

Third  
Kentucky Trauma  
Registry Report  
1995-2006

Spring 2008

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## Forward

The Kentucky State Trauma Registry Report 1995-2006 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 three Level I trauma centers in the state. This information was gathered by each hospital and submitted to KIPRC, where it has been analyzed as a whole. SPSS software (SPSS Corporation: Chicago, Illinois) was used for data analyses.

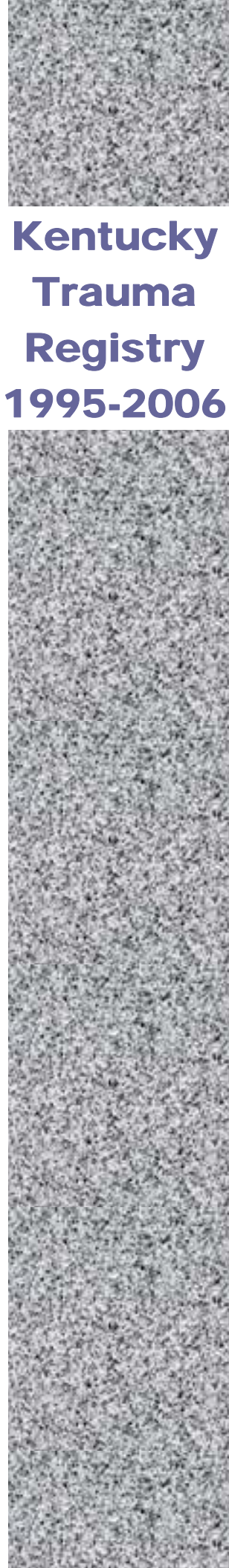
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### **University of Louisville Hospital**

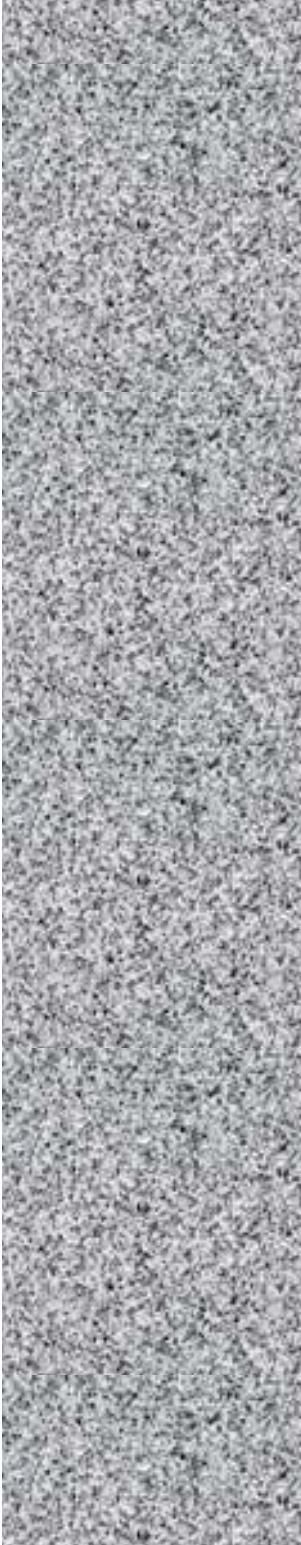
Glen Franklin, M.D., Chief of Trauma, Director of Injury Prevention and  
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Davis Potter, M.P.H., and all those who worked on the initial trauma  
registry reports, published in summer 2002 and winter 2004.



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We would like to acknowledge the generous donation of time, energy, staff support, and data access from the three hospitals contributing data in Kentucky: the University of Kentucky Hospital (UKH); the University of Louisville Hospital (ULH); and Kosair Children's Hospital (KCH), a regional pediatric trauma center.

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 Struttman and Glyn Caldwell continued to support the project, as has Julia Costich, KIPRC director since April 2003. From 2002 until 2006, partial funding was provided by a trauma system development grant from the Health Resources and Services Administration, through the Kentucky Board of Emergency Medical Services. For the past two years, the Kentucky Hospital Association (KHA) has funded the trauma registry work.

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 wrote the necessary grants for federal funding and contributed to all aspects of the data collection process and analysis. For the past two years, Richard Bartlett has coordinated trauma registry support through KHA and we recognize his support with heartfelt thanks.

# Kentucky Trauma Registry 1995-2006

## Introduction

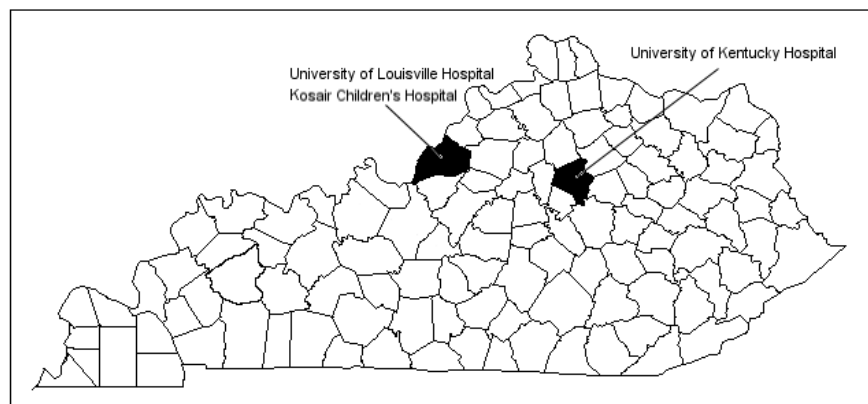
Kentucky law (KRS 311A.010) defines “trauma” as a single or multi-system life-threatening or limb-threatening injury requiring immediate medical or surgical intervention or treatment to prevent death or permanent disability.

The body of this report is the summary of 1995-2006 data for trauma cases seen only at the three Level I Kentucky trauma centers. 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 three Level I trauma centers. It is important to note that this data thus represents only the most serious survivable injuries and not the larger group of 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. Also, injuries sustained in border counties may be transported to the nearest, out of state trauma center. Border areas are thus under-represented in this report, and efforts continue to acquire additional Tennessee and Ohio data for future reports.

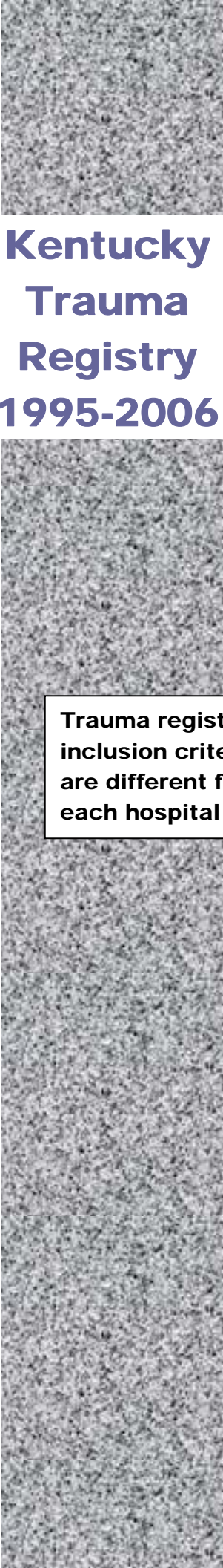
### *Kentucky's Regional Level I Trauma Centers:*

- o Kosair Children's Hospital - Louisville
- o University of Louisville Hospital - Louisville
- o University of Kentucky Chandler Medical Center - Lexington

**Figure 1.** Geographic location of hospitals in report.



## Inclusion Criteria



## Kentucky Trauma Registry 1995-2006

Trauma cases reported by the three trauma centers 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 (ICD-9) is used to determine the cause of the injury, and there are 22 possible groupings of this code.

Criteria for inclusion in the individual trauma databases are set by the reporting hospitals and can vary from hospital to hospital. Steps have been taken to insure analysis of similar data in the case of differing inclusion rules on the hospital level.

Trauma registry inclusion criteria 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 direct comparisons between hospitals inappropriate. ULH uses National TRACS software (American College of Surgeons: Chicago, Illinois) for data collection.

**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.



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### Hospital Inclusion Criteria

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

In order to maintain comparable results, trauma cases from UKH as well as Kosair that report a length of stay of less than 48 hours are analyzed separately. This subset will **not** include cases where death occurs upon arrival at either hospital or those that have been transferred, as these will remain in the original Trauma Registry database to assure uniformity of inclusion criteria. The resulting Trauma Registry database will therefore be more consistent for analysis though possibly still showing some skew until the inclusion criteria are uniform across hospitals.



# Kentucky Trauma Registry 1995-2006



## 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.

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 is not included.

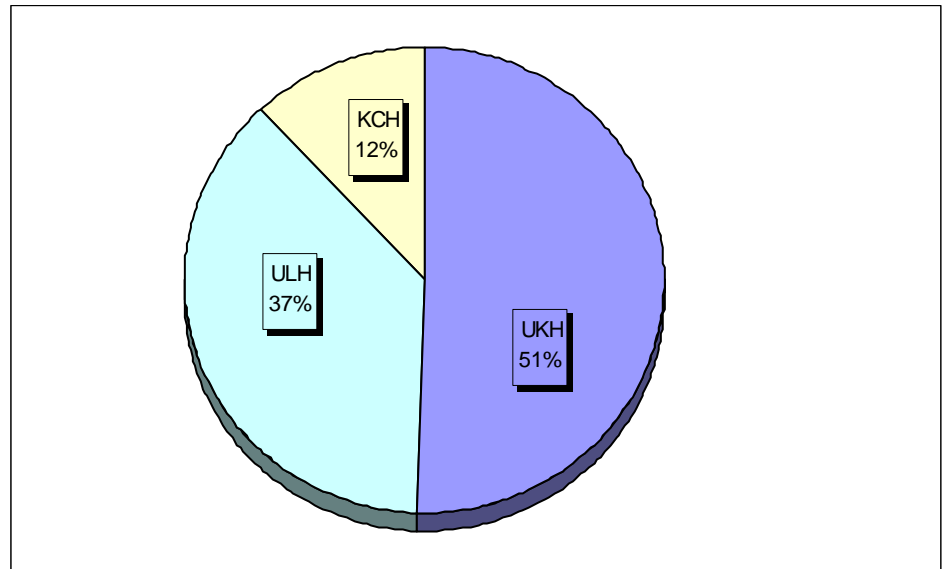
In order to estimate the number of Kentucky trauma patients treated in other states, we can hypothesize that their number is approximately the same as the number of non-Kentucky residents who receive trauma care in Kentucky. The total number of out-of-state residents treated in Kentucky facilities is 6,562, or 13.2% of the 49,745 cases in the 12-year trauma registry database. We can estimate that the trauma registry is missing data on about 13% 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 and Ohio. Efforts are in progress to obtain this data.

# Kentucky Trauma Registry 1995-2006

**Table 1.** Trauma registry patient distribution by hospital, 1995-2006.

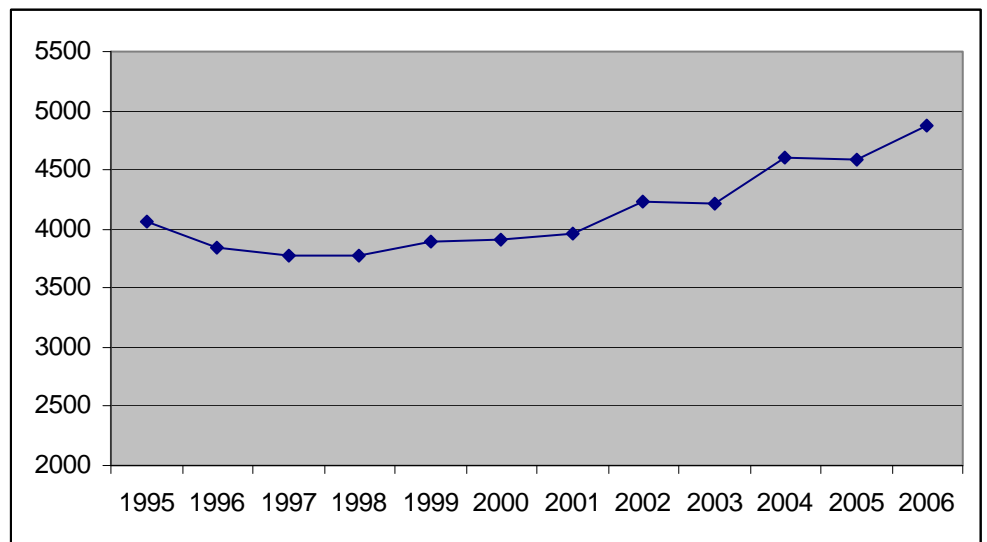
	UKH	ULH	KCH	Total
<b># of Cases</b>	25,183	18,554	6,008	49,745
<b>%</b>	50.6	37.3	12.1	100

**Figure 2.** Patient composition of the trauma registry, 1995-2006.



Last 10 years (1997-2006) showing slight increase in trauma cases treated.

**Figure 3.** Distribution of trauma cases by year, 1995-2006.

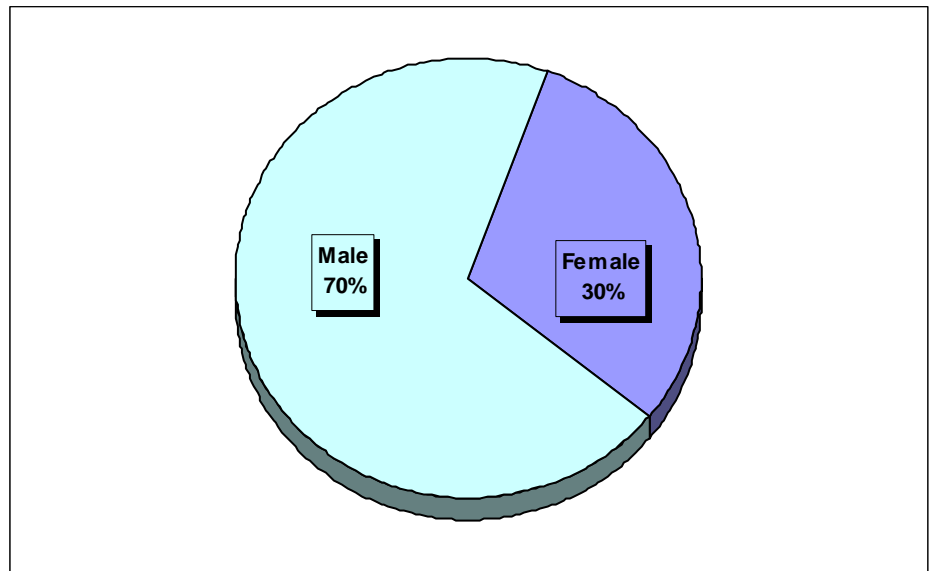


# Kentucky Trauma Registry 1995-2006

## Gender

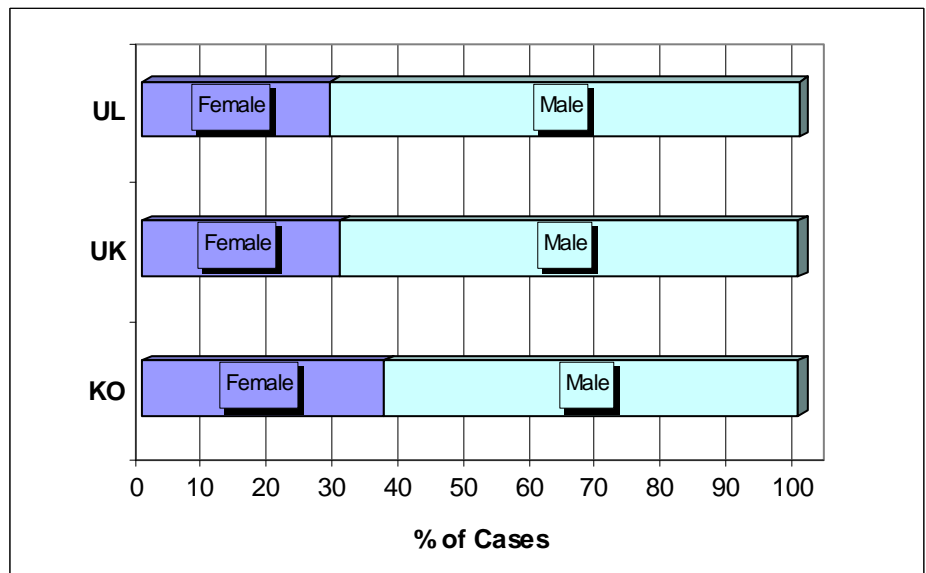
Data collection over the past twelve years has indicated a consistent proportion of patients by sex that is approximately the same in all hospitals. The registry currently contains 49,745 patients of whom 34,633 (69.6%) are male and 15,098 (30.4%) female. In comparison, Kentucky's 2000 census population 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 4.** Gender composition of the trauma registry, 1995-2006.



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

**Figure 5.** Gender composition by hospital, 1995-2006.



## Age Distribution

**Table 2.** Kentucky trauma registry age distribution, 1995-2006.

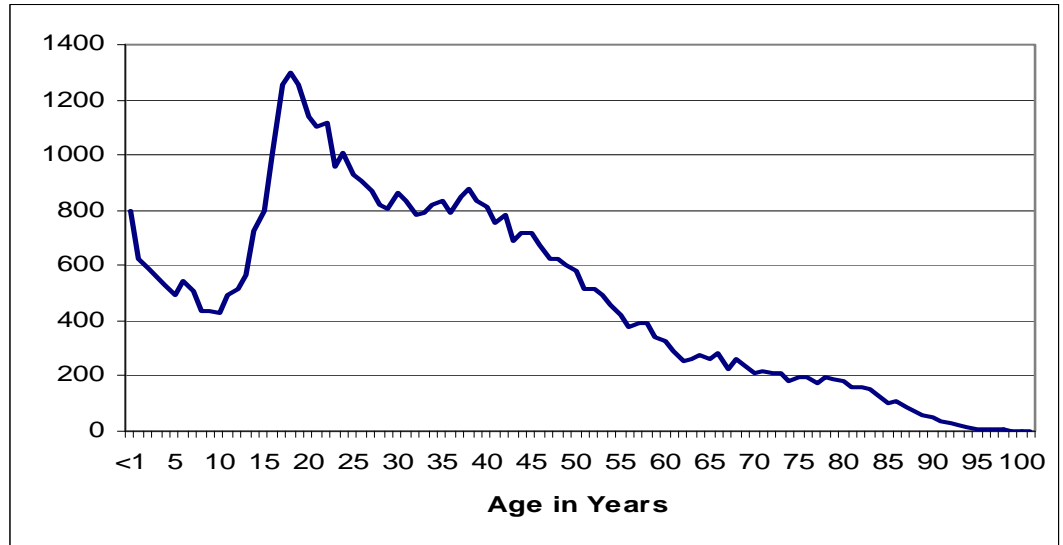
Age in Yrs	KCH		UKH		ULH		Total	
	cases	%	cases	%	cases	%	cases	%
<1 yr	591	9.8	213	0.8	92	0.5	896	1.8
1-4 yrs	1407	23.4	804	3.2	3	0.0	2214	4.5
5-9 yrs	1509	25.1	908	3.6	2	0.0	2419	4.9
10-14 yrs	1631	27.1	1028	4.1	77	0.4	2736	5.5
15-17 yrs	845	14.1	1340	5.3	868	4.7	3053	6.1
18-25 yrs	21	0.3	4738	18.8	4028	21.7	8787	17.7
26-35 yrs	0	0.0	4644	18.4	3680	19.8	8324	16.7
36-45 yrs	0	0.0	4217	16.7	3602	19.4	7819	15.7
46-55 yrs	0	0.0	2835	11.3	2680	14.4	5515	11.1
56-65 yrs	0	0.0	1723	6.8	1450	7.8	3173	6.4
66-75 yrs	0	0.0	1215	4.8	1012	5.5	2227	4.5
76-85 yrs	0	0.0	844	3.4	800	4.3	1644	3.3
86-95 yrs	0	0.0	267	1.1	220	1.2	487	1.0
96-120 yrs	0	0.0	7	0.0	17	0.1	24	0.0
Missing	4	0.1	400	1.6	23	0.1	427	0.9
<b>Total</b>	<b>6008</b>	<b>100</b>	<b>25183</b>	<b>100</b>	<b>18554</b>	<b>100</b>	<b>49745</b>	<b>100.00</b>

The National Trauma Data Bank (NTDB) provides the best representation of nationwide data, comprising nearly three million trauma cases from 712 hospitals nationwide. This includes Level I – Level IV trauma centers. Throughout this report, NTDB 2002-2006 data (the most recent report) is compared to Kentucky trauma registry data from 1995-2006. The 153 Level I trauma centers reporting data in this most recent NTDB report represent 78% of all U.S. Level I trauma centers. NTDB figures indicate that children aged 0-19 years made up 22.5% of all cases. Kentucky data for the same age group made up 28.5% 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. Kentucky is consistently higher in each age group until 45-54 yrs. At the opposite end of the age spectrum, patients in KY aged 55+ make up 16.1% of the registry, whereas the national average according to the NTDB is higher at 26.4%. Again, it is possible that this difference is related to the fact that the Kentucky database does not include in the registry patients admitted for less than 48 hours. Older patients may be admitted more frequently for shorter periods of time. Another possible explanation is the exclusion of isolated hip fractures from the Kentucky trauma registry data.

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# Kentucky Trauma Registry 1995-2006

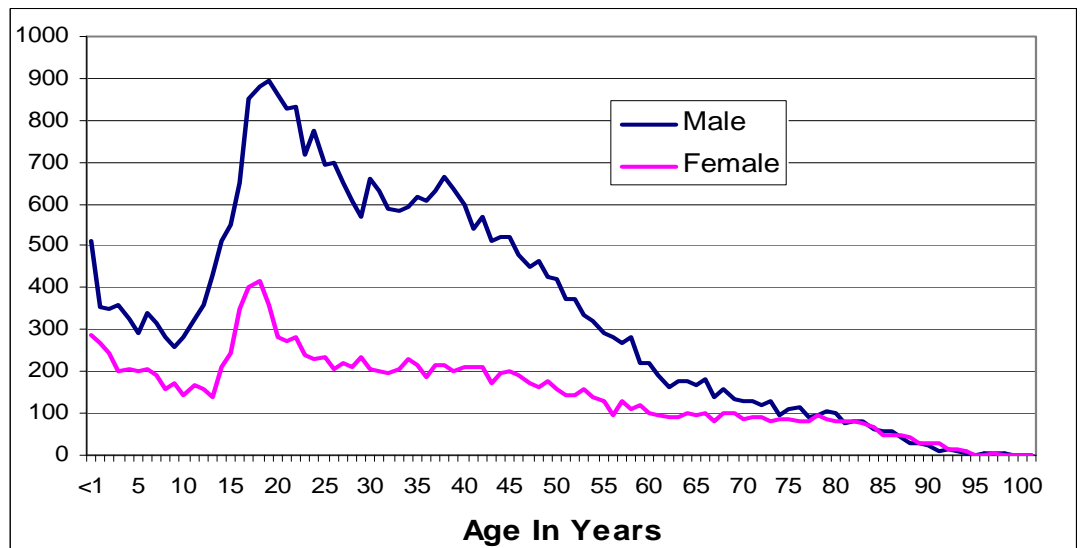
**Figure 6.** Number of patients by age, 1995-2006.



A peak of 1,328 cases is reached at age 18.

We see a peak in the trauma registry age distribution in infants, followed by a relatively steady decline until age 11, at which point there is an increase in cases that reaches a peak at age 18, with 1,328 cases. The rest of the graph indicates a slow decline until the end, with another slight peak at age 38. Both of these peaks mirror national data. 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. In addition, isolated hip fractures, a common traumatic injury in older adults, are not typically referred to trauma services, or included in registry data.

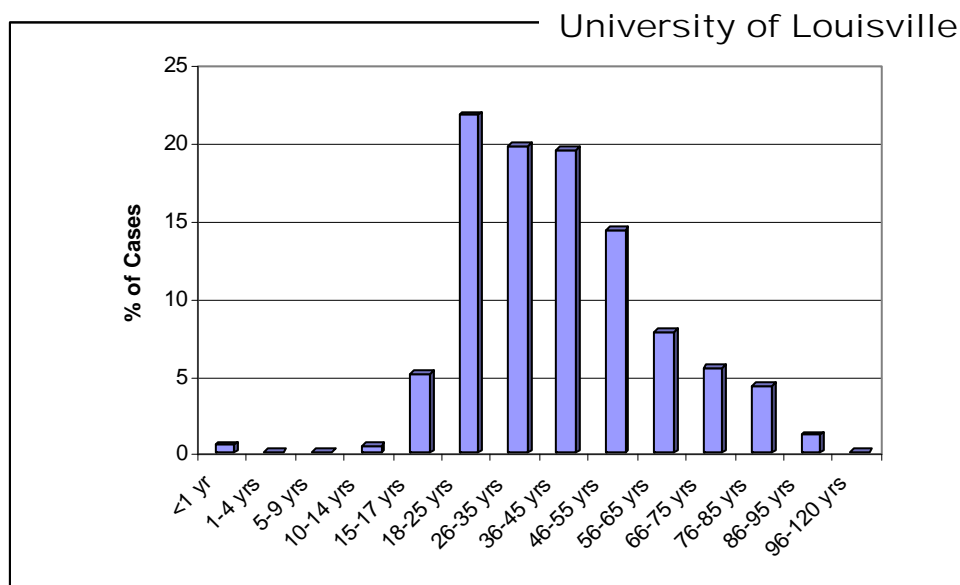
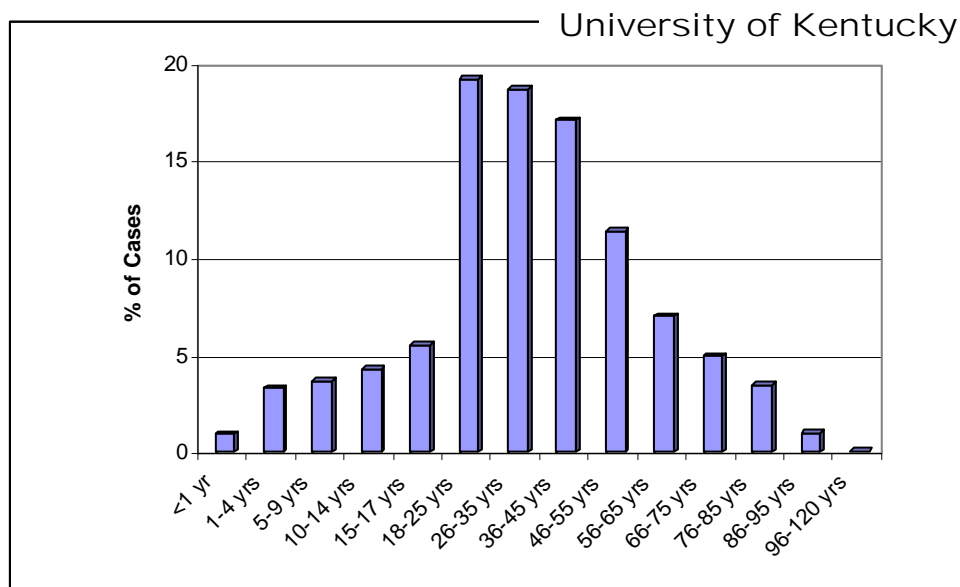
**Figure 7.** Number of patients by age and gender, 1995-2006.



# Kentucky Trauma Registry 1995-2006

While both genders follow a distribution similar to Figure 6, there are clearly more male patients at all but the oldest ages. The Kentucky trauma age distribution is consistent with NTDB data: 65.1% 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 mid-70's, reflecting the disproportionate number of women in the oldest age groups.

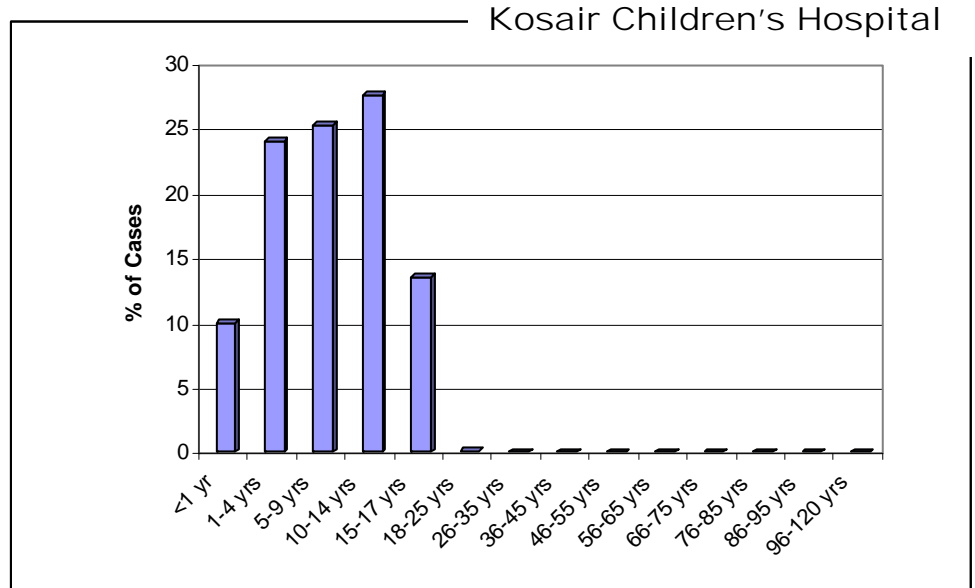
**Figure 8.** Trauma registry age distribution by hospital, 1995-2006.



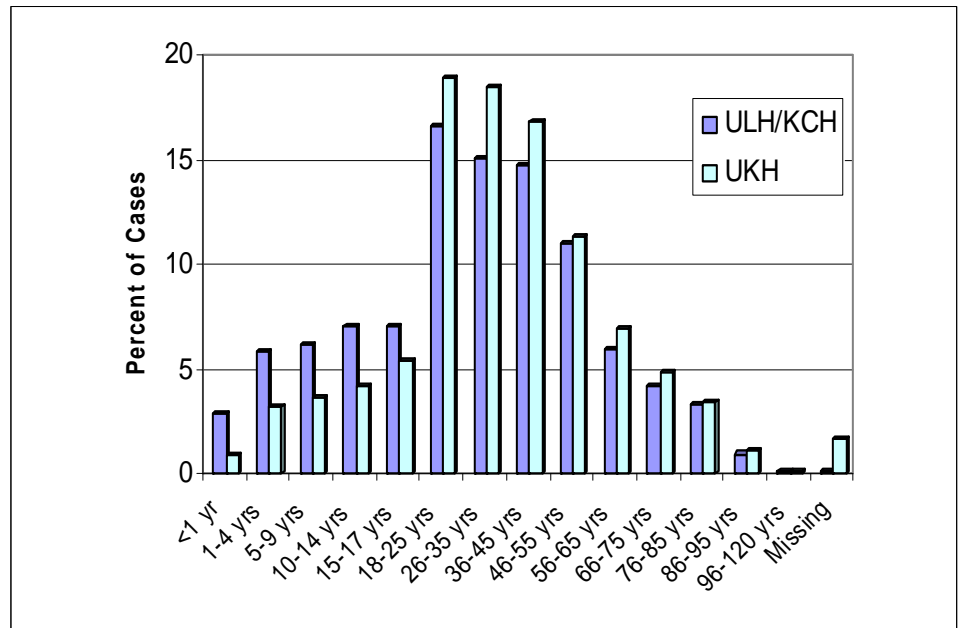
# Kentucky Trauma Registry 1995-2006

The age distribution follows a bell curve in each graph, for the most part. Combining KCH and ULH, the data follows a bell curve as well.

**Figure 8 cont.** Trauma registry age distributions by hospital, 1995-2006.

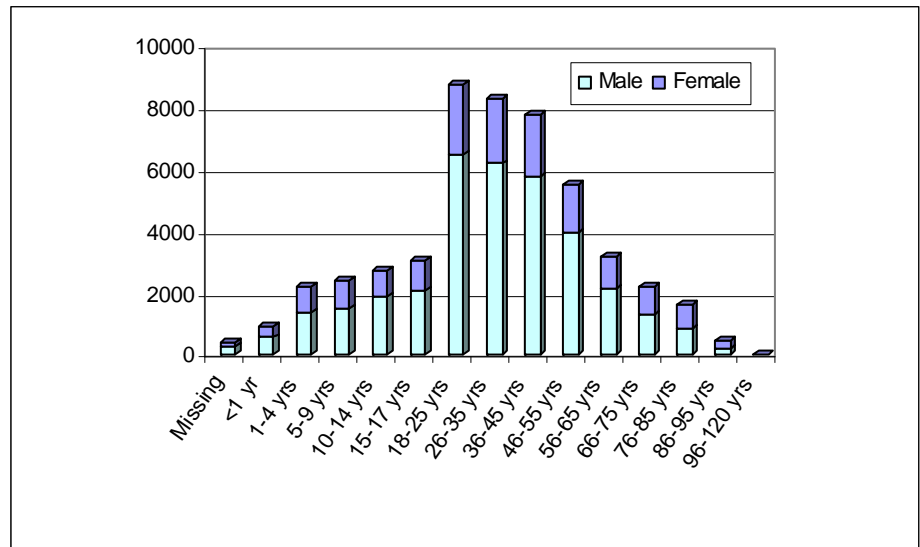


Combining ULH and KCH data allows a comparison of the ages of patients treated with the UKH patient database. The result shows a higher percentage of youth treated at the Louisville trauma centers, which serve a more urban population, and a higher percentage of elderly treated at the UKH trauma center, which serves a more rural population.



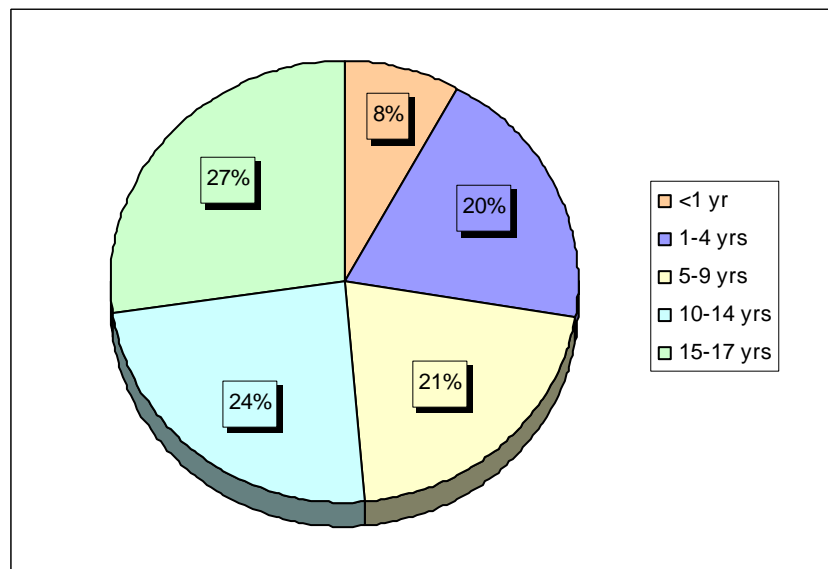
# Kentucky Trauma Registry 1995-2006

**Figure 9.** Trauma registry age distribution by gender, 1995-2006.



The above figure shows a substantial difference between the genders in all age groups through the 66-75 years cohort. There is a narrowing of the gap in the senior population.

**Figure 10.** Composition of Pediatric Patients, 1995-2006.



# Kentucky Trauma Registry 1995-2006

## Patient Residence

**Table 3.** Patient residence (percent), 1995-2006.

	<b>KCH</b>	<b>UKH</b>	<b>ULH</b>	<b>Total</b>
Kentucky	52.5	86.2	77.8	79.0
Indiana	18.7	0.6	18.2	9.3
Ohio	0.1	1.8	0.6	1.1
Tennessee	0.4	0.3	0.5	0.4
Michigan	0.0	0.4	0.3	0.3
Missing	27.3	9.2	0.7	8.2
Other	0.9	1.6	2.0	1.7

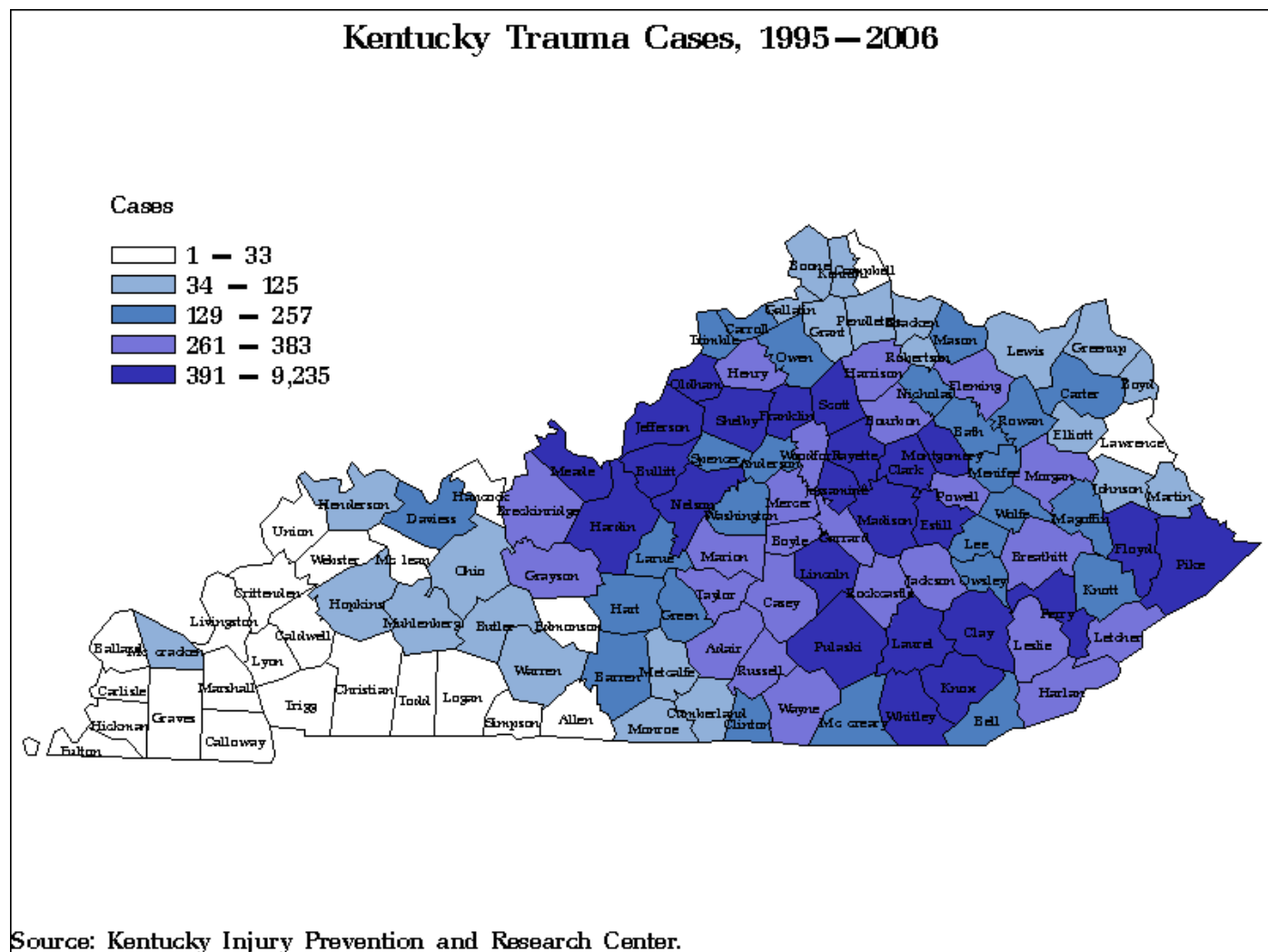
A large majority of the patients treated in Kentucky trauma centers reside in Kentucky. Residents of Indiana comprised the second largest number, with 18.7% of Kosair's patients, and 18.2% of Louisville's patients (some Louisville suburbs are located in Indiana). Percentage totals here may not equal 100% due to rounding.

**Table 4.** Leading counties of residence, by incidence and rate, 1995-2006.

<b>Top 10 counties of residence by # of cases</b>				<b>Top 10 counties of residence by rate</b>			
	N	%	County rate (per 1000)		N	%	County rate (per 1000)
Jefferson	<b>9235</b>	18.6	13.2	Owsley	192	0.4	<b>40.9</b>
Fayette	<b>2906</b>	5.8	10.7	Clay	683	1.4	<b>28.4</b>
Madison	<b>992</b>	2.0	12.6	Nicholas	196	0.4	<b>28.2</b>
Hardin	<b>937</b>	1.9	9.7	Jackson	372	0.7	<b>26.9</b>
Nelson	<b>862</b>	1.7	20.5	Estill	400	0.8	<b>26.4</b>
Laurel	<b>842</b>	1.7	14.8	Leslie	306	0.6	<b>25.6</b>
Bullitt	<b>702</b>	1.4	9.6	Powell	338	0.7	<b>24.4</b>
Clay	<b>683</b>	1.4	28.4	Lee	185	0.4	<b>24.2</b>
Pulaski	<b>660</b>	1.3	11.0	Wolfe	171	0.3	<b>24.1</b>
Clark	<b>591</b>	1.2	16.8	Casey	369	0.7	<b>22.6</b>
Other Ky Counties	21260	41.7	N/A	Other Ky Counties	35943	72.3	N/A
Unknown	4028	8.1	N/A	Unknown	4028	8.1	N/A

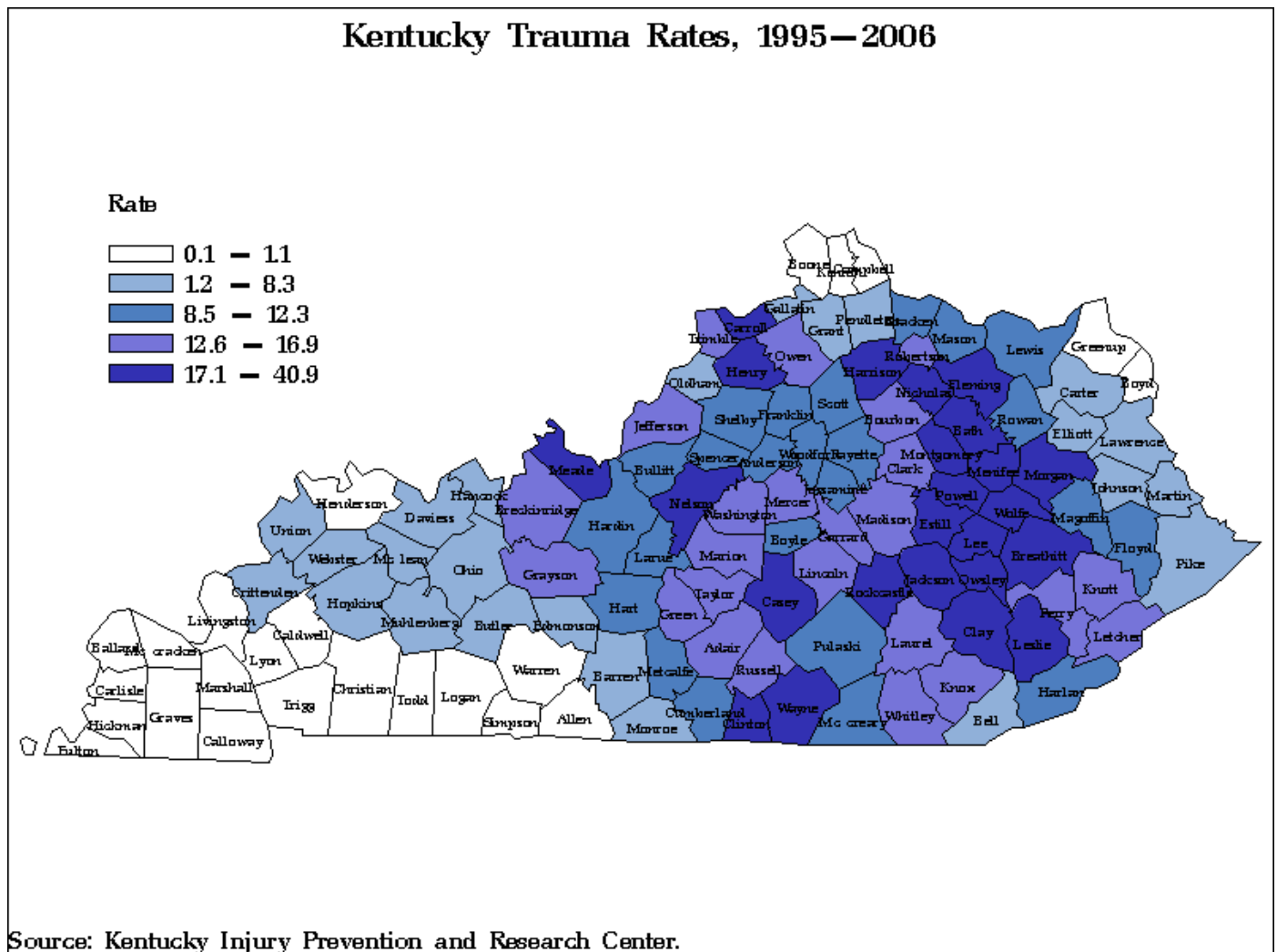
The rates in table 4 are crude rates based on the most recent county population estimates. These rates are over the 12 year period covered by the trauma registry (i.e. not yearly rates) and are per 1000 residents. While the "Top 10 counties of residence by rate" make up less than 10% of the trauma registry, these counties have higher rates of occurrences with respect to the population of the county. These counties may be candidates for closer scrutiny and prevention/education programs. Note that 8% 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. Therefore, border counties are underrepresented in the trauma registry. This can be seen clearly in Figures 11 and 12. Comparing only raw numbers, the leading counties of trauma patient residence are those with the highest populations, near the trauma centers.

**Figure 11.** Trauma cases by county, 12 year period, 1995-2006.



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**Figure 12.** Crude trauma rates by county, 12 year period, 1995-2006.



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**Table 5.** Race (percent) by hospital.

	University of Kentucky				
	Caucasian	African-American	Hispanic	Other	Missing
1995	94.3	4.3	0.8	0.5	0.0
1996	93.0	5.0	1.5	0.4	0.0
1997	93.2	5.3	1.4	0.1	0.0
1998	93.8	3.6	2.4	0.2	0.0
1999	93.7	3.9	2.3	0.2	0.0
2000	94.1	3.1	2.5	0.2	0.0
2001	94.0	3.2	2.7	0.2	0.0
2002	94.1	2.8	2.9	0.2	0.0
2003	93.3	3.9	2.7	0.2	0.0
2004	93.5	3.0	3.0	0.4	0.0
2005	93.4	3.1	2.8	0.3	0.4
2006	93.3	3.2	2.7	0.2	0.7
Average	93.6	3.7	2.3	0.3	0.1

	University of Louisville				
	Caucasian	African-American	Hispanic	Other	Missing
1995	80.6	17.4	1.2	0.7	0.1
1996	80.2	17.7	1.2	0.5	0.4
1997	80.3	16.8	2.0	0.7	0.2
1998	84.1	13.6	0.7	1.7	0.0
1999	81.8	14.9	1.1	2.2	0.0
2000	81.9	14.0	1.5	2.6	0.1
2001	82.1	12.9	1.1	3.9	0.0
2002	83.9	11.9	1.2	2.9	0.1
2003	83.6	12.2	1.7	2.6	0.0
2004	80.8	14.2	1.8	3.2	0.0
2005	79.6	14.8	2.2	3.2	0.1
2006	81.1	14.0	2.3	2.7	0.0
Average	81.7	14.5	1.5	2.2	0.1

	Kosair Children's Hospital				
	Caucasian	African-American	Hispanic	Other	Missing
1995	77.1	20.4	0.0	2.6	0.0
1996	82.5	17.0	0.0	0.5	0.0
1997	77.0	21.6	0.0	1.4	0.0
1998	75.4	21.8	0.0	2.8	0.0
1999	79.3	17.6	0.0	3.1	0.0
2000	77.7	18.8	0.0	3.5	0.0
2001	82.6	13.7	2.0	1.5	0.2
2002	81.2	15.3	1.6	1.9	0.0
2003	83.3	14.1	1.9	0.6	0.2
2004	81.5	13.6	2.6	2.3	0.0
2005	81.1	13.8	2.7	2.5	0.0
2006	84.4	12.1	2.5	0.9	0.0
Average	80.3	16.6	1.1	2.0	0.0

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**Table 6.** Race (percent) for all reporting facilities

	Combined Hospitals				
	Caucasian	African-American	Hispanic	Other	Missing
1995	87.1	11.2	0.9	0.8	0.0
1996	87.0	11.2	1.3	0.4	0.2
1997	86.9	11.1	1.5	0.5	0.1
1998	88.4	9.0	1.5	1.0	0.0
1999	87.7	9.4	1.6	1.3	0.0
2000	87.2	9.4	1.8	1.6	0.0
2001	87.9	8.2	2.0	1.8	0.0
2002	88.3	8.2	2.0	1.5	0.0
2003	87.8	8.8	2.1	1.3	0.0
2004	87.3	8.5	2.5	1.7	0.0
2005	87.6	8.0	2.6	1.4	0.3
2006	88.1	7.9	2.5	1.1	0.3
Average	87.6	9.3	1.9	1.2	0.1

The combined data for all hospitals and all years shows that a large majority (87.6%) of all patients were Caucasian, 9.3% of all patients were African-American, and 1.9% of patients were Hispanic. The average percentage of Hispanic patients in all trauma centers is 1.9%, but UKH sees a larger percentage at 2.3%. KCH and ULH see a much higher percentage of African-American trauma patients in their hospitals (16.6% and 14.5%) than does UKH (3.7%), reflecting the much higher proportion of African-Americans in the Metro Louisville population.

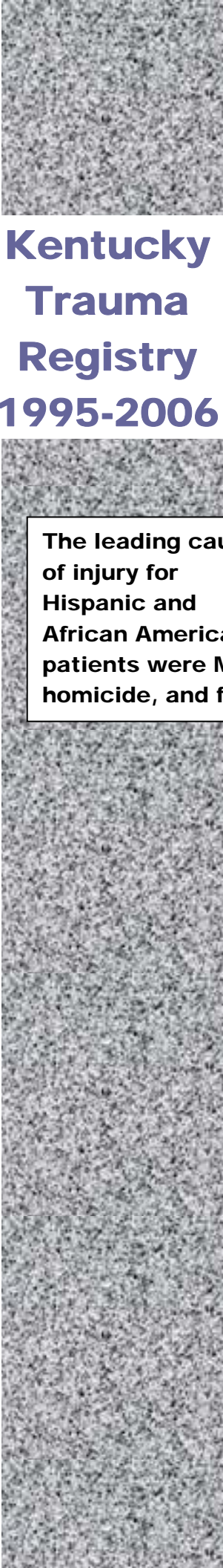
The Caucasian proportion of trauma cases has remained relatively stable across the eight years of data, and the African-American proportion has steadily decreased. While the numbers are not large, an increase in the Hispanic population can be seen across the twelve years of data, a trend that should 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, slightly higher than the trauma registry average of 87.6%. Conversely, the proportion of African-Americans in the trauma registry, 9.3%, 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, while the trauma registry shows an average of 1.9%. 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 4,570 African-American patients received care at the three level one trauma hospitals. Their mean age was 29.3 years with a median age of



## Kentucky Trauma Registry 1995-2006

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

27 which shows a somewhat younger population than the entire trauma database (mean age 33.6 with a median age of 31). 27.7% of African-American trauma registry patients were under the age of 18 vs 23.3% of trauma registry patients as a whole.

The leading cause of injury for African-American trauma registry patients (as for all registry patients) was motor vehicle crashes, though at a lower rate than the trauma database as a whole (44.1% vs 59.4%, respectively). Assault/homicide was the second leading cause of trauma injury for African-Americans with a significantly higher rate (28.1%) than for the entire trauma database (8.3%). Falls, though still one of the leading causes of injury, were slightly lower for this population (8.9%) than the population as a whole (13.3%).

Deaths for African American trauma patients (9.7%) were slightly higher than the database as a whole (7.7%). This also appeared to be a younger population with African-American trauma patients who died having a mean age of 33.4 and a median age of 30 while overall the mean age for deaths in the trauma database was 43.4 with a median age of 41. Just under one third (32.7%) of these deaths were assault/homicide related. This number was much higher than the trauma population as a whole with only 9.4% of deaths being assault/homicide related.

### **Hispanic Data Summary**

A total of 943 Hispanic trauma registry patients received care at the three level one trauma hospitals. Their mean age was 28 years with a median age of 27, and this was also a younger population than the trauma patients as a whole. Conversely, only 14.7% of Hispanic trauma registry patients were under the age of 18 vs 23.3% of the registry overall. Males comprised an even higher percentage of the Hispanic population (87.9%) than the already high rate of males in the entire trauma population.

The leading causes of injury for Hispanics were motor vehicle crashes (49.7%), followed by assault/homicide (19.2%) and falls (14.4%). Both assault/homicide and fall rates were higher than the trauma population as a whole (8.3% and 13.3%, respectively).

Trauma registry cases resulted in death for 7.6% of Hispanic patients. While closer to the overall death rate, these deaths are occurring even younger than the African-American population with a mean age of 27.7 and a median age of 27. Occupants in car crashes are the leading cause of death for the Hispanic trauma patients with homicide being the second leading cause of death with 15.3%. As with the African-American trauma patients, this rate is higher than the trauma population as a whole.

# Kentucky Trauma Registry 1995-2006

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

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

## Monthly Distribution

More traumatic injury occurs in the warmer months of May through October than in the rest of the year. July (10.3%), August (9.8%), and September (9.6%) saw the highest percentages of trauma registry patients. Monthly trends over the 12 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.

**Figure 13.** Distribution of patients (percent) by month, 1995-2006.

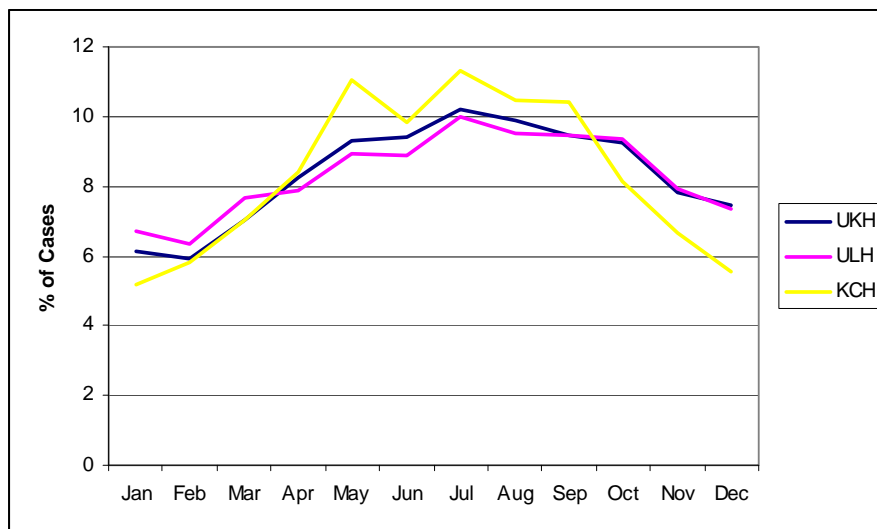
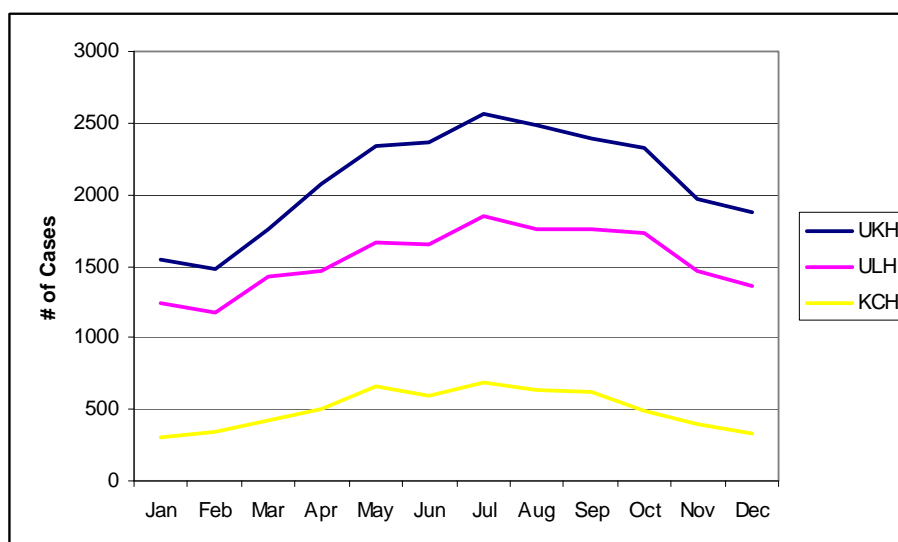


Figure 11 shows the monthly averages (percent) at each hospital over the twelve year period. Figure 12 shows the same monthly averages at each hospital, this time using the numbers of patients rather than percent of patients seen each month.

**Figure 14.** Distribution of patients (number) by month, 1995-2006.



## II. Cause of Injury

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 7 cases out of 49,725 were missing an e-code. Because poisoning cases are not typically admitted to trauma units, they are not typically included in the trauma registry data.

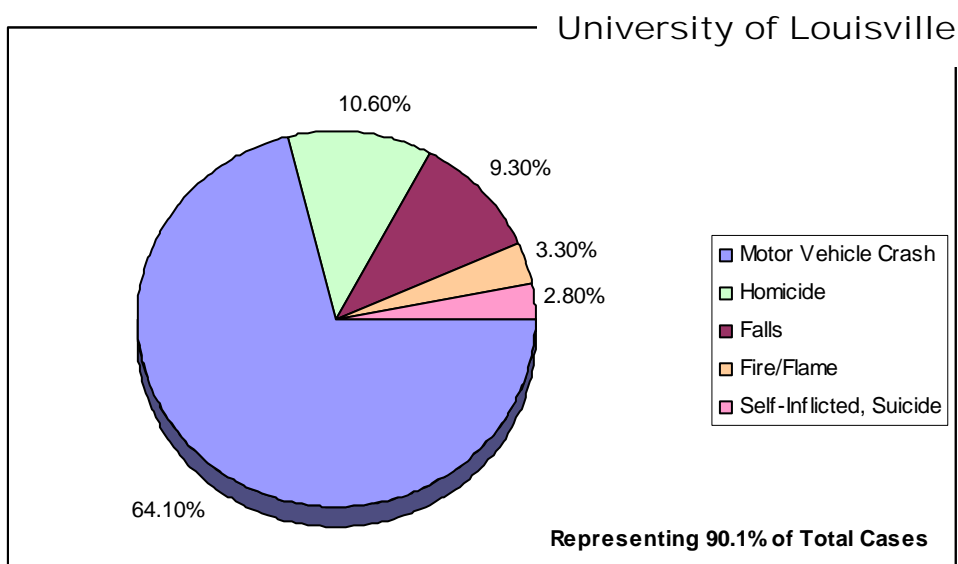
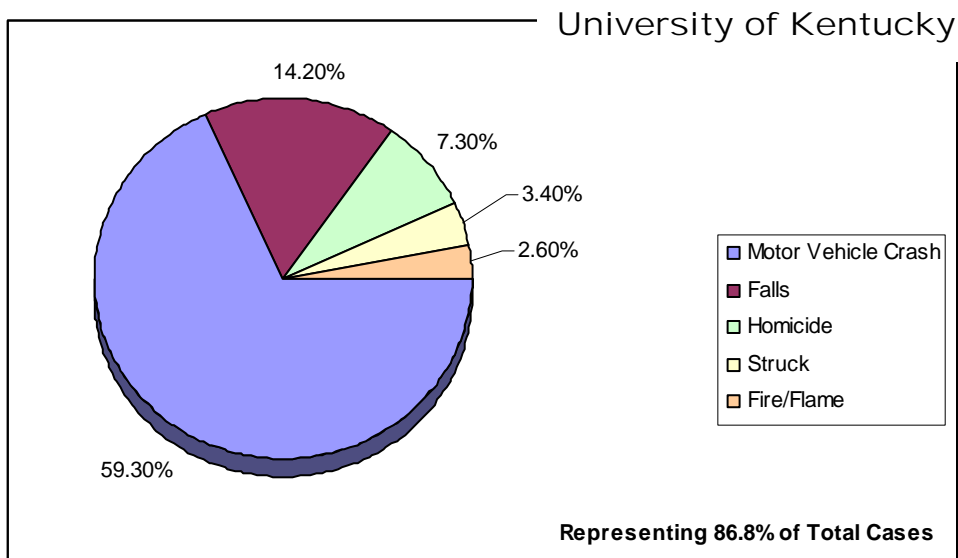
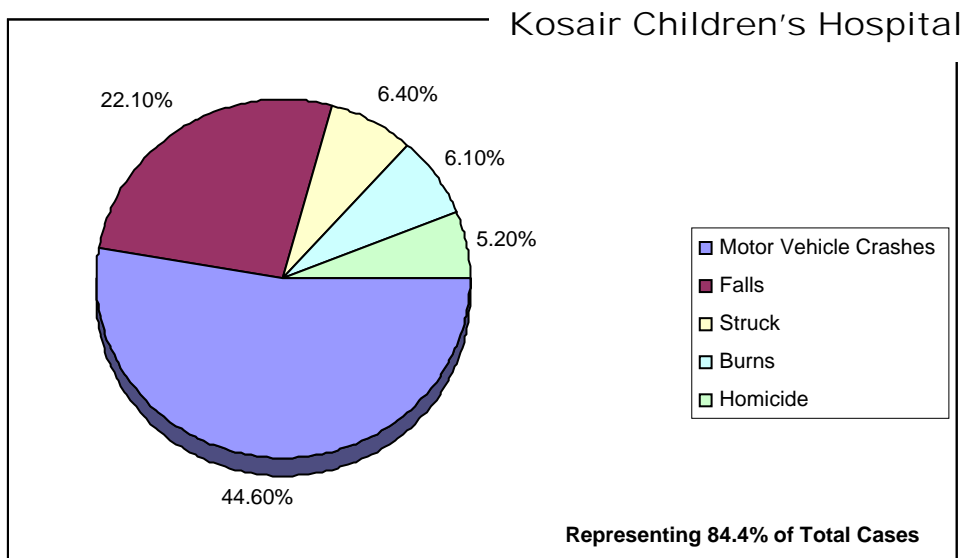
**Table 7.** Cause of injury, 1995-2006.

E-Code Group	KCH		UKH		ULH		Total	
	cases	%	cases	%	cases	%	cases	%
Cut/Pierce	73	1.2	389	1.5	102	0.5	564	1.1
Drowning/Submersion	66	1.1	70	0.3	5	0.0	141	0.3
Fall	1326	22.1	3579	14.2	1722	9.3	6627	13.3
Fire/Flame	224	3.7	667	2.6	617	3.3	1508	3.0
Burn	368	6.1	314	1.2	220	1.2	902	1.8
Firearm	61	1.0	421	1.7	310	1.7	792	1.6
Machinery	45	0.7	507	2.0	225	1.2	777	1.6
MV Occupant	1258	21.0	7250	28.8	8656	46.7	17164	34.5
Motorcycle	90	1.5	780	3.1	1047	5.6	1917	3.9
MV - Other	17	0.3	33	0.1	45	0.2	95	0.2
MV - Unspecified	33	0.5	151	0.6	278	1.5	462	0.9
Pedal Cyclist	457	7.6	330	1.3	156	0.8	943	1.9
Pedestrian	432	7.2	842	3.3	780	4.2	2054	4.1
ATV's	110	1.8	494	2.0	147	0.8	751	1.5
Transport, Other	281	4.7	5060	20.1	792	4.3	6133	12.3
Natural/Environmental	55	0.9	152	0.6	61	0.3	268	0.5
Bites/Stings	100	1.7	149	0.6	13	0.1	262	0.5
Overexertion	48	0.8	6	0.0	5	0.0	59	0.1
Poisoning	6	0.1	21	0.1	8	0.0	35	0.1
Struck	384	6.4	852	3.4	262	1.4	1498	3.0
Suffocation	6	0.1	6	0.0	1	0.0	13	0.0
Other Unintentional	158	2.6	525	2.1	360	1.9	1043	2.1
Adverse Medical Care	1	0.0	1	0.0	24	0.1	26	0.1
Adverse Drugs	0	0.0	1	0.0	17	0.1	18	0.0
Self-Inflicted, Suicide	13	0.2	630	2.5	522	2.8	1165	2.3
Homicide	313	5.2	1830	7.3	1961	10.6	4104	8.3
Undetermined	61	1.0	77	0.3	151	0.8	289	0.6
Unintentional, Missing	4	0.1	8	0.0	14	0.1	26	0.1
Legal Intervention	0	0.0	16	0.1	31	0.2	47	0.1
Unspecified/Missing	11	0.2	9	0.0	22	0.1	42	0.1
<b>Total</b>	<b>6001</b>	<b>100.0</b>	<b>25170</b>	<b>100.0</b>	<b>18554</b>	<b>100.0</b>	<b>49725</b>	<b>100.0</b>

Motor vehicle-related events accounted for a majority (59.4%) of trauma patients at the three hospitals. The top five causes of injury for all trauma patients were motor vehicle incidents (59%), falls (13%), attempted homicide (8%), struck by/against (3%), and fire/flame (3%).

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Figure 15. Leading causes of injury by hospital, 1995-2006.



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 two of the three hospitals as well as overall. 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 (84.4 - 90.1%) 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 latest report from the National Trauma Data Bank (covering years 2002-2006) lists motor vehicle injuries as the leading cause of injury (45.1%). Kentucky’s motor vehicle injuries come in at a much higher percentage (59.4%). Falls come in second for both as well, with the NTDB registry listing 30.2% falls, and Kentucky listing 13.3% of cases as falls. The lower Kentucky percentage for falls may be attributable to the exclusion of stays under 48 hours and many isolated hip fractures from the data. The Kosair data points to the high incidence of serious falls among children.

**Table 8.** Cause of injury by age, percentages within cause of injury, 1995-2006.

	MV Related		Fall		Homicide		Fire		Struck By/Against		Other		Total	
	cases	%*	cases	%*	cases	%*	cases	%*	cases	%*	cases	%*	cases	%*
Missing	12	0.0	4	0.1	5	0.1	0	0.0	1	0.1	6	0.1	28	0.1
<1 yr	170	0.6	269	4.1	227	5.5	18	1.2	34	2.3	195	3.0	913	1.8
1-4 yrs	688	2.3	591	8.9	89	2.2	89	5.9	115	7.7	693	10.7	2265	4.6
5-9 yrs	1280	4.3	585	8.8	23	0.6	82	5.4	145	9.7	308	4.8	2423	4.9
10-14 yrs	1670	5.7	399	6.0	55	1.3	116	7.7	200	13.4	358	5.5	2798	5.6
15-17 yrs	2369	8.0	163	2.5	177	4.3	70	4.6	112	7.5	237	3.7	3128	6.3
18-25 yrs	6069	20.6	476	7.2	1002	24.4	174	11.5	157	10.5	958	14.8	8836	17.8
26-35 yrs	5090	17.2	677	10.2	1047	25.5	232	15.4	196	13.1	1114	17.2	8356	16.8
36-45 yrs	4525	15.3	887	13.4	901	22.0	263	17.4	236	15.8	1082	16.7	7894	15.9
46-55 yrs	3252	11.0	794	12.0	393	9.6	177	11.7	174	11.6	720	11.1	5510	11.1
56-65 yrs	1877	6.4	595	9.0	122	3.0	120	8.0	72	4.8	404	6.2	3190	6.4
66-75 yrs	1331	4.5	505	7.6	34	0.8	94	6.2	43	2.9	241	3.7	2248	4.5
76-85 yrs	970	3.3	460	6.9	26	0.6	51	3.4	12	0.8	131	2.0	1650	3.3
86-95 yrs	204	0.7	214	3.2	3	0.1	19	1.3	1	0.1	22	0.3	463	0.9
96-120 yrs	12	0.0	8	0.1	0	0.0	3	0.2	0	0.0	0	0.0	23	0.0
Total	29519	100.0	6627	100.0	4104	100.0	1508	100.0	1498	100.0	6469	100.0	49725	100.0

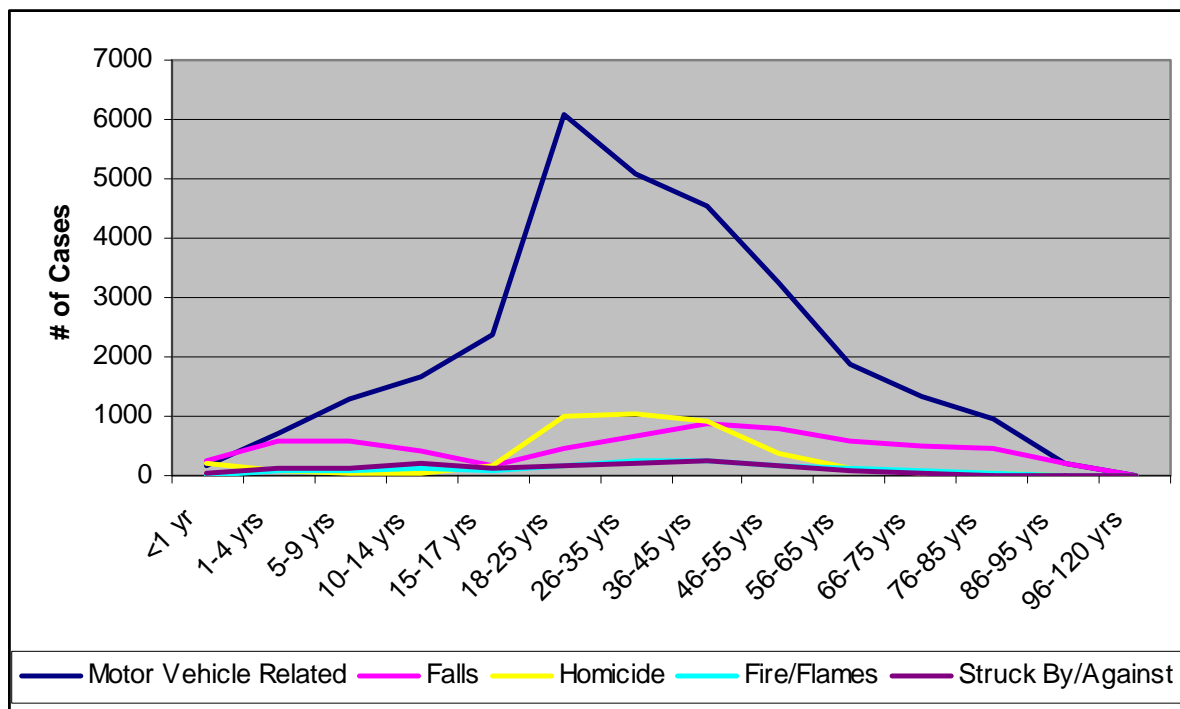
\*Percentages within Cause of Injury

**Table 9.** Cause of Injury by Age, Percentages within Age Group, 1995-2006.

	MV Related		Fall		Homicide		Fire		Struck By/Against		Other		Total	
	cases	%*	cases	%*	cases	%*	cases	%*	cases	%*	cases	%*	cases	%*
Missing	12	42.9	4	14.3	5	17.9	0	0.0	1	3.6	6	21.4	28	100.0
<1 yr	170	18.6	269	29.5	227	24.9	18	2.0	34	3.7	195	21.4	913	100.0
1-4 yrs	688	30.4	591	26.1	89	3.9	89	3.9	115	5.1	693	30.6	2265	100.0
5-9 yrs	1280	52.8	585	24.1	23	0.9	82	3.4	145	6.0	308	12.7	2423	100.0
10-14 yrs	1670	59.7	399	14.3	55	2.0	116	4.1	200	7.1	358	12.8	2798	100.0
15-17 yrs	2369	75.7	163	5.2	177	5.7	70	2.2	112	3.6	237	7.6	3128	100.0
18-25 yrs	6069	68.7	476	5.4	1002	11.3	174	2.0	157	1.8	958	10.8	8836	100.0
26-35 yrs	5090	60.9	677	8.1	1047	12.5	232	2.8	196	2.3	1114	13.3	8356	100.0
36-45 yrs	4525	57.3	887	11.2	901	11.4	263	3.3	236	3.0	1082	13.7	7894	100.0
46-55 yrs	3252	59.0	794	14.4	393	7.1	177	3.2	174	3.2	720	13.1	5510	100.0
56-65 yrs	1877	58.8	595	18.7	122	3.8	120	3.8	72	2.3	404	12.7	3190	100.0
66-75 yrs	1331	59.2	505	22.5	34	1.5	94	4.2	43	1.9	241	10.7	2248	100.0
76-85 yrs	970	58.8	460	27.9	26	1.6	51	3.1	12	0.7	131	7.9	1650	100.0
86-95 yrs	204	44.1	214	46.2	3	0.6	19	4.1	1	0.2	22	4.8	463	100.0
96-120 yrs	12	52.2	8	34.8	0	0.0	3	13.0	0	0.0	0	0.0	23	100.0
Total	29519	59.4	6627	13.3	4104	8.3	1508	3.0	1498	3.0	6469	13.0	49725	100.0

\*Percentages within Age Group

**Figure 16.** Five leading causes of injury by age group (number of cases), 1995-2006.



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### III. Pre-Hospital Transport

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

**Table 10.** Hours to arrival (percent), 1995-2006.

	KCH	UKH	ULH	Total
Up to 1 hrs	6.1	8.6	24.0	14.1
1-2 hrs	7.5	17.5	7.0	12.4
3-5 hrs	9.7	21.6	3.7	13.5
6-12 hrs	3.9	10.5	2.9	6.9
13-24 hrs	3.9	0.7	1.7	1.5
24+ hrs	1.4	2.3	0.5	1.5
No Info	67.5	38.8	60.2	50.3

A greater percentage of ULH (24.0%) patients arrive within one hour of injury than KCH (6.1%) or UKH (8.6%). This may be due to the fact that more of the Louisville hospital's patients reside in Jefferson County, whereas UKH and KCH receive 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 50% of patients, including the majority of ULH (60%) and KCH (68%) patients, there was no information on either injury time or arrival time, making it impossible to calculate hours to arrival. Taking missing values out of the analysis leaves ULH with 60.4% of patients arriving within one hour of injury.

**Table 11.** Percent of deaths by arrival time, 1995-2006.

	KCH	UKH	ULH	Total
Up to 1 hrs	7.7	15.4	11.9	12.7
1-2 hrs	4.9	11.7	9.9	10.8
3-5 hrs	1.4	3.7	4.2	3.5
6-12 hrs	2.5	1.2	8.7	2.5
13-24 hrs	0.0	1.6	6.7	3.3
24+ hrs	0.0	3.4	6.0	3.3
No Info	3.7	7.4	9.3	7.6

The percentage of deaths under one hour for UKH (15.4%) appears to be significantly higher than that reported in past Kentucky Trauma Registry reports. This discrepancy reflects the steps taken to minimize differences among the hospitals' databases, which have led to the exclusion of the less seriously injured patients who were admitted for less than 48 hours. The result of excluding these less severe injuries appears to cause a large jump from previous results. 12.7% of all trauma patients who arrived within one hour of injury died. However, given the amount of missing data this numbers may not be reliable. Death data is not weighted for Injury Severity Scores (ISS).

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## 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 12.** 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

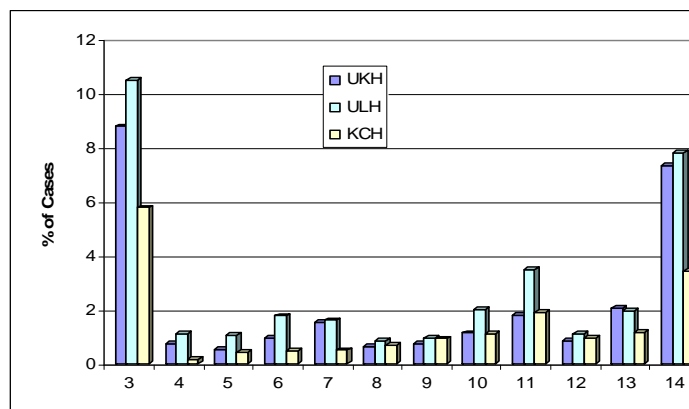
1 in 4 UKH patients, 1 in 3 ULH, and under 1 in 5 KCH patients had a GCS below 15.

**Table 13.** GCS means, std deviations and missing data by hospital (excluding GCS scores of 15), 1995-2006

	KCH	UKH	ULH	Overall
<b>Mean GCS</b>	8.38	8.53	8.33	8.46
<b>Std Deviation</b>	4.42	4.65	4.47	4.58
<b>% Missing Data*</b>	49.1	0.3	53.8	26.2

\*Not Included in Statistical Calculations

**Figure 17.** Distribution of GCS; UKH, ULH and KCH, 1995-2006.



Of the cases with a GCS score, 73.0% of UKH, 66.0% of ULH and 82.6% of KCH cases had GCS scores of 15. The percentages shown at left do not include missing scores.

# Kentucky Trauma Registry 1995-2006

The mean ISS for the three hospitals (excluding missing cases) was 12.94 (moderate).

## 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.

**Table 14.** Distribution of ISS by hospital (percent), 1995-2006.

ISS	KCH	UKH	ULH	Total
0-4	43.6	20.8	8.7	19.0
5-9	29.7	26.9	14.0	22.4
10-14	9.7	17.1	11.8	14.3
15-19	7.2	11.3	7.9	9.5
20-24	1.5	6.6	4.9	5.3
25-29	2.6	9.0	5.5	6.9
30-34	0.7	2.9	1.5	2.1
35-39	0.3	1.7	0.9	1.2
40-75	0.2	2.6	1.0	1.7
No Info	4.4	1.1	43.9	17.5
<b>Total</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>	<b>100.0</b>

ISS scores were missing in 8693 cases (17.5%), a majority of which were from ULH, making comparisons among the hospitals difficult.

**Table 15.** Comparison of NTDB 2002-2006 data to KY trauma data.

ISS Score	% of Cases*		Length of Stay		ICU Stay	
	NTDB	KY	NTDB	KY	NTDB	KY
Minor	45.2	31.7	2.8 days	4.0 days	0.4 days	1.2 days
Moderate	32.4	35.2	5.4 days	6.3 days	1.2 days	1.9 days
Severe	12.8	18.0	8.4 days	9.8 days	3.6 days	5.3 days
Very Severe	9.6	14.5	13.4 days	13.1 days	7.6 days	8.5 days

\*Percentage based on non-missing data

Using the NTDB classifications, 31.7% of all KY trauma patients have an ISS that is minor, compared to 45.2% of the NTDB. The 712 trauma centers included in the NTDB report include level II, III and IV hospitals, so it is not surprising that there is 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.

# Kentucky Trauma Registry 1995-2006

## VI. Hospital Data

### Admissions by Shift

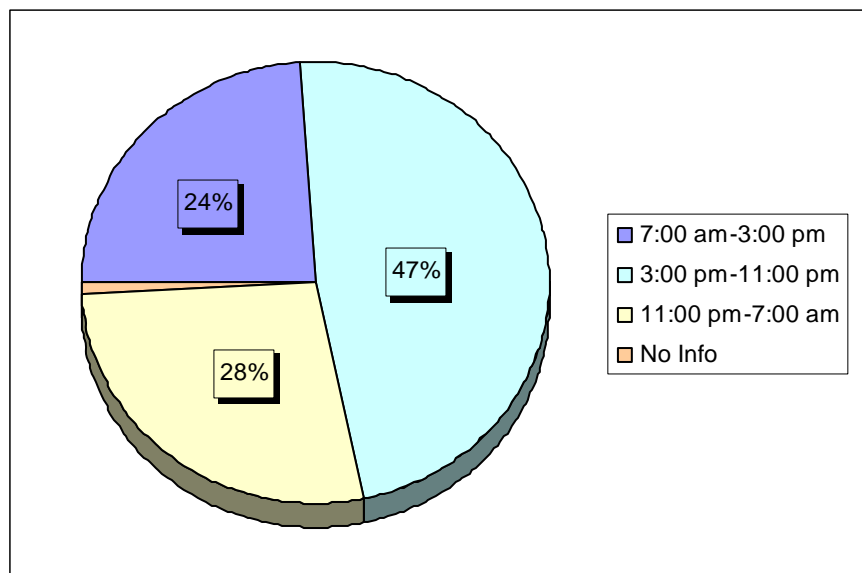
The frequency of admissions according to standard hospital employee work shift was examined. On average, there were nearly twice as many admissions (47.9%) on the second shift, 3:00 - 11:00 p.m., as on either the first shift (23.8%), 7:00 - 3:00 p.m., or the third shift (27.6%), 11:00 p.m. - 7:00 a.m. 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 16.** Patient admission by standard work shifts (percent), 1995-2006.

Shift of Arrival	KCH	UKH	ULH	Total
7:00 am-3:00 pm	20.4	22.9	26.0	23.8
3:00 pm-11:00 pm	58.9	48.5	43.6	47.9
11:00 pm-7:00 am	19.3	28.6	29.0	27.6
No Info	1.4	0.0	1.4	0.7

Nearly half (48%) of all patients arrive between 3 pm and 11 pm.

**Figure 18.** Distribution of patient admission, 1995-2006.



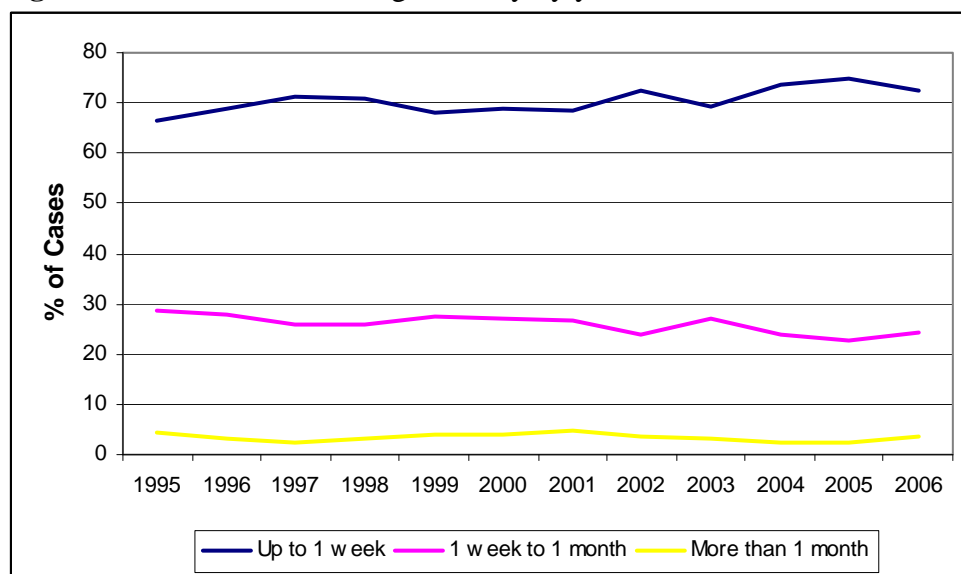
# Kentucky Trauma Registry 1995-2006

## Length of Stay (LOS)

**Table 17.** Length of stay (LOS) distribution (percent), 1995-2006.

<b>Length of Stay</b>	<b>KCH</b>	<b>UKH</b>	<b>ULH</b>	<b>Total</b>
Up to 1 week	83.8	72.8	61.3	69.9
1 week to 1 month	14.2	23.2	33.3	25.9
More than 1 month	0.9	2.6	5.2	3.3
No Info	1.1	1.5	0.2	0.9
<b>Mean (days)</b>	<b>4.7</b>	<b>6.7</b>	<b>9.5</b>	<b>7.5</b>
<b>Std Deviation</b>	<b>5.9</b>	<b>10.1</b>	<b>12.3</b>	<b>10.7</b>
<b>Range (days)</b>	<b>0-93</b>	<b>0-373</b>	<b>0-366</b>	<b>0-373</b>

**Figure 19.** Distribution of length of stay by year, 1995-2006.



The average length of stay for all hospitals was 7.5 days

Only 61.3% 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. As previously noted, ULH does not report stays of less than 48 hours which differs from UKH's trauma reporting criteria. Despite steps taken to ensure compatibility between data sets, it appears that ULH continues reporting the more severe injuries. The mean LOS at ULH (9.5 days) is still almost three days longer than that of UKH (6.7 days). More research is needed to determine if more serious injuries are being seen at ULH vs UKH or whether more work is needed to truly make the two databases compatible.

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Length of Stay (LOS) continued

**Figure 20.** Aggregate length of stay (in days) by E-code, 1995-2006.

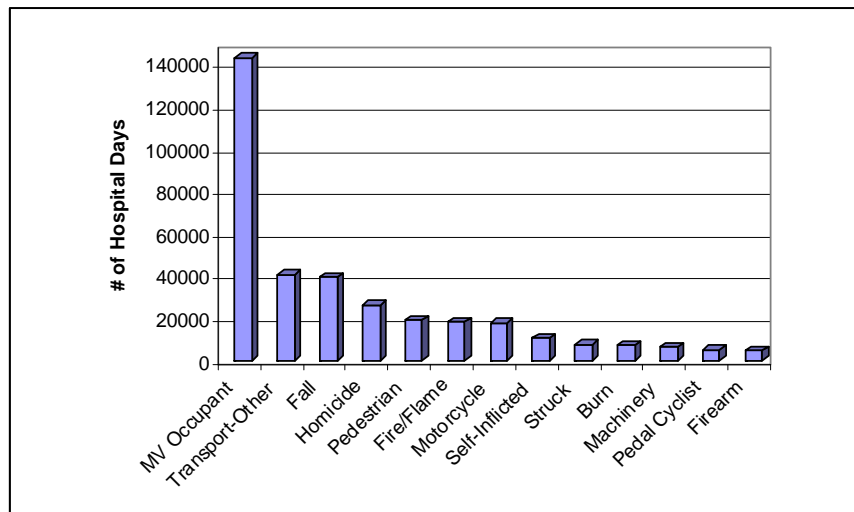


Figure 20 above shows the trauma hospital length of stay grouped by E-code (mechanism of injury). Total hospital length of stay for all E-codes was 370,833 days (120 cases were missing LOS). MV occupants had the highest numbers of days in the hospital at 143,202 followed by the category Transport-Other with 40,593 days.

**Figure 21.** Average length of stay (in days) by E-code, 1995-2006.

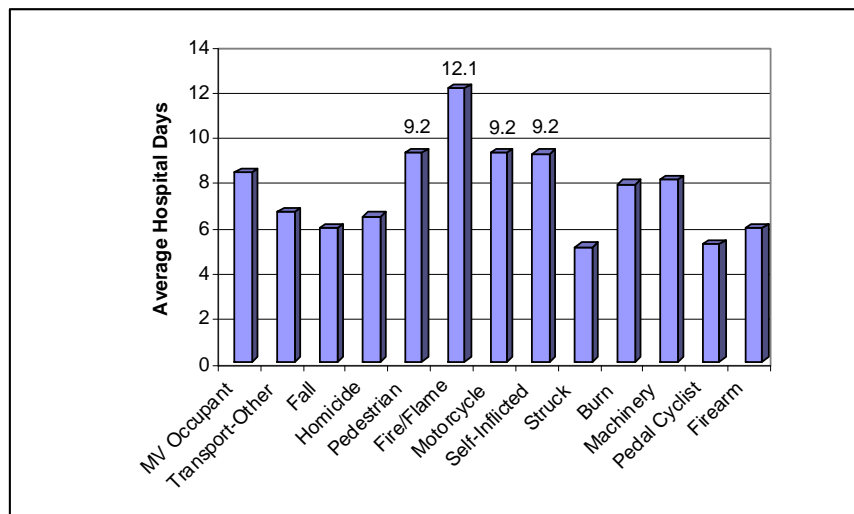


Figure 21 above shows the average hospital length of stay grouped by E-code. Average hospital length of stay is the total hospital length of stay divided by the number of patients within each E-code. For both figures the E-codes with the highest numbers of patients were used. Fire/flame, motorcycle, pedestrian, and self inflicted injuries had the highest average length of stay.

Intensive Care Unit Days

**Table 18.** Distribution of the number of days in the intensive care unit (ICU) (percent), 1995-2006.

<b>Length of ICU Stay</b>	<b>KCH</b>	<b>UKH</b>	<b>ULH</b>	<b>Total</b>
Zero days	7.3	31.3	33.6	29.2
Up to 1 week	15.5	20.8	27.7	22.7
1 week to 1 month	2.8	8.3	14.0	9.7
More than 1 month	0.3	0.8	2.1	1.2
No Info	74.1	38.9	22.6	37.1
Mean (days)	3.5	3.3	5.2	4.2
Std Deviation	6.2	7.3	9.6	8.4
Range (days)	0-58	0-133	0-157	0-157

ULH had the widest range of ICU days, zero to 157 days as well as a higher mean number of ICU days (5.2). Again, missing data makes an accurate comparison impossible with KCH having missing data for almost three quarters of their cases and UKH missing almost 40%. ULH's , while missing less data than the other two, is still missing nearly one quarter of data on ICU days.

# Kentucky Trauma Registry 1995-2006

Inclusion criteria complicate comparison of patient discharge status between hospitals.

## Hospital Outcome

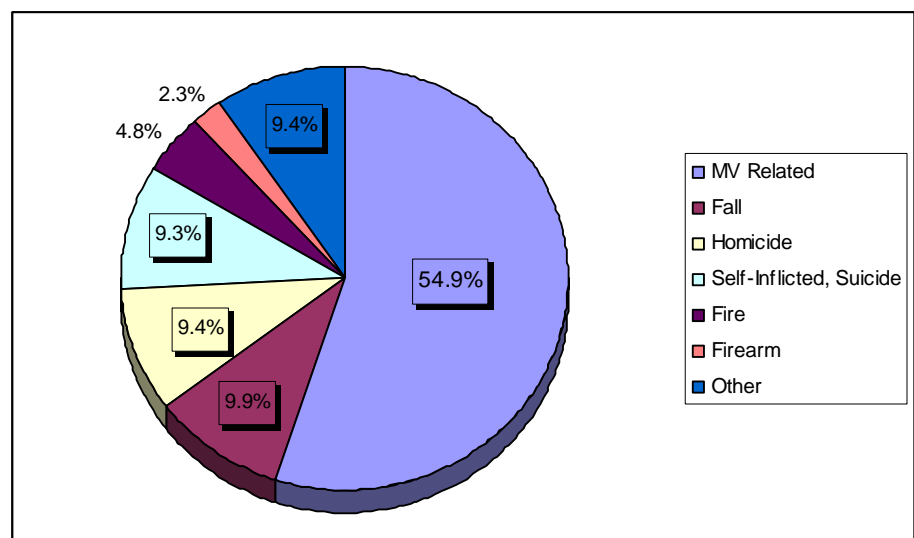
**Table 19.** Percent of patients by discharge status, 1995-2006.

Hospital Disposition	KCH	UKH	ULH	Total
Home	88.0	76.9	69.4	75.4
Death	3.6	7.2	9.7	7.7
Nursing Home	0.0	0.4	2.8	1.2
Hospital Transfer/ Medical Facility	2.4	0.1	2.7	1.3
LTC	0.0	1.0	0.0	0.5
Rehab	3.1	11.0	14.0	11.2
Foster Care	1.9	0.1	0.0	0.3
HOSP	0.0	0.8	0.0	0.4
Jail/Prison	0.0	0.0	0.6	0.2
Non-Medical Facility	0.2	0.0	0.0	0.0
Other	0.4	1.6	0.5	1.1
No Info	0.4	0.7	0.4	0.5

Coding differences between hospitals could affect the results shown here, and caution should be exercised when interpreting them. For example, despite attempts to standardize the data between hospitals, ULH 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.

Just over three-quarters (75.4%) of all patients were discharged home. 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.

**Figure 22.** Cause of injury leading to death, 1995-2006.



# Kentucky Trauma Registry 1995-2006

## 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. There were slightly more transfer (52.8%) than non-transfer (47.1%) patients when all three hospitals were combined.

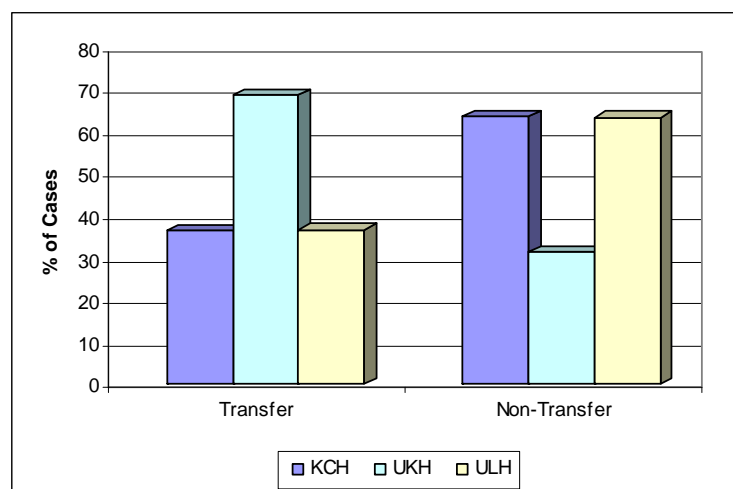
**Table 20.** Transfer vs. non-transfer patient percentages, 1995-2006.

	Transfer	Non-Transfer
Kosair Children's Hospital	36.5	63.4
University of Kentucky	68.6	31.4
University of Louisville	36.6	63.3
Total	52.8	47.1

Because UKH serves the rural eastern part of the state, it receives the majority of its patients (68.6%) through transfers from local hospitals, while ULH has a higher percentage (63.3%) of direct-from-the-scene transports because of its urban setting. This discrepancy can be seen in Figure 21 below.

Over 2 out of 3 of UKH's trauma patients were transfers from other facilities, whereas only just over 1 out of 3 of ULH's patients were transfers.

**Figure 23.** Transfer distribution, 1995-2006.



# Kentucky Trauma Registry 1995-2006

## Pre-Hospital Transport

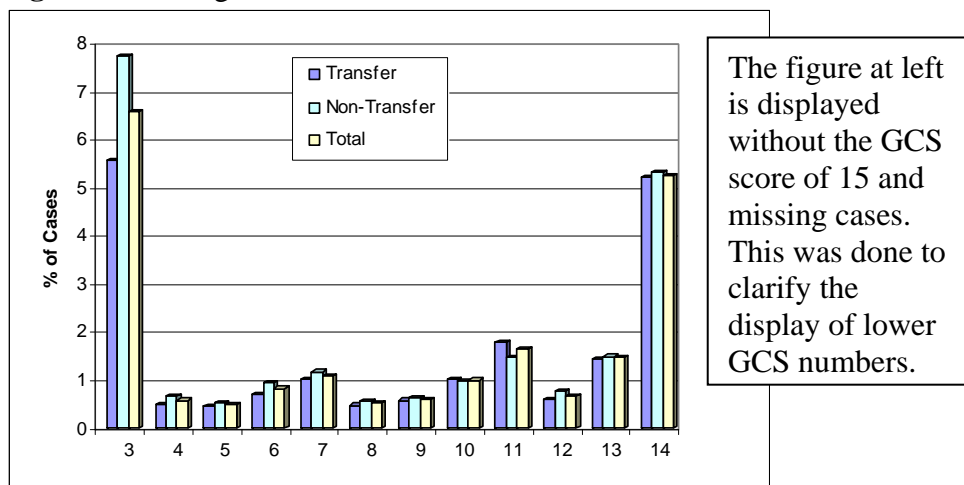
**Table 21.** Hours to arrival, 1995-2006.

Hours To Arrival	Transfer		Non-Transfer		Total	
	#	%	#	%	#	%
Up to 1	99	0.4	6900	32.1	6999	14.1
1-2	3257	12.4	2896	13.5	6154	12.4
3-5	6298	24.0	394	1.8	6694	13.5
6-12	3030	11.5	398	1.9	3429	6.9
12-24	528	2.0	206	1.0	734	1.5
24+	513	2.0	221	1.0	734	1.5
No Info	12538	47.7	12493	58.2	25003	50.3
Total	26263	100.0	21479	100.0	49747	100.0

As expected, there is a large discrepancy in the transfer vs. non-transfer patients regarding hours to arrival. Almost one-third (32.1%) of non-transfer patients arrived at the hospital within one hour of injury, whereas only 0.4% 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. A large percentage of transfer (47.7%) and non-transfer (58.2%) patients lacked information on hours to arrival.

## Glasgow Coma Score

**Figure 24.** Glasgow Coma Score, 1995-2006.



Transfer patients were less likely than others to have impaired consciousness: 64.9% of transfer patients, 40.3% of non-transfer patients, and 53.3% of all patients had a GCS of 15. GCS information was missing on 16.7% of transfer patients, 37.5% of non-transfer patients, and 26.2% of all patients.

### 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 22.** Distribution of ICU days (percent), 1995-2006.

	Transfer	Non-Transfer	Total
Zero days	32.5	25.6	29.2
Up to 1 week	21.4	24.2	22.7
1 week to 1 month	8.6	11.1	9.7
More than 1 month	1.0	1.4	1.2
No Info	36.4	37.8	37.1

Over one third of both non-transfer and transfer patients were missing data on number of ICU days. Just over one in four of all patients in the trauma system spent no days in the ICU. Non-transfer patients spent an average of 4.9 days in the ICU. This average excludes the 8,864 non-transfer patients with no information on ICU days. Transfer patients spent an average of 3.6 days in the ICU.

### Length of Stay (LOS)

**Table 23.** Length of stay (LOS) distribution, 1995-2006.

Hospital Days	Transfer		Non-Transfer		Total	
	#	%	#	%	#	%
Up to 1 week	19584	74.6	15503	66.1	35102	70.6
1 week to 1 month	5981	22.8	6860	29.2	12852	25.8
More than 1 month	651	2.5	1016	4.3	1671	3.4
No Info	47	0.2	75	0.3	122	0.2
Total	26263	100.0	23454	100.0	49747	100.0

Most transfer (74.6%) and non-transfer (66.1%) patients were treated and released within one week of admission.

Length of stay percentages are comparable for transfer and non-transfer patients. The average length of stay was lower for transfers (6.5 days) with the average length of stay for non-transfer patients being 8.6 days. Calculation of LOS for transfer patients does not include hospital time before the transfer to a trauma center, so total LOS could be longer for transfer patients.

Length of Stay (LOS) (continued)

**Table 24.** Transfer patients LOS percentages by hospital, 1995-2006.

Hospital Days	KCH		UKH		ULH	
	Transfer	Non-Transfer	Transfer	Non-Transfer	Transfer	Non-Transfer
0	0.3	1.4	4.3	7.4	0.9	3.7
1	45.6	1.5	20.7	2.5	17.7	4.4
2	17.5	29.5	16.4	11.7	9.1	9.6
3	10.6	19.7	11.3	13.6	9.0	12.5
4	7.0	12.2	8.5	11.0	8.3	10.3
5	3.7	8.4	6.7	9.0	7.3	8.2
6	2.8	5.4	5.0	6.8	6.2	6.7
7	2.9	3.5	4.0	5.1	4.7	5.1
8-14	6.4	11.9	14.3	18.5	18.9	20.5
15-21	1.7	3.9	4.4	6.6	8.3	8.3
22-31	1.1	1.5	2.7	4.4	5.4	5.4
More than 1 month	0.3	1.2	1.8	3.5	4.2	5.3

Hospital Outcome

**Table 25.** Transfer patients by discharge status, 1995-2006.

Outcome	Transfer		Non-Transfer		Total	
	#	%	#	%	#	%
Home	21006	80.0	16508	70.4	37534	75.4
Death	1341	5.1	2497	10.6	3838	7.7
Home Health	9	0.0	25	0.1	35	0.1
LTC	181	0.7	81	0.3	262	0.5
Nursing Home	224	0.9	389	1.7	614	1.2
Foster Care	65	0.2	65	0.3	130	0.3
Rehab	2535	9.7	3023	12.9	5564	11.2
Jail	29	0.1	85	0.4	114	0.2
Prison	4	0.0	5	0.0	9	0.0
Medical Facility	0	0.0	147	0.6	147	0.3
Hospital Transfer	243	0.9	277	1.2	521	1.0
Other	458	1.7	247	1.1	706	1.4
No Info	168	0.6	105	0.4	273	0.5
Total	26263	100.0	23454	100.0	49747	100.0

A somewhat larger proportion of transfer patients were discharged home (80.0% of transfer patients and 70.4% of non-transfer patients). There were 2,497 (10.6%) non-transfer deaths and 1,341 (5.1%) transfer deaths. 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 discrepancies in inclusion criteria may confound the analysis.

As mentioned previously, these results should be interpreted cautiously. 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 (23.2%) involved children. However, the proportion is much higher among teens 16 and older than in younger children (Table 24).

Table 26 lists the number of MV cases for each age from 0-17 years. The percentage of all MV cases (for the 0-17 age group) is listed next, followed by the percentage of all trauma registry cases for each age. For example, there are 179 MV cases for two year olds in the registry. This is 2.9% of the 6,176 MV cases for ages 0-17. This is also 30.4% of all registry cases for two year olds. Again, motor vehicle-related trauma increases in significance as children grow older.

**Table 26.** Number of children by age involved in motor vehicle incidents, 1995-2006.

	MV Related Cases	% of MV cases for 0-17 year olds	% of all registry cases for this age*
<1	171	2.8	18.7
1	117	1.9	19.1
2	179	2.9	30.4
3	182	2.9	32.4
4	209	3.4	41.6
5	236	3.8	44.8
6	254	4.1	48.8
7	281	4.5	53.1
8	256	4.1	60.4
9	254	4.1	59.3
10	234	3.8	54.0
11	300	4.9	59.5
12	300	4.9	58.4
13	348	5.6	59.9
14	488	7.9	63.5
15	546	8.8	68.0
16	822	13.3	76.0
17	999	16.2	80.4
Total	6176	100	53.5

\*This number represents the percentage of all injury types that MV represent for this age.

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.

# Kentucky Trauma Registry 1995-2006

When combined, the percentage of cases in the 16 and 17 year old age groups represent over one-fourth (29.5%) of all youth MV cases. In addition, 76.0% and 80.4% of all trauma registry cases in the 16 and 17 year old age groups were attributable to motor vehicles. Just over one in 20 (5.4%) youth MV cases resulted in death, but those deaths represented more than half (59.8%) 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. 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 27.** Comparison of pediatric NTDB 2002-2006 data and KY trauma data

Age in Years	% MVC of All Injuries		% MVC Resulted in Death		% All Deaths MVC Related	
	NTDB	KY	NTDB	KY	NTDB	KY
<1 yr	12.7	17.5	6.9	15.1	29.7	29.6
1-4 yrs	21.7	22.1	3.8	6.4	44.4	28.6
5-9 yrs	28.5	32.3	2.9	4.7	67.4	46.3
10-14 yrs	30.6	41.6	2.9	2.6	56.6	34.1
15-19 yrs	51.2	70.4	3.6	5.7	51.0	63.0
Total	37.2	47.0	3.5	5.3	51.2	48.3

The percentage of MV cases (shown in columns 2 and 3) is calculated by dividing the number of MVC cases in the age group by the total number of injury cases in that age group. Percentages are most comparable for the 1-4 age group, (21.7 vs 22.1) but beyond that, Kentucky's averages exceed the national averages in every grouping. Nationally, an average of 37.2% of all pediatric cases are motor vehicle related, while 47.0%, 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 3.5% nationally and 5.3% 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.

The last rate (columns 6 and 7) is calculated by dividing the number of MVC deaths by the total number of deaths for all injuries in each age group. The majority of Kentucky deaths for 15-19 year olds are a result of MVC, at a higher rate than national rates.

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**Table 28.** Number of children in the trauma registry aged 3 to 8 years\* involved in motor vehicle crashes\*\*, 1995-2006.

Year	Count
1995	77
1996	55
1997	54
1998	59
1999	44
2000	63
2001	77
2002	79
2003	76
2004	83
2005	93
2006	88
Total	848
Average per Year: 71	

\*Age range for which booster seats are recommended.

\*\* For tables 28 and 29, 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 29 below.

**Table 29.** Number of 16 and 17 year olds in the trauma registry involved in motor vehicle crashes, 1995-2006.

Year	Count
1995	150
1996	146
1997	158
1998	152
1999	180
2000	128
2001	138
2002	143
2003	128
2004	155
2005	153
2006	135
Total	1767
Average per Year: 147	

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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 6,176 youth MV cases, 493 (8.0%) involved ATVs. These 493 cases compose 35.1% of the 1,406 ATV cases in the registry. These 493 cases are broken down by age below.

**Table 30.** Number of children by age, involved in ATV incidents, 1995-2006.

Age in Years	ATV Cases	% of All MVC		Age in Years	ATV Cases	% of All MVC
<1	5	2.9		10	22	9.4
1	1	0.9		11	33	11.0
2	11	6.1		12	33	11.0
3	7	3.8		13	49	14.1
4	5	2.4		14	68	13.9
5	18	7.6		15	67	12.3
6	19	7.5		16	56	6.8
7	22	7.8		17	31	3.1
8	18	7.0				
9	28	11.0		Total	493	8.0

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 38 ATV deaths in the trauma registry. Of these, 14 (36.8%) 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. There are 110 cases missing information on county of injury. Only those counties with more than 9 cases are listed. ATV activity is customarily associated with rural locations, so the prominence of Jefferson County is noteworthy.

**Table 31.** Number of children by county involved in ATV incidents, 1995-2006.

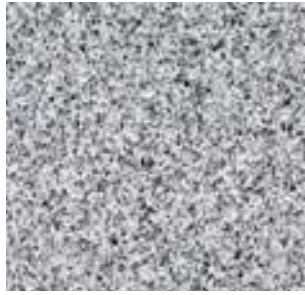
County of Residence (n)	County of Injury (n)
Jefferson (26)	Clay (24)
Clay (23)	Jefferson (21)
Laurel (22)	Laurel (21)
Breathitt (14)	Perry (13)
Nelson (13)	Letcher (12)
Knox (10)	Madison (12)
Letcher (10)	Breathitt (11)
Perry (10)	Knox (11)
All Others (280)	Nelson (10)
	All Others (224)



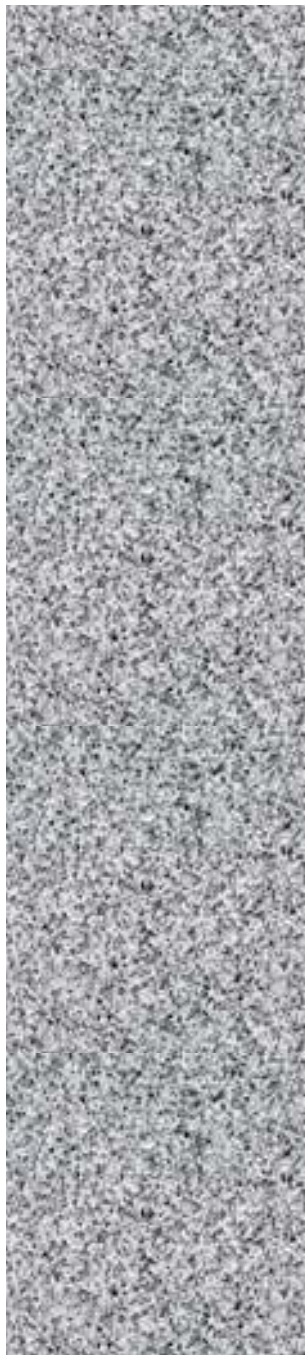
# Kentucky Trauma Registry 1995-2006

## 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. As this edition of the Kentucky Trauma Registry is being finalized, it appears that HB 371 will become law, establishing the framework and governance structure for a state trauma system. While HB 371 outlines funding options and allocations, there is no expectation of an appropriation for trauma system funding in the 2008 budget.
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.



# Kentucky Trauma Registry 1995-2006



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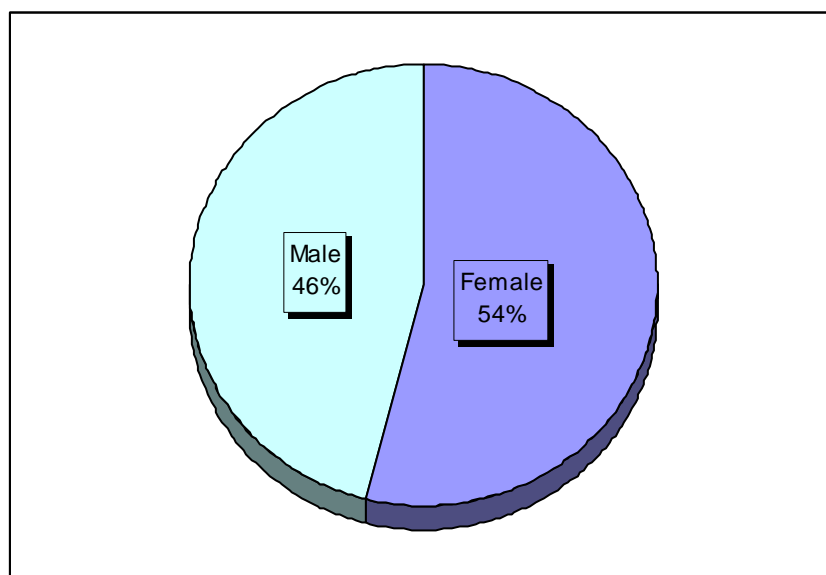
# Kentucky Hospital Injury Patients 2003-2006

## Appendix

### **Injured patients in all Kentucky hospitals**

The main body of this report has presented information on trauma patients seen in the three Level I trauma hospitals. This appendix will focus on Kentucky hospitals as a whole, with aggregate information on all 414,536 trauma inpatients seen in 2003-2006 at over 100 Kentucky hospitals. These patients all experienced some sort of trauma, but their injuries are generally 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 2006. When “Kentucky hospital injury patients” are referred to, we mean the dataset of all trauma inpatients seen in Kentucky hospitals from 2003-2006.

**Figure 25.** Gender composition of Kentucky injury patients, 2003-2006.



44.8% of all KY hospitals' injury patients and 69.6% of serious trauma patients are male.

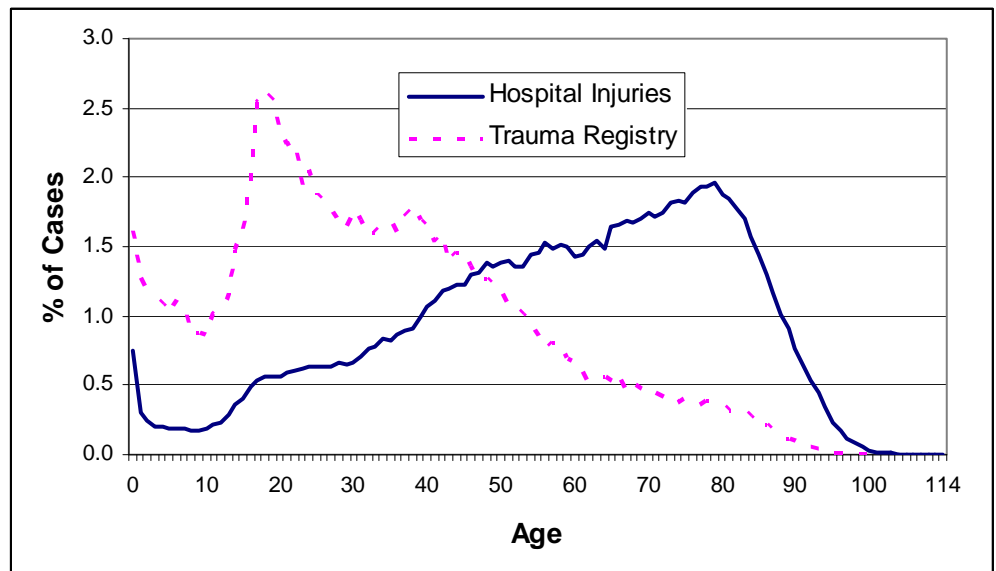
There is a striking difference in distribution of cases by gender between the two datasets, with a greater proportion of male patients seen for trauma in the trauma registry (69.6%) than for general trauma hospital admissions (44.8%). This distinction appears to reflect the disproportionate number of older persons—overwhelmingly female—with injuries due to falls in the broader hospitalized population (Fig. 26).

Age Distribution

**Table 32.** Kentucky hospital injury patients age distribution, 2003-2006.

Age in Years	cases	%
< 1 yr.	3091	0.7
1-4 yrs.	3962	1.0
5-9 yrs	3816	0.9
10-14 yrs	5332	1.3
15-17	5908	1.4
18-25	19827	4.8
26-35	29584	7.1
36-45	44226	10.7
46-55	56954	13.7
56-65	62587	15.1
66-75	72203	17.4
76-85	74342	17.9
86-95	30544	7.4
96-120	2160	0.5
<b>TOTAL</b>	<b>414536</b>	<b>100</b>

**Figure 26.** Number of Kentucky hospital injury patients by age, percentages, 2003-2006.



The broken 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 included in the trauma registry.

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# Kentucky Hospital Injury Patients 2003-2006

Motor vehicle related causes account for 5.4% of all Kentucky injury cases, but 59.4% of Kentucky trauma cases.

## Cause of Injury

Table 33 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 7 out of 49,725 cases, the data for all Kentucky hospitals is missing E-codes for 181,528 (44.8%) out of 414,536 cases.

**Table 33.** Cause of injury, 2003-2006.

E-Code Group	N	%
Cut/Pierce	1237	0.3
Drowning/Submersion	66	0.0
Fall	53479	12.9
Fire/Flame	952	0.2
Burn	999	0.2
Firearm	554	0.1
Machinery	777	0.2
MV Occupant	13845	3.3
Motorcycle	1873	0.5
MV - Other	88	0.0
MV - Unspecified	1270	0.3
Pedal Cyclist	766	0.2
Pedestrian	983	0.2
ATV	1778	0.4
Transport, Other	1770	0.4
Natural/Environmental	4154	1.0
Overexertion	1573	0.4
Poisoning	6119	1.5
Struck	2526	0.6
Suffocation	544	0.1
Other Unintentional	5774	1.4
Adverse Medical Care	29007	7.0
Adverse Drugs	77514	18.7
Self-Inflicted, Suicide	12460	3.0
Homicide	3561	0.9
Undetermined	5071	1.2
Unspecified	4268	1.0
Missing Code	181528	43.8
<b>Total</b>	<b>414536</b>	<b>100.0</b>

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 (18.7%), falls (12.9%), adverse effects of medical care (7.0%), motor vehicle incidents (5.4%), and suicide (3.0%). With such a high number of missing cases, however, it is difficult to say how accurate these percentages are.

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Patient Residence

In table 34 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 1% or greater of all cases are listed.

**Table 34.** Leading KY counties of residence, 2003-2006.

County of Residence	N	%*	County rate (per 1000)**
Jefferson	72927	19.1	104.0
Fayette	18338	4.8	67.7
Kenton	11514	3.0	74.3
Daviess	10527	2.8	112.5
McCracken	8509	2.2	131.0
Hardin	8339	2.2	85.9
Warren	7783	2.0	76.9
Boone	6763	1.8	61.4
Campbell	6330	1.7	72.9
Pike	6318	1.7	94.5
Pulaski	6092	1.6	102.0
Whitley	5724	1.5	150.1
Boyd	5526	1.4	111.9
Graves	5171	1.4	136.5
Laurel	4991	1.3	87.6
Perry	4957	1.3	166.6
Hopkins	4935	1.3	105.4
Madison	4889	1.3	61.9
Franklin	4682	1.2	97.2
Bullitt	4621	1.2	63.4
Floyd	4149	1.1	98.1
Bell	3963	1.0	134.1
Harlan	3920	1.0	123.7
Nelson	3821	1.0	90.8
Oldham	3804	1.0	68.8
All other counties	153997	40.3	N/A

\*Percent of Kentucky Residents

\*\*These are not yearly rates as they cover several years, but are based on the populations of the counties using the most recent population estimates for each county.

Kentucky residents made up 92.3% (382,590 cases) of all hospital injury admissions. There was no information on county of residence for 1610 (0.4%) cases, and residents from other states made up the remaining 11,012 (7.1%) cases (see Table 33).

The final column of Table 34 lists the rate at which people are hospitalized for injury, for each county (per 1000 residents). Perry County (36<sup>th</sup> in population rank) has an injury hospitalization rate of over 165 people per 1000 population over the four year period, the highest of the counties listed above. Other counties with high rates (not necessarily shown above, i.e. counties with less than 1% of injury cases) are Owsley, Wolfe, Clinton, Whitley, and Monroe. While these counties do not make up a large percentage of the injury patients, their high rate of injury bears further investigation.

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**Table 35.** Leading non-KY states of residence

Leading States	N	%
Indiana	12962	3.1
Ohio	6789	1.6
Illinois	3065	0.7
Tennessee	2714	0.7
West Virginia	2298	0.6
All Other States	4118	1.0

Admissions

**Table 36.** Kentucky hospital injury patients admit type, 2003-2006.

Admit Type	N	%
Emergency	225046	54.3
Elective	125098	30.2
Urgent	58379	14.1
Newborn	889	0.2
No Info/Unknown	5124	1.2

A majority of injury patients (68.4%) were admitted on an urgent or emergent basis during the 4-year period. Only a small percentage (1.2%), 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 37.** Kentucky hospital injury patients admit source, 2003-2006.

Admit Source	N	%
Emergency room	223001	53.8
Physician referral	147149	35.5
Transfer from a hospital	26702	6.4
Clinic referral	7181	1.7
Transfer from another health care facility	3326	0.8
Transfer from a skilled nursing facility	1456	0.4
Court/Law enforcement	334	0.1
Other	1685	0.4
No info/Unknown	3702	0.9

As would be expected, a majority (53.8%) of Kentucky hospital patients were admitted from the emergency department, followed by physician referrals at 35.5%.

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Hospital Outcome

**Table 38.** Number and percent of KY hospital patients by discharge status, 2003-2006.

<u>Discharge Status</u>	<u>N</u>	<u>%</u>
Home/self care	233661	56.4
Transfer to home under care of home health	56850	13.7
Transfer to skilled nursing facility	54817	13.2
Transfer to rehab facility	16051	3.9
Death	14645	3.5
Transfer to short term general hospital	10710	2.6
Transfer to another type of institution	7847	1.9
Transfer to intermediate care facility	3687	0.9
Hospice	3613	0.9
Left against medical advice	2965	0.7
Transfer to long term care hospital	2564	0.6
Transfer to psychiatric hospital	1537	0.4
Other	5589	1.3

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--70.1% of injury patients and 75.4% 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.

Payer Codes

**Table 39.** Payer codes for Kentucky hospital patients, 2003-2006.

<u>Payer Codes</u>	<u>N</u>	<u>%</u>
Medicare	208898	50.4
Commercial	91994	22.2
Medicaid	42913	10.4
Other	39114	9.4
Self pay	19641	4.7
Worker's comp	7541	1.8
CHAMPUS	2354	0.6
Other fed programs	2081	0.5

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