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Journal article: *Discharge destination and readmission rates in older trauma patients*

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Discharge destination and readmission rates in older trauma patients

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ABSTRACT

Background: In older trauma patients, the impact of discharge destination on readmission rates is not known. The objective of this study was to evaluate the association between the discharge destination and the 30-day readmission rate in older trauma patients.

Materials and methods: A previously validated database of all patients aged 45 years or older undergoing trauma evaluation at our level 1 trauma center between January 1, 2008 and December 31, 2008 was analyzed to retrospectively compare the incidences of 30-day readmission between patients discharged to home, to inpatient rehabilitation facilities, and to other extended care facilities (ECFs). Demographic information including age and gender and potentially confounding factors including injury severity, trauma activation level, comorbidities, medications, and preinjury functional status were included. Univariate analysis was undertaken using chi-square testing. Multiple logistic regression was performed with potential confounding variables to evaluate for independent contribution to readmission risk.

Results: A total of 960 patients were evaluated; 81 patients (8.4%) were excluded, leaving 879 patients included in the analysis. Seventy-six patients (8.6%) were readmitted within 30 d of discharge. Overall, 6% of those discharged to home, 13% of those discharged to ECF, and 16% of those discharged to rehabilitation were readmitted ($P < 0.01$ on univariate analysis). Overall, 866 (98.5%) patients had data recorded for all variables analyzed using multiple logistic regression; among these, only discharge destination was independently associated with the rate of readmission ($P < 0.01$).

Conclusions: Discharge to ECFs and inpatient rehabilitation facilities appear to be an independent risk factor for hospital readmissions in this population despite controlling for injury severity and comorbidities. Recognition of this risk factor may aid in the disposition planning of these patients and suggests the need for further evaluation of this correlation at other US medical centers.

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Introduction

The rate of unplanned readmissions is a quality measure often used to evaluate individual hospital care.[1,2] Readmissions pose a major economic burden, with associated costs of $12 billion annually in 2005[3] and account for 17% of total hospital payments from Medicare in 2004.[4] Preventing avoidable readmissions may improve patient quality of life and the financial state of the health system. As a result, the Affordable Care Act instituted the Hospital Readmissions Reduction Program in 2012 allowing the Centers for Medicare and Medicaid Services to reduce payments to hospitals with excess disease-specific and hospital-wide readmissions to incentivize improvement in the quality of care.[2]

Hospital readmissions after hospitalization for traumatic injury are frequent. Nearly 30% of 30-d readmissions are due to complications of injury and treatment; in the older population, this is most frequently due to anastomotic disruption, wound infection, pneumonia, and iatrogenic congestive heart failure.[4] Elderly trauma patients in particular are at increased risk for morbidity and mortality after injury in both the inpatient and the postdischarge settings.[5,6] Determining the best discharge destination for patients in this population may be difficult, as it is based on medical, functional, and social aspects of the patient's injury in association with the patient's acute and chronic medical conditions.[7] Although there is some literature identifying independent risk factors for hospital-wide readmissions,[8] little is known about the relationship between discharge destination and readmission in older trauma patients.

The objective of this study was to identify the proportion of older trauma patients who required unplanned hospital readmission and to evaluate the association between the discharge destination and 30-d readmission rates.

Materials and methods

We used a previously validated database of trauma patients evaluated at the Ohio State University Wexner Medical Center, an American College of Surgeons verified level 1 trauma center, between January 1, 2008 and December 31, 2008. The database was formed by querying the trauma registry for all patients aged 45 years and over; our group's prior work[9,10] established this age as a lower threshold for meaningful evaluation of trauma patients with multiple comorbidities and pre-existing medications. Level of trauma alert (1, the most critically injured; 2, moderately injured; or 3, trauma consult), Glasgow coma score (GCS), injury severity score (ISS), length of stay (LOS), intensive care unit (ICU) LOS, and age was obtained from the trauma registry for each patient. Manual review of electronic medical records was used to identify patients who were incarcerated or pregnant, who died before discharge, and who were readmitted to our institution within 30 d of discharge, as well as to record each patient's gender, number of preinjury medical problems, number of preinjury prescription medications, preinjury functional status (independent, partially dependent, or fully dependent on assistance), preinjury location (home or extended care facility [ECF]), and discharge destination, grouped as home, inpatient rehabilitation, or other ECFs (including long-term acute care hospitals, skilled nursing facilities, and nursing homes). Comorbidity-polypharmacy score (CPS) was evaluated for each patient using the preinjury medical problems and medications.[9,10] Creation and use of this database for research purposes was approved by the institutional review board of The Ohio State University.

Our analysis included all patients aged 45 years or older who were evaluated by the trauma team at our institution during the 2008 calendar year. Excluded patients were those who were incarcerated, patients who died during their hospitalizations, patients who were discharged to hospice, and pregnant patients.

Patients' reasons for discharge to a facility other than home, functional status at time of discharge, incidences of admission to other medical centers, and specific reasons for readmission were not available in the database.

With the dichotomous outcome of 30-d readmission, univariate analysis for association was undertaken using chi-square testing for categorical variables (trauma level, gender, initial functional status, preinjury location, and discharge destination), and simple logistic regression was used for interval variables (age, CPS, GCS, LOS, and ICU LOS). Variables which demonstrated a univariate association with readmission ($P < 0.10$) were included in a multiple logistic regression model to evaluate for an independent contribution to readmission risk; a P value of less than 0.05 on multiple logistic regression was considered statistically significant. For the categorical variables of discharge destination, linearly independent contrasts of home *versus* ECF and home *versus* rehab were coded for use in the multiple logistic regression evaluation.

Results

During the 1-y study period, 960 patients aged 45 years and older were evaluated. Overall, 81 (8.4%) patients met exclusion criteria, leaving 879 patients to comprise the study population (Fig. 1). Patients without data available for a particular variable were excluded from analysis of that variable. In addition, two homeless patients were excluded from analysis of the "preinjury location" variable and two patients with impossible GCS values were excluded from that analysis.

Baseline characteristics included an age range from 45 to 103 y (median 58), with an ISS range 0-50 (median 5), and CPS range 0-39 (median 7). Further characteristics of the patients are listed in Table 1.

Seventy-six patients (8.6%) were readmitted within 30 d of discharge. Thirty-three patients were readmitted of 564 patients discharged to home (6%). Twenty-two patients were readmitted of 175 discharged to an ECF (13%), and 21 patients were readmitted of 133 discharged to inpatient rehabilitation (16%; Fig. 2). Seven patients had indeterminate discharge destination or were homeless and discharged to a shelter; none were readmitted. Univariate analysis comparing readmission rates after discharge to home, rehab, ECF, or other demonstrated statistical significance, with $P = 0.00009$. Other

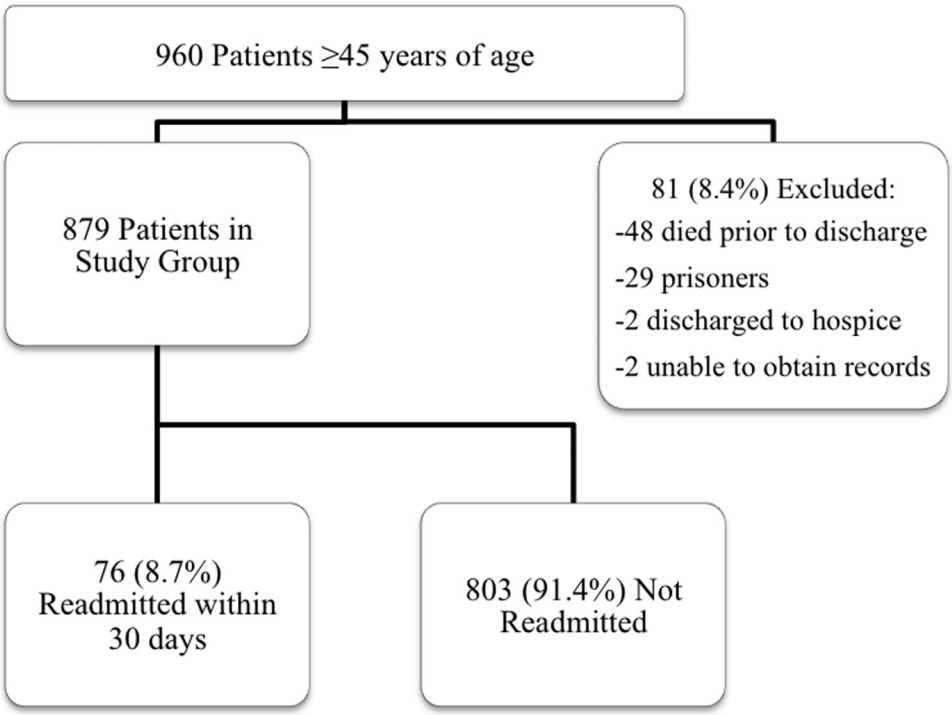

Fig. 1 – All trauma patients age 45 years and older identified and evaluated for rate of readmission.

univariate analyses demonstrated associations (with $P < 0.1$) between readmission rates and patient ISS, CPS, and LOS but not trauma activation level, age, ICU LOS, GCS, gender, preinjury functional status, or preinjury location (Table 2).

A total of 866 (98.5%) patients had data recorded for the confounding variables; patients without all data were excluded from the multiple logistic regression analysis. In addition, those patients with indeterminate discharge location were excluded from the multivariate analysis, for a total analyzed group of 860 patients. Multiple logistic regression was used to analyze these variables; among these, only discharge destination other than home was independently associated with increased rate of readmission ($P = 0.0078$; adjusted odds ratio, 1.0497-1.3755 compared to discharge to home). Discharge to rehab was associated with a 1.51 times increased likelihood of readmission compared with home (adjusted odds ratio, 1.0244-2.2364, $P = 0.0374$) while the adjusted odds ratio (AOR) for readmission from ECF was 0.7358-1.577 ($P = 0.6983$) when compared with home. There was no statistically significant independent difference

Table 1 – Characteristics of the patients identified for analysis of readmission factors.

Characteristic	Overall*
Age (y)	58 (45-103)
Gender ($n = 659$), n (%)	
Male	384 (58.3)
Female	275 (41.7)
Trauma level, n (%)	
1	57 (6.5)
2	306 (34.8)
Consult	516 (58.7)
ISS ($n = 867$)	5 (0-50)
CPS	7 (0-39)
LOS (d) ($n = 878$)	3 (0-124)
ICU LOS (d)	0 (0-124)
GCS ($n = 797$)	15 (3-15)

CPS = comorbidity-polypharmacy score; ICU = intensive care unit; ISS = injury severity score; LOS = length of stay.
*Represented as median (range) or number (percent) when appropriate.

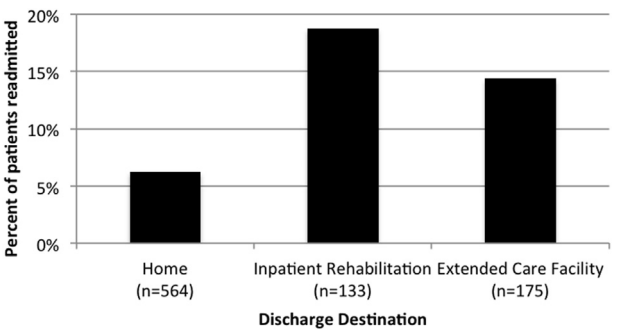

Fig. 2 – Rates of readmission to the same medical center within 30 d of discharge among older trauma patients discharged to their home, an inpatient rehabilitation facility, or an ECF (including long-term acute care hospitals, skilled nursing facilities, and nursing homes). An additional 7 patients had an indeterminate or other discharge destination; none of these were readmitted.

Table 2 – Univariate evaluation of discharge destination and potentially confounding variables.

Variable	Readmitted, *n* (%)	Not readmitted, *n* (%)	*P* value
Trauma level			
1	8 (14.0)	49 (86.0)	0.273
2	23 (7.5)	283 (92.5)	
3	45 (8.7)	471 (91.3)	
ISS	9 (1-38)	5 (0-50)	0.012
CPS	9.5 (0-32)	7 (0-39)	0.014
Age	59.5 (47-99)	58 (45-103)	0.670
LOS	5 (0-43)	3 (0-124)	0.075
ICU LOS	0 (0-16)	0 (0-124)	0.924
GCS	15 (3-15)	15 (3-15)	0.445
Gender			
Male	34 (8.9)	350 (91.1)	0.577
Female	21 (7.6)	254 (92.4)	
Initial function			
Independent	32 (6.6)	453 (93.4)	0.142
Partially dependent	12 (11.3)	94 (88.7)	
Fully dependent	1 (20)	4 (80)	
Pretrauma location			
Home	42 (7.4)	525 (92.6)	0.600
ECF	3 (10)	27 (90)	
Discharge destination			
Home	33 (5.9)	531 (94.1)	<0.01
ECF	22 (12.6)	153 (87.4)	
Rehab	21 (15.8)	112 (84.2)	
Other	0 (0)	7 (100)	

CPS = comorbidity-polypharmacy score; ECF = extended care facility; GCS = Glasgow coma score; ICU = intensive care unit; ISS = injury severity score; LOS = length of stay; rehab = inpatient rehabilitation facility.
Categorical variables are listed as number of patients (percent of category); interval variables are listed as median (range).

between discharge to ECF *versus* rehab (AOR = 0.6002-1.1868, $P = 0.3294$). The adjusted unit odds ratio for ISS was 0.9887-1.0646 ($P = 0.1744$); for CPS 0.9973-1.0636 ($P = 0.0723$); and for LOS 0.9756-1.0243 ($P = 0.9789$).

Discussion

The rate of unplanned readmissions after hospitalization is becoming a major quality measure used to evaluate hospital care and physician performance. Readmissions after hospitalization for trauma are frequent with complications of injury the most frequently cited cause. Older trauma patients are at increased risk for morbidity and mortality after injury when compared with younger trauma patients; the aging population brings increased dependence on long-term care than trauma systems have traditionally provided, including planning for discharges to rehabilitation and ECFs rather than to patients' homes.

We reviewed our institution's trauma database to determine the effect of discharge destination on 30-d readmission in the older trauma patient. We found that patients who were discharged to a location other than home, including inpatient rehabilitation, long-term acute care hospitals, skilled nursing facilities, and nursing homes, were statistically more likely to return to the trauma center. Furthermore, discharge destination appeared to be an independent risk factor for readmission in this population when adjusting for other confounding variables.

Both utilization of long-term care facilities and unplanned readmissions are significant sources of expenditure in the health care system. In 2011, Medicare spent $31.3 billion, or about 6% of spending, on 1.7 million beneficiaries during 2.4 million stays.[11] An additional $6.14 billion was spent on inpatient rehabilitation facilities and $5.4 billion on long-term care hospitals in 2011. It is estimated that the cost of unplanned hospital readmissions to Medicare from all destinations including home was $17.4 billion in 2004.[4]

Prior evaluations of outcomes and their relationships to discharge destination are inadequate and contradictory. A review of over 124,000 patients in the Washington State Trauma Registry determined older trauma patients and those discharged to a skilled nursing facility had a statistically higher risk of death.[12] A large multicenter study in Canada revealed a higher rate of unplanned hospital readmission in patients discharged to inpatient rehabilitation but lower rates when discharged to a long-term care setting rather than to home.[5] An analysis of elective total knee arthroplasty demonstrated discharge destination to skilled nursing facility to be an independent risk factor for readmission.[13] Such contradictory and inconclusive findings in prior literature demonstrate an incomplete understanding of the factors influencing readmission.

The finding that readmission rates are higher in older trauma patients discharged to an ECF and inpatient rehabilitation center in our investigation, regardless of comparable patient illness, appears in some ways contradictory. Logically, the function of these types of posthospital care centers is to provide superior care than may be available in a patient's home setting and reduce the need for inpatient services. The increased rate of readmissions may be attributed to the integral role of health care workers in ECFs in recognizing new or worsening medical conditions requiring rehospitalization. Conversely, when patients are at home, patients and family members often call their on-call physician regarding new concerning issues. Some of these concerns may be alleviated as expected in the normal post-trauma course, possibly reducing the rate of emergency room visits from home.

On the other hand, it is reasonable to expect that more seriously ill and injured patients are more likely to be discharged to higher levels of care such as skilled nursing facilities; hence, such patients are more likely to be readmitted. The prior work variably demonstrating decreased readmission of patients admitted to long-term care facilities[5]

clouds this picture, however, and suggests the need for the present study and further evaluation.

Some other likely reasons for increased readmission rates are decreased in possibility thanks to the design of our review. While it may be expected that patients discharged to ECFs or inpatient rehabilitation facilities have an increased burden of chronic medical problems or increased frailty, inclusion of the CPS in the logistic regression model mitigates this confounding factor. However, socioeconomic status, functional outcome at time of discharge, and specific reasons for readmission were not available in this data set, and thus may present confounding in the model.

The outcomes of patients discharged to ECFs have yet to be determined. A recently published study by Hakkarainen *et al.* examined the outcomes of patients discharged to skilled nursing facilities after acute care hospitalizations. Of a cohort of over 400,000 patients across five states discharged to a skilled nursing facility after a trauma, surgical, or cerebrovascular accident diagnosis, nearly 29% of patients required hospital readmission.[14] Only 60.5% of patients were ultimately discharged home. Furthermore, almost 8% of patients died in a skilled nursing facility, with an overall 1-y mortality of 26%. Previously published literature supports the idea that little is known about the determinants that influence successful transition to home instead of an unplanned readmission to the hospital. Certainly complex, often unmeasurable factors are incorporated into the decision to recommend the appropriate discharge destination for injured patients, including the subjective opinions of health care providers and the quality of patients' social and support networks. As less-experienced providers evaluate potential patient discharge destinations, they are often able to draw less on the subjective and complex analyses available to the more senior clinician; recognition that the more objective findings of comorbidities, injury severity, and preinjury functional status (along with the other considered variables) do not appear to predict readmission rate as effectively as the "summary" variable of discharge destination is thus important in planning patient disposition.

We believe the major strength of the study is the question at hand; the association between discharge destination and readmission needs further exploration. Our study is the first in the US literature to examine this trend in the older trauma population. However, our study is not without its limitations. While the data set contains hundreds of patients and multiple confounding variables were analyzed, this is a single-institution study evaluating patients over only a single calendar year; the specific data set used was chosen due to its relative completeness and revalidation by multiple users. A larger data set may provide a more robust multivariate analysis but could suffer from higher rates of incomplete data; this limitation will likely only be overcome with a prospective analysis. The study's limitation to a single institution may decrease generalizability to all trauma centers. In addition, as all trauma patients examined were admitted and discharged before the introduction of an electronic medical record system at our institution, not all data that might be desired were available for collection. Our data set did not include information such as the reason for readmission, the patients' reasons for discharge to a facility other than home, functional status at time of discharge, or incidences of admission to a different medical center. Furthermore, the markers of severity analyzed were based on admission rather than on discharge; this limits evaluation of the specific severity of acute care needs of patients at their discharge destinations. Although the admissions measures may adjust for markers of long-term comorbidities and immediate surgical care needs, they ignore long-term outcomes of the acute injuries. Finally, since this study is based on patients treated in 2008, it is possible that the identified associations may have changed over time.

Furthermore, as a retrospective review, we can postulate the association and reasons for readmission but cannot draw any conclusions about causality. Despite the potential explanations noted previously mentioned, it is quite possible that an unstudied factor is the underlying reason for readmission in many patients. This inherent limitation of the use of multiple regression has been well documented,[15] and the authors recognize the need for caution in interpreting the statistical analysis, regardless of the *P* value associated with such an independent risk factor.[16] Only a prospective study will provide evidence strong enough to recommend direct intervention in influencing patient outcomes; the role of this retrospective study in testing the previously unexamined hypothesis associating discharge destination with readmission risk must be considered a pilot for further investigation.

Advancing the care of the more common older injured patient remains a challenge. To improve outcomes of older trauma patients in our institution, we partnered with the Department of Medicine's geriatric program in 2013. Geriatricians are consulted to assist the patients over 65 years old admitted onto our trauma service if there are concerns with polypharmacy, delirium, or dementia management. Discharge destination is frequently addressed in conjunction with case managers and social workers, especially in situations where previous residency location is unsafe (e.g., providing a significant fall risk). Conceivably, a future study may reveal that this partnership results in improving rates of discharge to an appropriate destination and lower rates of readmission in the older trauma population.

Conclusions

In this study of outcomes based on discharge destination of the older trauma patient, discharge to inpatient rehabilitation facilities or other ECFs appears to be a strong independent risk factor for hospital readmissions in this population. While causation is not assumed, recognition of this risk factor as independent of a patient's level of acute and chronic illness may aid in the disposition planning of these patients and suggests the need for further evaluation of this correlation at other US medical centers.

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Authors' contributions: C.J. conceived the idea. B.C.H. performed data collection, and C.J., B.C.H., and D.S.S. performed data analysis. S.M.S. provided critical feedback and recommendations. D.S.S. and C.J. wrote the manuscript, and S.M.S., B.C.H., D.V., and A.R. performed critical review and edits. D.S.S. and C.J. incorporated changes recommended in the peer review process.

Disclosure

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