

ORIGINAL RESEARCH

Rehospitalization During 9 Months After Inpatient Rehabilitation for Traumatic Brain Injury



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Abstract

Objective: To assess the frequency of, causes for, and factors associated with acute rehospitalization during 9 months after discharge from inpatient rehabilitation for traumatic brain injury (TBI).

Design: Multicenter observational cohort.

Setting: Community.

Participants: Individuals with TBI (N=1850) admitted for inpatient rehabilitation.

Interventions: Not applicable.

Main Outcome Measures: Occurrences of proxy or self-report of postrehabilitation acute care rehospitalization, as well as length of and causes for rehospitalizations.

Results: A total of 510 participants (28%) had experienced 775 acute rehospitalizations. All experienced 1 admission (510 participants [66%]), whereas 154 (20%) had 2 admissions, 60 (8%) had 3, 23 (3%) had 4, 27 had between 5 and 11, and 1 had 12. The most common rehospitalization causes were infection (15%), neurological (13%), neurosurgical (11%), injury (7%), psychiatric (7%), and orthopedic (7%). The mean time from rehabilitation discharge to first rehospitalization was 113 days. The mean rehospitalization duration was 6.5 days. Logistic regression analyses revealed that older age, history of seizures before injury or during acute care or rehabilitation, history of brain injuries, and non-brain injury medical severity increased the risk of rehospitalization. Injury etiology of motor vehicle collision and high motor functioning at discharge decreased rehospitalization risk.

Conclusions: Approximately 28% of patients with TBI were rehospitalized within 9 months of TBI rehabilitation discharge owing to various medical and surgical reasons. Future research should evaluate whether some of these occurrences may be preventable (such as infections, injuries, and psychiatric disorders) and should evaluate the extent to which persons at risk may benefit from additional screening, surveillance, and treatment protocols.

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In the United States and Canada, there has been increasing concern about the costs and effect of acute care hospitalization soon after hospital discharge. In a review of general acute care hospital readmission studies,¹ 9% to 48% of readmissions in the

United States and 9% to 59% in Canada were considered preventable. These readmissions are believed to have resulted from inadequate treatment of the originating medical problem, instability at discharge, and inadequate postdischarge care. It is believed that better identification of those most likely to return to an acute care hospital within a short period and improvement in the care they receive after discharge may reduce these admissions.² Readmission to an acute care hospital within 30 days of discharge varies greatly across hospitals in the United States, with

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11.4% to 18.1% being medical discharges and 7.6% to 18.3% surgical discharges at 306 hospital referral regions.³ In Canada, approximately 8.5% of all inpatients are readmitted to an acute care hospital within 30 days of discharge.⁴ The 181,551 readmissions over the 11-month study period carried an estimated cost of \$1.8 billion or 11% of all the money spent on inpatient care, not including physician fees for services. In addition to the increased financial burden, rehospitalizations may disrupt community integration and increase health risks.¹

Corollaries between rehospitalization after acute care discharge and rehospitalization after inpatient rehabilitation discharge may exist. Efforts to reduce rehospitalization after acute rehabilitation will require data to determine common modifiable triggers for readmission. However, in individuals with traumatic brain injury (TBI), there are limited data on rehospitalization rates, causes, and risk factors. Such information may allow clinicians and hospital administrators to design systems of care to better prevent rehospitalizations and improve health after TBI.

There has been an increasing demand on acute rehabilitation professionals and hospitals in the United States and Canada to more efficiently and effectively manage all aspects of medical care during and after inpatient rehabilitation. Over recent decades, acute rehabilitation length of stay (RLOS) has progressively shortened in duration⁵ whereas medical acuity and complexity has progressively increased.^{6,7} Furthermore, in 2002 the United States implemented the Inpatient Rehabilitation Facility Prospective Payment System for postacute care settings, which, on the basis of reimbursement on case-mix groups (ie, higher payment for higher acuity), incentivized inpatient rehabilitation facilities to select admission of more severe patients.⁸⁻¹⁰ Subsequent passage of the Affordable Care Act (ACA)⁶ has aligned incentives with markers of quality care, such as rehospitalization soon after discharge. In accordance with the ACA, the Centers for Medicare and Medicaid Services, a primary payer for acute and rehabilitation services in the United States, has introduced penalties for rehospitalization within 30 days of acute care discharge for some diagnoses. The Centers for Medicare and Medicaid Services has also released "draft" criteria for a quality measure of all-cause rehospitalization within 30 days of rehabilitation discharge. These efforts have increased the attention by many rehabilitation providers to reduce rehospitalizations during and after inpatient rehabilitation.^{11,12} The advent of performance-based bundled payment systems resulting from the ACA may further affect medical care decisions related to rehabilitation service delivery in 4 primary ways: (1) shifting patients to the most appropriate and cost-effective rehabilitation setting within an episode of care; (2) providing comprehensive rehabilitation treatment within a compressed time frame to produce functional gains; (3) minimizing rehospitalization during inpatient rehabilitation; and (4) surveilling current and emergent medical conditions to prevent rehospitalization after inpatient rehabilitation discharge in both the short- and long-term.

Harrison-Felix et al¹³ found that in the years after inpatient rehabilitation, death is increased 37-fold due to seizures, 12-fold due to septicemia, 4-fold due to pneumonia, and 3-fold due to respiratory conditions, digestive conditions, and external causes of injury in individuals with TBI compared with the general population. Four TBI registry studies¹³⁻¹⁶ have shown that external injury is a leading cause of death (18%–20%) in the year after discharge. Reinjury also causes high rates of emergency department visits and hospitalizations. In one study,¹⁷ 32% of 504 participants with TBI had 228 emergency department visits or hospitalizations due to unintentional injuries within a wide range of follow-up from 3 months to several years after discharge.

Three studies using data collected from the Traumatic Brain Injury Model Systems (TBIMS) registry that uses annual follow-up interviews have focused on incidence of and causes for rehospitalization after TBI rehabilitation discharge. Cifu et al¹⁸ found that the annual rehospitalization incidence in 665 individuals with TBI in years 1, 2, and 3 after injury ranged from 20% to 23%. Of the first year rehospitalizations, 44% were classified as "orthopedic or reconstructive," which in that study included removal of hardware, cranioplasty, fracture repair, and reconstructive operations. Orthopedic and reconstructive operations remained the most common reason for rehospitalizations in years 2 and 3. Infections accounted for 8% to 17% of the rehospitalizations across the 3-year period. Infections in year 1 included hardware infections (36%), meningitis (18%), pneumonia (18%), and gastrointestinal tract infections (18%). Seizures and psychiatric disorders accounted for 6% to 15% of the rehospitalizations, with most of these incidences occurring in years 2 and 3. Rehospitalization for rehabilitation accounted for approximately 4% of all readmissions during the first year and none thereafter. Rehospitalization occurrence and etiology did not have a statistical association with demographic characteristics, injury severity, payer source for rehabilitation, concurrent injuries, acute care and rehabilitation length of stays, discharge Functional Assessment Measure, and discharge residence. Similarly, Marwitz et al¹⁹ found a 23% rehospitalization rate during the first year after inpatient rehabilitation for 895 individuals with TBI, with reasons including orthopedic/reconstructive (25%), general health maintenance (21%), seizures (13%), psychiatric disorders (12%), infection (10%), neurological issues (6%), and rehabilitation (3%), and 10% of unknown causes. Elective rehospitalizations accounted for one third of the admissions. As in Cifu, no relation was found between rehospitalization and injury characteristics, demographic characteristics, functional status, or lengths of stay, though both studies are notably small and lack sufficient power to fully assess this issue. More recently, Nakase-Richardson et al²⁰ reported a 20.6% incidence of rehospitalizations during the year after TBI rehabilitation for 9028 individuals. Persons with more severe levels of cognitive impairment at the time of inpatient rehabilitation admission had higher rates of postdischarge rehospitalization with a 2-fold increase in rehospitalization in patients with disorders of consciousness at rehabilitation admission relative to those with moderate or severe TBI who were not following commands at the time of rehabilitation admission. This article focuses on rehospitalizations in those with disordered consciousness. Reasons for rehospitalization were grossly similar to those reported in other TBIMS studies.

With an increased awareness of the cost of rehospitalizations and the need to reduce them, there is a great need for large TBI

List of abbreviations:

ABS	Agitated Behavior Scale
ACA	Affordable Care Act
CSI	Comprehensive Severity Index
PBE	practice-based evidence
RLOS	rehabilitation length of stay
TBI	traumatic brain injury
TBIMS	Traumatic Brain Injury Model Systems

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