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Traumatic Brain Injury Practice-Based Evidence Study: Design and Patients, Centers, Treatments, and Outcomes

Susan D. Horn, PhD^a, John D. Corrigan, PhD^b, Jennifer Bogner, PhD^b, Flora M. Hammond, MD^c, Ronald T. Seel, PhD^d, Randall J. Smout, MS^a, Ryan S. Barrett, MS^a, Marcel P. Dijkers, PhD^e, and Gale G. Whiteneck, PhD^f

^aInstitute for Clinical Outcomes Research, International Severity Information Systems, Inc, Salt Lake City, UT

^bDepartment of Physical Medicine and Rehabilitation, Ohio State University, Columbus, OH

^cCarolinas Rehabilitation, Charlotte, NC, and Indiana University School of Medicine, Indianapolis, IN

^dCrawford Research Institute, Shepherd Center, Atlanta, GA

^eDepartment of Rehabilitation Medicine, Icahn School of Medicine at Mount Sinai, New York, NY

^fResearch Department, Craig Hospital, Englewood, CO

Abstract

Objective—To describe study design, patients, centers, treatments, and outcomes of a traumatic brain injury (TBI) practice-based evidence (PBE) study and to evaluate the generalizability of the findings to the US TBI inpatient rehabilitation population.

Presentations: Parts of these data were presented at the following conferences.

- International Brain Injury Association (IBIA) Eighth World Congress in March 2010 in Washington, DC; March 2014 in San Francisco, CA.
- Annual Canadian Association of Physical Medicine and Rehabilitation meetings in May 2010 in Winnipeg, Manitoba.
- Federal TBI Interagency Conference in June 2011 in Washington, DC.
- Annual American Academy of Physical Medicine and Rehabilitation meetings in November 2012 in Atlanta, GA.

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Corresponding author: Susan D. Horn, PhD, 699 East South Temple, Suite 300, Salt Lake City, Utah 84102, Office: 801-466-5595 x203, Home: 801-718-9149, shorn@isisicor.com.

[•] Annual meetings of the American Congress of Rehabilitation Medicine (ACRM) in October 2009 in Denver, CO; October 2011 in Atlanta, GA; October 2012 in Vancouver, BC, Canada.

Design—Prospective, longitudinal observational study

Setting-10 inpatient rehabilitation centers (9 US, 1 Canada)

Participants—Patients (n=2130) enrolled between October 2008 and Sept 2011, and admitted for inpatient rehabilitation after an index TBI injury

Interventions-Not applicable

Main Outcome Measures—Return to acute care during rehabilitation, rehabilitation length of stay, Functional Independence Measure (FIM) at discharge, residence at discharge, and 9 months post-discharge rehospitalization, FIM, participation, and subjective wellbeing.

Results—Level of admission FIM Cognitive score was found to create relatively homogeneous subgroups for subsequent analysis of best treatment combinations. There were significant differences in patient and injury characteristics, treatments, rehabilitation course, and outcomes by admission FIM Cognitive subgroups. TBI-PBE study patients overall were similar to US national TBI inpatient rehabilitation populations.

Conclusions—This TBI-PBE study succeeded in capturing naturally occurring variation within patients and treatments, offering opportunities to study best treatments for specific patient deficits. Subsequent papers in this issue report differences between patients and treatments and associations with outcomes in greater detail.

Keywords

brain injuries; comparative effectiveness research; rehabilitation

Traumatic brain injury (TBI) inpatient rehabilitation has been studied largely as an undifferentiated "black box", with comparisons being made between patients who received rehabilitation and those who did not, between those who received it early versus late, or between those who received intensive treatment and those whose program was less intense.^{1–6} However, Chestnut et al. observed that knowing time spent without knowing what impairments were being treated or what methods of treatment were used may be too blunt an instrument to identify important sources of variance in rehabilitation outcomes.⁷ This assumption is supported by results of a stroke rehabilitation comparative effectiveness study: average time spent in physical therapy (PT) and occupational therapy (OT) per day did not increase percent of variance explained in outcomes, but average time spent in specific PT and OT activities per day did.⁸

High reviewed effectiveness studies of acute rehabilitation following TBI that described (1) gains made during rehabilitation, (2) effects of early intervention, and (3) effects of intensity of rehabilitation efforts. ⁹ His conclusions were consistent with those of an NIH Consensus Conference and the Chestnut et al. evidence-based review: persons with TBI unequivocally make functional gains during inpatient rehabilitation–including gains in ambulation, independence, and cognition.^{7,9,10} However, it was less clear how much these gains can be attributed to specific rehabilitation therapies and interventions and how much should be attributed to age, natural recovery as modified by brain injury severity, and patient pre-injury characteristics. Also, there was insufficient evidence to inform what the timing of

interventions should be, what type and intensity of interventions are most appropriate, and for whom specific interventions are most effective.

Inpatient TBI rehabilitation practice remains highly variable, which, in part, reflects lack of empirical evidence of how the complex interweaving of rehabilitation treatments from different professionals, in conjunction with patient prognostic factors (e.g., comorbidities, injury severity), influences recovery. Understanding what treatment factors and processes lead to better outcomes, and for which patient subgroups, would allow development of more effective TBI rehabilitation. However, the information required to gain this understanding is very complex and requires capturing detailed information regarding injury type and severity, the types, timing, and amounts of interventions received, and how these factors affect outcomes across diverse types of patients. A necessary first step in deciphering the content of the "black box" is to develop a comprehensive index of patient prognostic factors that allows for standardized assessment of patient differences in illness and injury severity following TBI. Second, a standard taxonomy of TBI inpatient rehabilitation treatments for each discipline would allow researchers to capture reliably the targets of treatments, the types, intensities, and durations of rehabilitation activities performed, as well as other treatment process factors. We can then identify variance in outcomes, along with those patient and treatment factors that are associated with that variance. The evidence gleaned may be used to inform delivery of future treatment by patient characteristics, design of randomized controlled trials, guide clinical pathways development, or stimulate development of new and innovative treatment approaches.

It is likely that an interaction of interventions and patient factors influences outcomes-that is, what is optimal treatment for one patient subgroup may have no or very limited impact on another group with different needs or abilities to benefit. In rehabilitation, multiple interventions are provided daily by professionals from varied disciplines, backgrounds, and experiences, and nested within rehabilitation facilities with varied customs, cultures, and physical environments. Relatively small effects of a single intervention may be magnified when used in combination with other interventions.¹¹ Interventions that seem effective when studied in isolation may be antagonistic when provided together. In current TBI rehabilitation practice, the large variation in treatments delivered and outcomes produced, between as well as within facilities, affords an opportunity to compare the relative effectiveness of combinations and intensities of interventions among patients with TBI.

Practice-Based Evidence (PBE) study methodology provides an efficient, comprehensive means of implementing comparative effectiveness research.¹¹ The 5-year TBI rehabilitation project described in this paper and in other articles in this supplement used PBE research methodology to isolate specific components of rehabilitation treatments, as has been done in previous PBE rehabilitation inpatient treatment studies.^{8,12–14} The specific aims of the TBI-PBE project were to: (1) identify individual patient characteristics, including demographic data, severity of brain injury, and severity of illness (complications and comorbidities), that may be associated with significant variation in treatments selected and in outcomes of acute rehabilitation for TBI, (2) identify medical procedures and therapy interventions, alone or in combination, that are associated with better outcomes, controlling for patient characteristics,

In this introductory paper, we first provide an overview of the study design, centers, and methods. Second, we briefly describe the primary measures and variables used to describe patients who sustained TBI, with an emphasis on stratification by admission Functional Independence Measure (FIM) Cognitive Scale Score groupings, and the results in our sample. Third, we provide an overview of the point of care forms (POC) incorporating our treatment taxonomy used to capture information on treatments and the most common treatments used by each discipline. Fourth, we describe inpatient rehabilitation outcomes for our sample. Lastly, for the purposes of evaluating generalizability, we compare the project's US subsample to the US rehabilitation population of persons with TBI.

METHODS

Study Design

The TBI-PBE project was led by the first and second author, with local Co-investigators in the 10 participating centers listed in table 1. The process used was as follows:

- A multi-center, trans-disciplinary Clinical Project Team was established that was comprised of Co-Investigators (medical director or lead researcher) and leads from each discipline (Rehabilitation Medicine, Nursing, PT, OT, Speech Language Pathology (SLP), Therapeutic Recreation, Social Work, and Neuropsychology) at 9 TBI rehabilitation centers in the US and 1 in Canada. Persons who had sustained a TBI several years prior and family members of persons with TBI were also part of this team. The Clinical Project Team (a) identified and defined all study variables including outcomes of interest, (b) proposed hypotheses for testing, (c) provided leadership and guidance through all phases of data collection and analysis, and (d) contributed to reporting and drawing conclusions. They fostered trans-disciplinary communication and training across traditional scientific and clinical boundaries.
- 2. Front-line clinicians developed a TBI Auxiliary Data Module (ADM) to capture detailed patient, process, and outcome data that are found in the patient's medical record. Many ADM variables had date and time fields so that they could be associated with other variables in time sequence. Examples of variables included in the ADM are demographic data, past medical history, injuries, injury severity, medical comorbidities and complications, rehabilitation interruptions, laboratory findings, vital signs, weight, height, use of restraints, weight bearing restrictions, presence of tracheostomy and gastrostomy tubes, and tube feeding information. Longitudinal data on rehabilitation progress and barriers were collected, including routinely measured functional independence, agitation, sleep, pain, and level of treatment engagement. To take into account each patient's comorbidities and severity of illness, we used the Comprehensive Severity Index (CSI[®]) as the primary severity adjustment measure.^{15–21}
- **3.** Data abstractors at each center were trained to collect ADM data using a web-based software system. These staff attended a 4-day training that included both didactic

and practice sessions. After training, we used weekly conference calls of all abstracters to address such issues as how to handle certain chart wording. Chart review occurred after patient discharge and took approximately 4 hours per subject. Reliability monitoring was conducted for abstracters after their first 4 charts were completed and again after 25 charts. Subsequently, reliability testing occurred periodically throughout the years when data were being collected. Charts were selected randomly from completed cases and re-abstracted by a reliability team member. A 95% agreement rate between the abstracter and reliability staff was required for each reliability test. Re-training was performed as needed if the data abstractor did not attain 95% agreement.

- 4. Using weekly conference calls, lead therapists of various disciplines from participating centers engaged in an iterative process to (a) identify and define individual components of each discipline's care process, (b) create discipline-specific documentation tools to document care processes not detailed in the medical record in order to quantify the delivery of those components (called POC documentation tools used for each therapy session), and (c) incorporate POC documentation into routine facility practices (See Appendix 1 containing POC tools). Clinicians created the POC tools based on their theoretical understanding, research evidence to date, existing guidelines, and their clinical experience. POC forms allowed recording of time spent on specific functional activities (e.g., sitting, transfers, sit-to-stand, pre-gait, gait, advanced gait, community mobility, etc. in PT).²²
- The Lead Therapist in each participating discipline at each center underwent 5. extensive training using POC training materials established by the project team. Train-the-trainer sessions were held for Lead Therapists who conducted subsequent discipline-specific training programs for their colleagues to teach them how to use the POC documentation. In total, over 950 therapists were trained. During the 30 months of data collection, weekly discipline-specific conference calls of the Lead Therapists were held to address questions concerning documentation and ensure consistent POC data completion across centers. To check reliability, periodically clinicians were given case scenarios and asked to complete POC documentation based on the scenarios. Agreement with the answer key was measured and aggregated results for each discipline in each center were reported back to the center. Clinician-specific problems were identified, and if necessary, additional training was held if agreement was <90%. Each therapy session was documented by the treating therapist after the patient encounter. Group therapy was recorded and included documentation of the number of patients, therapists, and assistants involved in the group. Nurses documented pain, sleep, and agitation during each shift. Hardcopy POC information was entered into a web-based data collection system by research assistants.
- **6.** Medication administration data were downloaded from center electronic medical record systems into the centralized research database.

- 7. Staff from each center was trained on how to track patients for follow-up after leaving inpatient care, as well as how to conduct follow-up interviews. Protocols used by the TBI Model Systems for tracking and interviewing were adapted for the study;²³ training was conducted by experienced TBI Model Systems researchers. The TBI Model Systems protocol for interviewing the "best source" of information —patient or proxy—was used in this study. Follow-up phone interviews with patients or their proxies were conducted at 3 and 9 months post-discharge, using a +/- 1-month window.
- 8. Short surveys (provider profiles) were used to collect information on clinician training and experience at each site. In addition, local investigators completed a facility survey with questions about structures and processes in the brain injury rehabilitation unit (See TBI-PBE study facility descriptions in this issue).²⁴
- **9.** Using site and patient ID the data center merged these data from multiple sources to create a patient-level database with all the data elements over the course of each patient's rehabilitation stay and follow-up interviews.
- **10.** Data were checked for completeness and accuracy (e.g., sensible value entries such as dates within the study time period and sequential timing of linked process steps or unrealistic values and obvious outliers). Data were cleaned before analysis was started.

Study Sample

Ten participating rehabilitation centers enrolled all consenting eligible patients admitted to their specialty brain injury unit, resulting in a consecutive sample of adolescents and adults with TBI receiving inpatient rehabilitation between October 2008 and September 2011 (overall 82.5% of patients consented). We chose to include sites in the US as well as Canada in order to study a broad range of patient characteristics and treatment practices. The Institutional Review Board at each study center approved the study; each patient or his/her proxy gave informed consent.

The final study sample was 2130 patients (586 females and 1544 males; 113 between age 14 and 18) treated over 2.5 years. Inclusion criteria were:

- **1.** Age over 14 years
- 2. Sustained a TBI, defined as damage to brain tissue caused by external force and evidenced by loss of consciousness, post-traumatic amnesia (PTA), skull fracture, or objective neurological findings
- **3.** TBI was characterized with an International Classification of Diseases (ICD-9-CM) code consistent with the Centers for Disease Control and Prevention Guidelines for Surveillance of Central Nervous System Injury:¹

800.0-801.9 - Fracture of the vault or base of the skull

803.0-804.9 - Other and unqualified multiple fractures of the skull

850.0–854.1 – Intracranial injury, including concussion, contusion, laceration, and hemorrhage

873.0-873.9 - Other open wound to the head

905.0 - Late effects of fracture of the skull and face

907.0 - Late effects of intracranial injury without mention of skull fracture

959.01 - Head injury, unspecified

4. Received their first, complete inpatient care on the designated adult brain injury rehabilitation unit

Functional severity—The FIM, used as a measure of the severity of functional deficits upon entry into treatment, consists of 18 items in two domains: Motor (13 items) and Cognitive-communicative (5 items). Each item is rated on a 7-category scale, ranging from 1: total assistance, to 7: complete independence. To eliminate distortion in quantifying the status of patients whose capability is at the extremes of the instrument's range, the Motor and Cognitive subscores were recoded separately using tables published by Heinemann et al. that were based on Rasch analysis of data of a large brain injury sample.²⁵

Comorbidity—CSI, developed over a period of 30 years, defines severity as the physiologic and psychological complexity presented to medical personnel due to the extent and interactions of a patient's injury(s) and disease(s). CSI is age- and disease-specific, and is independent of treatments. It provides an objective, consistent method to operationalize patient severity of illness based on over 2,100 individual signs, symptoms, and physical findings and over 5,600 disease-specific criteria sets related to all of a patient's injury(s) and disease(s), not just on diagnostic information (ICD-9-CM coding) included in a discharge summary. CSI has been validated extensively in inpatient, ambulatory, rehabilitation, and long-term care studies since 1982.^{15–21}

The CSI modification used in the present study allowed separation of severity of brain injury from severity of illness resulting from all other injuries, complications, and comorbidities. This use of CSI allowed detection of patient brain dysfunction differences that might otherwise be hidden or "washed out" by the effect of an overall injury severity score. Some criteria included in the brain CSI component were amount of intracranial bleeding, length of PTA, Glasgow Coma Scale (GCS), amount of compression, hydrocephalus, pupil reaction, etc.

CSI scores were calculated for three time spans of the patient's stay in rehabilitation:

- Admission CSI is based on all information available for the first 72 hours of the rehabilitation stay. It assesses how sick the patient was on admission to the rehabilitation facility.
- Discharge CSI reflects information from the last 72 hours before discharge.

• Maximum CSI uses information from the entire stay, including the admission and discharge periods. It measures the most aberrant findings, regardless of when they occurred.

Patient Variables—Variables describing patient characteristics, including demographics and injury characteristics, are included in table 2 overall and by admission FIM Cognitive subgroup.

Process Variables—As described above, we collected process variables in two ways: from therapy intervention POC forms and from chart review (ADM). Table 3 provides a selection of relevant findings. It also includes clinician experience calculated for the "average" clinician within a discipline who saw the patient as follows: Clinician experience index = ((sum of minutes by clinician #1 * years experience of clinician #1) + (sum of minutes by clinician #2 * years experience of clinician #2) + (etc))/(total minutes with included clinicians).

Rehabilitation Course Variables—Besides the patient data available on admission, we collected additional variables that describe the patients during the course of their rehabilitation unit stay using the ADM. These include descriptions of aphasia, dysphagia, ataxia, PTA (based on neuropsychologists' ratings on one of two analogous standardized assessments, i.e., the Orientation Log and the Galveston Orientation and Amnesia Test), pain, agitation, sleep, and falls. Table 4 provides information on these data elements.

Outcome Variables—Three main outcome variables at discharge were: discharge FIM, length of stay (LOS) (which excludes days out of the rehabilitation facility for readmission to acute care), and discharge destination. We also examined readmission to acute care during rehabilitation as an outcome. In addition, outcomes collected post-discharge via telephone interview included hospitalizations post-discharge, employment, education, FIM, community participation (measured by the Participation Assessment with Recombined Tools Objective- PART-O, a 17-item objective tool representing functioning at the societal level),²⁶ and subjective well-being (measured by Satisfaction with Life Scale- SWLS, a 5-item instrument used to measure life satisfaction).²⁷ The summary score for the PART-O represents the average of item scores ranging from 0 to 5, while the SWLS Total score is a sum of the 5 items, ranging from 7–35. For both measures, higher scores represent better functioning or satisfaction. A summary of these data elements is provided in tables 5 and 6.

Data Analyses

Analyses were performed using SAS version 9.2 (SAS Institute, Inc., Cary, NC). When data were missing, one or more adjustments were made depending on the variable and its intended use in analyses. Sometimes we categorized values simply as "unknown" (and included the category in analysis as a dummy variable representing missingness); sometimes we excluded patients with missing data from analysis; and sometimes we collapsed continuous variables with missing data into categorical variables and placed the cases with missing information into a category using corroborating data available. For example, we did not always have a patient's Body Mass Index, but had other weight- and height-related

information (e.g., an order for a bariatric wheelchair) that allowed categorizing a patient broadly, e.g., as overweight or obese.

Since we knew that our sample had patients with a wide range of functional disability, in the analysis our first step was to determine homogeneous subgroups of patients with TBI severity of brain injury. We tried different ways to create homogeneous subgroups and compared these ways based on how much variation in the outcomes was explained (R^2 and c statistics) and how distinct the subgroups were. After exploring many possible approaches, including Case Mix Groups as defined for inpatient rehabilitation patients with TBI,²⁸ time to clear PTA, and various combinations of admission FIM motor and cognitive scores, we determined that the admission FIM cognitive score was the best way to form relatively homogenous subgroups of TBI patients and defined five subgroups (score 6, 7–10, 11–15, 16–20, 21).

We used frequencies and percentages for categorical patient, treatment, rehabilitation course, and outcome measures, and means, medians, and amount of variation (SD and range) to summarize continuous measures. We conducted bivariate analyses to examine how different the patients were across the 5 FIM cognitive subgroups. For categorical variables, we created contingency tables and used chi-squared tests to determine significance of bivariate associations. For continuous variables we used analysis of variance. A two-sided p value <0.05 was considered statistically significant.

In order to examine how the TBI-PBE study patients compare to patients with TBI who received inpatient rehabilitation in the US during specific years, we used two sources of data regarding the total US TBI inpatient rehabilitation population (i.e., 99,438 for 2001–2007, and 156,447 for 2001–2010). Two papers provided most variables of interest (e.g. age group, LOS category, etc.) in percentages, which were converted to raw numbers by multiplying each with their respective US TBI population totals.^{29,30} The 2001–2007 values were subtracted from the 2001–2010 values to get the 2008–2010 values. These raw numbers were then converted back into percentages using 156,447 – 99,438 = 57,009 as the denominator (our estimate for the US TBI population between 2008 and 2010). As done with previous comparisons to national data, differences less than 5% were considered *immaterial;* those 5% but < 10% were considered *minor;* and those 10% were considered *important*.²⁶ Only US TBI-PBE patients were included in the comparison.

RESULTS

The average age of the 2130 patients was 44.5 (SD=21.3), with 72.5% male and 74.4% white non-Hispanic, 15.1% black, 6.2% white Hispanic, and 4.4% in the Miscellaneous race/ethnicity group. In table 2 we show the patient pre-injury and injury characteristics overall and within each admission cognitive subgroup. The less impaired cognitive subgroups (score 16) generally were older and contained more retired people; had a greater percentage females; were better educated; had Medicare more often as payer and Medicaid less often; and were heavier (higher BMI). These groups had a lower percentage of patients with paralysis or diabetes; a lower admission CSI; and a higher percentage with injury due to falling with more mild impairment (GCS 13–15) immediately after injury. Higher

cognitive subgroups also had the following: less frequently midline shift present; fewer subarachnoid or intraventricular hemorrhages; fewer craniectomies performed; and less time from injury to rehabilitation admission. These patients also had less functional impairment as measured by FIM motor score.

The admission FIM cognitive subgroups had different percentages of patients receiving various medications, nutritional supports, and other treatments. The lowest admission cognitive subgroups (score 10) had a greater percentage of patients being physically restrained and getting one-on-one observers during rehabilitation; more often had enteral and parental nutrition; more often had a tracheotomy; and received more psychoactive and other medication use.

The lower cognitive functioning subgroups also differed in percentage of patients receiving various therapy activities, as well as in amount of treatment (cumulatively over their stay) by each discipline for those patients receiving each activity. Treatment time differences were closely associated with LOS differences. Examples of these data are presented in table 3. The low functioning groups had fewer minutes/week of PT therapeutic exercise and more minutes/week gait training and standing. In OT, these subgroups had fewer minutes/week in upper extremity activity and lower body dressing and more minutes/week in cognitive activity. For SLP, lower functioning cognitive patients had fewer minutes/week of education and verbal reasoning, along with more minutes/week of verbal orientation review. In psychology, in general the highest percent of patients receiving each activity and for more minutes/week was the middle functioning cognitive subgroup (score 11–15); subgroups functioning at a lower level on admission tended to receive fewer minutes/week of psychology activities. Recreational therapy also tended to be given more frequently to patients in the middle cognitive functioning subgroup, but more minutes/week of most activities were given to patients in the higher functioning admission cognitive subgroups. A higher percent of patients in the lowest admission cognitive subgroup received social work/ case management activities.

Whereas table 2 provides patient pre-injury and injury characteristics, table 4 offers information on events and experiences during the rehabilitation stay. As expected, patients in the lower admission cognitive functioning subgroups had moderate to severe aphasia, dysphagia, and ataxia more often, longer time in PTA, and a greater percentage of their stay characterized by an agitated state.

Outcomes at discharge and at approximately 3- and 9-months post-discharge (approximately 1-year post-injury for most) are presented in tables 5 and 6, respectively. Table 7 provides key information on the original sample of 2130 (last column), and the samples that we classified as having a 3-month post-discharge and a 9-month post discharge follow-up interview, as well as for ANY follow-up. For the 3-month interviews, the average time from discharge to the interview was 98.5 days (SD=28.0. range 56 – 189 days); for the 9-month interviews, the average time from discharge to the interview was 309.3 days (SD=43.3. range 208 – 402 days). In Table 7 we also included a description of patients who had a 1-year *post-injury interview*. Because the 1-year *post-injury* anniversary date could fall in the window for any post-discharge interview, depending on the patient's length of stay in acute

and rehabilitation settings, additional questions required for the 1-year post-injury interview for TBI Model Systems database participants were included in the follow-up interview that fell within the window for 3- or 9-month post-discharge interview. The outcomes generally show an association with the severity of the cognitive impairment at admission, with less impaired patients showing shorter LOS, more discharges to home, higher levels of functioning (FIM) at discharge, 3, and 9 months, fewer post-discharge hospitalizations, and fewer deaths post discharge.

In table 8 we compare the TBI-PBE US study patients to the US inpatient rehabilitation population. With such large numbers for the US TBI patients, all differences are statistically significant (p<.001). The TBI-PBE patients tend to be younger, and hence are less often covered by Medicare and more often by Medicaid and private payers. TBI-PBE patients are more severely injured, with a higher percentage with an admission motor FIM 23 and admission cognitive FIM 15; there also is a greater percentage of patients in the most severe TBI Case Mix Group (207) and with a rehabilitation LOS of over 20 days. However, after we separated the TBI-PBE sample by age at < and 65 years, the vast majority of differences became immaterial or minor (<10%).

DISCUSSION

There is a significant need for evidence in TBI rehabilitation that delineates the extent that differences in outcomes are attributable to patients' characteristics such as age, severity, time since injury, and pre-injury factors, and how much outcomes can be attributed to the timing and dose of specific rehabilitation interventions. Our large sample, 10-center, comparative effectiveness study using the PBE methodology provides information on a comprehensive set of patient prognostic factors; information on the types, intensity, and duration of key activities used in interdisciplinary rehabilitation using a separate taxonomy for each discipline; and outcomes at inpatient rehabilitation discharge and 3 and 9 months later.

Our sample of 2,130 was diverse with regard to demographics, injury (etiology, physiologic damage, and severity), and functioning (FIM Cognitive and Motor scores) at inpatient rehabilitation admission. Sample stratification into 5 levels of functional capacity based on admission FIM Cognitive scores resulted in sufficiently large subsamples (N range 339 to 504) for between group analyses. Strong evidence of differentiation between the 5 cognitive groups was observed with regard to acute brain injury severity (GCS scores), brain damage (midline shift and subarachnoid hemorrhage), nature of the acute care received (craniectomy, tracheotomy or ventilation, and length of stay), inpatient rehabilitation admission brain injury severity (CSI Brain Injury scores and presence of severe dysphagia, aphasia, and ataxia), and inpatient rehabilitation admission motor functioning.

Our POC forms developed as part of this study allowed clinicians to document a wide range of therapeutic activities potentially used within each discipline including PT (19 separate activities), OT (36), SLP (86), TR (43), PSY (8), and Social Work (6).). In each discipline, significant heterogeneity in treatment activities delivered was observed within and between groups. For example, gait training was the most frequently delivered PT activity (about 80

minutes per week) across all subgroups but the consistently large SDs indicate that the average minutes per week of gait training ranged from 0 minutes to well over 3 hours within each group (table 3). Within and across subgroups, there is variation in whether or not patients get a particular treatment (%), and the average minutes they get per week. Across disciplines, persons in the highest functioning cognitive group participated in the most minutes of formal assessment/testing per week, likely reflecting a combination of short stays and greater ability to complete test requirements, resulting in less overall time in other activities.

Inpatient rehabilitation outcomes showed trends in the expected direction across the 5 admission cognitive categories. Patients admitted with more severe cognitive impairments had lower inpatient rehabilitation discharge cognitive and motor functional outcomes, higher inpatient rehabilitation discharge brain injury CSI scores, longer inpatient rehabilitation stay, and were more likely to be discharged to an institutional setting. Nine-month post discharge outcome data suggest that all patient subgroups had improved cognitive and motor functioning (table 6).

The quality of evidence to be derived from our prospective, multi-center, longitudinal study rests on standardized data collection tools, completeness of data collection, and very low attrition rates after inpatient rehabilitation discharge. The follow-up rate (79%) for one-year post-injury outcomes approached the benchmark of 80% for follow-up completeness. Examination of interactions and potential confounds as alternative explanations for the differences in outcomes between the 5 admission cognitive subgroups as well as evaluation of the effects of treatments on outcomes was beyond the scope of this introductory paper. Future analyses, including studies published in this supplement, will explore confounds when evaluating: (1) what percent of variation in treatment is accounted for by variation in patient characteristics, (2) what percent of variation in outcomes is accounted for by variation in treatment after controlling for patient and injury characteristics, and (3) what treatments and treatment patterns are most strongly related to positive outcomes for specific subgroups of patients.

Evidence from this study has important implications for future research as well as for the way that injury is categorized for persons with TBI receiving inpatient rehabilitation. The demographic, injury severity, and functional diversity of this large, multi-center sample along with the heterogeneity of both treatments delivered and outcomes observed within each of the cognitive subgroups increases the likelihood that statistical modeling will identify treatments that are associated with outcomes of interest. Preliminary evidence suggests that categorization of patients with TBI based on functional cognition at inpatient rehabilitation admission produces associations with injury characteristics, inpatient rehabilitation admission level of motor functioning and secondary conditions, rehabilitation discharge outcomes, and one-year post-injury outcomes. Historically, case-mix stratification in rehabilitation, e.g., Case Mix Groups 201–207, has focused on the physical dimension of functioning, differentiating 7 levels of FIM motor functioning within TBI admissions. Cognitive functioning (dichotomized as FIM Cognitive scores < or 23.5 is used only to differentiate among patients with a (weighted) Motor score of more than 44.25. Yet, our preliminary data show that cognition- and behavior-focused activities are common if not

predominant in SLP, OT, and psychology interventions and that the current Case Mix Groups may undervalue the cognitive dimension. Our preliminary analysis indicates that additional levels of stratification by cognitive functioning in the TBI rehabilitation population yield important prognostic information. Further evidence that patients in specific cognitive subgroups substantially benefit from additional rehabilitation treatment not factored into current case-mix groups may argue for case-mix reform with more emphasis placed on the cognitive dimension in inpatient rehabilitation treatment.

Findings from the TBI-PBE study are likely to generalize to the US rehabilitation population of persons with TBI. A comparison of our sample to a concurrent group of U.S. patients, when dichotomized at age 65, indicated that persons in our sample were similar to persons in their respective age groups in the wider US TBI rehabilitation population.

CONCLUSIONS

This prospective, 10-center, comparative effectiveness study using the PBE methodology succeeded in developing a standardized treatment taxonomy and prospectively capturing naturally occurring variation within patients and treatments. This preliminary information offers a basis for subsequent papers from this study to investigate best treatments for specific patient impairments and groups.

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Abbreviations

| ADM | Auxiliary Data Module |
|-----|---------------------------------|
| CSI | Comprehensive Severity Index |
| FIM | Functional Independence Measure |
| GCS | Glasgow Coma Scale |
| LOS | Length of stay |
| ОТ | Occupational therapy |
| PBE | Practice-Based Evidence |

| POC | Point of care documentation forms |
|-----|-----------------------------------|
| РТ | Physical therapy |
| РТА | Post traumatic amnesia |
| SLP | Speech Language Pathology |
| TBI | Traumatic brain injury |
| | |

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Appendix 1

TBI-PBE Physical Therapy Form v.3.19.09



TBI-PBE Occupational Therapy Form v.11.19.08

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TBI-PBE Speech and Language Pathology Form v. 1.15.09



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Arch Phys Med Rehabil. Author manuscript; available in PMC 2016 August 01.

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TBI-PBE Therapeutic Recreation Form v.10.6.08

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KEY

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KEY

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TBI-PBE Psychology Form v.10.6.08



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TBI-PBE Agitated Behavior Scale (ABS) - Nursing POC v.10.1.08

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| 1 = Absent: The bahavior is a Stight Degree. 2. Impulsive, impatient, toe tolerance for pain or frustration 2 = Present to a Monterab Degree. 3. Uncooperative, resistant to care 2 = Operative to a Monterab Degree. 5. Update and/or threataning violence toward people or property Chronic State and State an | culturior recy | 1. Short attention span, easy distra | ctibility, inabi | ity to cance | ntrab | e | | | |
| The behavior is not present: 2. Implaints, mediating, two toleramon for pain of thrustration 3. Uncooperative, resistant to care 3. Explosive and/or unpredictable anger 3. Parisent to andecate Degree 3. Restlissands, pacing, excessive movement 3. Restlissands, pacing, excessive movement 3. Repol, foud, or excessive tailing 3. Sudden form sub 3. Sudden | 1 = Absent: | | | | | | | | |
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| ornamiscular y appropriate behavior Section to provided Section to provide to an other section to an other sectin | he behavior is present, but does not | 4. Violent and/or threatening violen | nce toward pe | ople or prop | erty | | | | |
| The individual many redinet: | ontextually appropriate behavior | | | | | | | | |
| portaneously or the continuation 6. Rocking, nubbing, moaning, or other self-stimulating behavior Insrp1 appropriate behavior. 7. Puting at tubes, restraints, etc. In an appliate of bankwork. 8. Rocking, nubbing, moaning, or other self-stimulating behavior In Present to a Moderate Degree: 8. Rocking, nubbing, moaning, or other self-stimulating behavior In an appliate of bankwork. 9. Restifications, motor and/or verbal In Present to a Moderate Degree: 1. Repditive behaviors, motor and/or verbal In Present to a Modeling or other or applies or applies and the oragges appropriate behavior due to be regiment. 1. Repditive behaviors, motor and/or verbal In advisition at locating or other oragenesis or approved and the oragges appropriate behavior due to be oragenes are sproved and to be reacessive cashing and/or laughter 13. Easily initiated or eacessive crying and/or laughter In Serviced. 14. Serf-abusiveness, physical and/or verbal 14. | The individual may redirect | 5. Explosive and/or unpredictable anger 6. Rocking subhists meaning or other self-stimulating behavior | | | | | | | |
| be agitated behavior: does not 7. Pulling at tubes, restraints, etc. 7. Pulling at tubes, restraints, | pontaneously or the continuation of | | | | | | | | |
| Singli appropriate behavior.) 7. Puting at ubes, restraints, dc. Present 8 and extreme Dargene: 9. Winderking from treatment areas Ins individual in appropriate behavior. 9. Rastitisanes, pacing, excessive movement Ins individual in table to engage 1. Rapid, foud, or model and to engage I = Present 8 an Extreme Dargene: 1. Rapid, foud, or model and to engage I = Resting behavior, due to be conditioned an appropriate behavior, due to be conditioned and to be engage 1. Rapid, foud, or excessive atlang I = Resting behavior due to be to engage 13. Eably initiate or excessive and/or and/or lengther I = Stereme Dargene: 13. Eably initiate or excessive and/or and/or verbal I = Stereme Dargene: 14. Self-abusiveness, physical and/or verbal | he agitated behavior does not | a recently received, meaning, or other perioriting bendrich | | | | | | | |
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| ann en agtanziated bei an agtorprovide 9. Resitiesnoss, paicing, excessive movement 10. Repetitive behaviors, motor andriv verbal 11. Rapid, loud, or excessive talking 12. Saudan charger of mod 12. Easily initiated or excessive talking 12. Easily initiated or excessive calking 13. Easily initiated or excessive calking 14. Sef-abusiveness, physical and/or verbal | = Present to a Moderate Degree: | o. wanneng nom reasoned antida | | | | | | | |
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| the end of the againstic enderwork. The Early initiated or excessive crying and/or laughter develoon is provided. T4. Self-abusiveness, physical and/or verbal | appropriate behavior due to the | | | | | | | | |
| edirection is provided. 14. Self-abusiveness, physical and/or verbal | wen when external cuaina or | 13. Easily initiated or excessive crying and/or laughter | | | | | | | |
| | redirection is provided. | 14. Self-abusiveness, physical and | | | | | | | |
| TOTAL SCORE | | | | TOTAL SC | ORE | | | | 1 |

TBI-PBE Nursing Form v.10.1.08



TBI-PBE SW/CM ADMISSION FORM v.10.6.08



The primary social worker or case manager assigned to the patient should complete the admission form after meeting the family, but within the first 72 hours after admission.

At the top of the admission form, write your assigned clinician ID, the patient's name, and the date. The admission form ha

. Caregiver's Relationship to Patient Itarify how the patient knows the caregiver. Examples may include: sister, bro

2. Caregiver Engagement with the Rehab Process The goal of his scale is to capture the primary caregiver's level of ergagement with the rehab process and with the tread sup of rehabilitation. The scale measures the average level of the caregiver's interaction with the rehab tear provided from other team members. Select the level of engagement that best describes the caregiver. Options incl the scale of the scale of

- In som other team members. Send the level of engagement that beat obscribes the caregiver . Option include: gent The caregiver point point officiation. The caregiver is reading the member method is the transformer adjusts avoid-memb based on feedback from the include team. The caregiver is willing to be incident in the goal making process, willing to accept agreed upoint basks, and demonstrates stoles include. The caregiver is autive pather in the reliab process. It programs that and demonstrates stoles include to the method beam's goals. The caregiver is deson and constrates and demonstrates stoles include to the network beam's goals. The caregiver is **programs Engaged**: The caregiver also also that the caregiver is and the network beam's goals. The caregiver is **programs Engaged**: The caregiver base of netbacks from the reliab bases. The caregiver is interceptive is **active Engaged**: The caregiver reliable to be constrained and programs **and active a**

- autoricross manager: aged: The caregiver refuses to or is unable to comply with the social worker/case manager's instructions or requests. The patient has no primary caregiver, family or significant support network

Level of Understanding of the Injury and its Consequences irde the level of understanding that best describes the primary caregiver. Options include:

- If every on unumeritationing that baset describes the primary caregolute. Options include: patiently inderstanding. The caregolute is able to articitate that a problem it docut as the result of some deficit. The shelling the anticipate the occurrence of a problem requires knowledge that a problem it docut as the result of some deficit. The shelling the anticipate the occurrence of a problem requires knowledge that a problem iteration in rigory. perful Understanding. The caregolier is developing the ability to apply intellectual knowledge in some situations. Heiche is learning to respond to changes in padeits that and reliable these changes to the term inity as well as to recoping and as to product the second term of the second term initiation and reliable to everificational by theiring to improve change. The second term of the second term initiation and reliable to everificational by theiring to many people in the room, the care cales having needs to clear the room. Initiation of the second term of the patient of the second term initiation. All of the sapply the loweledge to appendix that and reliable to everificational by theiring that are problem to the care cales having reads to clear the room. Initiation of the second term of the patient. The caregolity of the sample in the room. Initiation of the second term of the patient of the patient of the patient of the second term of the sapple in the room. Initiation of the second term of the second term of the second term of the second term of the sapple in the room of the second term of the caregolution of the second term of the second term of the caregolution of the second term of the consequence the integration of the second term of the the second term of the consequence of the the term of the consequence of the consequence of the consequence of the integration of the determine the second term of the consequence of the consequence of the consequence of the consequence o
- Complete: Caregiver cannot communicate effectively enough for the SW/CM to determine his/her level of under ematively, the patient has no family or primary caregiver.

Primary Caregiver Not Yet Assigned a primary caregiver has not been identified within the first 72 hours of admission (time slot in which to complete this form), check the box is

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ADMISSION FORM-KEY

The primary social worker or case manager assigned to the patient should complete the admission form after meeting the family, but will first 72 hours after admission.

At the top of the admission form, write your assigned clinician ID, the patient's name, and the date. The admission form has four question

. Caregiver's Relationship to Patient Clarify how the patient knows the caregiver. Examples

. Caregiver Engagement with the Rehab Process he goal of this scale is to capture the primary caregiver's level of engagement with the rehab process and with the rene days of rehabilitation. The scale measures the **average level** of the caregiver's interaction with the rehab to cruded from other team members. Second the level of engagement that beds describes the caregiver. Options in

- It is non more ream members. Select the level of engagement that best docubles the caregiver. Options include: get: The caregiver geosen ago-diverses the caregiver providely enforcing careful the reach providence. The caregiver requires the react of the sense providence of the sense providence and the sense that and the rest is the sense that the rest is the sense of the sense o

Level of Understanding of the Injury and its Consequences irde the level of understanding that best describes the primary caregiver. Options include

- I level of understanding. The caregiver is able to anticipate that a problem will occur as the result of some deficit. The ability to anticipate the documents of a problem requires knowledge that a problem will occur as the result of some deficit. The ability to anticipate the documents of a problem requires knowledge that a problem will social and recognition of problems that occur. The senting to respond the document of a problem requires knowledge that a problem will social and recognition of problems that occur. The senting to respond to changes in patient status and relates that a problem version to changes in patient status and relates these changes to the term insyrt, as well as to recognize and act on problems as they occur. For example, (1) the caregiver ray understand the patient's physical deficits, but is ability integration to example in the room, the care changes to patient status and relates to eversimitate on the howing to many problem the room, the care changes to patient is example. (1) the caregiver can pipcing the responder to the patient, but does not associated cognitive deficits or (2) at a patient is oversimated and to howing to many problem the room, the care changes to patient the patient is ability to active the patient's physical deficits, but is ability room to the caregiver can pipcing the caregiver can pipcing the caregiver can pipcing the patient's physical deficits, but is and the owner that also efficient about the patient. But does not associated with a brain approximation (1) the patient's physical deficits, but is a not associated the patient is patient ability that are offletered about the patient. But does not associated with a brain approximation (1) the patient's physical deficits, but is a not associated with a brain approximation the patient's physical deficits, and and and and and a state and the patient about the patient. But does not associated with a brain approximation the patient's physical deficits abindead equations for this about the patient about the patie on one provide the second s
- ary Caregiver Not Yet Assigned ary caregiver has not been identified within the first 72 hours of admission (time slot in which to complete this form), check the box in

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TBI-PBE SW/CM DISCHARGE FORM v.10.6.08

| Clinician ID Patient Name Date | How many 'family members' were "actively " How many 'family members' were "actively " involved" with the patient during rehab? 2. Is the family type "chaotic"? (VES / NO) |
|---|--|
| Answe Primary C | 3-7 for the regiver ONLY (Example: "State") (Example: "State") (Exampl |
| Check one) (Check one) Minin Unenga N/A (No familynig | Intelligence Coping Style: Engaged Coping Style: Mostly Engaged Anticipatory Understanding Mostly Engaged Intelligence Intelligence Engaged Intelligence Intelligence Intelligence Engaged Intelligence Engaged Intelligence Engaged Intelligence Engaged Intelligence Engaged Intelligence Engaged Unable to complete Engaged Unable to Complete Engaged Unable to Complete Englete to Complete Engletencies Engletencies Unable to Complete Engletencies Engletencies Engletencies |
| 8. Limitation Culture Citizenship Distance fr Education I Envir, Barri Family Dyn | Barriers to Rehab & Reaching Independence (Inver.ALL exploate tarriers) sues moneter Dimited Community Resources (stations to Dimited Social Resources Dimited Socia |
| 9. Referrals Home Health: | dentified by Discharge (Check ALL that apply) OT PT_SLP_Aide_RN_SWAdute: Care_Other Rehab |
| Outpatient: | OTPTSLPPSYSWTRDay Rehab/TreatmentAquatic TherapyVoc Rehab |
| Care: | _Hospice/Pallative _Long Term _LTAC/Complex Continuing _Substance Abuse _VA Facility |
| SNF: | _Sub-acute RehabSkilled Nursing Facility |
| Residential: | _Group HomePost-Acute RehabShelterSupported LivingTBI Community |
| Community: | _Case Management _Culturally Specific _Disabled Parking _Transport _School |
| Assistance: | _HomemakingMeals-on-Wheels/Food DellveryPharmacy |
| Services: | _AgingBrain Injury AssociationCaregiver Support GroupsLegal AidRespite |
| Financial: | Medicaid/Medi-Cal Maiver SSDI/SSI State Welfare/Food Stamps |

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DISCHARGE FORM-KEY

The primary social worker or case manager assigned to the patient should complete this fi of the form, write your assigned clinician ID, patient's name, and date. The discharge form

. How many family members, friends, etc. were "actively involved" with the patient during rehab? Actively involve ho come to therapy, family trainings, and family conferences, will accept follow up care responsibilities, return calls, and d ischarge plans with the rehab team.

. Is the family type "chaotic"? Chaotic family: a family that does not function well as a unit, has po rovides inconsistent information, has a lack of consensus, and does not work well together as a group

Caregiver's Communication Via Phone Was the majority of communication with the primary caregiver or Caregiver's Relationship to Patient Clarify how the patient is related to the caregiver. Examples may include: sister, brother, andmother, girlfriend, son, roommate, neighbor, etc.

ther, difficult, son, normality, neighbor, etc. here: **Spageness** with the **scheb** hereas. The spagin of this societ is to capture the primary campier's level of spaces as so with the relate herean over the series relationship. The scale instaurus the **series primary** campier's level of spaces as a with the relate herean over the series relation to the team members. Select the wird of engagement the base to concomment of the series of t

nding of the Injury and its Consequences Circle the level of understanding that b H of Ur

under tropp Understandingen. The caregiver is able to anticipate that a problem will occur as the result of score defuel. The careners of a problem requires knowledge that a problem with and recorprised of problems that occur. The caregi-gring has and physical consequences of the trans ruly or U Inderstanding. The caregiver is devoluting the ability to apply reflectual investigation is some sharings . Here anyon is during the standard state is devoluting the ability to apply reflectual problems that occur. The second is during the problem states and reflect the during state is the term injury, as well as its income sharings . Here states in the states of the state of the states of the state of the states of diated by having ding: The careg aregiver realizes herst mation about brain in to apply the knowledge to

i ne parenti. Then promoted, the caregiver can pirpoint things that are different about the patient, but does not associate them with smallase the patient's behavior ("Mom was always like that") is near a submations for charges ("Here just act ma"). The caregiver does not understand extern of the consequences of the signs).

e injury. his/her level of und sipal coping styles by checking the approp

r's Coping Styles Indicate the primary caregiver's two pri-tech only one box.

ny one oco. We This type of lamity neety visits the patient, is unable to discuss the injury, and/or has difficulty discussing and plannin ICR-billenging: This type of caregover angues with or challenges, the staff and/or dhers occorreing what is best for the p rest, such as origing on learn member to an other. This type of caregover approximation the injury as a challenge and locks for ways to solve problems associated with rehue the field Resources: This type of caregover even is on others in the locks members, support, case workers, etc. (b) is made of the field Resources: This type of caregover even is on others in their solver the locks for ways to solve problems associated with rehue the lock of the lock

mental Support: This type of caregiver seeks assistance, information, advice, sympathy, and/or emotional support from r makes final decisions.

and Barriers to Rehab and Reaching Independence. Circle the limitations and barriers to ref ment post-discharge that you identified within the family during the patient's stay (all that apply)

rais identified by discharge Circle the referrals you made for patient and caregiver during the rehab stay. relevant referrals.

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| DISCHU | ARGE FORM-KEY |
|---|--|
| The prid of the fo | mary social worker or case manager assigned to the patient should complete this form within 72 hours of patient discharge. At the top mm, write your assigned clinician ID, patient's name, and date. The discharge form has nine questions: |
| 1. How who con dischar | many family members, friends, etc. were "actively involved" with the patient during rehab? Actively involved: refers to people me to theapy, family trainings, and family conferences, will accept follow up care responsibilities, return calls, and docuss the patient ge plans with the relab team. |
| 2. Is th provider | e family type "chaotic"? Chaotic family: a family that does not function well as a unit, has poor communication among members, s inconsistent information, has a lack of consensus, and does not work well together as a group. |
| 3. Care | giver's Communication Via Phone Was the majority of communication with the primary caregiver conducted over the phone? |
| 4. Care grandm | giver's Relationship to Patient. Clarify how the patient is related to the caregiver. Examples may include: sister, brother, mother, other, girlfriend, son, roommate, neighbor, etc. |
| 5. Care the reha with the caregive | giver's Engagement with the Rehab Process. The goal of this scalar is to capture the primary caregiver's lovel of engagement with the process and with the rehab tame over the entire rehabilition. The scalar measures the average level of the caregiver's interaction rehab team, so consider information provided from other team members. Select the level of engagement that best describes the c. Octoors include: |
| Enga | ged: The caregiver appears goal-directed. The caregiver proactively anticipates patient needs at discharge. The caregiver adjusts involvement base on feedback from the rehals fearm. The caregiver is willing to be involved in the goal making process, willing to accept agreed upon tasks, and demonstrative follow through. The caregiver is an active pathers in the rehats process. |
| Mosti | y Engaged: The caregiver is goal-directed, but the caregiver's goals are not consistent with the rehab team's goals. Caregiver does not consistently adjust involvement based on feedback from the rehab team. The caregiver is willing to accept agreed upon tasks, and demonstrates some follow through. The caregiver is the rehab team cores. |
| Some | what Engaged: The caregiver releas on the social worker/case manger to direct all tasks. The caregiver is receptive to accepting responsibility for some tasks. The caregiver bandlist from encouragement and prompting to follow through with tasks. The caregiver may or may not initiate contact with the social indexidence management. |
| Minin Unen N/A: | In the Company of the campion relies on the rinkul bana to set goals, and is often unresponsive. The campion majors fragment indirection, promoting, and encourgement to follow through with lask. The campion does not initiate contract with the social vectoristics manager. ggggdt: The campion reliance to ris unable to comply with the social vectoricizes manager's instructions or requests. The particular and on privaly campion. |
| 6. Leve | I of Understanding of the Injury and its Consequences. Circle the level of understanding that best describes the primary caregive |
| Options Antic | include: ipatory Understanding: The caregiver is able to anticipate that a problem will occur as the result of some defoit. The ability to anticipate the occurrence of a problem requires knowledge that a problem exists and recognition of problems that occur. The caregiver is able to acknowledge |
| Emer | cognitive and physical consequences of the train yury. gent Understanding: The caregiver is developing the ability to apply intellectual knowledge in some situations. Herishe is learning to respond to changes in patient status and relate these changes to the brain injury, as well as to recognize and act on problems as they court. For example, (1) the caregiver may understand the patient's physical disflox, but is all thing to understand the associated cognitive deficitio or (2) if a |
| Intelle | patient is over-stimulated by having too many people in the room, the caregiver realizes he/she needs to clear the room. ectual Understanding: The caregiver is able to verbalize general information about brain injuries, but is not able to apply the knowledge to |
| Limit | specific situations with the patient. ad Understanding: When prompted, the caregiver can pinpoint things that are sifterent about the patient, but does not associate them with a brain injury. Heihim rang notmatize the patient's behavior ("Mom was always like that") or seek alternate explanations for charges ("Heri just acting like th |
| Unab | because he wint at home?). The caregiver does not understand extent of the consequences of the injury. le to Complete: Caregiver cannot communicate effectively enough for the SWICM to determine his/her level of understanding. Alternatively, the patient has no tunky or primary caregiver. |
| 7. Care | giver's Coping Styles Indicate the primary caregiver's two principal coping styles by checking the appropriate boxes. If only one style is the check note note that |
| Esca Confr | part Avoidance: This type of family meety visits the patient, is unable to discuss the injury, and/or has difficulty discussing and planning for discharge, ontational/Challenging; This type of caregover anyoes with or challenges the staff and/or others concerning what is best for the patient. Challeng may be indirect with a softwaine on learn member to another. |
| Probl | em-Solving: This type of caregiver approaches the injury as a challenge and tooks for ways to solve problems associated with rehab and discharge nce on Outside Resources: This type of caregiver reles on others (rehab team members, lawyers, case workers, etc.) to make decisions for him- her concerning the partient. |
| Seek | ing Emotional/Instrumental Support: This type of caregiver seeks assistance, information, advice, sympathy, and/or emotional support from others, but the caregiver makes final decisions. |
| 8. Limi continui | tations and Barriers to Rehab and Reaching Independence. Circle the limitations and barriers to rehabilitation treatment and to ng treatment post-discharge that you identified within the family during the patient's stay (all that apply). |
| | |

TBI-PBE Social Work/Case Management Form v.10.6.08

| Weekly Information | | | | | Famil | y Care | Confere | nce | Family Ca (amily & re | e Confe | (patient m | tormal acit lay or may | not be p |
|---|-----------------------------|-------|--------|----------|-------------|---------|-----------|--------|--------------------------|------------------------|------------------------------|---------------------------|-------------|
| rations reactio: | | - | | | Time S | pent: P | atient Pr | esent: | Team Mee | ting: A w | eekty or d | iscneige (elv meetin | ig with the |
| Date Week Starts | 1 | (Mc | onday) | | | | Yes ! | No | Inan to di | icuss reh | ab care pl | anning, be | an goals |
| Clinician ID: | 1 | | | | minu | bes | (circle o | ne) | upon disch | ers to go erge. (Do | current be | dow] | s passer |
| Time Spent (in mine | ites): | Pa | itient | Fa | miy P.P. | Patient | & Family | 5 | Staff | or F | Patient &/ amily P.P.c | Behalf o | Patien |
| Monday | - | 1.20 | 5. | A. R. 12 | 5.9 | 8.6 | 5 20 | 8.4 | 2 2 3 | 6.4 | 5.0 | 8.49 | 54 |
| Psychosocial Assessme | int L | 111 | U L | 100 | U U | 00 | 0.0 | LU L | | 00 | 0.0 | U U | 00 |
| Discharge Hanning/Hel | emais L | 111 | 111 | 1 4 4 | <u> </u> | 1111 | 111 | | | 44 | <u> </u> | | 1111 |
| Crisis Intervention | | 10 | 0.0 | | 0.0 | 00 | 00 | | | 00 | 00 | 00 | 00 |
| Utilization Review | | | 00 | | 00 | 00 | | 00 | | 00 | 00 | 00 | |
| Patient Advocacy | | 1.17 | | 100 | | 0.0 | 0.0 | 00 | 1 0 0 | 0.0 | 00 | 00 | |
| Education/Support | | | | Tim | a Snent | in Team | Meeting | | | nutes | | 00 | |
| - | | | | | e opene | | and only | | ··· | indias | | | |
| Psychosocial Assessme | nt D | | 00 | 00 | 00 | 00 | 00 | | 100 | | 00 | 00 | 00 |
| Discharge Planning/Ref | errals | 10 | 0.0 | 00 | 00 | 00 | 00 | DE | 00 | 00 | 00 | 00 | 00 |
| Crisis Intervention | 0 | 10 | 0.0 | 100 | 00 | 00 | 0.0 | 00 | 1 0 0 | 00 | 00 | 00 | 0.0 |
| Utilization Review | | 10 | 0.0 | 00 | 00 | 00 | 00 | 00 | 00 | 00 | 0.0 | 00 | 0.0 |
| Patient Advocacy | 1 | 10 | 0.0 | 0.0.0 | 0.0 | 00 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | nn | 0.0 |
| Education/Support | - | 1 [1] | 0.0 | 100 | 0.0 | 00 | 0.0 | 0.0 | 1 0 0 | 0.0 | 00 | 0.0 | 0.0 |
| Euocasianauppon | | | | Tim | e Spent | in Team | Meeting | | | inutes | | | |
| Wednesday | | | | | | _ | | _ | | | | | |
| Psychosocial Assessme | init 🗆 | | | | | 00 | | 00 | | 0.0 | | | |
| Discharge Planning/Ref | errals [| | | 100 | | 0.0 | | 0.0 | | 0.0 | | 00 | |
| Crisis Intervention | | | 00 | | | 00 | | 00 | | 00 | | 00 | |
| Utilization Review | | | | 100 | | 0.0 | | 13.0 | | 0.0 | | 00 | |
| Patient Advocacy | | | | | | 00 | | 00 | | | | | |
| Education/Support | | | | 100 | | 00 | | | | | | | |
| | | | | Tim | e Spent | in Team | Meeting | ۴ L. | m | inutes | | | |
| Thursday | | 101 | ri r | lan | 0.0 | [rin | 0.0 | Inc | 1 1 1 | inn | nn | Laa | nin |
| Dischama Planning/Raf | arrala [| 1.73 | 11.0 | 0.0 | 0.0 | 00 | 0.0 | DI | 0.0 | 0.0 | 00 | 0.0 | 0.0 |
| Crisis Intervention | 1 | 107 | 0.0 | Inc | 0.0 | D.C. | 0.0 | 111 | 1 00 | DP | 00 | no | 0.0 |
| Utilization Review | 1 | 1.01 | 110 | 100 | DP | 00 | 00 | 0.0 | | 0.0 | 00 | DP | 0.0 |
| Patient Advocacy | | 1/7 | 11 1 | 100 | DD | 00 | 0.0 | me | | 00 | 0.0 | I II II | 0.0 |
| Education Present | | 1 (1) | F1 C | 100 | 0.0 | 00 | 0.0 | 0.0 | 1 11 10 | 0.0 | 0.0 | 00 | 0.0 |
| concentratippon | | | | Tim | e Spent | in Team | Meeting | Ē | m | inutes | | 1.0.0 | |
| | | | | | | | | | | | | | |
| Friday | | | | | | | | 00 | | 0.0 | | 00 | |
| Friday Psychosocial Assessme | nt (| 10 | | | | | | | | | | | |
| Friday Psychosocial Assessme Discharge Planning/Ref | ent (| | 00 | | 00 | 00 | | | | 5.4 5.4 | | 10 LU | |
| Friday Psychosocial Assessme Discharge Planning/Ref Crisis Intervention | errals [| | | | 00 | 00 | 00 | | | 00 | 00 | 00 | 00 |
| Friday Psychosocial Assessme Discharge Planning/Ref Crisis Intervention Utilization Review | errals (| | | | | | | | | 00 | 00 | 00 | |
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| Friday Psychosocial Assessme Discharge Planning/Ref Crisis Intervention USization Review Patient Advocacy Education/Support | ent C crrais C C C | | | | | | | | | | | | |

Table 1

Participating Rehabilitation Centers

| Facility | Location |
|--|--------------------|
| Wexner Medical Center* | Columbus, OH |
| Carolinas Rehabilitation, Carolinas HealthCare System* | Charlotte, NC |
| Mount Sinai Medical Center* | New York, NY |
| National Rehabilitation Hospital | Washington, DC |
| Shepherd Center | Atlanta, GA |
| Intermountain Medical Center | Salt Lake City, UT |
| Rush University Medical Center | Chicago, IL |
| Brooks Rehabilitation Hospital | Jacksonville, FL |
| Loma Linda University Rehabilitation Institute | Loma Linda, CA |
| Toronto Rehabilitation Institute | Toronto, Ontario |

* TBI Model System center

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Table 2

| | | | | | * | | |
|--|-------------------------|-------------|--------------|----------------------|----------------------|--------------|---------------------------|
| | | | Admission] | FIM Cognitive Sc | ore* | | |
| <u>Characteristics</u> | Overall (n=2130) | <=6 (n=339) | 7-10 (n=374) | <u>11–15 (n=495)</u> | <u>16-20 (n=408)</u> | >=21 (n=504) | P |
| Demographics | | | | | | | |
| Male (%) | 72.5 | 71.7 | 76.5 | 75.8 | 71.3 | 67.7 | 0.018 $\dot{\tau}$ |
| Age at rehabilitation admission (mean, SD) | 44.5 (21.3) | 43.0 (21.9) | 42.3 (20.0) | 43.1 (20.9) | 46.9 (21.6) | 46.8 (21.8) | $<.001 \mathring{\tau}$ |
| Race/Ethnicity (%) | | | | | | | 0.083 $\mathring{\tau}$ |
| Black | 15.1 | 15.3 | 13.9 | 16.8 | 15.4 | 13.9 | |
| White non Hispanic | 74.4 | 9.77 | 73.5 | 73.5 | 74.3 | 73.4 | |
| White Hispanic | 6.2 | 5.0 | 8.0 | 5.7 | 6.6 | 5.8 | |
| Other and $unknown^{S}$ | 4.4 | 1.8 | 4.5 | 4.0 | 3.7 | 6.9 | |
| Highest education achieved (%) | | | | | | | 0.008 $\dot{\tau}$ |
| Some high school, no diploma | 23.0 | 20.4 | 26.2 | 25.3 | 26.5 | 17.5 | |
| High school diploma | 25.9 | 25.1 | 27.5 | 28.1 | 25.7 | 22.6 | |
| Work towards or completed Associate's degree | 16.2 | 15.9 | 13.9 | 14.9 | 17.9 | 18.1 | |
| Work towards or completed Bachelor's degree | 19.7 | 21.2 | 20.3 | 18.8 | 15.9 | 22.0 | |
| Work towards or completed Master's/Doctoral degree | 9.7 | 11.5 | 8.0 | 8.3 | 8.3 | 12.1 | |
| Unknown | 5.7 | 5.9 | 4.0 | 4.6 | 5.6 | 7.7 | |
| Marital status prior to injury (%) | | | | | | | 0.267 $\dot{\tau}$ |
| Single/never married | 42.6 | 43.7 | 44.9 | 44.8 | 38.2 | 40.9 | |
| Married/common law | 36.5 | 36.3 | 35.6 | 35.8 | 37.0 | 37.9 | |
| Previously married | 17.5 | 16.2 | 15.5 | 16.2 | 22.5 | 17.1 | |
| Other/unknown // | 3.5 | 3.8 | 4.0 | 3.2 | 2.2 | 4.2 | |
| Occupation prior to injury (%) | | | | | | | 0.006 |
| Employed and student | 4.0 | 4.1 | 4.0 | 4.4 | 2.9 | 4.4 | |
| Employed only | 47.1 | 45.4 | 48.4 | 47.5 | 43.9 | 49.4 | |
| Unemployed | 13.3 | 13.6 | 15.8 | 13.7 | 14.2 | 10.3 | |
| Retired | 23.1 | 20.9 | 17.9 | 21.0 | 28.4 | 26.4 | |
| Student only | 11.4 | 13.6 | 12.0 | 12.7 | 9.6 | 9.3 | |

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| | | | Admission I | FIM Cognitive Sc | * :0re | | |
|-----------------------------------|-------------------------|-------------|--------------|-------------------------|----------------------|--------------|---------------------------|
| Characteristics | <u>Overall (n=2130)</u> | <=6 (n=339) | 7-10 (n=374) | <u>11–15 (n=495)</u> | <u>16-20 (n=408)</u> | >=21 (n=504) | d |
| Unknown | 1.1 | 2.4 | 1.9 | 0.6 | 1.0 | 0.2 | |
| Able to drive before injury (%) | | | | | | | 0.128 $\dot{\tau}$ |
| Yes | 73.1 | 70.2 | 75.7 | 75.6 | 6.69 | 73.0 | |
| No | 10.8 | 9.4 | 10.7 | 9.5 | 13.9 | 10.5 | |
| Unknown | 16.1 | 20.4 | 13.6 | 14.9 | 16.2 | 16.5 | |
| Primary payer (%) | | | | | | | $<.001$ $\mathring{\tau}$ |
| Medicare | 19.4 | 18.0 | 15.0 | 18.4 | 23.0 | 22.2 | |
| Medicaid | 15.5 | 20.9 | 18.2 | 16.4 | 17.2 | 7.7 | |
| Private insurance | 24.5 | 26.3 | 24.6 | 30.1 | 24.0 | 17.9 | |
| Centralized (single payer system) | 6.9 | 0.3 | 1.9 | 2.4 | 6.4 | 20.2 | |
| Worker's compensation | 6.8 | 5.9 | 8.6 | 6.7 | 6.1 | 6.5 | |
| Self pay | 2.2 | 0.9 | 3.5 | 3.4 | 1.5 | 1.4 | |
| MCO/HMO | 14.3 | 13.9 | 18.4 | 14.1 | 13.2 | 12.3 | |
| No-fault auto insurance | 4.5 | 7.1 | 4.0 | 3.2 | 2.9 | 5.8 | |
| None | 2.4 | 3.2 | 2.4 | 2.0 | 2.0 | 2.8 | |
| Other/unknown | 3.4 | 3.5 | 3.5 | 3.2 | 3.7 | 3.0 | |
| Secondary payer (%) | | | | | | | $<.001$ $\dot{\tau}$ |
| Medicare | 1.8 | 2.1 | 1.3 | 1.6 | 2.7 | 1.4 | |
| Medicaid | 4.2 | 4.4 | 4.5 | 4.8 | 4.2 | 3.2 | |
| Private insurance | 12.7 | 14.5 | 8.8 | 8.5 | 14.2 | 17.3 | |
| Worker's compensation | 0.3 | 0.0 | 0.0 | 0.2 | 0.2 | 0.8 | |
| Self pay | 3.4 | 1.2 | 4.8 | 4.9 | 2.9 | 2.6 | |
| MCO/HMO | 2.4 | 3.5 | 1.6 | 2.6 | 1.7 | 2.4 | |
| No-fault auto insurance | 6.7 | 8.9 | 5.3 | 6.3 | 6.6 | 6.5 | |
| None | 42.0 | 51.0 | 45.2 | 42.1 | 38.0 | 36.9 | |
| Other/unknown | 26.7 | 14.5 | 28.3 | 29.1 | 29.4 | 29.0 | |
| Admission body mass index (%) | | | | | | | $<.001$ $\mathring{\tau}$ |
| <16 | 1.4 | 2.4 | 2.1 | 1.6 | 1.0 | 0.4 | |
| 16-<=18.5 | 8.5 | 11.8 | 11.0 | 8.1 | 8.1 | 5.2 | |
| >18.5-<=25 | 49.7 | 55.5 | 55.1 | 50.5 | 46.3 | 43.1 | |

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| | | | Admission] | FIM Cognitive Sc | ore * | |
|--|-------------------------|-------------|--------------|----------------------|----------------------|--------------|
| Characteristics | <u>Overall (n=2130)</u> | <=6 (n=339) | 7-10 (n=374) | <u>11–15 (n=495)</u> | <u>16-20 (n=408)</u> | >=21 (n=504) |
| >25-<=30 | 23.6 | 18.0 | 18.7 | 25.1 | 26.5 | 27.6 |
| >30-<=35 | 7.9 | 6.5 | 7.5 | 7.9 | 8.3 | 9.1 |
| >35-<=40 | 2.3 | 1.8 | 1.3 | 2.4 | 1.7 | 3.6 |
| >40 | 1.3 | 0.0 | 1.3 | 1.2 | 1.2 | 2.4 |
| Unknown | 5.3 | 4.1 | 2.9 | 3.2 | 6.9 | 8.7 |
| Pre-existing and co-existing conditions | | | | | | |
| History of alcohol use before injury (%) | 44.6 | 38.3 | 50.0 | 48.1 | 44.6 | 41.1 |
| Alcohol use at time of injury (%) | 1.9.1 | 18.6 | 17.4 | 20.2 | 20.1 | 18.5 |
| History of alcohol abuse before injury (%) | 35.6 | 30.4 | 36.9 | 39.0 | 37.3 | 33.7 |
| History of drug abuse before injury (%) | 20.5 | 17.7 | 22.5 | 20.8 | 25.0 | 17.1 |
| Drug abuse at time of injury (%) | 6.4 | 7.7 | 8.0 | 5.9 | 6.9 | 4.6 |
| ADHD (%) | 7.6 | 6.2 | 7.2 | 7.9 | 8.6 | 7.7 |
| Anxiety (%) 🕅 | 40.9 | 32.5 | 46.5 | 45.3 | 41.4 | 37.5 |
| CAD (%) | 8.9 | 7.1 | 6.4 | 10.3 | 9.8 | 6.6 |
| CHF (%) | 3.7 | 1.8 | 4.3 | 4.4 | 3.2 | 4.4 |
| Depression (%) $ mathbb{I} $ | 48.9 | 47.5 | 52.9 | 54.1 | 49.8 | 41.1 |
| Diabetes (%) | 16.8 | 21.2 | 15.2 | 21.0 | 14.2 | 12.9 |
| Hypertension (%) | 43.5 | 46.6 | 41.7 | 44.8 | 45.3 | 39.9 |
| Paralysis (%) | 38.0 | 47.5 | 45.5 | 43.6 | 30.2 | 26.8 |
| Renal failure (%) | 8.4 | 8.6 | 8.6 | 8.1 | 7.8 | 8.7 |
| Previous brain injury (%) | 8.9 | 5.6 | 7.2 | 6.6 | 12.0 | 8.9 |
| Number of previous brain injuries (mean, SD) $^{\#}$ | 1.3 (0.7) | 1.3 (0.7) | 1.3 (0.6) | 1.3 (0.6) | 1.4(1.1) | 1.2 (0.5) |
| Tracheotomy or ventilation on admission (%) | 22.1 | 51.0 | 34.0 | 22.2 | 7.6 | 5.4 |
| Brain injury and severity information | | | | | | |
| Cause of injury (%) | | | | | | |
| Fall | 31.9 | 28.0 | 26.2 | 30.1 | 35.0 | 38.3 |
| Motor vehicle crash | 55.6 | 63.7 | 57.8 | 57.2 | 52.5 | 49.2 |

0.235 \dagger <.001† <.001 $\mathring{\tau}$ $0.246~\dot{\tau}$ <.001† 0.989 $\dot{\uparrow}$ 0.023 $\dot{\tau}$ 0.649 $\dot{\tau}$

0.217 $\dot{\tau}$ 0.799 $\dot{\tau}$ <.001 $\dot{\tau}$ $0.166 \,\dot{\tau}$

0.091 $\dot{\uparrow}$ 0.024 $\dot{\tau}$

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0.005 $\dot{\uparrow}$ 0.816 $\dot{\tau}$ 0.001 $\dot{\uparrow}$

<.001 $\mathring{\tau}$

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| | | | Admission] | FIM Cognitive Sc | ore* | | |
|--|-------------------------|-------------|--------------|----------------------|----------------------|--------------|---------------------------|
| Characteristics | <u>Overall (n=2130)</u> | <=6 (n=339) | 7-10 (n=374) | <u>11–15 (n=495)</u> | <u>16-20 (n=408)</u> | >=21 (n=504) | L I |
| Sports | 1.8 | 1.2 | 2.4 | 1.0 | 2.2 | 2.4 | |
| Violence | 7.0 | 4.4 | 7.8 | 8.3 | 7.1 | 7.1 | |
| Miscellaneous | 3.6 | 2.7 | 5.9 | 3.4 | 3.2 | 3.0 | |
| GCS score immediately after injury or upon arrival in acute care (%) | | | | | | | $<\!.001$ † |
| Mild (13–15) | 14.7 | 6.8 | 9.1 | 11.1 | 17.9 | 25.6 | |
| Moderate (9–12) | 7.7 | 4.1 | 4.8 | 8.3 | 7.6 | 12.1 | |
| Severe (3–8) | 32.3 | 46.0 | 42.0 | 35.4 | 24.5 | 18.8 | |
| Intubated/sedated | 12.2 | 12.4 | 15.0 | 11.7 | 13.7 | 8.7 | |
| Unknown | 33.0 | 30.7 | 29.1 | 33.5 | 36.3 | 34.7 | |
| Nature of brain injury (%) | | | | | | | 0.045 $\mathring{\tau}$ |
| Skull closed, contusion/hemorrhage present | 71.1 | 74.9 | 72.7 | 69.7 | 71.6 | 68.8 | |
| Skull closed, no contusion/hemorrhage | 21.6 | 15.3 | 19.5 | 24.0 | 21.6 | 24.6 | |
| Skull open, contusion/hemorrhage present | 7.3 | 9.7 | 7.8 | 6.3 | 6.9 | 6.5 | |
| Facial fracture (%) | 13.6 | 10.3 | 16.8 | 14.3 | 15.9 | 10.9 | 0.020 $\dot{\tau}$ |
| Skull fracture (%) | 26.8 | 25.1 | 32.6 | 28.3 | 25.7 | 23.0 | 0.022 $\dot{\tau}$ |
| Brain injury location (%) | | | | | | | 0.034 $\mathring{\tau}$ |
| Bilateral brain involvement | 64.2 | 64.9 | 68.7 | 61.8 | 64.7 | 62.3 | |
| Left brain involvement only | 18.4 | 22.4 | 16.3 | 20.0 | 16.4 | 17.3 | |
| Right brain involvement only | 17.5 | 12.7 | 15.0 | 18.2 | 18.9 | 20.4 | |
| Midline shift (%) | | | | | | | $<$ 001 $\dot{\tau}$ |
| No midline shift | 30.5 | 22.4 | 23.8 | 26.5 | 35.8 | 40.9 | |
| >0-<=5 mm of midline shift | 12.4 | 13.6 | 13.6 | 12.5 | 12.5 | 10.9 | |
| >5 mm of midline shift | 12.1 | 13.9 | 17.4 | 11.3 | 11.0 | 8.5 | |
| Midline shift, mm not specified | 11.1 | 15.3 | 9.1 | 10.7 | 9.6 | 11.5 | |
| Unknown | 33.9 | 34.8 | 36.1 | 39.0 | 31.1 | 28.2 | |
| Subdural hematoma (%) | 46.8 | 49.3 | 52.1 | 46.5 | 45.6 | 42.9 | 0.075 \dagger |
| Epidural hematoma (%) | 8.2 | 8.8 | 8.3 | 8.9 | 6.4 | 7.9 | 0.672 $\mathring{\tau}$ |
| Subarachnoid hemorrhage (%) | 59.2 | 71.1 | 65.0 | 58.2 | 55.1 | 51.0 | $<\!.001$ † |

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| | | | Admission I | FIM Cognitive Sc | ore* | | |
|---|-------------------------|-----------------|---------------------|-------------------------|----------------------|------------------|---------------------------|
| Characteristics | <u>Overall (n=2130)</u> | <=6 (n=339) | 7-10 (n=374) | <u>11-15 (n=495)</u> | <u>16-20 (n=408)</u> | >=21 (n=504) | P |
| Intraventricular hemorrhage (%) | 18.6 | 29.2 | 23.8 | 18.0 | 14.2 | 11.7 | $<.001$ $\dot{\tau}$ |
| Brain stem involved at injury (%) | 5.7 | T.T | 6.1 | 5.3 | 4.4 | 5.2 | 0.362 \dagger |
| Craniotomy during care episode (%) | 20.3 | 18.6 | 24.1 | 20.6 | 20.6 | 18.5 | $0.289 \ ^{\uparrow}$ |
| Craniectomy during care episode (%) | 7.2 | 12.7 | 9.6 | 6.9 | 2.9 | 5.4 | $<.001$ $\mathring{\tau}$ |
| Weight bearing precaution during rehabilitation (%) | 26.0 | 25.1 | 24.3 | 21.8 | 30.4 | 27.8 | 0.038~ |
| Days from injury to rehabilitation admission (mean, SD) | 29.3 (34.3) | 36.5 (38.7) | 34.2 (37.6) | 27.5 (32.3) | 26 (33.5) | 24.9 (30.1) | <.001 ‡ |
| Brain injury component of admission CSI score (mean, SD) | 44.7 (23.7) | 71.4 (19.3) | 62 (17.6) | 47.7 (14.3) | 33.2 (12.6) | 19.7 (10.0) | <.001 ‡ |
| Non-brain injury component of admission CSI score (mean, SD) | 16.9 (15.0) | 19.1 (16.1) | 20.3 (15.2) | 18.1 (14.7) | 16.1 (15.7) | 12.2 (11.9) | <.001 ‡ |
| Moderate to severe dysphagia on admission (%) | 53.4 | 89.1 | 75.4 | 56.4 | 36.0 | 23.4 | $<.001$ $\mathring{\tau}$ |
| Moderate to severe aphasia on admission (%) | 46.5 | 74.3 | 68.2 | 50.3 | 37.3 | 15.1 | $<.001$ $\mathring{\tau}$ |
| Moderate to severe ataxia on admission (%) | 15.4 | 21.8 | 21.4 | 17.0 | 12.7 | 6.5 | $<.001$ $\mathring{\tau}$ |
| Functional indepedence measures | | | | | | | |
| Admission FIM motor score - untransformed (mean, SD) | 34.7 (19.7) | 17.3 (8.8) | 24.0 (13.1) | 33.5 (16.2) | 40.8 (16.4) | 50.8 (20.0) | $<.001 \mathring{\tau}$ |
| Admission FIM motor score - Rasch transformed (mean, SD) | 33.2 (19.3) | 11.5 (14.5) | 23.2 (16.4) | 34.2 (14.8) | 40.5 (12.5) | 48.3 (15.2) | $<.001 \mathring{\tau}$ |
| Admission FIM cognitive score - untransformed (mean, SD) | 14.8 (7.2) | 5.3 (0.4) | 8.6 (1.1) | 13.1 (1.4) | 17.9 (1.4) | 24.9 (3.3) | $<.001 \mathring{\tau}$ |
| Admission FIM cognitive score - Rasch transformed (mean, SD) | 37.2 (19.5) | 2.5 (4.4) | 25.7 (4.8) | 38.4 (3.0) | 47.5 (2.4) | 59.6 (7.7) | $<.001 \mathring{\tau}$ |
| NOTE: Abbreviations: MCO/HMO, Managed care organization/Health 1 disorder: CCC_Closcov, Come Scole: CCL_Commediance Scovering Lade | naintainance organizati | ion; CHF, Conge | stive heart failure | ; CAD, Coronary | artery disease; AD | HD, Attention de | ficit hyperact |

tivity disorder; GCS, Glasgow Coma Scale; CSI, Comprehensive Severity Index;

n=10 patients missing admission FIM cognitive score.

*

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 $^{\dagger}\mathrm{Chi} ext{-Square analysis.}$

 \sharp Analysis of variance test.

 $^{\&}$ Miscellaneous includes 69 Asians, 8 Native Americans, 7 Pacific Islanders, and 3 with unknown race.

 $^{\prime\prime}$ Other/unknown includes 62 Separated status, 2 listed as Significant Other, and 10 with unknown or missing status.

 $lap{rel}$ Includes symptoms existing during rehab.

Data include only patients who had previous brain injury before the current injury requiring rehabilitation.

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Rehabilitation Treatments by Admission FIM Cognitive Score Subgroup

| | | | Admission I | TM Cognitive Sc | ore* | | |
|---|------------------|--------------|--------------|----------------------|----------------------|---------------|---------------------------|
| <u>Characteristics</u> | Overall (n=2130) | <=6 (n=339) | 7-10 (n=374) | <u>11–15 (n=495)</u> | <u>16-20 (n=408)</u> | >=21 (n=504) | P |
| Selected non-therapy treatments | | | | | | | |
| Restraints used ($\%$) † | 56.7 | 85.0 | 76.5 | 64.2 | 44.9 | 25.0 | $<\!.001 \ddagger$ |
| Number of days of restraint use (mean, SD) $^{\$}$ | 23.8 (20.6) | 32.9 (29.1) | 27.6 (19.2) | 21.4 (15.0) | 16.6 (12.9) | 11.2 (8.7) | <.001 // |
| Sitter used (%) | 20.6 | 33.9 | 28.1 | 23.6 | 16.4 | 6.6 | $<\!\!.001\sharp$ |
| Number of days of sitter use (mean, $\mathrm{SD})^{\$}$ | 14.9 (14.9) | 22.2 (19.2) | 15.3 (13.9) | 11.2 (10.1) | 10.0 (8.4) | 11.0 (16.8) | <.001 // |
| Enteral nutrition (%) | 36.1 | 77.6 | 58.3 | 35.8 | 15.9 | 8.3 | $<\!.001 \ddagger$ |
| Number of days of enteral nutrition (mean, SD) $^{\$}$ | 20.3 (17.9) | 26.6 (20.1) | 19.5 (15.4) | 15.9 (17.6) | 12.9 (10.0) | 11.9 (12.4) | <.001 // |
| Parenteral nutrition adminstered (%) | 6.1 | 13.9 | 9.4 | 6.1 | 2.5 | 0.8 | $<\!.001 \mathring{\tau}$ |
| Medications | | | | | | | |
| Medications administered (%) | | | | | | | |
| Analgesic narcotic/opioid | 74.3 | 75.9 | 75.9 | 74.5 | 75.9 | 70.2 | 0.214 \ddagger |
| Analgesic non-narcotic | 80.2 | 87.0 | 83.2 | 80.7 | 78.6 | 74.4 | $<\!\!.001\ddagger$ |
| Anticholinergic | 52.4 | 76.5 | 61.0 | 48.1 | 46.3 | 38.7 | $<\!.001 \mathring{\tau}$ |
| Anticoagulant | 72.1 | 85.2 | 80.5 | 78.4 | 68.7 | 53.8 | $<\!.001 \ddagger$ |
| Anticonvulsant | 50.1 | 54.8 | 53.4 | 49.8 | 49.5 | 44.6 | 0.033 |
| Antidepressant | 69.2 | 81.3 | 77.8 | 69.3 | 6.69 | 53.8 | $<\!\!.001\sharp$ |
| Antiulcer | 73.9 | 83.4 | 80.8 | 77.4 | 73.9 | 58.8 | $<\!\!.001\sharp$ |
| Trazadone | 54.8 | 68.1 | 65.9 | 56.6 | 52.2 | 37.5 | $<\!.001 \ddagger$ |
| Therapy activities | | | | | | | |
| % of study population receiving any PT | 99.3 | 100.0 | 7.66 | 0.66 | 99.5 | 98.8 | 0.172 |
| Total minutes/week (mean, SD) $\$$ | 314.2 (109.5) | 343.8 (95.0) | 319.2 (98.8) | 308.7 (98.5) | 304.9 (115.0) | 303.3 (127.6) | <.001 // |
| % of study population receiving any OT | 99.2 | 7.66 | 99.5 | 99.2 | 99.5 | 98.4 | 0.212 \ddagger |
| Total minutes/week (mean, SD) $\$$ | 298.1 (101.3) | 321.8 (89.6) | 304.5 (88.4) | 299.3 (92.1) | 283.9 (107.9) | 287.5 (117.1) | <.001 // |
| % of study population receiving any speech language pathology | 96.7 | 100.0 | 98.9 | 98.4 | 97.3 | 90.7 | $<\!.001 \ddagger$ |

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| | | | Admission] | FIM Cognitive Sc | ore* | | |
|--|------------------|--------------|--------------|----------------------|----------------------|---------------|------------------|
| <u>Characteristics</u> | Overall (n=2130) | <=6 (n=339) | 7-10 (n=374) | <u>11–15 (n=495)</u> | <u>16-20 (n=408)</u> | >=21 (n=504) | L i |
| Total minutes/week (mean, SD) $\$$ | 253.6 (114.9) | 268 (108.1) | 290.5 (99.7) | 281.5 (109.4) | 239.9 (107.8) | 194.2 (118.8) | <.001 // |
| % of study population receiving any psychology | 75.2 | 71.4 | 82.1 | 84.0 | <i>T.T</i> | 61.7 | $<\!.001 $ |
| Total minutes/week (mean, SD) $^{\$}$ | 85 (82.0) | 56.5 (62.0) | 71.7 (62.3) | 97.6 (75.8) | 92.2 (91.8) | 96.3 (101.9) | <.001 // |
| % of study population receiving any recreational therapy | 72.0 | 71.7 | 78.6 | 82.2 | 71.8 | 57.3 | $<.001 \ddagger$ |
| Total minutes/week (mean, SD) $\$$ | 91.6 (71.2) | 66.4 (50.5) | 87.6 (62.4) | 105 (79.8) | 102.5 (71.8) | 87 (75.1) | <.001 // |
| % of study population receiving any social work/case management services | 84.1 | 89.1 | 82.1 | 83.6 | 84.3 | 82.3 | 0.069 |
| Total minutes/week (mean, SD) $\$$ | 118.5 (74.7) | 101.3 (64.2) | 106.1 (73.3) | 117.6 (66.8) | 126.3 (72.5) | 133.7 (87.5) | <.001 // |
| PT activities (Three most frequently used) | | | | | | | |
| Theraputic exercise | | | | | | | |
| % patients receiving | 95.0 | 98.2 | 97.3 | 94.9 | 94.1 | 91.7 | <.001 |
| Minutes per week (mean, SD) $\$$ | 56 (41.9) | 50.7 (35.0) | 45 (33.0) | 49 (37.9) | 59.2 (40.3) | 73.5 (51.6) | <.001 // |
| Gait training | | | | | | | |
| % patients receiving | 88.2 | 89.7 | 92.8 | 90.3 | 88.7 | 81.2 | <.001 |
| Minutes per week (mean, SD) $\$$ | 80.6 (70.3) | 92.4 (71.7) | 75.4 (61.4) | 75 (61.0) | 77 (68.4) | 86.1 (85.1) | 0.002 // |
| Standing | | | | | | | |
| % patients receiving | 83.8 | 95.3 | 94.4 | 87.3 | 78.4 | 69.0 | <.001 |
| Minutes per week (mean, $\mathrm{SD})^{\hat{S}}$ | 31.4 (23.2) | 33.5 (22.1) | 31.4 (20.7) | 31.3 (22.6) | 30.2 (25.8) | 30.5 (24.7) | 0.411 // |
| OT activities (Three most frequently used) | | | | | | | |
| Cognitive activity | | | | | | | |
| % patients receiving | 91.2 | 97.3 | 95.5 | 92.3 | 90.7 | 82.9 | $<\!.001 $ |
| Minutes per week (mean, $\mathrm{SD})^{\hat{S}}$ | 68.9 (61.4) | 83 (67.7) | 66.1 (57.5) | 66.2 (60.1) | 65.3 (58.3) | 67.1 (62.9) | <.001 // |
| Lower body dressing | | | | | | | |
| % patients receiving | 82.0 | 92.9 | 95.7 | 86.7 | 7.67 | 61.5 | $<\!.001 $ |
| Minutes per week (mean, $\mathrm{SD})^{\widehat{S}}$ | 16.5 (12.9) | 17.3 (11.7) | 16.1 (11.5) | 14.9 (11.3) | 16.7 (13.6) | 18 (16.4) | 0.014 // |
| Upper extremity activity | | | | | | | |
| % patients receiving | 79.6 | 92.9 | 84.5 | 82.6 | 76.7 | 66.3 | $<\!.001 $ |
| Minutes per week (mean, $\mathrm{SD})^{\widehat{S}}$ | 49.1 (42.4) | 46.2 (40.4) | 47.2 (36.9) | 43.8 (35.6) | 51.2 (40.4) | 57.7 (55.6) | <.001 |

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| | | | Admission I | TM Cognitive Sco |)re* | | |
|--|-------------------------|-------------|--------------|-------------------------|----------------------|--------------|---------------------------|
| <u>Characteristics</u> | <u>Overall (n=2130)</u> | <=6 (n=339) | 7-10 (n=374) | <u>11–15 (n=495)</u> | <u>16-20 (n=408)</u> | >=21 (n=504) | Ð |
| Speech language pathology activities (Three most frequently used): | | | | | | | |
| Education | | | | | | | |
| % patients receiving | 72.4 | 79.4 | 79.9 | 79.0 | 70.8 | 56.7 | <.001 |
| Minutes per week (mean, SD) $^{\$}$ | 17.9 (14.1) | 13.2 (12.3) | 15.5 (11.7) | 18.9 (13.7) | 20.2 (13.9) | 21.3 (17.1) | <.001 // |
| Verbal reasoning | | | | | | | |
| % patients receiving | 62.6 | 63.7 | 65.5 | 74.9 | 66.7 | 44.8 | <.001 |
| Minutes per week (mean, SD) $^{\$}$ | 19.8 (18.0) | 11.6 (10.9) | 18.4 (16.3) | 22.6 (19.4) | 21.1 (19.2) | 23 (19.1) | <.001 // |
| Verbal orientation review | | | | | | | |
| % patients receiving | 59.6 | 87.6 | 84.0 | 70.7 | 45.1 | 22.8 | <.001 |
| Minutes per week (mean, SD) $^{\$}$ | 19.6 (18.2) | 22.7 (19.9) | 23.3 (19.6) | 18.2 (17.2) | 14.6 (13.3) | 12.1 (11.8) | <:001 |
| Psychology activities (Three most frequently used): | | | | | | | |
| Neurobehavioral assessment | | | | | | | |
| % patients receiving | 57.3 | 55.5 | 67.1 | 69.3 | 56.4 | 40.1 | <.001 ₽ |
| Minutes per week (mean, SD) $^{\$}$ | 19.2 (16.9) | 18.3 (18.2) | 21.4 (16.2) | 20.3 (14.6) | 17.1 (20.7) | 17.8 (15.4) | 0.023// |
| Psychotherapeutic and behavior intervention | | | | | | | |
| % patients receiving | 44.6 | 37.8 | 50.5 | 55.4 | 46.6 | 31.9 | <.001 ₽ |
| Minutes per week (mean, SD) $^{\$}$ | 22.6 (22.0) | 14.5(14.0) | 18.7 (16.6) | 24.6 (20.0) | 24.8 (22.8) | 28 (31.1) | <.001 // |
| Neuropsychological testing | | | | | | | |
| % patients receiving | 38.5 | 23.9 | 36.6 | 53.1 | 43.1 | 31.5 | $<\!.001 \mathring{\tau}$ |
| Minutes per week (mean, SD) $^{\$}$ | 38.5 (36.9) | 19.5 (16.9) | 27.6 (21.3) | 40.8 (32.4) | 39.5 (34.1) | 52.7 (54.5) | <.001 // |
| Recreational therapy activities (Three most frequently used): | | | | | | | |
| Board/table top games | | | | | | | |
| % patients receiving | 31.8 | 32.7 | 34.0 | 38.4 | 34.3 | 21.2 | $<\!.001 \mathring{\tau}$ |
| Minutes per week (mean, SD) $^{\$}$ | 25.3 (23.1) | 14.3 (12.9) | 21.1 (19.0) | 23.1 (21.4) | 31.5 (22.8) | 38.1 (30.4) | <.001 // |
| Card games | | | | | | | |
| % patients receiving | 27.5 | 28.9 | 33.2 | 31.3 | 31.6 | 15.5 | $<.001 \ddagger$ |
| Minutes per week (mean, SD) $^{\&}$ | 29 (28.3) | 15.7 (15.0) | 25.8 (27.7) | 30.3 (29.0) | 36.9 (31.7) | 35.8 (28.7) | <.001 // |

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| | | | Admission] | FIM Cognitive Sc | ore* | | |
|--|-------------------------|-------------|--------------|----------------------|----------------------|--------------|---------------------------|
| Characteristics | Overall (n=2130) | <=6 (n=339) | 7-10 (n=374) | <u>11–15 (n=495)</u> | <u>16-20 (n=408)</u> | >=21 (n=504) | P |
| Community reintegration | | | | | | | |
| % patients receiving | 24.4 | 26.5 | 27.8 | 33.9 | 21.8 | 12.5 | $<\!.001 \mathring{\tau}$ |
| Minutes per week (mean, SD) $\$$ | 57.9 (47.2) | 29.9 (22.6) | 46.9 (32.2) | 63.5 (47.0) | 66.1 (43.0) | 92.2 (69.4) | <.001 // |
| Social work/case management activities (Three most frequently used): | | | | | | | |
| Team meetings | | | | | | | |
| % patients receiving | 80.3 | 87.9 | 79.9 | 82.6 | 79.2 | 74.0 | $<\!.001 \mathring{\tau}$ |
| Minutes per week (mean, SD) $\$$ | 10.4 (6.4) | 9.6 (5.3) | 10.6 (6.3) | 10.4 (5.8) | 10.2 (6.2) | 10.9 (7.9) | 0.158 // |
| Discharge planning for patient | | | | | | | |
| % patients receiving | 68.0 | 76.4 | 69.0 | 67.5 | 67.6 | 62.5 | $0.001\ddagger$ |
| Minutes per week (mean, SD) $\$$ | 21.3 (20.7) | 15 (17.8) | 18.7 (17.1) | 21.2 (19.1) | 22.7 (20.9) | 28 (25.0) | <.001 // |
| Education/support for family | | | | | | | |
| % patients receiving | 54.5 | 75.8 | 58.3 | 56.2 | 51.2 | 38.1 | $<\!\!.001\ddagger$ |
| Minutes per week (mean, $\mathrm{SD})^{\widehat{S}}$ | 18 (16.9) | 16.1 (16.3) | 18.6 (17.8) | 19.2 (17.4) | 19.9 (18.9) | 15.6 (12.5) | 0.021 // |
| Therapist experience | | | | | | | |
| Clinician Experience Index in years (mean, SD) | | | | | | | |
| Overall | 4.8 (3.1) | 4.6 (3.3) | 4.3 (2.6) | 4.6 (2.8) | 5.2 (3.6) | 5.0(3.0) | <.001 // |
| Physical therapy | 4.0 (4.4) | 3.8 (4.0) | 3.8 (4.7) | 3.7 (3.9) | 4.4 (4.7) | 4.2 (4.9) | 0.143 % |
| Occupational therapy | 3.1 (3.0) | 3.3 (2.9) | 2.8 (2.6) | 2.9 (2.9) | 2.9 (3.0) | 3.6 (3.5) | <.001 // |
| Speech language pathology | 5.1 (3.1) | 4.7 (2.9) | 4.8 (3.1) | 4.8 (3.1) | 5.4 (3.1) | 5.7 (3.3) | <.001 // |
| Recreational therapy | 1.9 (2.1) | 1.7 (2.0) | 1.8 (2.1) | 1.8 (2.2) | 1.8 (2.0) | 2.1 (2.3) | 0.380 // |
| Psychology | 4.5 (5.3) | 4.9 (5.6) | 4.3 (4.6) | 4.3 (4.6) | 5.1 (6.3) | 4.2 (5.6) | 0.326 // |
| Social work | 8.7 (9.0) | 8.9 (8.9) | 8.2 (8.4) | 9.1 (9.4) | 9.3 (9.9) | 8.3 (8.1) | 0.491// |
| KOTE: | | | | | | | |

* n=10 patients missing admission FIM cognitive score.

 $\dot{\tau}$ Restraint types include: posey rolls and vests, posey Swedish locking belt-beds, abdominal binders, bed alarms, bed side rails, bed nets/enclosures, cameras, bed, lap and, seat belts, mitts, limb holders, and wander guards.

 ‡ Chi-Square analysis.

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 $^{\$}$ Data include only patients who had the specified treatment.

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//Analysis of variance test.

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Table 4

Events and Patient Characteristics during Rehabilitation by Admission FIM Cognitive Score Subgroup

| | | | | | * | | |
|---|-------------------------|-------------|--------------|----------------------|----------------------|--------------|-----------------------------|
| | | | Admission F | TM Cognitive Sc | ore | | |
| <u>Characteristics</u> | Overall (n=2130) | <=6 (n=339) | 7-10 (n=374) | <u>11–15 (n=495)</u> | <u>16-20 (n=408)</u> | >=21 (n=504) | P |
| Severity information | | | | | | | |
| Maximum brain injury component of CSI score (mean, SD) | 48.4 (24.8) | 77.2 (18.3) | 66.8 (16.6) | 50.8 (15.6) | 36.1 (13.3) | 22 (10.2) | $<\!.001$ $\mathring{\tau}$ |
| Maximum non-brain injury component of CSI score (mean, SD) | 24.8 (20.9) | 30.6 (23.5) | 30.7 (21.7) | 25.8 (20.7) | 22.7 (20.3) | 16.8 (15.4) | <.001† |
| Moderate/severe dysphagia (%) | 54.0 | 90.06 | 76.2 | 56.8 | 37.0 | 23.6 | $<\!.001 \ddagger$ |
| Moderate/severe aphasia (%) | 47.8 | 76.4 | 69.3 | 50.9 | 38.7 | 16.5 | $<\!.001 \ddagger$ |
| Moderate/severe ataxia (%) | 15.9 | 23.6 | 21.7 | 17.2 | 13.2 | 6.5 | $<\!\!.001\sharp$ |
| Days from injury to clearing PTA (mean, SD) | 37.6 (42.7) | 70.7 (54.4) | 56.4 (45.9) | 35.6 (36.1) | 19.9 (23.1) | 10.6 (14.0) | $<\!.001\sharp$ |
| Time of PTA clearance (%) | | | | | | | $<.001 \mathring{\tau}$ |
| Prior to rehabilitation | 42.2 | 2.1 | 8.3 | 27.9 | 66.2 | 89.1 | |
| During rehabilitation | 34.3 | 44.5 | 48.4 | 49.7 | 26.2 | 8.3 | |
| After rehabilitation discharge | 23.5 | 53.4 | 43.3 | 22.4 | 7.6 | 2.6 | |
| Days from rehabilitation admission to clearing PTA (for patients who cleared PTA during rehabilitation) | 15.6 (13.5) | 25.2 (16.9) | 17.9 (13.7) | 12.4 (9.9) | 8.9 (7.2) | 7.4 (5.0) | <.001 |
| Pain, agitation, and falls | | | | | | | |
| Pain (mean, SD) | | | | | | | |
| Percent of days with pain score >=1 | 38.3 (32.8) | 26.2 (23.8) | 32.2 (27.8) | 39.3 (32.6) | 43.3 (34.7) | 45.6 (36.9) | $<\!\!.001 \mathring{\tau}$ |
| Percent of days with pain score >=3 | 32.9 (32.6) | 18.6 (21.2) | 26.8 (27.1) | 35.0 (32.2) | 39.3 (34.7) | 39.8 (37.4) | $<.001 \mathring{\tau}$ |
| Percent of days with pain score >=5 | 27.9 (30.9) | 14.1 (18.3) | 21.7 (24.9) | 30.2 (30.5) | 34.3 (33.4) | 34.3 (35.8) | $<.001 \mathring{\tau}$ |
| Percent of days with pain score >=7 | 17.2 (25.3) | 7.0 (12.5) | 11.5 (18.3) | 18.1 (24.1) | 24.2 (30.2) | 21.6 (29.8) | $<.001 \mathring{\tau}$ |
| Average high pain score \S | 4.6 (2.8) | 4.0 (2.7) | 4.6 (2.6) | 5.0 (2.6) | 5.1 (3.0) | 4.3 (3.1) | <.001 |
| Percent of rehabilition days agitated (mean, SD)// | 8.9 (19.4) | 18.8 (25.2) | 15.9 (25.1) | 8.5 (17.8) | 4.1 (12.9) | 1.2 (7.2) | $<.001 \mathring{\tau}$ |
| Average of three highest ABS scores (mean, SD) | 21.8 (8.5) | 27 (9.8) | 25.6 (9.5) | 22.6 (7.8) | 19.2 (6.2) | 16.6 (4.0) | $<.001 \mathring{\tau}$ |
| Fall (%) | 6.5 | 11.8 | 9.4 | 6.1 | 4.4 | 3.2 | $<.001 \mathring{\tau}$ |
| Number of falls (mean, SD) $ lap{V}$ | 1.2 (0.6) | 1.3 (0.6) | 1.2 (0.6) | 1.1 (0.3) | 1.4(1.0) | 1.0 (0.0) | 0.147 $\mathring{\tau}$ |
| Fall with injury (%) | 2.0 | 3.2 | 3.7 | 1.2 | 1.5 | 1.2 | $0.016{\ddagger}$ |

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| | | | Admission 1 | TM Cognitive Sc | ore* | | |
|---|--------------------------|--------------------|------------------|------------------------|----------------------|--------------|--------------------|
| Characteristics | <u>Overall (n=2130)</u> | <=6 (n=339) | 7-10 (n=374) | <u>11–15 (n=495)</u> | <u>16-20 (n=408)</u> | >=21 (n=504) | Ā |
| Number of falls with injury (mean, SD) $\!\!\!/$ | 1.1 (0.3) | 1.1 (0.3) | 1.2 (0.4) | 1.0 (0.0) | 1.0 (0.0) | 1.0 (0.0) | $0.394~^{\dagger}$ |
| NOTE: Abbreviations: CSI, Comprehensive Severity Index; PTA, Post traumatic ann | nesia; ABS, agitated b | ehavior scale; | | - | - | | |
| $_{n=10}^{*}$ patients missing admission FIM cognitive score. | | | | | | | |
| t^{\dagger} Analysis of variance test. | | | | | | | |
| † Chi-Square analysis. | | | | | | | |
| $^S_{ m Average}$ of highest of 3 daily pain scores over rehabilitation stay. | | | | | | | |
| $^{\prime\prime}$ Percent of rehabilition days agitated, starting with the beginning of the first bout to t | the end of the last bout | t, interruptions b | etween bouts exc | luded. | | | |
| ${I\!\!I}_{ m D}$ ata include only patients who fell. | | | | | | | |

Table 5

Rehabilitation Discharge Outcomes by Admission FIM Cognitive Score Subgroup

| | | | Admission F | TM Cognitive Sc | ore* | | |
|--|-------------------------|-------------|--------------------|------------------------|---------------|--------------|----------------------------|
| <u>Characteristics</u> | <u>Overall (n=2130)</u> | <=6 (n=339) | 7-10 (n=374) | <u>11-15 (n=495)</u> | 16-20 (n=408) | >=21 (n=504) | P |
| LOS and discharge disposition | | | | | | | |
| Rehabilitation LOS - excludes interruptions (mean, SD) | 26.5 (19.9) | 40.4 (27.6) | 32.5 (18.4) | 24.4 (15.4) | 21 (15.5) | 19 (15.1) | $<\!.001$ † |
| Discharge disposition (%) | | | | | | | $<\!\!.001 \sharp$ |
| Private home | 83.9 | 73.7 | 78.1 | 85.7 | 85.0 | 92.3 | |
| Acute care hospital | 2.0 | 4.1 | 2.7 | 0.6 | 2.7 | 0.8 | |
| Other post acute setting | 14.0 | 22.1 | 19.3 | 13.7 | 12.3 | 6.9 | |
| Severity scores | | | | | | | |
| Discharge brain injury component of CSI score (mean, SD) | 22.6 (15.3) | 34.3 (19.9) | 30.7 (15.8) | 22.9 (10.8) | 18.3 (8.8) | 11.5 (7.6) | $<\!001$ $\mathring{\tau}$ |
| Discharge non-brain injury component of CSI score (mean, SD) | 10.2 (11.1) | 10.9 (12.6) | 12.3 (11.5) | 10.8 (10.6) | 10 (11.5) | 7.4 (8.8) | $<\!.001$ † |
| Functional indepedence measures | | | | | | | |
| Discharge FIM motor score - untransformed (mean, SD) | 63.0 (18.8) | 50.0 (21.1) | 56.8 (18.8) | 64.1 (16.2) | 66.9 (16.0) | 72.4 (14.8) | $<\!.001$ † |
| Discharge FIM motor score - Rasch transformed (mean, SD) | 55.7 (15.9) | 44.8 (17.5) | 50.7 (13.7) | 56 (12.6) | 58.7 (13.2) | 64.4 (15.4) | <:001† |
| Discharge FIM cognitive score - untransformed (mean, SD) | 22.0 (6.6) | 15.9 (7.0) | 18.0 (5.3) | 21.2 (4.7) | 23.9 (4.0) | 28.4 (3.7) | $<\!.001$ † |
| Discharge FIM cognitive score - Rasch transformed (mean, SD) | 54.4 (15.1) | 40.2 (18.0) | 47 (10.6) | 53 (9.4) | 57.9 (8.5) | 68.3 (11.1) | <:001† |
| Discharge FIM cognitive score (%) | | | | | | | $<\!\!.001\ddagger$ |
| <=e | 2.1 | 11.5 | 0.5 | 0.6 | 0.3 | 0.0 | |
| 7–10 | 3.9 | 15.3 | 7.5 | 0.6 | 0.0 | 0.0 | |
| 11-15 | 9.8 | 20.7 | 24.6 | 8.1 | 1.2 | 0.2 | |
| 16-20 | 21.8 | 25.1 | 35.6 | 34.6 | 16.2 | 1.6 | |
| >=21 | 62.3 | 27.4 | 31.8 | 56.2 | 82.4 | 98.2 | |
| | | | | | | | |

Arch Phys Med Rehabil. Author manuscript; available in PMC 2016 August 01.

NOTE: Abbreviations: CSI, Comprehensive Severity Index;

* n=10 patients missing admission FIM cognitive score.

[†]Analysis of variance test. [‡]Chi-Square analysis.

| None Month Post Discharge Outcomes by Admission Cognitiv | e FIM Score Subg | group | | | | | |
|---|--------------------------------|-------------|--------------|----------------------|---------------|--------------|---------------------------|
| | | | Admission I | TIM Cognitive Sc | ore | | |
| Characteristics | Overall (n=1850 [*]) | <=6 (n=301) | 7-10 (n=331) | <u>11–15 (n=434)</u> | 16-20 (n=353) | >=21 (n=424) | Ā |
| Functional indepedence measures | | | | | | | |
| 9-month post discharge FIM motor score - untransformed, n=1538 (mean, SD) | 82.6 (15.6) | 75.9 (22.0) | 80.6 (17.6) | 83.5 (15.0) | 84.9 (10.7) | 86.2 (10.1) | $<.001$ $\dot{\tau}$ |
| 9-month post discharge FIM motor score - Rasch transformed, n=1538 (mean, SD) | 80.8 (20.0) | 72.3 (25.1) | 77.9 (20.7) | 82.5 (19.1) | 83 (16.8) | 85.4 (16.4) | $<.001$ $\mathring{\tau}$ |
| 9-month post discharge FIM cognitive score - untransformed, n=1560 (mean, SD) | 29.9 (5.7) | 27.1 (7.5) | 28.5 (6.4) | 30.3 (5.0) | 30.8 (4.7) | 31.8 (3.7) | $<.001$ $\mathring{\tau}$ |
| 9-month post discharge FIM cognitive score - Rasch transformed, n=1560 (mean, SD) | 76.3 (18.0) | 68.1 (20.8) | 72.1 (18.8) | 76.9 (16.6) | 78.9 (16.3) | 82.2 (14.9) | $<.001$ $\mathring{\tau}$ |
| 9-month post discharge FIM cognitive score subgroups, n=1560 (%) | | | | | | | $<.001 \mathring{\tau}$ |
| 9=> | 0.5 | 2.0 | 0.7 | 0.3 | 0.0 | 0.0 | |
| 7–10 | 0.8 | 2.4 | 1.4 | 0.6 | 0.0 | 0.0 | |
| 11–15 | 1.7 | 5.7 | 1.8 | 0.3 | 2.0 | 0.3 | |
| 16-20 | 5.5 | 11.3 | 10.4 | 5.2 | 1.7 | 1.1 | |
| >=21 | 91.5 | 78.6 | 85.7 | 93.7 | 96.3 | 98.6 | |
| Participation Assessment With Recombined Tools | | | | | | | |
| PART score and subscores (mean, SD) | | | | | | | |
| Total score, n=1665 | 1.6 (0.7) | 1.4(0.7) | 1.6 (0.7) | 1.7 (0.7) | 1.7 (0.7) | 1.8 (0.7) | $<.001$ $\mathring{\tau}$ |
| Productivity score, n=1672 | 1.1 (1.0) | 0.7 (0.8) | 1.0 (0.9) | 1.1 (0.9) | 1.1 (1.0) | 1.3 (1.0) | <.001† |
| Social relations score, n=1666 | 2.3 (1.0) | 2.1 (1.0) | 2.3 (0.9) | 2.3 (0.9) | 2.3 (1.0) | 2.4 (0.9) | 0.007 \ddagger |
| Out and about score, n=1669 | 1.6 (0.8) | 1.5(0.9) | 1.6 (0.8) | 1.6 (0.8) | 1.6(0.8) | 1.7 (0.7) | $0.034~\dot{\tau}$ |
| Selected outcomes | | | | | | | |
| Employed at 9-month interview (%) | 17.7 | 7.0 | 14.8 | 18.7 | 18.4 | 26.2 | $<.001\rlap/$ |
| Pursuing education at 9-month interview (%) | 10.8 | 9.3 | 10.6 | 13.1 | 9.4 | 11.1 | 0.412 \ddagger |
| Hospitalized overnight after rehabilitation discharge (%) | 27.5 | 30.6 | 29.6 | 28.1 | 26.4 | 23.8 | 0.253 \ddagger |
| Seen in emergency department (%) | 28.8 | 29.9 | 32.6 | 28.1 | 30.0 | 25.0 | $0.208 \rar $ |
| Overnight stay in a long term care facility (%) | 15.0 | 21.9 | 22.7 | 11.1 | 16.7 | 6.8 | <.001 ‡ |

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Table 6

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| | | | Admission 1 | TM Cognitive Sc | ore | | |
|---|---------------------------|------------------|-------------------|-------------------|---------------|--------------|---------------------------|
| Characteristics | <u>Overall (n=1850</u> *) | <=6 (n=301) | 7-10 (n=331) | 11-15 (n=434) | 16-20 (n=353) | >=21 (n=424) | P |
| Days from rehabilitation discharge to 9-month interview, n=1683 (mean, SD) | 312.4 (46.0) | 300.6 (47.2) | 305.1 (44.8) | 311.2 (42.9) | 318.8 (47.7) | 323.0 (44.3) | $<.001$ $\mathring{\tau}$ |
| Satisfaction with life scale | | | | | | | |
| Satisfaction with life total score, n=1345 (mean, SD) | 21.7 (8.4) | 20.3 (8.6) | 21.8 (8.2) | 21.6 (8.4) | 21.8 (8.5) | 22.5 (8.3) | 0.093 $\dot{\tau}$ |
| Patient satifaction with life score $>=21$, n=1345 (%) | 56.9 | 52.5 | 57.3 | 56.4 | 56.3 | 59.7 | $0.654~\dot{\tau}$ |
| NOTE: | | | | | | | |
| * When sample size is indicated in a characteristic label, it represents that the sample | e size is smaller than 18 | 50 because inter | viewees did not a | nswer every quest | ion. | | |
| ${}^{\dot{f}}$ Analysis of variance test. | | | | | | | |

 ${}^{\sharp}$ Chi-Square analysis.

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Table 7

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| Follow-up Interview Rate | es and Subpopulatio | n Comparison | | | | |
|--|------------------------|------------------------|-------------------------|---|---|-------------------------------|
| Time of interview | 3-month post-discharge | 9-month post-discharge | 1-year post-injury* | Any follow-up data † | | |
| Interview conducted | 1742 | 1649 | 1605 | 1850 | | |
| Deceased or incarcerated | 40 | 92 | 69 | 92 | | |
| Lost to follow-up | 199 | 240 | 307 | 39 | | |
| Ineligible for follow-up | 149 | 149 | 149 | 149 | | |
| % with interview conducted | 81.8% | 77.4% | 75.4% | 86.9% | | |
| $\%$ with known outcome ^{\ddagger} | 83.7% | 81.7% | 78.6% | 91.2% | | |
| | | | | | | |
| <u>Characteristic</u> | 3-month pos | st-discharge (n=1742) | -month post-discharge (| n=1649) <u>1-year post-injury (n=1605</u> |) <u>Any follow-up</u> data (n=1850) | Full Sample (n=2130 $^{\$}$) |
| Age at rehabilitation admission SD) | (mean, | 13.7 (20.8) | 43.3 (20.9) | 43.3 (20.9) | 43.8 (20.9) | 44.5 (21.3) |
| Male (%) | | 72.7 | 71.9 | 71.6 | 72.4 | 72.5 |
| Race/Ethnicity (%) | | | | | | |
| Black | | 14.5 | 13.9 | 13.8 | 14.6 | 15.1 |
| White | | 77.0 | 77.2 | 77.8 | 76.1 | 74.4 |
| White Hispanic | | 5.1 | 5.3 | 5.0 | 5.6 | 6.2 |
| Other and unknown | | 3.5 | 3.6 | 3.4 | 3.7 | 4.4 |
| Highest education achieved (%) | | | | | | |
| Some high school, no diplom | а | 23.4 | 23.3 | 23.1 | 23.7 | 23.0 |
| High school diploma | | 25.9 | 26.0 | 26.1 | 26.2 | 25.9 |
| Work towards or completed | | 17.2 | 18.8 | 18.6 | 17.7 | 16.2 |
| Associate's degree | | | | | | |
| Work towards or completed | | 20.2 | 20.4 | 20.7 | 19.9 | 19.7 |
| Bachelor's degree | | | | | | |
| Work towards or completed | | 10.2 | 10.4 | 10.2 | 10.0 | 9.7 |
| Master's/Doctoral degree | | | | | | |
| Unknown | | 3.0 | 1.2 | 1.2 | 2.5 | 5.7 |
| Primary payer for inpatient stay | (%) | | | | | |
| Medicare | | 18.7 | 18.0 | 18.3 | 18.9 | 19.4 |
| Medicaid | | 16.7 | 15.6 | 15.6 | 16.4 | 15.5 |

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| <u>Characteristic</u> | <u>3-month post-discharge (n=1742)</u> | <u>9-month post-discharge (n=1649)</u> | <u>1-year post-injury (n=1605)</u> | <u>Any follow-up</u> data (n=1850) | Full Sample (n=2130 $\$$) |
| Private insurance | 25.1 | 25.1 | 25.2 | 24.6 | 24.5 |
| Centralized (single payer system) | 6.2 | 6.4 | 5.9 | 6.3 | 6.9 |
| Worker's compensation | 5.9 | 5.9 | 5.9 | 5.9 | 6.8 |
| Self pay/None | 4.8 | 5.0 | 5.1 | 4.8 | 4.6 |
| MCO/HMO | 15.4 | 16.1 | 16.2 | 15.2 | 14.4 |
| No-fault auto insurance | 4.1 | 4.7 | 4.5 | 4.6 | 4.5 |
| Other/unknown | 3.0 | 3.2 | 3.2 | 3.2 | 3.4 |
| Marital status at injury (%) | | | | | |
| Single/never married | 43.7 | 44.0 | 44.2 | 43.1 | 42.6 |
| Married/common law | 35.8 | 35.9 | 35.8 | 36.3 | 36.5 |
| Previously married | 17.0 | 16.7 | 16.7 | 17.1 | 17.5 |
| Other/unknown | 3.5 | 3.4 | 3.4 | 3.5 | 3.5 |
| Employment prior to injury (%) | | | | | |
| Employed and student | 4.0 | 4.2 | 4.2 | 4.1 | 4.0 |
| Employed only | 46.8 | 47.7 | 47.3 | 47.0 | 47.1 |
| Unemployed | 14.4 | 13.8 | 14.1 | 14.2 | 13.3 |
| Retired | 21.9 | 21.3 | 21.5 | 22.3 | 23.1 |
| Student only | 11.8 | 11.8 | 11.8 | 11.4 | 11.4 |
| Unknown | 1.1 | 1.1 | 1.1 | 1.1 | 1.1 |
| Brain injury component of admission CSI score (mean, SD) | 45.7 (23.8) | 46 (23.7) | 45.7 (23.6) | 45.5 (23.7) | 44.7 (23.7) |
| Non-brain injury component of admission CSI score (mean, SD) | 17.1 (15.1) | 17.2 (14.9) | 17.1 (15.1) | 17.0 (15.1) | 16.9 (15.0) |
| Admission FIM cognitive score - untransformed (mean, SD) | 14.6 (7.2) | 14.6 (7.1) | 14.7 (7.2) | 14.7 (7.2) | 14.8 (7.2) |
| Admission FIM motor score - untransformed (mean, SD) | 34.0 (19.4) | 33.9 (19.5) | 34.2 (19.5) | 34.3 (19.5) | 34.7(19.7) |
| NOTE: Abbreviations: MCO/HMO, Manag | ed care organization/Health maintainanc | e organization; CSI, Comprehensive S | everity Index; | | |
| * Because the anniversary date for a person' to 402 days post-discharge), the additional <u>c</u> | s injury could fall in the window for any uestions required were included in the fi | post-discharge interview (3 month hac ollow-up interview that fell within the | l a window from 56 to 189 days p window of a post-discharge interv | ost-discharge; 9-mon iew. | ih had a window from 208 |

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 $\dot{\tau}$ At the commencement of the study there were also 6-month post-discharge interviews, however this facet of the study was discontinued due to feasibility issues.

 \sharp Includes interviewed patients and those who were deceased or incarcerated at the indicated interview time.

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TBI-PBE sample and US TBI rehabilitation population: key demographic and clinical characteristics

Table 8

| | | <u>All ages</u> | | 7 | Age less than 65 | | | <u>Age 65+</u> | |
|-------------------------------------|------------------------------------|---|-------------|------------------------------------|--|-------------|-----------------------------------|--|-------------|
| Characteristics | <u>TBI-PBE_US</u> only (n=1981) | $\frac{\text{US National}}{\text{TBI}^*}$ $(\mathbf{n}^{-1}\overline{57009})$ | Difference: | <u>TBI-PBE US</u> only (n=1562) | <u>US National</u> <u>TBI (n~27146)</u> | Difference: | <u>TBI-PBE US</u> only (n=419) | <u>US National</u> <u>TBI (n~29863)</u> | Difference: |
| Age at rehabilitation admission (%) | | | | | | | | | |
| <16 | 0.7 | 0.0 | -0.7 | 0.0 | 0.0 | -0.9 | NA | NA | NA |
| 16–19 | 10.2 | 4.4 | -5.8 | 13.0 | 9.3 | -3.7 | NA | NA | NA |
| 20–29 | 24.4 | 9.6 | -14.5 | 31.0 | 21.3 | -9.7 | NA | NA | NA |
| 30–39 | 12.6 | 6.4 | -6.2 | 15.9 | 14.1 | -1.8 | NA | NA | NA |
| 40-49 | 14.0 | 9.0 | -5.0 | 17.7 | 19.5 | 1.8 | NA | NA | NA |
| 50-59 | 11.7 | 11.0 | -0.7 | 14.9 | 23.4 | 8.5 | NA | NA | NA |
| 60-69 | 9.8 | 12.9 | 3.1 | 6.6 | 12.2 | 5.6 | 22.0 | 13.4 | -8.6 |
| 70–79 | 8.6 | 19.7 | 11.1 | NA | NA | NA | 40.8 | 36.3 | -4.5 |
| 80–89 | 6.9 | 22.5 | 15.6 | NA | NA | NA | 32.5 | 42.4 | 9.6 |
| 66-06 | 1.0 | 4.2 | 3.2 | NA | NA | NA | 4.5 | 7.9 | 3.4 |
| 100 and older | 0.1 | 0.1 | 0.0 | NA | NA | NA | 0.2 | 0.0 | -0.2 |
| Missing | 0.0 | 0.0 | 0.0 | NA | 0.0 | NA | 0.0 | 0.0 | 0.0 |
| Gender (%) | | | | | | | | | |
| Male | 72.5 | 62.7 | -9.8 | 76.2 | 73.9 | -2.3 | 58.7 | 52.4 | -6.3 |
| Female | 27.5 | 37.4 | 6.6 | 23.8 | 25.8 | 2.0 | 41.3 | 47.6 | 6.3 |
| Race/ethnicity (%) | | | | | | | | | |
| White | 74.7 | 77.2 | 2.5 | 73.0 | 70.5 | -2.5 | 80.7 | 83.2 | 2.5 |
| African-American | 15.8 | 8.4 | -7.4 | 16.8 | 11.9 | -4.9 | 11.9 | 5.1 | -6.8 |
| Hispanic | 6.6 | 7.4 | 0.8 | 7.1 | 9.7 | 2.6 | 4.8 | 5.2 | 0.4 |
| Other | 2.8 | 5.6 | 2.8 | 2.9 | 5.8 | 2.9 | 2.6 | 4.9 | 2.3 |
| Missing | 0.1 | 1.6 | 1.5 | 0.1 | 1.5 | 1.4 | 0.0 | 1.3 | 1.3 |
| Primary payer (%) | | | | | | | | | |
| Private | 46.6 | 29.6 | -17.0 | 56.6 | 54.3 | -2.3 | 9.3 | 7.8 | -1.5 |
| Medicare | 20.9 | 53.6 | 32.7 | 4.4 | 11.9 | 7.5 | 82.6 | 90.5 | 7.9 |
| Medicaid | 16.7 | 6.7 | -10.0 | 20.2 | 13.9 | -6.3 | 3.6 | 0.5 | -3.1 |

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| | | All ages | | Ŧ | Age less than 65 | | | <u>Age 65+</u> | |
|--|------------------------------------|----------------------------|--------------------|------------------------------------|-------------------------------------|-------------|-----------------------------------|-------------------------------------|-------------|
| | | <u>US National</u> TR1* | | | | | | | |
| Characteristics | <u>TBI-PBE US</u> only (n=1981) | $\frac{100}{(n^{-1})}$ | Difference: | <u>TBI-PBE US</u> only (n=1562) | <u>US National</u> TBI (n~27146) | Difference: | <u>TBI-PBE US</u> only (n=419) | <u>US National</u> TBI (n~29863) | Difference: |
| Workers' Compensation | 7.3 | 2.8 | -4.5 | 8.4 | 4.7 | -3.7 | 3.1 | 0.7 | -2.4 |
| Self-pay or no pay | 4.9 | 4.8 | -0.1 | 6.0 | 10.2 | 4.2 | 1.0 | 0.2 | -0.8 |
| Other | 3.4 | 2.5 | -0.9 | 4.2 | 4.8 | 0.6 | 0.5 | 0.4 | -0.1 |
| Missing | 0.3 | 0.0 | -0.3 | 0.3 | 0.0 | -0.3 | 0.0 | 0.0 | 0.0 |
| FIM motor score at admission (%) | | | | | | | | | |
| 13 | 16.0 | 5.8 | -10.2 | 17.1 | 7.6 | -9.5 | 11.9 | 4.4 | -7.5 |
| 14–23 | 24.4 | 18.3 | -6.1 | 23.7 | 18.4 | -5.3 | 27.0 | 18.3 | -8.7 |
| 24–33 | 17.1 | 18.5 | 1.4 | 15.9 | 14.1 | -1.8 | 21.5 | 22.4 | 0.9 |
| 34-43 | 15.5 | 21.0 | 5.5 | 13.9 | 16.9 | 3.0 | 21.5 | 24.7 | 3.2 |
| 44–53 | 12.8 | 21.3 | 8.5 | 13.3 | 20.9 | 7.6 | 11.0 | 21.4 | 10.4 |
| 54-63 | 9.1 | 11.5 | 2.4 | 10.1 | 15.6 | 5.5 | 5.5 | 7.7 | 2.2 |
| 64–73 | 3.3 | 2.9 | -0.4 | 3.8 | 4.9 | 1.1 | 1.4 | 0.7 | -0.7 |
| 74–83 | 1.0 | 0.5 | -0.5 | 1.2 | 0.9 | -0.3 | 0.2 | 0.2 | 0.0 |
| 84–91 | 0.3 | 0.1 | -0.2 | 0.3 | 0.1 | -0.2 | 0.0 | 0.0 | 0.0 |
| Missing | 0.5 | 0.0 | -0.5 | 0.6 | 0.0 | -0.6 | 0.0 | 0.0 | 0.0 |
| FIM cognitive score at admission (%) | | | | | | | | | |
| 5 | 12.7 | 8.9 | -3.8 | 12.4 | 12.5 | 0.1 | 14.1 | 5.9 | -8.2 |
| 6-15 | 47.2 | 34.9 | -12.3 | 49.9 | 39.2 | -10.7 | 37.2 | 31.2 | -6.0 |
| 16–25 | 32.6 | 40.4 | 7.8 | 31.1 | 35.5 | 4.4 | 37.9 | 44.3 | 6.4 |
| 26–35 | 7.0 | 15.8 | 8.8 | 6.0 | 12.8 | 6.8 | 10.7 | 18.6 | 7.9 |
| Missing | 0.5 | 0.0 | -0.5 | 0.6 | 0.0 | -0.6 | 0.0 | 0.0 | 0.0 |
| Case-mix groups [‡] (%) | | | | | | | | | |
| 201 MotorWt [§] >53.36, Cog>23.5 | 2.3 | 2.5 | 0.2 | 2.4 | 3.9 | 1.5 | 1.7 | 1.1 | -0.6 |
| 202 44.25 <motorwt<53.35, cog="">23.5</motorwt<53.35,> | 1.8 | 5.0 | 3.2 | 1.8 | 4.9 | 3.1 | 1.9 | 4.8 | 2.9 |
| 203 MotorWt>44.25, Cog<23.5 | 13.8 | 10.7 | -3.1 | 15.7 | 16.9 | 1.2 | 6.7 | 4.9 | -1.8 |
| 204 40.65 <motorwt<44.25< td=""><td>4.3</td><td>8.1</td><td>3.8</td><td>4.4</td><td>8.5</td><td>4.1</td><td>4.1</td><td>7.9</td><td>3.8</td></motorwt<44.25<> | 4.3 | 8.1 | 3.8 | 4.4 | 8.5 | 4.1 | 4.1 | 7.9 | 3.8 |
| 205 28.75 <motorwt<40.65< td=""><td>20.3</td><td>28.4</td><td>8.1</td><td>19.0</td><td>23.5</td><td>4.5</td><td>25.3</td><td>32.6</td><td>7.3</td></motorwt<40.65<> | 20.3 | 28.4 | 8.1 | 19.0 | 23.5 | 4.5 | 25.3 | 32.6 | 7.3 |
| 206 22.05 <motorwt<28.75< td=""><td>13.2</td><td>14.6</td><td>1.4</td><td>12.4</td><td>11.5</td><td>-0.9</td><td>16.2</td><td>17.7</td><td>1.5</td></motorwt<28.75<> | 13.2 | 14.6 | 1.4 | 12.4 | 11.5 | -0.9 | 16.2 | 17.7 | 1.5 |
| 207 MotorWt<22.05 | 43.8 | 30.7 | -13.1 | 43.7 | 30.9 | -12.8 | 44.2 | 31.1 | -13.1 |

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| | Difference: | 0.0 | |
|------------------|---|---------|---|
| <u>Age 65+</u> | <u>US National</u> TBI (n~29863) | 0.0 | |
| | <u>TBI-PBE US</u> only (n=419) | 0.0 | |
| | Difference: | -5.8 | |
| Age less than 65 | <u>US National</u> TBI (n~27146) | -5.2 | |
| Ŧ | <u>TBI-PBE US</u> only (n=1562) | 0.6 | |
| | Difference: | -0.6 | |
| <u>All ages</u> | $\frac{\text{US National}}{\text{TBI}^*}$ | -0.1 | |
| | TBI-PBE US only (n=1981) | 0.5 | |
| | | | |
| | Characteristics | Missing | - |

N-57009 (2008-2010) based on US National TBI n=156447 (2001-2010) minus US National TBI n=9438 (2001-2007). Slight overlap TBI-PBE and 2009/2010 US TBI samples. TBI-PBE includes US facilities only.

 $\dot{\tau}_{approximately.}$

 ${}^{\sharp}$ Centers for Medicare and Medicare Services case mix groups for payment of patients with TBI in rehabilitation centers.

 $^{\&}$ Weighted FIM motor score from CMG definitions.