

Traumatic Brain Injury Occurrence and Mortality in New Hampshire Based on 2001-2009 Surveillance Data

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Introduction

Traumatic Brain Injuries Are A Public Health Issue In New Hampshire. Traumatic brain injury (TBI), often referred to as the “Silent Epidemic,” presents as an often unseen and under-reported public health issue. “Recent data shows that on average in the United States, 52,000 people died, 275,000 were hospitalized, and 1.4 million were treated and released from an emergency department all due to a TBI.”¹ At a minimum 5.3 million Americans live with the long-term consequences of a TBI.² This report is an effort to comprehensively describe the frequency, causes, and demographic characteristics of new cases (2001-2009) of traumatic brain injuries (TBI) among New Hampshire residents.

What is a traumatic brain injury and why should we be concerned? A traumatic brain injury is caused by a blow or jolt to the head or a penetrating head injury that disrupts the normal function of the brain. Such a blow can launch the brain on a collision course with the inside of the skull. The skull itself can often withstand a forceful external impact without fracturing. The result, an injured brain inside an intact skull, is known as a closed-head injury. A traumatic brain injury may also occur when a projectile, such as a bullet, rock, or fragment of a fractured skull, actually penetrates the brain. This is much less common and is known as an open-head injury. Primary brain injuries, occurring immediately as a direct result of the force applied to the brain, include the following conditions: contusions, lacerations, hemorrhage, and diffuse axonal injury. Secondary injuries, which evolve over time, include the following conditions: cerebral edema, cerebral infarction, cerebral anoxia or hypoxia, cerebral infection, seizures, and changes in brain chemistry and neurotransmitter functioning. Not all blows or jolts to the head result in a TBI. The severity of a TBI may range from “mild” or a brief change in mental status or consciousness to “severe” or an extended period of unconsciousness or amnesia after the injury. The majority of TBIs that happen in a year are concussions or another form of mild traumatic brain injury.

Why are traumatic brain injuries a public health issue? Traumatic brain injuries can cause many different types of changes to the way a person thinks and understands the world around him. They can affect senses such as touch, taste, and smell. A traumatic brain injury may interfere with communication and the expression of one’s thoughts. And it may also result in social inappropriateness, depression, anxiety, personality changes, aggression, and acting out.³ Additionally, changes in attention and concentration, memory, and executive functioning are all hallmarks of traumatic brain injury.

Traumatic brain injuries may also increase a person’s risk for developing Alzheimer’s disease, Parkinson’s disease, and other brain disorders that become more prevalent as one ages.⁴ Sustaining a traumatic brain injury can also lead to epilepsy.

Repeated mild traumatic brain injuries that occur over months and even years can result in additive neurological and cognitive deficits. Repeated mild traumatic brain injuries that occur over hours, days, or weeks, can be fatal.⁵

Brain injuries do not heal like other injuries. Recovery is a functional recovery, based on mechanisms that remain uncertain. No brain injuries are alike and the consequence of two similar injuries may be very different. Symptoms may appear right away or may not be present for days or weeks after the injury.

How Many?

In the past, most people who sustained a serious brain injury died. Today, with advances in medicine and technology, most survive, often living with permanent disabilities. The implication for New Hampshire of improved acute medical treatment at the critical “life saving” stage of injury is that the number of people needing extended medical treatment, rehabilitation, and lifelong supports for complex and chronic conditions are increasing. Thus, traumatic brain injuries can require ongoing and often life-long supports, with significant impact on the people and families they affect.

- In 2009 in New Hampshire, there were 171 deaths, 1,069 inpatient hospitalizations, and 12,306 emergency room discharges all due to TBI.
- In New Hampshire during the years 2001-2009, for every death due to a TBI, there were approximately five TBI inpatient discharges and 45 cases of TBI that were treated and released from an emergency department (ED).
- Recent data show that on average in the United States, 52,000 people died, 275,000 were hospitalized, and 1.4 million were treated and released from an emergency department all due to a TBI.⁶
- New Hampshire’s emergency department utilization compared with deaths for TBI is higher (1 death to 45 ED visits) than it is nationally (1 death to 26 ED visits).

Table 1: Total number of hospital discharges, emergency department discharges, and deaths of NH residents from TBI, between the years 2001 and 2009

Year	Total TBI Emergency Department Discharges	Total TBI Inpatient Discharges	Total TBI Deaths
2001	6,514	695	186
2002	6,556	741	171
2003	7,056	757	188
2004	7,521	831	189
2005	8,491	831	204
2006	9,102	855	178
2007	9,988	992	212
2008	10,058	999	211
2009	12,306	1,069	171

The number of deaths, inpatient hospitalizations, and emergency department discharges from TBI has increased from 2001 to 2009. There are several explanations that may account for this increase. For example, increased understanding of the severity of

concussion may lead to more patients seeking treatment after a blow to the head. It is important to note that the number of people with TBI who are not seen in an emergency department or who do not seek medical care is unknown.

Who is sustaining TBI?

- In New Hampshire, as it is nationally, adults age 75 years and older have the highest rates of TBI-related mortality or deaths. Infants and children have the lowest mortality rate due to TBI.
- Males in the State are more likely to die, become hospitalized, and visit an emergency department from TBI than are their female counterparts.
- The rate for TBI ED discharges in males is consistently and statistically significantly higher than the rate for females.
- Nationally, the two age groups at highest risk for a TBI in general are 0 to 4 year olds and 15 to 19 year olds.⁷ In New Hampshire, people ages 15 to 24 and 75 and older are at greatest risk.
- Coos County residents had a higher rate of hospitalization for TBI than any other county. Rates of hospitalization are statistically significantly higher than all other counties other than Carroll and Sullivan.
- Coos County residents had a statistically significantly higher rate for emergency department visits due to a TBI than every county except Carroll.

What are the leading causes of TBI?

- For deaths due to a TBI, the leading mechanisms were firearms (suicides primarily), motor vehicles, and falls. Adolescents were hospitalized for TBI mostly due to motor vehicle crashes, as opposed to the elderly who were hospitalized for TBI mostly due to falls.
- Falls are the highest age-adjusted cause of hospitalizations due to TBI in the State, followed by motor vehicle crashes.
- For emergency room visits, falls were the number one cause of TBI for all age groups, followed by struck by or against and then motor vehicle crashes. Struck by or against is defined as colliding with a stationary or moving object.
- Fall related injuries led to TBI ED discharge rates that were highest in children age 0 to 4 and adults age 75 and older.
- Adolescents between the ages of 15 to 24 had the highest rate of TBI in the emergency room due to motor vehicle crashes.
- Nationally, falls are the leading cause of traumatic brain injuries overall.⁸
- Approximately 1.6 to 3.8 million sports and recreation related TBIs occur in the United States each year. Most of these are mild TBIs that are not treated in a hospital or emergency department.⁹

Are TBI costly? Traumatic brain injuries are very costly. Direct medical costs and indirect costs such as lost productivity, due to TBI totaled an estimated \$60 billion in the United States in 2000.¹⁰ In New Hampshire, the cost of fatalities due to TBI on average in years 2000-2004 was estimated at an aggregate cost of \$568,031,000. Each fatality due to TBI during those years cost an estimated \$3,242,186. This takes into account the medical

costs, lost productivity, and quality of life costs. In New Hampshire, for hospitalizations due to TBI in 2003, the total aggregate cost was \$368,803,522 (in 2006 dollars). Each hospitalization in 2003 due to TBI cost an estimated, \$701,278. Again this takes in to account medical costs, lost productivity, and quality of life.¹¹

Are TBI preventable? Many of the causes of TBI are predictable and preventable. Prevention includes, but is not limited to:

- Wearing a seat belt every time you drive or ride in a motor vehicle.
- Buckling your child in the car using a child safety seat, booster seat, or seat belt (according to the child's height, weight, and age).
- Never driving while under the influence of alcohol or drugs.
- Storing firearms, unloaded, in a locked cabinet or safe. Store bullets in a separate location.
- Wearing a helmet while riding a bicycle, skateboard, motorcycle, snowmobile or all-terrain vehicle. Also wear head protection when you bat or run bases, ski, skate, ride a horse, or play a contact sport.
- Installing safety features in your home, such as handrails on stairways, non-slip mats in the bathtub, grab bars in the bathroom, window guards, and safety gates on the top and bottom of stairs (especially when young children are around) to limit falls. An exercise program can improve your strength, balance, and coordination. Regular vision tests also can help lower the risk of falling.
- Making sure the surface on your child's playground is made of shock-absorbing material.

Methodology

Data Analysis

The data sources selected for analysis were TBI hospital discharge data from both inpatient and ED visits and vital record death certificate data. Staff of the New Hampshire Department of Health and Human Services, Division of Public Health Services, Injury Surveillance Program performed the analysis, and staff from the Health Statistics and Data Management Section provided quality assurance on the data outputs.

- Death Data Source:* Bureau of Data and Systems Management (BDSM), Office of Medicaid Business and Policy (OMBP), NH Department of Health and Human Services (NH DHHS), and the NH Department of State, Division of Vital Records Administration, [2001-2009]. Underlying cause of death is classified in accordance with the International Classification of Disease. Deaths for 1999 and beyond are classified using the Tenth Revision (ICD-10).
- Hospital Discharge Data Source:* Bureau of Data and Systems Management (BDSM), Office of Medicaid Business and Policy (OMBP), NH Department of Health and Human Services (NH DHHS), with assistance from a DHHS contractor, [2000-2009].

Case Inclusion Criteria

The above datasets were filtered to include only residents of New Hampshire and the presence of codes indicating TBI. In the hospital data, TBI codes were searched in the principle diagnosis field and the nine secondary diagnosis fields, excluding patients who died (Disposition code 8). The death data were searched in the certified underlying cause of death field and the fifteen “Rec_Axis” code fields. The following is a list of the ICD-9 and ICD-10 codes included in this study:

A. ICD-9, Hospital Discharges

Fracture of Vault or Base of Skull:	800-80199
Other Skull Fractures:	803-80499
Intra-cranial Injury, Concussion:	850-85419
Injury to Spinal Cord:	9501-95039
Head Injury, unspecified:	95901
Shaken Infant Syndrome:	99555

B. ICD-10, Deaths

Injuries to the head:	S010-S0199, S020-S0219, S023, S027-S0299, S040, S060-S0699, S070, S071, S078, S079, S097-S0999
Injuries involving multiple body regions:	T010, T020, T040, T060
Sequelae of injuries to the head:	T901, T902, T904, T905, T908, T909

Explanation of Tabulations

- *Occurrence*: For the purposes of the report, an occurrence can be described as an incident of TBI in an individual.
- *Age*: In order to stabilize rates, this variable has been grouped into 10-year age groups.
- *Rate*: Rates are calculated using the estimated State population matching each year of data. Rates for aggregated years of data are calculated using aggregated years of estimated State population. All rates in this report are per 100,000 people.
- *Discharge Disposition*: Instances where the patient was admitted to the ED or inpatient care with a disposition coded as “8” or “Died” were excluded so they would not be duplicated in the death data.
- *Data Suppression*: When there is a small number of events, which may lead to the ability to identify individual people, the data are suppressed to protect confidentiality. Rates are also suppressed if the estimate is too uncertain to be useful.
- *Data Aggregation*: Data aggregation groups the counts of events into age groups, groups of years, or groups of towns/counties, in order to improve the statistical significance of the rates and/or to avoid the necessity of data suppression.

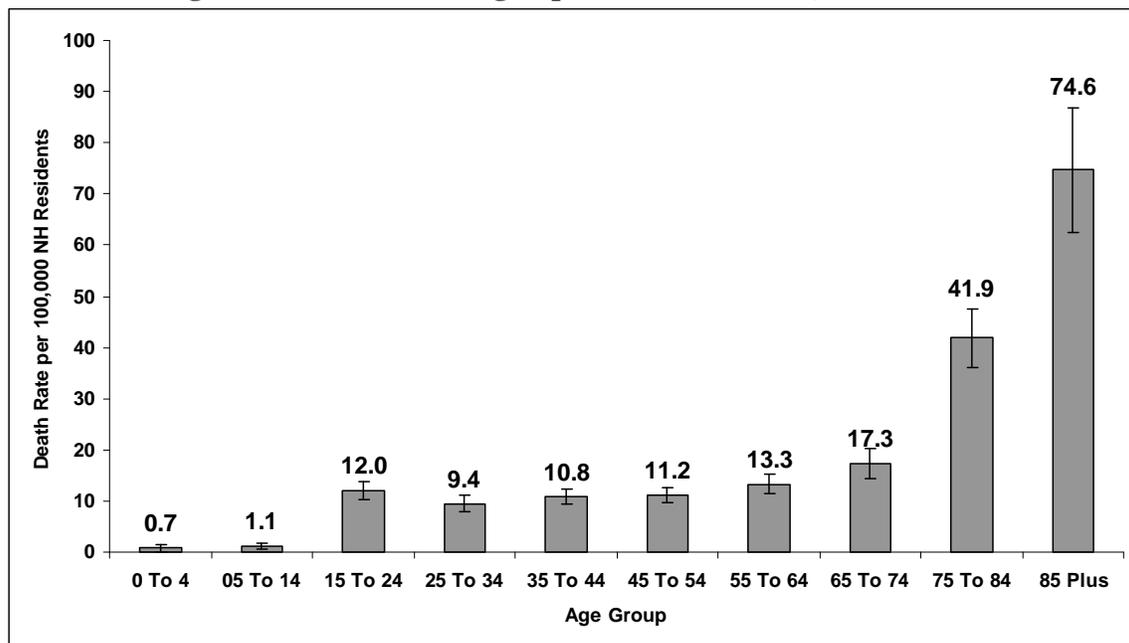
Tables and Figures

Mortality Rate, TBI by Age, 2001 to 2009

Table 2: TBI-Related Age-Specific Death Rates, 2001 – 2009

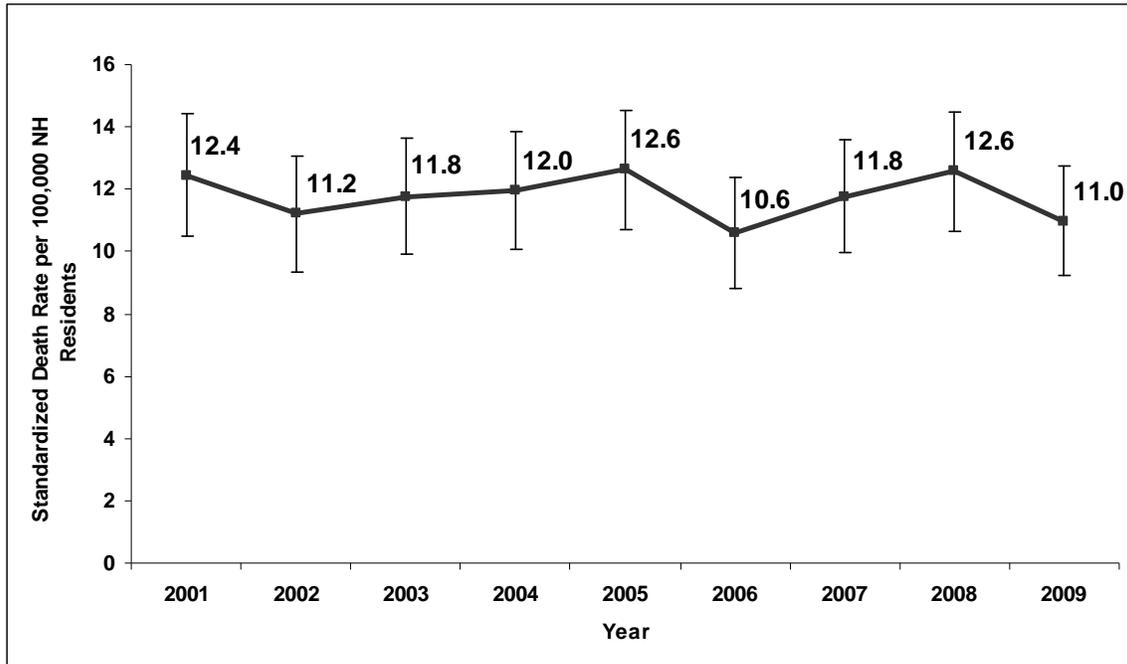
Age Group	TBI Deaths	Age-Specific Rate	Lower 95% CI	Upper 95% CI
0 To 4	5	0.7	0.2	1.7
05 To 14	17	1.1	0.6	1.7
15 To 24	188	12.0	10.3	13.7
25 To 34	126	9.4	7.8	11.1
35 To 44	201	10.8	9.3	12.3
45 To 54	212	11.2	9.7	12.7
55 To 64	175	13.3	11.4	15.3
65 To 74	130	17.3	14.3	20.2
75 To 84	208	41.9	36.2	47.6
85 Plus	144	74.6	62.4	86.8
Total Crude Rate	1,406	12.1	11.4	12.7

Figure 1: TBI-Related Age-Specific Death Rates, 2001 – 2009



Between 2001 and 2009, the mortality rate for TBI-related deaths was highest among New Hampshire residents 75 years and older and lowest in infants and children up to age 14.

Figure 2: NH Resident TBI-Related, Standardized Death Rates by Year, 2001-2009



There is no statistically significant difference in the rate of deaths for TBI between the years 2001 and 2009. The width of the confidence intervals overlaps across all years, showing that the difference from year to year may be from chance. While counts appear to change, when weighted against the annual populations, the rates do not change.

Inpatient Hospital Discharges for TBI by Age, Occurrence and Rate

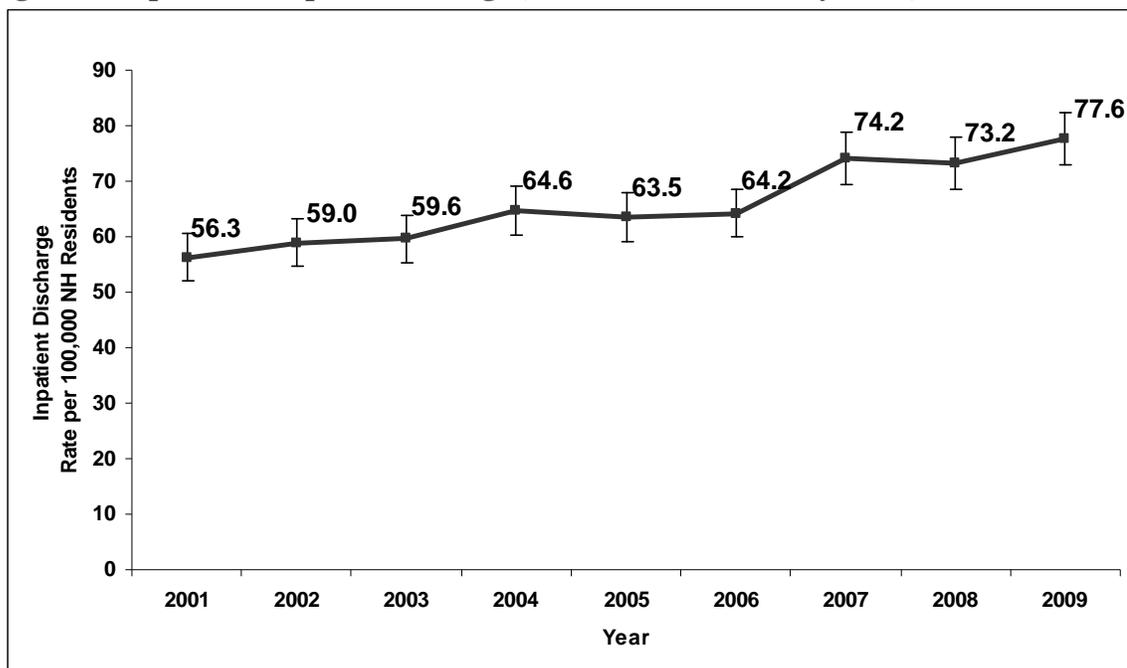
Table 3a: Inpatient Hospital Discharges for TBI, Occurrence by Age and Year, 2001-2009

Age Group	2001	2002	2003	2004	2005	2006	2007	2008	2009
0 To 4	32	25	26	19	21	25	36	25	47
05 To 14	49	41	41	55	44	43	35	34	33
15 To 24	120	113	129	131	143	138	138	119	112
25 To 34	66	72	68	85	65	60	88	70	66
35 To 44	113	97	93	96	81	95	93	92	83
45 To 54	72	99	92	87	97	115	113	126	136
55 To 64	45	63	66	88	81	84	103	111	129
65 To 74	65	70	73	89	82	85	111	102	128
75 To 84	72	100	99	113	122	124	156	190	188
85 Plus	61	61	70	68	95	86	119	130	147
Total	695	741	757	831	831	855	992	999	1069

Table 3b: Inpatient Hospital Discharges for TBI, Standardized Rate by Year, 2001-2009

Year	Count	Inpatient Rate per 100,000	L 95% CI Standardized Rate	U 95% CI Standardized Rate
2001	695	56.3	52.1	60.5
2002	741	59.0	54.7	63.2
2003	757	59.6	55.3	63.9
2004	831	64.6	60.2	69.0
2005	831	63.5	59.2	67.9
2006	855	64.2	59.9	68.6
2007	992	74.2	69.5	78.9
2008	999	73.2	68.6	77.8
2009	1,069	77.6	72.8	82.3

Figure 3: Inpatient Hospital Discharges, Standardized Rate by Year, 2001-2009



There is no statistically significant difference in the rate of inpatient discharges for TBI between the years 2001 and 2005. There is a statistically significant increase in rates between 2006 and 2009.

Emergency Department (ED) Discharges for TBI by Age, Occurrence and Rate

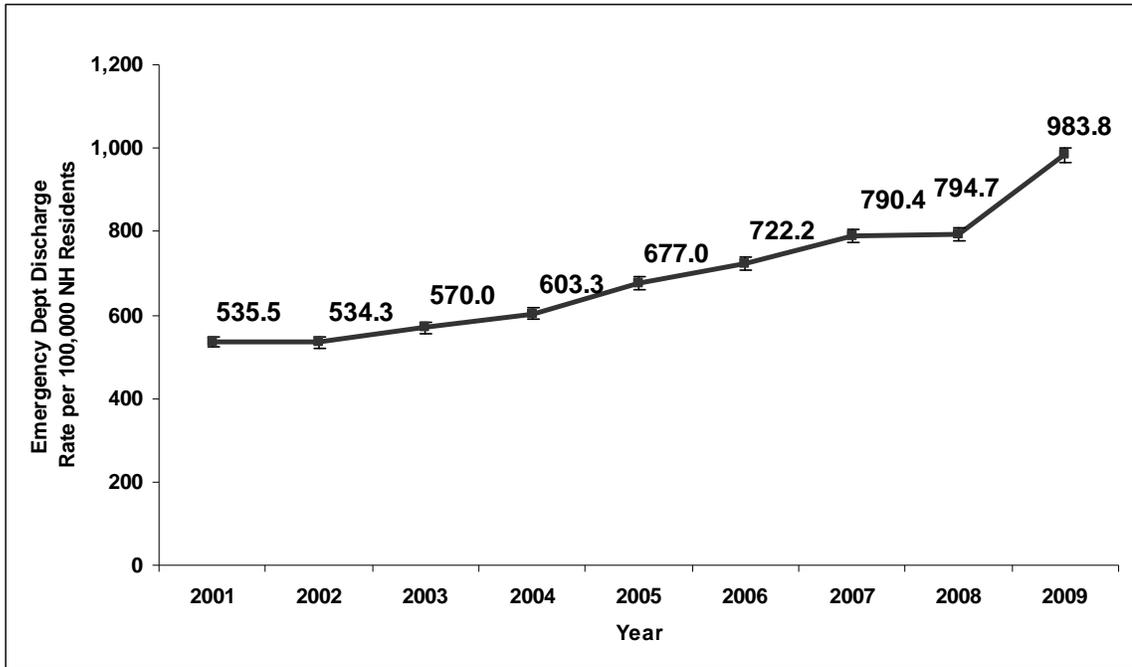
Table 4a: ED Discharges for TBI, Occurrence by Age and Year, 2001-2009

Age Group	2001	2002	2003	2004	2005	2006	2007	2008	2009
0 To 4	845	810	825	828	885	1,051	1,065	1,084	1,415
05 To 14	1,141	1,114	1,085	1,198	1,286	1,355	1,363	1,351	1,886
15 To 24	1,514	1,607	1,745	1,904	2,099	2,222	2,439	2,273	2,740
25 To 34	765	802	790	826	946	972	1,087	1,112	1,276
35 To 44	806	808	884	844	934	947	1,051	981	1,191
45 To 54	514	549	570	612	734	886	984	996	1,233
55 To 64	262	257	369	430	458	502	624	726	770
65 To 74	231	204	290	275	327	359	442	500	596
75 To 84	244	256	310	370	473	457	536	605	685
85 Plus	192	149	188	234	349	351	397	430	514
Total	6,514	6,556	7,056	7,521	8,491	9,102	9,988	10,058	12,306

Table 4b: ED Discharges for TBI, Standardized Rate by Year, 2001-2009

Year	Count	ED Rate per 100,000	L 95% CI Standardized Rate	U 95% CI Standardized Rate
2001	6,514	535.5	522.5	548.6
2002	6,556	534.3	521.3	547.3
2003	7,056	570.0	556.6	583.3
2004	7,521	603.3	589.6	617.0
2005	8,491	677.0	662.5	691.5
2006	9,102	722.2	707.2	737.1
2007	9,988	790.4	774.7	806.0
2008	10,058	794.7	778.9	810.4
2009	12,306	983.8	966.2	1001.4

Figure 4: Standardized Rates for TBI ED Discharges, 2001-2009



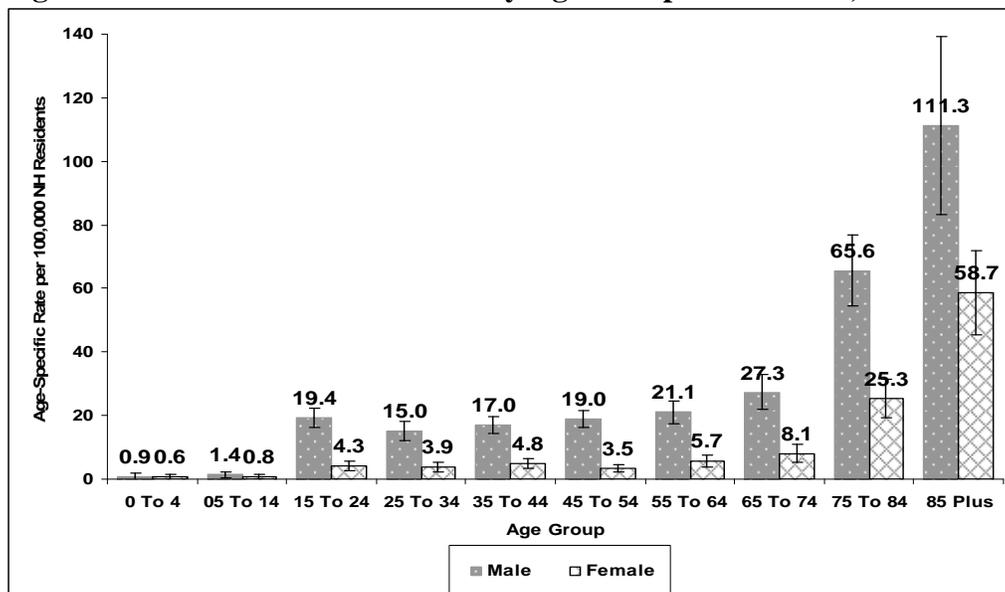
There is a statistically significant increase in the rate of ED discharges for TBI between the years 2002 and 2009.

TBI Mortality by Age Group and Gender

Table 5: TBI-Related Death Rates by Age Group and Gender, 2001 – 2009

Age Groups	Male			Female		
	Standardized Rate	L 95% CI Standardized Rate	U 95% CI Standardized Rate	Standardized Rate	L 95% CI Standardized Rate	U 95% CI Standardized Rate
0 To 4	0.9	0.2	2.6	0.6	0.1	2.2
05 To 14	1.4	0.7	2.5	0.8	0.3	1.7
15 To 24	19.4	16.4	22.5	4.3	2.9	6.0
25 To 34	15.0	12.1	18.0	3.9	2.5	5.7
35 To 44	17.0	14.3	19.6	4.8	3.5	6.4
45 To 54	19.0	16.2	21.7	3.5	2.4	4.9
55 To 64	21.1	17.6	24.6	5.7	4.1	7.9
65 To 74	27.3	22.2	33.3	8.1	5.6	11.5
75 To 84	65.6	54.5	76.7	25.3	19.9	31.8
85 Plus	111.3	85.9	141.9	58.7	46.5	73.2

Figure 5: TBI-Related Death Rates by Age Group and Gender, 2001 – 2009



Among all TBI-related deaths, the rate of incidence per 100,000 males is significantly higher than the rate for females starting at age 15 years and up, during years 2001-2009. There is little statistically significant difference within genders and between age groups until age 75 and older where there is a noted increase in TBI deaths in both females and males.

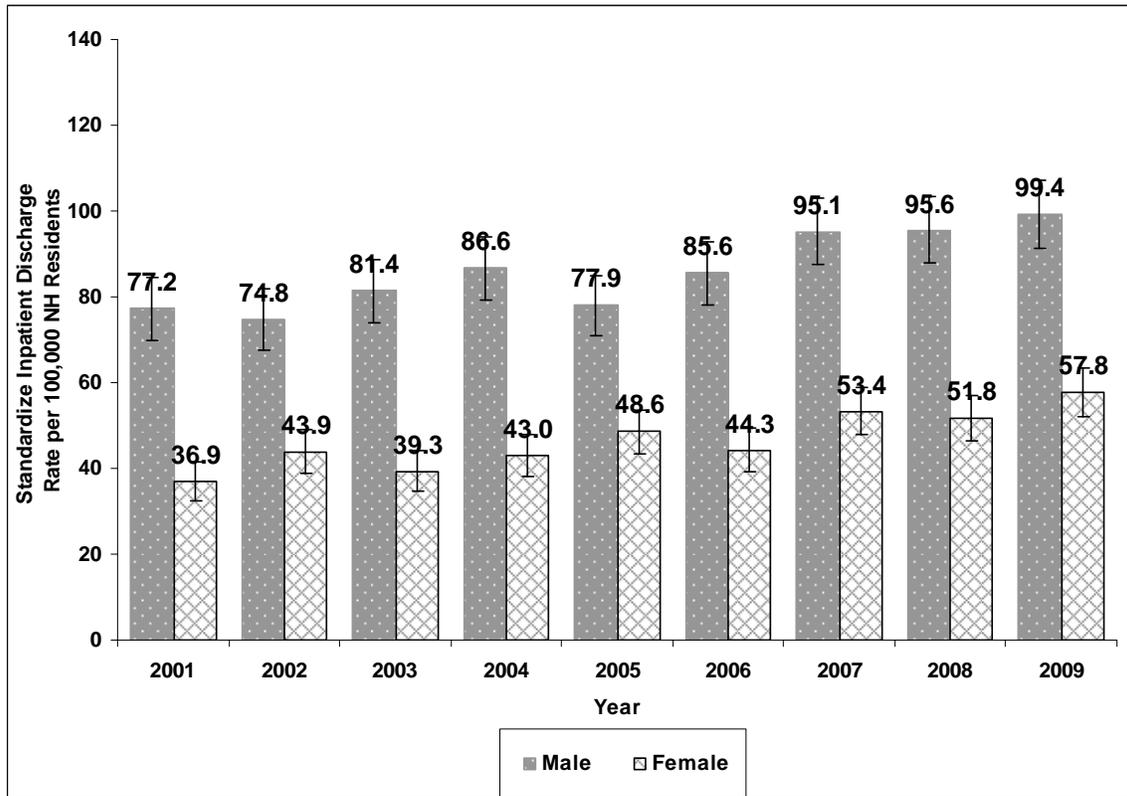
Inpatient Hospital Discharges for TBI by Age and Gender, Occurrence and Rate
Table 6a: Occurrence of Inpatient Hospital Discharges for TBI by Age and Gender,
2001-2009

Gender	Age Group	2001	2002	2003	2004	2005	2006	2007	2008	2009
Female	0 To 4	14	11	6	6	14	11	12	9	14
	05 To 14	15	13	10	19	13	14	10	10	13
	15 To 24	30	28	43	34	35	35	36	27	39
	25 To 34	16	22	14	19	22	17	29	18	13
	35 To 44	31	38	30	23	18	30	25	26	31
	45 To 54	23	38	21	41	37	37	29	47	58
	55 To 64	18	23	27	18	30	30	36	36	42
	65 To 74	23	28	29	27	38	31	48	37	49
	75 To 84	39	58	47	69	72	62	85	99	91
85 Plus	37	40	45	46	70	53	84	86	89	
Female Total		246	299	272	302	349	320	394	395	439
Male	0 To 4	18	14	20	13	7	14	24	16	33
	05 To 14	34	28	31	36	31	29	25	24	20
	15 To 24	90	85	86	97	108	103	102	92	73
	25 To 34	50	50	54	66	43	43	59	52	53
	35 To 44	82	59	63	73	63	65	68	66	52
	45 To 54	49	61	71	46	60	78	84	79	78
	55 To 64	27	40	39	70	51	54	67	75	87
	65 To 74	42	42	44	62	44	54	63	65	79
	75 To 84	33	42	52	44	50	62	71	91	97
85 Plus	24	21	25	22	25	33	35	44	58	
Male Total		449	442	485	529	482	535	598	604	630
Grand Total		695	741	757	831	831	855	992	999	1,069

Table 6b: Standardized Rate of Inpatient Hospital Discharges for TBI by Gender,
2001-2009

Year	Male			Female		
	Standardized Rate	L 95% CI Standardized Rate	U 95% CI Standardized Rate	Standardized Rate	L 95% CI Standardized Rate	U 95% CI Standardized Rate
2001	77.2	70.0	84.5	36.9	32.3	41.6
2002	74.8	67.7	81.9	43.9	38.9	48.9
2003	81.4	74.1	88.8	39.3	34.6	44.1
2004	86.6	79.1	94.1	43.0	38.1	47.9
2005	77.9	70.9	85.0	48.6	43.4	53.7
2006	85.6	78.2	93.0	44.3	39.4	49.3
2007	95.1	87.4	102.9	53.4	48.0	58.8
2008	95.6	87.8	103.3	51.8	46.6	57.1
2009	99.4	91.5	107.3	57.8	52.2	63.3

Figure 6: Standardized Rate of Inpatient Hospital Discharges for TBI by Gender, 2001-2009



Between 2001 and 2009, the rates of male inpatient discharges for TBI were significantly higher than female rates. From year to year, there is not a significant difference within the male group or the female group. As the chart above shows, the confidence intervals overlap within the gender groups.

ED Hospital Discharges for TBI by Age and Gender, Occurrence and Rate

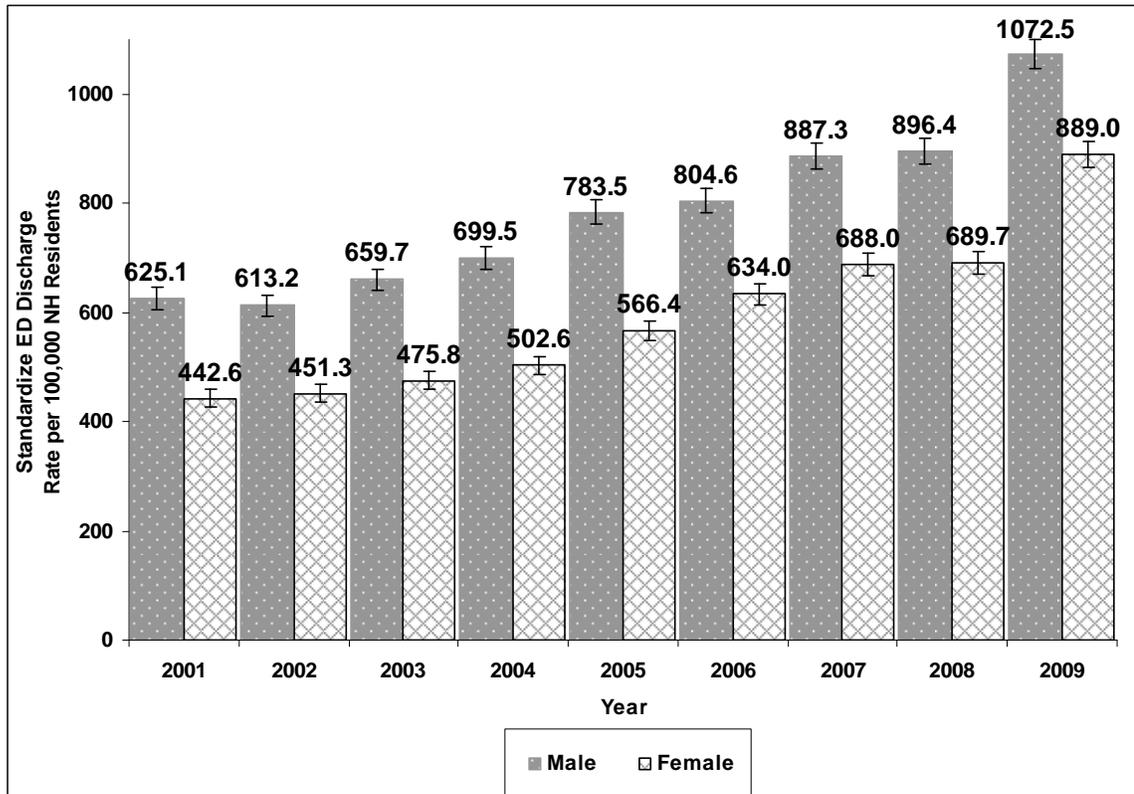
Table 7a: Occurrence of ED Hospital Discharges for TBI by Age and Gender, 2001-2009

Gender	Age Group	2001	2002	2003	2004	2005	2006	2007	2008	2009
Female	0 To 4	341	318	346	351	382	454	463	457	597
	05 To 14	357	388	364	386	391	469	443	466	650
	15 To 24	585	628	656	741	813	849	958	922	1,177
	25 To 34	310	339	317	325	397	431	459	481	576
	35 To 44	372	386	402	371	420	456	512	445	605
	45 To 54	250	267	242	291	349	431	486	481	611
	55 To 64	121	121	195	216	207	284	319	367	419
	65 To 74	127	104	153	133	173	199	248	253	341
	75 To 84	155	162	197	237	285	302	331	351	431
	85 Plus	138	113	139	169	246	243	277	293	345
Female Total		2,756	2,826	3,011	3,220	3,663	4,118	4,496	4,516	5,752
Male	0 To 4	504	492	479	477	503	597	602	627	818
	05 To 14	784	726	721	812	895	886	920	885	1,236
	15 To 24	929	979	1,089	1,163	1,286	1,373	1,481	1,351	1,563
	25 To 34	455	463	473	501	549	541	628	631	700
	35 To 44	434	422	482	473	514	491	539	536	586
	45 To 54	264	282	328	321	385	455	498	515	622
	55 To 64	141	136	174	214	251	218	305	359	351
	65 To 74	104	100	137	142	154	160	194	247	255
	75 To 84	89	94	113	133	188	155	205	254	254
	85 Plus	54	36	49	65	103	108	120	137	169
Male Total		3,758	3,730	4,045	4,301	4,828	4,984	5,492	5,542	6,554
Grand Total		6,514	6,556	7,056	7,521	8,491	9,102	9,988	10,058	12,306

Table 7b: Standardized Rate of ED Hospital Discharges for TBI by Gender, 2001-2009

Year	Standardized Rate	L 95% CI Standardized Rate	U 95% CI Standardized Rate	Standardized Rate	L 95% CI Standardized Rate	U 95% CI Standardized Rate
2001	625.1	604.9	645.2	442.6	426.0	459.3
2002	613.2	593.4	633.0	451.3	434.5	468.0
2003	659.7	639.2	680.2	475.8	458.6	492.9
2004	699.5	678.4	720.6	502.6	485.1	520.1
2005	783.5	761.2	805.8	566.4	547.8	584.9
2006	804.6	782.0	827.1	634.0	614.4	653.7
2007	887.3	863.6	911.1	688.0	667.6	708.5
2008	896.4	872.5	920.3	689.7	669.2	710.2
2009	1072.5	1046.2	1098.8	889.0	865.5	912.5

Figure 7: Standardized Rate of ED Hospital Discharges for TBI by Gender, 2001-2009



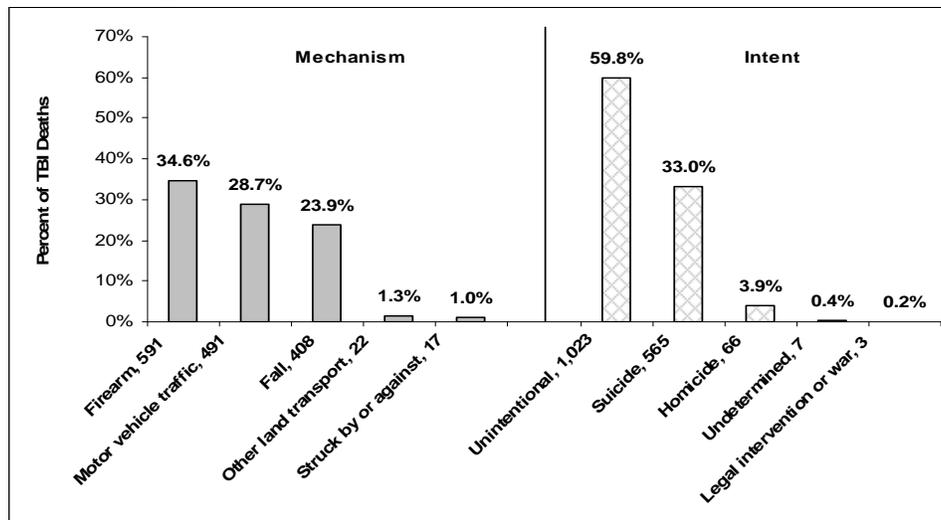
As with the Inpatient discharge data, between 2001 and 2009, the rates of male ED discharges for TBI were significantly higher than female rates. Unlike the Inpatient discharge data, in the later years there is a significant difference within the male group and the female group. As the chart above shows, the confidence intervals do not overlap within the gender groups in the year 2009 showing an increase in rates of ED discharges from 2005 to 2009.

TBI Mortality by Cause, 2001-2009

Table 8: TBI Mortality by Cause and Intent

Mechanism of TBI-Related Death	Adverse effects	NA	Legal intervention or war	Undetermined	Homicide	Suicide	Unintentional	Total by Mechanism	Percent by Mechanism
Firearm			2	1	28	552	8	591	34.6%
Motor vehicle traffic					2	1	488	491	28.7%
Fall				2		8	398	408	23.9%
Other land transport							22	22	1.3%
Struck by or against					4		13	17	1.0%
Other	0	45	1	4	26	3	57	136	8.0%
Machinery							10	10	0.6%
Pedestrian - other							10	10	0.6%
Other transport							8	8	0.5%
Cut/pierce					6			6	0.4%
Drowning							4	4	0.2%
Natural/environmental							3	3	0.2%
Pedal cyclist - other							2	2	0.1%
Adverse effects	1							1	0.1%
Poisoning						1		1	0.1%
Total by Intent	1	45	3	7	66	565	1,023	1,710	
Percent by Intent	0.1%	2.6%	0.2%	0.4%	3.9%	33.0%	59.8%		

Figure 8: Top 5 TBI Related Deaths by Intent and Top 5 TBI-Related Deaths by Mechanism, 2001-2009



Most TBI-related deaths are unintentional or accidental (59.8%), followed by suicide (33.0%). The mechanism of most accidental TBI deaths is motor vehicle crashes or falls, and the mechanism of most suicide TBI deaths are from firearms.

TBI Inpatient Hospital Discharges by Cause, 2001-2009

Table 9a: TBI Inpatient Discharges by Mechanism and Year 2001-2009

INJURY_CAUSE1_DSC	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total	Percent
Fall	273	286	315	340	371	376	463	510	578	3512	45.2%
Motor vehicle traffic	249	258	253	307	282	263	296	206	260	2374	30.6%
Struck by or against	43	46	51	45	44	58	57	62	76	482	6.2%
Transport - other	42	28	31	46	39	27	44	37	43	337	4.3%
Pedal cyclist - other	16	13	17	11	13	14	18	13	18	133	1.7%
Other	63	84	68	62	63	96	94	141	41	712	9.2%
Adverse effects	6	13	7	8	8	7	11	17	30	107	1.4%
Firearm	2	3	4	1	2	3	1	4	4	24	0.3%
Poisoning		1	3	3	1	5	2	3	4	22	0.3%
Cut/pierce	1	5	2	1	1	3		1	3	17	0.2%
Natural/environmental			3	4	1	1	3	1	1	14	0.2%
Pedestrian - other		3	1	1	3	1	1	1	2	13	0.2%
Machinery		1	2	1	2	1	1	1	2	11	0.1%
Drowning/submersion				1				1	1	3	0.04%
Overexertion							1		1	2	0.03%
Fire or hot object/substance								1		1	0.01%
Suffocation					1					1	0.01%
Total	695	741	757	831	831	855	992	999	1064	7765	100%

Table 9b: Age-Adjusted Rate of TBI Inpatient Discharges by Mechanism of Injury, 2001-2009

Age Group	Fall	Motor vehicle traffic	Pedal cyclist - other	Struck by or against	Transport - other	Other
0 To 4	5.2	0.6	0.0	1.0	0.1	2.6
05 To 14	1.5	1.9	0.6	0.9	0.7	0.4
15 To 24	2.3	11.2	0.3	1.8	1.5	1.2
25 To 34	2.1	6.2	0.1	1.3	1.0	1.3
35 To 44	3.1	4.9	0.2	0.9	0.7	1.5
45 To 54	4.5	4.4	0.4	0.8	0.5	1.7
55 To 64	7.0	4.6	0.3	0.6	0.5	1.7
65 To 74	17.0	4.2	0.3	0.9	0.4	3.8
75 To 84	44.7	4.8	0.1	0.8	0.6	7.5
85 Plus	88.1	5.3	0.0	1.4	0.5	12.8

The age-adjusted rates for causes of injury, for TBI Inpatient discharges identify falls as the most common cause, followed by motor vehicle crashes. People ages 65 and older are most likely to have a hospital stay for TBI from falls, and those ages 15 to 24 are more likely to have hospital stay for TBI from a motor vehicle crash.

TBI Emergency Department Hospital Discharges by Cause

**Table 10a: ED Discharges for TBI by Cause and Year
2001-2009**

INJURY_CAUSE1_DSC	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total	Percent
Fall	2602	2754	2944	3144	3621	3849	4448	4709	5646	33717	44.02%
Struck by or against	1622	1628	1757	1880	2105	2322	2460	2535	3067	19376	25.30%
Motor vehicle traffic	1133	1150	1321	1387	1519	1593	1558	1469	1636	12766	16.67%
Transport - other	206	195	213	233	236	200	229	221	260	1993	2.60%
Pedal cyclist - other	176	192	179	215	202	211	220	187	295	1877	2.45%
Other	678	551	561	547	684	800	946	397	672	5836	7.62%
Cut/pierce	24	26	28	43	47	54	56	37	48	363	0.47%
Natural/environmental	15	23	11	26	25	18	24	29	29	200	0.26%
Machinery	12	6	12	14	15	6	10	11	19	105	0.14%
Overexertion	10	8	5	8	10	11	6	15	20	93	0.12%
Adverse effects	11	8	4	2	5	9	6	7	12	64	0.08%
Pedestrian - other	9	6	5	7	4	9	6	7	11	64	0.08%
Poisoning	5	2	4	8	6	7	6	9	6	53	0.07%
Firearm	5	1	2	1	3	6	8	5	4	35	0.05%
Drowning/submersion	4	4	6	1	6	3	2	3	1	30	0.04%
Fire or hot object/substance		1	4	5	1	4	1	1	1	18	0.02%
Suffocation	2	1			2		2		1	8	0.01%
Total	6514	6556	7056	7521	8491	9102	9988	9642	11728	76598	100%

Table 10b: Age-Adjusted Rate of ED Discharges for TBI by Cause of Injury, 2001-2009 (rates based on fewer than 20 total events excluded)

Age Group	Fall	Motor vehicle traffic	Other	Pedal cyclist - other	Struck by or against	Transport - other
0 To 4	238.9	5.2	15.8	2.9	62.5	1.3
05 To 14	75.6	9.6	10.8	14.3	70.4	6.6
15 To 24	66.1	80.1	30.4	6.3	98.8	10.5
25 To 34	40.8	42.0	20.6	1.8	47.1	5.6
35 To 44	38.1	25.5	14.1	2.1	28.9	3.6
45 To 54	40.0	19.1	9.7	2.1	18.2	2.6
55 To 64	47.7	14.0	6.8	1.4	10.8	1.4
65 To 74	75.4	12.8	7.3	0.9	7.8	0.8
75 To 84	159.6	11.7	12.5	0.2	8.8	1.1
85 Plus	316.6	7.8	20.0	0.4	9.6	0.5

Most ED discharges for TBI are for falls of young children (ages 0 to 4) and the elderly (ages 75 and older). The second most common TBI ED discharges are for being “struck by or against” in ages 0 to 24 years, followed by motor vehicle crashes in the 15 to 24 year old age group.

Inpatient Discharges for TBI Occurrences by Diagnosis

NOTE: The total numbers here are slightly higher than the total count of patients because some patients had more than one type of head injury. These data have been de-duplicated as much as possible.

Table 11a: Count of Inpatient Discharges, TBI Occurrences by Diagnosis, across Principle Diagnosis and All Secondary Diagnosis' Fields, 2001-2009

TBI Diagnosis	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Fracture of Vault or Base of Skull	175	180	191	221	224	246	294	287	291	2109
Other Skull Fractures	13	18	13	14	25	9	14	18	19	143
Intracranial Injury or Concussion	427	438	482	528	508	509	608	628	680	4808
Head Injury, unspecified	77	89	79	62	83	95	114	90	109	798
Shaken Infant Syndrome	2	4	2		1	2	1			12
Total	694	729	767	825	841	861	1031	1023	1099	7870

Table 11b: Percent of Inpatient Discharges, TBI Occurrences by Diagnosis, across Principle Diagnosis and All Secondary Diagnosis' Fields, 2001-2009

TBI Diagnosis	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Fracture of Vault or Base of Skull	25%	25%	25%	27%	27%	29%	29%	28%	26%	27%
Other Skull Fractures	2%	2%	2%	2%	3%	1%	1%	2%	2%	2%
Intracranial Injury or Concussion	62%	60%	63%	64%	60%	59%	59%	61%	62%	61%
Head Injury, unspecified	11%	12%	10%	8%	10%	11%	11%	9%	10%	10%
Shaken Infant Syndrome	0.3%	0.5%	0.3%		0.1%	0.2%	0.1%			0.2%

The table above clearly shows the highest percent of total Inpatient discharges of total TBI diagnoses are for Intra-Cranial Concussion (59% to 64%), followed by Fracture of the Vault or Base of Skull (25% to 29%), and lastly unspecified head injury (9% to 12%). The annual numbers for other skull fractures and abusive head trauma (also known as shaken infant syndrome) are too small to generate statistically significant information.

Emergency Department Discharges for TBI Occurrences by Diagnosis

NOTE: The total numbers here are slightly higher than the total count of patients because some patients had more than one type of head injury. These data have been de-duplicated as much as possible.

Table 12a: Count of ED Discharges, TBI Occurrences by Diagnosis, across Principle Diagnosis and All Secondary Diagnosis' Fields, 2001-2009

TBI Diagnosis	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Fracture of the Vault or Base of Skull	178	172	165	190	197	195	158	269	295	1819
Other Skull Fracture	22	22	36	35	39	29	32	46	58	319
Intracranial Injury of Concussion	2400	2537	2702	2859	2803	2962	2357	3684	4472	26776
Head Injury, unspecified	3393	3383	3559	3888	4746	5059	4457	6256	7693	42434
Shaken Infant Syndrome	1	3	1		2	2			2	11
Total	5995	6119	6465	6973	7788	8247	7005	10255	12521	71368

Table 12b: Percent of ED Discharges, TBI Occurrences by Diagnosis, across Principle Diagnosis and All Secondary Diagnosis' Fields, 2001-2009

TBI Diagnosis	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
Fracture of the Vault or Base of Skull	3%	3%	3%	3%	3%	2%	2%	3%	2%	3%
Other Skull Fracture	0.4%	0.4%	0.6%	0.5%	0.5%	0.4%	0.5%	0.4%	0.5%	0.4%
Intracranial Injury of Concussion	40%	41%	42%	41%	36%	36%	34%	36%	36%	38%
Head Injury, unspecified	57%	55%	55%	56%	61%	61%	64%	61%	61%	59%
Shaken Infant Syndrome	0.02%	0.05%	0.02%		0.03%	0.02%			0.02%	0.02%

Total ED discharges of total TBI diagnoses are different than Inpatient discharges. Head injuries, unspecified are the largest category. This may be due to insufficient detail in the medical record resulting in a large number of diagnoses being coded in the unspecified category. Again, the annual numbers for other skull fractures and abusive head trauma are too small to generate statistically significant information.

Inpatient Discharges for TBI Occurrences by Disposition

NOTE: The validity of disposition data is uncertain because data are not available to confirm that these events occurred after the patient was discharged.

Table 13: Inpatient Discharges for TBI Occurrences by Disposition and Year, 2001-2009

DISPOSITION	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total	Percent
Other Short Term Hospital	29	30	27	23	26	27	36	26	33	257	3.27%
Skilled Nursing Facility	79	95	103	99	127	97	157	144	174	1075	13.67%
Intermediate Care Facility	6	9	6	9	7	5	4	30	40	116	1.47%
Structured/Assisted Living	12	10	5	12	15	13	10	129	143	349	4.44%
Home THEN Self Care	389	394	411	431	414	466	511	385	366	3767	47.89%
Home Health Service	74	100	90	117	107	124	129	154	185	1080	13.73%
Against Medical Advice	8	5	10	9	10	10	9	11	10	82	1.04%
Transfer To Rehabilitation Facility	48	57	63	89	72	73	96	77	52	627	7.97%
Transfer To Rehab. In Acute Facility	39	31	33	28	44	33	35	36	79	358	4.55%
Transfer To Substance Abuse Facility		1		1		1			1	4	0.05%
Transfer To Psychiatric Facility	2	3		3		4	4	1		17	0.22%
Transfer To Psych. In Acute Facility	4	3	7	2	3	2	1	5	5	32	0.41%
Other or Unknown	5	3	2	8	6	0	0	39	39	102	1.30%
Sub Total	695	741	757	831	831	855	992	1037	1127	7866	93.69%
Died during Inpatient Hospitalization	58	58	56	60	64	68	73	43	50	530	6.31%
Grand Total	753	799	813	891	895	923	1065	1080	1177	8396	100%

Most TBI Inpatient discharges released the patient to go home and practice self-care (48%), or are released to go home with home health services (14%). The remaining patients need further care in a professional rehabilitation setting (approximately 36%). Although most are discharged to home and then self-care, this does not mean that there was a full recovery. In fact, most of these people have ongoing disabilities that take months and years to fully heal, if at all. About 6% died during inpatient hospitalization.

Emergency Department Discharges for TBI Occurrences by Disposition

Table 14: Emergency Department Discharges for TBI Occurrences by Disposition and Year, 2001-2009

DISPOSITION	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total	Percent
Other Short Term Hospital	164	212	277	325	345	330	370	392	536	2951	3.71%
Skilled Nursing Facility	19	21	21	39	50	61	54	71	76	412	0.52%
Intermediate Care Facility	19	15	17	18	28	31	51	16	23	218	0.27%
Structured/Assisted Living	13	8	18	13	34	26	33	627	793	1565	1.97%
Home THEN Self Care	6239	6224	6635	7002	7874	8497	9273	8763	12524	73031	91.84%
Home Health Service	4	8	15	17	11	21	25	30	36	167	0.21%
Against Medical Advice	28	30	34	52	60	47	60	56	84	451	0.57%
Transfer To Rehabilitation Facility		1	1	1	10	3	5	4	4	29	0.04%
Transfer To Rehab. In Acute Facility		1		1	2	2	3	4	5	18	0.02%
Transfer To Substance Abuse Facility	1		1	2	6	4	9	15	17	55	0.07%
Transfer To Subs. Abuse In Acute Facility				1						1	0.00%
Transfer To Psychiatric Facility	4	4	4	5	3	6	6	6	4	42	0.05%
Transfer To Psych. In Acute Facility	3	3	2	2	2	3	5	2	4	26	0.03%
Other or Unknown	20	29	31	43	66	71	94	102	95	551	0.69%
Sub Total	6514	6556	7056	7521	8491	9102	9988	10088	14201	79517	99.67%
Died in Emergency Department	19	28	17	27	44	18	26	41	40	260	0.33%
Grand Total	6533	6584	7073	7548	8535	9120	10014	10129	14241	79777	100%

Most TBI ED discharges released the patient to go home and practice self-care (92%). Four percent required a short-term hospital stay, and the remaining (approximately 1%) were discharged to various professional rehabilitation facilities. Less than 1% died in the emergency department.

Inpatient Discharges for TBI by NH County

Table 15a: Occurrence of Inpatient Discharge for TBI by NH County and Year, 2001-2009

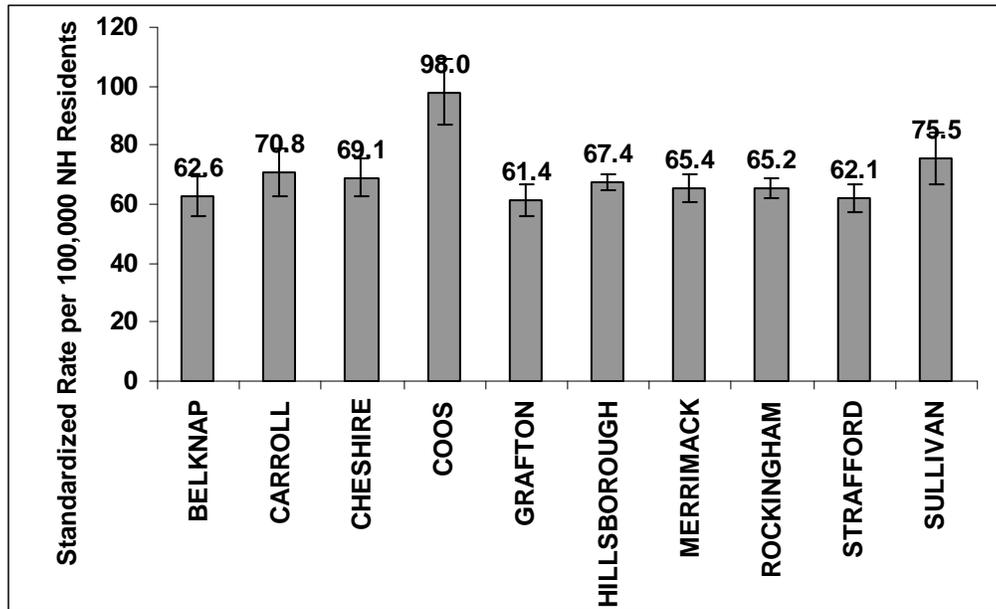
COUNTY	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
BELKNAP	34	25	34	46	34	33	50	50	53	359
CARROLL	35	27	31	33	48	37	28	41	37	317
CHESHIRE	44	36	39	37	54	58	63	90	83	504
COOS	28	33	34	38	37	21	44	42	50	327
GRAFTON	37	51	52	53	53	52	63	63	89	513
HILLSBOROUGH	229	231	233	238	258	261	312	292	269	2,323
MERRIMACK	78	85	71	101	98	94	101	116	119	863
ROCKINGHAM	136	142	166	185	154	187	213	187	257	1,627
STRAFFORD	49	77	67	68	64	77	88	85	76	651
SULLIVAN	25	34	30	32	31	35	30	33	60	310
Total	695	741	757	831	831	855	992	999	1,093	7,794

Table 15b: Standardized Rate of Inpatient Discharge for TBI by NH County, 2001-2009

County	Count	Standardized Rate	Lower 95% CI	Upper 95% CI
BELKNAP	359	62.6	55.9	69.2
CARROLL	317	70.8	62.6	79.1
CHESHIRE	504	69.1	62.9	75.2
COOS	327	98.0	86.9	109.1
GRAFTON	513	61.4	56.0	66.8
HILLSBOROUGH	2,323	67.4	64.6	70.2
MERRIMACK	863	65.4	61.0	69.8
ROCKINGHAM	1,627	65.2	62.0	68.5
STRAFFORD	651	62.1	57.3	66.9
SULLIVAN	310	75.5	66.9	84.1

The chart above shows that there is no significant difference in the rate of TBI Inpatient discharges for all counties between 2001 and 2009, except for Coos County. Coos has a significantly higher rate than every other county (98.0 per 100,000, CI 86.9-109.1), with the exception of Carroll and Sullivan.

Figure 15: Standardized Rate of Inpatient Discharge for TBI by NH County, 2001-2009



Emergency Department Discharges for TBI by NH County

Table 16a: Occurrence of ED Discharges for TBI by NH County and Year, 2001-2009

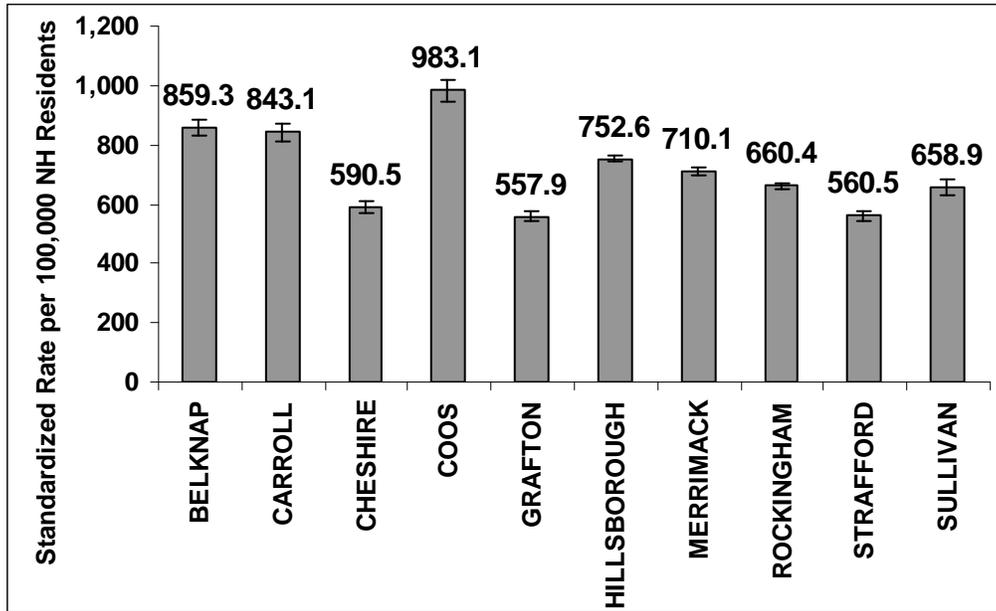
COUNTY	2001	2002	2003	2004	2005	2006	2007	2008	2009	Total
BELKNAP	336	378	443	462	535	574	531	485	558	4,302
CARROLL	275	256	348	357	337	399	323	368	427	3,090
CHESHIRE	280	280	319	333	371	442	513	672	800	4,010
COOS	256	245	271	260	308	270	330	334	420	2,694
GRAFTON	426	395	385	430	454	428	492	519	656	4,185
HILLSBOROUGH	2,168	2,170	2,203	2,470	2,862	3,207	3,465	3,261	4,102	25,908
MERRIMACK	755	808	868	888	1,004	1,049	1,132	1,109	1,311	8,924
ROCKINGHAM	1,289	1,312	1,522	1,589	1,747	1,830	2,125	2,124	2,641	16,179
STRAFFORD	493	484	489	491	653	679	783	904	1,012	5,988
SULLIVAN	236	228	208	241	220	224	294	296	394	2,341
Total	6,514	6,556	7,056	7,521	8,491	9,102	9,988	10,072	12,321	77,621

Table 16b: Standardized Rate of ED Discharges for TBI by NH County, 2001-2009

County	Count	Standardized Rate	Lower 95% CI	Upper 95% CI
BELKNAP	4,302	859.3	833.1	885.5
CARROLL	3,090	843.1	812.2	874.1
CHESHIRE	4,010	590.5	571.8	609.2
COOS	2,694	983.1	944.7	1,021.6
GRAFTON	4,185	557.9	540.5	575.3
HILLSBOROUGH	25,908	752.6	743.4	761.8
MERRIMACK	8,924	710.1	695.3	725.0
ROCKINGHAM	16,179	660.4	650.1	670.7
STRAFFORD	5,988	560.5	546.0	574.9
SULLIVAN	2,341	658.9	631.7	686.0

The chart below shows that there are significant differences in the rate of TBI emergency department discharges among most counties between 2001 and 2009. Belknap, Carroll, and Coos counties have significantly higher rates than the other counties. Cheshire, Grafton, and Strafford have significantly lower rates than the other counties.

Figure 16: Standardized Rate of ED Discharge for TBI by NH County, 2001-2009



References:

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- ¹¹ Correspondence from Bruce Lawrence, Pacific Institute for Research and Evaluation, Children’s Safety Network, July 2008

Caveats for costing data:

- Case selection for fatalities was based on state of residence, while that for hospital admissions was based on state of hospitalization, since the data source, HCUP-NIS, does not give state of residence.
- The hospitalized incidence shown here is not reliable. The HCUP-NIS is stratified to be representative at the national level, not the state level.
- Entity axis field from part one, not part of the death certificate field were selected.
- For hospitalizations, the first five head-injury diagnoses fields were selected.