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ORIGINAL RESEARCH

Interhospital Transfer Patients Discharged by Academic Hospitalists and General Internists: Characteristics and Outcomes

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BACKGROUND: Prior work suggests interhospital transfer (IHT) may be a risky event. Outcomes for patients transferred from another acute care institution and discharged by hospitalists and general internists at academic health systems are not well described.

OBJECTIVE: Investigate the characteristics and outcomes of IHT patients compared with patients admitted from the emergency department (ED) to academic health systems.

DESIGN: Retrospective cohort study.

SETTING/PATIENTS: A total of 885,392 adult inpatients discharged by hospitalists or general internal medicine physicians from 158 academic medical centers and affiliated hospitals participating in the University HealthSystem Consortium Clinical Database and Resource Manager from April 1, 2011 to March 31, 2012.

METHODS: Patient cohorts were defined by admission source: those from another acute care institution were IHTs, and those coming through the ED whose source of origination was not another hospital or ambulatory surgery site were ED admissions. In-hospital mortality was our primary outcome. We analyzed our data using descriptive statistics, *t* tests, χ^2 tests, and logistic regression.

RESULTS: Compared with ED admissions, IHT patients had a longer average length of stay, higher proportion of time spent in the intensive care unit, higher costs per hospital day, lower frequency of discharges home, and higher inpatient mortality (4.1% vs 1.8%, $P < 0.01$). After adjusting for patient characteristics and risk of mortality measures, IHT patients had a higher risk of in-hospital death (odds ratio: 1.36, 95% confidence interval: 1.29–1.43).

CONCLUSIONS: In this large national sample, IHT status is independently associated with inpatient mortality. *Journal of Hospital Medicine* 2016;11:245–250. © 2015 Society of Hospital Medicine

Interhospital transfers (IHTs) to academic medical centers (AMCs) or their affiliated hospitals may benefit patients who require unique specialty and procedural services. However, IHTs also introduce a potentially risky transition of care for patients suffering from complex or unstable medical problems.[1] Components of this risk include the dangers associated with transportation and the disrupted continuity of care that may lead to delays or errors in care.[2,3] Furthermore, referring and accepting providers may face barriers to optimal handoffs including a lack of shared communication standards and difficulty accessing external medical records.[3–5] Although some authors have recommended the creation of formal guidelines for interhospital transfer processes for all patients to mitigate the risks of transfer, the available guidelines governing the IHT triage and communication process are limited to critically ill patients.[6]

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A recent study of a diverse patient and hospital dataset demonstrated that interhospital transfer patients have a higher risk of mortality, increased length of stay (LOS), and increased risk of adverse events as compared with non-transfer patients.[7] However, it is unknown if these findings persist in the population of patients transferred specifically to AMCs or their affiliated hospitals (the combination is hereafter referred to as academic health systems [AHSs]). AMCs provide a disproportionate share of IHT care for complex patients and have a vested interest in improving the outcomes of these transitions.[8] Prior single-center studies of acute care adult medical patients accepted to AMCs have shown that IHT is associated with a longer LOS, increased in-hospital mortality, and higher resource use.[9,10] However, it is difficult to generalize from single-center studies due to the variation in referral practices, geography, and network characteristics. Additionally, AMC referral systems, patient mix, and utilization of hospitalists have likely changed substantially in the nearly 2 decades since those reports were published.

Hospitalists and general internists often manage the transfer acceptance processes for internal medicine services at receiving hospitals, helping to triage and coordinate care for IHT patients. As a result, it is important for hospitalists to understand the characteristics and outcomes of the IHT population. In addition to informing the decision making around transfer for a given patient, such an understanding is the foundation for helping providers and institutions begin to systematically identify and mitigate peritransfer risks.

We conducted this large multicenter study to describe the characteristics and outcomes of a current, nationally representative IHT patient population discharged by hospitalists and general internists at AHSs. To identify unique features of the IHT population, we compared patients transferred from another hospital to an AHS to those admitted to the AHS directly from the AHS's emergency department (ED). Based on our anecdotal experiences and the prior single-center study findings in adult medical populations,[9,10] we hypothesized that the IHT population would be sicker, stay in the hospital and intensive care unit (ICU) longer, and have higher costs and in-hospital mortality than ED patients. Although there may be fundamental differences between the 2 groups related to disease and patient condition, we hypothesized that outcome differences would persist even after adjusting for patient factors such as demographics, disease-specific risk of mortality, and ICU utilization.

PATIENTS AND METHODS

We conducted a retrospective cohort study using data from the University HealthSystem Consortium (UHC) Clinical Database and Resource Manager (CDB/RM). UHC is an alliance of 120 academic medical centers and 300 of their affiliated hospitals for the purposes of collaboration on performance improvement. Each year, a subset of participating hospitals submits data on all of their inpatient discharges to the CDB/RM, which totals approximately 5 million records. The CDB/RM includes information from billing forms including demographics, diagnoses, and procedures as captured by International Classification of Diseases, Ninth Revision (ICD-9) codes, discharge disposition, and line item charge detail for the type of bed (eg, floor, ICU). Most hospitals also provide detailed charge information including pharmacy, imaging, blood products, lab tests, and supplies. Some hospitals do not provide any charge data. The Beth Israel Deaconess Medical Center and University of Washington institutional review boards reviewed and approved the conduct of this study.

We included all inpatients discharged by hospitalists or general internal medicine physicians from UHC hospitals between April 1, 2011 and March 31, 2012. We excluded minors, pregnant patients, and prisoners. One hundred fifty-eight adult academic medical centers and affiliated hospitals submitted data throughout this time period. Our primary independent variable, IHT status, was defined by patients whose admission source was another acute care institution. ED admissions were defined as patients admitted from the AHS ED whose source of origination was not another hospital or ambulatory surgery site.

Admission Characteristics

Admission characteristics of interest included age, gender, insurance status, the most common diagnoses in each cohort based on Medicare Severity Diagnosis-Related Group (MS-DRG), the most common Agency for Healthcare Research and Quality (AHRQ) comorbitidies,[11] the most common procedures, and the admission 3M All-Patient Refined Diagnosis-Related Group (APR-DRG) risk of mortality (ROM) scores. 3M APR-DRG ROM scores are proprietary categorical measures specific to the base APR-DRG to which a patient is assigned, which are calculated using data available at the time of admission, including comorbid condition diagnosis codes, age, procedure codes, and principal diagnosis codes. A patient can fall into 1 of 4 categories with this score: minor, moderate, major, or extreme.[12]

Outcomes

Our primary outcome of interest was in-hospital mortality. Secondary outcomes included LOS, the cost of care, ICU utilization, and discharge destination. The cost of care is a standardized estimate of the direct costs based on an adjustment of the charges submitted by CDB/RM participants. If an IHT is triaged through a receiving hospital's ED, the cost of care reflects those charges as well as the inpatient charges.

Statistical Analysis

We used descriptive statistics to characterize the IHT and ED patient populations. For bivariate comparisons of continuous variables, 2-sample t tests with unequal variance were used. For categorical variables, χ^2 analysis was performed. We assessed the impact of IHT status on in-hospital mortality using logistic regression to estimate unadjusted and adjusted relative risks, 95% confidence intervals (CIs), and P values. We included age, gender, insurance status, race, timing of ICU utilization, and 3M APR-DRG ROM scores as independent variables. Prior studies have used this type of risk-adjustment methodology with 3M APR-DRG ROM scores,[13–15] including with interhospital transfer patients.[16] For all comparisons, a P value of <0.05 was considered statistically significant. Our sample size was determined by the data available for the 1-year period.

Subgroup Analyses

We performed a stratified analysis based on the timing of ICU transfer to allow for additional comparisons of mortality within more homogeneous patient groups, and to control for the possibility that delays in ICU transfer could explain the association between IHT and in-hospital mortality. We determined whether and when a patient spent time in the ICU based on daily accommodation charges. If a patient was charged for

TABLE 1. Characteristics of 885,392 Patients Discharged by Academic General Internists or Hospitalists by Source of Admission*

	ED			IHT		
Demographic/Clinical Variables	1st	2nd		3rd	4th	Rank
No. of patients	809,868	91.5[†]		75,524	8.5†	
Age, y	62.2 ± 19.1			60.2 ± 18.2		
Male	381,563	47.1		38,850	51.4	
Female	428,303	52.9		36,672	48.6	
Race						
White	492,894	60.9		54,780	72.5	
Black	205,309	25.4		9,968	13.2	
Other	66,709	8.1		7,777	10.3	
Hispanic	44,956	5.6		2,999	4.0	
Primary payer						
Commercial	154,826	19.1		17,130	22.7	
Medicaid	193,585	23.9		15,924	21.1	
Medicare	445,227	55.0		39,301	52.0	
Other	16,230	2.0		3,169	4.2	
Most common MS-DRGs (top 5 for each group)						
Esophagitis, gastroenteritis, and miscellaneous digest disorders without MCC	34,116	4.2	1st	1,517	2.1	2nd
Septicemia or severe sepsis without MV 96+ hours with MCC	25,710	3.2	2nd	2,625	3.7	1st
Cellulitis without MCC	21,686	2.7	3rd	871	1.2	8th
Kidney and urinary tract infections without MCC	19,937	2.5	4th	631	0.9	21st
Chest pain	18,056	2.2	5th	495	0.7	34th
Renal failure with CC	15,478	1.9	9th	1,018	1.4	5th
GI hemorrhage with CC	12,855	1.6	12th	1,234	1.7	3rd
Respiratory system diagnosis w ventilator support	4,773	0.6	47th	1,118	1.6	4th
AHRQ comorbidities (top 5 for each group)						
Hypertension	468,026	17.8	1st	39,340	16.4	1st
Fluid and electrolyte disorders	251,339	9.5	2nd	19,825	8.3	2nd
Deficiency anemia	208,722	7.9	3rd	19,663	8.2	3rd
Diabetes without CCs	190,140	7.2	4th	17,131	7.1	4th
Chronic pulmonary disease	178,164	6.8	5th	16,319	6.8	5th
Most common procedures (top 5 for each group)						
Packed cell transfusion	72,590	7.0	1st	9,756	5.0	2nd
(Central) venous catheter insertion	68,687	6.7	2nd	13,755	7.0	1st
Hemodialysis	41,557	4.0	3rd	5,351	2.7	4th
Heart ultrasound (echocardiogram)	37,762	3.7	4th	5,441	2.8	3rd
Insert endotracheal tube	25,360	2.5	5th	4,705	2.4	6th
Continuous invasive mechanical ventilation	19,221	1.9	9th	5,280	2.7	5th
3M APR-DRG admission ROM score						
Minor	271,702	33.6		18,620	26.1	
Moderate	286,427	35.4		21,775	30.5	
Major	193,652	23.9		20,531	28.7	
Extreme	58,081	7.2		10,527	14.7	

NOTE: **Abbreviations:** AHRQ, Agency for Healthcare Research and Quality; APR-DRG admission ROM score, All-Patient Refined Diagnosis-Related Group Admission Risk of Mortality score; CC, complication or comorbidity (except under the AHRQ comorbidities where it refers to chronic complications); ED, emergency department (patients admitted from the academic health system's emergency department whose source of origination was not another hospital or ambulatory surgery site); GI, gastrointestinal; IHT, interhospital transfer (patients whose admission source was another acute care institution); MCC, major complication or comorbidity; MS-DRG, Medicare Severity Diagnosis-Related Group; MV, mechanical ventilation; SD, standard deviation. *All differences were significant at a level of $P < 0.001$. [†]Denominator is the total number of patients. All other denominators are the total number of patients in that column. Subgroups may not sum to the total denominator due to incomplete data.

an ICU bed on the day of admission, we coded them as a direct ICU admission, and if the first ICU bed charge was on a subsequent day, they were coded as a delayed ICU admission. Approximately 20% of patients did not have the data necessary to determine the timing of ICU utilization, because the hospitals where they received care did not submit detailed charge data to the UHC.

Data analysis was performed by the UHC. Analysis was performed using Stata version 10 (StataCorp, College Station, TX). For all comparisons, a P value of <0.05 was considered significant.

RESULTS

Patient Characteristics

We identified 885,392 patients who met study criteria: 75,524 patients admitted as an IHT and 809,868 patients admitted from the ED. The proportion of each hospital's admissions that were IHTs that met our study criteria varied widely (median 9%, 25th percentile 3%, 75th percentile 14%). The average age and gender of the IHT and ED populations were similar and reflective of a nationally representative adult inpatient sample (Table 1). Racial compositions of the

TABLE 2. Outcomes of 885,392 Academic Health System Patients Based on Source of Admission*

	ED, n = 809,868	IHT, n = 75,524
LOS, mean ± SD	5.0 ± 6.9	8.0 ± 13.4
ICU days, mean ± SD†	0.6 ± 2.4	1.7 ± 5.2
Patients who spent some time in the ICU	14.3%	29.8%
% LOS in the ICU (ICU days ÷ LOS)	11.0%	21.6%
Average total cost ± SD‡	\$10,731 ± \$16,593	\$19,818 ± \$34,665
Average cost per day (total cost ÷ LOS)	\$2,139	\$2,492
Discharged home	77.4%	68.6%
Died as inpatient	14,869 (1.8%)	3,051 (4.0%)
Died within 48 hours of admission (% total deaths)	3,918 (26.4%)	780 (25.6%)

NOTE: **Abbreviations:** ED, emergency department (patients admitted from the academic health system's emergency department whose source of origination was not another hospital or ambulatory surgery site); ICU, intensive care unit; IHT, interhospital transfer (patients whose admission source was another acute care institution); LOS, length of stay; SD, standard deviation. *All differences were significant at a level of $P < 0.001$ except the portion of deaths in 48 hours. †ICU days data were available for 798,132 patients admitted from the ED and 71,054 IHT patients. ‡Cost data were available for 792,604 patients admitted from the ED and 71,033 IHT patients.

TABLE 3. Multivariable Model of In-hospital Mortality (n = 707,248)

Variable	Unadjusted OR (95% CI)	Adjusted OR (95% CI)
Age, y	1.00 (1.00–1.00)	1.03 (1.03–1.03)
Gender		
Female	Ref.	Ref.
Male	1.13 (1.09–1.70)	1.05 (1.01–1.09)
Medicare status		
No	Ref.	Ref.
Yes	2.14 (2.06–2.22)	1.39 (1.33–1.47)
Race		
Nonblack	Ref.	Ref.
Black	0.57 (0.55–0.60)	0.77 (0.73–0.81)
ICU utilization		
No ICU admission	Ref.	Ref.
Direct admission to the ICU	5.56 (5.29–5.84)	2.25 (2.13–2.38)
Delayed ICU admission	5.48 (5.27–5.69)	2.46 (2.36–2.57)
3M APR-DRG admission ROM score		
Minor	Ref.	Ref.
Moderate	8.71 (7.55–10.05)	6.28 (5.43–7.25)
Major	43.97 (38.31–50.47)	25.84 (22.47–29.71)
Extreme	238.65 (207.69–273.80)	107.17 (93.07–123.40)
IHT		
No	Ref.	Ref.
Yes	2.36 (2.26–2.48)	1.36 (1.29 –1.43)

NOTE: **Abbreviations:** APR-DRG admission ROM score, All-Patient Refined Diagnosis-Related Group Admission Risk of Mortality score; CI, confidence interval; ICU, intensive care unit; IHT, interhospital transfer (patients whose admission source was another acute care institution); OR, odds ratio.

populations were notable for a higher portion of black patients in the ED admission group than the IHT group (25.4% vs 13.2%, $P < 0.001$). A slightly higher portion of the IHT population was covered by commercial insurance compared with the ED admissions (22.7% vs 19.1%, $P < 0.001$).

Primary discharge diagnoses (MS-DRGs) varied widely, with no single diagnosis accounting for more than 4.2% of admissions in either group. The most common primary diagnoses among IHTs included severe sepsis (3.7%), esophagitis and gastroenteritis (2.1%), and gastrointestinal bleeding (1.7%). The top 5 most common AHRQ comorbidities were the same between the IHT and ED populations. A higher proportion of IHTs had at least 1 procedure performed during their hospitalization (68.5% vs 49.8%, $P < 0.001$). Note that ICD-9 procedure codes include interventions such as blood transfusions and dialysis (Table 1), which may not be considered procedures in common medical parlance.

As compared with those admitted from the ED, IHTs had a higher proportion of patients categorized with major or extreme admission risk of mortality score (major + extreme, ED 31.1% vs IHT 43.5%, $P < 0.001$).

Overall Outcomes

IHT patients experienced a 60% longer average LOS, and a higher proportion spent time in the ICU than patients admitted through the ED (Table 2). On average, care for IHT patients cost more per day than for ED patients (Table 2). A lower proportion of IHTs were discharged home (68.6% vs 77.4% of ED patients), and a higher proportion died in the hospital (4.1% vs 1.8%) ($P < 0.001$ for both). Of the ED or IHT patients who died during their admission, there was no significant difference between the proportion who died within 48 hours of admission (26.4% vs 25.6%, $P = 0.3693$). After adjusting for age, gender, insurance status, race, ICU utilization and 3M APR-DRG admission ROM scores, IHT was independently associated with the risk of in-hospital death (odds ratio [OR]: 1.36, 95% CI: 1.29–1.43) (Table 3). The C statistic for the in-hospital mortality model was 0.88.

Subgroup Analyses

Table 4 demonstrates the unadjusted and adjusted results from our analysis stratified by timing of ICU utilization. IHT remained independently associated with in-hospital mortality regardless of timing of ICU utilization.

DISCUSSION

Our study of IHT patients ultimately discharged by hospitalists and general internists at US academic referral centers found significantly increased average LOS, costs, and in-hospital mortality compared with patients admitted from the ED. The increased risk of mortality persisted after adjustment for patient characteristics and variables representing endogenous risk of mortality, and in more homogeneous subgroups after stratification by presence and timing of ICU utilization. These data confirm findings from single-center studies and suggest that observations about the difference between IHT and ED populations may be generalizable across US academic hospitals.

Our work builds on 2 single-center studies that examined mixed medical and surgical academic IHT

TABLE 4. Unadjusted and Adjusted Associations Between IHT and In-hospital Mortality, Stratified by ICU Timing*

Subgroup	In-hospital Mortality, n (%)	Unadjusted OR [95% CI]	Adjusted OR [95% CI]
No ICU admission, n = 552,171			
ED, n = 519,421	4,913 (0.95%)	Ref.	Ref.
IHT, n = 32,750	590 (1.80%)	1.92 [1.76–2.09]	1.68 [1.53–1.84]
Direct admission to the ICU, n = 44,537			
ED, n = 35,614	1,733 (4.87%)	Ref.	Ref.
IHT, n = 8,923	628 (7.04%)	1.48 [1.35–1.63]	1.24 [1.12–1.37]
Delayed ICU admission, n = 110,540			
ED, n = 95,573	4,706 (4.92%)	Ref.	Ref.
IHT, n = 14,967	1,068 (7.14%)	1.48 [1.39–1.59]	1.25 [1.17–1.35]

NOTE: **Abbreviations:** CI, confidence interval; ED, emergency department (patients admitted from the academic health system's emergency department whose source of origination was not another hospital or ambulatory surgery site); ICU, intensive care unit; IHT, interhospital transfer (patients whose admission source was another acute care institution); OR, odds ratio. *Timing of ICU utilization data were available for 650,608 of the patients admitted from the ED (80% of all ED admissions) and 56,640 of the IHT patients (75% of all IHTs).

populations from the late 1980s and early 1990s,[9,10] and 1 studying surgical ICU patients in 2013.[17] These studies demonstrated longer average LOS, higher costs, and higher mortality rates (in both adjusted and unadjusted analyses). Our work confirmed these findings utilizing a more current, multicenter large dataset of IHT patients ultimately discharged by hospitalists and general internists. Our work is unique from a larger, more recent study[7] in that it focuses on patients transferred to academic health systems, and therefore has particular relevance to those settings. In addition, we divided patients into subpopulations based on the timing of ICU utilization, and found that in each of these populations, IHT remained independently associated with in-hospital mortality.

Our analysis does not explain why the outcomes of IHTs are worse, but plausible contributing factors include that (1) patients chosen for IHT are at higher risk of death in ways uncaptured by established mortality risk scores, (2) referring, transferring, or accepting providers and institutions have provided inadequate care, (3) the transfer process itself involves harm, (4) socioeconomic bias in selection for IHT,[18] or (5) some combination of the above. Regardless of the causes of the worse outcomes observed in these "outside-hospital transfers," as these patients are colloquially known at accepting hospitals, they present challenges to everyone involved. Referring providers may feel a sense of urgency as these patients' needs exceed their management capabilities. The process is often time consuming and burdensome for referring and accepting providers because of poorly developed systems.[19] The transfer often takes patients further from their home and may make it more difficult for family to participate in their care. The transfer may delay care if the accepting institution cannot immediately accept the patient or if the time in transport is prolonged, which could result in decompensation at a critical juncture. For providers inheriting such patients, the stress of caring for these patients is compounded by the difficulty obtaining records about the prior hospitalization.[20] This frustrating experience is often translated into unfounded judgment of the institution that referred the patient and the care provided there.[21] It is important for hospitalists making decisions throughout the transfer process and for hospital leaders who determine staffing levels, measure the quality of care, manage hospital networks, or write hospital policy to appreciate that the transfer process itself may contribute to the challenges and poor outcomes we observe. Furthermore, regardless of the cause for the increased mortality that we observed, our findings imply that IHT patients require careful evaluation, management, and treatment.

Many accepting institutions have transfer centers that facilitate these transitions, utilizing protocols and templates to standardize the process.[22,23] Future research should focus on the characteristics of these centers to learn which practices are most efficacious. Interventions to mitigate the known challenges of transfer (including patient selection and triage, handoff communication, and information sharing) could be tested by randomized studies at referring and accepting institutions. There may be a role for health information exchange or the development of enhanced pretransfer evaluation processes using telemedicine models; there is evidence that information sharing may reduce redundant imaging.[24] Perhaps targeted review of IHTs admitted to a non-ICU portion of the hospital and subsequently transferred to the ICU could identify opportunities to improve triaging protocols and thus avert some of the bad outcomes observed in this subpopulation. A related future direction could be to create protected forums—using the patient safety organization framework[25]—to facilitate the discussion of interhospital transfer outcomes among the referring, transporting, and receiving parties. Lastly, future work should investigate the reasons for the different proportions of black patients in the ED versus IHT cohorts. Our finding that black race was associated with lower risk of mortality has been previously reported but may also benefit from more investigation.[26]

There are several limitations of our work. First, despite extensive adjustment for patient characteristics, due to the observational nature of our study it is still possible that IHTs differ from ED admissions in ways that were unaccounted for in our analysis, and which could be associated with increased mortality independent of the transfer process itself. We are unable to characterize features of the transfer process, such as the reason for transfer, differences in transfer processes among hospitals, or the distance and mode of travel, which may influence outcomes.[27] Because we used administrative data, variations in coding could incorrectly estimate the complexity or severity of illness on admission, which is a previously described risk.[28] In addition, although our dataset was very large, it was limited by incomplete charge data, which limited our ability to measure ICU utilization in our full cohort. The hospitals missing ICU charge data are of variable sizes and are distributed around the country, limiting the chance of systematic bias. Finally, in some settings, hospitalists may serve as the discharging physician for patients admitted to other services such as the ICU, introducing heterogeneity and bias to the sample. We attempted to mitigate such bias through our subgroup analysis, which allowed for comparisons within more homogeneous patient groupings.

In conclusion, our large multicenter study of academic health systems confirms the findings of prior single-center academic studies and a large general population study that interhospital transfer patients have an increased average LOS, costs, and adjusted in-hospital mortality than patients admitted from the ED. This difference in mortality persisted even after controlling for several other predictors of mortality. Our findings emphasize the need for future studies designed to clarify the reason for the increased risk and identify targets for interventions to improve outcomes for the interhospital transfer population.

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