Second Kentucky Trauma Registry Report 1995-2002

Winter 2004

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Kentucky Trauma Registry 1995-2002

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Kentucky Trauma Registry 1995-2002

Forward

The Kentucky State Trauma Registry Report 1995-2002 is a publication of the Kentucky Injury Prevention and Research Center (KIPRC) at the University Of Kentucky College of Public Health. This report presents trauma data collected by the two Level I trauma centers in the state, a regional pediatric trauma center, and two other trauma centers. This information was gathered by each hospital and submitted to KIPRC, where it has been analyzed as a whole. In addition, aggregate Kentucky hospital data is presented in a special section containing information on the 155,000 cases seen in Kentucky hospitals from 2002-2003. Data on the 329 cases of Kentucky patients seen in Ohio from 1999-2002 was supplied by the Ohio Department of Public Safety, Division of Emergency Medical Services, Ohio Trauma Registry. SPSS software (SPSS Corporation: Chicago, Illinois) was used for data analyses.

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Published December 2004

Kentucky Trauma Registry 1995-2002

Acknowledgements

We would like to thank the following people whose contributions have made this report and the Kentucky trauma registry possible.

Kosair Children's Hospital

Mary E. Fallat, M.D., Chief of Trauma Services
Vicki Hardwick-Barnes, R.N., Trauma Nurse Coordinator
Patricia Thompson, Trauma Registrar

University of Kentucky Hospital

Paul A. Kearney, M.D., Chief, Trauma and Critical Care Section
Ginger Alford, R.N., B.S.N., C.C.R.N., Trauma Nurse Coordinator
Penne Allison, R.N., B.S.N., M.S.O.M., Director of Emergency and Trauma Services
Portia Loveless, B.A., Trauma Research Coordinator

University of Louisville Hospital

Glen Franklin, M.D., Chief of Trauma, Director of Injury Prevention and Outreach
Janet Wallace, R.N., Trauma Coordinator

Trover Regional Medical Center

Sharen Baker, R.N., (Former) Trauma Coordinator
Ray Simon, R.N., (Current) Trauma Coordinator

Taylor County Hospital

Eric Bentley, M.D., Chief Trauma Surgeon, Director of Trauma
Carol Wright, R.N., Trauma Coordinator
Kathy Brock, R.N., Nursing Service Administrator
Michelle Leach, R.N., Emergency Department Nurse

Ohio Department of Public Safety, Ohio Trauma Registry

Timothy Erskine, EMT-P, Data Program Manager
Sue Morris, EMT-P, Data Analyst

Kentucky Injury Prevention and Research Center

Glyn Caldwell, M.D., Former KIPRC Acting Director

All those who worked on the initial trauma registry report, published in summer 2002.

Kentucky Trauma Registry 1995-2002

We would like to acknowledge the generous donation of time, energy, staff support, and data access from the five hospitals contributing data in Kentucky: the University of Kentucky Hospital; the University of Louisville Hospital; Kosair Children's Hospital, a regional pediatric trauma center; and two self-designated facilities, Trover Regional Medical Center, and Taylor County Hospital in Campbellsville.

Under the leadership of the late Dr. Pamela Kidd, KIPRC advocated for the establishment of a statewide trauma registry that came to fruition in July 2001. Subsequent KIPRC acting directors Tim Struttmann, Glyn Caldwell, and Julia Costich have continued to support the project. Since 2002, partial funding has been provided under contract with the Kentucky Board of Emergency Medical Services.

We would also like to give special acknowledgement to the tireless efforts of Dr. Mary Fallat to find and provide support for all aspects of trauma research and care. Dr. Fallat has willingly written the necessary grants for federal funding and contributed to all aspects of the data collection process and analysis.

During 2001-2002, KIPRC was the recipient of a contract for trauma systems planning as part of the Trauma Supplement to the state EMSC Partnership Grant (HRSA/MCHB/EMSC), and some of the data for this report was originally analyzed in conjunction with that project.

Kentucky Trauma Registry 1995-2002

Introduction

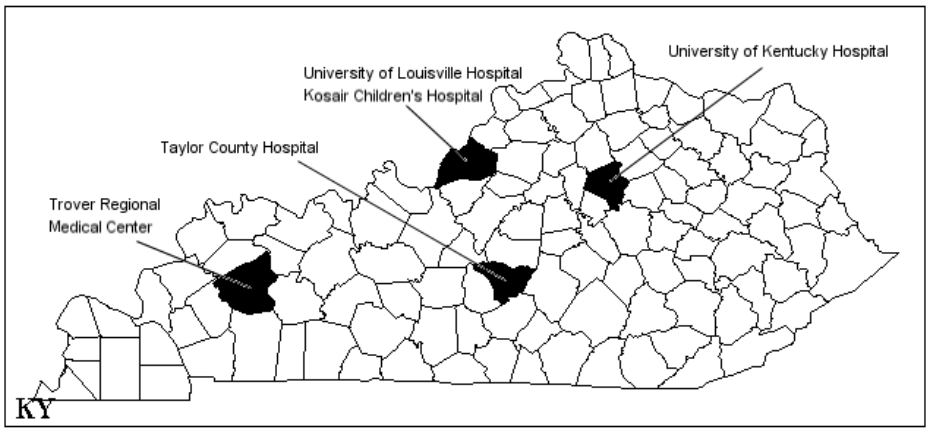
Kentucky law (KRS 311A.010) defines "trauma" as a single or multi-system life-threatening or limb-threatening injury requiring immediate medical or surgical intervention or treatment to prevent death or permanent disability.

The body of this report is the summary of 1995-2002 data for trauma cases seen only at the five Kentucky trauma centers, and Kentucky patients treated in Ohio from 1999-2002. Data from other hospitals is analyzed in the Appendix. The registry does not include any trauma data from other Kentucky hospitals unless individuals were transferred from another hospital to one of the 5 trauma centers. It is important to note that this data thus represents only the most serious survivable injuries and not all traumatic injuries in the state. Trauma cases leading to death at the scene of the event are obviously not part of the reported data. Trauma that is sustained in Kentucky but treated in Ohio hospitals is included, but other out-of-state facility data is not yet available. Border areas are thus under-represented in this report, and efforts are under way to acquire additional Tennessee data for future reports.

Kentucky's Regional Trauma Centers:

- Kosair Children's Hospital - Louisville
- University of Louisville Hospital - Louisville
- University of Kentucky Chandler Medical Center - Lexington
- Trover Regional Medical Center - Madisonville
- Taylor County Hospital - Campbellsville

Figure 1. Geographic location of hospitals in report.



Kentucky Trauma Registry 1995-2002

Trauma registry inclusion criteria are different for each hospital

Inclusion Criteria

Trauma cases reported by the five hospitals (and Ohio data) can involve any cause of injury, including motor vehicle crashes, bicycle incidents, falls, penetrating injuries, drowning, burns, child abuse, sports-related incidents, all-terrain vehicle injuries, motorcycle/moped crashes, assaults, crush incidents, and poisonings. E-coding is used to determine the cause of the injury, and there are 22 possible codes.

Criteria for inclusion in the Kentucky trauma registry database are set by the reporting hospitals and are different for each hospital.

The **University of Kentucky Hospital (UKH)** trauma registry includes all patients who meet trauma alert criteria if the injury is potentially life-threatening prior to and upon arrival, regardless of whether the patient requires admission. Any patient receiving blunt, penetrating, or burn injuries that require inpatient admission is also in the registry, as are patients with traumatic injuries who arrive at the emergency department but die before admission. UKH uses Traumabase software (Clinical Data Management: Denver, Colorado) for data collection.

The **University of Louisville Hospital (ULH)** trauma registry includes all traumatically injured patients admitted to the hospital for longer than 48 hours. All trauma patients who are transferred from another facility are also included, as are trauma-related deaths, including those patients who arrived at the hospital but died in the emergency department before admission. Because no patients admitted for observation or for less than two days are included, the Louisville registry has fewer cases than that of UKH, making comparisons between hospitals inappropriate. UL uses National TRACS software (American College of Surgeons: Chicago, Illinois) for data collection.

The trauma registry for **Taylor County Hospital in Campbellsville (CMB)** includes all trauma patients seen in the emergency department. This includes all trauma patients transferred to another facility, all trauma patients who die in the ED, or who die from injuries received in a motor vehicle crash while on their way to CMB. Data from Campbellsville has been collected since 1998. Campbellsville now uses National TRACS for data collection, but this report contains data using Cales and Associates trauma software (Cales and Associates, LLC: Louisville, KY).

Inclusion Criteria (continued)

Kosair Children's Hospital (KCH) trauma registry includes all patients admitted to the hospital (including 23-hour admissions) after being involved in a trauma incident, and admitted patients with any significant traumatic injury. Patients who would have been admitted to the hospital if they had not died due to their traumatic injuries prior to arriving are also included. As Kosair is a children's hospital, patients range in age from 0 to 18 years, and include transfers from other facilities. KCH used Cales and Associates software for data collection until 2001, when it began using National TRACS software.

Trover Regional Medical Center's (TR) trauma registry includes patients with any significant traumatic injury if they are admitted for 23-hour observation, as well as any trauma patient who is admitted to the hospital. Children presenting with falls greater than 5 feet and adults presenting with falls greater than 10 feet are also included. Data from Trover has only been collected since 2001. Trover uses National TRACS/ software for data collection.

The **Ohio Trauma Registry (OTR)** includes injured patients hospitalized for 48 hours or longer, or who die at any point during their treatment. Those who transfer in or out of a hospital, regardless of length of stay, are also included.

Hospital Inclusion Criteria

	Stays of less than 48 hours	Death before admission
UKH	included	included
ULH	not included	included
KCH	included	included
TR	included	not included
CMB	included	included
OHIO	not included	included

I. Demographics

Hospital Distribution

- Kosair Children's Hospital (KCH), a Louisville pediatric regional trauma center, accepts local and regional referral patients from birth through age 18 years.

- The University of Louisville Hospital (ULH) is an urban Level I trauma center that draws most of its patients from Louisville, the state's largest city, and the surrounding metropolitan area. ULH cares for patients of any age, but reports few pediatric cases due to its proximity to KCH.

- The University of Kentucky Hospital (UKH), a Level I center, serves its central Kentucky urban and rural neighbors but was also designed to serve rural eastern Kentucky.

- Trover Regional Medical Center (TR) is located in Madisonville and serves western Kentucky and the surrounding area.

- Taylor County Hospital (CMB) is located in South Central Kentucky, serving Campbellsville and contiguous counties.

Trauma patients from any other facility in the state that are referred to one of these hospitals are included in the trauma registry data regardless of their state of residence. Conversely, any Kentucky resident treated at an out-of-state trauma center in a state other than Ohio is not included.

From 1999-2002 (4 years) there were 329 cases of residents from Kentucky being injured in Kentucky and treated in Ohio hospitals. If we extrapolate to 8 years, we can estimate that a total of about 660 Kentucky trauma patients were cared for in Ohio facilities.

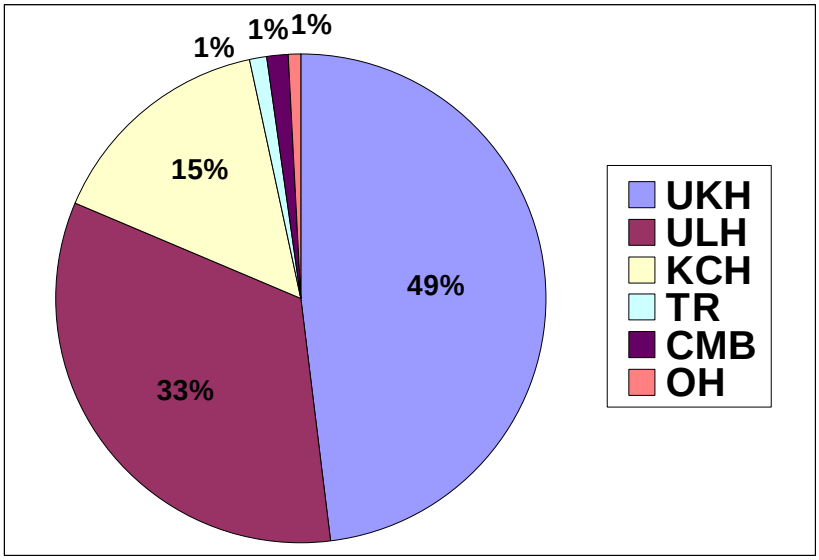
In order to estimate the number of Kentucky trauma patients treated in other states, we can hypothesize that their number is approximately the same as the number of non-Kentucky residents who receive trauma care in Kentucky. The total number of out-of-state residents treated in Kentucky facilities is 4,604, or 13.4% of the 34,398 cases in the 8-year trauma registry database. If we subtract 660 from this total to account for the Ohio patients whose data is now available, we can estimate that the trauma registry is missing data on about 11.5% of Kentucky trauma victims because of their treatment in out-of-state facilities. It appears that the majority of these patients are hospitalized in Tennessee. Efforts are being made to obtain this data.

Kentucky Trauma Registry 1995-2002

Table 1. Trauma registry patient distribution by hospital, 1995-2002.

	KCH	ULH	UKH	TR	CMB	OH	total
# cases	5621	12284	17647	342	533	329	36756
%	15	33	48	1	1	1	100%

Figure 2. Patient composition of the trauma registry, 1995-2002.

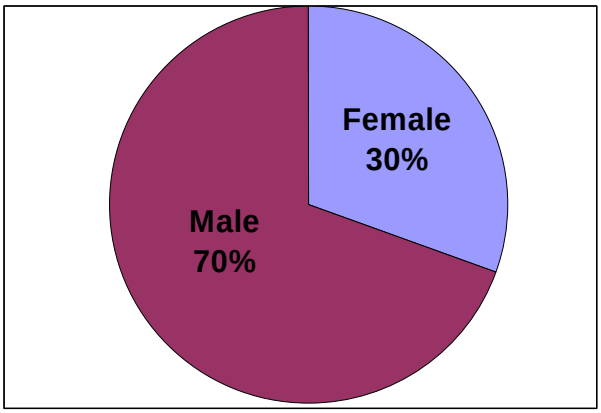


Almost half (48%) of all cases are from UKH

Gender

Data collection over the past eight years has indicated a consistent proportion of patients by sex that is approximately the same in all hospitals. The registry currently contains 36,756 patients of whom 25,543 (69.5%) are male and 11,213 (30.5%) female. In comparison, Kentucky's 2000 census population indicates only 48.9% of the state is male. This is consistent with national data reporting that males are injured at much higher rates and more frequently than females.

Figure 3. Gender composition of the trauma registry, 1995-2002.



Almost 70% of KY trauma cases are male, while only 49% of the KY population is male

Age Distribution

Table 2. Kentucky trauma registry age distribution, 1995-2002.

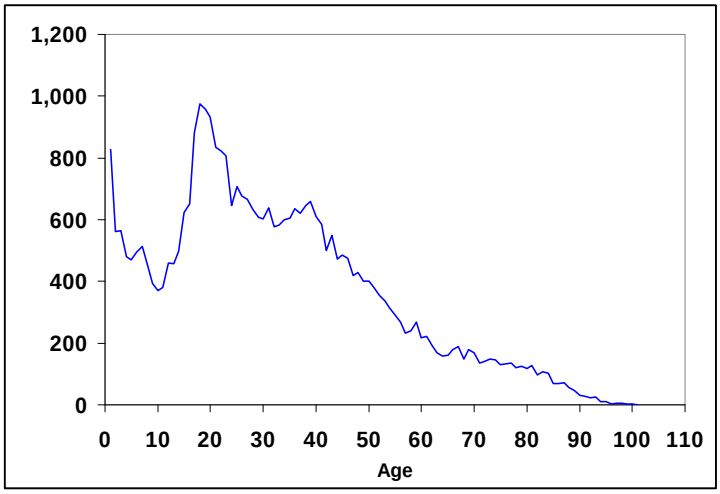
Age in Yrs	KCH		ULH		UKH		TR		CMB		OH		TOTAL	
	cases	%	cases	%	cases	%	cases	%	cases	%	cases	%	cases	%
missing	4	0.1	14	0.1	3	0.0	0	0.0	1	0.2	1	0.3	23	0.1
< 1 yr.	542	9.6	80	0.7	194	1.1	1	0.3	3	0.6	7	2.1	827	2.2
1-4	1371	24.4	2	0.0	665	3.8	5	1.5	14	2.6	16	4.9	2073	5.6
5-9	1450	25.8	2	0.0	713	4.0	20	5.8	19	3.6	28	8.5	2232	6.1
10-14	1471	26.2	64	0.5	785	4.4	23	6.7	27	5.1	48	14.6	2418	6.6
15-17	781	13.9	616	5.0	1027	5.8	28	8.2	30	5.6	26	7.9	2508	6.8
18-25	2	0.0	2654	21.6	3550	20.1	55	16.1	92	17.3	31	9.4	6384	17.4
26-35	0	0.0	2543	20.7	3438	19.5	62	18.1	73	13.7	36	10.9	6152	16.7
36-45	0	0.0	2410	19.6	3008	17.0	53	15.5	77	14.4	53	16.1	5601	15.2
46-55	0	0.0	1661	13.5	1811	10.3	35	10.2	58	10.9	31	9.4	3596	9.8
56-65	0	0.0	879	7.2	1068	6.1	26	7.6	46	8.6	20	6.1	2039	5.5
66-75	0	0.0	685	5.6	763	4.3	14	4.1	34	6.4	17	5.2	1513	4.1
76-85	0	0.0	519	4.2	485	2.7	16	4.7	39	7.3	9	2.7	1068	2.9
86-95	0	0.0	147	1.2	133	0.8	4	1.2	17	3.2	6	1.8	307	0.8
96-120	0	0.0	8	0.1	4	0.0	0	0.0	3	0.6	0	0.0	15	0.0
TOTAL	5621	100.0	12284	100.0	17647	100.0	342	100.0	533	100.0	329	100.0	**36756**	100

The National Trauma Data Bank (NTDB) provides the best representation of nationwide data, comprising over 700,000 trauma cases from 268 hospitals nationwide. Throughout this report, NTDB 1997-2002 data is compared to Kentucky trauma registry data from 1995-2002. NTDB figures indicate that children aged 0-14 years made up 10.92% of all cases. Kentucky data for the same age group made up 20.54% of all cases. This difference appears to indicate that Kentucky children are injured at much higher than national rates, but further study is needed to determine the effect of variation in inclusion criteria, particularly between ULH and KCH. At the opposite end of the age spectrum, patients in KY aged 56+ make up 13.44% of the registry, whereas the national average according to the NTDB is higher at 23.59%. Again, it is possible that this difference is related to the fact that ULH does not include in their registry patients admitted for less than 48 hours. Older patients may be admitted more frequently for shorter periods of time.

Kentucky Trauma Registry 1995-2002

A peak of 976 cases is reached at age 17.

Figure 4. Number of patients by age, 1995-2002.

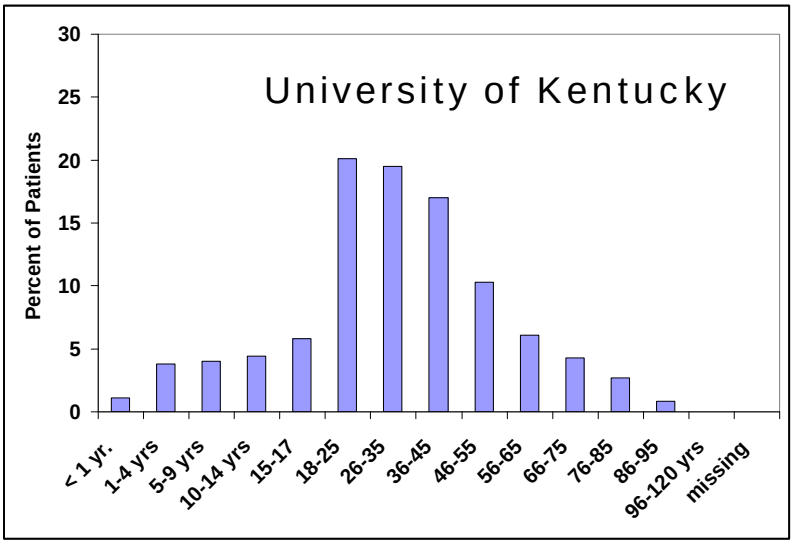


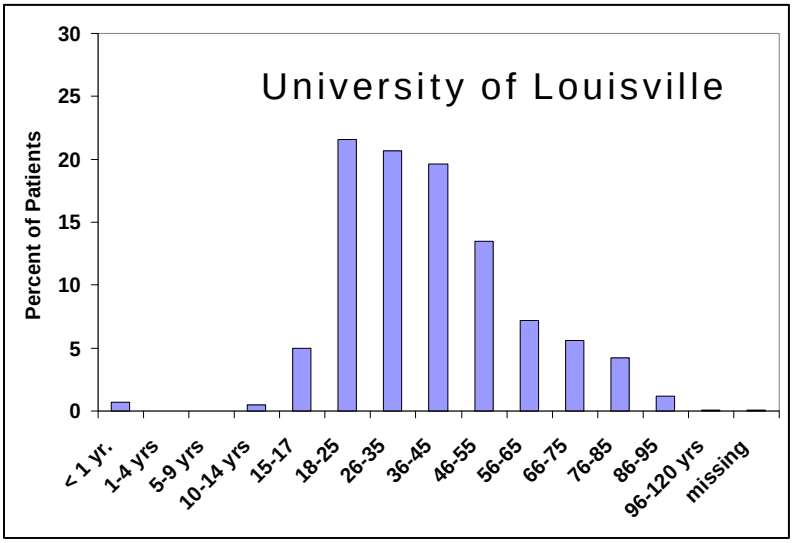
We see a peak in the trauma registry age distribution at birth, followed by a relatively steady decline until age 10, at which point there is an increase in cases that reaches a peak at age 17, with 976 cases. The rest of the graph indicates a slow decline until the end, with another slight peak at age 38. The low representation of older patients in the trauma registry data may reflect a higher rate of death at the scene of the traumatic incident as well as their lower rates of participation in activities that would put them at risk. Data in figures 4 and 5 include patients injured in Kentucky and treated in Ohio.

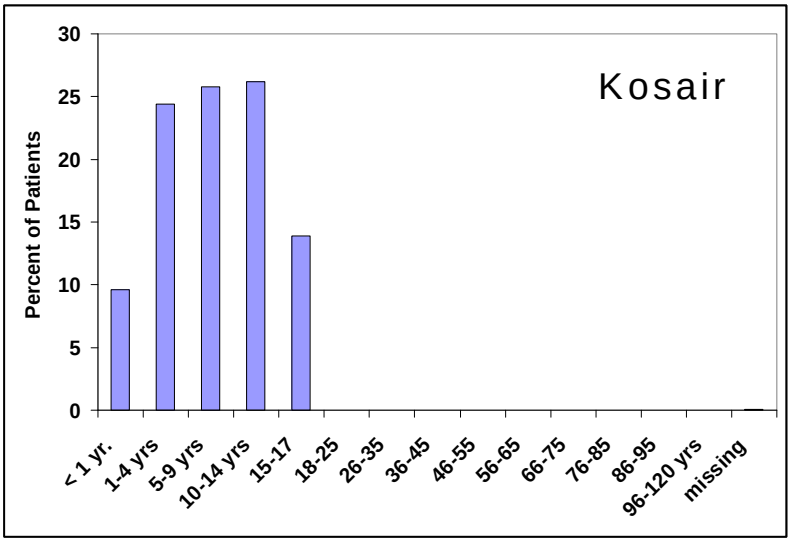
Figure 5. Number of patients by age and gender, 1995-2002.

While both genders follow a distribution similar to figure 4, there are clearly more male patients at all but the oldest ages. The Kentucky trauma age distribution is consistent with NTDB data: 65.5% of nationwide trauma cases are male, and a higher number of male patients are found at all ages until age 70. Kentucky's male and female cases converge at around age 70, reflecting the disproportionate number of women in the oldest age groups.

Figure 6. Trauma registry age distribution by hospital, 1995-2002.

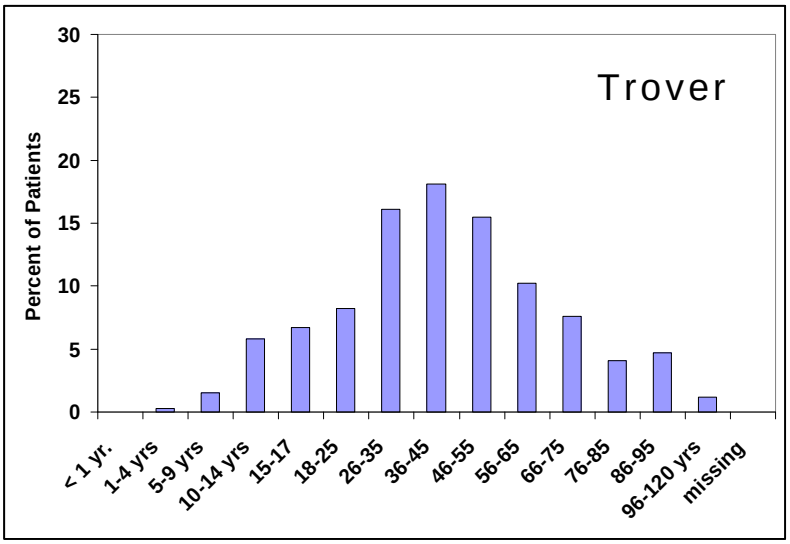


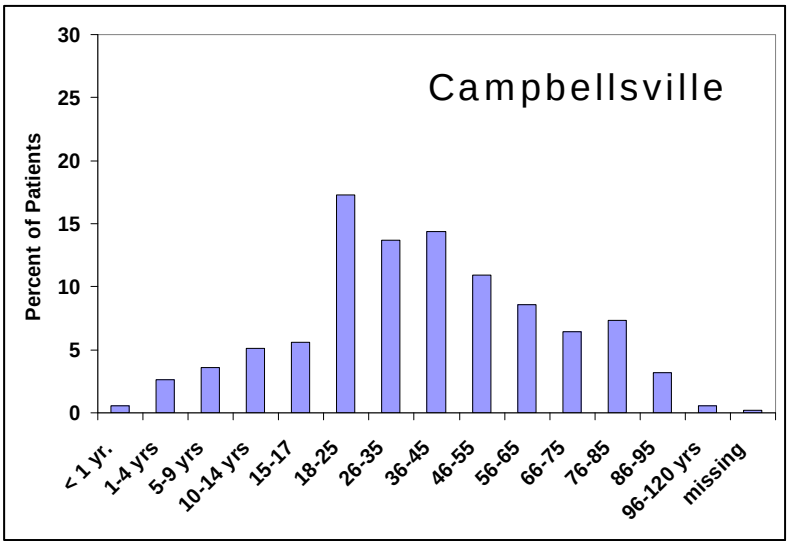


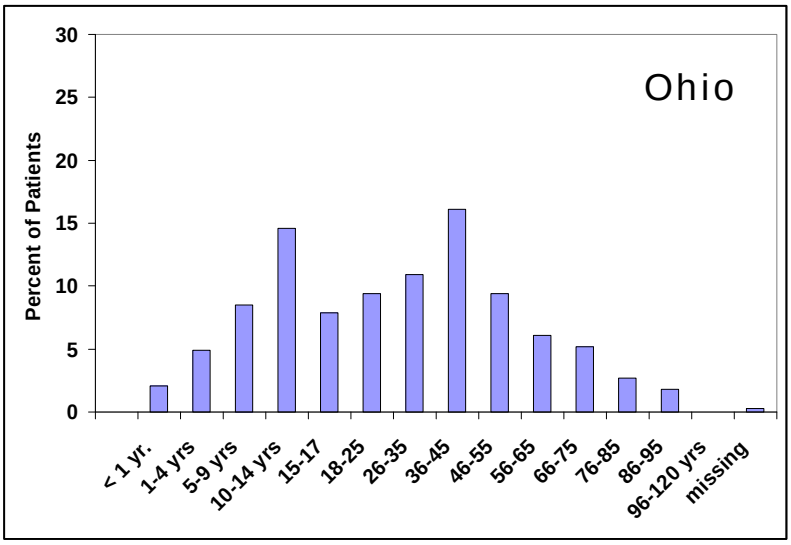


Kentucky Trauma Registry 1995-2002

Figure 6 cont. Trauma registry age distributions by hospital, 1995-2002.







The age distribution follows a bell curve in each graph, for the most part. If we combined KCH and ULH, data would follow a bell curve as well.

Patient Residence

Table 3. Patient residence (percent), 1995-2002.

	KCH	ULH	UKH	TR	CMB	OH	Total
Kentucky	81.9	77.8	82.3	92.4	96.2	84.2	81.1
Indiana	15.8	17.9	0.5	0.6	0.8	0.9	8.7
Michigan	0.1	0.3	0.4	0.3	0.2	0.6	0.3
Ohio	0.4	0.7	1.8	0.0	0.0	10.9	1.2
Tennessee	0.4	0.5	0.4	0.0	0.0	0.6	0.4
Missing	0.3	0.8	12.6	0.0	1.7	1.8	6.4
Other	0.1	2.0	2.0	0.0	1.1	0.9	1.8

A large majority of the patients treated in Kentucky trauma centers reside in Kentucky. Residents of Indiana comprised the second largest number, with 15.8% of Kosair's patients, and 17.9% of Louisville's patients (some Louisville suburbs are located in Indiana). Ohio residents comprised 10.9% of patients injured in Kentucky but treated in Ohio. Percentage totals here may not equal 100% due to rounding.

Table 4. Leading counties of residence, 1995-2002.

	# Cases	%
Jefferson	8188	27.7%
Fayette	2589	8.8%
Hardin	772	2.6%
Madison	640	2.2%
Nelson	626	2.1%
Bullitt	579	2.0%
Laurel	455	1.5%
Taylor	452	1.5%
Pulaski	407	1.4%
Clay	397	1.3%
Jessamine	394	1.3%
Clark	387	1.3%
other KY counties	13710	46%
no info	196	0.7%

Only 0.7% of the trauma registry lacks information on county of residence. This data excludes Kentucky residents injured in the state but seen in hospitals outside of the state (with the exception of Ohio, which is included). Border counties are underrepresented in the trauma registry with the exception of the counties in suburban Cincinnati. The leading counties of trauma patient residence are those with the highest populations, near the trauma centers.

Race

Table 5. Race (percent) by hospital.

	1995	1996	1997	1998	1999	2000	2001	2002	Total
KCH									
Caucasian	76.6	81.4	78.2	75.6	80.5	78.0	78.0	79.4	78.5
African-American	20.8	17.9	20.5	22.1	17.0	19.1	19.0	17.3	19.2
Hispanic							1.5	1.7	0.5
Other	2.6	0.7	1.3	2.2	2.3	2.8	1.3	1.5	1.8
Missing					0.2		0.1		0.0
Total	100	100	100	100	100	100	100	100	100.0
ULH									
Caucasian	80.3	80.2	80.4	83.9	81.7	82.0	82.2	83.7	81.8
African-American	17.8	17.7	16.8	13.7	15.0	13.9	12.8	12.0	14.9
Hispanic	1.2	1.2	2.0	0.7	1.0	1.5	1.1	1.3	1.2
Other	0.7	0.4	0.7	1.7	2.3	2.5	3.9	3.0	2.0
Missing	0.0	0.4	0.2			0.1			0.1
Total	100	100	100	100	100	100	100	100	100.0
UKH									
Caucasian	93.2	91.4	91.8	92.7	92.8	92.6	92.8	93.1	92.6
African-American	5.0	6.2	6.5	4.5	4.4	4.2	3.9	3.5	4.8
Hispanic	0.9	1.9	1.4	2.5	2.6	3.0	3.1	3.3	2.3
Other	0.8	0.5	0.2	0.2	0.1	0.1	0.2	0.1	0.3
Missing									0.0
Total	100	100	100	100	100	100	100	100	99.9
TR									
Caucasian							5.4	17.4	11.4
African-American							0.8	4.7	2.8
Hispanic							0.8	0.5	0.7
Other							0.8		0.8
Missing							92.2	77.5	84.9
Total							100	100	100.5
CMB									
Caucasian				95.7	93.8	94.0	91.0	47.9	81.4
African-American				2.2	5.0	3.6		4.2	3.1
Hispanic									
Other				1.4			7.7	47.9	14.5
Missing				0.7	1.3	2.4	1.3		1.0
Total				100	100	100	100	100	100.0
OH									
Caucasian					88.5	90.4	90.0	91.9	90.6
African-American					3.3	5.5	1.7	5.9	4.6
Hispanic							1.7	1.5	0.9
Other					6.6	4.1	6.7	0.7	3.6
Missing					1.6				0.3
Total					100	100	100	100	100.0

Table 6. Race (percent) for all reporting facilities

Year	Caucasian	African-American	Hispanic	Other	No info	Total
1995	86	12	0.8	1.1	0	100
1996	86	12.1	1.3	0.5	0.1	100
1997	86.1	12	1.4	0.5	0	100
1998	87.8	9.7	1.5	1	0	100
1999	87.4	9.7	1.7	1.2	0	100
2000	86.5	10	1.9	1.5	0	100
2001	84.6	9	2	1.8	2.5	100
2002	83.2	8.7	2.1	2.6	3.1	100
Average	85.9	10.3	1.6	1.3	0.8	100

The combined data for all hospitals and all years shows that a large majority (85.9%) of all patients were Caucasian, 10.3% of all patients were African-American, and 1.6% of patients were Hispanic. The average percentage of Hispanic patients in all trauma centers is 1.6%, but UKH sees a larger percentage at 2.3%. Kosair and ULH see a much higher percentage of African-American trauma patients in their hospitals (19.2% and 14.9%) than does UKH (4.8%), reflecting the much higher proportion of African-Americans in the greater Louisville population.

The Caucasian proportion of trauma cases has remained relatively stable across the eight years of data, and the African-American proportion has steadily decreased. We can see this trend most clearly at ULH, where the proportion of African-American trauma patients was at a high of 17.8% in 1995, and a low of 12% in 2002. While the numbers are not large, an increase in the Hispanic population can be seen across the eight years of data, a trend that should be recognized for translation and other resource planning. Totals may not add to 100% in tables 5 and 6 due to rounding.

The 2000 Census reports that 90% of all Kentuckians identify themselves as Caucasian, somewhat higher than the trauma registry average of 85.9%. Conversely, the proportion of African-Americans in the trauma registry, 10.3%, is substantially higher than the 7.3% African-Americans in the census data. Census data on the Hispanic population, widely judged to be a significant undercount, indicates that they represent 1.4% of the state's population, close to the trauma registry average of 1.6%. A disproportionate burden of trauma on racial and ethnic minorities appears in Kentucky as well as nationally. For this reason, additional information is included on the following page.

Race

African-American Data Summary

A total of 3,796 African-American patients received care at the five trauma hospitals and in Ohio. Their mean age was 26.5 years with a median age of 23 and a mode of children under a year old. 36.2% of African-American trauma registry patients were under the age of 18. Males comprised 70.8% of patients entered into the registry. Leading counties of residence for African-Americans trauma patients were Jefferson (2474 / (3048) = 81.1%) and Fayette (504 / (3048) = 16.5%). The most common residential zip codes were 40211 (n=385, 12.6%), 40210 (n=272, 8.9%), 40203 (n=222, 7.3%), and 40212 (n=209, 6.9%) in the Louisville metropolitan area, and 40508 (n=215, 7.1%) in the Lexington metropolitan area. 748 cases (19.7%) were missing data on zip code, and are not used for these calculations.

The leading causes of injury for African-American trauma registry patients were the same for all trauma hospitals: motor vehicle crashes (42.8%), assault/homicide (26.7%), and falls (10.6%). The leading cause of injury for African-Americans (and all races) was motor vehicle crashes. 42.8% of cases at UL, 42.3% of cases at UK, and 42.9% of cases at Kosair were related to MVC. Motor vehicle occupancy was the leading cause of injury within MVC at all trauma hospitals. Homicides accounted for 34.8% of UL cases, 31.7% of UK cases, and 9.5% of cases at Kosair. Falls accounted for 5% of UL cases, 10.6% of UK cases and 20.1% of cases at Kosair.

The leading causes of injury for Hispanic and African American patients were MVC, homicide, and falls.

Hispanic Data Summary

A total of 593 Hispanic trauma registry patients received care at the five trauma hospitals and in Ohio. Their mean age was 28.3 years with a median age of 26 and mode of 24. 11.3% of Hispanic trauma registry patients were under the age of 18. Males comprised 90.2% of patients entered into the registry. The leading counties of residence for Hispanic trauma patients were Fayette (35.8%), and Jefferson (20.2%). The most common zip codes were 40508 (n=44), 40504 (n=43), 40511 (n=30) and 40505 (n=27). 62 cases (10.5%) were missing data on zip code, and are not used for these calculations.

The leading causes of injury for Hispanics were motor vehicle crashes (47.4%), followed by assault/homicide (23.6%) and falls (13.8%). 53.3% of cases at UL, 45.1% of cases at UK, and 50% of cases at Kosair were related to MVC. Homicides accounted for 17.8% of UL cases, 26.3% of UK cases, and 15.4% of Hispanic cases at Kosair. Falls accounted for 13.2% of UL cases, 13.9% of UK cases and 19.2% of cases at Kosair.

Monthly Distribution

More traumatic injury occurs in the warmer months of May through October than in the rest of the year. July (10.2%), August (9.8%), and September (9.4%) saw the highest percentages of trauma registry patients. Monthly trends over the eight year period indicate similar patterns, so only the aggregate is shown here. Implications of this seasonal trend include modifying staffing patterns to accommodate the surge in patients, and targeting injury prevention programs during the summer months.

There is a seasonal effect on the number of trauma cases, with a peak in warm summer months.

Figure 7. Distribution of patients (percent) by month, 1995-2002.

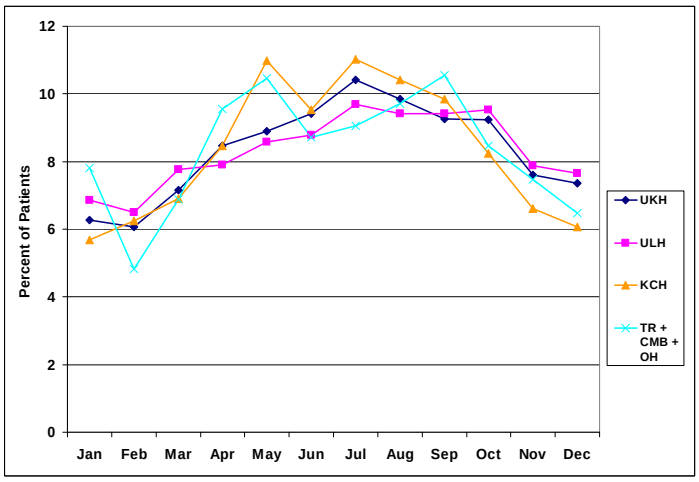
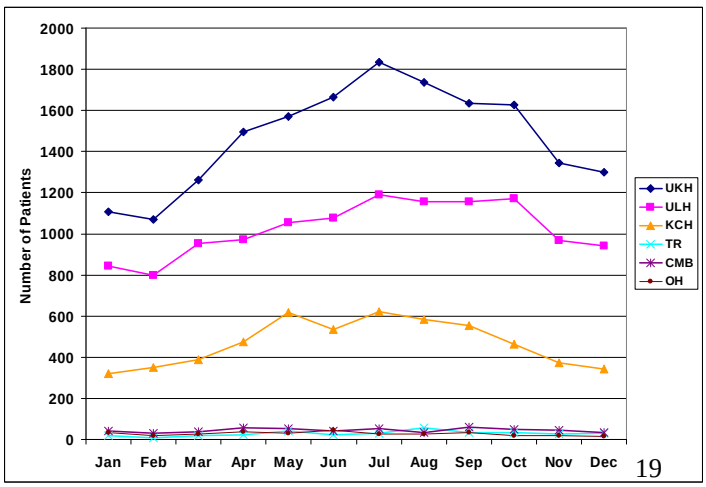


Figure 7 shows the monthly averages (percent) at each hospital over the eight year period. Seasonal trends appear consistent with the exceptions of TR, CMB, and OH due to the small number of trauma patients included in the registry (Trover, Campbellsville and Ohio data sets were therefore combined). Figure 8 shows the same monthly averages at each hospital, this time using the numbers of patients rather than percent of patients seen each month.

UK sees the most patients per month, followed by ULH and KCH.

Figure 8. Distribution of patients (number) by month, 1995-2002.



II. Cause of Injuries

E-codes are used to describe the external cause of injury. They can be used to inform prevention efforts, as prevention strategies might differ for a broken arm caused by abuse, a playground fall, or a motor vehicle accident. Listed in Table 7 are all e-codes included in the trauma registry. All motor vehicle related causes are shaded in grey. Only 18 cases out of 36,427 were missing an e-code. Because poisoning cases are not typically admitted to trauma units, they are not reported systematically in the trauma registry data.

Table 7. Cause of injury, 1995-2002.

	UKH		ULH		KCH		TR		CMB		OH		All Hospitals	
E-Code Group	#	%	#	%	#	%	#	%	#	%	#	%	#	%
Missing Code	0	0.0	0	0.0	8	0.1	0	0.0	10	1.9	0	0.0	18	0.05
Cut/Pierce	339	1.9	53	0.4	69	1.2	1	0.3	9	1.7	8	2.4	479	1.30
Drowning/Submersion	58	0.3	4	0.0	80	1.4	0	0.0	2	0.4	0	0.0	144	0.39
Fall	2351	13.3	1148	9.3	1452	25.8	34	9.9	156	29.3	71	21.6	5212	14.18
Fire/Flame	452	2.6	411	3.3	180	3.2	4	1.2	2	0.4	4	1.2	1053	2.86
Burn	236	1.3	134	1.1	298	5.3	4	1.2	2	0.4	1	0.3	675	1.84
Firearm	295	1.7	216	1.8	61	1.1	6	1.8	12	2.3	2	0.6	592	1.61
Machinery	317	1.8	152	1.2	34	0.6	4	1.2	11	2.1	6	1.8	524	1.43
MV Occupant	3786	21.5	5833	47.5	1213	21.6	155	45.3	177	33.2	125	38.0	11289	30.71
Motorcycle	298	1.7	526	4.3	63	1.1	17	5.0	14	2.6	8	2.4	926	2.52
MV-Other	14	0.1	28	0.2	14	0.2	2	0.6	2	0.4	0	0.0	60	0.16
MV-Unspecified	33	0.2	161	1.3	39	0.7	5	1.5	6	1.1	2	0.6	246	0.67
Pedal Cyclist	273	1.5	93	0.8	430	7.6	8	2.3	9	1.7	14	4.3	827	2.25
Pedestrian	673	3.8	549	4.5	421	7.5	10	2.9	6	1.1	14	4.3	1673	4.55
ATV's	415	2.4	110	0.9	87	1.5	13	3.8	20	3.8	17	5.2	662	1.80
Transport-Other	4622	26.2	532	4.3	133	2.4	26	7.6	11	2.1	9	2.7	5333	14.51
Nature/Environment	105	0.6	39	0.3	39	0.7	11	3.2	5	0.9	0	0.0	199	0.54
Bites/Stings	104	0.6	3	0.0	80	1.4	1	0.3	4	0.8	1	0.3	193	0.53
Overexertion	2	0.0	2	0.0	49	0.9	0	0.0	0	0.0	0	0.0	53	0.14
Poisoning	3	0.0	7	0.1	12	0.2	0	0.0	0	0.0	3	0.9	25	0.07
Struck	668	3.8	173	1.4	329	5.9	12	3.5	24	4.5	9	2.7	1215	3.31
Suffocation	4	0.0	1	0.0	12	0.2	0	0.0	0	0.0	0	0.0	17	0.05
Other Unintentional	453	2.6	237	1.9	184	3.3	6	1.8	9	1.7	6	1.8	895	2.43
Adverse Medical	0	0.0	20	0.2	1	0.0	0	0.0	0	0.0	0	0.0	21	0.06
Adverse Drugs	0	0.0	8	0.1	1	0.0	0	0.0	0	0.0	0	0.0	9	0.02
Suicide	461	2.6	381	3.1	11	0.2	7	2.0	11	2.1	8	2.4	879	2.39
Homicide	1611	9.1	1311	10.7	268	4.8	14	4.1	28	5.3	17	5.2	3249	8.84
Undetermined	56	0.3	118	1.0	41	0.7	0	0.0	3	0.6	3	0.9	221	0.60
Unintentional-Missing	8	0.0	14	0.1	11	0.2	2	0.6	0	0.0	0	0.0	35	0.10
Legal Intervention	10	0.1	20	0.2	1	0.0	0	0.0	0	0.0	1	0.3	32	0.09
Total	17647	100	12284	100	5621	100	342	100	533	100	329	100	36756	100

Motor vehicle-related events accounted for a majority (57.2%) of trauma patients at the five hospitals. The top five causes of injury for all trauma patients were motor vehicle incidents (57%), falls (14%), homicides (9%), struck by/against (3%), and fire/flame (3%).

Table 8. Leading causes of injury by hospital, 1995-2002.

KCH	
Motor vehicle	42.7%
Falls	25.8%
Struck	5.9%
Burns	5.3%
Homicide	4.8%
total	84.5%

ULH	
Motor vehicle	63.8%
Homicide	10.7%
Fall	9.3%
Fire	3.4%
Suicide	3.1%
total	90.3%

UKH	
Motor vehicle	57.3%
Falls	13.3%
Homicide	9.1%
Struck	3.8%
Suicide	2.6%
Fire	2.6%
total	88.7%

TR	
Motor vehicle	69.0%
Falls	9.9%
Homicide	4.1%
Struck	3.5%
total	86.5%

CMB	
Motor vehicle	45.9%
Falls	29.3%
Homicide	5.3%
Struck	4.5%
total	85.0%

OH	
Motor vehicle	57.4%
Falls	21.6%
Homicide	5.2%
Struck	2.7%
Suicide	2.4%
total	89.3%

When the leading causes of injury are broken down by hospital, the picture is similar to the overall results. Motor vehicle crashes, falls, and homicides are the top three causes of injury at five of the six hospitals. At Kosair Children's Hospital, homicide ranks fifth behind being struck and burns. The data for each year does not vary significantly, so only the cumulative numbers are shown here. The top five or six leading causes of injury at each hospital are not only similar, but account for a large majority (84.5 - 90.3%) of trauma cases.

With 22 possible coding options when all motor vehicle injuries are combined, the fact that the six leading causes account for such a large proportion of the data indicates that injury prevention strategies targeting only these six causes would significantly reduce traumatic injuries in Kentucky.

The 2003 National Trauma Data Bank lists motor vehicle crashes as the leading cause of injury (50.44%). This is slightly lower than Kentucky's rate (57.2%). Falls come in second for both as well, with the NTDB registry listing 30.4% falls, and Kentucky listing 14.1% of cases as falls. The lower Kentucky percentage for falls may be attributable to the exclusion of stays under 48 hours from the UL data. The Kosair data points to the high incidence of serious falls among children.

III. Pre-Hospital Transport

Pre-hospital transport data continues to challenge analysts because so many elements are missing or vary across hospitals.

Table 9. Hours to arrival (percent), 1995-2002.

	UKH	ULH	KCH	TR	CMB	Total
Up to 1	18.6	29.3	8.1	49.1	34.9	21.1
1-2	27.5	7.6	7.6	35.1	5.3	17.5
3-5	31.0	4.6	7.6	3.2	0.8	17.8
6-12	15.1	2.0	3.4	2.3	0.4	8.6
13-24	1.2	0.2	0.4	2.6	0.9	0.8
24+	3.8	0.6	1.7	1.2	1.3	2.3
No info	2.7	55.7	71.3	6.4	56.5	32.0

A greater percentage of ULH (29.3%) patients arrive within one hour of injury than KCH (8.1%) or UKH (18.6%). This may be due to the fact that more of the Louisville hospital's patients reside in Jefferson County, whereas UKH receives many patients from more distant parts of the state. Information on hours to arrival does not take into account whether patients were transferred; it includes all patients in each hospital's registry. For this reason, TR and CMB have much higher rates of patients (49.1% and 34.9%) arriving within one hour of injury, as they are lower level trauma centers and would not receive many transfer patients from other hospitals. Transport data for Kentucky injuries treated in Ohio was not available. For 32% of patients, including the majority (55.7%) of UL patients, there was no information on either injury time or arrival time, making it impossible to calculate hours to arrival.

Table 10. Percent of deaths by arrival time, 1995-2002.

Hours to arrival	UKH	ULH	KCH	TR	CMB	Combined
Up to 1	10.1	11.8	5	2.4	7.6	10.4
1-2	10.6	11.4	4.6	6.7	3.6	10.2
3-5	3.7	4.4	1.1		25	3.6
6-12	1.2	4.8	3.1			1.7
13-24	1.4	16.7				2.6
24+	2.8	10				3
No info	7.2	9.8	2.6	4.5	1.4	7

Discrepancies in case inclusion criteria again give rise to data that cannot be compared across facilities. Percentages may be interpreted as follows: For UK, 10.1% of all trauma patients who arrived within one hour of injury died. ULH may have higher percentages of death because trauma patients admitted for less than 48 hours (i.e., less severe cases) are excluded from the registry. TR and CMB percentages may be misleading because of the small number of patients reported. Death data is not weighted for Injury Severity Scores (ISS).

V. Severity

Glasgow Coma Score

The Glasgow Coma Score (GCS) is a numerical system used to quantify significant neurotrauma. GCS ranges from 3 to 15, with 3 being the most severe classification and 15 the least severe. Scores in three categories, best eye response, best verbal response, and best motor response, are added to compile this value (Teasdale & Jennett, 1974).

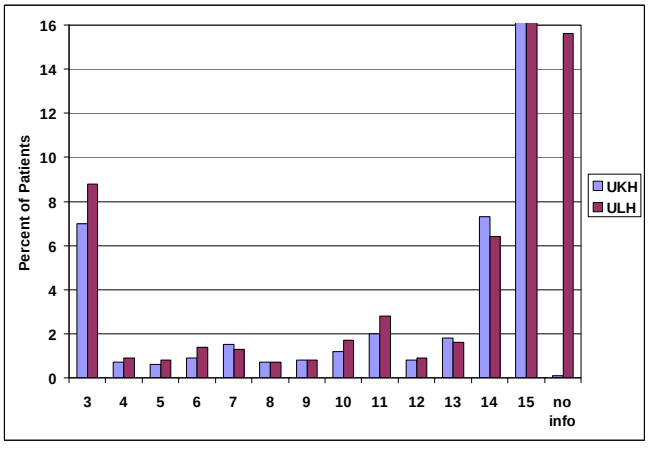
Table 11. Glasgow Coma Score Scale

Verbal Output		Eye Opening		Motor Response	
Score	Finding	Score	Finding	Score	Finding
				6	patient follows commands
5	normal, fluent, appropriate speech			5	patient locates pain on their body
4	normal, affluent, appropriate speech	4	eyes open without stimulation	4	patient pulls away from pain
3	mumbling, occasional word recognizable	3	eye opening to loud noise	3	patient flexor postures
2	vocalizations but no verbalizations	2	eye opening pain only	2	patient extensor postures
1	no vocalization or verbalization	1	no eye opening	1	no motor response

Nearly 25% of adult UKH patients and 32% of adult ULH patients had a GCS below 15.

Excluding a GCS of 15, the mean GCS for UKH and ULH patients over 18 was 8.65 with a standard deviation of 4.53. KCH reported limited data and did not yield adequate numbers for comparison across hospitals (81% missing cases). Because KCH sees only children, and was excluded, children were excluded from the UKH and ULH data as well. TR, CMB, and OH data was also excluded (due to the small number of cases), but would not have changed the mean.

Figure 9. Distribution of GCS, UKH and ULH 1995-2002.



The scale has been reduced to adequately view the lower GCS numbers. 74.7% of UK cases and 56.4% of UL cases had GCS scores of 15.

Injury Severity Score

The Injury Severity Score (ISS) is an anatomical scoring system that provides numerical values for patients with multiple injuries. Each injury is assigned an Abbreviated Injury Scale (AIS) score according to one of six body regions: head, face, chest, abdomen, extremities (including pelvis), and external. The scores of the top three injured regions are squared and summed to produce the ISS, with values ranging from 0 to 75. An AIS of 6 is an unsurvivable injury and is automatically assigned an ISS of 75 (Baker et al., 1974). There are limitations to the ISS, including the difficulty of comparing multiple trauma with life-threatening injury of one isolated system. The National Trauma Data Bank (NTDB) categorizes ISS from 1-9 as minor, 10-15 as moderate, 16-24 as severe and 24+ as very severe.

The mean ISS for the five hospitals (excluding missing cases) was 11.73 (moderate)

Table 12. Distribution of ISS by hospital, 1995-2002.

ISS	KCH	UKH	ULH	TR	CMB
0-4	52.1	26.4	11.6	20.8	53.5
5-9	26	26.8	18.1	20.2	31.3
10-14	7	15.5	14.9	8.5	6
15-19	4.9	9.7	9.8	3.5	3.6
20-24	1	5.5	5.9	1.2	1.3
25-29	2	8.1	6.5	2	2.6
30-34	0.6	2.6	1.8	0.9	0.6
35-39	0.3	1.5	0.9	0.6	0
40-75	0.2	2.5	0.9	0	0
no info	5.9	1.5	29.8	42.4	1.1
total	100	100.1	100.2	100.1	100

ISS scores were missing in 4416 cases (12.1%), a majority of which were from ULH, making comparisons among the hospitals difficult. ISS scores for Kentucky patients treated in Ohio were not available.

The average length of stay (LOS) increased with each ISS

Table 13. Comparison of NTDB 2003 data to KY trauma data.

ISS	NTDB%	KY%	NTDB LOS	KY LOS
Minor	63.6	49.4	3.7 days	4.1 days
Moderate	11.6	13.8	6.2 days	6.7 days
Severe	11.1	13.7	9.3 days	10.4 days
Very Severe	9.1	11	13.2 days	13.0 days
Unknown	4.5	12.1	4.3 days	8.93 days

Using the NTDB classifications, 49.4% of all KY trauma patients have an ISS that is minor, compared to 63.6% of the NTDB. The 268 trauma centers included in the NTDB report include level II, III and IV hospitals, so it is no surprise that there are a higher percentage of less severe cases than in the Kentucky trauma registry. Length of stay (LOS) is comparable between the two, given that KY has a larger percentage of missing data.

VI. Hospital Data

Admissions by Shift

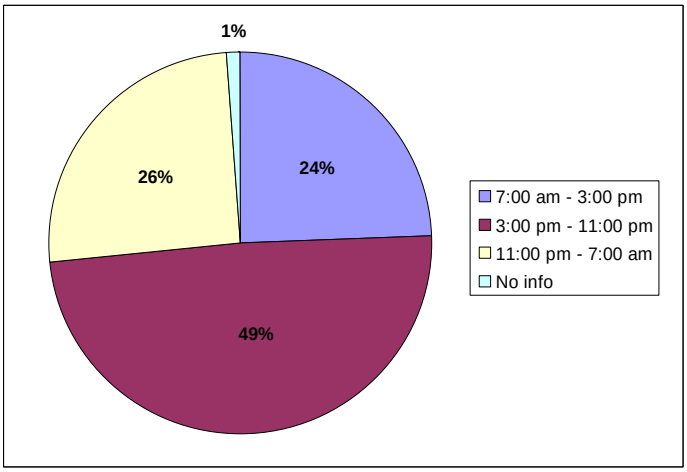
The frequency of admissions according to standard hospital employee work shift was examined. On average, there were twice as many admissions (49%) on the second shift, 3:00 - 11:00 p.m., as on either the first shift (24.4%), 7:00 - 3:00 p.m., or the third shift (25.6%), 11:00 p.m. - 7:00 a.m. Patient admission times play a significant role in planning a trauma system for the state, as more resources should be available during the afternoon shift. This information can also be used to assist in hospital staffing and surgery room scheduling.

Table 14. Patient admission by standard work shifts (percent), 1995-2002.

Shift of arrival	UKH	ULH	KO	TR	CMB	OH	Combined
7:00 am - 3:00 pm	23.1	26.1	23.4	33.3	27.2	29.5	24.4
3:00 pm - 11:00 pm	49	42.9	61.3	46.8	59.7	51.7	49
11:00 pm - 7:00 am	27.9	29.2	12.8	19.6	13.1	16.7	25.6
No info	0	1.8	2.5	0.3	0	2.1	1

Figure 10. Distribution of patient admission, 1995-2002.

Almost half (49%) of all patients arrive between 3 pm and 11 pm.



Length of Stay (LOS)

Table 15. Length of stay (LOS) distribution, 1995-2002.

% of patients	KCH	UKH	ULH	TR	CMB	OH
Up to 1 week	87.9	76.2	60.1	88.9	69.4	79
1 week to 1 month	10.6	21.4	34.6	9.6	6.2	20.4
More than 1 month	0.8	2.2	5.1	0.9	0.8	0.6
No info	0.8	0.2	0.3	0.6	23.6	0
Mean (days)	3.74	6.03	9.68	3.7	4.16	5.46
Std Deviation	5.56	8.5	12.53	5.97	13.52	5.38
Range (in days)	0-93	0-102	0-366	0-63	0-168	1-35

The length of stay did not vary significantly over the eight years of data, so only the averages are shown. A majority of Trover's patients (88.9%) were treated and released within one week of admission. This reflects the fact that Trover is a level III hospital and would therefore see less severe trauma patients. More seriously injured patients, if taken to Trover initially, would be transferred to a Level I trauma center. This should hold true at CMB hospital as well, but 23.6% of their data was missing LOS, so it cannot be characterized definitively.

The average length of stay for all hospitals was 6.85 days

Only 60.1% of ULH patients had stays of a week or less. The impossibility of making meaningful comparisons between the two Level I centers must be kept in mind. Because ULH does not report stays of less than 48 hours, its mean LOS (9.68 days) is over three days longer than that of UKH (6.03 days).

The range of length of stay at KCH was zero to 93 days, at UKH zero to 102 days, at ULH 0 to 366 days, at TR zero to 63 days, at CMB 0-168 days, and in Ohio 1-35 days. It should be noted that UK only codes patients as staying up to 99 days, so if a patient stayed for 150 days, it was entered into the database as 99 days (1 patient out of 17,650 was coded at 102 days). The data from Ohio did not include patients hospitalized for less than one day.

Length of Stay (LOS) continued

Figure 11. Aggregate length of stay (in days) by E-code, 1995-2002.

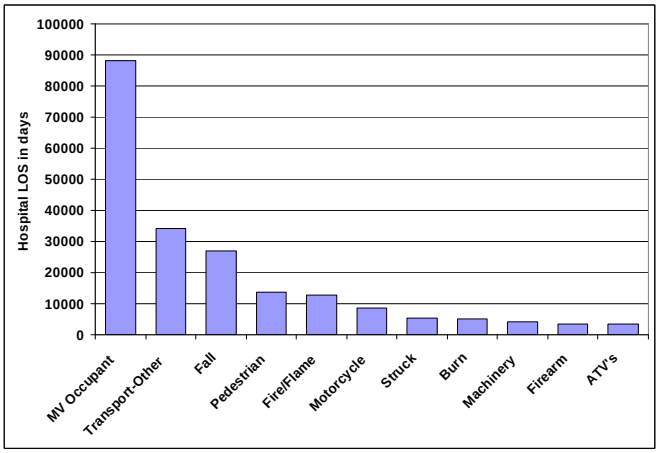


Figure 11 above shows the trauma hospital length of stay grouped by E-code (mechanism of injury). Total hospital length of stay for all E-codes was 250,451 days (234 cases were missing LOS). MV occupants had the highest numbers of days in the hospital at 88,200 followed by the category transport other with 34,211 days.

Figure 12. Average length of stay (in days) by E-code, 1995-2002.

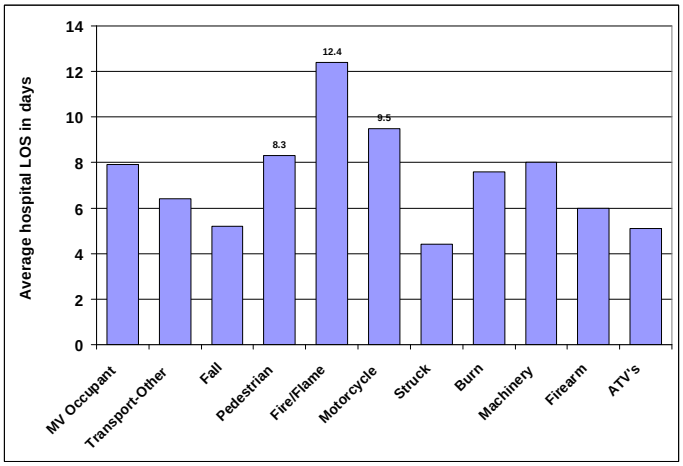


Figure 12 above shows the average hospital length of stay grouped by E-code. Average hospital length of stay is the total hospital length of stay divided by the number of patients within each E-code. For both figures the E-codes with the highest numbers of patients were used. Fire/flame, motorcycle and pedestrian injuries had the highest average length of stay.

Intensive Care Unit Days

Table 16. Distribution of the number of days in the intensive care unit (ICU), 1995-2002.

% of patients	KCH	UKH	ULH	TR	CMB	OH
Zero days	25.1	69.9	58	83.3	13.5	73.9
Up to 1 week	10.2	21.4	25.4	14.6	3.6	21.2
1 week to 1 month	2.1	7.8	14.4	1.8	0	4.9
More than 1 month	0.2	0.8	2.2	0.3	0	0
No info	62.4	0	0	0	82.9	0
Mean (days)	1.76	2.02	4.04	0.81	0.56	1.18
Std Deviation (days)	4.93	5.78	4.38	3.39	1.26	3.52
Range (in days)	0-58	0-90	0-148	0-35	0-6	0-31

ULH had the widest range of ICU days, zero to 148 days. In comparison with UKH, ULH had a higher mean number of ICU days (4.04 vs. 2.02) and a lower percentage of patients who did not require ICU care (58 vs. 69.9). Again, ULH's exclusion of patients with stays under 48 hours seems likely to account for these large differences. KCH and CMB hospitals were missing large percentages of information on number of ICU days (62.4% and 82.9%) so accurate characterization of their patient population is impossible. A majority (73.9%) of Kentucky patients treated in Ohio did not require stays in the intensive care unit.

Hospital Outcome

Table 17. Percent of patients by discharge status, 1995-2002.

	KCH	UKH	ULH	TR	CMB	Combined
Home	91.7	78.9	68.8	69.6	67.0	77.2
Death	2.9	6.4	10.2	3.8	4.3	7.1
Nursing Home	0.0	0.6	2.6	1.5	0.0	1.2
Hospital Transfer/ Medical Facility	3.0	0.3	3.3	16.7	25.7	2.2
LTC	0.0	0.9	0.0	1.8	0.0	0.4
Rehab	1.1	9.1	14.2	2.6	2.4	9.4
Foster Care	0.8	0.0	0.0	0.0	0.0	0.2
HOSP	0.0	1.1	0.0	0.0	0.0	0.6
Prison	0.0	0.1	0.6	0.9	0.0	0.2
Non-Medical Facility	0.3	0.0	0.0	0.0	0.6	0.1
Other	0.0	2.5	0.0	2.6	0.0	1.2
Not Available	0.2	0.1	0.3	0.6	0.0	0.2

Coding differences between hospitals could affect the results shown here, and caution should be exercised when interpreting them. For example ULH hospital outcome data may differ considerably from that of UKH because of inclusion criteria that define a patient population with more severe trauma. Rehabilitation referral patterns may differ among institutions.

Over three-quarters (77.2%) of all patients were discharged home. As would be expected, the two Level III facilities transferred much higher proportions of trauma patients than the Level I hospitals. Data on discharge status of patients injured in Kentucky and treated in Ohio were not available at this level of detail. The death rate for Ohio patients (6.4%) was similar to the combined rate of 7.1% for Kentucky facilities. It is again important to note that trauma victims who die at the scene of the event are not included, so this data should not be interpreted as representing the death toll associated with all trauma in Kentucky.

Inclusion criteria complicate comparison of patient discharge status between hospitals.

VI. Transfer Patients

The ability of trauma systems to improve the quality of medical care depends to a large extent on the quality of transfer decisions. If patients who need Level I care are kept at community hospitals and patients with less serious trauma are transferred in significant numbers, resources may be wasted and care may not be delivered at an appropriate level. The following analysis addresses these and related issues. Definitive analysis would require comparable information on trauma patients who are not transferred from community hospitals. Patient insurance coverage data is not included in the trauma registry and would also help elucidate transfer issues.

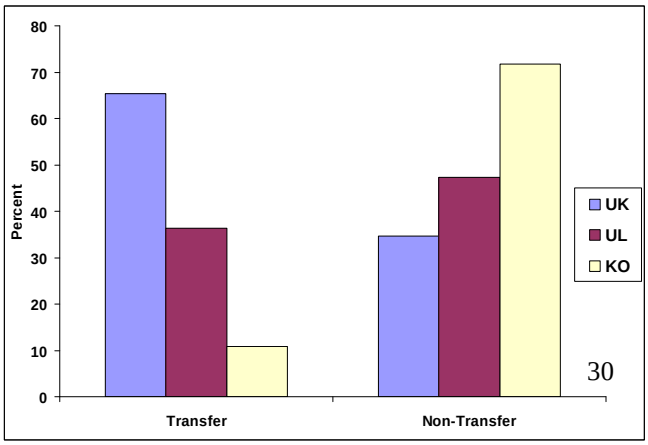
Transfer patients receive initial care at a community hospital and are then transferred to a trauma facility for further care. Much of the state is rural, so patients who are seriously injured are likely to be stabilized at a local hospital before transport to a trauma center. No transfer information was available on patients injured in Kentucky and treated in Ohio. There were approximately equal numbers of transfer (45.7) and non-transfer (45.3) patients when all five hospitals were combined. 3,292 cases (9%) were missing information and are not included.

Table 18. Transfer vs. non-transfer patient percentages, 1995-2002.

	Transfer	Non-trans	N/A
University of Kentucky	65.4	34.6	0
University of Louisville	36.4	47.4	16.1
Kosair Children's Hospital	10.9	71.7	17.5
Total	45.7	45.3	9

Because UKH serves the rural eastern part of the state, it receives the majority of its patients (65.4%) through transfers from local hospitals, while ULH has a higher percentage (47.4%) of direct-from-the-scene transports because of its urban setting. This discrepancy can be seen in Figure 13 below. Trover and Campbellsville are not included in the figure below because of their low numbers of transfer patients. UK's transfer data is complete, but 16.1% of UL's data and 17.5% of Kosair's data was missing information.

Figure 13. Transfer distribution, 1995-2002.



65.4% of UK's trauma patients were transfers from other facilities, whereas only 36.4% of UL's patients were transfers.

Pre-Hospital Transport

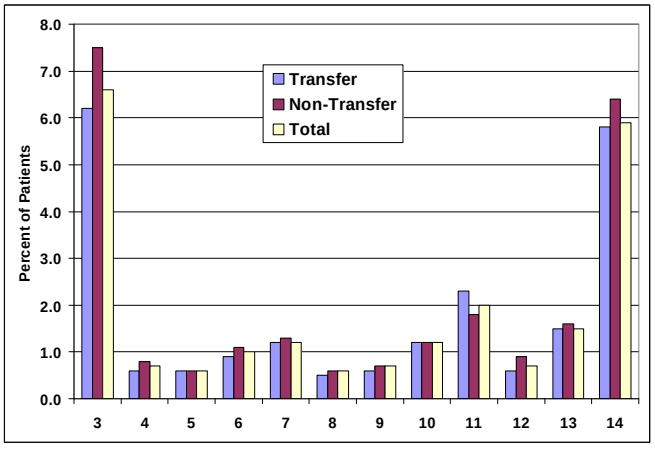
Table 19. Hours to arrival, 1995-2002.

Hours to arrival	Transfer		Non-Transfer		N/A		Total	
	#	%	#	%	#	%	#	%
Up to 1	78	0.5	6303	38.2	1310	39.8	7691	21.1
1-2	3090	18.6	2853	17.3	431	13.1	6374	17.5
3-5	5902	35.5	530	3.2	35	1.0	6467	17.7
6-12	2846	17.1	246	1.5	28	0.9	3120	8.6
12-24	201	1.2	54	0.3	20	0.6	275	0.8
24+	536	3.2	291	1.8	20	0.6	847	2.3
No info	3979	23.9	6226	37.7	1448	44.0	11653	31.9
Total	16632	100	16503	100	3292	100	36427	100

As expected, there is a large discrepancy in the transfer vs. non-transfer patients regarding hours to arrival. Over one-third (38.2%) of non-transfer patients arrived at the hospital within one hour of injury, whereas only 0.5% of transfer patients did. This is to be expected given the time transfer patients spend traveling to, and receiving treatment in, an initial treatment facility. For those without transfer status listed, 39.8% arrived within an hour, which is consistent with non-transfer patients. A large percentage of transfer (23.9%) and non-transfer (37.7%) patients lacked information on hours to arrival.

Glasgow Coma Score

Figure 14. Glasgow Coma Score, 1995-2002.



The figure at right is displayed without the GCS score of 15 and missing cases. This was done to clarify the display of lower GCS numbers.

Transfer patients were less likely than others to have impaired consciousness: 71.2% of transfer patients, 50.1% of non-transfer patients, and 59.3% of all patients had a GCS of 15. GCS information was missing on 6.7% of transfer patients, 25.5% of non-transfer patients, and 18.2% of all patients. Most (96%) non-transfer cases that were missing GCS come from Kosair. The Total columns also include those patients with no information on GCS.

Injury Severity Score

Information regarding injury severity score for transfer vs. non-transfer patients is not listed because there were no significant differences between the two groups.

Intensive Care Unit (ICU) Days

Table 20. Distribution of ICU days, 1995-2002.

ICU days	Transfer %	Non-Trans %	N/A %	Total %
Zero	66.4	47.6	70.8	51.8
Up to 1 week	23.0	18.8	19.0	20.7
1 week to 1 month	9.4	8.5	9.0	8.9
More than 1 month	1.2	1.1	1.2	1.2
No info	0.0	23.9	0.1	17.3
Total	100	100	100	100

A greater percentage of transfer patients (33.6%) spent time in the ICU than non-transfer patients (28.5%)

A greater percentage of transfer patients (33.6%) spent time in the ICU than non-transfer patients (28.5%); the high number of cases missing information makes this finding inconclusive. Non-transfer patients were missing data on number of ICU days for 23.9% of cases, whereas transfer patients were only missing 5.6% of cases. Over half (51.8%) of all patients in the trauma system spent no days in the ICU. Non-transfer patients spent an average of 3.11 days in the ICU. This average excludes the 4020 non-transfer patients with no information on ICU days. Transfer patients spent an average of 2.54 days in the ICU. Those patients without transfer status available also spent an average of 2.54 days in the ICU.

Length of Stay (LOS)

Table 21. Length of stay (LOS) distribution, 1995-2002.

LOS range	Transfer		Non-Transfer	
	#	%	#	%
Up to 1 week	12080	72.6	12023	72.9
1 week to 1 month	4081	24.5	3798	23.0
More than 1 month	433	2.6	502	3.0
No info	38	0.2	180	1.1
Total	16632	100	16503	100

Most transfer (72.6%) and non-transfer (72.9%) patients were treated and released within one week of admission.

Length of stay percentages are comparable for transfer and non-transfer patients. There were a total of 3,292 cases missing information on LOS that were excluded from the table above. The average length of stay did not vary significantly between transfer (6.78 days) and non-transfer patients (6.8 days). Calculation of LOS for transfer patients does not include hospital time before the transfer to a trauma center, so total LOS would be longer for transfer patients.

Table 22. Transfer patients LOS percentages by hospital, 1995-2002.

LOS	KCH		UKH		ULH	
	Transfer	Non-trans	Transfer	Non-trans	Transfer	Non-trans
0	0.7	2.1	4.7	10.4	1.0	5.4
1	36.2	37.1	22.1	21.7	17.0	5.3
2	19.3	19.8	15.3	12.0	8.2	7.6
3	11.3	11.0	10.7	9.2	8.2	12.7
4	8.2	6.6	8.1	7.8	7.8	9.6
5	5.4	5.0	6.7	6.3	7.0	7.7
6	3.1	3.2	4.9	4.7	6.3	7.0
7	2.8	2.2	3.9	3.5	5.0	5.0
8-14 days	8.4	7.4	14.3	13.2	19.7	20.9
15-21 days	2.6	2.6	4.4	5.1	8.8	8.5
22 days- 31 days	1.3	1.1	2.7	3.2	5.9	5.1
More than 1 month	0.5	0.9	2.0	2.8	4.6	5.0
No info	0.2	1.0	0.2	0.1	0.4	0.1
Total	100	100	100	100	100	100

Hospital Outcome

Table 23. Transfer patients by discharge status, 1995-2002.

disposition	Transfer		Non-Transfer		N/A		Total	
	#	%	#	%	#	%	#	%
Home	13169	79.2	12499	75.7	2454	74.5	28122	77.2
Death	887	5.3	1462	8.9	233	7.1	2582	7.1
Home Health / LTC	115	0.7	42	0.3	6	0.2	163	0.4
Nursing Home	166	1.0	176	1.1	81	2.5	423	1.2
Foster Care	24	0.1	3	0.0	28	0.9	55	0.2
Rehab	1610	9.7	1505	9.1	325	9.9	3440	9.4
Jail/Prison	21	0.1	45	0.3	16	0.5	82	0.2
Medical Facility	15	0.1	295	1.8	6	0.2	316	0.9
Hospital Transfer	346	2.1	249	1.5	108	3.3	703	1.9
Other	144	0.9	143	0.9	11	0.3	298	0.8
No info	135	0.8	84	0.5	24	0.7	243	0.7
total	16632	100	16503	100	3292	100	36427	100

A slightly larger proportion of transfer patients were discharged home (79.2% of transfer patients and 75.7% of non-transfer patients). There were 1462 (8.9%) non-transfer deaths and 887 (5.3%) transfer deaths. Only 9% of all trauma deaths were missing transfer status. We might expect to see more deaths among transfer patients, as they were cases that were severe enough to be transferred to a trauma facility after initial treatment at a non-trauma facility, resulting in a possible delay of definitive care. However, these results indicate this is not the case, with a higher percentage of non-transfer patients dying. Once again, the exclusion of UL data for stays less than 48 hours confounds the analysis.

As mentioned previously, caution must be exercised when interpreting these results. Inclusion criteria vary among hospitals, and while only aggregate data are shown here, transfer patterns vary among hospitals making comparison among the groups more difficult.

VII. Pediatric Motor Vehicle (MV) Injuries

The following analysis of pediatric motor vehicle injuries, like all the data in this report, should not be interpreted as a complete account of trauma in Kentucky because it does not include children who died at the scene of a motor vehicle crash without reaching a hospital.

Youth 0-17 years of age comprise 24.6% of Kentucky's population. Of the 20,827 motor vehicle cases in the trauma registry, 5,044 cases (24.2%) involved children. However, the proportion is much higher among teens 16 and older than in younger children (Table 24).

Table 24 lists the number of MV cases for each age from 0-17 years. The percentage of all MV cases is listed next, followed by the percentage of all trauma registry cases for each age. For example, there are 160 MV cases for two year olds in the registry. This is 3.2% of the 5,044 MV cases for ages 0-17. This is also 28.5% of all registry cases for two year olds. Again, motor vehicle-related trauma increases in significance as children grow older. Data presented in the pediatric section exclude Ohio patients.

There were 5,044 motor vehicle cases involving children 17 and under. Of these, there were 232 MV deaths (4.6% of all youth MV cases, and 57.7% of all youth deaths)

Table 24. Number of children by age involved in motor vehicle incidents, 1995-2002.

Age in Years	MV cases	% of all 0-17 MV cases	% of all registry cases
< 1	135	2.7	16.4
1	104	2.1	18.6
2	160	3.2	28.5
3	149	3.0	31.2
4	189	3.7	41.1
5	215	4.3	44.1
6	230	4.6	45.5
7	233	4.6	51.3
8	211	4.2	54.5
9	203	4.0	55
10	208	4.1	55.6
11	272	5.4	60.3
12	246	4.9	55
13	274	5.4	56.7
14	386	7.7	62.8
15	418	8.3	64.8
16	638	12.6	73.6
17	773	15.3	79.7
Total	5044	100	N/A

Note that the number of MV cases increases both with age and as a percentage of both MV and registry cases. Motor vehicle incidents are more likely to occur in children of driving age.

When combined, the percentage of cases in the 16 and 17 year old age groups represent over one-fourth (27.9%) of all youth MV cases. In addition, 73.6% and 79.7% of all trauma registry cases in the 16 and 17 year old age groups were attributable to motor vehicles. Less than one in 20 (4.6%) youth MV cases resulted in death, but those deaths represented more than half (57.7%) of all youth trauma deaths in the trauma system.

The National Trauma Data Bank (NTDB) data on pediatric cases is shown below. The NTDB excludes pedestrian and pedal cyclist E-codes from their classification of motor vehicle crashes; therefore, the comparison with Kentucky trauma registry data also excludes these cases. Kentucky data also excludes those patients injured in KY and treated in Ohio. In addition, the breakdown of age groups below is shown as it is in the NTDB data (so pediatric cases range from <1 to 19 years).

Table 25. Comparison of pediatric NTDB 2003 data and KY trauma data

Age in Yrs	NTDB % of MV patients	KY % of MV patients	NTDB % of MV deaths	KY % of MV deaths
< 1 yr.	32.5	15.5	11.8	12.6
1-4 yrs	28	20.2	4.6	5.5
5-9 yrs	29.1	28.3	3.5	4.3
10-14 yrs	31.5	38.2	3.5	2.4
15-19	58.4	68.3	4.1	5.3
Total	44.0	42.7	4.1	4.9

The percentage of MV cases (shown in columns 2 and 3) is calculated by dividing the number of motor vehicle crash (MVC) cases by the total number of MVC cases in each age group. Note that for ages <1 and 1-4 the Kentucky trauma registry average is well below the national average. As age increases, however, this pattern changes. Percentages are comparable for the 5-9 age group, (29.1 vs. 28.3), and Kentucky's averages exceed the national averages for ages 10-14 and 15-19. Nationally, an average of 44% of all pediatric cases are motor vehicle related, and a similar proportion, 42.7%, of all Kentucky pediatric trauma registry cases are motor vehicle related.

The MV death rate (shown in columns 4 and 5) is calculated by dividing the number of motor vehicle crash deaths by the total number of MVC cases in each age group. Kentucky's percentages are higher than the national average for every pediatric age group except 10-14 years. The average rate of pediatric motor vehicle death is 4.2% nationally and 4.9% for Kentucky. The higher death rate may reflect some combination of inadequate access to emergency or trauma care between the crash and definitive care time, and inadequate use of child passenger safety devices. Again, it is important to note that these figures do not include children who die at the scene of the crash.

Table 26. Number of children in the trauma registry aged 3 to 8 years* involved in motor vehicle crashes**, 1995-2002.

Year	Count
1995	99
1996	74
1997	71
1998	103
1999	69
2000	82
2001	103
2002	86
Total	687
Average	86 per year

*Age range for which booster seats are recommended.
** For tables 26 and 27, motor vehicle crashes exclude ATV, pedestrian, and pedal cyclist E-codes.

Since the first trauma registry report was distributed in 2002, trauma registry data has been used in the context of specific legislative initiatives. Injuries to children ages 3-8 resulting from motor vehicle crashes were reviewed to educate lawmakers about booster seats, which are recommended for most children in that age range. Cases shown in Table 26 probably lacked a booster seat because usage has remained below 5 percent. These injuries might have been prevented had a booster seat been used. Similarly, to educate policy makers about the need to strengthen the graduated drivers' licensing law, the trauma registry data was used to describe injuries to 16 and 17 year olds who were injured in a motor vehicle crash. See Table 27 below.

Table 27. Number of 16 and 17 year olds in the trauma registry involved in motor vehicle crashes, 1995-2002.

Year	Count
1995	162
1996	163
1997	167
1998	161
1999	194
2000	133
2001	152
2002	149
Total	1281
Average 160 per year	

Pediatric ATV incidents

The inappropriate use of all-terrain vehicles (ATVs) by children as drivers or passengers is a growing concern in Kentucky. Of the 5,044 youth MV cases, 248 (4.9%) involved ATVs. These 248 cases compose 38.4% of the 645 ATV cases in the registry. These 248 cases are broken down by age below.

Table 28. Number of children by age, involved in ATV incidents, 1995-2002.

Age	ATV cases	% of all MV cases		Age	ATV cases	% of all MV cases
< 1	3	2.2		10	9	4.3
1	1	0.9		11	18	6.6
2	3	1.9		12	18	7.3
3	1	0.7		13	31	11.3
4	4	2.1		14	35	9.1
5	6	2.8		15	35	8.4
6	12	5.2		16	19	2.9
7	11	4.7		17	19	2.5
8	6	2.8				
9	17	8.4		**TOTAL**	248	N/A

Percentages listed are the percentage of all MV cases for that age. Rates are highest in the early teen years, and drop after the age of driver license eligibility. There were 21 ATV deaths in the trauma registry. Of these, 8 (38.1%) were children. Again, it is important to remember that trauma registry data include only children who survived long enough to get to the hospital; ATV deaths on the scene are not reflected in this data.

The leading counties of injury and county of residence for youth ATV trauma cases are listed below. Note that 72 cases are missing information on county of injury. Only those counties with more than five cases are listed. ATV activity is customarily associated with rural locations, so the prominence of Jefferson County is noteworthy.

Table 29. Number of children by county involved in ATV incidents, 1995-2002.

County of Residence	n	County of Injury	n
Jefferson	21	Jefferson	15
Laurel	11	Laurel	8
Clay	8	Clay	7
Leslie	7	Madison	7
Nelson	7	blank	72
Pike	6	All other	139
All other	188		

Children comprised 248 (38.4%) of ATV-related trauma patients, and 8 (38.1%) of ATV-related deaths.

Recommendations

1. The effort to establish and refine a statewide trauma registry should continue because it adds important information to the evaluation of current trauma causes, services and care. A state trauma registry also provides essential data for planning future trauma services and injury prevention efforts at the hospital, municipal, county and state level.
2. Stable, ongoing funding should be sought to make the state trauma registry, data analysis and reporting a sustainable effort.
3. Authority for a state trauma system funding, hospital designation, transfer arrangements, prevention, data systems, evaluation protocols and rehabilitation should be addressed in legislation.
4. Training and standardized assessments on E-coding should be conducted to facilitate uniform coding and reporting across hospitals.
5. EMS data should be collected and linked to the trauma data to determine how services complement one another and to identify areas for improvement. Trauma data should also be linked to rehabilitation data for the evaluation of additional outcomes.
6. Cooperative agreements should be developed with state registries or trauma centers at Kentucky borders to facilitate the exchange of data, including University of Cincinnati Hospitals and Cincinnati Children's Hospital, Cabell-Huntington Hospital (WV), University of Tennessee Hospital in Knoxville and Knoxville Children's Hospital, Vanderbilt University Hospital, and possibly others such as Riley Children's Hospital in Indianapolis. When an injury occurs near a state border, the patient is often taken to an adjacent state, yet the cause of injury may have implications for Kentucky prevention initiatives and some services in the Kentucky trauma system may have been used for the patient's care.
7. Whenever possible, the Kentucky data should be compared to the national trauma data bank (NTDB). Specifically, a detailed analysis of the pediatric trauma in Kentucky is needed to address the apparently elevated percentage of pediatric trauma.
8. Trauma places an economic burden on the medical care delivery system. Analysis of the hospital charges and costs is necessary to put trauma in context with other health care issues. This information is currently unavailable within the trauma registry database. One important element of such information is patient insurance status, which is also missing from current registry data.
9. Analysis of trauma data should continue to provide information for prevention initiatives of the state legislature and other entities, on such topics as head injury, graduated drivers' licensing, all-terrain vehicles, and booster seats.

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Kentucky Hospital Injury Patients 2002-2003

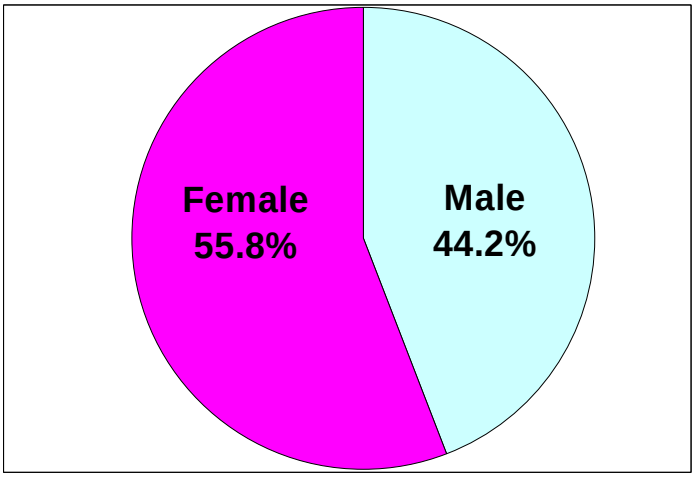
Appendix

Injured patients in all Kentucky hospitals

The main body of this report has presented information on trauma patients seen in the five trauma hospitals. This appendix will focus on Kentucky hospitals as a whole, with aggregate information on all 156,000 hospital trauma inpatients seen in 2002-2003 at over 100 Kentucky hospitals. These patients all experienced some sort of trauma, but their injuries are considered less severe than those in the trauma registry. Where appropriate, these numbers will be compared to the trauma patient numbers previously mentioned. When "trauma patients" are referenced, we mean the trauma patients in the Kentucky trauma registry through 2002. When "Kentucky hospital injury patients" are referred to, we mean the dataset of all trauma inpatients seen in Kentucky hospitals from 2002-2003.

44.2% of all KY hospitals' injury patients and 69.5% of serious trauma patients are male.

Figure 15. Gender composition of Kentucky injury patients, 2002-2003.



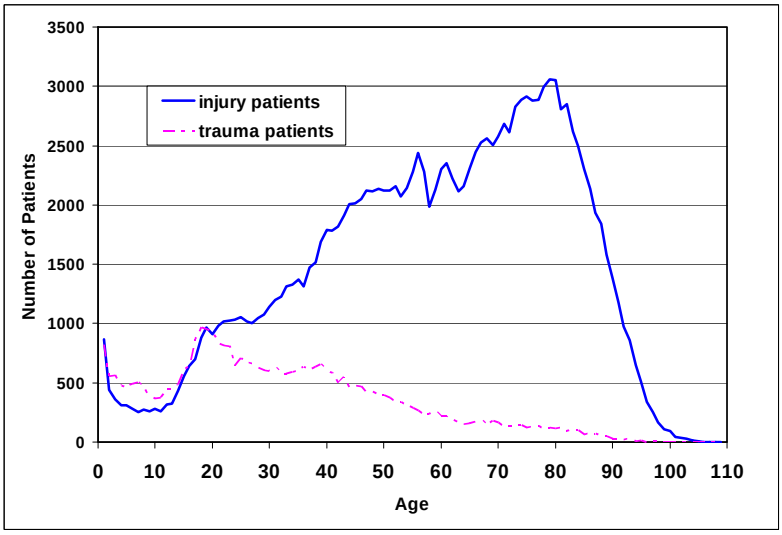
There is a gender discrepancy between the two datasets, with a greater proportion of male patients seen for trauma in the trauma registry (69.5%) than for general trauma hospital admissions (44.2%).

Age Distribution

Table 30. Kentucky hospital injury patients age distribution, 2002-2003.

Age in Years	cases	%
< 1 yr.	867	0.6
1-4 yrs.	1423	0.9
5-9 yrs	1347	0.9
10-14 yrs	1891	1.2
15-17	2218	1.4
18-25	7999	5.1
26-35	12018	7.7
36-45	18045	11.6
46-55	21701	13.9
56-65	22284	14.3
66-75	26972	17.3
76-85	27203	17.4
86-95	11239	7.2
96-120	760	0.5
TOTAL	155,967	100%

Figure 16. Number of Kentucky hospital injury patients by age, 2002-2003.



The dashed line represents data from the trauma registry, mapped here to compare to the Kentucky hospital injury patient group (solid line) as a whole. Notice that the trauma patient distribution peaks early and tapers off, whereas the KY hospital injury patient distribution steadily rises with age, dropping off around age 80. This discrepancy can be explained by the frequency with which older adults are hospitalized for falls that are not serious enough to be included in the trauma registry.

Kentucky Hospital Injury Patients 1995-2002

Motor vehicle related causes account for 6.03% of all Kentucky injury cases, but 57.2% of Kentucky trauma cases.

Cause of Injury

Table 31 below lists all E-codes for Kentucky hospital injury patients. All motor vehicle related causes are shaded in grey. Note that while the trauma registry is only missing E-codes for 18 out of 36,440 cases, the data for all Kentucky hospitals is missing E-codes for 55,419 (35%) out of 155,967 cases.

Table 31. Cause of injury, 2002-2003.

E-Code Group	N	%
Missing Code	55419	35.53
Cut/Pierce	573	0.37
Drowning/Submersion	40	0.03
Fall	23668	15.18
Fire	462	0.30
Burn	354	0.23
Firearm	284	0.18
Machinery	431	0.28
MV Occupant	6286	4.03
Motorcycle	693	0.44
MV-Other	28	0.02
MV-Unspecified	627	0.40
Pedal Cyclist	325	0.21
Pedestrian	458	0.29
ATV's	258	0.17
Transport-Other	728	0.47
Natural/Environmental	232	0.15
Bites/Stings	438	0.28
Overexertion	813	0.52
Poisoning	2587	1.66
Struck	1136	0.73
Suffocation	113	0.07
Other Unintentional	3107	1.99
Adverse Effects Medical Care	12483	8.00
Adverse Effects Drugs	35029	22.46
Suicide	6082	3.90
Homicide	1458	0.93
Undetermined	1341	0.86
Unintentional-Missing	484	0.31
Legal Intervention	22	0.01
War	8	0.01
Total	155967	100

Where codes were available, the top five causes of injury for all Kentucky hospital patients were adverse effects of drugs administered for therapeutic purposes in correct dosages (22.5%), falls (15.2%), adverse effects of medical care (8%), motor vehicle incidents (6%), and suicide (3.9%). With such a high number of missing cases, however, it is difficult to say how accurate these percentages are.

Patient Residence

In table 32 below, counties with the highest number of hospital patients are listed. Note that this information is based on county of patient residence, not county of injury. Only counties with greater than 1% of all cases are listed.

Table 32. Leading KY counties of residence, 2002-2003.

Counties of residence	N	%	county rate (per 1000)
Jefferson	25638	16.4%	36.7
Fayette	7443	4.8%	27.9
Daviess	4475	2.9%	48.4
Kenton	3837	2.5%	25.2
McCracken	3387	2.2%	52.3
Hardin	2923	1.9%	30.4
Pike	2672	1.7%	39.6
Warren	2662	1.7%	27.8
Pulaski	2536	1.6%	43.7
Boone	2309	1.5%	23.8
Campbell	2293	1.5%	26.1
Whitley	2289	1.5%	61.4
Laurel	2247	1.4%	40.5
Hopkins	2152	1.4%	45.9
Franklin	2125	1.4%	44.2
Perry	2111	1.4%	71.6
Graves	2110	1.4%	56.6
Boyd	2091	1.3%	42.2
Floyd	1881	1.2%	44.5
Bell	1857	1.2%	62.0
Harlan	1762	1.1%	54.9
Henderson	1650	1.1%	36.6
Bullitt	1547	1.0%	23.8
Madison	1529	1.0%	20.4
All other counties	70441	45.2%	N/A

Kentucky residents made up 92.5% (144,346 cases) of all hospital injury admissions. There was no information on county of residence for 609 (0.39%) cases, and residents from other states made up the remaining 11,012 (7.1%) cases (see Table 33). If we added the 2002 data on Kentucky patients seen in Ohio to this count, Kenton County would move to third on the list.

The final column of Table 32 lists the rate at which people are hospitalized for injury, for each county (per 1000 residents). Perry County has an injury hospitalization rate of 71.6 people per 1000 population, the highest of the counties listed above. Other counties with rates above 50 people per 1000 are Bell (62), Whitley (61.4), Graves (56.6), and McCracken (52.3). While these counties do not make up a large percentage of the injury patients, their high rate of injury bears further investigation.

Table 33. Leading non-KY states of residence

Leading States	N	%
Indiana	4749	3.0%
Ohio	2272	1.5%
Illinois	1258	0.8%
Tennessee	887	0.6%
West Virginia	804	0.5%
All other states	1042	0.7%

Admissions

Table 34. Kentucky hospital injury patients admit type, 2002-2003.

Admit type	Number	%
Emergency	84528	54.2%
Elective	45252	29.0%
Urgent	22052	14.1%
Newborn	195	0.1%
Unknown	3913	2.5%

A majority of injury patients (68.3%) were admitted on an urgent or emergent basis during the 2-year period. Only a small percentage (2.5%), were un-coded for admission type. Elective admissions may include care provided at some length of time after initial hospitalization, such as restorative surgery or treatment of infections.

Table 35. Kentucky hospital injury patients admit source, 2002-2003.

Admit Source	Number	%
Emergency room	81557	52.3%
Physician referral	60127	38.6%
Transfer from hospital	7825	5.0%
Clinic referral	3038	1.9%
Unknown	1832	1.1%
Transfer from other health care facility	1124	0.7%
Transfer from skilled nursing facility	382	0.2%
Court / law	82	0.1%

As would be expected, a majority (52.3%) of Kentucky hospital patients were admitted from the emergency department, followed by physician referrals at 38.6%.

Hospital Outcome

Table 36. Number and percent of KY hospital patients by discharge status, 2002-2003.

	N	%
Home/self care	94966	60.9%
Transfer home under organized care	18641	11.9%
Skilled nursing facility	18411	11.8%
Transfer to other institution	5534	3.5%
Rehab	4308	2.8%
Death	4232	2.7%
Transfer to another short-term hospital	3675	2.4%
Intermediate care facility	2051	1.3%
Discharged against medical advice	1143	0.7%
Inpatient / still a patient	966	0.6%
Hospice	747	0.5%
Long term care	630	0.4%
Other	470	0.3%
Discharge no longer covered by Medicaid	181	0.1%
Transfer to a federal hospital	12	0.0%

Coding for discharge status among the Kentucky hospital injury patients and trauma patients differs, so numbers are not comparable. A majority in both data sets however--72.8% of injury patients and 77.2% of trauma patients--were discharged home. The relatively high number of older patients in the injury data set may explain the higher proportion of discharges to skilled nursing and intermediate care facilities.

Payor Codes

Given the higher hospitalization rate for injury to older patients, the high rate of Medicare coverage is to be expected.

Table 37. Payor codes for Kentucky hospital patients, 2002-2003.

Payer codes	Number	%
Medicare	76370	49.0%
Commercial	42945	27.6%
Medicaid	16377	10.5%
Other	10625	6.8%
Self Pay	5225	3.4%
Workers compensation	3214	2.1%
Other federal programs	607	0.4%
CHAMPUS	604	0.4%

Kentucky Patients in Ohio 2002

Kentucky Patients Seen in Ohio

In an attempt to better understand what data the trauma registry may be missing due to cases of patients injured in the state but hospitalized out of state, the following section provides information on Kentucky injury patients treated in Ohio in 2002. There were 1,844 such cases. Note that this data includes injuries that are not severe enough to warrant inclusion in a trauma registry. This dataset is distinct from the data on patients injured in Kentucky but seen in Ohio hospitals (329 cases) that has been included in the report up to this point. The all-injury data set of 1,844 patients was collected by the Kentucky Hospital Association (KHA).

Table 38. Gender composition of KY patients seen in Ohio, 2002.

	N	%
Male	989	53.6
Female	855	46.4

Over half (53.6%) of all Kentucky patients seen in Ohio were male. This figure falls between the 2002-03 data for all Kentucky injury patients in which 44.2% of patients were male, and the trauma registry, in which 69.5% of trauma patients were male.

Table 39. Leading counties of residence, 2002.

	# Cases	%
Kenton	497	27.0%
Campbell	360	19.5%
Boone	281	15.2%
Grant	92	5.0%
Lewis	75	4.1%
Mason	62	3.4%
Greenup	55	3.0%
Bracken	42	2.3%
Fayette	32	1.7%
Pendleton	32	1.7%
Jefferson	26	1.4%
Gallatin	22	1.2%
Fleming	13	0.7%
Other KY counties	246	13.2%
blank	9	0.5%

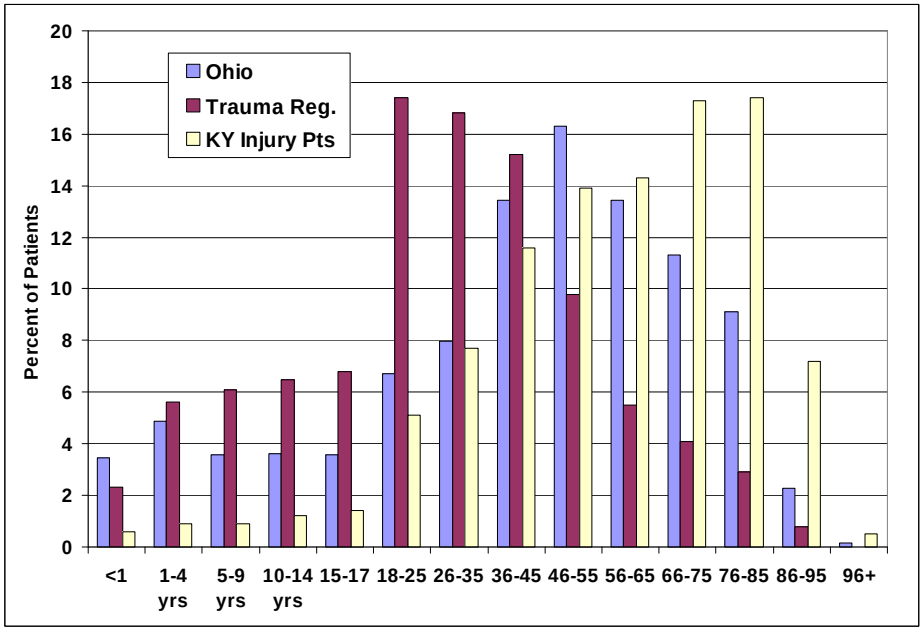
Most (61.7%) of Ohio-treated injuries to Kentuckians came from the three populous counties of suburban Cincinnati. This information provides insight into the injury cases (a subset of which would be considered trauma cases) that are currently missing from Kentucky trauma data analysis.

Kentucky Patients seen in Ohio continued

Table 40. Age distribution, 2002.

Age in Yrs	OHIO	
	cases	%
missing	1	0.05
<1 year	64	3.47
1-4	90	4.88
5-9	66	3.58
10-14	67	3.63
15-17	66	3.58
18-25	124	6.72
26-35	147	7.97
36-45	248	13.45
46-55	301	16.32
56-65	248	13.45
66-75	209	11.33
76-85	168	9.11
86-95	42	2.28
96-120	3	0.16
TOTAL	1844	100

Figure 17. Comparison of ages across data sets (percentage).



An overview of the three data sets shows that the elderly are captured mainly in the injury data, whereas trauma patients are younger. Ohio data, as mentioned previously, lies between the trauma and injury data, as the Ohio data set contains both injury and trauma patients.