KENTUCKY TRAUMATIC BRAIN INJURY & SPINAL CORD INJURY SURVEILLANCE PROJECT

FISCAL YEAR 2004 FINAL REPORT

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FOR MORE INFORMATION

This report was prepared by Michael Singleton and Huifang Qin of the Kentucky Injury Prevention and Research Center (Acting Director: Dr. Julia Costich). Data requests, questions, or other correspondence should be directed to the address/phone numbers below.

Address: 333 Waller Avenue, Suite 202
Lexington, KY 40504

Telephone: (859) 257-5809

Fax: (859) 257-3909

E-mail: msingle@email.uky.edu

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Introduction

In 2001 traumatic brain injury (TBI) was a factor in the deaths of 1,094 Kentuckians as well as the live discharges of 3,976 Kentuckians from licensed, acute-care hospitals across the state. TBI played a role in the death or hospitalization of approximately 14 state residents per day. Acquired Brain Injury (ABI) was diagnosed in 1,178 deaths and 2,062 live discharges (nearly 9 ABI per day), and Spinal cord injury (SCI) was reported in 64 deaths and 273 live discharges (approximately 1 SCI per day). This report finds that the primary areas in need of research and programming for the prevention of central nervous system (CNS) injury are:

- Motor vehicle traffic crashes (MVTC) in persons aged 15-24;
- Falls in persons aged 65 and older;
- Substance abuse and misuse (particularly, but not limited to, prescription medications) in persons aged 25-54.

These are by no means the only areas of need, but they are ones that were discovered by this inquiry to be associated with both high numbers and rates of CNS injury. There are more details on these findings in the Results and Discussion sections which follow.

Over the first three years in which this report was produced (1998-2000), the number and rate of TBI, SCI, and ABI identified increased steadily due primarily to improvements in the hospital discharge data collection system. In this year's report that trend continues. One reason is a 16% increase in case capture on the hospital discharge dataset (HDD) in 2001 over 2000. A second is a large increase in the percentage of trauma registry (TR) cases for which computerized diagnosis codes were available. The overall case capture for the TR has held steady over the eight years for which we have data, but until 2001 the majority of reported cases had text diagnoses rather than ICD-9 codes. For 2001 ICD-9 diagnosis codes were available for nearly all of the TR cases (Figure 8). In addition, the HDD case capture seems finally to be leveling off (Table 29), which means that we should be approaching true benchmarks for TBI and SCI.

ABI actually remained level for 2001 even with the data system improvements. However, because KIPRC traditionally has needed to work with only those hospital discharges associated with an injury diagnosis, in this and past years we have only been capturing ABI that were comorbid with an injury diagnosis. For the 2002 report we plan to address this gap by utilizing the entire HDD file, rather than the injury subset only, so we can expect the capture of non-fatal ABI to increase significantly next year.

We have tried in the current year's report to provide an additional focus on non-fatal injuries, as they are the ones that may require ongoing services and support. We have estimated, by several measures, the number of persons likely to experience significant impairments in their ability to function as independent members of their communities. We also tried to show more clearly which mechanisms of TBI affect different age groups and funding sources.

A final remark regarding the data systems: as with most things, the more they are exercised the stronger they tend to become. One of the major objectives in the state's TBI strategic plan is the continual improvement of the data systems that support TBI surveillance. The funding and production of this report contribute significantly to the achievement of that objective.

Methods

Data collection

Data used for surveillance were all received electronically. Hospital Discharge Data files from the Kentucky Department for Public Health (KDPH) are routinely received by the Kentucky Injury Prevention and Research Center (KIPRC) for surveillance purposes, as are trauma registry databases from the five American College of Surgeons-certified trauma centers in Kentucky: University of Kentucky Hospital (UKH), University of Louisville Hospital (ULH), Kosair Children's Hospital (KCH), Trover Regional Medical Center (TRMC), and Taylor County Hospital (TCH). The National Center for Health Statistics' Multiple Cause of Death File (NCHS Death) was required, as this data set contains information on up to 20 supplemental causes of death, whereas KDC generally only captures the external cause of injury (E-code) for trauma cases. In addition to these data sets, we were able to obtain data on Kentucky residents treated in Tennessee from that state's TBI registry. We have reported the number of TBI identified on that dataset. However due to late receipt of the dataset, these cases were not included in the data linkage or in the final count or rates.

Traumatic brain injury case definition

The Centers for Disease Control and Prevention (CDC) have established standards for TBI case identification (CDC, 1995). Hospitals and trauma registries commonly use ICD-9 codes for injury coding. For death certificates, state and federal authorities use ICD-10 codes. The following ICD-9 diagnosis codes (n-codes) were used for identifying TBI in HDD and trauma registry data:

- Fracture of vault or base of skull: 800.0-801.9
- Other, unqualified, and multiple fractures of skull: 803.0-804.9
- Intracranial injury, including concussion, cerebral laceration, subdural hemorrhage, unspecified intracranial injury, etc: 850.0-854.1
- Head injury, unspecified: 959.01

ICD-10 codes were used to identify TBI in mortality data:

- Open wound of head: S01.0-S02.9
- Fracture of skull and facial bones: S02.0-S02.1, S02.3, S02.7-S02.9

- Intracranial injury: S06.0, S06.2-S06.9
- Crushing injury of head: S07.0-S07.1, S07.8-S07.9
- Other unspecified injuries of head: S09.7-S09.9
- Open wounds involving head with neck: T01.0
- Fractures involving head with neck: T02.0
- Crushing injuries involving head with neck: T04.0
- Injuries of brain and cranial nerve with injuries of nerves and spinal cord at neck level: T06.0
- Sequelae of injuries of head: T90.1-T90.2, T90.4-T90.5, T90.8-T90.9

If one or more of these codes was found in any of the diagnosis code fields in HDD, NCHS Death, or trauma registry data, the record was determined to be a TBI.

Acquired brain injury case definition

In addition to CDC-defined TBI, there are many brain injuries that have non-traumatic etiologies. These are ABI. Because these diagnoses are not included in the CDC definition of TBI, they have been linked and analyzed separately. These conditions were also identified by ICD-9 diagnosis codes, as follows:

- Anoxia/Hypoxia: 348.1, 668.2, 669.4, 768.1, 768.5, 768.6, 768.9, 799.0, 994.1
- Allergy/Anaphylaxis: 995.0, 999.4, 999.5
- Acute Medical Clinical Incidents: 320.0-320.9, 321.0-321.8
- Toxic Substances: 964.2, 967.0-967.9, 968.0-968.9, 980.0-980.9, 985, 986, 988.0-988.2, 989.0, 994.1, 994.7, 995.4, 995.5, 997.0, 998.0

The following ICD-10 codes were used to identify ABI in NCHS death records:

- Anoxia/Hypoxia: G93.1, O29.2, O74.3, O75.4, O89.2, P20.1, P21.0, P21.1, P21.9, R09.0, T75.1
- Allergy/Anaphylaxis: T78.0, T78.2, T80.5, T80.6, T88.1, T88.6
- Acute Medical Clinical Incidents: G00.0, G00.1, G00.2, G00.3, G00.8, G01, G07, G02.0, G02.1, G02.8, G04.2, G04.8, G05.0, G05.1, G06.2
- Toxic Substances: G03.8, G03.9, G97.1, G97.2, G97.8, G97.9, N14.3, R29.1, T40.5, T41.0, T41.1, T41.2, T41.3, T41.4, T42.3, T42.4, T42.6, T42.7, T45.5, T49.0, T51.0, T51.1, T51.2, T51.3, T51.8, T51.9, T56.1, T56.2, T56.3, T56.4, T56.5, T56.6, T56.7, T56.8, T57.0, T57.2, T57.3, T57.8, T58, T60.4, T61.9, T62.0, T62.1, T62.2, T62.8, T62.8, T64, T65.0, T65.8, T65.9, T71, T81.1, T88.2, T88.5

If one or more of these codes was found in any of the diagnosis code fields in HDD, NCHS Death, or trauma registry data, the record was classified as an ABI.

Spinal cord injury case definition

The CDC defines SCI by the following ICD-9 diagnosis codes (CDC, 1995):

- Fracture of vertebral column with spinal cord injury: 806.0-806.9
- Spinal cord injury without evidence of spinal bone injury: 952.0-952.9

The following ICD-10 codes were used to identify SCI in mortality records:

- Fracture of neck: S12.0-S12.2, S12.7, S12.9
- Fracture of thoracic vertebra and thoracic spine: S22.0-S22.1
- Fracture of lumbar spine: S32.0, S32.7
- Injury of nerves and spinal cord at neck level: S14.0-S14.1
- Injury of nerves and spinal cord at thorax level: S24.0-S24.1
- Injury of nerves and lumbar spinal cord at abdomen, lower back, and pelvis level: S34.0-S34.1, S34.3
- Fracture of spine, level unspecified: T08
- Injury of nerves and spinal cord involving other multiple body regions: T06.1
- Injury of spinal cord, level unspecified: T09.3
- Sequelae of injury of spinal cord: T91.3

For this report, SCI records had to contain one of the above codes in one of the first three diagnosis code fields in HDD, NCHS Death, or trauma registry data.

Probabilistic data linkage

Probabilistic data linkage has been described in previous reports of this surveillance project, and in scholarly depth by Jaro (1995, 1989). Briefly, probabilistic data linkage is a statistical method for matching records in unrelated databases. By comparing the frequencies of all individuals' characteristics, such as age, birth date, and zip code, the data linkage software decides which records in the different databases probably pertain to the same person. Thus, we avoid counting these cases more than once when calculating incidence. For this project, the ratio of authentic to spurious links was set to 99:1.

Standardized variables were created from variables necessary for linkage. These included dates (of injury, admission, discharge, death, birth), geographic variables (resident county, resident state, zip codes), and demographic characteristics (age, gender, race, martial status) and others and others (hospital ID, TBI indicator, cause of injury). Data from the Tennessee TBI registry were not included in the data linkage, as previously mentioned.

<u>Self match:</u> As a first step, we matched each file against itself to determine the extent of duplication of cases within the datasets. We found that 1.3% of the HDD records, 0.3% of the trauma registry records, and almost none of the NCHS death records had at least one record that appeared to be a duplicate. In other words, duplication of cases within the datasets appeared to be minimal.

File linkages and master dataset: Next we linked the HDD and trauma registry datasets, then the HDD and NCHS death datasets, and finally the trauma registry and NCHS death datasets. We then created a master dataset containing three sections: one for the HDD portion of the record; one for the trauma registry portion, and one for the NCHS death portion. For example, if a case was identified by data linkage in both the HDD and trauma registry files, the master file would contain a single record with an HDD and a trauma registry portion. If it was found in the HDD only, the master file would contain a single record with only the HDD portion populated, and so on.

Create analytical file: From the master dataset we created a simplified dataset from which the tables and figures in this report were derived. In doing so we made several choices which we outline briefly here. First, we defined a master record to represent a TBI, ABI, or SCI case if there was a TBI, ABI, or SCI diagnosis on any of the three files. Second, we declared a master record to represent a fatality if there was an NCHS death record present, or if there was a HDD or a trauma registry record with a patient disposition indicating death. Third, we established rules of precedence for the data source. For fatalities, if a NCHS death record was found its values were used to populate the analytical file. If a death was indicated on the HDD or trauma registry files but no death record was found, then those files were used to populate the analytical file. For non-fatal injuries, the HDD was the preferred data source. If a value was missing on that file and a trauma registry record was available, then the value from that file was used.

Using these rules we reduced the master file to an analytical file with a single value for each data element (age, gender, diagnosis codes, etc.).

Incidence rates

Crude incidence rates were calculated for each injury type by dividing the number of injuries by 4,065,556, the 2001 population estimate for the population of Kentucky according to the Kentucky State Data Center, and then multiplying by 100,000. This figure represents the number of TBI, ABI, or SCI that occurred per 100,000 residents of Kentucky. Age-adjusted rates were calculated using the Year 2000 Standard Population.

Data analysis

All data analysis, including mapping, was performed using SAS Version 8.2.

Results

Traumatic brain injury

There were 5,070 TBI cases for Kentucky residents identified in 2001 (Table 1). This number is 31% higher than the number of cases identified in 2000. The reasons for the increase are addressed in the Discussion section. The crude incidence rate was 124.7 per 100,000 population. The Venn diagram in Figure 1 shows the distribution of cases among the three databases. Of the 1,753 cases found in the trauma registry, 73% were also found in the HDD, meaning that 27% were *not* found in the HDD. Some, if not most, of this discrepancy is likely due to the fact that trauma registry inclusion criteria capture patients who are treated and released from the emergency department as well as those who die before admission. In both of those cases, there would have been no admission and therefore no hospital discharge record.

Table 1 also shows that the highest rates of TBI are found among those aged 65 and over, and those aged 15-24. From Table 2 we find that 63% of non-fatal, and 70% of fatal TBI occurred in males. The leading mechanisms of injury overall were motor vehicle traffic crashes (MVTC), which caused 41% of all TBI, and falls, which caused 20% (Table 3). The top three mechanisms varied by age group (Tables 4 to 9).

As one would expect, the frequency of TBI was highest in the larger counties (Figure 2). The six most populous counties in 2001 (Jefferson, Fayette, Kenton, Hardin, Warren, and Daviess) were among the top ten in TBI incidence. A notable exception was Perry county, which was 7th in TBI incidence but 37th in population.

Unsurprisingly then, Perry had the third highest age-adjusted TBI rate in the state. Viewing the entire state in terms of age-adjusted rates, there were several clusters of high-incidence counties (Figure 3). These include Breckinridge-Grayson-Hart-Metcalfe, Spencer-Nelson, Taylor-Casey-Russell, Wayne, Clinton, Nicholas-Fleming, and Jackson-Lee-Wolfe-Owsley-Breathitt-Knott-Perry-Leslie-Letcher. Table 10 shows the number of TBI cases per county, with percent of state total, age-adjusted rate, and crude rate per 100,000 population.

Nearly 4 out of 5 TBI (78%) were non-fatal (Table 1). We attempted by several means to estimate the number of the non-fatal TBI that inclined toward the higher end of the severity spectrum. Each of the three methods placed the number somewhere between 1,200 and 1,500.

Table 11 indicates that 1,290 non-fatal TBI discharges had a disposition other than “routine”. The three most frequent non-routine discharges were “inpatient – other type of facility”, “home health”, and “skilled nursing facility.” A total of 1,045 discharges had one of these three dispositions.

Table 12 shows that 1,467 non-fatal TBI discharges had an injury severity score (ISS) of "severe" or "critical". Details about the ISS measure are available at http://www.traumacare.com/newsletter_Winter_1999.htm (Bishop + Associates 1999). It must be noted that ISS is based on injuries to six designated body regions, not only head injuries. It is therefore possible for a high ISS to result from, for example, a relatively mild head injury plus major injuries to the torso and/or lower extremities. So a high ISS does not necessarily indicate a severe head injury. In future reports we will try to look specifically at head injury severity scores.

Table 13 presents an analysis of TBI in terms defined by the Barell Injury Diagnosis Matrix (Barell et al 2002). The definitions are as follows:

- A Type I TBI is one in which there is "recorded evidence of an intracranial injury or a moderate or a prolonged loss of consciousness (LOC), Shaken Infant Syndrome, or injuries to the optic nerve pathways."
- A Type 2 TBI is one in which there is "no recorded evidence of intracranial injury, and LOC of less than one hour, or LOC of unknown duration, or unspecified level of consciousness."
- A Type 3 TBI is one in which there is "no evidence of intracranial injury and no LOC."

From this Table we see that 1,306 non-fatal TBI discharges had a principal diagnosis indicating a "Type I" TBI.

Commercial (46.8%) or government (33.3%) sources were the primary payers billed for acute care charges in 80% of non-fatal TBI, based on discharges identified from the HDD (Table 14). Commercial payers were billed nearly $56 million in 2001, and government payers over $23 million.

Figures 9 through 13 demonstrate that the leading mechanism of TBI varies according to the primary insurance source billed. For example, MVTC was the mechanism of injury in 63% of TBI for which 'Commercial Insurance' was the primary payer billed. Falls were the leading mechanism of TBI when "Government" was the primary payer, at 44%. These insurers should be viewed as stakeholders in programs to prevent those injuries that result in a substantial portion of their claims.

Acquired brain injury

There were 3,240 ABI cases for Kentucky residents identified in 2001 (Table 15). Unlike TBI and SCI, the incidence of ABI did not increase appreciably over 2000. The crude incidence rate for 2001 was 79.7 per 100,000 population, compared to 78.6 in 2000. The Venn diagram in Figure 4 shows the distribution of cases among the three databases. Not surprisingly, very few of the non-fatal cases were derived from the trauma registry, since ABI as defined in this report is generally non-traumatic in nature. Of the 72 cases that *were* identified in the trauma registry, 76% were also found in the HDD.

ABI was skewed toward the middle and older age groups, with 86% occurring in persons aged 25 and older, compared to 70% of TBI (Table 15). Also in contrast to TBI, of which 64% occurred in males, ABI affected the genders in nearly equal proportions (Table 16). The 25-44 group showed a different distribution of diagnoses than the 45 and older group. In the former age group, 'toxic substance' diagnoses predominated, whereas in the latter 'toxic substances' and 'anoxia/hypoxia' both were prevalent and approximately evenly distributed. Overall, exposure to toxic substances accounted for 60% of ABI cases. Another 35% were anoxia/hypoxia. Allergies and acute medical clinical incidents comprised the other 5% of ABI (Table 18).

In general, as with TBI, the more populous counties had the higher numbers of ABI (Figure 5). The four most populous counties in 2001 (Jefferson, Fayette, Kenton, and Hardin) were among the top ten in TBI incidence. Again as with TBI, Perry county was an exception to this rule, being 9th in ABI incidence compared to 37th in population. As a result, Perry had the highest age-adjusted rate of ABI in the state.

Viewing the entire state in terms of age-adjusted rates, there was a very strong concentration of higher ABI incidence in Eastern Kentucky, and a second, smaller group in the far Western part of the state in Livingston, Crittenden, Webster, and Hopkins counties (Figure 6). With TBI, by contrast, the high-incidence clusters were dispersed more widely. Table 24 shows the number of ABI cases per county, along with percent of state total, age-adjusted rate, and crude rate per 100,000 population.

Among those ABI discharges that were reported to have some relationship with an injury (i.e., included an E-code), 80% of the non-fatal ones were poisonings. Either poisoning, suffocation or drowning was indicated in 7 out of 10 of the fatal, injury-related ABI (Table 19). (Note that we are making a distinction here between "injury-related" and traumatic, with trauma being considered one of several forms of injury. As we have said, ABI is by our definition non-traumatic).

Table 20 indicates that more than one-third (37%) of ABI discharges were other than "routine." The three most frequent non-routine discharges were "inpatient – other type of facility", "skilled nursing facility", and "home health."

Government (55%) or commercial (23.5%) sources were the primary payer billed for acute care charges in nearly 4 out of every 5 non-fatal ABI, based on discharges identified from the HDD (Table 21). Government payers were billed more than $28 million in 2001, and commercial payers over $12 million.

Spinal cord injury

SCI patients often are readmitted for problems stemming from the original injury. In an effort to avoid double-counting in such cases, for SCI we looked only at the three first-listed diagnosis codes. There were 337 SCI cases for Kentucky residents identified in 2001 (Table 22). This number is more than double the number of cases identified in 2000. The reasons for the increase are addressed in the Discussion section (p. 13). The crude incidence rate was 8.3 per 100,000 population. The Venn diagram in Figure 4 shows the distribution of cases among the three databases. Of the 83 cases found in the trauma registry, 89% were also found in the HDD.

As with TBI, the age groups 15-24 and 65 and over had the highest rates of SCI (Table 22). Rates of non-fatal SCI were similar across the age groups starting at 15 years of age. Males had more than double the SCI rate of females, and had 71% of the non-fatal SCI (Table 23).

Table 24 presents the number of SCI per county. Due to the small number of cases per county, we did not attempt a graphical analysis of SCI rates by county, as the rates would be unstable.

Among SCI's for which an E-code was reported, MVTC and falls were the leading mechanisms of injury (Table 25). Unfortunately, for nearly half (46%) of the non-fatal SCI discharges, no E-code was reported.

Two-thirds of the non-fatal SCI discharges had dispositions other than “routine” (Table 26). In terms of ISS, more than half (56%) were “severe” or “critical” (Table 27).

Commercial (51%) or government (36%) sources were the primary payer billed for acute care charges in 87% of non-fatal SCI, based on discharges identified from the HDD (Table 28). Commercial payers were billed $9.7 million in 2001, and government payers over $4.5 million.

Discussion

Comment on the Data Sources

Over the course of the four years for which this report has been produced, the underlying datasets for non-fatal injuries have evolved and improved substantially. The case capture of the HDD has improved dramatically since 1999, as demonstrated in Table 29. Furthermore, while the case capture for the trauma registry data has remained level since 1995, the availability of computerized ICD-9 diagnosis codes had been incomplete before 2001 (Table 30). Without those diagnosis codes it was impossible to identify TBI, ABI, and SCI cases for a substantial percentage of the trauma registry cases prior to 2001. Figure 8 shows the change over time in the number of cases having ICD-9 codes, and the resulting increase in the number of TBI cases identified. While we might expect that this would have a negligible impact on surveillance - since we would reasonably assume that any person who appears in a trauma registry should also have a UB92 submitted to the HDD, in actuality we were unable to match 27% of the TBI cases found in the trauma registry to the HDD. The reasons for this discrepancy are discussed in the Results section (p. 9).

Putting Kentucky's CNS Injury Experience in Perspective

Comparisons with results from other states and other studies are possible, but must be made carefully because methodologies vary. According to CDC's *State Injury Indicators Report (2nd Edition – 1999 Data)* (SIIR), Kentucky had the 11th highest age-adjusted rate of TBI-related deaths per 100,000 population among the 21 states for which rates were reported (Thomas et al 2004). As for non-fatal TBI, unfortunately, a significant number of Kentucky hospitals did not report discharges in 1999, so the SIIR results on TBI hospitalizations do not accurately reflect Kentucky's situation. Furthermore, the methodology for counting TBI hospitalizations used in the present report differs from that used in the SIIR, because we included trauma registry cases and because our definition of a TBI hospitalization is more inclusive than theirs. Therefore we cannot use that document as a standard against which to compare the non-fatal TBI rates in this report.

There are a couple of commonly cited benchmark studies that were conducted according to a standard methodology for TBI surveillance, which is documented in the *Guidelines for Surveillance of Central Nervous System Injury* (CDC 1995). In both studies, hospitalizations were derived from state HDD files, as in our study, but did not include state trauma registry files. If we omit, for the purpose of this discussion, those cases that we identified only in the Kentucky trauma registry, then we can make some fair comparisons to those studies, from a methodological standpoint. (However, the problem remains that those studies are based on data at least ten years old.) With those limitations in mind, we determined that the HDD-only TBI rate for Kentucky in 2001 (including those who died in the hospital) was 94.1; the fatality rate was 25.1 (only counting deaths found in NCHS, not those found in HDD); and the total TBI rate was 114.3.

The first of the studies, published in the CDC's *Morbidity and Mortality Weekly Review* (CDC 1997), reported on the incidence rate of TBI in Colorado, Missouri, Oklahoma, and Utah from 1990-1993. Each state used the CDC surveillance guidelines, with hospitalizations identified through the HDD and fatalities through death certificates and medical examiner reports. The following overall rates (combined results for all states) were reported: 84.8 for hospitalizations (including those who died in the hospital); 23.2 for fatalities; and 102.1 overall.

In the second study, Thurman *et al* (1999) reported on the 1994 incidence of TBI in seven states - Arizona, Missouri, Colorado, Oklahoma, South Carolina, Minnesota, and New York (excluding New York City). The methodology was similar to the previously cited study. The reported overall crude incidence rate for those seven states combined was 90.0/100,000, and ranged from 70.8/100,000 to 113.7/100,000. The combined crude hospitalization and death rates were 75.5/100,000 and 20.7/100,000, respectively.

Kentucky's rates are all slightly higher than those reported in both studies. But again, those studies are based data from at least ten years ago.

The SCI rate for Kentucky in 2001, 8.3/100,000, is higher than the range of 1.5 to 4.0 per 100,000 reported by Sekhon and Fehlings (2001) for SCI incidence in developed nations. However, that range includes only persons who reached the hospital alive. Furthermore, they did not discuss the methodological details upon which those estimates are based, so this may not be a valid comparison.

Unlike TBI and SCI, there is not a standard case definition for ABI, making comparison with other sources more problematic.

Traumatic Brain Injury and Spinal Cord Injury Prevention

TBI affects all ages, with the mechanisms and circumstances differing according to age group. However, two issues are clearly suggested by our results as being primary candidates for further study and intervention, by virtue of being the leading cause of TBI in the age groups with the highest incidence rates. They are and falls in persons aged 65 and older and MVTC in 15-24 year-olds.

The rate of TBI in persons aged 65 and older (246.1) was nearly twice the rate for all ages (124.7) (Table 1). Forty-four percent (548) of the TBI in this age group resulted from a fall, more than 2 ½ times as many as were caused by the second-leading mechanism, MVTC (Table 9). (One-quarter of the cases did not indicate the cause of injury.) Government insurance sources (primarily Medicare and Medicaid) were the most common primary payers billed for TBI-related hospital discharges resulting from falls (Figures 9-13).

In the 15-24 age group, MVTC was the mechanism of injury in more than 3 out of every 5 TBI. MVTC caused nearly 7 times more TBI in this age group than the second-leading mechanism, non-traffic land transportation incidents (Table 6). Commercial insurers were the most common primary payers billed for TBI-related hospital discharges resulting from MVTC (Figures 9-13).

As MVTC's and falls are the leading causes of SCI as well as TBI, a focus on those two issues should have an impact on the occurrence of SCI also.

Acquired Brain Injury Prevention

In general Eastern Kentucky exhibited a higher incidence of ABI than the rest of the state. Of the four broad categories comprising our definition of ABI, 'toxic substances' and 'anoxia/hypoxia' accounted for 95% of the cases (Table 25). In the 25-44 age group, 'toxic substance' diagnoses predominated, an observation that indicates that a focus on substance abuse in that age group may be an appropriate countermeasure. This suggestion is supported by additional evidence. First is Eastern Kentucky's well-documented problem with the misuse and abuse of prescription medications. Second is the recent report of an elevated, and rising, mortality rate in that area due to unintentional poisoning (Singleton 2003; CDC 2004). Prescription medications were overwhelmingly the most commonly reported substance on death certificates in those cases. Furthermore, the highest rates were found in the 35-44 age group, with 25-34 and 45-54 being next highest.

For ages 45 and over, 'anoxia/hypoxia' diagnoses were equally prevalent with 'toxic substance' diagnoses, but the ICD-9 codes (348.1 and 799.0) provide no insights regarding the causes or contributing circumstances. Review of medical records may be necessary for these cases in order to gain information useful for preventive purposes.

It must be noted that the methodology used in this report under-represents the incidence of ABI. The reason is that the injury subset of the HDD used in this and previous years included only those cases of ABI that were comorbid with at least one injury diagnosis. In 2001 we found 638 cases of anoxia/hypoxia in the injury subset. At our request, KDPH identified 1,107 cases in the complete HDD dataset, nearly twice our number (personal communication). The injury subset captured all cases of TBI and SCI, but not all cases of ABI. Beginning with the fiscal year 2005 report, we will modify the methodology to examine all cases in the HDD, rather than only those with an injury diagnosis.

Limitations

Double counting of cases is possible for several reasons, including multiple representation of cases within individual data sets (e.g., transfers between hospitals), or across linked data sets (due to failure of data linkage to identify duplicate records). In particular, the rate of linkage of trauma registry cases to HDD observed in the Discussion section requires further understanding before we place full confidence in the incidence estimates, particularly for TBI.

“Non-fatal” in this report refers to Kentucky-resident inpatients discharged alive from a licensed, acute-care hospital *in Kentucky* (including trauma centers). It does not include those treated and released at emergency departments (with the exception of certain cases treated and released from ED’s at certified trauma centers), those treated by emergency medical services who refused transport to a hospital, or those hospitalized outside of Kentucky. The incidence of non-fatal TBI in Kentucky residents, in that larger sense, is certainly several times larger than the results reported here.

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FIGURES

Figure 1. Distribution of TBI among databases, 2001

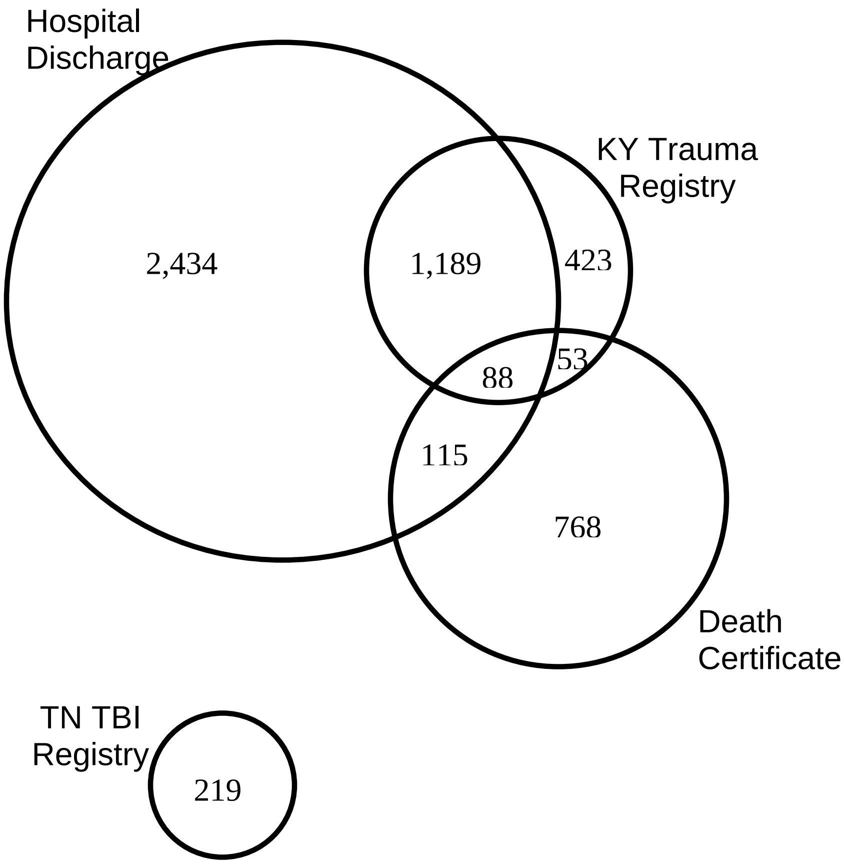

Figure 3. Age-adjusted incidence rate of TBI by county, 2001