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## Factors Associated with Short-Term Bounce-back Admissions Following Emergency Department Discharge

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### Abstract

**Objective**—Hospitalizations that occur shortly after emergency department (ED) discharge may reveal opportunities to improve ED or follow-up care. There currently is limited, population-level information about such events. We identified hospital and visit-level predictors of bounce-back admissions, defined as 7-day unscheduled hospital admissions after ED discharge.

**Methods**—Using the California Office of Statewide Health Planning and Development (OSHPD) files, we conducted a retrospective cohort analysis of adult (age ≥ 18 years) ED visits resulting in discharge in 2007. Candidate predictors included index hospital structural characteristics such as ownership, teaching affiliation, trauma status, and index ED size; along with index visit patient characteristics of demographic information, day of service, against medical advice or eloped disposition, insurance, and ED primary discharge diagnosis. We fit a multivariable, hierarchical logistic regression to account for clustering of ED visits by hospitals.

**Results**—The study cohort contained a total of 5,035,833 visits to 288 facilities in 2007. Bounce-back admission within 7 days occurred in 130,526 (2.6%) visits and was associated with Medicaid (OR 1.42, 95% CI 1.40–1.45) or Medicare insurance (OR 1.53, 95% CI 1.50–1.55) and a disposition of leaving against medical advice (AMA) or before the evaluation was complete (OR 1.9, 95% CI 1.89–2.0). The three most common age-adjusted index ED discharge diagnoses associated with a bounce-back admission were chronic renal disease, not end stage (OR 3.3, 95% CI 2.8–3.8), end stage renal disease (OR 2.9, 95% CI 2.4–3.6), and congestive heart failure (OR 2.5, 95% CI 2.3–2.6). Hospital characteristics associated with a higher bounce-back admission rate were for-profit status (OR 1.2, 95% CI 1.1–1.3) and teaching affiliation (OR 1.2, 95% CI 1.0–1.3).

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**Conclusion**—We found 2.6% of discharged patients from California EDs to have a bounce-back admission within 7 days. We identified vulnerable populations, such as the very old and the use of Medicaid Insurance, and chronic or end stage renal disease as being especially at risk. Our findings suggest that quality improvement efforts focus on high-risk individuals and that the disposition plan of patients consider vulnerable populations.

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## INTRODUCTION

### Background and Importance

Hospitalizations occurring shortly after emergency department (ED) discharge, or bounce-back admissions, may signal missed diagnoses of serious illness, incomplete ED care, or insufficient outpatient follow-up after discharge. Understanding the factors associated with bounce-back admissions may inform the design of ED quality improvement interventions.

There is currently a limited understanding of the factors associated with bounce-back admissions within the U.S. healthcare system.<sup>1</sup> Previous studies evaluating health service use following ED discharge are limited in that they focus on ED revisits<sup>2–6</sup>; involve small sample sizes, occur at single institutions<sup>4,5,7–12</sup>; evaluate specific patient subgroups such as the elderly<sup>6–8,10–19</sup>; are conducted in countries with different health system characteristics than the U.S.<sup>4–7,11,16–22</sup>, or assess follow-up periods of 30 to 90 days<sup>7,8,10,12,14–17</sup>, which are more likely to include events unrelated to the initial ED visit. To our knowledge, our study is the first large-scale analysis that identifies hospital and patient characteristics of US patients who are admitted shortly after discharge from the ED.

### Goal of This Investigation

We describe the prevalence, characteristics, and predictors of 7-day bounce-back admissions after ED discharge in a cohort of California hospitals.

## METHODS

### Study Design, Setting, and Sample

We conducted a retrospective cohort study of ED discharges from general, acute, non-federal hospitals in California in 2007. Eligible patients were adults discharged from an ED to a non-acute care facility. Bounce-back admission to an inpatient bed within 7 days of the ED visit was identified through linkage of inpatient and emergency department data of the Office of Statewide Health Planning and Development (OSHPD) files based on date of birth, sex, and record linkage number, a scrambled social security number. 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. We obtained OSHPD non-public use files for all ED visits and unscheduled hospital admissions for general, acute-care hospitals. We obtained hospital-level financial and structural indicators using the 2007 OSHPD public-use files.

### Selection of Participants

Our source population included ED visits by adults (age ≥ 18 years) that resulted in ED discharge in 2007. From the original ED discharge files that contained 8,781,846 records we excluded 23% of records that lacked any or all of the following: a record linkage number, date of birth, and sex to arrive at our base cohort of index ED visits (n=6,745,320). We then

excluded index visits to facilities that closed their hospital or ED in 2007, to hospitals without basic or comprehensive emergency services, and to children's hospitals (n=307,473). Index visits with a disposition of death in the ED and transfer to an acute care facility or to hospice care were similarly excluded.

We excluded multiple ED visits by the same patient on the same day for two reasons: First, the index visits on Day 0 did not have time stamps and we were unable to determine which of the ED visits were most proximate to the admission and second, our prior experience with manual reviews of charts for a distinct analysis suggests that these may reflect duplicate coding for a single visit<sup>24</sup>. We also excluded ED visits that had a hospital admission on the same day as similarly our prior work and manual chart reviews suggested that admissions on the same day of an ED visit were linked to the ED visit more than 80% of the time. Finally, we excluded ED visits occurring in the last week of 2007 because of lack of complete 7-day follow-up data.

Of the study cohort (n=5,035,833) we then linked the ED files with the inpatient files to identify patients who had a bounce-back admission (n=130,526). Prior to linking the inpatient records (n=3,151,664) to the ED records, we excluded 28% of the inpatient records that lacked any of the three linkage variables: record linkage number, date of birth, and sex. This resulted in 2,272,431 inpatient records. For both the ED files and the inpatient files greater than 99% of the missing variable was the RLN. To qualify as having a bounce-back admission, the patient identified in the index ED visit needed to match with an inpatient admission on all of the three previously identified variables.

### Outcome Measures

The outcome was an unscheduled hospital admission from any source (ED and non-ED) within 7 days after ED discharge. We selected a 7-day time frame based on its policy implications, prior studies of adverse events after ED discharge<sup>25-28</sup>, local quality improvement efforts that often track 7-day admissions, and the belief of our research team that longer time frames were likely to include an increasing proportion of events unrelated to the index ED visit. If there were multiple 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 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, 100). We assessed visit-level demographic information on age, sex, race/ethnicity (White, Black, Hispanic, Asian, American Indian, and other), insurance status (private, self-pay/uninsured, Medicaid, Medicare, and other), and day of week (weekday or weekend). The "other" category of the variables included any missing information. In California, Medicaid is equivalent to Medi-Cal/SCHIP; other insurance refers to coverage from worker's compensation, automobile or disability programs, Champus/TriCare, Veteran's Affairs, and other federal programs. We created a dichotomous variable identifying ED visits with a disposition of 'Against Medical Advice (AMA) or eloped'. Left Without Being Seen data is not collected by OSHPD.

Finally, we collected information on the primary ED discharge diagnosis of the index visit. We obtained primary ICD diagnosis codes from emergency department encounters, which were sorted into 39 categories. We have previously described the rationale and development of this classification system.<sup>24</sup> Briefly, all possible ICD-9 codes were mapped to the Agency for Health Care Research and Quality Clinical Categorization Software (CCS) multi-level

diagnosis codes and ICD-9 Codes. A multi-specialty team further aggregated the codes into 39 categories based on clinical coherence and relevance to the ED. (Appendix Table)

## Data Analysis

We assessed individual predictors using hospital-level random effects for continuous variables and the Cochran-Mantel-Haenzel test stratified by hospital for categorical variables. We modeled the outcome using hierarchical logistic regression with ED visits clustered within hospitals; all models included a hospital random effect. All other candidate predictors were modeled as fixed effects. The unit of analysis was at the patient visit level.

We report odds ratios and 95% confidence intervals (CI) from this model. To illustrate the absolute effect associated with each predictor, we first estimated the probability of bounce-back admissions for a reference group (age=less than 40 years, male, white, weekday, no AMA/elope, 'other' payment, ED diagnosis category= 'asthma'; not-for-profit, non-teaching, non-trauma center). We then estimated the outcome predicted probability associated with varying each candidate predictor in isolation. For example, the absolute effect estimate for 'minority' was generated by changing the race value of the reference group while keeping all other characteristics of the reference group unchanged. We chose a reference index ED visit discharge diagnosis of asthma as that is a common diagnosis and fell in the median distribution of bounce-back admissions. Data analyses were performed with SAS 9.2 (SAS Institute, Cary, NC) and the publicly available R software.

## RESULTS

### Characteristics of Study Subjects

Our study cohort contained a total of 5,035,833 ED visits to 288 facilities in 2007 (Figure 1). There were 130,526 (2.6%) patients with bounce-back admissions. Table 1 describes the characteristics of the study cohort, stratified by outcome. The mean age of the patients who were admitted within 7 days was 53.6 years (SD 20.0) and that of the non-admitted group was 45.1 years (SD 19.0).

Table 2 shows the primary discharge diagnoses of the study cohort stratified by outcomes.<sup>24</sup> The most common discharge diagnoses are other injuries, which includes burns, wounds and superficial injuries (12.8%); sprains fractures and joint disorders (9.0%); and diseases of the musculoskeletal system (8.5%), however patients with these discharge diagnoses relatively rarely were admitted within 7 days (respectively 1.2%, 1.2% and 2.1%). The discharge diagnoses with the highest proportions of bounce-back admissions were renal disease (12.2% raw admission rate), congestive heart failure (CHF) (10.6%), and diseases of the blood (8.0%). Among more common discharge diagnoses, mental illness (3.9% of discharge diagnoses) had a 5.9% rate of bounce-back admissions compared to abdominal pain (5.4% of discharge diagnoses, but a 3.9% admission rate).

In the subset of patients who experienced the outcome and for the top 16 discharge diagnoses, we provide the top three bounce-back inpatient diagnoses associated with each index ED visit primary discharge diagnosis in Table 4. For a large number of patients, the most common bounce-back admission diagnosis was identical to the prior index ED visit discharge diagnosis. The diagnosis otherwise prevalent in the subsequent bounce-back admissions was mental illness.

### Predictors of 7-Day Bounce-back Admissions

Table 3 describes the results of our multivariate model. We found increasing age (age 40–59 OR 1.64, 95% CI 1.61–1.7; age 60–79 OR 2.18, 95% CI 2.1–2.22; age 80+ OR 2.82, 95% CI

2.76–2.9, compared with the reference group of 18–39, to be strongly associated with bounce-back admissions. Patients who left against medical advice or eloped (OR 1.9, 95% CI 1.89–2.0), had Medicaid insurance (OR 1.42, 95% CI 1.40–1.45), or Medicare insurance (OR 1.53, 95% CI 1.50–1.55) were also at higher risk for a bounce-back admission. Hospital characteristics associated with a higher likelihood of bounce-back admissions were for-profit status (OR 1.2, 95% CI 1.1–1.3) and teaching affiliation (OR 1.2, 95% CI 1.0–1.3).

The top 6 primary discharge diagnoses associated with a bounce-back admission after discharge include chronic renal disease not inclusive of end stage renal disease (OR 3.3, 95% CI 2.8–3.8); end stage renal disease (OR 2.9, 95% CI 2.4–3.6); Congestive Heart Failure (OR 2.5, 95% CI 2.3–2.6); diseases of the blood including sickle cell disease, anemia, and coagulation disorders (OR 2.4, 95% CI 2.2–2.6); neoplasms (OR 2.2, 95% CI 2.0–2.4); and mental illness (OR 2.0, 95% CI 1.9–2.2).

The predicted probabilities in Table 3 inform us of the chance of a bounce-back admission occurring given a selected predictor setting all other covariates to the referent group. Patients with a greater chance of returning and being admitted are older, leave AMA/elope, or have a diagnosis of renal disease. Patients over age 80 have over a 5% chance of a bounce-back admission within 7 days (PP 5.36%) and patients age 60–79 have greater than a 4% chance of returning (PP 4.19%). An index ED visit resulting in leaving AMA or eloping has a close to 4% chance of bouncing back (PP 3.75%). An index ED visit diagnosis of chronic renal disease, not end stage, and end stage renal disease have close to a 6% chance of a bounce-back admission (CRD PP 6.18%, ESRD PP 5.57%).

## LIMITATIONS

Our study has potential limitations. First, our findings are not generalizable to non-federal hospitals, hospitals outside of California, and more recent years since 2007. OSHPD does not provide information about federal hospitals and although California represents 12% of the US population<sup>31</sup> and this study provides us with important information for policy makers and hospital administrators, our findings cannot be generalized to the entire US population. Also, the process of obtaining the OSHPD data and accessing, programming, and analyzing the data can take 3 years at minimum; the year analyzed in this project may not mirror current trends in admission practices given the recent focus on readmissions. Second, the OSHPD ED files lack data of pre-existing comorbidities or visit acuity level, which may be important predictors of bounce-back admissions. Third, the files lack information on patients without a record linkage number which in prior experience have represented undocumented immigrants, vulnerable populations at risk for bounce-back admissions. The files also lack information on out of state admissions. In addition, based on prior work assessing admissions following ED discharge, we excluded patients with multiple visits on day 0 and with same day admissions.<sup>24</sup> These limitations most probably resulted in an underestimation of the bounce-back admission rate. Finally, our analysis is based on retrospective data derived from ICD-9 codes and cannot provide explanations of causation between the patient and hospital characteristics and outcomes.

## DISCUSSION

Using the California Office of Statewide Health Planning and Development (OSHPD) files for 2007, we examined the relationship between certain patient and hospital characteristics and 7-day bounce-back admission following discharge from California EDs. An admission following ED discharge may have important implications regarding the ED care and follow-up of patients after discharge. We found older white males and patients with a disposition of eloped or having left against medical advice (AMA) especially at risk for a bounce-back

admission. We also found that use of Medicaid or Medicare was associated with higher rates of bounce-back admission. We identified a number of primary discharge diagnoses associated with bounce-back admission and found that hospitals more likely to discharge patients that get admitted within a week of discharge either have for-profit status or a teaching affiliation. Interestingly, we found that a majority of bounce-back admission diagnoses mirror the diagnosis of the index ED visit.

To our knowledge our study is the first large scale evaluation of 7-day bounce-back admissions in the United States involving adults age 18 and older. Existing literature conducted in the US provides an important foundation and reports a bounce-back admission rate of 0.06% to 1.3%, but is limited by sample size, measurement bias, prolonged follow-up time, and focus on a population not generalizable to the entire US.<sup>8–10,12,14,32</sup> Studies conducted in foreign countries are limited by differences in health care systems, patient population, and sample size.<sup>11,17,22</sup>

We report a bounce-back admission rate of 2.6%, suggesting that more than 1 of every 50 patients discharged from an ED require an admission within 7 days. We found that the patients at highest risk for a bounce-back admission are the most vulnerable and include the very old (age 80+ OR 2.82, 95% CI 2.76–2.9), individuals with Medicare insurance (OR 1.53, 95% CI 1.50–1.55), or the underinsured (California's Medicaid program) (OR 1.42, 95% CI 1.40–1.45). Previous studies have suggested that older patients with poor physical functioning often recover poorly following an ED visit.<sup>8,12,16,33</sup> Older patients also have a higher baseline risk due to an increased comorbidity burden. This combined with our findings suggests that when evaluating older patients who are less able to care for themselves, special attention should be paid to their ability to recover and their support mechanisms following the ED visit.

A patient's insurance is not a direct measure of the need for services; nonetheless, we found that despite controlling for age and diagnosis, those with Medicare or Medicaid insurance had a higher likelihood of bounce-back admissions. For Medicare patients, this could represent unmeasured co-morbidities or be attributed to non-elderly individuals with Medicare such as persons with renal disease or a disability. The association between Medicaid use and bounce-back admission may be attributed to the increasing dependence of Medicaid patients on the ED for care<sup>34,35</sup> and the possibility that these patients are not receiving the needed follow-up care they require following discharge due to a limited availability of willing providers that use Medicaid. Our findings strengthen the notion that a key component of the ED evaluation of vulnerable patients is an assessment of their access to care both prior to and following the ED visit.

We confirm the notion that patients who leave against medical advice or elope are at high-risk for worse outcomes following the ED visit. Contrary to popular belief, these patients are not less ill than other ED patients but are found to leave the ED as a result of other factors such as insurance status or social reasons.<sup>36–39</sup> Although not in the control of the ED provider, we recommend that when encountering a patient who may leave prior to completion of the ED visit, all attempts to prevent the patient from leaving be made.

We discovered that hospitals most likely to discharge patients that require bounce-back admissions are for-profit (OR 1.2, 95% CI 1.1–1.3) or have a teaching affiliation (OR 1.2, 95% CI 1.0–1.3). This phenomenon can be attributed to several factors. Historically, for-profit hospitals have been found to rely heavily on a private patient payer mix.<sup>40,41</sup> Since the implementation of the Emergency Medical Treatment And Labor Act in 1986 mandating the emergent evaluation of all patients, it is possible that for-profit hospitals are stabilizing patients with emergencies, but due to financial strains, administrative pressures, and variable

availability of consultants, are prematurely discharging these patients. Teaching hospitals often see patients with more complex medical needs, such as transplant recipients,<sup>42</sup> that require more frequent admissions and are staffed by trainees, resulting in variability of diagnostic accuracy and admission practices.

We identify the top discharge diagnoses that place patients at greater risk of bounce-back admission. Although the diagnoses of chronic and end stage renal disease (CRD PP 6.18%, ESRD PP 5.57%), congestive heart failure (OR 2.5, 95% CI 2.3–2.6), and blood disease disorders (OR 2.4, 95% CI 2.2–2.6), which includes anemia, sickle cell disease, coagulation defects, and diseases of white blood cells, describe chronic conditions that often require regular encounters, the need for a short-term bounce-back admission could indicate a more concerning disease process or a limitation of appropriate follow-up care following the ED visit. An especially concerning diagnosis is chronic or end stage renal disease. Chronic renal disease includes a diagnosis of nephritis, nephrosis, renal sclerosis, acute renal failure, and chronic renal failure, not end stage. Both include conditions that may seem stable but in reality harbor more devastating disease processes. Emergency physicians evaluating patients with advanced stages of renal disease should pay particular attention to the whole patient and the potential role renal disease could play in their presenting chief complaint.

Our findings suggest that bounce-back admission diagnoses often mirror the index ED visit diagnosis. This suggests that patients visited the ED with a complaint that could have been incompletely managed either during the visit or shortly following discharge. A similarly concerning finding was that mental illness, which includes the diagnosis of substance abuse, psychosis, dementia, and developmental delay was not only a common bounce-back admission diagnosis but also common as a subsequent admission diagnosis for a large number of prior ED visit encounters. The literature has found that patients with these conditions have a greater tendency to return to hospitals and EDs for a variety of reasons.<sup>43,44</sup> Patients with a mental illness are a vulnerable population at risk for being misdiagnosed due to errors in communication and estimation of risk as well as lacking the ability to receive proper follow-up.

A surprising finding was that symptomatic diagnoses such as chest pain, headache, or syncope were not associated with bounce-back admission. This is confirmed in a previous study our group conducted evaluating poor outcomes after discharge from the ED.<sup>24</sup> A possible explanation is that ED physicians assessing these patients exercise a greater amount of caution and only discharge the patients who appear to be at lowest risk for poor outcomes.

Bounce-back admissions may be an indicator of incomplete ED or follow-up care and have important policy and quality improvement implications. Our study found that a majority of bounce-back admissions have the same diagnosis as the index ED visit and could reflect care given during the index ED visit. We identify important patient and hospital characteristics associated with bounce-back admissions within 7 days of ED discharge. Our findings suggest that quality improvement efforts focus on high-risk individuals, such as the old or patients with renal disease, and that the disposition plan of patients include consideration of vulnerable individuals.

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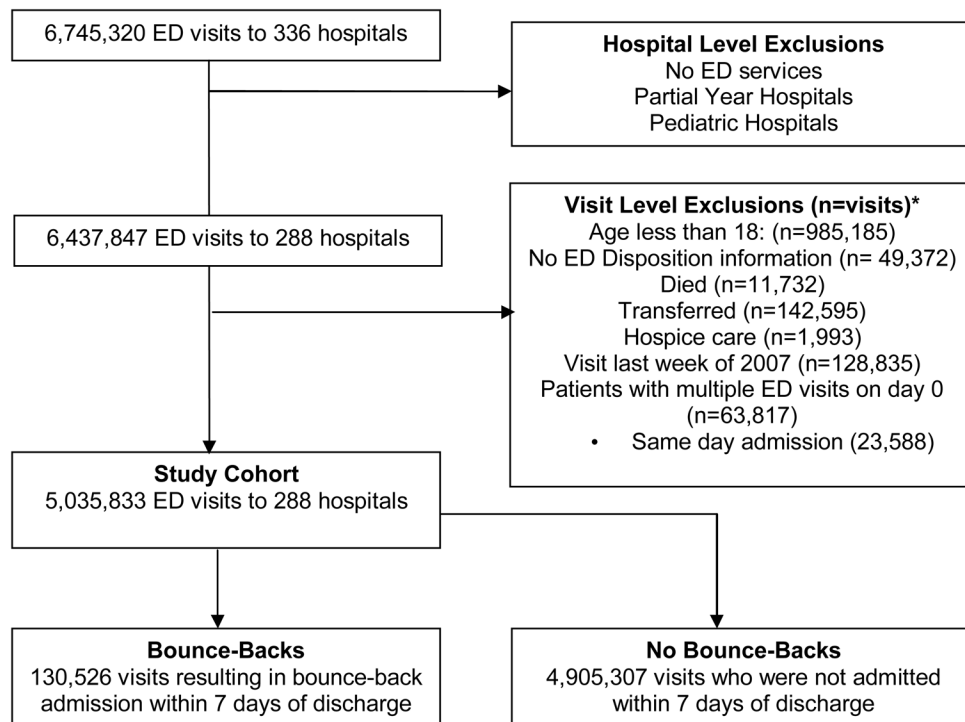
design and conduct of the study; management, analysis, and interpretation of the data; and preparation, review, or approval of the manuscript.

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**Figure 1. Flow Diagram of Study Cohort**  
\*Multiple patients with more than 1 exclusion

**Table 1**

Characteristics of the Study Cohort

Hospital Characteristic	Facilities (n=287)	Total Visits (%) (n=5,035,833)	Admitted within 7 days (%) (n=130,526)	Not Admitted within 7 Days (%) (n=4,905,307)
<b>Ownership</b>				
Not-For-Profit	207	3,812,303 (75.7)	97,293 (74.5)	3,715,010 (75.7)
For-Profit	63	778,792 (15.5)	20,370 (15.6)	758,422 (15.5)
County	17	444,738 (8.8)	12,863 (9.9)	431,875 (8.8)
Trauma center	42	1,132,874 (22.5)	32,127 (24.6)	1,100,747 (22.4)
Teaching	22	532,252 (10.6)	16,603 (12.7)	515,649 (10.5)
<b>Med-Surg Hospital</b>				
<b>Beds</b>				
(1) < 100	108	1,171,500 (23.3)	27,017 (20.7)	1,144,483 (23.3)
(2) 100	179	3,864,333 (76.8)	103,509 (79.3)	3,760,824 (76.7)
<b>Patient Characteristics</b>				
Age (Mean ± SD)		45.3 ± 19.1	53.6 ± 20.0	45.1 ± 19.0
80+		343,639 (6.8)	17,886 (13.7)	325,753 (6.6)
60–79		776,584 (15.4)	30,916 (23.7)	745,668 (15.2)
40–59		1,720,478 (34.2)	46,928 (36.0)	1,673,550 (34.1)
18–39		2,195,132 (43.6)	34,796 (26.7)	2,160,336 (44.0)
Male		2,144,051 (42.6)	58,944 (45.2)	2,085,107 (42.5)
Race/Ethnicity *				
White		2,613,852 (51.9)	74,089 (56.8)	2,539,763 (51.8)
Black		602,999 (12.0)	16,229 (12.4)	586,770 (12.0)
Hispanic		1,212,368 (24.1)	27,676 (21.2)	1,184,692 (24.2)
Asian		238,768 (4.7)	5,891 (4.5)	232,877 (4.8)
American Indian		19,029 (0.4)	488 (0.4)	18,541 (0.4)
Other		348,817 (6.9)	6,153 (4.7)	342,664 (7.0)
Day of week of service				
Weekday		3,584,350 (71.2)	93,711 (71.8)	3,490,639 (71.2)
Weekend		1,451,483 (28.8)	36,815 (28.2)	1,414,668 (28.8)
AMA/Eloped		113,811 (2.3)	5,564 (4.3)	108,247 (2.2)
Expected source of payment **				
Self Pay		884,675 (17.6)	15,664 (12.0)	869,011 (17.7)
Medicaid		889,550 (17.7)	25,341 (19.4)	864,209 (17.6)
Medicare		750,342 (14.9)	35,495 (27.2)	714,847 (14.6)
All others		2,511,266 (49.9)	54,026 (41.4)	2,457,240 (50.1)

\* The race variable had 3.2% missing information that was included as “other”

\*\* The source of payment variable had 0.04% missing information that was included as “other”

Table 2

## Discharge Diagnoses of the Study Cohort

Discharge diagnosis	Total Cohort (%) <sup>1</sup> (n=5,035,833)	Admitted within 7 days (%) <sup>2</sup> (n=130,526)
Chronic Renal Disease	1,694 (0.03)	215 (12.7)
End Stage Renal Disease	1,102 (0.02)	127 (11.5)
Congestive Heart Failure	14,080 (0.3)	1,494 (10.6)
Diseases of the blood	14,650 (0.3)	1,179 (8.0)
Neoplasms	10,423 (0.2)	764 (7.3)
Ischemic Heart Disease I	4,986 (0.1)	361 (7.2)
Cerebrovascular Disease	11,579 (0.2)	718 (6.2)
Nonatherosclerotic Heart Disease	2,668 (0.1)	162 (6.1)
Pneumonia	28,855 (0.6)	1,752 (6.1)
Noninfectious Lung Disease	7,330 (0.1)	442 (6.0)
Mental Illness	196,130 (3.9)	11,532 (5.9)
Complications and Adverse events	40,354 (0.8)	2,254 (5.6)
Diabetes Mellitus	49,722 (1.0)	2,422 (4.9)
Endocrine, nutritional, immunity and metabolic diseases	50,424 (1.0)	2,393 (4.7)
Chronic Obstructive Pulmonary Disease	62,358 (1.2)	2,743 (4.4)
Symptoms: Abdominal pain	274,024 (5.4)	10,578 (3.9)
GI System Diseases	319,079 (6.3)	11,832 (3.7)
Other symptoms	179,106 (3.6)	6,241 (3.5)
Congenital and Perinatal Anomalies	1,247 (0)	43 (3.4)
Circulatory Disorders	33,353 (0.7)	1,120 (3.4)
Skin and Subcutaneous Infection	163,617 (3.2)	5,060 (3.1)
Other Respiratory Disease	123,838 (2.5)	3,740 (3.0)
Urinary Tract infection	139,941 (2.8)	3,912 (2.8)
Asthma	64,974 (1.3)	1,784 (2.7)
Hypertension	42,289 (0.8)	1,142 (2.7)
Other Residual Codes	233,315 (4.6)	5,818 (2.5)
Symptoms: Chest pain	191,519 (3.8)	4,657 (2.4)
Intestinal Infections	8,322 (0.2)	197 (2.4)
Other Renal and GU Diseases	213,933 (4.2)	5,060 (2.4)
Dysrhythmias and conduction disorders	60,121 (1.2)	1,393 (2.3)
Pregnancy and childbirth related disorders	170,842 (3.4)	3,872 (2.3)
Other Infectious and Parasitic	61,799 (1.2)	1,311 (2.1)
Diseases of the musculoskeletal system, skin and connective tissue	427,280 (8.5)	8,857 (2.1)
Nervous System Disorders	243,320 (4.8)	4,918 (2.0)
Symptoms: Headache	164,828 (3.3)	3,014 (1.8)
Symptoms: Dizziness, vertigo and syncope	123,254 (2.4)	2,141 (1.7)
Major Injuries	22,180 (0.4)	305 (1.4)
Other Injuries	643,038 (12.8)	7,747 (1.2)
Sprains, fractures and joint disorders	454,615 (9.0)	5,326 (1.2)

Discharge diagnosis	Total Cohort (%) <sup>1</sup> (n=5,035,833)	Admitted within 7 days (%) <sup>2</sup> (n=130,526)
Upper respiratory infections	179,644 (3.6)	1,900 (1.1)

<sup>1</sup>Percent of total cohort

<sup>2</sup>Percent readmitted

**Table 3**

Hierarchical Logistic Regression of 7-day Bounce-back Admissions<sup>1</sup>

	OR (95% CI)	Predicted Probability <sup>2</sup> (%)
<b>Hospital Characteristics</b>		
<b>Ownership</b> (Ref=Not for profit hospital)		1.97
For Profit	1.2 (1.1–1.3) **	2.12
County	1.1 (0.9–1.2)	2.41
<b>Teaching Hospital</b> (Ref=Non-teaching hospital)	1.2 (1.0–1.3) *	2.27
<b>Trauma Center</b> (Ref=Non-Trauma Center)	1.0 (0.93–1.1)	2.03
<b>Med-Surg Hospital Beds</b> (Ref 100 Beds)		
< 100	0.86 (0.80–0.91) **	1.70
<b>Patient Characteristics</b>		
<b>Age</b> (Ref=18–39 yrs)		1.97
80+	2.82 (2.76–2.9) **	5.36
60–79	2.18 (2.1–2.22) **	4.19
40–59	1.64 (1.61–1.7) **	3.19
<b>Female</b> (Ref=Male)	0.86 (0.85–0.87) **	1.69
<b>Race/Ethnicity</b> (Ref=White)		
Black	0.93 (0.91–0.95) **	1.84
Hispanic	0.82 (0.80–0.83) **	1.61
Asian	0.78 (0.76–0.81) **	1.55
American Indian	0.91 (0.83–1.0)	1.79
Other	0.62 (0.60–0.64) **	1.23
<b>Weekend</b> (Ref=Weekday)	1.00 (0.99–1.01)	1.97
<b>AMA/Eloped</b> (Ref=Non AMA/Eloped)	1.9 (1.89–2.0) **	3.75
<b>Expected source of payment</b> (Ref=Other)		
Self Pay	0.85 (0.83–0.86) **	1.67
Medicaid	1.42 (1.40–1.45) **	2.78
Medicare	1.53 (1.50–1.55) **	2.97
<b>Index ED visit Discharge Diagnosis</b> (Ref=Asthma)		
Chronic Renal Disease <sup>3</sup>	3.3 (2.8–3.8) **	6.18
End Stage Renal Disease	2.9 (2.4–3.6)	5.57
Congestive Heart Failure	2.5 (2.3–2.6) **	4.69
Diseases of the blood	2.4 (2.2–2.6) **	4.58
Neoplasms	2.2 (2.0–2.4) **	4.24
Mental Illness	2.0 (1.9–2.2) **	3.94
Noninfectious Lung Disease	2.0 (1.8–2.3) **	3.91



	OR (95% CI)	Predicted Probability <sup>2</sup> (%)
Pneumonia	1.8 (1.7–1.9) **	3.48
Non-atherosclerotic Heart Disease	1.7 (1.4–2.0) **	3.29
Ischemic Heart Disease	1.5 (1.4–1.7) **	2.97
Complications and Adverse events	1.5 (1.4–1.6) **	2.86
Symptoms: Abdominal pain	1.4 (1.3–1.5) **	2.72
Cerebrovascular Disease	1.4 (1.2–1.5) **	2.66
Endocrine, nutritional, immunity and metabolic diseases	1.4 (1.27–1.4) **	2.65
Diabetes Mellitus	1.3 (1.26–1.4) **	2.62
GI System Diseases	1.27 (1.21–1.3) **	2.49
Chronic Obstructive Pulmonary Disease	1.23 (1.2–1.3) **	2.40
Pregnancy and childbirth related disorders	1.22 (1.2–1.3) **	2.39
Congenital and Perinatal Anomalies	1.2 (0.9–1.6)	2.27
Other Symptoms	1.15 (1.1–1.2) **	2.26
Skin and Subcutaneous Infections	1.1 (1.07–1.2) **	2.22
Urinary Tract infections	1.0 (0.9–1.02)	1.90
Circulatory Disorders	0.94 (0.9–1.0)	1.85
Intestinal Infections	0.9 (0.8–1.0)	1.79
Other Respiratory Diseases	0.9 (0.8–0.92) **	1.72
Other Renal and GU Diseases	0.83 (0.8–0.9) **	1.63
Other Infections and Parasitic Diseases	0.8 (0.7–0.8) **	1.53
Other Residual Codes	0.77 (0.7–0.8) **	1.51
Symptoms: Chest pain	0.73 (0.7–0.8) **	1.43
Hypertension	0.7 (0.66–0.77) **	1.4
Symptoms: Headache	0.69 (0.65–0.73) **	1.36
Nervous System Disorders	0.68 (0.6–0.7) **	1.34
Dysrhythmias	0.67 (0.62–0.72) **	1.32
Diseases of the musculoskeletal system, skin and connective tissue	0.66 (0.62–0.69) **	1.30
Major Injuries	0.52 (0.46–0.59) **	1.04
Symptoms: Dizziness, vertigo and syncope	0.48 (0.45–0.51) **	0.96
Minor Injuries	0.43 (0.40–0.45) **	0.85
Upper respiratory infections	0.42 (0.40–0.45) **	0.84
Other Injuries	0.41 (0.39–0.43) **	0.81

<sup>1</sup> For total cohort of 5,035,833 ED discharges; Reference groups noted adjacent to variables

<sup>2</sup> Probability when all variables are at reference group is 2%

<sup>3</sup> Chronic Renal Disease excludes diagnosis of End Stage Renal Disease

\*\* p<0.0001

\*  
p<0.05

**Table 4**  
Top 3 Admission Diagnoses for Bounce-back Admissions (16 Most Common ED Discharge Diagnoses Shown)

ED Discharge Diagnosis	N=130,526	Most common subsequent inpatient diagnosis*	N (%)	2nd Most common subsequent inpatient diagnosis*	N (%)	3rd Most common subsequent inpatient diagnosis*	N (%)
GI System Diseases	11,832	GI System Diseases	6,470 (54.7)	Mental Illness	657 (5.6)	Other Infectious and Parasitic Diseases	438 (3.7)
Mental Illness	11,532	Mental Illness	8946 (77.6)	GI System Diseases	419 (3.6)	Other Injuries	266 (2.3)
Symptoms: Abdominal pain	10,578	GI System Diseases	4722 (44.7)	Symptoms: Abdominal pain	837 (7.9)	Mental Illness	592 (5.6)
Diseases of the musculoskeletal system, skin and connective tissue	8,857	Diseases of the musculoskeletal system, skin and connective tissue	1725 (19.5)	Mental Illness	1019 (11.5)	Other Infectious and Parasitic Diseases	636 (7.2)
Other Injuries	7,747	Mental Illness	1816 (23.4)	Other Injuries	704 (9.1)	Skin and Subcutaneous Infections	576 (7.4)
Symptoms: Other symptoms, signs and ill-defined conditions	6,241	GI System Diseases	1046 (16.8)	Other Infectious and Parasitic Diseases	576 (9.2)	Mental Illness	413 (6.6)
Other Residual Codes	5,818	Mental Illness	1268 (21.8)	Other Respiratory Disease	542 (9.3)	Skin and Subcutaneous Infections	412 (7.1)
Minor Injuries	5,326	Minor Injuries	(39.2)	Mental Illness	447 (8.4)	Diseases of the musculoskeletal system, skin and connective tissue	323 (6.1)
Skin and Subcutaneous Infections	5,060	Skin and Subcutaneous Infections	3158 (62.4)	Other Infectious and Parasitic Diseases	241 (4.8)	Diseases of the musculoskeletal system, skin and connective tissue	222 (4.4)
Other renal and genito-urinary diseases	5,060	Other renal and genito-urinary diseases	2173 (42.9)	GI System Diseases	383 (7.6)	Urinary Tract infection	313 (6.2)
Nervous System Disorders	4,918	Nervous System Disorders	1158 (23.6)	Mental Illness	803 (16.3)	GI System Diseases	325 (6.6)
Symptoms: Chest pain	4,657	Symptoms: Chest pain	982 (21.1)	Ischemic Heart Disease	649 (13.9)	Mental Illness	510 (11.0)
Urinary Tract infection	3,912	Urinary Tract infection	1073 (27.4)	GI System Diseases	441 (11.3)	Other Infectious and Parasitic Diseases	421 (10.8)
Pregnancy and childbirth related disorders	3,872	Pregnancy and childbirth related disorders	3629 (93.7)	Mental Illness	58 (1.5)	GI System Diseases	54 (1.4)
Other Respiratory Disease	3,740	Other Respiratory Disease	439 (11.7)	Congestive Heart Failure	339 (9.1)	Pneumonia	261 (7.0)
Symptoms: Headache	3,014	Symptoms: Headache	486 (16.1)	Mental Illness	406 (13.5)	Other Infectious and Parasitic Diseases	294 (10.0)

**Appendix Table**

**Discharge Diagnosis Codes**

Category	Definition	Multilevel CCS Codes	CCS Code Description
1	Minor Injuries	16.1 16.2 16.7	Sprains, fractures and joint disorders
2	Major Injuries	16.3 16.4 16.5	Spinal cord, Intracranial, Crushing/internal organ injury
3	Other Injuries	16.6 16.8 16.9 16.11 16.12	Including burns, wounds, poisonings, superficial injuries
4	Symptoms: Abdominal pain	17.1.7	Abdominal pain
5	Symptoms: Chest pain	7.2.5	Chest pain
6	Symptoms: Dizziness, vertigo and syncope	6.8.2 17.1.1	Dizziness, vertigo and syncope
7	Symptoms: Headache	6.5	Headache
8	Other Symptoms	17.1.2 17.1.3 17.1.4 17.1.5 17.1.6 17.1.8 17.1.9	Other symptoms, signs and ill-defined conditions
9	Upper respiratory infections	8.1.2 8.1.3 8.1.4 8.1.5	Upper respiratory infections excluding pneumonia
10	Intestinal infections	9.1	Intestinal Infections
11	Urinary Tract Infection	10.1.4	Urinary Tract infection and symptoms
12	Other Infectious and Parasitic Diseases	1 6.1 13.1	Other Infectious and Parasitic Diseases, Meningitis, Infective arthritis, Bacterial, Mycoses, Viral
13	Skin and Subcutaneous Infection	12.1	Skin and SubQ Infection
14	Endocrine, nutritional; immunity and metabolic disorders	3.1 3.4 3.5 3.6 3.7 3.8 3.9 3.10 3.11	Endocrine diseases; Nutritional and metabolic diseases; Immunity disorders
15	Diabetes Mellitus	3.2 3.3	Diabetes with and without complications
16	Hypertension	7.1	Hypertension
17	Non-atherosclerotic Heart Disease	7.2.1 7.2.2 7.2.6 7.2.7 7.2.10	Valvular heart disease, Myocarditis, Pericarditis
18	Dysrhythmias	7.2.8 7.2.9	Dysrhythmias and conduction disorders
19	Ischemic Heart Disease	7.2.3 7.2.4	Ischemic Heart Disease and MI
20	Congestive Heart Failure	7.2.11	Congestive Heart Failure
21	Circulatory Disorders	7.4 7.5	Diseases of arteries; arterioles; veins; lymphatics and capillaries
22	Cerebrovascular Disease	7.3	Cerebrovascular Disease
23	Diseases of the blood	4	Diseases of the blood and blood-forming organs
24	Neoplasms	2	Neoplasms
25	Mental Illness	5	Mental Illness
26	Nervous System Disorders	6.2 6.3 6.4 6.6 6.7 6.8.1	Nervous System Disorders
27	Pneumonia	6.8.3 6.9 8.1.1	Pneumonia
28	Other Respiratory Disease	8.6 8.7 8.8 8.9	Respiratory insufficiency, Lung disease due to external agents, Other lower and upper respiratory diseases
29	Chronic Obstructive Pulmonary Disease	8.2	Chronic Obstructive Pulmonary Disease
30	Asthma	8.3	Asthma
31	Non-infectious Lung Disease	8.4 8.5	Pleurisy, Pneumothorax, Pneumonitis

Category	Definition	Multilevel CCS Codes	CCS Code Description
32	GI System Diseases	9.2 9.3 9.4 9.5 9.6 9.7 9.8 9.9 9.10 9.11 9.12	Disorders of mouth, esophagus, and upper GI tract; Abdominal hernia; Lower GI disorders, Biliary, liver, and pancreatic tree disorders; GI hemorrhage; Non-infectious gastroenteritis
33	Other Renal and GU Diseases	10.1.5 10.1.6 10.1.7 10.2 10.3 10.1.8	Renal or urinary tract calculus; Other diseases of bladder and urethra; Diseases of male and female genital organs; GU symptoms
34*	End Stage Renal Disease*	(585.5 585.6 792.5 V451 V560 V561 V560 V561 V562 V563.2 V568)*	End Stage Renal Disease
35**	Chronic Renal Disease**	10.1.1 10.1.2 10.1.3	Nephritis, Nephrosis, Renal Sclerosis; Acute renal failure; Chronic renal failure
36	Pregnancy and childbirth related disorders	11	Pregnancy and childbirth related disorders
37	Diseases of the musculoskeletal system, skin and connective tissue	12.2 12.3 12.4 13.2 13.3 13.4 13.5 13.6 13.7 13.8 13.9	Diseases of the musculoskeletal system, skin and connective tissue; Skin disorders; Joint disorders and arthritis;
38	Complications and Adverse events	16.10	Complications and Adverse events
39	Other Residual codes	17.2 14 15 18	Other: Residual codes and other factors influencing healthcare; Congenital and Perinatal Anomalies

\* To differentiate between Chronic Renal Disease and End Stage Renal Disease ICD-9 Codes were used instead of CCS codes for End Stage Renal Disease (ESRD)

\*\* Chronic Renal Disease was categorized based on the CCS codes described subtracting out the ESRD ICD-9 codes