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This report was updated on September 19, 2016. The values for speech and occupational therapy received in follow-up outpatient visits were corrected in the text on page 5 and in Figure 7. The values for the percentage of traumatic brain injury encounters by setting were corrected in Table 1.

National Hospital Care Survey Demonstration Projects: Traumatic Brain Injury

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Abstract

Purpose—This report demonstrates the analytical potential of the National Hospital Care Survey (NHCS) through a case study of inpatient discharges and ambulatory visits for traumatic brain injury (TBI) based on unweighted data from the 2013 NHCS of inpatient and emergency department (ED) encounters and the 2013 and 2014 NHCS for outpatient department (OPD) encounters.

Methods—For the 2013 NHCS data collection, 97 hospitals provided inpatient administrative claims data and 88 hospitals provided ambulatory claims data. Although the data are not intended to be nationally representative, the survey provides unique opportunities to study rare but serious conditions, such as TBI, because all inpatient discharges and ambulatory encounters from participating hospitals are collected for a 12-month period. Analyses were conducted to study TBI encounters in and across the inpatient, ED, and OPD settings. Differences among subgroups were evaluated using a chi-squared 2-sample test for equality of proportions at the 0.05 level.

Results—Analyses were conducted to examine TBI encounters across various hospital settings and highlight the tremendous analytical capabilities of NHCS, capabilities that have not been available before in previous surveys. New data elements such as intensive care use and diagnostic and physical services received, and the ability to link individuals in NHCS across hospital settings are used in the analyses.

Keywords: traumatic brain injury (TBI) • health care • National Hospital Care Survey

Introduction

Traumatic brain injury (TBI) is a disruption of normal brain function caused by a blow to the head or a penetrating head injury. The severity of TBI may range from "mild" (i.e., a brief change in mental status or consciousness) to "severe" (i.e., an extended period of unconsciousness or amnesia after the injury) (1,2). TBI is a serious health problem in the United States, contributing to a substantial number of deaths and cases of permanent disability each year. According to data from the National Hospital Discharge Survey, the National Hospital Ambulatory Care Survey, and the National Vital Statistics System, an estimated 1.7 million people suffer from TBI annually, 52,000 of whom die (2).

Data from only inpatient hospitalizations likely underreport the occurrence of TBI because most TBIs are mild and those patients are not admitted to the hospital (3). Therefore, the analysis of TBI in both hospital inpatient and ambulatory settings is a helpful indicator for measuring the incidence of TBI in the United States. Nearly 80% of individuals sustaining TBI seek treatment in emergency departments (ED) and 275,000 are hospitalized annually (2). Studies have found sex and age differences in TBI cases, with males, young children, and older adults at high risk of TBI (2,4,5). The National Hospital Care Survey (NHCS) presents unique opportunities to study how TBI is diagnosed and treated, as well as the continuum of care for TBI patients in U.S. hospitals. Patient identifiers allow for the linkage of patient records across settings, and the collection of data on services received (such as intensive care unit use and diagnostic and therapeutic services) allows for analysis of hospital utilization. This report analyzes inpatient and ED data on TBI from the 2013 NHCS data collection and outpatient department (OPD) data from the 2013 and 2014 NHCS data collections to

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illustrate the tremendous analytical capabilities of NHCS.

Background

The National Center for Health Statistics (NCHS) gathers statistics on the use, access, and quality of health care provided in the United States. Historically, NCHS has conducted three national surveys annually across five ambulatory and hospital-based settings: physician offices, inpatient settings, EDs, OPDs, and hospital ambulatory surgery locations (ASLs). In an effort to streamline data collection across health care settings and move toward collecting health care utilization data by electronic means, NCHS launched NHCS, which integrates the National Hospital Discharge Survey (NHDS) and the National Hospital Ambulatory Medical Care Survey (NHAMCS). NHCS also incorporates the Drug Abuse Warning Network (DAWN), previously conducted by the Substance Abuse and Mental Health Services Administration (SAMHSA).

Before NHCS implementation, NHDS, conducted by NCHS during 1965–2010, provided critical information on the utilization of the nation's nonfederal short-stay hospitals and on the nature and treatment of illness among the hospitalized population. NHAMCS, also conducted by NCHS, has provided data annually since 1992 about the nation's use of EDs and OPDs, and since 2009, on the use of ASLs. These data have been extensively used for monitoring changes and analyzing the types of ambulatory care provided in the nation's hospitals. DAWN, which began in the early 1970s and was conducted by SAMHSA during 1992–2011, was designed to collect data on substance-involved ED visits.

The goal of NHCS is to provide timely and reliable hospital utilization statistics. To accomplish this goal, NHCS has five objectives. First, NHCS is moving toward all electronic data collection, particularly using electronic health record data as it becomes more widely available. Second, when the survey is fully implemented, NHCS will provide nationally representative utilization statistics for hospital inpatient care, ambulatory medical care, and ambulatory surgery from a national probability sample of hospitals. Third, NHCS data will permit special studies to be conducted for both inpatient and ambulatory care as policy and research needs arise. Fourth, with the collection of personally identifiable information (PII) (e.g., name, address, and social security number), NHCS data can be linked across hospital settings within a sampled hospital and to outside data sources, such as the National Death Index (NDI) or data from the Centers for Medicare and Medicaid Services (CMS). Finally, when fully implemented, NHCS will produce nonidentifiable microdata public-use files of inpatient discharges and ED and OPD visits, including ambulatory surgery, and will disseminate timely data that can be used by health policy researchers, the public, and the research community. Using these data files, researchers will be able to study trends and changes in health care practices and changes in patterns of health care-seeking behavior.

Methods

Sample design

NHCS' target universe is inpatient discharges and in-person visits made to EDs and OPDs, including hospital-based ambulatory surgery in noninstitutional, nonfederal hospitals that have six or more staffed beds in the 50 states and the District of Columbia. Average length of stay is not used as an exclusion criterion as was done in NHDS and NHAMCS, thus expanding the frame beyond short-stay hospitals with an average length of stay of less than 30 days. No geographic primary sampling units were used in this design. Unlike the sampling for NHDS, hospitals with the most beds or discharges annually are not selected with certainty. The sampling frame is from the 2010 spring release of "Healthcare Market Index" and "Hospital Market Profiling Solution, Second Quarter, 2010," both by Verispan.

A stratified-list sample of 1,000 hospitals was selected and then split into two samples: a base sample of 500 hospitals and a reserve sample of 500 hospitals. The base sample was fielded in 2011. In 2013, 81 hospitals with 500 or more staffed beds were moved from the reserve sample into the base sample. The current sample consists of 581 hospitals: 506 acute care hospitals and 75 other specialty hospitals, including children's, psychiatric, long-term acute care, and rehabilitation hospitals.

Data source

NHCS electronically collects Uniform Bill (UB)–04 administrative claims data from participating hospitals. UB–04 is the administrative claim required by CMS and most commercial payers. Included on UB–04 claims are physician and patient identifiers and data on patient demographics, diagnoses, procedures, and revenue codes. Starting in 2011, NHCS-participating hospitals were asked to electronically submit their inpatient UB–04 administrative claims data. Beginning in 2013, participating hospitals were also asked to provide ambulatory UB–04 administrative claims, in addition to the inpatient data. The participation rate of NHCS has remained at approximately 17% for the 2011–2013 data collection period. See the Technical Notes for more information on data collection.

Using UB–04 claims data presents the challenge of deduplication of claims, because one discharge or ambulatory visit can have multiple claims. The initial deduplication is performed at the hospital level, using processes developed by NCHS to identify duplicate claims for the same discharge or visit within a hospital. After unique discharges and visits are identified, patient identifiers are created. See the Technical Notes for more information about deduplication and patient identifiers.

NHCS uses PII on the UB–04 to deduplicate claims and to allow linkage of patient data across hospital settings and with other data sources, such as NDI and the Medicare and Medicaid claims databases. With the exception of the medical record number, which was used for sampling, NHDS, NHAMCS, and DAWN do not collect PII. The list of PII items for patients includes name, birth date, address, zip code, social security number (where available), medical record number (where available), patient control number, and Medicare health insurance

benefit or claim number (if applicable). The PII items for physicians include the attending national provider identifier (NPI) number for the attending physician and the operating NPI number for a physician who performs an operation.

With the collection of PII, NHCS is able to "follow" patients during an episode of care by linking records within the same hospital. An individual can be traced from an initial visit to the ED to admission to the hospital, discharge from the hospital, and finally, for any treatment in the hospital's OPD. Another benefit of PII is that patients who return to the hospital after an inpatient discharge or an ED visit can be identified. Linkage to the NDI allows researchers to conduct a wide range of outcome studies (e.g., 30-, 60-, and 90-day mortality after discharge from a hospital) designed to investigate the association of a number of factors related to health care mortality. By linking NHCS data with Medicare and Medicaid data, researchers will be able to study changes in health status and health care utilization for low-income families, the elderly, and individuals with disabilities.

For the 2013 data collection, 97 hospitals provided UB–04 inpatient claims data and 88 hospitals provided ambulatory claims data (response rates of 16.7% and 15.1%, respectively). Of the 97 hospitals providing inpatient claims, 86% were general acute care hospitals, 7% were children's hospitals, 2% were psychiatric hospitals, and 5% were rehabilitation or long-term acute care hospitals. Of the 88 hospitals providing ambulatory claims, 88% were general acute care hospitals, 8% were children's hospitals, 2% were psychiatric hospitals, and 2% were rehabilitation or long-term acute care hospitals. Participating hospitals were asked to provide all encounters in inpatient and ambulatory settings in the 2013 calendar year. The unweighted total number of encounters was approximately 1.5 million inpatient discharges (1.3 million non-newborn inpatient discharges), 3.8 million ED visits, and 15.1 million OPD visits. The number of inpatient discharges with a first-listed diagnosis of TBI was 11,473, the number of ED visits was 62,806, and the number of OPD visits was 36,112. Although the data are unweighted and the intent is not to generalize to the U.S. population, the number of encounters and types of data collected far exceed the data previously collected in NHDS and NHAMCS, and therefore provide a richer data set for analysis. This report demonstrates the potential that NHCS has for researchers in future data releases that are generalizable to the United States.

Analysis

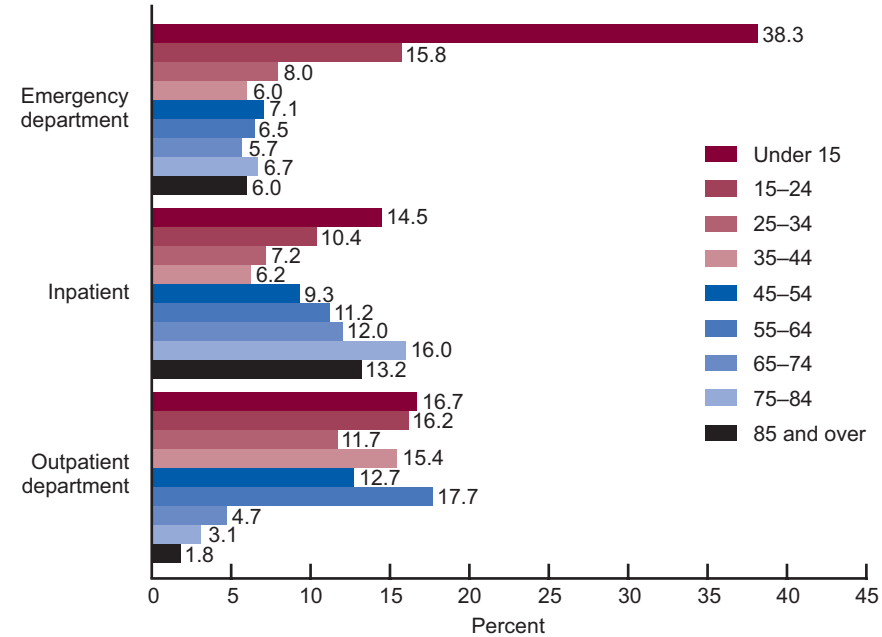
A chi-squared two-sample test for equality of proportions was used to test for statistically significant differences in the tables and figures. A p value of less than 0.05 indicates statistical significance. All counts and percentages in this report are unweighted. Due to the low response rate of sampled hospitals and unweighted data, the statistics presented in this report are not intended to be nationally representative. Terms that express differences, such as "higher," "lower," "largest," "smallest," "leading," "increased," or "decreased," were used only when the differences were statistically significant. All comparisons reported in the text were statistically significant unless otherwise indicated. Data analyses were performed using the statistical package SAS version 9.3 (SAS Institute, Cary, N.C.).

Results

Demographics

NHCS collects data on patient demographics for all settings. Patient age and sex distributions are shown in Figure 1 and Table 1.

- A first-listed diagnosis of TBI accounted for 1.7% of all ED encounters. Of the 62,806 ED encounters for TBI, most were made by children under age 15 (38.3%), followed by those aged 15–24 (15.8%) (Figure 1 and Table 1).
- In the inpatient setting, 11,473 encounters had a first-listed diagnosis of TBI. Most visits were made by those aged 75–84 (16.0%), and the fewest visits were made by those aged 35–44 (6.2%).
- Only 0.2% of all OPD encounters were for a first-listed diagnosis of TBI (n = 36,112). Adults aged 55–64 had the most encounters (17.7%), while those aged 85 and over had the smallest number of encounters (1.8%).
- The percentage of children under age 15 seen for TBI was higher than the percentage of children under age 15 seen for any reason in all



NOTES: Emergency department: n = 62,806; inpatient: n = 11,473; outpatient department: n = 36,112.
SOURCE: NCHS, National Hospital Care Survey, 2013.

Figure 1. Age distribution of first-listed diagnosis of traumatic brain injury in emergency department, inpatient, and outpatient department settings: National Hospital Care Survey, 2013

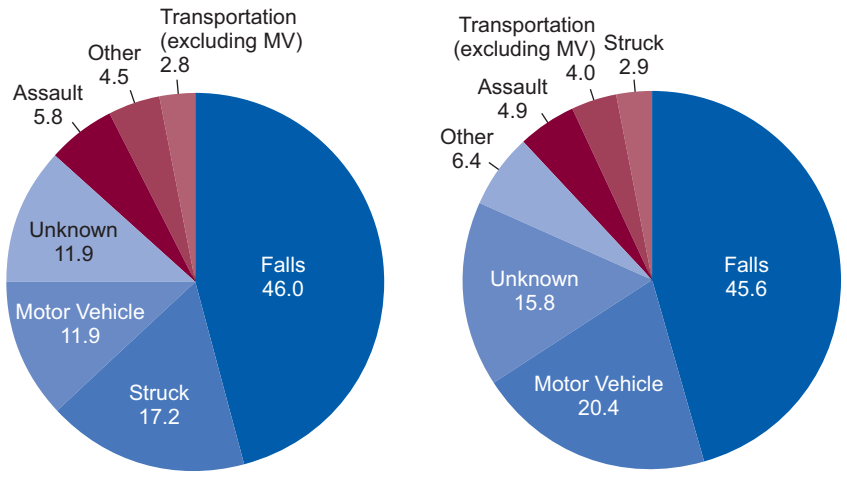
three settings. In the ED, 38.3% of TBI visits were for children under age 15, while 25.2% of all visits were for the same age group. In the inpatient setting, 14.5% of TBI hospitalizations were for children under age 15, but only 9.4% of all hospitalizations were for children under age 15. In the OPD, 16.7% of TBI encounters were for children under age 15, while 13.8% of all visits were for children under age 15.

- In the ED and OPD settings, the three youngest age groups (under 15, 15–24, and 25–34) accounted for a higher percentage of visits than the three oldest age groups (65–74, 75–84, and 85 and over). However, in the inpatient setting, the three oldest age groups accounted for a higher percentage of visits than the three youngest age groups (Figure 1).
- Males accounted for a higher percentage of encounters for TBI in all settings than for all encounters in all settings: 53.4% compared with 44.8% in EDs; 61.1% compared with 43.2% in inpatient settings; and 64.1% compared with 40.8% in OPDs. Males were also more likely than females to have an encounter for TBI in all settings: 53.4% compared with 46.6% in EDs; 61.1% compared with 38.9% in inpatient settings; and 64.1% compared with 35.9% in OPDs (Table 1).
- Females accounted for a lower percentage of encounters for TBI in all settings than for all encounters in all settings: 46.6% compared with 55.2% in EDs; 38.9% compared with 57.7% in inpatient settings; and 35.9% compared with 59.2% in OPDs.

External cause of injury

Unlike NHDS, external cause-of-injury codes are collected separately from diagnosis codes in NHCS. E-codes are not required on the administrative bill but can be provided—84% of inpatient records with a first-listed diagnosis of TBI and 88% of ED records with a first-listed diagnosis of TBI had at least one E-code. Analyses using E-codes are shown in Figure 2 and Tables 2 and 3.

- The most common cause of TBI encounters in the ED and inpatient settings was falls (46.0% and 45.6%, respectively). Injuries from motor vehicles was the second most common cause in the inpatient setting (20.4%), while accidental strikes from falling objects or against objects or persons was the second most common cause in the ED setting (17.2%) (Figure 2).
- For all age groups except 15–24 and 25–34, the most common cause of TBI encounters in the ED setting was falls. The most common cause for those aged 15–24 was accidental strikes from falling objects or against objects or persons (26.8%), while the most common cause for adults aged 25–34 was injuries from motor vehicles (27.4%) (Table 2).
- Falls were the most common cause of TBI encounters in the inpatient setting for children under age 15 and for all adults aged 55 and over. For adults aged 15–44, the most common cause of TBI leading to hospitalization was injuries from motor vehicles. For adults aged 45–54, the most common causes of TBI hospitalizations were falls and injuries from motor vehicles.
- Encounters for TBI in the inpatient setting were more likely to involve secondary diagnoses of alcohol abuse (10.0%) and drug abuse (1.3%) than encounters for TBI in the ED setting (3.5% and 0.4%, respectively) (Table 3).



NOTES: MV is motor vehicle. Emergency department: *n* = 62,806; inpatient: *n* = 11,473.
SOURCE: NCHS, National Hospital Care Survey, 2013.

Figure 2. Percent distribution of external cause of injuries with a first-listed diagnosis of traumatic brain injury, by setting: National Hospital Care Survey, 2013

Diagnostic and therapeutic services for TBI

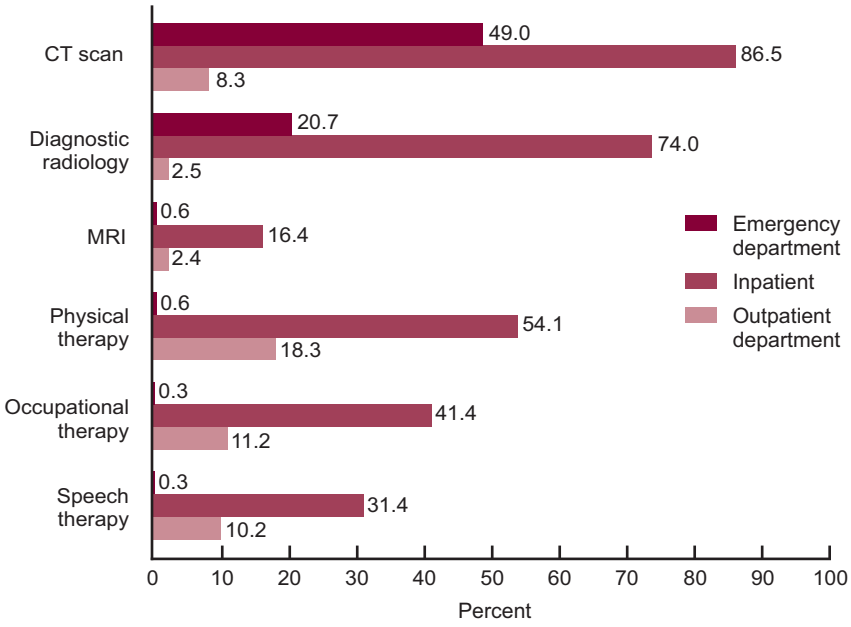
Because NHCS collects administrative claims data, revenue codes are included in the record of a patient. These codes describe services provided during an encounter, from room and board to diagnostic and therapeutic services received by a patient. Analyses describing selected services received during an encounter for TBI are shown in Figure 3 and Tables 4 and 5.

- The most common diagnostic service received in encounters for TBI in all settings was a computed tomography (CT) scan: approximately 1 in 2 encounters in the ED, 9 in 10 encounters in the inpatient setting, and 1 in 10 encounters in the OPD setting (Figure 3).
- Patients were more likely to receive any type of diagnostic and therapeutic service in the inpatient setting, compared with the ED and OPD settings.
- The most common therapeutic service received during encounters for TBI in the inpatient and OPD settings was physical therapy (54.1% and 18.3%, respectively).

Intensive care unit (ICU) use among inpatients hospitalized for TBI

Revenue codes collected through NHCS also indicate stays in the ICU. Analyses for ICU stays related to TBI are shown in Figure 4 and Table 6.

- The average length of stay for inpatients with a first-listed diagnosis of TBI with a stay in the ICU was 7.3 days, with an average of 1.2 days in the ICU (Figure 4).
- The average length of stay for inpatients hospitalized for TBI without a stay in the ICU was 3.2 days.
- Six in ten hospitalizations for TBI resulted in an ICU stay (Table 6).
- The age group most likely to have a stay in the ICU during a hospitalization for TBI is adults aged 75–84, followed by children under age 15.



NOTES: CT is computed tomography. MRI is magnetic resonance imaging. Emergency department: *n* = 62,806; inpatient: *n* = 11,473; outpatient department: *n* = 36,112.
SOURCE: NCHS, National Hospital Care Survey, 2013.

Figure 3. Percentage of first-listed diagnosis of traumatic brain injury encounters receiving diagnostic and therapeutic services in emergency department, inpatient, and outpatient department settings: National Hospital Care Survey, 2013

Discharge status of ED and inpatient encounters for TBI

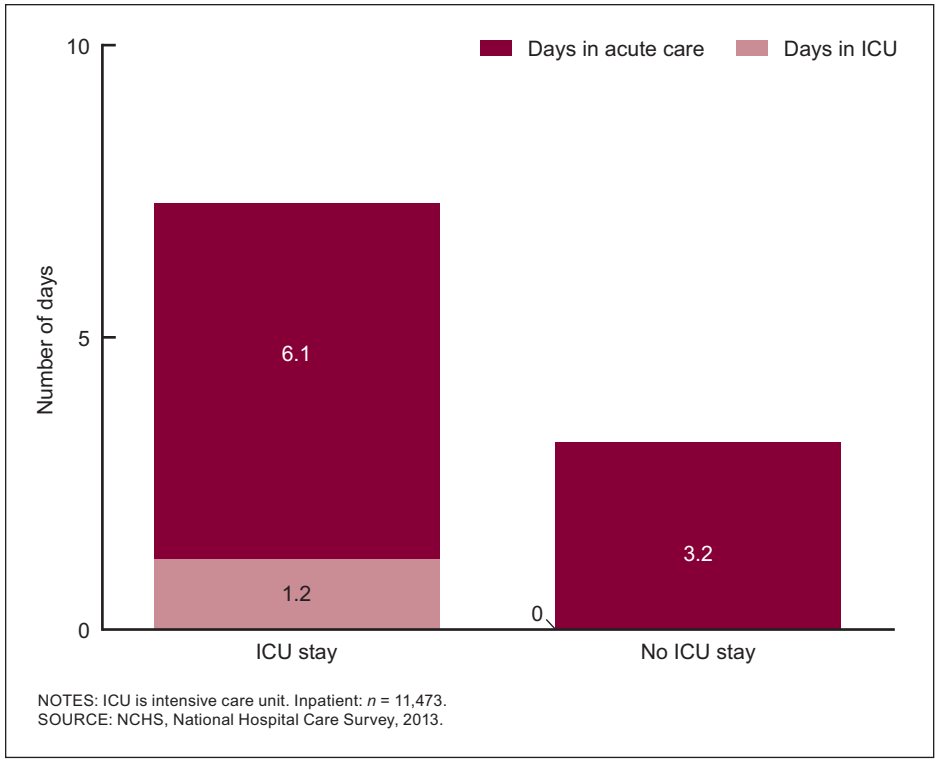
NHCS provides additional specificity to discharge status through a code for home health or home hospice care. In previous studies, these discharges would have been classified as "other." Discharge status for the ED and inpatient settings is described in Figure 5 and Table 7.

- ED encounters for TBI were more likely than inpatient encounters for TBI to end in discharge home (80.8% and 51.8%, respectively) (Figure 5).
- More than three out of four inpatient hospitalizations with a first-listed diagnosis of TBI were transferred to a short-term care facility and almost one in ten were discharged to home health or home hospice care.
- Fifteen percent of ED visits with a first-listed diagnosis of TBI were admitted as inpatients, the second most common discharge status for ED encounters.
- Children under age 15 with an ED visit or an inpatient discharge for a first-listed diagnosis of TBI were more likely to be discharged home than any other age group (92.6% and 92.2%, respectively) (Table 7).
- Adults aged 85 and over were the least likely to be discharged home in the inpatient setting (16.8%), while adults aged 75–84 and 85 and over were the least likely to be discharged home in the ED setting (57.2% and 55.6%, respectively).
- Women were more likely than men to be discharged home from the ED setting (83.4% compared with 78.4%), while men were more likely than women to be discharged home from the inpatient setting (55.1% compared with 46.7%).

TBI-related OPD follow-up care for inpatient discharges for TBI

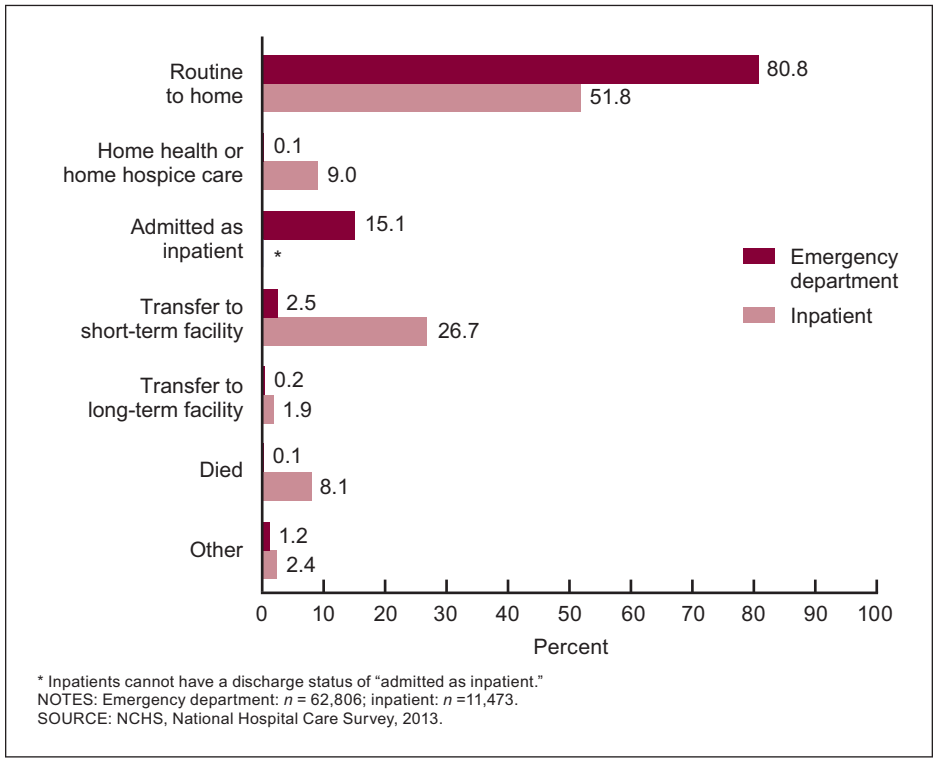
For the first time, individual patients can be followed through their entire experience in a hospital. Patients are identified through the PII included on the billing claims, including name, date of birth, and social security number, and are given a unique identifier. Figures 6 and 7 describe the hospital outpatient follow-up care received within 12 months of discharge by inpatients with TBI.

- Of the 11,473 inpatient discharges for TBI, 11,202 were individual patients. The first inpatient discharge for TBI was considered the index visit and follow-up care in the OPD (at the same hospital where inpatient services were rendered) for any-listed TBI was considered for 1 year following the index visit. Of the 11,202 inpatients with TBI, 1,209 had a follow-up visit in the OPD with a diagnosis of TBI within 1 year of discharge (Figure 6).
- The mean number of follow-up OPD visits made by the 1,209 patients who received care in the inpatient setting for a first-listed TBI was 3.0 (data not shown).
- Physical therapy was the most common therapeutic service received in follow-up OPD visits for any-listed TBI—almost one in three OPD follow-up visits included physical therapy services—followed by speech therapy and occupational therapy (Figure 7).
- Diagnostic services were less common than therapeutic services in follow-up OPD visits for any-listed TBI: Less than 3% of OPD follow-up visits included diagnostic radiology and magnetic resonance imaging (MRI) services, while 13% included a CT scan.



NOTES: ICU is intensive care unit. Inpatient: *n* = 11,473.
SOURCE: NCHS, National Hospital Care Survey, 2013.

Figure 4. Average length of stay for inpatients hospitalized with a first-listed diagnosis of traumatic brain injury, by intensive care unit status: National Hospital Care Survey, 2013



* Inpatients cannot have a discharge status of "admitted as inpatient."
NOTES: Emergency department: *n* = 62,806; inpatient: *n* =11,473.
SOURCE: NCHS, National Hospital Care Survey, 2013.

Figure 5. Discharge status for first-listed diagnosis of traumatic brain injury in the emergency department and inpatient settings: National Hospital Care Survey, 2013

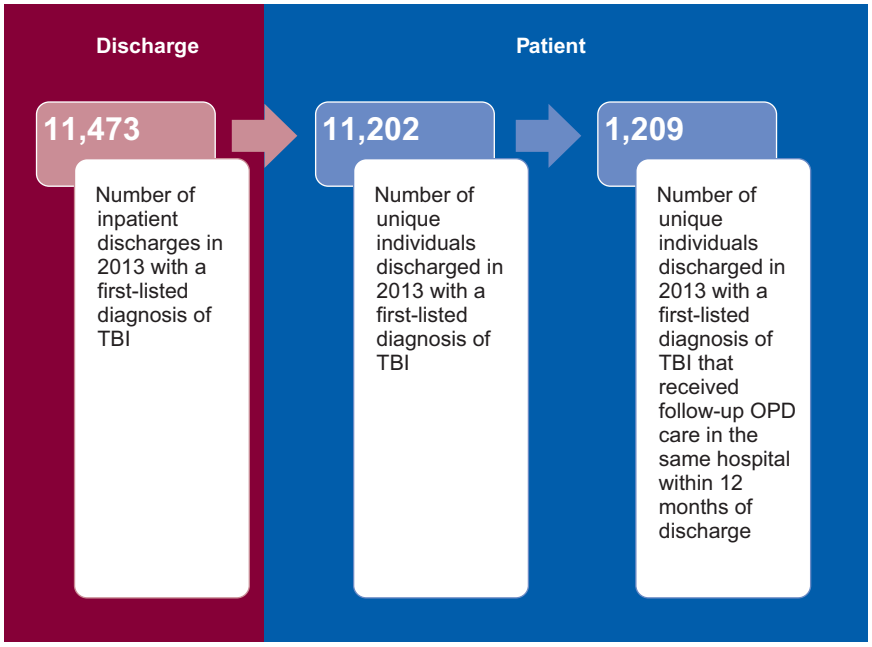
Discussion

This report examines TBI encounters in various hospital settings. While the NHCS data used were not nationally representative, the results presented are consistent with previous research studies (2,7). Males have more TBI encounters than females across the inpatient, ED, and OPD settings and across all age groups. Children under age 15 comprise most ED visits for TBI. Adults aged 65 and over accounted for most TBI hospitalizations. Falls were the most common cause of TBI encounters.

This report also demonstrates the type of analyses that are now possible with NHCS data. In particular, NHCS provides a unique opportunity to study rare but serious conditions, such as TBI, and the care and services received by patients. In addition to the diagnostic and physical services received, NHCS data include data on cognitive rehabilitative services received by inpatients and outpatients, such as occupational and speech therapy. Additionally, this report showcases the ability to link individuals in NHCS across settings—ED to inpatient to follow-up care in the hospital's OPD. As NHCS continues to collect data from more hospitals and moves toward the collection of electronic health records, the benefit of NHCS data to researchers and the public will continue to grow.

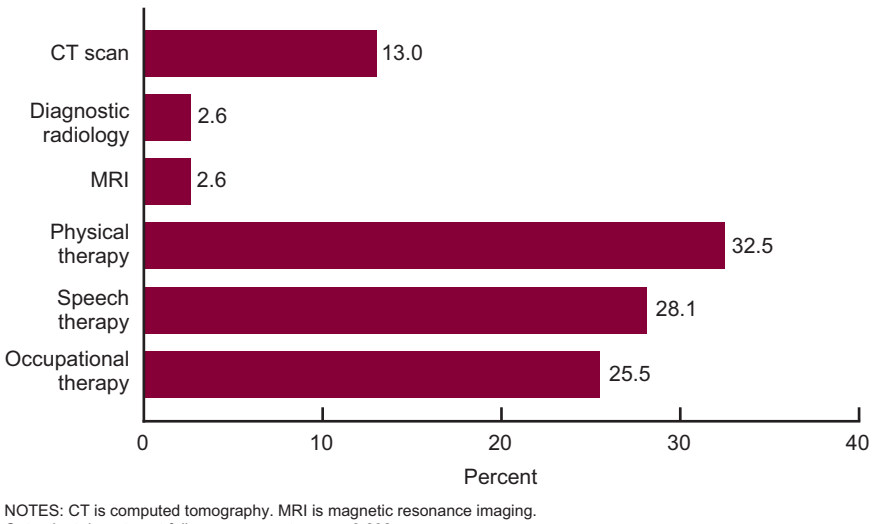
References

1. National Institute of Neurological Disorders and Stroke. Traumatic brain injury information page. Available from: http://www.ninds.nih.gov/disorders/tbi/tbi.htm.
2. Faul M, Xu L, Wald MM, Coronado VG. Traumatic brain injury in the United States: Emergency department visits, hospitalizations and deaths 2002–2006. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. 2010.
3. McKinlay A, Grace RC, Horwood LJ, Fergusson DM, Ridder EM, MacFarlane MR. Prevalence of traumatic brain injury among children, adolescents and young adults: Prospective evidence from a birth cohort. Brain Inj 22(2):175–81. 2008.
4. Rutland-Brown W, Langlois JA, Thomas KE, Xi YL. Incidence of traumatic brain injury in the United States, 2003. J Head



NOTES: TBI is traumatic brain injury. OPD is outpatient department.
SOURCE: NCHS, National Hospital Care Survey, 2013–2014.

Figure 6. Flow chart of inpatient discharges for first-listed traumatic brain injury to follow-up outpatient department visits for any-listed traumatic brain injury: National Hospital Care Survey, 2013–2014



NOTES: CT is computed tomography. MRI is magnetic resonance imaging.
Outpatient department follow-up encounters: *n* = 3,636.
SOURCE: NCHS, National Hospital Care Survey, 2013–2014.

Figure 7. Percentage of any-listed traumatic brain injury follow-up visits receiving diagnostic and therapeutic services in the outpatient department setting: National Hospital Care Survey, 2013–2014

Trauma Rehabil 21(6):544–8. 2006.
5. Bruns J Jr, Hauser WA. The epidemiology of traumatic brain injury: A review. Epilepsia 44(Suppl 10):2–10. 2003.
6. Winglee M, Valliant R, Scheuren F. A case study in record linkage. Surv Methodol 31(1):3–11. 2005.
7. Langlois JA, Rutland-Brown W, Thomas KE. Traumatic brain injury in the United States: Emergency department visits, hospitalizations, and deaths. Atlanta, GA: Centers for Disease Control and Prevention, National Center for Injury Prevention and Control. 2004.

Table 1. Percent distribution of first-listed traumatic brain injury, by setting, age, and sex: National Hospital Care Survey, 2013

	Emergency department		Inpatient		Outpatient department	
	Total	Traumatic brain injury	Total	Traumatic brain injury	Total	Traumatic brain injury
			Number			
Number of encounters	3,784,397	62,806 (1.7%)	1,324,033	11,473 (0.9%)	15,144,448	36,112 (0.2%)
			Percent			
Total	100	100	100	100	100	100
Age						
Under 15	25.2	38.3	9.4	14.5	13.8	16.7
0–4	11.1	15.3	4.4	5.8	5.1	3.7
5–9	8.3	11.7	2.7	4.5	4.7	4.2
10–14	5.8	11.2	2.3	4.1	4.0	8.9
15–24	13.4	15.8	8.4	10.4	7.2	16.2
25–34	12.8	8.0	12.4	7.2	7.9	11.7
35–44	10.6	6.0	9.0	6.2	9.1	15.4
45–54	11.6	7.1	11.6	9.3	14.3	12.7
55–64	9.8	6.5	14.7	11.2	17.8	17.7
65–74	7.2	5.7	14.8	12.0	16.7	4.7
75–84	5.7	6.7	12.0	16.0	9.7	3.1
85 and over	3.7	6.0	7.5	13.2	3.5	1.8
Sex						
Male	44.8	53.4	42.3	61.1	40.8	64.1
Under 15	30.5	43.9	12.2	14.7	18.4	15.1
0–4	13.6	16.4	5.9	5.3	7.0	3.2
5–9	10.0	13.8	3.6	4.6	6.4	3.9
10–14	6.9	13.7	2.8	4.8	5.0	8.0
15–24	11.4	16.4	5.8	12.7	6.4	16.0
25–34	10.1	7.8	5.6	9.1	5.0	12.7
35–44	9.8	5.6	7.3	7.2	7.2	14.7
45–54	12.1	6.9	13.8	10.9	13.3	13.0
55–64	10.6	6.1	18.3	12.1	18.3	21.5
65–74	7.5	4.7	17.6	11.2	18.0	3.8
75–84	5.3	5.0	12.9	13.5	10.3	2.3
85 and over	2.8	3.6	6.5	8.7	3.2	0.9
Female	55.2	46.6	57.7	38.9	59.2	35.9
Under 15	20.9	31.9	7.3	14.2	10.6	19.6
0–4	9.1	14.2	3.3	6.7	3.8	4.5
5–9	6.8	9.3	2.0	4.4	3.5	4.6
10–14	5.0	8.4	2.0	3.0	3.3	10.4
15–24	15.1	15.1	10.3	6.8	7.7	16.6
25–34	14.9	8.2	17.4	4.3	9.9	9.9
35–44	11.3	6.4	10.3	4.7	10.5	16.6
45–54	11.2	7.3	10.1	6.7	15.1	12.2
55–64	9.1	7.0	12.1	9.7	17.4	11.0
65–74	7.1	6.7	12.8	13.3	15.8	6.2
75–84	6.0	8.7	11.4	20.0	9.3	4.5
85 and over	4.5	8.7	8.3	20.3	3.7	3.4

Table 2. Percent distribution of external cause of injury for first-listed diagnosis of traumatic brain injury, by sex, age, and setting: National Hospital Care Survey, 2013

External cause of injury	Number of encounters	Male	Female	Under 15	15–24	25–34	35–44	45–54	55–64	65–74	75–84	85 and over
Emergency department							Percent					
Falls	28,867	41.5	51.0	51.6	20.0	20.4	27.9	36.4	50.3	66.4	78.1	82.1
Struck	10,802	19.0	15.2	23.0	26.8	15.4	13.6	12.0	8.9	5.6	3.5	2.2
Motor vehicle	7,471	11.9	11.9	3.6	21.5	27.4	24.5	19.2	16.0	9.8	5.1	2.9
Assault	3,633	6.7	4.7	1.4	12.0	16.1	13.2	11.4	5.2	1.7	---	---
Transportation[1]	1,740	3.4	2.1	2.9	3.6	3.7	3.5	3.5	2.9	2.0	---	---
Other	2,834	5.1	3.8	4.1	4.7	5.4	5.2	5.7	5.1	4.6	3.8	3.5
Unknown	7,459	12.4	11.3	13.4	11.5	11.6	12.2	11.9	11.7	10.0	8.5	8.8
Inpatient												
Falls	5,226	40.7	53.2	38.4	14.3	16.9	20.8	31.9	46.0	59.4	68.6	73.9
Struck	337	3.2	2.5	7.7	5.2	---	---	---	---	---	---	---
Motor vehicle	2,345	22.0	18.0	12.4	46.1	43.4	41.0	30.6	19.8	11.6	6.8	4.7
Assault	557	6.7	1.9	2.5	11.3	14.2	11.1	9.3	4.5	---	---	---
Transportation[1]	463	4.7	3.0	7.1	6.2	6.5	6.5	5.6	4.1	2.6	---	---
Other	737	7.0	5.5	5.8	6.0	6.0	7.7	7.4	7.3	7.8	6.5	4.3
Unknown	1,808	15.7	15.8	26.2	10.9	11.5	11.1	12.4	16.1	15.4	15.5	15.5

--- Data not available due to sample size of fewer than 30 records.
[1] Does not include injuries caused by motor vehicles.

Table 3. Percent distribution of external cause of injury for first-listed diagnosis of traumatic brain injury, by documented alcohol and drug abuse and setting: National Hospital Care Survey, 2013

External cause	Emergency department				Inpatient			
	Alcohol abuse only[1]	Acute alcoholic intoxication	Drug abuse only	Concurrent alcohol and drug abuse[1]	Alcohol abuse only[1]	Acute alcoholic intoxication	Drug abuse only	Concurrent alcohol and drug abuse[1]
	Percent							
Total	3.5	0.9	0.4	0.4	10.0	2.6	1.3	1.7
Motor vehicle	5.7	1.9	---	0.7	11.6	4.3	---	2.1
Falls	3.3	0.5	0.4	0.3	9.4	1.1	1.4	1.0
Assault	9.8	2.6	1.0	1.4	21.0	6.3	---	6.1
Struck	0.4	---	---	---	---	---	---	---
Transportation (excluding motor vehicles)	5.1	---	---	---	12.0	---	---	---
Other	4.7	1.5	1.1	---	6.8	4.2	---	---
Unknown	2.8	1.3	---	0.5	8.7	3.5	---	2.3

--- Data not available due to sample size of fewer than 30 records.
[1] Excludes ICD-9-CM 303.0 (acute alcoholic intoxication).

NOTE: Categories are mutually exclusive.

Table 4. Percent distribution of first-listed traumatic brain injury encounters receiving diagnostic services, by setting, sex, and age: National Hospital Care Survey, 2013

	CT scan			Diagnostic radiology			MRI		
	Emergency department	Inpatient	Outpatient department	Emergency department	Inpatient	Outpatient department	Emergency department	Inpatient	Outpatient department
					Number				
Number of encounters	30,804	9,925	3,001	12,989	8,492	896	357	1,878	867
Sex					Percent				
Male	48.7	61.7	49.5	47.5	61.5	49.4	53.5	59.6	54.7
Female	51.3	38.3	50.5	52.6	38.5	50.6	46.5	40.4	45.3
Age									
Under 15	21.5	12.2	16.7	17.6	11.5	33.7	18.8	16.6	35.4
15–24	18.5	10.9	15.0	16.8	10.8	15.6	24.7	11.6	25.0
25–34	10.3	7.8	7.2	11.0	7.9	7.7	8.1	7.7	5.8
35–44	8.0	6.7	6.7	8.4	6.8	7.6	10.4	8.5	7.4
45–54	9.5	9.9	9.4	9.8	10.1	7.8	10.9	10.9	7.5
55–64	8.4	11.6	11.2	9.1	11.9	9.2	9.8	13.0	7.8
65–74	7.2	12.1	13.6	7.8	12.0	5.6	---	11.3	6.3
75–84	8.6	15.9	12.8	10.1	15.7	7.3	---	13.5	3.6
85 and over	8.0	13.0	7.4	9.3	13.2	5.6	---	6.9	---

--- Data not available due to sample size of fewer than 30 records.

NOTES: CT scan is computed tomography scan. MRI is magnetic resonance imaging.

Table 5. Percent distribution of first-listed traumatic brain injury encounters receiving therapeutic services, by setting, sex, and age: National Hospital Care Survey, 2013

	Physical therapy			Occupational therapy			Speech therapy		
	Emergency department	Inpatient	Outpatient department	Emergency department	Inpatient	Outpatient department	Emergency department	Inpatient	Outpatient department
					Number				
Number of encounters	377	6,205	6,623	176	4,753	4,031	176	3,602	3,670
Sex					Percent				
Male	44.0	59.4	63.2	46.6	60.3	68.4	56.3	64.3	66.9
Female	56.0	40.6	36.8	53.4	39.7	31.7	43.8	35.7	33.1
Age									
Under 15	---	4.4	14.0	---	3.9	7.2	---	8.4	4.8
15–24	9.0	9.3	24.3	---	9.2	23.7	20.5	11.7	24.4
25–34	8.5	6.6	15.8	---	6.7	21.3	---	7.9	19.4
35–44	6.6	6.5	13.2	---	6.9	15.0	---	7.6	13.5
45–54	---	10.1	13.0	---	10.4	15.9	---	11.3	18.0
55–64	10.3	12.8	12.1	---	13.2	8.8	---	12.9	10.2
65–74	12.5	14.3	4.7	---	14.7	5.6	---	11.7	7.3
75–84	21.2	19.8	2.3	18.8	20.0	2.0	---	15.9	1.7
85 and over	19.1	16.2	0.6	17.6	15.0	---	---	12.7	---

--- Data not available due to sample size of fewer than 30 records.

Table 6. Percent distribution and average length of stay of first-listed diagnosis of traumatic brain injury intensive care unit stays, by sex and age: National Hospital Care Survey, 2013

	Total traumatic brain injuries	Intensive care unit stay	No intensive care unit stay
		Number	
Total	11,473	7,480	3,993
Sex		Percent	
Male	61.1	63.5	56.6
Female	38.9	36.6	43.4
Age			
Under 15	14.5	14.1	15.2
15–24	10.4	10.8	9.6
25–34	7.2	7.5	6.8
35–44	6.2	6.4	5.8
45–54	9.3	9.8	8.3
55–64	11.2	11.7	10.1
65–74	12.0	12.0	11.9
75–84	16.0	15.8	16.4
85 and over	13.2	11.9	15.8
Sex		Average length of stay (days)	
Male	6.5	8.0	3.3
Female	5.0	6.2	3.2
Age			
Under 15	3.8	4.8	2.0
15–24	5.7	7.3	2.5
25–34	7.3	9.5	2.7
35–44	8.2	10.3	3.8
45–54	7.6	9.4	3.5
55–64	7.2	8.8	3.7
65–74	5.9	7.1	3.7
75–84	5.6	6.5	3.9
85 and over	4.7	5.5	3.5

Table 7. Percent distribution of first-listed diagnosis of traumatic brain injury in emergency department and inpatient settings, by sex, age, and discharge status: National Hospital Care Survey, 2013

	Number of encounters	Sex		Age								
		Male	Female	Under 15	15–24	25–34	35–44	45–54	55–64	65–74	75–84	85 and over
							Number					
Emergency department	62,806	33,527	29,279	24,056	9,932	4,990	3,747	4,469	4,093	3,546	4,214	3,759
							Percent					
Routine to home	50,722	78.4	83.4	92.6	86.9	80.1	79.3	74.7	68.2	62.7	57.2	55.6
Home health or home hospice care	72	0.1	0.1	---	---	---	---	---	---	---	---	---
Admitted as inpatient	9,507	17.4	12.6	5.7	10.5	15.1	16.5	20.8	26.2	30.6	33.4	32.4
Transfer to short-term facility	1,567	2.4	2.6	1.3	1.0	1.4	1.3	2.2	2.8	4.8	7.2	9.5
Transfer to long-term facility	118	0.1	0.2	---	---	---	---	---	---	---	0.9	1.1
Died	71	0.2	---	---	---	---	---	---	---	---	---	---
Other	749	1.4	1.0	0.4	1.4	3.2	2.6	2.1	2.1	0.9	0.8	---
							Number					
Inpatient	11,473	7,006	4,467	1,660	1,193	830	713	1,064	1,281	1,375	1,837	1,520
							Percent					
Routine to home	5,948	55.1	46.7	92.2	70.8	66.8	61.4	59.3	51.3	39.6	26.8	16.8
Home health or home hospice care	1,037	7.5	11.4	---	3.2	5.3	7.4	8.1	8.4	11.7	15.8	15.4
Transfer to short-term facility	3,057	23.8	31.1	4.0	16.0	13.0	17.8	18.1	26.2	33.8	42.8	51.7
Transfer to long-term facility	221	2.1	1.6	---	---	---	---	---	2.5	2.6	2.1	2.8
Died	933	8.5	7.6	2.1	6.2	8.0	6.5	6.7	8.7	10.3	11.2	12.0
Other	277	2.9	1.6	---	---	5.1	5.3	5.1	2.9	---	---	---

--- Data not available due to sample size of fewer than 30 records.

Technical Notes

Data collection

Although hospitals are required to submit Uniform Bill (UB)–04 claims to the Centers for Medicare and Medicaid Services (CMS) in the 837 file format, submission of UB–04 claims in the 837 file format to the National Center for Health Statistics (NCHS) has been challenging. First, many hospitals use clearinghouses to process and submit their claims to CMS and other commercial insurance companies. In many instances, the small payment NCHS offers for each year of data collection is not enough to offset the cost the clearinghouse charges for constructing a file for the National Hospital Care Survey (NHCS). As an alternative, NCHS has accepted non-adjudicated data files directly from hospitals, which are cleaned and processed by the NHCS data collection contractor.

Second, hospitals that process their own UB–04 claims sometimes do not know how to output the data from their systems for submission to NHCS. Even for hospitals that can output digital data in-house, some are not able to output in the 837 format to the data collection contractor. Although not preferred, other file formats such XML, Excel, and ASCII are accepted. Third, hospitals with many patients handle volume by archiving their claims data daily, which makes obtaining the data for this study difficult, costly, or both. With the technological capabilities of the NHCS data collection contractor, automation of daily data transmission has provided a solution for obtaining archived data.

All inpatient and ambulatory claims data are transmitted through the contractor's secure transfer system. These data are compiled, processed, and sent to NCHS.

Claims deduplication

Using UB–04 claims data presented a challenge, because one encounter, both for inpatient discharges and ambulatory visits, can have multiple claims. Therefore, deduplication processes needed to be developed. The initial deduplication was performed at the hospital level, using processes to identify duplicate claims for the same encounter, inpatient or emergency department (ED), within a hospital. To develop the deduplication method for a hospital, claims were grouped in each of these three ways: (a) by Patient Control Number (PCN); (b) by beginning date of encounter and Medical Record Number (MRN); and (c) by beginning date of encounter, date of birth, and patient name. The purpose of this processing was to evaluate whether the PCN could be used to accurately identify duplicate claims for the same encounter, controlling for matching data elements for the beginning date of encounter, MRN, date of birth, and patient name. If the number of duplicate groups of claims identified by PCN was close to the other counts produced, PCN was used to deduplicate the claims. However, if the values of these variables in a group of duplicates were not similar, then the hospital's claims were further assessed through a manual review of the duplicate groups, and a final determination of the deduplication method to be used at that hospital was made.

Outpatient claims splitting—Although the vast majority of ambulatory visits involve a single day, many cases of ambulatory claims spanning two or more dates were detected among ambulatory claims. Multiple-date claims were examined, and in some cases, there was evidence justifying multiple-day visit claims. Three types of cases were identified as probably being valid multiple-day visit to the ambulatory department: (a) an ED visit could span several days, and even a short ED visit that started in the late evening of one day could easily continue into the next day and would appear as a 2-day visit; (b) a patient who received "observation services" was periodically monitored by hospital staff to determine the need for possible admission, and this period of monitoring could span several days; and (c) patients undergoing ambulatory surgery might be kept in the ambulatory center for longer periods of time pre- or post-surgery.

A claim for multiple dates that should not have been treated as a single visit spanning multiple days was split into two or more subclaims. One example of multiple-date claims that should have been split included repeated treatments over a period of time, say for weekly speech therapy or regular dialysis, for which some hospitals preferred to submit just one claim covering a period of time. Any claim with nonconsecutive dates in the ED or outpatient department (OPD) was split into two or more claims for single-day stays (or for consecutive-day stays). All consecutive-day claims were then separated into one claim per day, assuming that no evidence of a justifiable longer stay was found—such as visits to the ED, patients receiving observation services, or patients undergoing ambulatory surgery. Any consecutive-day visits with evidence of any of these three conditions were not split.

Patient identification

After deduplication of claims was complete, a probability-based record linkage method was used to identify patients. In the first round of patient identification, two records were compared by name (first, last, middle initial), date of birth, sex, hospital identifier, MRN, social security number (SSN), and ZIP code. If there was sufficient agreement of data elements between the two records, the records were retained as a pair (i.e., record pair) for further analysis. The second round compared the record pairs, controlling for agreement in the hospital identifier and MRN (pass 1); SSN, if reported (pass 2); and sex, year, month of birth, soundex (a phonetic coding system designed to suppress spelling variations) of last name, and state abbreviation (pass 3). The record pairs compared in the three passes had match weights assigned to 11 matching variables. The match weights were likelihood ratio scores based on the probability of agreement in the records retained as record pairs and the probability of agreement in the records that were not included in any record pairs. A match weight of 60.98 indicated perfect agreement in all of the comparison fields. Pairs with a match weight above a threshold of 30 were retained as likely matches based on selection thresholds suggested in Winglee, Valliant, and Scheuren (6).

Two additional reviews were conducted for record pairs of children

under age 10 at the time of discharge. The first review targeted newborn infants whose first names contained "BABY," "GIRL," "BOY," "FEMALE," or "MALE." The newborn pairs were then subject to one of three adjustments: (a) Pairs that contained records in which a name like "BABYGIRL" was in one record and a real name (e.g., "JANE") was in another were accepted as a match when the hospital identifier and medical record number were the same. (b) Pairs with the same hospital identifier, service date, and patient address but different medical record numbers were identified as twin or multiple-birth records and were manually split. (c) Pairs with different last names and medical record numbers were manually reviewed and split if the pair was determined to be false.

ED visits admitted as inpatients

ED visits in which the patients were admitted as inpatients did not have separate ED records; therefore, the inpatient record was duplicated in the ED file. However, the duplicated ED records maintained the inpatient discharge status. To get an accurate account of ED discharge status, inpatient records in the ED file had the discharge status changed to "admitted as an inpatient." Additionally, in order not to over count services provided, services on the duplicated ED records were only counted in the inpatient setting.

Definition of terms

Traumatic brain injury—Identified through the *International Classification of Diseases, Ninth Revision, Clinical Modification* (ICD–9–CM). The first-listed diagnosis is generally understood to be the primary diagnosis, the main cause of the encounter. When the following ICD–9–CM codes were found in the first-listed diagnosis, the encounter was considered to be for traumatic brain injury (TBI): 800, 801, 803, 804, 850, 851, 852, 853, 854.0, 854.1, 950.1, 950.2, 950.3, 959.01, and 995.55.

Alcohol and drug abuse—Alcohol and drug abuse associated with an encounter for TBI were identified through ICD–9–CM codes in the secondary diagnoses. The following ICD–9–CM codes were used in the analysis:

- Alcohol abuse only: 303.9, 305.0
- Acute alcoholic intoxication: 303.0
- Drug abuse only: 304, 305.2–305.9
- Concurrent alcohol and drug abuse: 303.9, 304, 305.0, 305.2–305.9

E-codes—External cause-of-injury and poisoning codes used in ICD–9–CM. E-codes provide information on how the injury or poisoning occurred, the intent such as accidental or intentional, and the place where the event occurred. E-codes are supplemental codes used in conjunction with ICD–9–CM diagnosis codes. E-codes are not required on the UB–04 but can be provided—84% of inpatient records with a first-listed diagnosis of TBI and 88% of ED records with a first-listed diagnosis of TBI had at least one E-code. The following E-codes were used in the analysis:

- Motor vehicle (MV): E810–E819
- Fall: E880–E886, E888, E987
- Assault: E960–E969
- Struck: E916–E917
- Transportation (excluding MV): E800–E807, E820–E829, E831, E833–E845
- Other: E808–E809, E830, E832, E846–E879, E887, E889–E915, E918–E959, E970–E986, E988–E999
- Unknown: No E-codes present on the record

Revenue codes—Four-digit numbers used on UB–04 administrative claims data that identify billable services provided during an inpatient stay or an ambulatory visit. The following revenue codes that are commonly associated with the diagnosis and treatment of TBI were used in the analysis:

- Computed tomography (CT) scan: 035x
- Radiology–diagnostic: 032x
- Magnetic resonance technology: 061x
- Physical therapy: 042x
- Occupational therapy: 043x
- Speech therapy: 044x

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