Admit or Transfer? The Role of Insurance in High-Transfer-Rate Medical Conditions in the Emergency Department

Dana R. Kindermann, MD, MPH*; Ryan L. Mutter, PhD; Lara Cartwright-Smith, JD, MPH; Sara Rosenbaum, JD; Jesse M. Pines, MD, MBA

*Corresponding Author. E-mail: danakindermann@gmail.com.

Study objective: We study the association of payer status with odds of transfer compared with admission from the emergency department (ED) for multiple diagnoses with a high percentage of transfers.

Methods: This was a retrospective study of adult ED encounters using the Healthcare Cost and Utilization Project 2010 Nationwide Emergency Department Sample. We used the Clinical Classification Software to identify disease categories with 5% or more encounters resulting in transfer (27 categories; 3.7 million encounters based on survey weights). We sorted encounters by condition into 12 groups according to expected medical or surgical specialist needs. We used logistic regression to assess the role of payer status on odds of transfer compared with admission and report adjusted odds ratios (ORs).

Results: Among high-transfer conditions in 2010, uninsured patients had double the odds of transfer compared with privately insured patients (OR 2.12; 95% confidence interval [CI] 1.72 to 2.62). Medicaid patients were also more likely to be transferred (OR 1.2; 95% CI 1.04 to 1.38). Uninsured patients had higher odds of transfer in all specialist categories (significant in 9 of 12). The categories with the highest odds of transfer for the uninsured included nephrology (OR 2.44; 95% CI 1.07 to 5.55), psychiatry (OR 2.26; 95% CI 1.65 to 3.25), and hematology-oncology (OR 2.21; 95% CI 1.50 to 3.25); the highest for Medicaid were general surgery (OR 1.61; 95% CI 1.09 to 1.83), hematology-oncology (OR 1.55; 95% CI 1.05 to 2.30), and vascular surgery (OR 1.55; 95% CI 1.02 to 2.28).

Conclusion: Insurance status appears to play a role in ED disposition (transfer versus admission) for many high-transfer conditions. [Ann Emerg Med. 2014;63:561-571.]

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INTRODUCTION

Background

Hospitals vary widely in the services available, and many lack access to certain specialists and diagnostic and treatment modalities. When a hospital does not have the resources to adequately care for a patient with an emergency condition, the patient may be transferred to another acute care hospital. Reasons for transfer may include patient needs (disease complexity[1,2] or specialist availability[3-5]), patient preference,[6] protocols based on regionalized systems of care,[7,8] or hospital operations (bed availability[8] or night versus day arrival[9]). Studies on the effect of transfer to a higher level of care have been mixed; some show mortality benefit as a result of transfer,[10-12] whereas others show no effect on outcomes, with increases in cost.[13,14]

Importance

Both clinical and nonclinical factors affect the decision to transfer a patient. Economic reasons, in particular insurance status, have been found to influence transfer decisions. Payer status, especially lack of insurance, has been found to play a role in transfers of orthopedic emergencies,[15,16] traumatic injuries,[17,18] psychiatric emergencies,[19] and neurosurgical emergencies,[1] but had no effect in other studies.[20,21] The effect of payer status on transfer for a broad variety of disease categories has not been studied, and no studies to our knowledge have used data at a national level.

Understanding the influence of insurance status on likelihood of transfer is important in the context of the Emergency Medicine Treatment and Labor Act (EMTALA), which was

Editor's Capsule Summary

What is already known on this topic

Patients are transferred for many reasons, including subspecialist availability, patient preference, and disease severity.

What question this study addressed

The relation between insurance status and the likelihood of transfer from an emergency department in a nationally representative weighted sample.

What this study adds to our knowledge

Uninsured and Medicaid patients are transferred more frequently than privately insured patients with the same conditions.

How this is relevant to clinical practice

Should these disparities in transfer rates be shown to cause differential outcomes, this would be yet another example of inequities in our health care system.

passed by Congress in 1986 and mandates that hospitals conduct a medical screening examination and stabilize all patients presenting to the emergency department (ED) regardless of their citizenship, legal status, or ability to pay.[22-24] EMTALA was enacted in response to evidence about denial of care for medical emergencies to the poor and uninsured, a problem known as "patient dumping." Its purpose is to ensure that all patients with an emergency medical condition, regardless of any factor other than the need for care, are appropriately examined and stabilized in the ED. EMTALA bars transferring medically unstable patients with emergencies except under appropriate and medically justifiable conditions; therefore, a key question is whether transfer patterns suggest that factors other than medical appropriateness are involved in transfer decisionmaking.

Goals of This Investigation

In this study, we use the Nationwide Emergency Department Sample (NEDS) to study the association of insurance status with odds of transfer compared with admission. Specifically, we identify diagnoses with high frequencies of transfer in adults (5% or more encounters resulting in transfer), group these high-transfer diagnoses according to predicted specialist need, and assess the association of payer status with the odds of transfer versus admission among these specialist categories.

MATERIALS AND METHODS

Study Design

This was a retrospective study of ED encounters for adult patients (aged 18 years and older), using the Healthcare Cost and Utilization Project (HCUP) NEDS for 2010.[25] HCUP is maintained by the Agency for Healthcare Research and Quality (AHRQ). The NEDS is the largest all-payer ED database in the United States. The 2010 NEDS is a nationally representative, weighted sample that estimates approximately 129 million ED encounters. Data come from 961 hospital-based EDs in 28 states and can be used to make national estimates of ED encounters. It includes diagnoses, procedures, total charges, and demographics, including sex, age, and expected payer source. The NEDS is constructed with records from the HCUP State Emergency Department Databases, which capture information on ED encounters that do not result in an admission to the same hospital (treat-and-release encounters, including transfers to other hospitals) and the State Inpatient Databases, which contain information on patients initially treated in the ED and then admitted to the same hospital. Previous studies have assessed the accuracy and completeness of hospital discharge data[26] and have found that estimates of ED use from the NEDS are similar to those from other national sources of ED data.[27]

The NEDS contains information about hospital characteristics from the 2010 American Hospital Association (AHA) annual survey of hospitals[28] (urban/rural location, ownership/control, teaching status, and bed size) and the Trauma Information Exchange Program (hospital trauma level). In addition, we obtained data on county-level racial demographic information from the 2010 Area Resource File, a project of the Health Resources and Services Administration, and linked this to the NEDS.[29]

Our goal was to examine the association of insurance status with decisions to transfer ED patients to another acute care hospital compared with hospital admission at the same hospital. Many patient and hospital characteristics can contribute to transfer decisions. Some of these characteristics are measurable with the NEDS database, whereas others are not and could not be included in our study. The Figure describes the process of ED arrival to disposition decision (transfer versus admission) and outlines the multiple patient-, hospital-, community-level and external factors that may affect this decision.

To isolate our study population, we first identified all ED encounters that had a disposition coded as "transferred to another short-term hospital" or "admitted as an inpatient to this hospital." Only encounters with these dispositions were included in the analysis. Transferred patients do not have an exact comparison group (not all transferred patients are admitted; some are evaluated and directly discharged from the receiving ED). However, we reasoned that transferred patients had more in common with admitted than with treat-and-release patients because they usually are transferred because of the requirement for a higher level of care.

We used the Clinical Classification Software (CCS) to identify disease categories to include in our study population.[30] The CCS is a tool developed by the AHRQ that aggregates illnesses and conditions into 285 mutually exclusive categories based on *International Classification of Diseases, Ninth Revision, Clinical Modification* (*ICD-9-CM*) diagnosis codes. We sorted the 285 CCS categories according to the percentage of encounters resulting in transfer from the ED to another acute care hospital

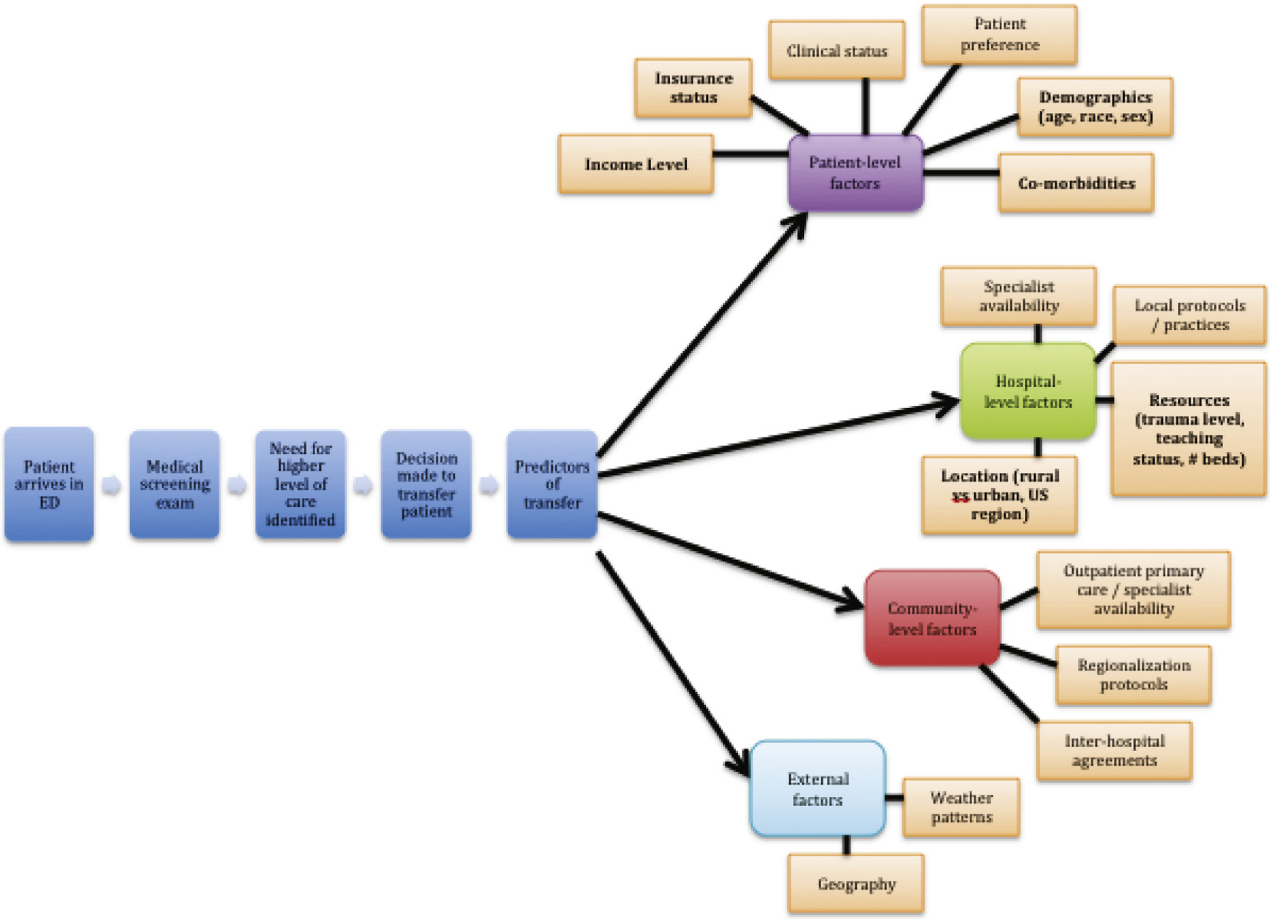

Figure. Study population selection and data processing. Conceptual map of the transfer decision process from ED arrival to transfer. Observable variables predicting transfer from NEDS, Area Resource File, and AHA are in bold.

and retained those disease categories in which 5% or more of the encounters among the adult population had a disposition of transfer to another short-term hospital. We concentrated on patients with diseases that most commonly require transfer to identify factors that predict transfer instead of admission.

There were 27 CCS categories in which 5% or more of encounters resulted in transfer. These conditions included a broad range of diseases and medical and surgical specialties. This 5% cutoff created a study population that included 22% of all transfers in 2010. Although the cutoff was not based on sample size calculations (not an issue with such a large data set), a less stringent 4% cutoff would have added an additional 14 CCS categories, and a more selective 6% cutoff would have omitted 12 CCS categories.

Our study population therefore consisted of all ED encounters resulting in transfer or admission among adult patients who had a CCS category with 5% or more of encounters resulting in transfer. There were 129 million potentially eligible encounters in the 2010 NEDS. There were some encounters (approximately 3.2%, or 124,000 encounters) that were excluded from our analysis because of missing variables. After selecting only those encounters that led to transfer or admission, and only those CCS categories with a 5% or greater frequency of transfer among adult patients, 3,747,187 ED encounters were included in our study population.

We further sorted the 3,747,187 encounters according to the expected specialist who would be consulted for definitive care based on the *ICD-9-CM* codes included in each CCS category. This was done to construct clinically meaningful categories and to compare odds of transfer across disease entities. We identified 12 specialist categories (eg, neurosurgical, vascular, psychiatric). We believed these categories would help explain predictors of transfer across different specialty categories, and in particular, the effect of insurance status. These 12 categories formed the basis of our analysis. The CCS categories that made up each specialist grouping are found in Table 1. For a full listing of each *ICD-9-CM* diagnosis in our study population and within each specialist category, see Appendix E1 (available online at http://www.annemergmed.com).

We used HCUP's Elixhauser Comorbidity Software (version 3.1; Elixhauser Comorbidity Software, Bethesda, MD) to adjust for patient comorbidities.[31] We ran the software on the NEDS to generate 29 comorbidity variables. The comorbidity

Table 1. Percentage of encounters leading to transfer and number of encounters by disease category in the study population (all encounters leading to transfer or admission)—disease categories with transfer frequencies greater than 5%.

Disease System and Diagnostic Categories	% Encounters in CCS Category Leading to Transfer	Total Number of Encounters Within Specialist Category (n=3,747,187)
Vascular emergencies		54,376
Aneurysm (aortic, peripheral, visceral artery)	16.5	
Aortic or peripheral arterial embolism or thrombosis	10.9	
Cardiac emergencies		906,634
Acute myocardial infarction	12.4	
Coronary atherosclerosis and other heart disease	9.7	
Cardiac conduction abnormalities	6.0	
Neurologic emergencies		410,684
Acute cerebrovascular disease (ischemic disease)	12.1	
Neurosurgical emergencies*		447,937
Spinal cord injury	10.5	
Intracranial injury	5.5	
Skull fractures	5.5	
Vertebral fractures from "other fractures"	5.5	
Coma, stupor, and brain damage		25,162
Coma, transient alteration in awareness, persistent vegetative state, "other" (drowsiness, semicoma, somnolence, stupor, unconsciousness)	10.0	
Orthopedic emergencies*		346,991
Femoral neck fracture	8.3	
Pelvic fracture and other fracture care	5.5	
Renal emergencies		16,311
Stages I–V renal failure	8.3	
Hematologic/oncologic emergencies		61,763
Neoplasm of unspecified nature	6.6	
Other hematologic condition	6.4	
Disorders of WBCs	5.5	
Malignant neoplasm	5.4	
Psychiatric emergencies		839,681
Suicide and intentional self-injury	14.9	
Schizophrenia/other psychosis	6.3	
Poisoning by psychotropic agents	6.1	
Personality disorder	5.8	
Mood disorder	5.4	
Facial fractures*	5.5	37,697
Fractures of nasal bones, maxillary bones, mandible, and orbital floor		
Surgical (nontraumatic) emergencies		512,953
Peritonitis/intestinal abscess	5.3	
Appendicitis	5.0	
Intestinal obstruction	5.0	
Traumatic emergencies		82,252
Crushing injury/internal injury	5.3	

*We reviewed the *ICD-9-CM* diagnoses included within each CCS category to be sure that the specialist grouping actually matched the clinical need according to the diagnosis. For example, the CCS category "acute myocardial infarction" includes the *ICD-9-CM* diagnosis for anterior wall ST-elevation myocardial infarction and appropriately fits into the cardiac emergency category because a cardiologist would be needed for treatment. In some cases, the CCS category included diagnoses that would more commonly be treated by a different type of specialist. For example, in the CCS category "skull fracture," most of the included *ICD-9-CM* diagnoses were diseases typically treated by a neurosurgeon such as subarachnoid; there were also facial fractures included in this CCS category. We removed these from the neurosurgery category and added them to the facial fracture category because they would be more typically treated by otolaryngologists, plastic surgeons, oral and maxillary facial surgeons, or ophthalmologists, depending on specialist availability and hospital preference. This also occurred in the "other fracture" CCS category, for which most injuries would be treated by an orthopedist, but some would more typically be treated by a neurosurgeon (such as cervical spine fracture with spinal cord injury). These *ICD-9-CM* diagnoses were added to the neurosurgical emergency category.

software has been validated and compared with another commonly used comorbidity risk-adjustment method.[32] The software considers a diagnosis to be a comorbidity only when it does not relate directly to the admitting diagnosis, screened for inpatient records through a diagnosis-related group.

The NEDS is a stratified probability sample of hospital-based EDs. Using the sample weights corrects the standard errors for clustering at the level of the primary sampling unit, the hospital-based ED, and below.[33]

Outcome Measures and Primary Data Analysis

We included variables from the 2010 NEDS, AHA survey, and Area Resource File. Patient-level variables included age, sex, primary expected payer, and quartile of median household income of patient's zip code. Hospital-level variables included ownership, teaching status, trauma level, US Census Bureau–defined region, and urban/rural designation. Appendix E2 (available online at http://www.annemergmed.com) provides more information on these variables. We used a variable for county racial composition from the Area Resource File because patient race data were not available for all states in the NEDS. Bed size was the only variable that we used from the AHA survey. We created categories for some of the continuous variables, including patient age, hospital bed size, and county racial demographics; see Table 2 for these categories.

We used logistic regression accounting for survey weights to identify factors associated with transfer compared with admission. The reference category for each variable in the model is listed in Table 2. The dependent variable in the model was a 0/1 binary variable that distinguished encounters leading to transfer from those leading to admission. We calculated odds ratios (ORs) and 95% confidence interval (CI) bands. We first ran the model on the entire study population (ie, the 3,747,187 ED encounters that met our inclusion criteria explained above). We then ran the model separately on each of the 12 specialist categories. The analysis was conducted with Stata (version 12.1 MP; StataCorp, College Station, TX). Appendix E3 (available online at http://www.annemergmed.com) provides a step-by-step guide of our data analysis, as well as sample programming commands used in each step.

RESULTS

Characteristics of Study Subjects

In 2010, according to sample weights, there were 128,970,364 ED encounters (95% CI 123,579,723 to 134,361,005). Of these, 19,733,530 encounters, or 15.3%, resulted in admission at the same hospital (95% CI 19,241,557 to 20,225,503) and 1,942,692, or 1.5%, led to transfer to another acute care hospital (95% CI 1,823,736 to 2,061,648). Although overall about 1.5% of encounters led to transfer, certain diagnostic categories had a higher percentage of encounters resulting in transfer.

Table 1 presents the CCS categories that defined our study population and lists the number of encounters in each specialty grouping. Our study population included 3,747,187 encounters; of these, 11.5% of patients were transferred; 88.5% were admitted. Table 2 breaks down the admitted and transferred cohorts to show the relative proportions of each category of predictor variable and lists unadjusted percentages of encounters transferred for each category of predictor variable. Medicare patients composed about 41% of transfers in comparison to the 17% by uninsured patients. Table 2 shows that transfer frequencies for uninsured patients were twice as high as for Medicare patients (20% versus 10%, respectively). The results indicate strong patient- (uninsured, age, and income) and hospital-level associations (ownership, region, teaching status, trauma, rurality, and bed size) with likelihood of transfer. The small hospital bed number effect and rural effect are sizable (47% and 36% transferred, respectively), but total encounters within our study population occurring at these hospitals were relatively small (10% and 14%, respectively).

We also assessed whether hospitals' propensity to transfer uninsured/self-pay and Medicaid patients varied with their transfer of private insurance patients. We categorized hospitals into quartiles according to the percentage of encounters with private insurance that were transferred. Table 3 shows that, in general, hospitals with a lower (higher) percentage of private payer encounters resulting in transfer from the ED had lower (higher) percentages of other payers transferred from the ED as well. Across quartiles, the percentage of private payer encounters resulting in transfer was less than that of uninsured/self-pay patients. The difference between the percentage of private-payer and Medicaid encounters transferred was small, except at hospitals with the highest percentage of private-payer encounters transferred. For those facilities, the percentage of private-payer encounters resulting in transfer was higher than the corresponding Medicaid percentage.

We analyzed the association of insurance status with the decision to transfer or admit a patient, with privately insured patients as the reference category. In the entire study population, uninsured patients had more than twice the odds (OR 2.12; 95% CI 1.73 to 2.60) of being transferred as privately insured patients (Table 4). Patients with Medicaid were also significantly more likely to be transferred, though the OR was smaller (OR 1.20; 95% CI 1.04 to 1.38). Table 5 shows odds of transfer within each specialty category. Uninsured patients had higher odds of transfer in each specialty category, with coefficients ranging from 1.2 to 2.4, though in 3 categories the coefficient was not statistically significant. Also, in 4 categories, patients with Medicaid were significantly more likely to be transferred. The effect of Medicare and other types of insurance was mixed, depending on the disease category.

Patient- and hospital-level variables were also significantly associated with transfer to another acute care hospital. Table 4 lists characteristics included in the adjusted model and shows ORs and 95% CIs for variables associated with transfer. At the patient encounter level, relative to patients aged 85 years or older, younger patients (aged 18 to 44 years) had lower odds of transfer and older patients (aged 55 to 84 years) had higher odds of transfer. At the hospital level, nonteaching, rural, small- and medium-sized hospitals, and hospitals in the South and Midwest had higher odds of transfer. For-profit hospitals had lower odds of transfer relative to public hospitals. Level II trauma centers had lower odds of transfer relative to nontrauma centers.

LIMITATIONS

The main limitation is that large administrative databases such as the NEDS are unable to fully adjust for several factors that can influence transfer decisions. We controlled for patient comorbidities, age, sex, zip code income quartiles, and county-level racial demographics, and compared admitted and transferred patients with the same diagnostic category; however,

Table 2. Description of study population: unadjusted frequencies of transfer within each category of predictor variable and composition of transfer and admitted cohorts by category of predictor variables (total study population n=3,872,293).

Patient-, hospital-, and county-level variables	Transferred (n=444,549; 11.5 of Study Population), %	Admitted (n=3,427,744; 88.5 of Study Population), %	Percentage Transferred by Predictor Variable (n=3,872,293)
Patient-level characteristics			
Primary insurance status			
Medicare	41.1*	50.5*	10.2†
Medicaid	11.9	13.1	10.6
Uninsured/self-pay	16.9	8.7	20.3
Other	3.6	3.7	11.4
Private insurance	26.3	23.9	12.6
Age, y			
18–24	7.5	6.0	13.9
25–34	9.7	8.1	13.6
35–44	11.3	9.7	13.3
45–54	17.4	15.6	13.0
55–64	16.7	15.8	12.4
65–74	14.5	14.8	11.8
75–84	14.1	16.8	10.5
>85	8.8	13.2	8.6
Sex			
Female	49.2	44.1	10.8
Median household income for patient's zip code, %‡			
0–25	35.6	27.7	14.7
26–50	30.1	26.9	13.6
51–75	19.6	23.9	9.9
76–100	14.7	21.6	8.1
Hospital-level characteristics			
Hospital ownership type			
Not for profit	63.7	71.6	10.8
For profit	14.4	15.7	11.0
Public	21.9	12.7	18.4
Hospital region			
Midwest	28.0	20.6	16.3
South	44.3	41.1	11.9
West	16.2	18.3	11.2
Northeast	11.4	20.1	7.0
Trauma level			
Level I	7.3	20.0	4.6
Level II	4.2	15.5	3.7
Level III	5.6	5.1	13.7
Nontrauma	82.9	59.4	16.2
Teaching status			
Teaching hospital	18.4	45.7	4.9
Nonteaching hospital	81.6	54.3	17.6
Urban vs rural setting			
Urban hospital	60.8	91.3	7.9
Rural hospital	39.2	8.7	36.2
Bed size			
Small (0–99)	37.7	5.8	47.1
Medium (100–199)	24.3	17.7	15.3
Large (≥200)	38.1	76.5	6.0
County-level characteristics			
Racial demographics			
>2/3 county nonwhite	2.6	2.0	14.6
1/3–2/3 of county nonwhite	26.4	35.5	8.3
<1/3 county nonwhite	80.0	62.1	13.7

*These columns represent column percentages for each variable in the transfer or admission group; for example, the uninsured made up 16.9% of transferred patient encounters and 8.7% of admitted patient encounters.

†This column represents the percent of encounters with the variable of interest that were transferred in our study population; for example, 10.2% of encounters with Medicare were transferred, whereas 20.3% among those without insurance were transferred.

‡Approximately 3.2% of encounters in our study population (about 124,000 encounters) were missing values for patient zip code income quartile. Encounters missing these variables were not included in the study analysis.

Table 3. Percentage of ED encounters transferred by payer category across hospital groups categorized by percentage of privately insured ED patients transferred.

	Quartile, %			
Transferred, %	**1***	**2**	**3**	**4**
Private	1.1 (n=247,061)	3.2 (n=237,691)	10.3 (n=225,905)	36.9 (n=230,785)
Medicare	0.3 (n=468,186)	1.7 (n=441,134)	6.0 (n=490,599)	31.1 (n=497,835)
Medicaid	1.5 (n=138,017)	3.1 (n=137,652)	11.5 (n=124,030)	31.2 (n=107,208)
Uninsured/self-pay	3.5 (n=82,183)	7.0 (n=93,623)	25.4 (n=100,679)	42.8 (n=94,547)
Other payer	2.1 (n=39,335)	4.6 (n=42,065)	8.5 (n=31,680)	34.1 (n=32,958)

*For example, hospitals in the lowest quartile had the smallest percentage of privately insured ED patients transferred.

our results might have been different had we had access to physiologic information, laboratory test results, or radiology reports to better adjust for disease severity. Some variables included were aggregated and not available at the encounter level (zip income quartiles and county racial demographics), which can cause ecological bias. We were also unable to study other clinical factors that could contribute to transfer decisions, such as patient/family choice, bed availability, the availability of on-call specialists at the transferring hospital, the willingness of a transferee hospital to accept a case, distances between hospitals, or weather conditions. The presence of protocols in systems that are more or less regionalized may have also affected transfer decisions, which could not be assessed.

This study did not assess where patients were being transferred or what their posttransfer outcomes were. Because the NEDS is an encounter-level database, not a patient-level one, we could not assess transfer destination, only that the patient was transferred to another acute care hospital. The patient may have been transferred to a higher level of care or to a hospital with a specific diagnostic or therapeutic resource. Although we found that uninsured patients were significantly more likely to be transferred than privately insured patients, we cannot conclude that those transfers were more or less appropriate.

There were some encounters (approximately 3.2%, or 124,000 encounters) that were excluded from analysis because of missing variables. Most of these encounters were missing data for the patient's zip code income quartile, and about 0.2% were missing primary insurance type. There was no association between income quartile and odds of transfer, but it is possible that omitting the small number of encounters missing for these variables changed our results; however, there is no reason for any nondifferential bias among transfers versus admissions.

We compared encounters leading to transfer with those leading to admission, not an exact comparison. Some patients are transferred from one hospital to another only to be discharged on evaluation and treatment at the receiving hospital. In these cases, the transferred patients would be more appropriately compared with discharged patients. However, we assumed that in most cases, the decision to transfer indicated a need for a higher level of care. Therefore, we concluded that admitted patients would be the best comparison group. Another limitation of our study was that transferred patients who were subsequently discharged from the receiving ED are not included in the study.

We excluded some patients from our study. We chose to study only disease categories in which a high percentage of the encounters were transferred. We assumed that because most of these categories were high acuity, emergency diagnoses, clinical status and resource availability would be the primary drivers of transfers, and insurance status should play a lesser role. It is possible that insurance status has a different effect on the decision to transfer in other diagnostic categories. We also limited the study population to adult patients; predictors of transfer may be different among pediatric patients.

Finally, we analyzed odds of transfer according to CCS category and sorted CCS categories into groups according to specialist need. At times this was not a perfect fit; the categories for alteration in consciousness and facial fractures would likely require various specialists, depending on disease specifics and specialist privileges. Use of CCS categories may have missed some *ICD-9-CM* diagnoses with high frequencies of transfer (included in a different CCS category that overall had less than 5% of encounters transferred) and erroneously included others with low transfer frequencies.

DISCUSSION

Among high-transfer diagnoses in US EDs in 2010, we found significant patient- and hospital-level predictors of transfer compared with admission. Our results suggest that many factors may affect the decision to transfer a patient, including clinical need and hospital resource availability. The majority of diseases with the highest transfer frequencies are complex and high-acuity conditions, and many require specialized centers for definitive care. Many transfers likely result in better care by providing necessary treatment in the appropriate setting.

However, we also found that the financial circumstances of patients are associated with the decision to transfer a patient. In particular, being uninsured is associated with higher odds of transfer. These differences are present across various types of hospitals, including nonprofit ones that have special obligations under federal and state tax laws to furnish financial assistance to patients unable to pay for care, as well as to participate in Medicaid and other means-tested programs. In general,

Table 4. Odds of transfer compared with admission for the study population.

Study Population (n=3,747,187)	Odds of Transfer (95% CI)
Patient-level characteristics	
Primary insurance status	
Medicare	1.06 (0.97–1.17)
Medicaid	1.20 (1.04–1.38)
Uninsured/self-pay	2.12 (1.73–2.60)
Other	1.00 (0.84–1.18)
Private insurance	Reference
Age, y	
18–24	0.64 (0.54–0.75)
25–34	0.70 (0.60–0.82)
35–44	0.81 (0.70–0.92)
45–54	0.98 (0.87–1.12)
55–64	1.12 (1.01–1.24)
65–74	1.25 (1.17–1.34)
75–84	1.24 (1.18–1.31)
>85	Reference
Sex	
Female	0.91 (0.88–0.94)
Median household income for patient's zip code, %	
0–25	Reference
26–50	0.93 (0.82–1.06)
51–75	0.88 (0.76–1.01)
76–100	0.85 (0.67–1.09)
Hospital-level characteristics	
Hospital ownership type	
Not for profit	0.73 (0.53–1.01)
For profit	0.46 (0.32–0.65)
Public	Reference
Hospital region	
Midwest	1.86 (1.38–2.50)
South	1.62 (1.16–2.27)
West	1.24 (0.89–1.74)
Northeast	Reference
Trauma level	
Level I	0.67 (0.36–1.25)
Level II	0.43 (0.28–0.64)
Level III	0.75 (0.56–1.01)
Nontrauma	Reference
Teaching status	
Teaching hospital	0.54 (0.40–0.73)
Urban vs rural setting	
Urban hospital	0.56 (0.46–0.69)
Bed size	
Small (0–99)	5.61 (4.43–7.11)
Medium (100–199)	1.81 (1.44–2.28)
Large (≥200)	Reference
County-level characteristics	
Racial demographics	
>2/3 county nonwhite	2.06 (0.84–5.06)
1/3–2/3 of county nonwhite	1.06 (0.81–1.38)
<1/3 county nonwhite	Reference

uninsured and Medicaid patients had significantly higher odds of transfer than their privately insured counterparts with the same diseases. However, among conditions with various specialty needs, the effect of insurance was variable. In 9 of 12 groups, uninsured patients had significantly higher odds of transfer, which suggests that, depending on the health condition, being uninsured or publicly insured might make a difference in transfer versus admission decisions.

Insurance is likely one among multiple factors affecting the decision to transfer within each specialty category. For example, among encounters with renal emergencies (which includes stages I to V and therefore included not only Medicare patients), uninsured patients had odds of transfer 2.5 times greater than that of privately insured patients. Yet in other specialty categories, such as cardiology, the uninsured effect was more modest (1.3), and in 3 categories, not significant. Appendix E4 (available online at http://www.annemergmed.com) breaks down the disease categories by patient insurance type. Previous studies have shown that insurance status has a similarly mixed effect.[24,34] In our study, the specialist category with the most encounters (and with 6% to 12% of encounters resulting in transfer) was cardiology (Table 1). Regionalization around centers able to provide catheterizations for acute coronary syndromes has become increasingly common and may explain the high transfer frequency for these encounters.[7] Regionalization for stroke care has also become increasingly common.[35] The smaller effect of insurance status among cardiac and neurologic emergencies, and in the case of neurology nonsignificant, may be explained by regionalization protocols. Differential transfer frequencies for psychiatric emergencies may be partially explained by the presence of a few select hospitals in a region that accept inpatient psychiatric admissions. Finding an accepting hospital for uninsured patients needing inpatient psychiatric care is often especially challenging.[36]

Our results also suggest that the availability of on-call specialists is a potential contributor to the decision to transfer patients. Although we could not assess whether specialist consultation occurred or whether it was a predictor of transfer, the disease categories in our study suggest consultation was a necessary component in providing definitive care. The CCS categories with the highest percentages of encounters resulting in transfer often require specialty care, such as neurosurgeons, interventional cardiologists, and vascular surgeons. Several studies have found that specialty coverage is becoming more challenging for many EDs, thereby increasing rates of transfer.[2-4] Specialists are increasingly less willing to be on call because of higher malpractice risk, less desirable schedules, and lower reimbursement in emergency cases. There are also less restrictive requirements for being on call. Previous disease-specific studies have shown that transfers are more likely among uninsured patients, likely because of lower reimbursement to the specialist for these cases at the sending hospitals.[18-21] Hospitals in some cases are forced to pay more for specialist call coverage or are simply not offering certain specialist care.[37] Inadequate coverage in some areas may be exacerbated by the 2003 federal regulations that gave hospitals greater discretion to base coverage levels on financial resources.[38] Specialist distribution is uneven across medical centers, pointing to a need for a greater regionalization of care to integrate systems to match patient needs with available resources. Indeed, putting aside the possibility that economic profiling may continue to be a factor in explaining transfers, even

Table 5. Odds of transfer compared with admission and 95% CIs for adults by payer class with private insurance as the reference category (diagnostic categories with a high percentage of ED encounters resulting in transfer).

Disease Category*	Uninsured	Medicaid	Medicare	Other (95% CI)
Vascular emergencies	1.72 (1.27–2.32)	1.53 (1.02–2.28)	1.34 (1.03–1.74)	0.89 (0.55–1.43)
Cardiac emergencies	1.30 (1.07–1.59)	1.10 (0.97–1.26)	0.99 (0.87–1.12)	0.80 (0.61–1.06)
Neurologic emergencies	1.17 (0.98–1.40)	1.09 (0.84–1.43)	1.03 (0.90–1.19)	1.03 (0.76–1.40)
Neurosurgical emergencies	1.62 (1.37–1.92)	1.37 (1.14–1.65)	1.00 (0.89–1.13)	0.65 (0.54–0.78)
Alteration in consciousness	1.35 (0.91–2.02)	0.81 (0.51–1.30)	0.75 (0.48–1.16)	0.57 (0.34–0.98)
Orthopedic emergencies	1.21 (0.95–1.56)	1.15 (0.86–1.53)	0.97 (0.77–1.21)	0.76 (0.60–0.97)
Renal emergencies	2.44 (1.07–5.55)	1.60 (0.63–4.07)	1.86 (0.87–4.00)	1.26 (0.22–7.26)
Hematologic/oncologic emergencies	2.21 (1.50–3.25)	1.55 (1.05–2.30)	1.40 (1.03–1.91)	0.85 (0.52–1.39)
Psychiatric emergencies	2.26 (1.65–3.10)	1.04 (0.81–1.33)	0.80 (0.66–0.96)	1.00 (0.69–1.46)
Facial fractures	1.32 (1.04–1.67)	1.12 (0.82–1.54)	1.07 (0.70–1.62)	0.93 (0.61–1.40)
Surgical emergencies (nontraumatic)	1.42 (1.09–1.83)	1.61 (1.09–1.83)	2.40 (1.93–2.99)	1.54 (1.05–2.26)
Traumatic emergencies	1.54 (1.15–2.06)	1.27 (0.84–1.92)	0.60 (0.44–0.82)	0.92 (0.66–1.26)

*See Table 1 for individual diagnoses included in each category.

at nonprofit hospitals whose obligations run to all residents of their communities, it may be that with greater clinical integration and regionalization will come more, not fewer, clinically appropriate transfers. The challenge becomes how to ensure such transfers while guarding against transfers based on ability to pay.

The events leading to the passage of EMTALA provide context for understanding the results of our study. In 1985, news reports documented cases of critically ill patients being turned away by hospitals because they had no insurance, sometimes with deadly consequences.[39,40] These reports, as well as Congressional concerns over the problem of "sicker and quicker" discharges after introduction of the Medicare inpatient prospective payment system, led to enactment of EMTALA, which establishes a unique standard of health care access in medical emergency situations. EMTALA is intended to ensure that hospitals with emergency care capabilities screen and stabilize individuals who seek care for medical emergencies. For this reason, transfers of unstable patients, when they do occur, should be confined to cases in which medical justification and clinical safeguards are present.

Our results suggest that, more than 25 years after the enactment of EMTALA, being uninsured is still associated with increased odds of transfer across multiple disease categories. Our study does not support the conclusion that hospitals are violating EMTALA, but it does question whether the impetus for its passage (ie, barring emergency treatment decisions according to insurance status) still exists. Unless the transfer is medically justifiable and clinically appropriate, the differential transfer frequencies observed here may lead to disparities in care and health outcomes.

Our results raise many questions for future studies. We need to better understand transfer patterns and hospital characteristics of sending and receiving hospitals. More research is also needed on how transfers affect patient outcomes, specifically, whether the higher transfer rate of uninsured patients negatively affects their care. As regionalization of services increases, we need to understand how protocols affect transfer rates and whether they protect against differential transfer by insurance status. Finally, we need to study how transfer practices will be affected by changes in coverage and reimbursement that will occur through the Patient Protection and Affordable Care Act.[41]

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Author affiliations: From the Department of Emergency Medicine, George Washington University Hospital, Washington, DC (Kindermann); the Agency for Healthcare Research and Quality, Rockville, MD (Mutter); the Department of Health Policy, George Washington University School of Public Health and Health Services, Washington, DC (Cartwright-Smith, Rosenbaum); and the Departments of Health Policy and Emergency Medicine, George Washington University, Washington, DC (Pines).

Author contributions: DRK and RLM had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the results. DRK, RLM, and JMP were involved in the study concept and design and statistical analysis. DRK and RLM were involved in data acquisition. RLM provided administrative and technical support. All authors were involved in data analysis and interpretation. DRK was primarily involved in drafting the article and all authors took part in its critical revision. DRK takes responsibility for the paper as a whole.

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IMAGES IN EMERGENCY MEDICINE

(continued from p. 528)

DIAGNOSIS:

Gonococcal arthritis of the shoulder. Gonococcal arthritis should be considered in suspected septic joints, particularly in young sexually active patients. Other risk factors include female sex, intravenous drug use, HIV, complement deficiency, lupus, and low socioeconomic status.[1] Gram-negative cocci account for 20% of septic arthritis cases.[2]

Gonococcal arthritis results from hematogenous spread of *Neisseria gonorrhea*. This organism is difficult to culture, and analysis of the patient's blood, synovial fluid, genitourinary tract, pharynx, rectum, and skin lesions may aid in diagnosis.[1] Elevations in WBC count, erythrocyte sedimentation rate, and C-reactive protein raise suspicion; however, normal levels do not rule out the diagnosis. These tests are also useful in monitoring response to treatment.[2]

Aspirated fluid should be sent for cell count, Gram stain, and culture. Infected fluid may appear turbid. Gram stain result is positive in up to 25% of cases; culture, in up to 50%.[3] The leukocyte count in gonococcal infected synovial fluid is expected to be inflammatory, with cell counts ranging from 10,000 to 100,000 cells/mm^3.[1]

Septic arthritis of the shoulder is difficult to diagnose, particularly with reported musculoskeletal injury. Our patient had multiple signs and symptoms concerning for an infected joint, including fever, tachycardia, and history of intravenous drug use, but no palpable or visible shoulder effusion. As observed in this case, ultrasonography is useful in the identification of joint effusions in the emergency setting.[4] Additionally, ultrasonographic use has been shown to increase success of diagnostic synovial fluid aspiration and improve provider confidence with joint aspiration.[4,5]

Author affiliations: From Kaiser Permanente, San Francisco Medical Center, San Francisco, CA (Zaia); the University of California at San Francisco, San Francisco, CA (Zaia, Soskin); and the San Francisco General Hospital, San Francisco, CA (Soskin).

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Appendix E1. CCS categories with 5% or more ED encounters resulting in transfer, *ICD-9-CM* diagnoses included in the CCS category, specialty category that the CCS category was placed in, and explanation for cases in which *ICD-9-CM* categories from a certain CCS category were placed into a different specialty category or removed from analysis.

CCS Number and Category Name	*ICD-9-CM* Disease Codes Included	Specialty Category	Notes
115: Aneurysm (aortic, peripheral, visceral artery)	441 (Aortic aneurysm and dissection), 442 (other aneurysm), 443 (other peripheral vascular disease), 447 (other disorders of arteries and arterioles)	Vascular surgery	All *ICD-9-CM* diagnoses fall into vascular surgery specialty category Traumatic vascular injuries added to this category
116: Aortic or peripheral arterial embolism or thrombosis	444 (Arterial embolism and thrombosis—abdominal aorta, thoracic aorta, arteries of extremities, unspecified artery), and 445 (atheroembolism—extremities, other sites)		
100: Acute myocardial infarction	410 (Acute myocardial infarction, including of anterior, inferior, lateral wall and posterior wall and of other unspecified sites; subendocardial infarction)	Cardiology	No changes—all *ICD-9-CM* diagnoses fall into cardiology specialty category Different cardiology subspecialists may be required, such as interventional cardiology or electrophysiology
101: Coronary atherosclerosis and other heart disease	411 (Other acute and subacute forms of ischemic heart disease), 412 (old myocardial infarction), 413 (angina pectoris), 414 (other forms of chronic ischemic heart disease), V4581 (status post–aortocoronary bypass), and V4582 (status post–percutaneous transluminal coronary angioplasty)		
105: Conduction abnormalities	426 (Conduction disorders, including arteroiventricular block, bundle-branch blocks, other heart block, other conduction disorders); V450 (status post–cardiac device placement), and V533 (status post–adjustment of cardiac device)		
109: Acute cerebrovascular disease	346.6 (Persistent migraine with cerebral infarction), 430 (subarachnoid hemorrhage), 431 (intracerebral hemorrhage), 432 (other and unspecified intracranial hemorrhage), 433 (occlusion and stenosis of precerebral arteries), 434 (occlusion of cerebral arteries), 436 (acute, but ill-defined, cerebrovascular disease)	Neurology	430 (Subarachnoid hemorrhage), 431 (intracerebral hemorrhage), and 432 (other and unspecified intracranial hemorrhage) moved to neurosurgery specialty category
227: Spinal cord injury	349.39 (Dural tear), 806 (fracture of vertebral column with spinal cord injury), 907.2 (late effect of spinal cord injury), 952 (cervical cord injury without spinal bone injury)	Neurosurgery	No changes made; all *ICD-9-CM* diagnoses fall into neurosurgery specialty category
233: Intracranial injury	800 (Frontal bone or parietal bone skull fracture with or without hemorrhage or contusion), 801 (fracture of base of skull with or without hemorrhage or contusion), 803 (other skull fractures with or without hemorrhage, including multiple skull fractures), 804 (multiple fractures involving skull or face with other bones with or without hemorrhage), 850 (concussion), 851 (cerebral laceration and contusion), 852 (traumatic subarachnoid, subdural, and extradural hemorrhage), 853 (other traumatic intracranial hemorrhage), 854 (other intracranial injury, including brain NOS, cavernous sinus, intracranial, and traumatic brain NOS), 9070 (late effect of intracranial injury), and V1552 (history of traumatic brain injury)		Removed 850 (concussion) because this is rarely a neurosurgical emergency
228: Skull and face fractures	800 (Fractures of vault of skull), 801 (fracture of base of skull), 802 (fracture of facial bones, including nasal bones, mandible, malar and maxillary bones, and orbital floor), 803 (other skull fractures), 804 (multiple fractures of face and skull), and 9050 (late effect of facture of skull and face bones)		Removed 802 (fracture of facial bones, including nasal bones, mandible, malar and maxillary bones, and orbital floor) because these diagnoses would more likely be treated by otolaryngologists, plastic surgeons, oral/maxillofacial surgeons, or ophthalmologists—placed in OMFS/plastics/ENT category
231: Other fractures	805 (Fractures of vertebral column with or without spinal cord injury), 807 (fractures of ribs, sternum, larynx, and trachea), 808 (fractures of pelvis), 809 (fractures of bones of trunk not including skull and face), 828 (multiple fractures involving limbs), 829 (fractures of unspecified bones), 9051 (late effect of spine or trunk fracture), 9055 (late effect of other fracture), V540 (orthopedic aftercare), V664 (palliative care after fracture care) V674 (follow-up of healing fracture)		Only included 805 (fractures of vertebral column with or without spinal cord injury) in neurosurgical category 828 (Multiple fractures involving limbs), 808 (fractures of pelvis), V540 (orthopedic aftercare), and V674 (follow-up of healing fracture) moved into orthopedic specialty category

Appendix E1. Continued.

CCS Number and Category Name	*ICD-9-CM* Disease Codes Included	Specialty Category	Notes
85: Coma, stupor, and brain damage	3481 (Anoxic brain damage), 7800 (alteration of consciousness, including coma, persistent vegetative state, semicoma, stupor, and unconsciousness)	Coma, stupor, and brain damage	These were kept as a separate specialty category because the included diseases may be a result of multiple different disease processes and would likely involve various specialists according to the specific case
226: Femoral neck fracture	820 (Fracture of neck of femur), 9053 (late effect of femur neck fracture), V5413 (aftercare of femur neck fracture), V5423 (aftercare of pathologic fracture of femur neck)	Orthopedics	All *ICD-9-CM* diagnoses fall into orthopedic specialty category Some *ICD-9-CM* diagnoses added from "other fracture" category and "crush injury" category
158: Chronic renal failure	585 (Chronic kidney disease stages I–V), 792.5 (cloudy dialysis effluent), V420 (status post–kidney transplant), V451 (dialysis status), V56 (dialysis care)	Nephrology	No changes made; all *ICD-9-CM* diagnoses fall into renal specialty category
44: Neoplasm of unspecified nature	235 (Neoplasm of uncertain behavior of digestive and respiratory system), 236 (neoplasm of unspecified behavior of genitourinary organs), 237 (neoplasms of uncertain behavior of endocrine glands and nervous system), 238 (neoplasm of uncertain behavior of other tissues and unspecified sites and tissues), 239 (neoplasms of unspecified nature)	Hematology/ oncology	No changes made; all *ICD-9-CM* diagnoses fall into hematology/oncology specialty category
64: Other hematologic condition	289 (Disease of blood and blood-forming organs), 7900 (abnormality of red blood cells), V123 (history of disease of blood and blood-forming organs, including polycythemia, hypercoagulable states, hypersplenism, blood dyscrasias, and anemia), V582 (blood transfusion)		
63: Disorders of WBCs	288 (Diseases of WBCs, including neutropenia, functional disorders of polymorphonuclear cells, genetic anomalies of leukocytes, eosinophilia, hemophagocytic syndromes, decreased WBC counts, elevated WBC counts), 289.53 (neutropenic splenomegaly)		
43: Malignant neoplasm	199 (Malignant neoplasm, including disseminated, unspecified site, or associated with transplanted organ), 209 (including malignant neuroendocrine tumors)		
662: Suicide or intentional self-injury	95.0-95.9 (Suicide and self-inflicted injury by various means), V6284 (suicidal ideation)	Psychiatry	No changes made; all *ICD-9-CM* diagnoses fall into psychiatry specialty category
659: Schizophrenia/other psychosis	293.82-293.83 (Psychotic disorder with delusions or hallucinations), 295 (schizophrenic disorders), 297 (biploar with mania), and 298 (other nonorganic psychoses)		
241: Poisoning by psychotropic agents	969.0-969.9 (Poisoning by antidepressants, phenothiazine-based tranquilizers, butyrophenone-based tranquilizers, other antipsychotics, benzodiazepines, other tranquilizers, psychostimulants, central nervous system stimulants		
658: Personality disorder	301 (Personality disorders, including paranoid, affective, schizoid, obsessive/compulsive, explosive, histrionic, dependent, antisocial, other, and unspecified)		
657: Mood disorder	293.83 (Mood disorder in conditions classified elsewhere), 296 (episodic mood disorder), 300.4 (dysthymic disorder), and 311 (depressive disorder NEC)		
148: Peritonitis/ intestinal abscess	032.83 (Diphtheritic peritonitis), 567.0 (peritonitis in infectious diseases), 567.1 (pneumococcal peritonitis), 567.2 (other suppurative peritonitis, including peritoneal abscess and spontaneous peritoneal peritonitis), 567.3 (retroperitoneal abscess), 567.8 (unspecified peritonitis), 569.5 (intestinal abscess)	General surgery	Some of these processes would likely be managed both medically (by antibiotics) and surgically (by percutaneous drainage or surgical drainage) We removed 032.83, 567.0, 567.1, and 567.23 (spontaneous bacterial peritonitis) because these would most likely be managed medically
142: Appendicitis	540 (Acute appendicitis), 541 (unqualified appendicitis), 542 (other appendicitis), 543.0 (lymphoid hyperplasia of appendix), 543.9 (other diseases of appendix, including diverticulum, fistula, fecalith, and intussusception)		No changes made; all *ICD-9-CM* diagnoses fall into surgical specialty category

Appendix E1. Continued.

CCS Number and Category Name	*ICD-9-CM* Disease Codes Included	Specialty Category	Notes
145: Intestinal obstruction	560.0 (Intussusception), 560.1 (paralytic ileus), 560.2 (volvulus), 560.30 (impaction of intestine), 560.31 (gallstone ileus), 560.39 (other impaction of intestine), 560.8 (intestinal or peritoneal adhesions with obstruction), 560.9 (unspecified intestinal obstruction)	General surgery	We removed 560.30 (impaction of intestine) because this would likely involve nonsurgical management
234: Crush injury	860 (Traumatic pneumothorax and hemothorax), 861 (injury to heart and lung, including contusion and laceration), 862 (injury to other intrathoracic organs, including diaphragm, bronchus, and esophagus), 863 (injury to gastrointestinal tract), 864 (injury to liver), 865 (injury to spleen), 866 (injury to kidney), 867 (injury to pelvic organs), 868 (injury to other intra-abdominal organs), 869 (internal injury to unspecified or ill-defined organs), 900 (injury to blood vessels of head and neck), 901 (injury to blood vessels of thorax), 902 (injury to blood vessels of abdomen and pelvis), 903 (injury to blood vessels of upper extremity), 904 (injury to blood vessels of lower extremity), 9064 (late effect of crush injury), 908 (late effect of other internal injuries) 925 (crush injury of face, scalp, and neck, including cheek, ears, larynx, pharynx, and throat), 926 (crush injury to trunk), 927 (crush injury of upper limb), 928 (crush injury of lower limb), 929 (crush injury of multiple sites)	Trauma surgery	900, 901, 902, 903 and 904 were moved to vascular surgery category because they involved traumatic vascular injuries 925 was moved to OMFS/plastics/ENT category because it involved traumatic injuries to face and neck 927 and 928 were moved into orthopedic injuries because they involved traumatic injuries to upper and lower limbs

Appendix E2. Description of NEDS variables: payer status, household income, hospital teaching status, trauma level, and ownership.

Insurance Categories

Primary insurance in the NEDS combines detailed categories into more general groups. We included only the primary listed insurance type because the variables that include patients' additional insurance categories are missing or invalid in 78% of records in the 2010 NEDS. In the NEDS, Medicare includes both fee-for-service and managed care Medicare patients and Medicaid includes fee-for-service and managed care Medicaid patients. Private insurance includes Blue Cross, commercial carriers, and private HMOs and PPOs. Other includes worker's compensation, CHAMPUS, CHAMPVA, Title V, and other government programs.

Household Income

The quartiles are derived from zip code demographic data obtained from Claritas and are updated yearly. In 2010, the lowest quartile made was than $40,999, the second quartile was $41,000 to $50,999, the third from $51,000 to $66,999, and the fourth was greater than $67,000. NEDS description of data elements: median household income for patient's zip code. http://www.hcup-us.ahrq.gov/db/vars/zipinc_qrtl/nedsnote.jsp.

Hospital Teaching Status

A teaching facility was defined as having an approved American Medical Association–accredited graduate medical education program, being a member of the Council of Teaching Hospitals, or having a ratio of full-time-equivalent interns and residents to beds of 0.25 or higher.

Hospital Trauma Level

The trauma level is based on information from the Trauma Information Exchange Program database (TIEP), a national inventory of trauma centers in the United States. Information is collected by the American Trauma Society and the Johns Hopkins Center for Injury Research and Policy and funded by the Centers for Disease Control and Prevention. The TIEP database identified all US hospitals that are identified as trauma centers by a state or regional authority or verified by the American College of Surgeons' Committee on Trauma.

Hospital Ownership

The hospital's ownership/control category was obtained from the AHA annual survey and includes categories for government nonfederal (public), private not for profit (voluntary), and private investor owned (proprietary).

Appendix E3. SAS and Stata commands used for regression analysis.

We present an overview of the steps performed in our analysis, followed by actual sample commands used in each step. We first created an analytic file by merging the 2010 NEDS, AHA survey, and Area Resource File at the hospital and county level. We then selected the variables of interest. This included patient variables (demographic variables, payer status, and ED disposition, specifically, transfer versus direct admission) and hospital information (trauma level, teaching status, etc) from the NEDS, hospital bed size from the AHA survey, and county-level socioeconomic data from the Area Resource File.

We then identified our study population, which was based on both diagnoses we selected and disposition status from the ED. We chose to narrow our focus to encounters with diagnoses that had a high frequency of transfer among the adult population and compare encounters that resulted in admission versus those that resulted in transfer for these diagnoses. We grouped these high-transfer diagnoses into 12 clinically meaningful categories based on the expected type of specialist who would be needed for their care. These 12 specialist categories formed the basis of our analysis.

We performed descriptive statistics of the study population as a whole, as well as within each specialty category. Finally, we performed adjusted regression analyses to identify which variables were associated with odds of transfer compared with admission. This was done for the study population as a whole, as well as for each specialty category.

1. Merged 2010 AHA, Area Resource File, and NEDS to create analytic file in SAS

2. Sorted CCS categories by transfer rate (transfer rate ranged from 0% to 21%)

```
data denom;
set neds10.neds_2010_core;
keep key_ed disp_ed dxccs1 discwt;
proc freq;
weight discwt;
tables dxccs1/out = freq_den noprint;
run;
data num;
set denom;
if disp_ed = 2;
proc freq;
weight discwt;
tables dxccs1/out = freq_num noprint;
run;
data ccs_den;
set freq_den;
if PERCENT ne .;
denom = COUNT;
proc sort;
by DXCCS1;
run;
data ccs_num;
set freq_num;
if PERCENT ne .;
num = COUNT;
drop PERCENT COUNT;
proc sort;
by dxccs1;
run;
data neds10.trans_rates;
merge ccs_den ccs_num;
by dxccs1;
ratio = (num/denom)*100;
diag = put(DXCCS1, dxccs.);
proc sort;
by ratio;
run;
```

Inclusion criteria: all CCS categories with 5% or more ED encounters resulting in transfer among adult population (n=27 CCS categories)

3. Converted file to Stata file with StatTransfer

4. Created categories for age, bed size of hospital, and percentage of county nonwhite

```
gen age0=0
replace age=1 if age<1
gen age1=0
replace age1=1 if age>/=1 & age<18
…
gen bed_small=0
replace bed_small=1 if b001<100
…
gen pop_white_0=0
replace pop_white_0=1 if F0453710>=0.667
```

(where F0453710 = % county population that is non-white from area resource file)

5. Created 12 specialty categories based on *ICD-9-CM* diagnoses included in 27 CCS categories with transfer frequencies greater than or equal to 5% (see Appendix E2)

For straightforward categories in which no changes were made according to *ICD-9-CM* codes and inclusion criteria were based on primary CCS category (cardiology, coma/stupor, chronic renal failure, psychiatry, and hematology-oncology) where disp_ed==2 indicates "transfer to another short-term hospital," disp_ed==9 indicates "admitted as an inpatient to this hospital," and dxccs1 indicates primary CCS category

```
Gen insample_1=0
Replace insample_1=1 if (disp_ed==2 | disp_ed==9) & (dxccs1== 100 | dxccs1==102 | dxccs1==105 | dxccs1==109) & age>17
Label variable in_sample_1 "Cardiac"
Gen insample_2=0
Replace insample_2=1 if (disp_ed==2 | disp_ed==9) & (dxccs1== 85) & age>17
Label variable in_sample_1 "Coma"
Gen insample_3=0
Replace insample_3=1 if (disp_ed==2 | disp_ed==9) & (dxccs1==158) & age>17
Label variable in_sample_3 "Chronic renal failure"
Gen insample_4=0
```

Replace insample_4=1 if (disp_ed==2 | disp_ed==9) & (dxccs1==662 | dxccs1==659 | dxccs1==241 | dxccs1==658 | dxccs1==657) & age>17

Label variable in_sample_4 "Psychiatry"

Gen insample_5=0

Replace insample_5=1 if (disp_ed==2 | disp_ed==9) & (dxccs1==43 | dxccs1==44 | dxccs1==63| dxccs1==64) & age>17

Label variable insample_5 "HematologyOncology"

For categories where *ICD-9-CM* codes were added from other categories (as was the case for orthopedics, vascular surgery, and joint OMFS/plastics/ENT surgery category), where dx1= primary *ICD-9-CM* code:

Gen insample_6=0

Gen vasctrauma=0

Replace vasctrauma=1 if (dx1=="90000" | dx1=="90001" | dx1=="90002" | dx1== "90003" | dx1== "9001" | dx1== "90081" | dx1== "90082" | dx1== "90089" | dx1== "9009" | dx1== "9010" | dx1== "9011" | dx1== "9012" | dx1== "9013" | dx1== "90140" | dx1== "90141" | dx1== "90142" | dx1== "90181" | dx1== "90182" | dx1== "90183" | dx1== "90189" | dx1== "9019" | dx1== "9020" | dx1== "90210" | dx1== "90211" | dx1== "90219" | dx1== "90220" | dx1== "90221" | dx1== "90222" | dx1== "90223" | dx1== "90224" | dx1== "90225" | dx1== "90226" | dx1== "90227" | dx1== "90229" | dx1== "90231" | dx1== "90232" | dx1== "90233" | dx1== "90234" | dx1== "90239" | dx1== 90240" | dx1== "90241" | dx1== "90242" | dx1== "90249" | dx1== "| dx1== "0250" | dx1== "90251" | dx1== "90252" | dx1== "90253" | dx1== 90254" | dx1== "90255" | dx1== "90256" | dx1== 90259" | dx1== "90281" | dx1=="90287" | dx1== "90289" | dx1== "9029" | dx1== "90300" |dx1== "90301" | dx1== "90302" | dx1== 9031" dx1== "9032" | dx1== "9033" | dx1== "9034" | dx1== "9035" | dx1== "9038" | dx1== "9039" | dx1== "9040" | dx1== "9041" | dx1== "9042" | dx1== "9043" | dx1== "90440" | dx1== "90441" | dx1== "90442" | dx1== "90450" | dx1== "90451" | dx1== "90452" | dx1== "90453" | dx1== "9045" | dx1== "9046" | dx1== "9047" | dx1== "9048" "| dx1== "9049")

Replace insample_6=1 if (disp_ed==2 | disp_ed==9) & (dxccs1== 115 | dxccs1==116 | vasctrauma==1) & age>17

Label variable insample_6 "Vascular surgery"

Gen insample_7=0

Gen orthotraum=0

Replace orthotraum=1 if (dx1=="92700" | dx1== "92701" | dx1== "92702" | dx1=="92703" | dx1== "92709" | dx1== "92711" | dx1 == "92720" | dx1 == "92721" | dx1== "9273" | dx1== "9278" | dx1 == "9279" | dx1== "92800" | dx1 == "92801" | dx1 == "92810" | dx1 == "92811" | dx1 == "92820" | dx1 == "92821" | dx1 == "92820" | dx1 == "92821" | dx1== "9283" | dx1== "9288" | dx1== "0289"

Gen ortho=0

Replace ortho=1 if (dx1== "8080" | dx1 == "8081" | dx1 == "8082" | dx1== "8083" | dx1== "80841" | dx1== "80842" | dx1== "80843" | dx1== "80844" | dx1== "80849" | dx1== "80851" | dx1== "80852" | dx1== "80853" | dx1== "80854" | dx1== "80859" | dx1== "8088 8089" | dx1== "8280" | dx1== "8281" | dx1== "8290" | dx1== "8291" | dx1== "9055" | dx1== "V540" | dx1== "V5401" | dx1== "V5402" | dx1== "V5409" | dx1== "V5419" | dx1== "V5427" | dx1== "V5429" | dx1== "V664" | dx1== "V674"

Replace insample_7=1 if (disp_ed==2 | disp_ed==9) & (orthotraum==1 | ortho==1 | dxccs1==226) & age>17

Label variable insample_7 "Orthopedics"

Gen insample_8=0

Gen omfs=0

Replace omfs=1 if ((dx1== "8020" | dx1== "8021" | dx1== "80220" | dx1== "80221" | dx1== "80222" | dx1== "80223" | dx1== "80224" | dx1== "80225" | dx1== "80226" | dx1== "80227" | dx1== "80228" | dx1== "80229" | dx1== "80230" | dx1== "80231" | dx1== "80232" | dx1== "80233" | dx1== "80234" | dx1== "80235" | dx1== "80236" | dx1== "80237" | dx1== "80238" | dx1== "80239" | dx1== "8024" | dx1== "8025" | dx1== "8026" | dx1== "8027" | dx1== "8028" | dx1== "8029"

Gen facefx=0

Replace facefx=1 if (dx1=="925" | dx1== "9251" | dx1== "9252")

Replace insample_8=1 if (disp_ed==2 | disp_ed==9) & (omfs==1 | facefx==1) & age>17

Label variable insample_8 "OMFSandENT"

For categories in which *ICD-9-CM* codes were removed from the study population or put into a different specialty category (neurology, neurosurgery, general surgery and trauma surgery)

Gen insample_9=0

Gen cva=0

Replace cva=1 if (dxccs1==109) and (dx1!="430" | dx1!= "431" | dx1!="432")

Replace insample_9=1 if (disp_ed==2 | disp_ed==9) & (cva==1) & age>17

Label variable insample_9 "Neurology"

Gen insample_10=0

Gen skullfx=0

Replace skullfx=1 if (dx1=="80000" | dx11== "80001" | dx11== "80002" | dx11== "80003" | dx11== "80004" | dx11== "80005" | dx11== "80006" | dx11== "80009" | dx11== "80050" | dx11== "80051" | dx11== "80052" | dx11== "80053" | dx11== "80054" | dx11== "80055" | dx11== "80056" | dx11== "80059" | dx11== "80100" | dx11== "80101" | dx11== "80102" | dx11== "80103" | dx11== "80104" | dx11== "80105" | dx11== "80106" | dx11== "80109" | dx11== "80150" | dx11== "80151" | dx11== "80152" | dx11== "80153" | dx11== "80154" | dx11== "80155" | dx11== "80156" | dx11== "80159" | dx11== "80300" | dx11== "80301" | dx11== "80302" | dx11== "80303" | dx11== "80304" | dx11== "80305" | dx11== "80306" | dx11== "80309" | dx11== "80350" |

dx11== “80351” | dx11== “80352” | dx11== “80353” | dx11== “80354” | dx11== “80355” | dx11== “80356” | dx11== “80359”

Gen cervicalfx=0

Replace cervicalfx=1 if dx1==“80500” | dx11== “80501” | dx11== “80502” | dx11== “80503” | dx11== “80504” | dx11== “80505” | dx11== “80506” | dx11== “80507” | dx11== “80508” | dx11== “80510” | dx11== “80511” | dx11== “80512” | dx11== “80513” | dx11== “80514” | dx11== “80515” | dx11== “80516” | dx11== “80517” | dx11== “80518” | dx11== “8052” | dx11== “8053” | dx11== “8054” | dx11== “8055” | dx11== “8056” | dx11== “8057” | dx11== “8058” | dx11== “8059”

Gen headvasc=0

Replace headvasc=1 if (dx1==“430” | dx1== “431” | dx1== “4320” | dx1 == “4321” | dx1 == “4329”)

Gen noconcussion=0

Replace nococussion=1 if dx1==233 & (dx1!=“8500” | dx1!=“8501” | dx1!=“85011” | dx1!=“85012” | dx1!= “8502” | dx1!=“8503” | dx1 != “8504” | dx1!= “8505” | dx1!=“8509”)

Replace in_sample_10=1 if (disp_ed==2 | disp_ed==9) & (dxccs1==227 | skullfx==1 | cervicalfx==1| | headvasc==1 | noconcussion==1) & age>17

Label variable in_sample_10 “Neurosurgical”

Gen insample_11=0

Gen abscess=0

Replace abscess=1 if (dxccs1==148) & (dx1!=“03283 | dx1!= “5670” | dx1!=“5671” | dx1!=56723”)

Gen obstr=0

Replace obstr=1 if (dxccs1==145) & (dx1!=56030”)

Replace insample_11=1 if (disp_ed==2 | disp_ed==9) & (abscess==1 | obstr==1 | dxccs1==142) & age>17

Label variable insample_11 “General surgery”

Gen insample_12=0

Gen traumgen=0

Replace traumgen=1 if (dxccs1==234) & (vasctraum!=1) & (orthotraum!=1) & (facefx!=1)

Replace insample_12=1 if (disp_ed==2 | disp_ed==9) & (traumgen==1) & age>17

Label variable insample_12 “Trauma surgery”

6. Created variable for study population (called “studypop”), which was created by joining 12 specialty categories

Gen studypop=0

Replace studypop=1 if (insample_1==1 | insample_2==1 | insample_3==1 | insample_4==1 |==1 | insample_5==1 | insample_6==1 | insample_7==1 | insample_8==1 | insample_9==1 | insample_10==1 | insample_11==1 | insample_12)

7. Ran logistic regression analysis to estimate odds of transfer compared with admission on entire study population, using survey weights to approximate US estimates and Elixhauser comorbidity software to control for 29 comorbidities

svy, subpop (studypop): logistic transfer age2 age3 age4 age5 age6 age7 age8 female medicare Medicaid uninsured other traumaone traumatwo traumathree i_hosp_control_orig i.hosp.region hosp_teach hosp_location bed_small bed_medium i-zipinc_qrtl pop_white_0 pop_white_1 pop_white_2 chf valve pulmcirc perivasc para neuro chrnlung dm dmcx hypoth renlfail liver ulcer aids lymph mets tumor arth coag obese wghtloss lytes bldloss anemdef alcohol drug psych depress htn_c

Results listed in Table 4 of the article.

8. Ran same regression analysis on each specialty category subpopulation

svy, subpop (insample_1): logistic transfer age2 age3 age4 age5 age6 age7 age8 female medicare Medicaid uninsured other traumaone traumatwo traumathree i_hosp_control_orig i.hosp.region hosp_teach hosp_location bed_small bed_medium i-zipinc_qrtl pop_white_0 pop_white_1 pop_white_2 chf valve pulmcirc perivasc para neuro chrnlung dm dmcx hypoth renlfail liver ulcer aids lymph mets tumor arth coag obese wghtloss lytes bldloss anemdef alcohol drug psych depress htn_c

ORs for insurance status for each specialty category listed in Table 5 of the article.

Appendix E4. Insurance status by disease category among encounters included in the study.

Disease Category	Insurance Type, %				
	Medicare	Medicaid	Private	Uninsured	Other
Vascular surgery	56.5	9.4	22.3	8.3	3.4
Cardiology	56.5	7.6	25.6	7.3	2.9
Neurology	65.8	7.3	18.8	6.1	2.2
Neurosurgery	49.0	8.9	26.7	10.1	5.2
Alteration in consciousness	62.0	11.9	16.4	6.8	3.0
Orthopedics	79.7	3.1	11.7	2.6	2.9
Nephrology	44.1	16.1	6.6	32.1	1.2
Hematology/oncology	52.9	11.6	28.1	4.8	2.6
Psychiatry	31.1	28.9	20.7	14.9	4.4
Facial fractures	22.1	15.5	24.7	26.0	11.6
General surgery	19.6	14.0	36.6	19.4	9.5
Trauma surgery	20.9	25.6	30.8	18.1	4.6