TRAUMATIC BRAIN INJURY & SPINAL CORD INJURY SURVEILLANCE PROJECT

FISCAL YEAR 2003 FINAL REPORT

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This project is located at the Kentucky Injury Prevention and Research Center, University of Kentucky, and funded by the Kentucky Traumatic Brain Injury Trust Fund

FOR MORE INFORMATION

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Introduction

The full spectrum of traumatic brain injury (TBI), spinal cord injury (SCI), and acquired brain injury (ABI) cases in Kentucky has been difficult to capture electronically in previous years, despite the funds and the will to do so. This was primarily due to the poor quality and reporting of hospital discharge data (HDD) to the Department for Public Health (DPH) in Frankfort. However, the HDD for the year 2000 have improved so dramatically as to significantly alter the picture of these injuries in Kentucky. For example, previous reports generated by this project have relied on data that excluded a great number of minor to moderate TBI treated in hospitals throughout the state. The data used to generate this report, however, are truly population-based. This means that the estimates of incidence and mortality are much more accurate than those of previous years. Thus, while the general appearance of this report will be familiar, careful inspection will show that TBI, SCI, and ABI are more common than previously suggested by this surveillance project.

The results of year 2000 surveillance are classified by injury. Within each injury section, one will find the following information: distribution of cases among data sources, geographic distribution of cases, demographic distribution of cases (by age, gender), major causes of injury, primary payers listed in HDD, inpatient discharge status of cases, length of stay for inpatient cases, and number of work-related cases.

Methods

Data collection

Data used for surveillance were all received electronically. HDD from DPH are routinely received by the Kentucky Injury Prevention and Research Center (KIPRC) for surveillance purposes, as well as the Kentucky Death Certificates data file (KDC), and trauma registry data from the three American College of Surgeons Level-I trauma centers in Kentucky—University of Kentucky Hospital (UKH), University of Louisville Hospital (ULH), and Kosair Children's Hospital (KCH). 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, while KDC contains only three supplemental causes. However, the NCHS Death data do not include information such as the exact date of death, or the decedent's zip code of residence. Therefore, shortly after NCHS Death and KDC were received, they were combined to form one larger data set containing the variables from both data sets. This will be referred to as the Kentucky Comprehensive Death Data set (KCDD) in this report. In addition to these data sets, the project was able to obtain data on Kentucky residents treated in Tennessee from that state's TBI registry. This ensures that all TBI among Kentucky residents are counted, not just those that occurred in Kentucky.

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. Here, linkage was conducted with AUTOMATCH software. By comparing the frequencies of all individuals' characteristics, such as age, birth date, and zip code, the AUTOMATCH software decides which records in the different databases probably pertain to the same person. Thus, one does not count 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, death, birth), geographic variables (county codes, zip codes), and demographic characteristics (age, gender). Since these variables were used for probabilistic data, they were required to be in the same format in all databases. Data from the Tennessee State TBI Registry were not included in the data linkage.

After data linkage was completed, the linked data and unlinked data were combined to form a comprehensive database of all hospital injury inpatient admissions, Level-I trauma center visits, and deaths. TBI, SCI, and ABI cases were then identified in this database using the following International Classification of Disease, Ninth and Tenth Revision (ICD-9, ICD-10) codes (CITE ICD BOOKS). The HDD has up to nine diagnosis codes for each record, while NCHS Death records have up to 20, and trauma registry data have up to 15.

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.

Spinal cord injury case definition

The CDC define 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.

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 determined to be an ABI.

Those records not identified as TBI, SCI, or ABI were deleted from the database. Three separate databases were then created, one for each type of injury. Tennessee TBI Registry data were added to the TBI data set at this time.

Incidence rates

Crude incidence rates were calculated for each injury type by dividing the number of injuries by 4,041,769, the U.S. Census 2000 population estimate for the population of Kentucky, and then multiplying by 100,000. This figure represents the number of TBI, SCI, or ABI that occurred per 100,000 residents of Kentucky.

Geographic analysis

Since county of residence was available for the majority of TBI, SCI, and ABI records, cases per county and county-specific incidence rates were mapped to investigate geographic patterns of injury. In cases where a county had fewer than 5 cases of any injury, a label of <5 is employed to ensure confidentiality. ArcView (Version 3.2) software was used to create these maps. ArcView's Natural Breaks method (also known as the Jenks method) was used to create four gradients of incidence rate for mapping.

Statistical analysis and tabular data

Statistical analysis was performed in Stata (Intercooled, Version 6.0), and is limited to summary statistics, χ^2 tests, and tests for trend. A χ^2 test was used to evaluate mortality associated with age and gender among those with TBI and ABI. There were too few SCI for this type of analysis. Tests for trend were employed to discern whether these injuries were more or less likely to result in death as one ages. Similarly χ^2 tests were used to detect gender differences in mortality, and to determine whether particular injury causes were more common in a certain gender or age group.

Tables in this report describe the above statistical analyses, TBI, SCI, and ABI by cause, HDD-derived primary payers, HDD discharge status, and length of stay (LOS). The

number of work-related cases was available in NCHS Death data and trauma registry data; these are reported for each injury type.

Results

Traumatic brain injury

There were 3882 cases of TBI identified for 2000. The crude incidence rate for TBI, therefore, is 96.0/100,000 residents. The TBI-related death rate was 24.5/100,000. The Venn diagram in Figure 1 displays the distribution of cases among the databases. The great majority of cases were identified in HDD. There were 167 cases, a mere 4.3% of the total, where the TBI occurred in Kentucky, but was treated in Tennessee.

Figure 2 displays TBI cases in each county (a map of Kentucky with county names appears in Appendix A). Not surprisingly, Jefferson County had the greatest number of TBI cases by far—738. Fayette County (144 cases) was the next highest, followed by Daviess (95), Hardin (89), and McCracken (88). The county with the highest incidence rate, however, was Green. Although only 28 TBI occurred in Green County in 2000, this was among a population of only 11,518. This is a crude incidence rate of 243.1/100,000—more than two and a half times the statewide rate. The county with the lowest incidence rate, 27.8/ 100,000, was Pendleton, where less than five TBI occurred in a population of over 14,000. A map of the crude incidence rates of TBI by county appears in Figure 3. One of the most notable features of this map is the contiguous block of high-incidence counties in the interior of eastern Kentucky. The counties forming this block are Breathitt (incidence rate 217.4/100,000), Lee (164.2/100,000), Leslie (169.3/100,000), Magoffin (157.5/100,000), Morgan (157.7/100,000), Perry (159.9/100,000), and Wolfe (184.0/100,000).

Table 1 lists fatal and non-fatal TBI by age group. Case fatality rates were higher among older Kentuckians, confirmed by a non-parametric test for trend ($P < 0.01$). Case fatality was lowest in the age group 5-14 (12.2% mortality), and highest among those 65 and older (30.5%). Table 1 also lists age-specific incidence rates, which do not follow this pattern. Incidence was highest in those ages 65 and older (incidence rate 184.4/100,000), followed by those ages 15-24 (137.1/100,000).

Table 2 lists fatal and non-fatal TBI by sex. Males were more likely to die from a TBI ($P <0.01$), and almost twice as likely to incur a TBI. The male incidence rate was 128.8/100,000, and the female incidence rate was 64.7/100,000.

The major causes of TBI are presented in Table 3. Motor vehicle traffic crashes were the cause of 1474 (38.0%) TBI; falls were the cause of 776 (20.0%). The cause was unknown for 421 (10.8%) TBI. There was great variation in case fatality among major causes, with suicide / self-inflicted cases suffering the highest case fatality rate (96.5%).

The two most common causes of TBI in each age group are listed in Table 4. Motor vehicle traffic crash was one of the top two causes in every age group. Other transport

injuries were common in those ages 5-14, 15-24, and 25-44. Falls were common in those ages 0-4, 45-64, and 65 and over.

Primary payer and discharge disposition were available for all 2915 HDD records. Table 5 lists the primary payers for TBI, in descending order. Insurance companies and Medicare were the most common primary payers, together accounting for about half of all TBI records in HDD. Table 6 lists discharge disposition. Over two-thirds of TBI patients (69.2%) were discharged routinely. Only 6.6% of TBI inpatients expired at the hospital.

Length of stay (LOS) was available for all HDD TBI cases. The mean LOS was 6.5 days, with a minimum of one, and a maximum of 218 days. The median LOS was three. Table 7 contains these and other summary statistics.

Data on whether TBI were work-related were available in HDD, Tennessee TBI registry, and NCHS Death data. There were 148 work-related cases of TBI identified. Thirty-six of these were fatalities. Another 221 cases were listed as "unknown" in NCHS Death and Tennessee TBI registry data.

Spinal cord injury

There were 147 SCI cases identified for Kentucky in 2000. The crude incidence rate was 3.6/100,000 residents. The SCI-related death rate was 0.35/100,000 (or 3.5 per million) in 2000. The Venn diagram in Figure 4 displays the distribution of cases among the databases. Since no data were available from Tennessee for SCI, it is possible that the incidence rate is slightly underestimated.

There were too few cases to map SCI by county. The county with the greatest number of SCI was Jefferson (29 cases). There were 57 counties with no SCI cases. The county with the highest incidence rate was Trimble, with 24.6/100,000. This is more than six times the statewide rate. The age-specific incidence rates of SCI are shown in Table 7. Incidence was highest in those ages 65 and over (incidence rate 6.1/100,000), and ages 15-24 (5.4/100,000).

Table 8 also displays fatal and non-fatal SCI by age group. The case fatality rate for SCI was much lower than TBI, at only 9.5%. Fatality rates were highest in the older age groups.

Table 9 shows SCI by gender, with gender-specific incidence rates. The incidence rate for males was 5.4/100,000, and for females was 2.0/100,000. Fisher's exact test (used instead of the χ^2 test due to small cell sizes) suggests that, unlike TBI, case fatality rates are similar for males and females.

Major causes of SCI are listed in Table 10. Motor vehicle traffic crash was the most common cause of SCI (27.9% of cases), followed by falls (16.3%), and other transport injuries (12.2%). The cause of SCI was unknown in 25.9% of cases.

Primary payer and discharge disposition were available for all 147 SCI cases, as all SCI cases had HDD records. Table 11 lists the primary payers for SCI, in descending order.

Insurance companies and Medicare were the most common primary payers, together accounting for more than half of all SCI records in HDD. Table 12 lists discharge disposition. About half of TBI patients (49.7%) were discharged routinely. Only 7.5% of SCI inpatients expired at the hospital.

LOS was also available for all cases of SCI. The mean LOS was 14.7 days, with a range of 1-114 days. The median LOS was nine. Table 13 contains these and other summary statistics.

Data on work-related SCI were available in HDD and NCHS Death data. There were only six SCI identified as work-related in 2000; all were non-fatal.

Acquired brain injury

There were 3177 ABI cases in 2000. The statewide crude incidence rate was 78.6/100,000. The Venn diagram in Figure 5 shows the distribution of ABI cases among the databases. The majority of ABI cases were identified in HDD records, and very few were found in the trauma registry.

Figure 6 displays ABI cases by county. Jefferson County had 510 ABI cases, the most of any county. Several counties had fewer than five cases in 2000.

Figure 7 shows ABI crude incidence rate by county. Eastern Kentucky had the greatest number of counties in the highest group, but high incidence counties were found in all regions of the state.

ABI incidence rates and case fatality rates were higher in the elderly in 2000, as shown in Table 14, and confirmed by a test for trend ($P < 0.01$). The incidence rate for those 65 and older (incidence rate 210.8/100,000) was more than twice as high as the next highest age group, those ages 45-64 (82.8/100,000). Incidence was lowest among those ages 15-24 (10.2/100,000).

Males were somewhat more likely to incur an ABI (males 81.1/100,000, females 76.2/100,000), and a χ^2 test confirms that males were more likely to die from an ABI than females ($P < 0.01$). Table 15 lists these results.

Causes of ABI are listed in Table 16. The most common cause was injury, accounting for 1270 cases (40.0%) of ABI. This injury category also includes poisoning, which alone was responsible for 335 cases of ABI. Anoxia or hypoxia was responsible for 755 cases (23.8%), and infectious disease was the cause of 46 cases (1.4%) of ABI. There were 365 cases (11.5%) that had multiple causes (e.g. anoxia and infectious disease, injury and anoxia, etc.).

Primary payer and discharge disposition data were available for 2295 cases (72.2%) of ABI, and are summarized in Table 17. Medicare was the most common primary payer, with 856 cases, or 37.3% of all ABI. Medicaid was the next most common primary payer in ABI cases, accounting for 364 (15.9%).

A routine discharge home was the most commonly listed disposition, representing 1334 cases (58.1%) of ABI (Table 18). A disposition of "expired" was more common in ABI than TBI or SCI, with 236 (10.3%) of cases.

Mean LOS was available for all 2295 cases with HDD records. The mean LOS was 7.5 days (Table 19).

Work-related data were available for ABI records with HDD or NCHS Death records. Overall 28 ABI cases were determined to be work-related in 2000. Ten of these were fatalities.

Discussion

The results of 2000 surveillance of TBI, SCI, and ABI suggest that incidence estimates have been, until recently, greatly understated. Table 20 shows the incidence estimates for 1998, 1999, and 2000, for all three injury types. TBI and ABI estimates have increased considerably. It is difficult to discern whether the incidence of these injuries has actually increased. Direct comparison with earlier years is impossible due to differences in HDD reporting (see the Final Report of this project from fiscal year 2002 for comparison of previous years). For 2000, reporting was excellent, and this should continue in the future. The incidence estimate for Kentucky in 2000, 96.0/100,000, is similar to recent estimates found in the literature. The CDC (1997) estimated the incidence rate of TBI in Colorado, Missouri, Oklahoma, and Utah combined to be 102.1/100,000. 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 crude incidence rate for these seven states combined was 90.0/100,000, and ranged from 70.8/100,000 to 113.7/100,000. Thurman *et al* (1999) also noted the TBI-related death rate was 20.7/100,000 in these states. As mentioned above, in Kentucky in 2000, the TBI-related death rate was 24.5/100,000.

The case fatality rate for TBI in 2000 was much lower than this project has reported previously. In 1998 and 1999, the case fatality rate was approximately 34% and 32%, respectively. This rate has dropped to 25.5% because the HDD reporting improved. The majority of TBI deaths have always been easy to identify, as death certificate data can provide this information. However, the increase in HDD records has improved the ability of this surveillance system to identify moderate and mild TBI. Thus, reported cases of non-fatal TBI have increased dramatically, while cases of fatal TBI have remained fairly constant. In 2000, 1999, and 1998, there were 989, 960, and 844 deaths, respectively, due to TBI.

SCI estimates have remained about the same, despite improved HDD reporting, as the definition of SCI has been refined since this surveillance project began. The definition of SCI used for 2000 was altered to exclude cases from earlier years that were returning as hospital inpatients for health problems related to earlier injuries. Thus, the 2000 estimate contains fewer false positive SCI. The rate for Kentucky in 2000, 3.6/100,000, is within the range reported by others for SCI incidence in developed nations (Sekhon and Fehlings, 2001; Kraus *et al*, 1996).

ABI incidence has increased dramatically. This is also due to HDD reporting. Since the ABI definition is unique to Kentucky, comparison to incidence rates from other studies is impossible.

A total of 7206 TBI, SCI, and ABI were sustained by Kentucky residents in 2000. This means that Kentucky's crude incidence rate for central nervous system injuries is 178.3/100,000. The death rate from these injuries combined was 55.3/100,000.

The major causes of TBI revealed in this report are unsurprising. TBI due to motor vehicle crashes occur across the spectrum of ages, but falls are especially common in the very young (age < 5 years), and in those aged 65 and over. Other sources in the literature have remarked on the great proportion of TBI caused by motor vehicle crashes and falls, and the age groups associated with these causes (Thurman *et al*, 1999; CDC, 1997). These same sources have also commented on the higher incidence among men, which was approximately twice that of women in Kentucky in 2000 (128.9/100,000 vs. 64.7/100,000). Similar trends have been identified among SCI cases as well (Dryden *et al*, 2003; Sekhon and Fehlings, 2001). That ABI do not follow this gender pattern is unsurprising, as they are not injuries in the etiological sense. In other words, there is no external physical or mechanical cause. There are likely very different behavioral risk factors associated with ABI.

Further study of high TBI incidence in eastern Kentucky is warranted. The contiguous seven-county area in Figure 3 may present opportunities for interesting epidemiologic analysis of risk factors for TBI. In addition, this area (and other high-incidence counties) may be ideal for targeted prevention efforts.

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FIGURES

Figure 1. Distribution of TBI among databases, 2000

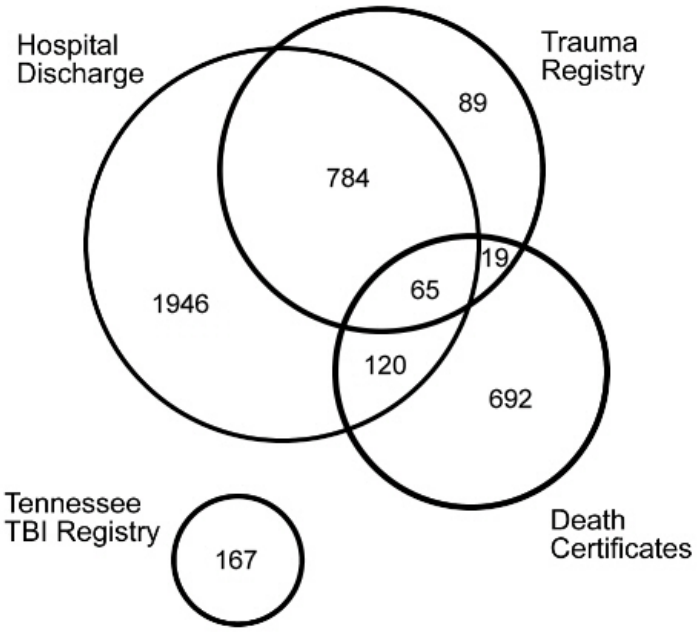


Figure 2. TBI by county, 2000

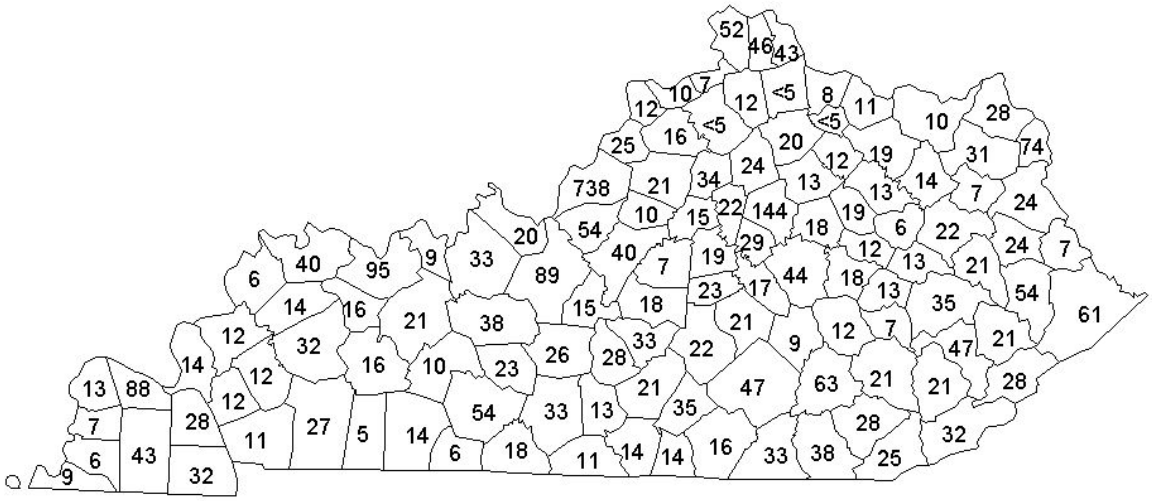


Figure 3. TBI crude incidence rate by county, 2000

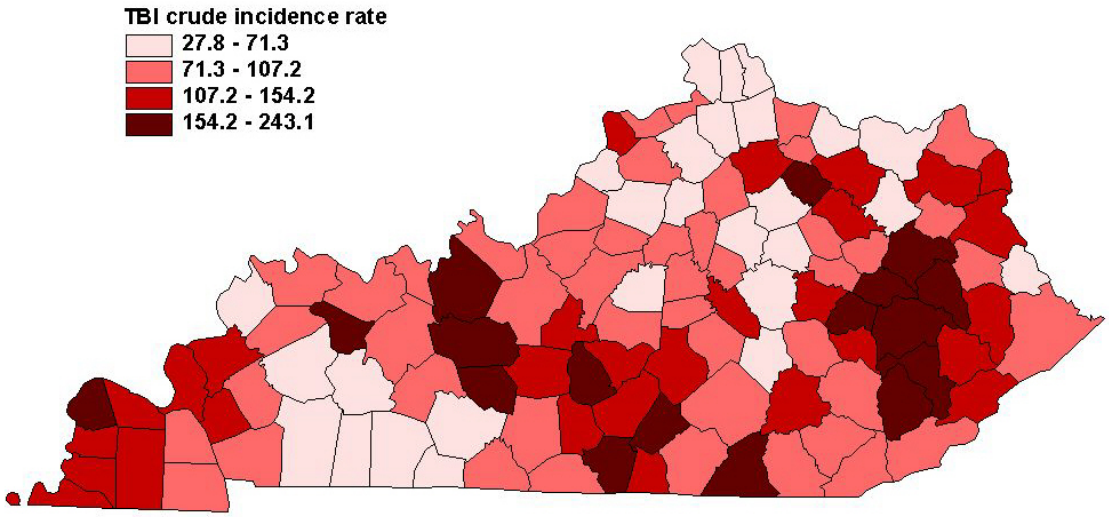


Figure 4. Distribution of SCI among databases, 2000

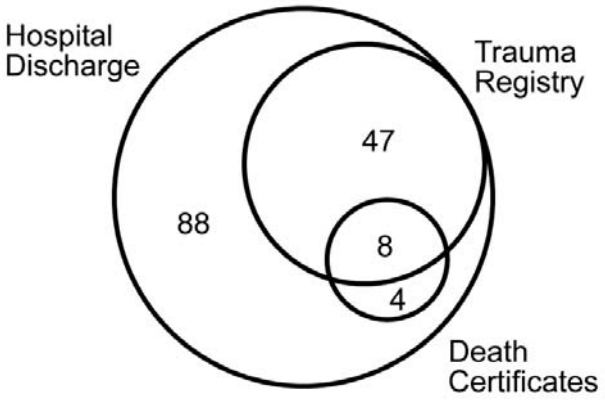


Figure 5. Distribution of ABI among databases, 2000

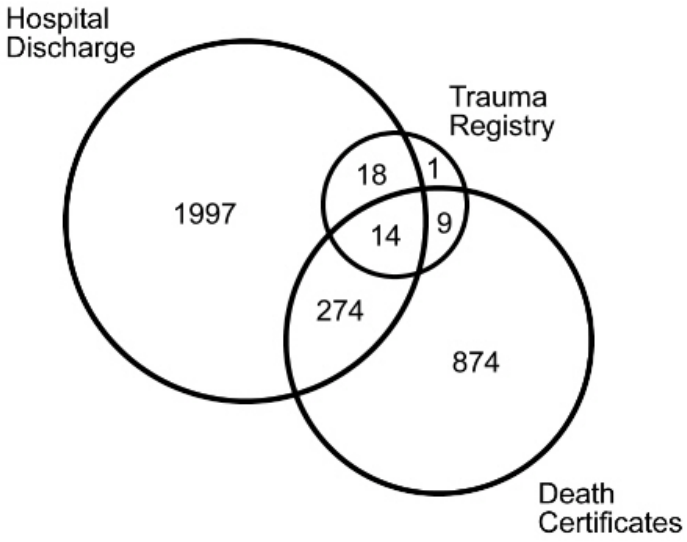


Figure 6. ABI by county, 2000

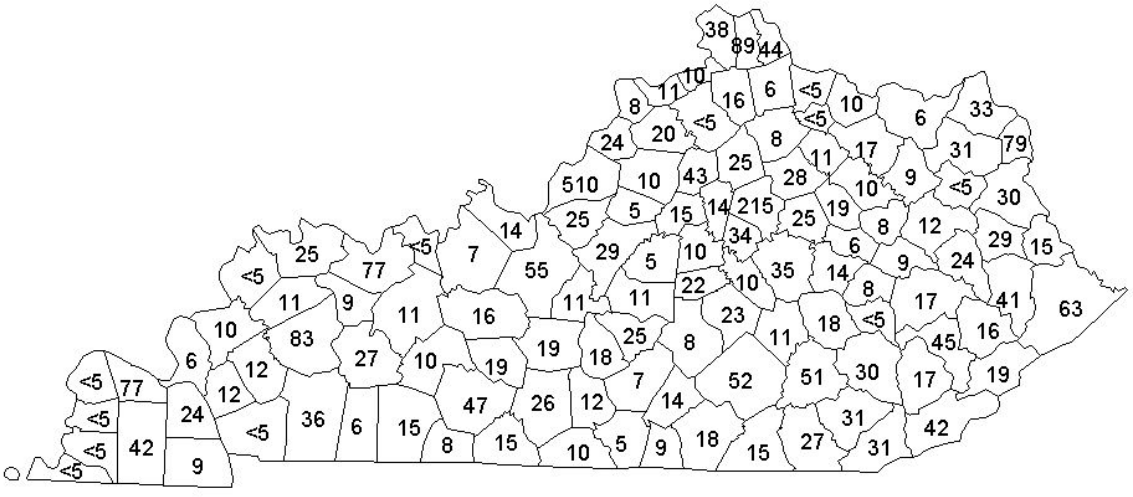
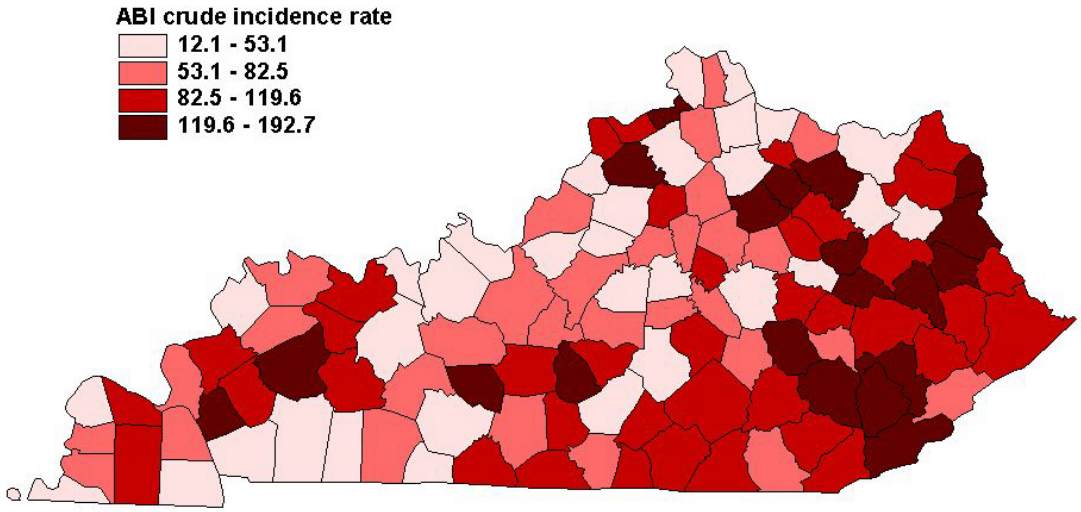


Figure 7. ABI crude incidence rate by county, 2000



TABLES

Table 1. TBI by age, 2000

Age	Non-Fatal (%)	Fatal (%)	Total (%)	% of TBI	Incidence rate
0-4	72 (76.6)	22 (23.4)	94 (100.0)	2.4	35.4
5-14	180 (87.4)	25 (12.1)	206 (100.0)	5.3	36.7
15-24	609 (77.7)	175 (22.3)	784 (100.0)	20.2	137.1
25-44	873 (74.8)	294 (25.2)	1167 (100.0)	30.1	96.4
45-64	512 (73.0)	189 (27.0)	701 (100.0)	18.1	75.4
65+	647 (69.5)	284 (30.5)	930 (100.0)	24.0	184.4
Total	2893 (74.5)	989 (25.5)	3882 (100.0)	100.0	96.0

Test for trend, $P < 0.01$

Table 2. TBI by gender, 2000

Sex	Non-Fatal (%)	Fatal (%)	Total (%)	% of TBI	Incidence rate
Male	1807 (71.0)	739 (29.0)	2546 (100)	65.6	128.9
Female	1086 (81.3)	250 (18.7)	1336 (100)	34.4	64.7
Total	2893 (74.5)	989 (25.5)	3882 (100)	100.0	96.0

$\chi^2 = 49.1$, $P < 0.01$

Table 3. Major causes of TBI, 2000

Cause	Non-fatal (%)	Fatal (%)	Total (%)	% of TBI
Motor vehicle traffic crash	1161 (78.8)	313 (21.2)	1474 (100.0)	38.0
Fall	613 (79.0)	163 (21.0)	776 (100.0)	20.0
Other transport injury	386 (88.1)	52 (11.9)	438 (100.0)	11.3
Unknown	412 (97.9)	9 (2.1)	421 (100.0)	10.8
Suicide / Self-inflicted	10 (3.6)	272 (96.5)	282 (100.0)	7.3
Other unintentional injury	147 (56.3)	114 (43.7)	261 (100.0)	6.7
Homicide / Assault	164 (71.3)	66 (28.7)	230 (100.0)	5.9
Total	2893 (74.5)	989 (25.5)	3882 (100.0)	100

Table 4. Major causes of TBI by age, 2000

Age	Cause	Cases	% of TBI in age group
0-4	Falls	28	29.8
	Motor vehicle traffic crash	23	24.5
5-14	Other transport injury	65	31.6
	Motor vehicle traffic crash	59	28.6
15-24	Motor vehicle traffic crash	440	56.1
	Other transport injury	142	18.1
25-44	Motor vehicle traffic crash	512	43.9
	Other transport injury	136	11.7
45-64	Motor vehicle traffic crash	275	39.2
	Falls	128	18.3
65+	Falls	430	46.2
	Motor vehicle traffic crash	165	17.7

Table 5. Primary payers for TBI identified in HDD, 2000

Primary payer	Frequency	%
Insurance company	801	27.5
Medicare	645	22.1
Commercial-Indemnity	432	14.8
Medicaid	305	10.5
Other	246	8.4
Self Pay	121	4.2
Workers Compensation	106	3.6
Commercial-Managed Care	74	2.5
BlueCross/Blue Shield	70	2.4
Commercial-Preferred Provider	55	1.9
Commercial-HMO	39	1.3
CHAMPUS	15	0.5
Other Federal programs	6	0.2
Total	2915	100

Table 6. Discharge disposition for TBI patients identified in HDD, 2000

Discharge disposition	Frequency	%
Routine discharge (home/self care)	2018	69.2
Inpatient at other type facility/outpatient at another institution	211	7.2
Skilled nursing facility	195	6.7
Expired	191	6.6
Home health	183	6.3
Intermediate care facility	45	1.5
Inpatient at other short-term hospital	40	1.4
Left/discontinued care against medical advice	26	0.9
Other	6	0.2
Total	2915	100.0

Table 7. Length of stay for TBI patients in HDD

N	2915
Mean	6.5
Standard Deviation	10.3
Median	3
Mode	1
Minimum	1
Maximum	218

Table 8. SCI by age group, 2000

Age	Non-Fatal (%)	Fatal (%)	Total (%)	% of SCI	Incidence rate
0-4	1 (50.0	1 (50.0)	2 (100.0)	1.4	0.8
5-14	3 (100.0)	0 (0.0)	3 (100.0)	2.0	0.5
15-24	31 (100.0)	0 (0.0)	31 (100.0)	21.1	5.4
25-44	37 (100.0)	0 (0.0)	37 (100.0)	25.2	3.1
45-64	39 (90.7)	4 (9.3)	43 (100.0)	29.3	4.6
65+	22 (71.0	9 (29.0)	31 (100.0)	21.1	6.1
Total	133 (90.5)	14 (9.5)	147 (100.0)	100.0	3.6

Table 9. SCI by gender, 2000

Sex	Non-Fatal (%)	Fatal (%)	Total (%)	% of SCI	Incidence Rate
Male	96 (90.6)	10 (9.4)	106 (100.0)	72.1	5.4
Female	37 (90.2)	4 (9.8)	41 (100.0)	27.9	2.0
Total	133 (90.5)	14 (9.5)	147 (100.0)	100.0	3.6

Fisher's exact test $P = 0.59$

Table 10. Major causes of SCI, 2000

Cause	Non-fatal (%)	Fatal (%)	Total (%)	% of SCI
Motor vehicle traffic crash	34 (82.9)	7 (17.1)	41 (100.0)	27.9
Unknown	38 (100.0)	0 (0.0)	38 (100.0)	25.9
Fall	22 (91.7)	2 (8.3)	24 (100.0)	16.3
Other transport injury	18 (100.0)	0 (0.0)	18 (100.0)	12.2
Other injury	12 (75.0)	4 (25.0)	16 (100.0)	10.9
Homicide / assault	8 (100.0)	0 (0.0)	8 (100.0)	5.4
Suicide / self-inflicted	1 (50.0)	1 (50.0)	2 (100.0)	1.4
Total	133 (90.5)	14 (9.5)	147 (100.0)	100.0

Table 11. Primary payers for SCI identified in HDD, 2000

Primary payer	Frequency	%
Insurance company	45	30.6
Medicare	30	20.4
Commercial-Indemnity	20	13.6
Medicaid	17	11.6
Other	11	7.5
Workers Comp.	6	4.1
Self Pay	5	3.4
Commercial-Managed Care	5	3.4
Commercial-Preferred Prov.	3	2.0
BlueCross/Blue Shield	2	1.4
CHAMPUS	2	1.4
Commercial-HMO	1	0.7
Total	147	100.0

Table 12. Discharge disposition for SCI patients identified in HDD, 2000

Discharge disposition	Frequency	%
Routine discharge (home/self care)	73	49.7
Inpatient at other type facility/outpatient at another institution	40	27.2
Expired	11	7.5
Skilled nursing facility	8	5.4
Home health	8	5.4
Inpatient at other short-term hospital	7	4.8
Total	147	100.0

Table 13. Length of stay for SCI patients in HDD

N	147
Mean	14.7
Standard Deviation	15.8
Median	9
Mode	4
Minimum	1
Maximum	114

Table 14. ABI by age group, 2000

Age	Non-Fatal (%)	Fatal (%)	Total (%)	% of ABI	Incidence rate
0-4	59 (50.9)	57 (49.1)	116 (100.0)	3.7	43.6
5-14	41 (70.7)	17 (29.3)	58 (100.0)	1.8	10.4
15-24	205 (73.5)	74 (26.5)	279 (100.0)	8.8	48.8
25-44	645 (72.5)	245 (27.5)	890 (100.0)	28.0	73.5
45-64	472 (61.3)	298 (38.7)	770 (100.0)	24.2	82.8
65+	522 (49.1)	542 (50.9)	1064 (100.0)	33.5	210.8
Total	1944 (61.2)	1233 (38.8)	3177 (100.0)	100.0	78.6

Test for trend, $P < 0.01$

Table 15. ABI by gender, 2000

Sex	Non-Fatal (%)	Fatal (%)	Total (%)	% of ABI	Incidence Rate
Male	907 (56.6)	696 (43.4)	1603 (100.0)	50.5	81.1
Female	1037 (65.9)	537 (34.1)	1574 (100.0)	49.5	76.2
Total	1944 (61.2)	1233 (38.8)	3177 (100.0)	100.0	78.6

$\chi^2 = 28.9$, $P < 0.01$

Table 16. Major causes of ABI, 2000

Cause	Non-fatal (%)	Fatal (%)	Total (%)	% of ABI
Injury (includes poisoning)	963 (75.8)	307 (24.2)	1270 (100.0)	40.0
Anoxia	152 (20.1)	603 (79.9)	755 (100.0)	23.8
Multiple causes	229 (62.7)	136 (37.3)	365 (100.0)	11.5
Infectious disease	35 (76.1)	11 (23.9)	46 (100.0)	1.4
Other	565 (76.3)	176 (23.8)	741 (100.0)	23.3
Total	1944 (61.2)	1233 (38.8)	3177 (100.0)	100.0

Table 17. Primary payers for ABI identified in HDD, 2000

Primary payer	Frequency	%
Medicare	856	37.3
Medicaid	364	15.9
Insurance company	263	11.5
Self Pay	207	9.0
Commercial-Indemnity	174	7.6
Other	116	5.1
Commercial-HMO	78	3.4
BlueCross/Blue Shield	67	2.9
Commercial-Managed Care	65	2.8
Commercial-Preferred Provider	62	2.7
Workers Compensation	20	0.9
Other Federal programs	12	0.5
CHAMPUS	11	0.5
Total	2295	100.0

Table 18. Discharge disposition for ABI patients identified in HDD, 2000

Discharge disposition	Frequency	%
Routine discharge (home/self care)	1334	58.1
Inpatient at other type facility/outpatient at another institution	245	10.7
Expired	236	10.3
Skilled nursing facility	139	6.1
Home health	132	5.8
Left/discontinued care against medical advice	67	2.9
Inpatient at other short-term hospital	62	2.7
No longer covered by Medicaid	33	1.4
Intermediate care facility	31	1.4
Other	16	0.7
Total	2295	100

Table 19. Length of stay for ABI patients in HDD

N	2295
Mean	7.5
Standard Deviation	16.7
Median	4.0
Mode	1
Minimum	1
Maximum	561

Table 20. Estimates of TBI, SCI, and ABI incidence in Kentucky

Year	TBI incidence estimate	SCI incidence estimate	ABI incidence estimate
1998	62.5 / 100,000	4.1 / 100,000	40.0 / 100,000
1999	76.7 / 100,000	3.2 / 100,000	55.9 / 100,000
2000	96 / 100,000	3.6 / 100,000	78.6 / 100,000

Appendix A—Map of Kentucky with county names