
Other Injuries	70,380	2,123 (3.0)	14
Symptoms: Dizziness, vertigo and syncope	25,047	669 (2.7)	5

In order of the emergency department diagnoses with the greatest % admission after discharge. The % is the number admitted after discharge divided by the number who present to the ED.

Table 3

Multivariable Logistic Regression of Hospital Admissions

Hospital Characteristic	OR (95% CI)	P-value
Ownership (Ref=Not-For-Profit)		
For-Profit	1.14 (1.03–1.26)	0.0125
County	0.93 (0.78–1.12)	0.4465
Trauma center	0.97 (0.86–1.10)	0.628
Teaching	1.11 (0.94–1.31)	0.2213
Med-Surg Hospital Beds (Ref= 100)		
< 100	0.90 (0.82–0.98)	0.0174
Patient Characteristics		
Age (Ref=65–69)		<.0001
80+	1.40 (1.35–1.46)	<.0001
75–79	1.18 (1.13–1.23)	<.0001
70–74	1.12 (1.07–1.17)	<.0001
Male	1.11 (1.08–1.14)	<.0001
Race/Ethnicity (Ref=white)		<.0001
Black	1.01 (0.95–1.07)	0.7177
Hispanic	0.92 (0.88–0.96)	<.0001
Asian	0.88 (0.83–0.93)	<.0001
American Indian	1.11 (0.87–1.41)	0.4089
Other	0.78 (0.72–0.84)	<.0001
Day of week of service (Ref= Weekday)		
Weekend (Sat–Sun)	0.96 (0.93–0.99)	0.0059
AMA [*]/Eloped	1.82 (1.67–1.98)	<.0001
Nursing Home Patient	1.82 (1.72–1.94)	<.0001
Discharge Diagnoses (Ref= Hypertension)		
End stage renal disease	3.83 (2.42–6.08)	<.0001
Chronic renal disease	3.19 (2.26–4.49)	<.0001
Congestive heart failure	3.01 (2.59–3.50)	<.0001
Neoplasms	2.95 (2.39–3.64)	<.0001
Noninfectious lung disease	2.95 (2.32–3.75)	<.0001
Chronic obstructive pulmonary disease	2.35 (2.05–2.69)	<.0001
Pneumonia	2.27 (1.95–2.65)	<.0001
Endocrine; nutritional; metabolic and immunity disorders	2.17 (1.89–2.50)	<.0001
Mental illness	2.17 (1.89–2.49)	<.0001
Diseases of the blood	1.97 (1.62–2.40)	<.0001
Symptom: Abdominal pain	1.97 (1.73–2.24)	<.0001
Other symptoms	1.85 (1.63–2.11)	<.0001
Asthma	1.81 (1.51–2.17)	<.0001
Diabetes	1.81 (1.56–2.09)	<.0001

Hospital Characteristic	OR (95% CI)	P-value
Complications and adverse events	1.78 (1.54–2.05)	<.0001
Urinary tract infection	1.77 (1.55–2.02)	<.0001
Gastrointestinal system disease	1.71 (1.50–1.93)	<.0001
Cerebrovascular disease	1.69 (1.42–2.01)	<.0001
Skin and subcutaneous infection	1.55 (1.34–1.80)	<.0001
Other infections	1.42 (1.19–1.69)	<.0001
Other renal and genitourinary disease	1.38 (1.20–1.58)	<.0001
Other Respiratory Disease	1.36 (1.19–1.55)	<.0001
Disease of the musculoskeletal system, skin and tissue	1.35 (1.19–1.53)	<.0001
Heart disease	1.32 (1.04–1.67)	0.023
Circulatory disorder	1.27 (1.07–1.51)	0.007
Other	1.19 (1.04–1.36)	0.013
Symptoms: Headache	1.15 (0.98–1.36)	0.094
Dysrhythmias	1.13 (0.97–1.32)	0.12
Nervous system disorder	1.13 (0.98–1.30)	0.089
Minor injuries	1.10 (0.97–1.25)	0.149
Major injuries	1.07 (0.80–1.45)	0.644
Upper respiratory infection	1.07 (0.91–1.26)	0.405
Symptom: Chest pain	1.05 (0.91–1.20)	0.51
Other injuries	0.87 (0.77–0.99)	0.032
Symptom: Dizziness, vertigo and syncope	0.79 (0.69–0.91)	0.001

[*]AMA= against medical advice