

Emergency Department Visits for Injury in Michigan, 2001



*Michigan Department
of Community Health*



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In addition, the Michigan Public Health Institute is responsible for aggregating, editing and managing this large database.

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EXECUTIVE SUMMARY

The Injury and Violence Prevention Section of the Michigan Department of Community Health (MDCH) has previously examined data from death certificates and hospital discharge records to characterize injury in Michigan. This report represents the first analysis of statewide injury data from emergency department records.

The Michigan Emergency Department Community Injury Information Network (MEDCIIN) is a sample of twenty-three hospitals that voluntarily submit to MDCH data on patients treated for injury in the emergency department. Data from MEDCIIN, a stratified one-stage cluster sample, are weighted to allow for the generation of statewide estimates. This study focuses on 2001 data which represents the first year of complete annual data from each of the twenty-three hospitals.

Key findings of the report are as follows:

General

- In 2001, there were an estimated 1,029,666 visits to MEDCIIN hospital emergency departments for which the principal diagnosis was injury.
- Michigan residents comprised 1,001,668 (97.3%) of all visits. This corresponds to an injury rate of 100 per 1,000 residents. Note that MEDCIIN does not capture data on Michigan residents treated at out-of-state hospital emergency departments.
- Visits with injury as the principal diagnosis comprised 26.8% of all visits to hospital EDs.
- Most (93.4%) patients had routine discharges, 4.2% were admitted to the hospital, and an estimated 469 patients died in the emergency department.

Demographic Characteristics

- Injury rates were highest for the 1-4 and 15-19 year old age groups. While rates decreased among those middle aged, they increased again among the elderly.
- Rates for males exceeded those for females among the younger ages while rates for females exceeded those for males among older residents.

Types of Injury

- Sprains/strains, open wounds, and contusions were the principal diagnoses for 71% of visits.
- There were nearly 12,000 visits for traumatic brain injury.

Causes of Injury

- A cause of injury analysis could not be performed on a statewide level nor for two regions because the cause of injury coding rate was less than 90%.
- The leading causes of injury were identical in the West, Central and North regions: 1) falls; 2) struck by objects/persons; 3) sharp objects; 4) overexertion; and 5) motor vehicle crashes. Together these five causes comprised approximately 75% of injury visits.

Work-related Injury

- Workers' compensation was the source of payment for 8.7% of those aged 16 and older.
- For males and females, work-related injury rates were highest for those aged 20-24. Rates for males exceeded those for females, but this difference diminished with age.
- The most common work-related injury was an upper extremity open wound. This type of injury comprised nearly one-quarter of all cases.

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INTRODUCTION

Injuries have a significant impact on the health of Michigan citizens. Each year, they cause more than 5,000 resident deaths^{1,2} and an additional 55,000 hospitalizations.³⁻⁵ Like other health conditions, injuries are preventable. The ongoing collection of high quality data is necessary to steer injury prevention efforts.

The Injury and Violence Prevention Section (IVPS) of the Michigan Department of Community Health (MDCH) manages programs related to injury prevention in the state and utilizes available data sources to characterize this health issue. Over the last five years, the IVPS has examined injuries resulting in death and hospitalization;¹⁻⁵ however, these outcomes represent only those most seriously injured. Most people who are injured either receive no medical attention or are treated in a health care facility such as an emergency department, outpatient clinic, or physician's office.

In 1998, the Injury and Violence Prevention Section designed a system called the Michigan Emergency Department Community Injury Information Network (MEDCIIN) whereby injury data are collected from a sample of twenty-three Michigan hospitals. These data are subsequently weighted to generate statewide estimates. The first year in which complete annual data are available for analysis from all twenty-three hospitals is 2001. This report utilizes 2001 MEDCIIN data to examine the characteristics of those injured, the causes of their injuries, and the type of injuries they sustained.

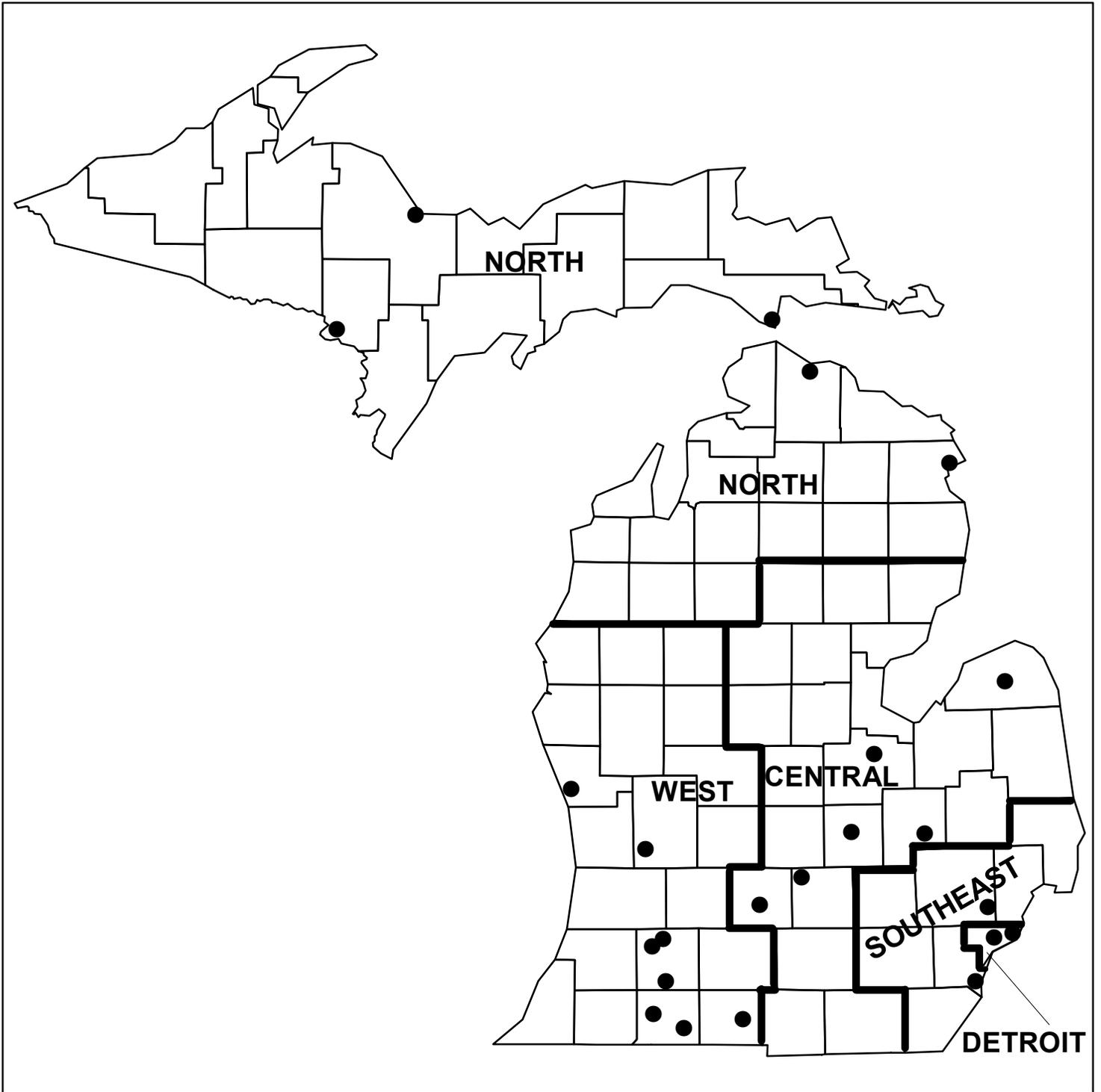
DATA SOURCES AND METHODS

Data Sources

The Michigan Emergency Department Community Injury Information Network (MEDCIIN) was the source of data on emergency department visits for injury. MEDCIIN is a stratified one-stage cluster sample of twenty-three Michigan hospitals. Participating hospitals, which are located in each of the eight Michigan Health and Hospital Association regions and the City of Detroit, voluntarily submit injury data to the Michigan Public Health Institute (MPHI). MPHI edits and aggregates the data then submits it to MDCH for appropriate weighting to allow for statewide estimates. For the development of hospital weights, the original strata were collapsed into five regions to allow for more precise estimates. Figure 1 illustrates the location of MEDCIIN hospitals and the regions used to report results. For more detailed information on the development of MEDCIIN and the weighting of sample data, refer to the description provided in Appendix E. The first year in which calendar year data were submitted by all hospitals was 2001.

The Population Estimates Branch of the United States Census Bureau provided estimates of the 2001 Michigan population⁶ which were used to calculate population-based injury rates. The Bureau of Labor Statistics of the U.S. Department of Labor provided data⁷ on the number of employed residents to allow for the calculation of worker-based injury rates. The Bureau of Health Policy, Planning and Access in the Michigan Department of Community Health provided data on the number of emergency department (ED) visits overall for each hospital in the state. These data were used to calculate the percentage of all ED visits that were injury-related.

FIGURE 1
Location of MEDCIIN hospitals and regions



Methods

A case was defined as a visit to an emergency department at a MEDCIIN hospital for which the principal diagnosis was an injury. The ICD-9-CM⁸ codes used to define “injury” were in the following range: 800.0-904.9, 910.0-957.9, 959.0-994.9, 995.50-995.59, 995.80-995.85. This code range, which was identified in 1999, differs slightly from the range recommended by a national panel of injury surveillance experts in 2003.⁹ (In contrast with the national recommendations, the MEDCIIN range excludes late effects (905-909) and certain early complications of trauma (958) in an effort to limit cases to incident injuries.)

Patients were limited to those who were admitted to an emergency department between January 1 and December 31, 2001. Followup visits for the same injury could not be identified and thus were not excluded. Analyses of patient and event characteristics (e.g., demographics, cause of injury) were conducted on all cases except those who died in the ED and those who were admitted to the hospital because these populations have been examined previously.¹⁻⁵

Injury diagnoses were categorized according to the Barell Matrix,¹⁰ a two-dimensional array of ICD-9-CM codes grouped by body region and nature of injury. Use of this matrix was recommended by the national injury surveillance workgroup.⁹ The Barell Matrix and the ICD-9-CM codes defining each cell are presented in Appendix C.

ICD-9-CM contains supplementary codes with which to specify the external cause of injury and poisoning. These “E-codes” indicate both the mechanism (e.g., struck by blunt object) and the intentionality (e.g., assault) of the injury cause. According to coding rules, an E-code should be assigned to every case involving an injury or poisoning (ICD-9-CM 800-999). Analyzing the causes of injury is crucial to developing well-targeted prevention efforts. However, the assignment of E-codes for ED injury visits in 2001 was incomplete. It is unknown if the characteristics of the cases for which information on injury cause was not provided are similar to the characteristics of cases for which this information was provided. For this report, cause of injury analyses were limited to regions where the E-coding rate was 90% or greater. This approach allows for important cause of injury information to be presented while minimizing errors associated with missing data.

A framework for presenting cause of injury information has been developed by the U.S. Centers for Disease Control and Prevention (CDC)¹¹ (see Appendix D for this framework). The matrix illustrates the cause and intent of each injury event and the E-codes that define each cell. Cells within this table that are shaded indicate that no ICD code exists for that category.

The MEDCIIN dataset does not include explicit information about work-relatedness of the injury, but it does include information about the payer for medical care received in the emergency department. The designation of workers' compensation as payer is a good proxy for the work-relatedness of hospital-treated injuries.¹²

Emergency department visit rates were calculated by dividing the number of ED visits by the appropriate population and multiplying by 1,000. For the analysis on work-related injuries, the population used was the number of people employed.

The “standard error” is a measure of the variability associated with obtaining data from a sample rather than an entire universe of cases. The chances are 95 in 100 that an estimate based on the sample differs from the value that would be obtained from a census by less than twice the standard error. Estimates and their corresponding standard errors were generated using SUDAAN¹³ software. Variance estimates were computed based on a Taylor series linearization with replacement.

Most tables in this report present standard errors in addition to the estimates (including standard errors for estimated percentages). These provide an indication of the precision of the estimates. The relative standard error (RSE) of an estimate is obtained by dividing the standard error by the estimate itself. If the RSE is greater than 30%, the estimate is considered unreliable. In addition, estimates based on sample sizes between 30 and 59 are considered unreliable. Estimates based on less than 30 are not presented.

SYMBOLS USED IN TABLES

Sample size is less than 30	---
Sample size is 30-59	*
Sample size is 60 or more, but the standard error is greater than 30% of the estimate	**

RESULTS

There were an estimated 1,029,666 visits to MEDCIIN hospital emergency departments for which the principal diagnosis was injury in 2001. The estimated number of visits for each region is illustrated in Table 1.

TABLE 1
Number and percentage of emergency department visits for injury
by hospital region, Michigan, 2001

Hospital Region	Estimated Number of Injury Visits	Standard Error of Estimate	Percent of Visits	Standard Error of Percent
Detroit	76,126	1,333	7.4	0.898
Southeast	352,180	91,695	34.2	6.482
West	242,355	50,051	23.5	4.532
Central	252,962	57,919	24.6	4.985
North	106,043	33,267	10.3	3.135
Total	1,029,666	124,001	100.0	-----

Source: Michigan Emergency Department Community Injury Information Network

Overall, slightly more than one in four visits to emergency departments were for an injury (Table 2). This proportion varied by region. In Detroit, only one in six visits was for injury.

TABLE 2
Percentage of all emergency department visits that were for injury
by hospital region, Michigan, 2001

Hospital Region	Estimated Number of Injury Visits	Actual Number of All ED Visits	Injury Visits/ All Visits (%)
Detroit	76,126	461,218	16.5
Southeast	352,180	1,342,280	26.2
West	242,355	885,094	27.4
Central	252,962	835,411	30.3
North	106,043	314,244	33.7
Total	1,029,666	3,838,247	26.8

Sources: Michigan Emergency Department Community Injury Information Network
Bureau of Health Policy, Planning and Access, MDCH

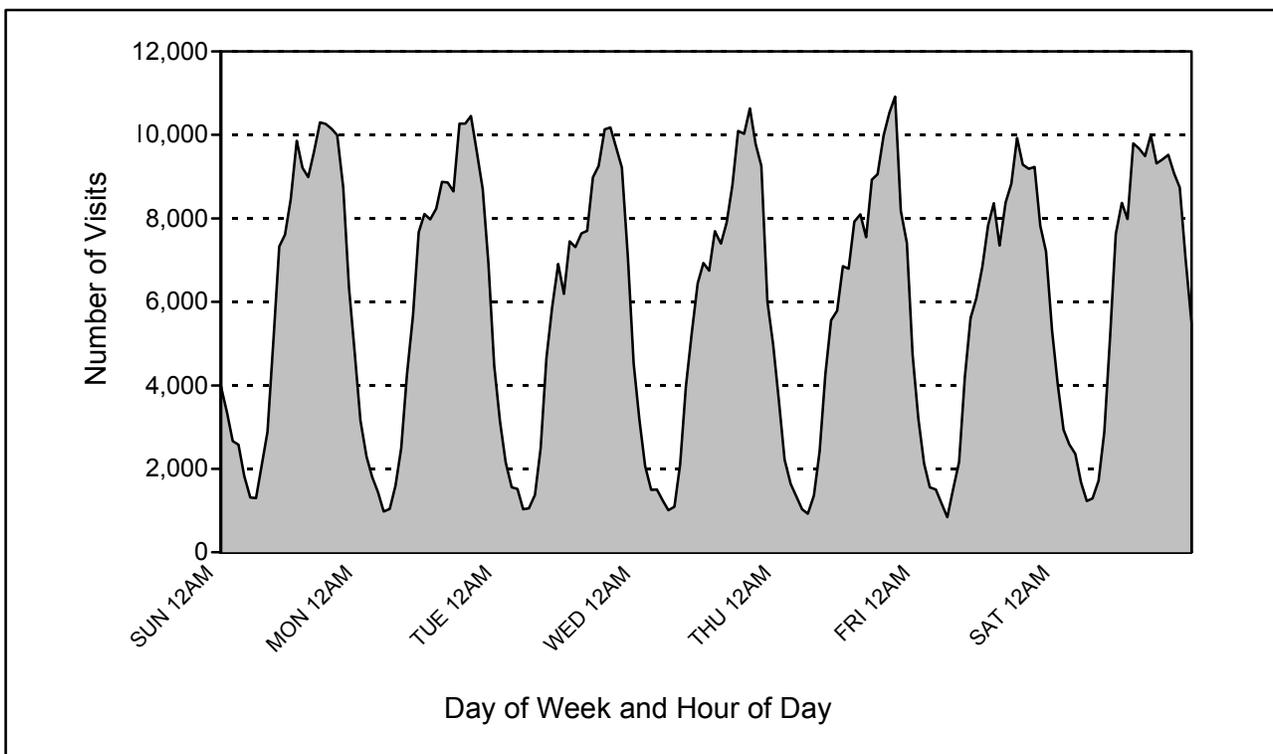
Michigan residents comprised 1,001,668 (97.3%) of all visits. This corresponds to an injury rate of 100.1 per 1,000 residents. Note that the number of visits and the rate are underestimates of injuries to Michigan residents requiring emergency department care due to some residents

obtaining treatment out-of-state. For comparison, in 2001, 2.2% of Michigan resident injury hospitalizations were out-of-state.

Temporal Characteristics of Visits

Emergency department injury patient volume followed a fairly consistent pattern throughout the week. Each day of the week, volume was lightest between 4:00 AM and 7:59 AM (Figure 2). Monday through Friday, volume was highest between 5:00 PM and 8:59 PM. On Saturday and Sunday, volume had an initial high spike at 1:00 PM and remained high through 9:59 PM. The peak volumes were comparable among the weekdays, ranging from 9,925 on Friday to 10,914 on Thursday. Overall, volume was heaviest Saturday through Monday (Table A-1 in Appendix A).

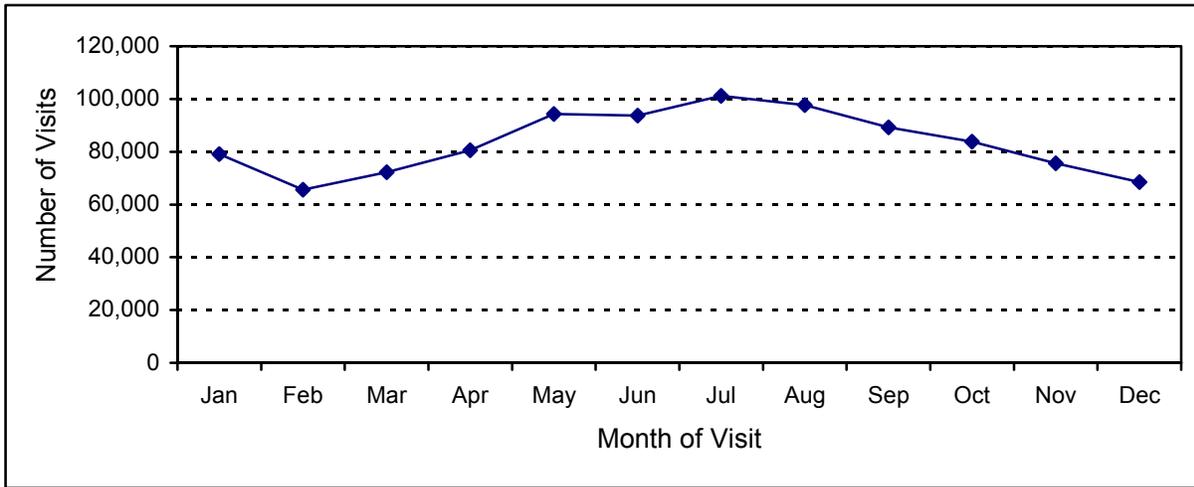
FIGURE 2
Emergency department injury patient volume by weekday and hour of visit
Michigan residents, 2001



Source: Michigan Emergency Department Community Injury Information Network

The number of emergency department visits peaked during May through August, with the most visits occurring in July (Figure 3). (For the number of visits by month, see Table A-2 in Appendix A.)

FIGURE 3
 Month of emergency department visit for injury
 Michigan residents, 2001



Source: Michigan Emergency Department Community Injury Information Network

Disposition from Emergency Department

Most (93.4%) patients had routine discharges, 4.2% were admitted to the hospital, and an estimated 469 patients died in the emergency department (Table 3).

TABLE 3
 Disposition from the emergency department
 Michigan residents, 2001

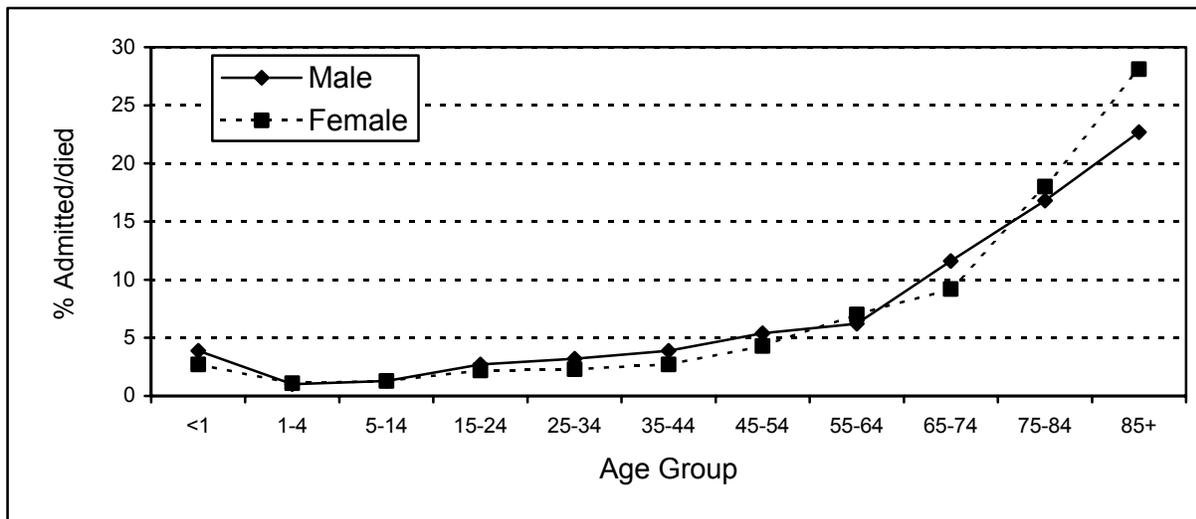
Disposition	Estimated Number of Injury Visits	Standard Error of Estimate	Percent of Visits	Standard Error of Percent
Routine/home	935,157	112,369	93.4	1.229
Transfer to another acute care hospital	6,552*	2,850	0.7	0.230
Other transfer	3,505	1,067	0.3	0.085
Left against medical advice	2,438	456	0.2	0.023
Observation unit	171*	133	0.0	0.014
Admitted to hospital	42,084	8,303	4.2	0.494
Died	469	95	0.0	0.008
Other	1,379*	768	0.1	0.088
Unknown	9,913*	9,292	1.0	0.892
Total	1,001,668	124,690	100.0	-----

* Estimate is considered unreliable because the standard error is greater than 30% of the estimate.

Source: Michigan Emergency Department Community Injury Information Network

The remainder of analyses exclude patients who either died in the emergency department or were admitted to the hospital as these cases have been characterized previously using death certificates and hospital discharge data, respectively.^{2,4} Note that this exclusion disproportionately removes older patients. As seen in Figure 4, after age 45 the proportion of injury patients admitted to the hospital or dying in the emergency department increased dramatically. (See Table A-3 in Appendix A for age and sex specific data.)

FIGURE 4
 Percentage of emergency department visits for injury
 for which the disposition was death or hospital admission,
 by age and sex, Michigan residents, 2001

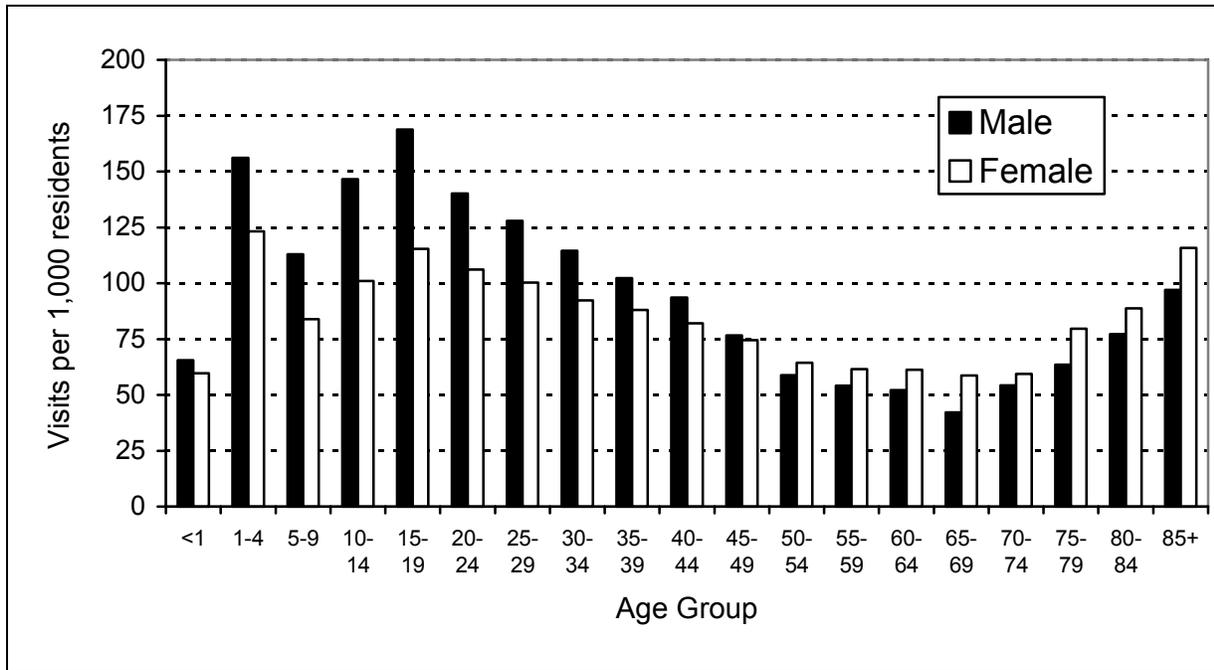


Source: Michigan Emergency Department Community Injury Information Network

Demographics of Injury Patients

The pattern of injury rates was similar for males and females (Figure 5). There were elevated rates among those aged 1-4 years, then another peak the 15-19 year olds. Rates then decreased with age up through the 65-69 age group whereupon they increased again. Rates for males exceeded those for females among the younger ages while rates for females exceeded those for males among older residents. (See Tables A-4, A-5, and A-6 in Appendix A for age and sex specific rates.)

FIGURE 5
 Rate of visits to Michigan emergency departments for injuries
 by age and sex, Michigan residents, 2001
 (excluding deaths and hospital admissions)



Sources: Michigan Emergency Department Community Injury Information Network
 U.S. Census Bureau, Population Estimates Branch

Race was specified for 79.3% of the sample visits. Coding of this variable varied substantially by hospital. For eighteen hospitals, race was regularly coded (85% or greater). One hospital coded race for 53% of visits. Four hospitals provided no information. These latter five hospitals were located in the Detroit (1), Southeast (1), Central (1) and North (2) regions. Because of the level of missing information and that it is primarily due to individual hospital non-reporting, data on race are not presented. Data on patient hispanic origin are not presented because information on this characteristic was missing for 72.9% of visits.

The MEDCIIN sample was not designed to provide representative data for county of residence, thus this level of detail cannot be presented. The sample was designed to allow estimates of patient region of residence. However, two hospitals did not provide information required to assign region of residence, thus a reliable result cannot be presented.

Source of Payment

Private insurance or managed care plans were the source of payment for nearly two-thirds (63.6%) of visits (Table 4). (Note that this category includes Medicaid managed care. The proportion of these cases that are Medicaid-based is unknown.) About one in ten (9.7%) patients paid for their care out-of-pocket.

TABLE 4
Source of payment for injuries treated in emergency departments
Michigan residents, 2001
(excluding hospital admissions and deaths)

Source of Payment	Estimated Number of Injury Visits	Standard Error of Estimate	Percent of Visits	Standard Error of Percent
Private insurance/managed care ¹	590,590	61,202	63.6	0.922
Medicare	88,223	14,908	9.5	0.778
Medicaid (non-managed care programs)	86,981	14,854	9.4	0.971
Workers' compensation	57,796	6,731	6.2	0.824
Other government payer	2,130*	708	0.2	0.077
Self-pay	90,065	26,059	9.7	2.124
Other	12,262*	6,595	1.3	0.817
Total	928,048	103,777	100.0	-----

1. Includes Medicaid managed care.

Information on source of payment was missing for 31,067 cases.

* Unreliable estimate; standard error is greater than 30% of the estimate.

Source: Michigan Emergency Department Community Injury Information Network

Type of Injury Sustained

The most prevalent type of injury was sprain/strain, followed by open wound and contusion/superficial (Table 5). These three forms of injury were the principal diagnoses for 71% of all injury visits. Sprains/strains were most likely to occur to the lower extremities, open wounds most often occurred to the upper extremities, and contusions most frequently occurred to the head. There were 11,944 traumatic brain injuries, only 4.8% of which were skull fractures.

TABLE 5
Injuries treated in emergency departments (excluding deaths and hospital admissions)
by type of injury and body region, Michigan residents, 2001
(standard errors in parentheses)

Body Region	Fracture	Dislocation	Sprain/ Strain	Internal	Open Wound	Amputation	Contusion/ Superficial	Crush	Burn	Nerves	Unspecified	TOTAL
Brain (TBI)	577 (158)			11,417 (2,548)						---		11,994 (2,596)
Other Head	6,844 (1,410)	136 (41)	---	---	92,012 (9,065)		59,904 (6,521)	---	3,141 (336)	---	27,900 (5,084)	190,178 (20,932)
Spinal Cord	---			---								206* (94)
Vertebral Column	2,949 (633)	---	77,592 (14,713)									80,688 (15,284)
Torso	7,962 (1,726)	270* (93)	17,448 (4,409)	895 (168)	2,849 (382)		33,430 (6,364)	---	1,219 (175)	---	4,004 (488)	68,133 (12,543)
Upper Extremity	65,696 (6,961)	10,895 (944)	46,430 (4,794)		100,117 (9,952)	1,881 (277)	57,887 (9,758)	2,373 (416)	8,814 (943)	404 (71)	11,859 (1,503)	306,418 (33,449)
Lower Extremity	36,165 (4,424)	3,007 (878)	89,922 (9,034)		33,413 (4,240)	---	50,320 (8,780)	404 (99)	2,696 (328)		10,947 (1,539)	226,955 (27,104)
Other/Unspecified	---	---	6,752 (1,177)	---	869** (670)		9,570 (1,428)	---	403 (72)	236* (55)	1,030 (167)	18,930 (2,332)
Systemwide												55,407 (7,510)
TOTAL	120,302 (14,640)	14,462 (1,701)	238,316 (32,419)	12,479 (2,651)	229,267 (23,095)	1,920 (272)	211,249 (31,026)	2,832 (491)	16,281 (1,626)	699 (106)	55,754 (7,117)	959,115 (117,868)

Injury categories based on principal diagnosis.

Totals include unknown body region or type of injury.

The matrix was designed to include injuries to blood vessels, however, there were too few cases to warrant their inclusion in the table. They are included in the totals.

See Appendix C for ICD-9-CM codes defining cells in this matrix.

--- Sample size less than 30. Result not presented due to the high level of unreliability.

* Sample size is between 30 and 59; estimate unreliable.

** Sample size greater than 60, but standard error is greater than 30% of estimate; estimate unreliable.

Source: Michigan Emergency Department Community Injury Information Network

Cause of Injury

The MEDCIIN sample hospitals provided an external cause of injury code (“E-code”) for 70.8% of injured Michigan residents patients treated in emergency departments in 2001 (excluding hospital admissions and deaths). E-coding rates varied widely by hospital: 15 of the 23 hospitals had coding rates of 90% or higher while two had rates of less than 5%. Subsequently, E-coding rates varied by region (see Table 6).

TABLE 6
External cause of injury coding (“E-coding”) rates
by hospital region, Michigan residents, 2001
(excluding hospital admissions and deaths)

Region	Number of ED visits (unweighted)	E-coding rate (%)
Detroit	24,616	49.9
Southeast	41,136	8.8
West	63,637	90.0
Central	63,655	92.8
North	19,380	93.6
Total	212,424	70.8

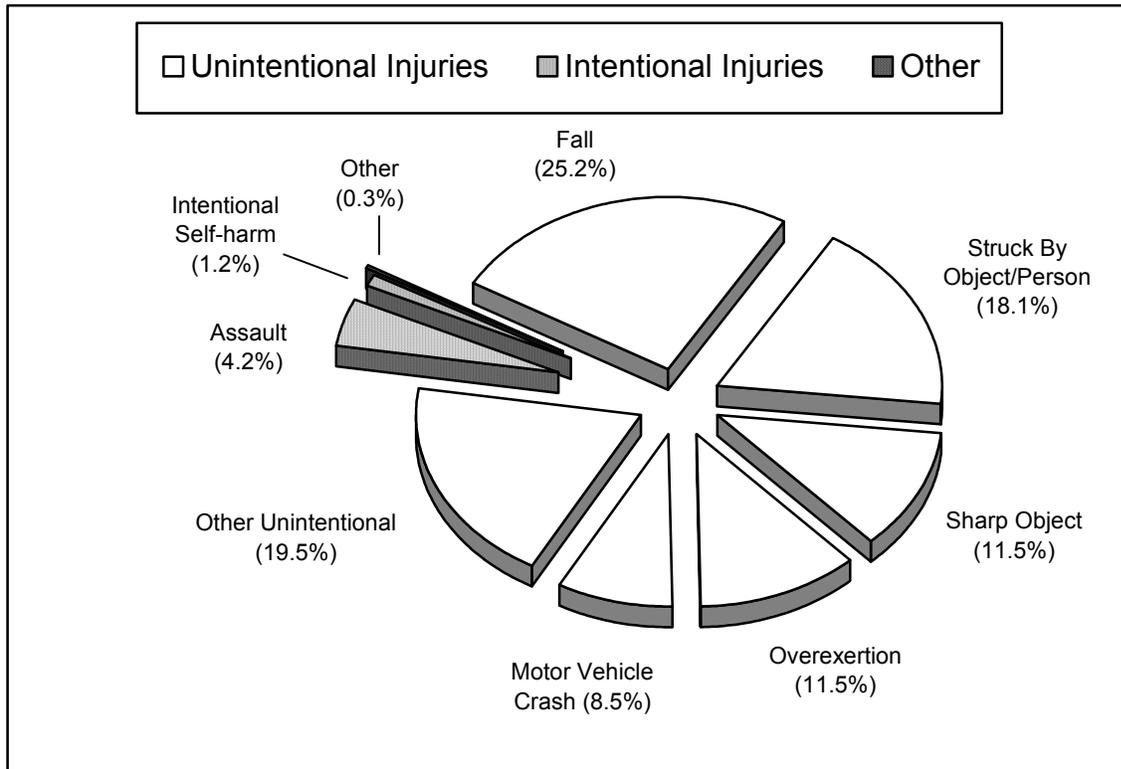
Source: Michigan Emergency Department Community Injury Information Network

A reliable presentation of cause of injury information cannot be generated for the state. It is unknown if the 70.8% of cases for which injury cause was specified are similar to those cases where cause was unspecified. In fact, there is reason to believe they are dissimilar. A study of 2001 injury hospitalizations⁴ found that assaults were coded as the cause of nearly one-quarter of injury hospitalizations among Detroit residents but at most 6% among each of the twenty-three counties that were also examined.

Cause of injury analyses were performed for the three regions for which E-coding rates were 90% or higher. This threshold level of coding has been used previously when analyzing cause of injury in hospitalization data.³⁻⁵

The leading causes of injury were identical in the West, Central and North regions: 1) falls; 2) struck by objects/persons; 3) sharp objects; 4) overexertion; and 5) motor vehicle crashes (MVCs). Together these five causes comprised approximately 75% of injury visits. Injuries caused by intentional acts (assaults and intentional self-harm/suicide attempt) comprised 5% or less of the cases. There were only minor differences in the leading causes of injury among the age groups.

FIGURE 6
Causes of injuries treated in emergency departments
Michigan residents, West Region hospitals
(N=195,553)



West Region E-coding rate: 90.0%

Excluded are hospital admissions and deaths.

Source: Michigan Emergency Department Community Injury Information Network

TABLE 7
Specific causes of injury, Michigan residents, West Region hospitals

Unintentional		Assault		Suicide Attempt/ Intentional Self-harm	
Cause	No.	Cause	No.	Cause	No.
Fall	49,237	Struck by Object/Person	5,958	Poisoning	1,408*
Struck by Object/Person	35,382	Sharp Object	763*	Other	950
Sharp Object	22,569	Other	1,546		
Overexertion	22,453				
MVC – Occupant	14,648				
Bite/Sting	7,650				
Bicycle, non-MV Crash	3,679				
Hot Object	3,197				
Machinery	2,064				
Poisoning	1,614				
Other	21,867				
Total	184,360	Total	8,267	Total	2,358

Causes not classifiable above comprise 567 cases.

West Region E-coding rate: 90.0%

Excluded are hospital admissions and deaths.

* Unreliable estimate; standard error is greater than 30% of the estimate.

Source: Michigan Emergency Department Community Injury Information Network

TABLE 8
 Leading causes of injury, by age group
 Michigan residents, West Region hospitals
 Cause of injury coding rate: 90.0%

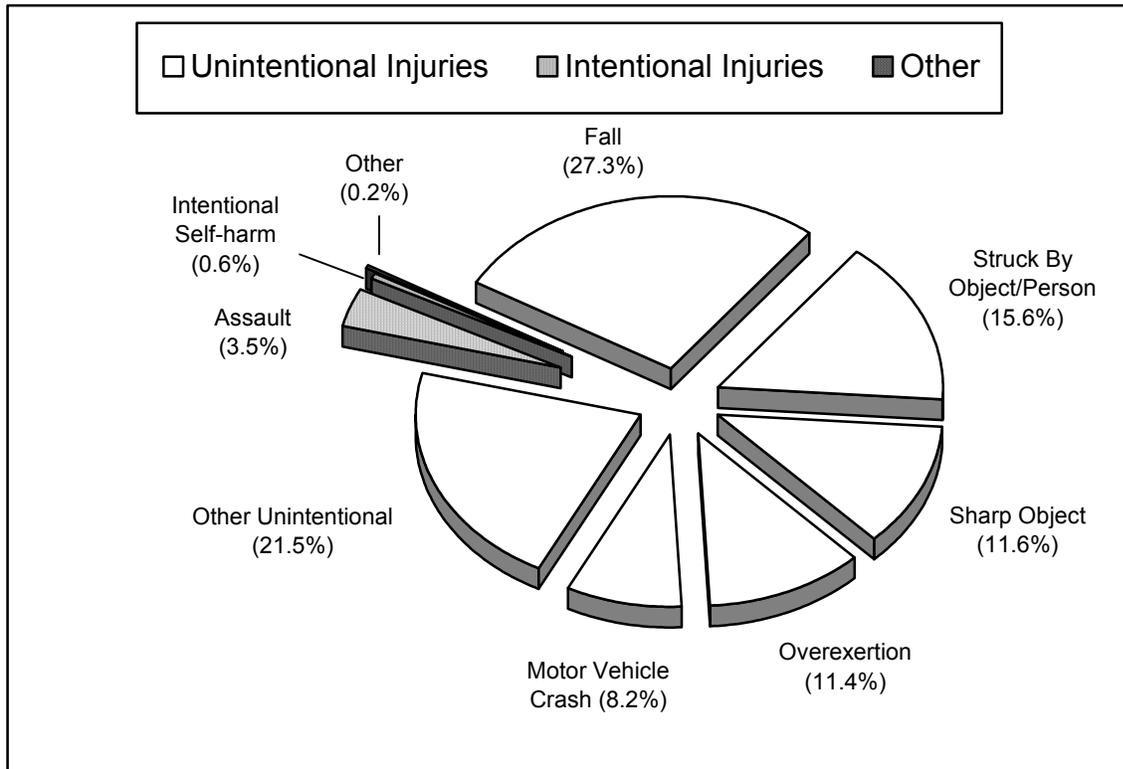
Age Group	Cause of Injury	No.	%
<5	1. Unintentional Fall	6,173	38.9
	2. Unintentional Struck by Object/Person	3,002	18.9
	3. Unintentional Bite/Sting	1,206	7.6
	All Causes ¹	15,875	100.0
5 – 14	1. Unintentional Struck by Object/Person	9,626	28.2
	2. Unintentional Fall	9,443	27.6
	3. Unintentional Sharp Object	3,588	10.5
	All Causes	34,177	100.0
15 – 24	1. Unintentional Struck by Object/Person	9,480	21.4
	2. Unintentional Fall	6,325	14.3
	3. Unintentional Overexertion	5,850	13.2
	4. Unintentional Motor Vehicle Crash	5,549	12.5
	5. Unintentional Sharp Object	5,215	11.8
	All Causes	44,255	100.0
25 – 44	1. Unintentional Fall	12,391	20.0
	2. Unintentional Overexertion	9,706	15.6
	3. Unintentional Struck by Object/Person	9,164	14.8
	4. Unintentional Sharp Object	8,100	13.1
	All Causes	62,025	100.0
45 – 64	1. Unintentional Fall	8,300	29.6
	2. Unintentional Sharp Object	3,733	13.3
	3. Unintentional Overexertion	3,524	12.6
	4. Unintentional Struck by Object/Person	3,167	11.3
	All Causes	28,013	100.0
65+	1. Unintentional Fall	6,604*	58.9
	2. Unintentional Struck by Object/Person	942*	8.4
	3. Unintentional Sharp Object	785*	7.0
	All Causes	11,207*	100.0

1. Represents the total number of E-coded cases, not the total number of emergency department visits.

* Unreliable estimate; standard error is greater than 30% of the estimate.

Source: Michigan Emergency Department Community Injury Information Network

FIGURE 7
Causes of injuries treated in emergency departments
Michigan residents, Central Region hospitals
(N=210,032)



Central Region E-coding rate: 92.8%

Excluded are hospital admissions and deaths.

Source: Michigan Emergency Department Community Injury Information Network

TABLE 9
Specific causes of injury, Michigan residents, Central Region hospitals

Unintentional		Assault		Suicide Attempt/ Intentional Self-harm	
Cause	No.	Cause	No.	Cause	No.
Fall	57,319	Struck by Object/Person	5,115	Poisoning	917*
Struck by Object/Person	32,705	Sharp Object	368*	Other	389
Sharp Object	24,469	Other	1,840		
Overexertion	23,915				
MVC – Occupant	14,894				
Bite/Sting	7,677				
Bicycle, non-MV Crash	3,521*				
Poisoning	3,159				
Hot Object	2,955				
Machinery	2,058				
Other	28,209				
Total	200,881	Total	7,323	Total	1,306*

Causes not classifiable above comprise 523 cases.

Central Region E-coding rate: 92.8%

Excluded are hospital admissions and deaths.

* Unreliable estimate; standard error is greater than 30% of the estimate.

Source: Michigan Emergency Department Community Injury Information Network

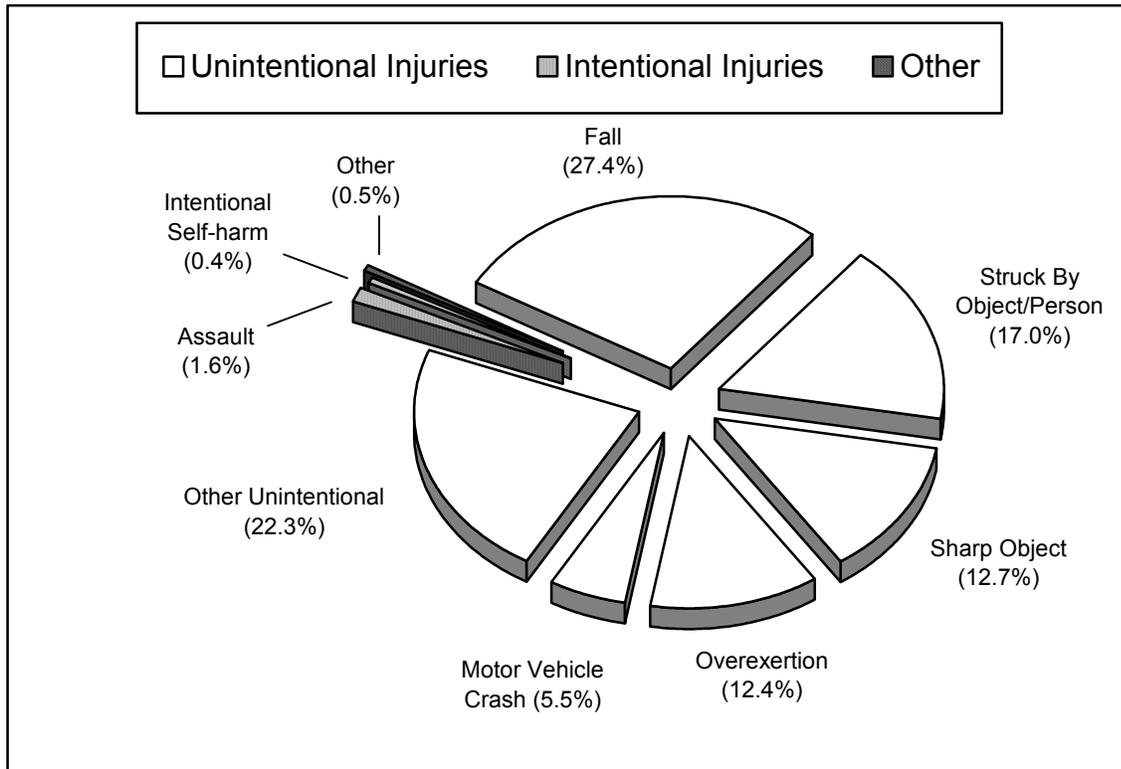
TABLE 10
 Leading causes of injury, by age group
 Michigan residents, Central Region hospitals
 Cause of injury coding rate: 92.8%

Age Group	Cause of Injury	No.	%
<5	1. Unintentional Fall	7,761	40.6
	2. Unintentional Struck by Object/Person	3,293	17.2
	3. Unintentional Sharp Object	1,295	6.8
	All Causes ¹	19,111	100.0
5 – 14	1. Unintentional Fall	11,896	31.5
	2. Unintentional Struck by Object/Person	8,734	23.1
	3. Unintentional Sharp Object	3,813	10.1
	All Causes	37,787	100.0
15 – 24	1. Unintentional Struck by Object/Person	8,246	18.4
	2. Unintentional Fall	7,207	16.1
	3. Unintentional Motor Vehicle Crash	5,825	13.0
	4. Unintentional Overexertion	5,818	13.0
	5. Unintentional Sharp Object	5,421	12.1
	All Causes	44,828	100.0
25 – 44	1. Unintentional Fall	11,813	19.0
	2. Unintentional Overexertion	9,899	15.9
	3. Unintentional Sharp Object	8,788	14.1
	4. Unintentional Struck by Object/Person	8,478	13.6
	All Causes	62,285	100.0
45 – 64	1. Unintentional Fall	8,748	29.7
	2. Unintentional Sharp Object	4,037	13.7
	3. Unintentional Overexertion	3,711	12.6
	4. Unintentional Struck by Object/Person	3,065	10.4
	All Causes	29,473	100.0
65+	1. Unintentional Fall	9,887	59.8
	2. Unintentional Sharp Object	1,115	6.7
	3. Unintentional Motor Vehicle Crash	1,018	6.2
	All Causes	16,539	100.0

1. Represents the total number of E-coded cases, not the total number of emergency department visits.
 Age was unknown for nine visits.

Source: Michigan Emergency Department Community Injury Information Network

FIGURE 8
Causes of injuries treated in emergency departments
Michigan residents, North Region hospitals
(N=89,393)



North Region E-coding rate: 93.6%

Excluded are hospital admissions and deaths.

Source: Michigan Emergency Department Community Injury Information Network

TABLE 11
Specific causes of injury, Michigan residents, North Region hospitals

Unintentional		Assault		Suicide Attempt/ Intentional Self-harm	
Cause	No.	Cause	No.	Cause	No.
Fall	24,479*	Struck by Object/Person	1,203	Poisoning	250
Struck by Object/Person	15,229*	Other	200	Sharp Object	89*
Sharp Object	11,379*			Other	57
Overexertion	11,114				
MVC – Occupant	3,859*				
Bite/Sting	2,989*				
Bicycle, non-MVC	1,669*				
Hot Object	1,371*				
Machinery	1,348*				
Snowmobile Crash	802*				
Other	12,876				
Total	87,115*	Total	1,403	Total	396

Causes not classifiable above comprise 479 cases.

North Region E-coding rate: 93.6%

Excluded are hospital admissions and deaths.

* Unreliable estimate; standard error is greater than 30% of the estimate.

Source: Michigan Emergency Department Community Injury Information Network

TABLE 12
 Leading causes of injury, by age group
 Michigan residents, North Region hospitals
 Cause of injury coding rate: 93.6%

Age Group	Cause of Injury	No.	%
<5	1. Unintentional Fall	2,456	38.0
	2. Unintentional Struck by Object/Person	1,196*	18.5
	3. Unintentional Sharp Object	426*	6.6
	All Causes ¹	6,461*	100.0
5 – 14	1. Unintentional Fall	4,733*	29.4
	2. Unintentional Struck by Object/Person	4,132*	25.7
	3. Unintentional Sharp Object	1,607*	10.0
	All Causes	16,104*	100.0
15 – 24	1. Unintentional Struck by Object/Person	3,847*	21.5
	2. Unintentional Fall	3,042	17.0
	3. Unintentional Overexertion	2,814	15.7
	4. Unintentional Sharp Object	2,120*	11.8
	5. Unintentional Motor Vehicle Crash	1,748*	9.8
	All Causes	17,927	100.0
25 – 44	1. Unintentional Fall	4,378	18.2
	2. Unintentional Sharp Object	3,982*	16.6
	3. Unintentional Overexertion	3,857	16.1
	4. Unintentional Struck by Object/Person	3,488	14.5
	All Causes	24,001*	100.0
45 – 64	1. Unintentional Fall	4,541*	29.2
	2. Unintentional Sharp Object	2,429*	15.6
	3. Unintentional Overexertion	2,073*	13.3
	4. Unintentional Struck by Object/Person	1,836*	11.8
	All Causes	15,542*	100.0
65+	1. Unintentional Fall	5,329*	56.9
	2. Unintentional Sharp Object	814*	8.7
	3. Unintentional Struck by Object/Person	729*	7.8
	4. Unintentional Overexertion	698*	7.5
	All Causes	9,359*	100.0

1. Represents the total number of E-coded cases, not the total number of emergency department visits.

* Unreliable estimate; standard error is greater than 30% of the estimate.

Source: Michigan Emergency Department Community Injury Information Network

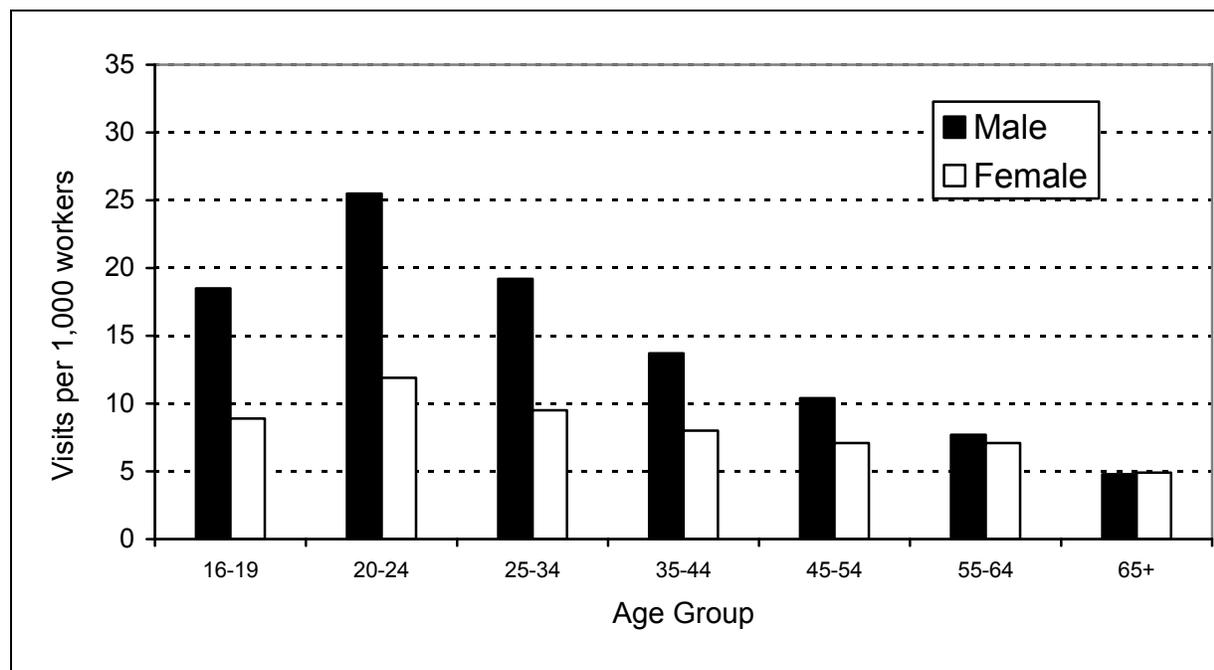
Work-related Injuries

Workers' compensation was listed as the source of payment for 57,607 (8.7%) of the 665,514 Michigan residents aged 16 and older who were treated for injuries in emergency departments (excluding hospital admissions and deaths).

Demographics of Injury Patients

Rates of work-related injuries by age and sex are presented in Figure 9. (The corresponding data can be found in Table B-1 in Appendix B). The group with the highest injury rates were males aged 20-24. This age group also had the highest rates among females. For each age group up through age 34, the rate for males was about double that of females. For each age group thereafter, the male-female rate ratio decreased. Rates were virtually equivalent for those aged 65 and older.

FIGURE 9
Rate of visits to Michigan emergency departments for work-related injuries
by age and sex, Michigan residents, 2001
(excluding deaths and hospital admissions)

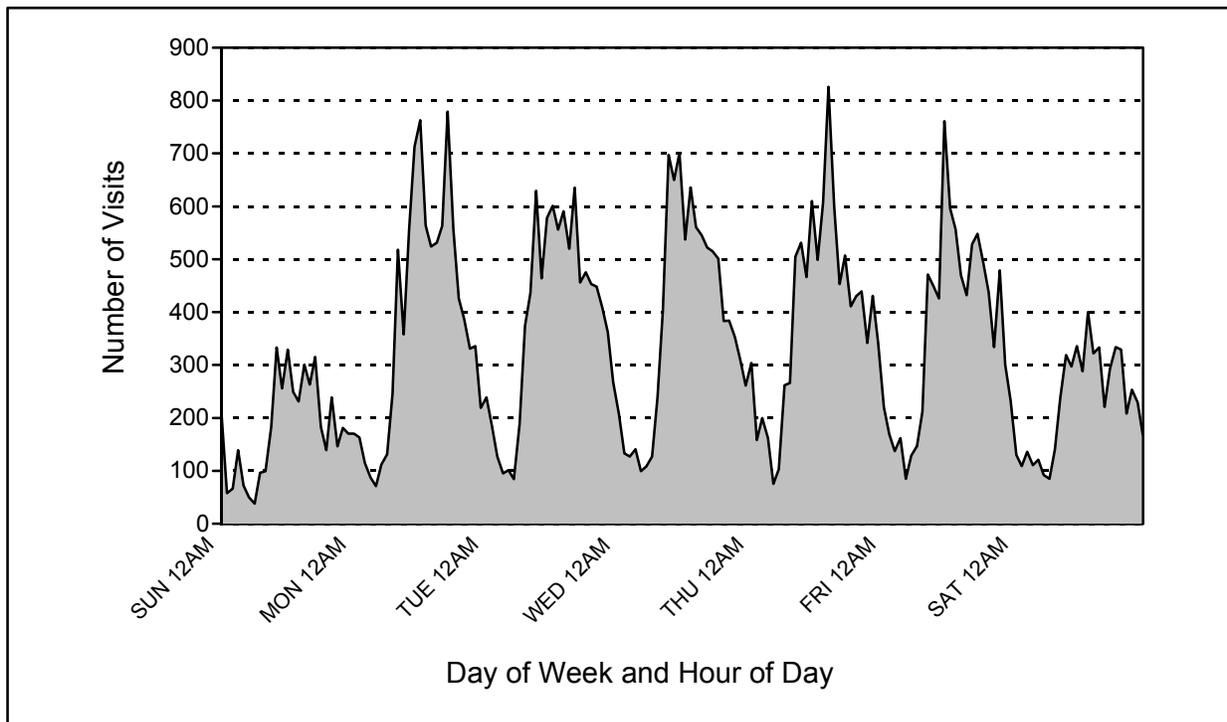


Sources: Michigan Emergency Department Community Injury Information Network
Bureau of Labor Statistics, U.S. Department of Labor, Local Area Unemployment Statistics

Temporal Characteristics of Visits

Overall, most work-related injury visits occurred between 11 AM and 2 PM. Each weekday generally followed the pattern of having visits peak between late morning and mid-afternoon (Figure 10). The average daily volume on weekdays was almost double that for weekends.

FIGURE 10
Time of day and day of week of visits for work-related injuries
Michigan residents, 2001 (excluding hospital admissions and deaths)



Source: Michigan Emergency Department Community Injury Information Network

The monthly pattern was very similar to injury visits overall. Work-related injury visits were elevated during May through August, and July had the highest monthly total. (See Table B-2 in Appendix B).

Type of Injury Sustained

The leading types of injuries were open wounds, sprains/strains, and contusions (Table 13). Of particular note were open wounds to upper extremities; these comprised nearly one-quarter (23.5%) of all injuries. This is in contrast to non-occupational injuries in which open wounds to upper extremities comprised 11.1%.

TABLE 13
 Work-related injuries treated in emergency departments
 by type of injury and body region (excluding deaths and hospital admissions)
 Michigan residents aged 16 and older, 2001
 (standard errors in parentheses)

Body Region	Fracture	Dislocation	Sprain/ Strain	Internal	Open Wound	Amputation	Contusion/ Superficial	Crush	Burn	Unspecified	TOTAL
Brain/Skull	---			591 (167)							596 (166)
Other Head, Face, Neck	170* (47)	---	---	---	2,408 (270)		2,606 (387)	---	448 (87)	839 (114)	6,476 (757)
Vertebral Column	---	---	4,878 (655)								4,992 (665)
Torso	197* (50)	---	1,685 (339)	---	112* (20)		1,527 (263)	---	95* (28)	224 (59)	3,877 (628)
Upper Extremity	2,412 (395)	330 (57)	3,777 (445)		13,556 (1,523)	413 (85)	4,234 (634)	593 (149)	1,376 (240)	730 (127)	27,461 (3,123)
Lower Extremity	1,343 (310)	74* (20)	3,973 (544)		1,229 (172)	---	2,782 (378)	---	235 (52)	388 (69)	10,147 (1,254)
Other/Unspecified	---	---	523 (113)	---	---		309 (91)	---	---	---	910 (189)
Systemwide											3,142 (405)
TOTAL	4,230 (609)	431 (72)	14,842 (1,839)	611 (166)	17,327 (1,917)	416 (85)	11,461 (1,506)	719 (148)	2,174 (381)	2,202 (319)	57,607 (6,705)

Injury categories based on principal diagnosis.

See Appendix C for ICD-9-CM codes defining cells in this matrix.

Work-related injury visits were defined as those for which the payment source was workers' compensation.

Totals include unknown body region or type of injury.

The matrix was designed to include injuries to the spinal cord, blood vessels and nerves however, there were too few cases to warrant their inclusion in the table. They are included in the totals.

--- Sample size less than 30. Result not presented due to the high level of unreliability.

* Sample size is between 30 and 59; estimate unreliable.

Source: Michigan Emergency Department Community Injury Information Network

DISCUSSION

Limitations

This report provides information only on those treated for injury in hospital emergency departments. The MEDCIIN system does not capture those who are treated in other settings. The National Health Care Survey (NHCS) conducted by the National Center for Health Statistics, Centers for Disease Control, which examines visits to physician offices, hospital outpatient departments and emergency departments, found that in 1999-2000, 28.5% of all patients treated for injury were seen in an emergency department.¹⁴ Injuries treated in emergency departments are not representative of all medically treated injuries. For example, the NHCS found that 88% of intentional self-inflicted injuries and 56% of assaults were seen in EDs, but only 21% of overexertion cases were treated in that setting.

Because MEDCIIN is composed entirely of Michigan hospitals, there is no information on Michigan residents treated at out-of-state emergency departments. It seems plausible that the proportion of injured Michigan residents treated at out-of-state EDs would be similar to the proportion of injured residents hospitalized out of state (2.2% in 2001).

Despite having a sample size of over one million observations (i.e., emergency department visits), relative standard errors (the standard error of an estimate divided by the estimate) were generally high. It was not uncommon to have results in which the RSE exceeded 30% which qualified the estimate as unreliable. This occurred even when the estimate of interest was not narrowly defined (e.g., leading causes of injury in the North Region). The reason for the large standard errors is that MEDCIIN was designed as a cluster sample (the “clusters” being the hospitals). Given the same total number of observations, the standard errors associated with cluster samples will be significantly higher than standard errors associated with a simple random sample. The most effective way to have reduced relative standard errors would have been to increase the number of hospitals when MEDCIIN was originally designed. Due to cost limitations, however, this was not feasible.

The level of cause of injury coding was insufficient (< 90%) in two regions (Detroit and Southeast) to perform region-specific analyses. Perhaps more importantly, the incomplete E-coding levels in these two regions precluded the development of a statewide cause of injury profile.

MEDCIIN was designed to allow for regional and statewide estimates. It cannot provide information at a level (e.g., county) that might be more useful for local injury prevention efforts.

Comparison of MEDCIIN Data to Other Sources

There are several sources independent from MEDCIIN that can provide comparative data. These comparisons are useful to evaluate the accuracy of the MEDCIIN system.

1. The National Center for Health Statistics annually collects data on emergency department utilization in the U.S. through the National Hospital Ambulatory Medical Care Survey (NHAMCS). According to the NHAMCS, in 2001 injury was the principal diagnosis for

27.0% of all ED visits.¹⁵ This was virtually equivalent to the Michigan results presented here (injuries comprised 26.8% of ED visits (Table 2)).*

2. NHAMCS identified the same five leading causes of injury as MEDCIIN although the order of these causes differed (according to NHAMCS, these causes were, in order: fall, struck by object/person, motor vehicle traffic crash, sharp object, and overexertion).
3. An analysis of the NHAMCS public use datatape found that workers' compensation was the source of payment for 9.4% of injury visits by those aged 16 and older in 2001. This is quite comparable to the 8.7% found in this study.
4. Per MEDCIIN, there were 416 work-related amputations in 2001 (excluding deaths and hospital admissions). In a Michigan study,¹⁶ hospitals reported that 222 such cases were treated in 1997. The authors estimated that another 230 should have been reported. Workers' compensation was identified as the payment source in 89.3% of the cases. Thus, in 1997 the estimated number of amputations treated in the ED (and not admitted to the hospital) for which workers' compensation was the payer was 404 (89.3% of 452). Although these two results are from different years, their comparability (416 vs. 404) is striking.
5. This study found that an estimated 42,084 patients treated in the emergency department for injury were admitted to the hospital. According to hospital discharge data for 2001, 39,198 Michigan residents hospitalized for injury in Michigan hospitals were first seen in the emergency department. (Note that information on admission type was missing for 1,921 inpatients.)

Future Directions

Previous public health data analyses have focused on deaths and hospitalizations for injuries, representing the most severe consequences. Analysis of emergency department data provides an assessment of the magnitude and nature of less severe injuries in Michigan. This is important because the causes and at-risk populations differ among injuries that result in deaths or hospitalization and those that are seen only in the emergency department. This knowledge will enable prevention practitioners to better target interventions to reduce the incidence of less severe injuries. Even though less severe injuries may not be as costly as those that are hospitalized, they are a public health issue due to their sheer magnitude and burden on the emergency health care system.

To date, complete MEDCIIN data have been collected for 2002-2003. By the end of 2005, it is anticipated that complete data will also be compiled for calendar year 2004. Weighting and analysis of these data will enable researchers to look at statewide trends in emergency department utilization for injuries over time. Starting in October 2005, data collection for MEDCIIN will be discontinued due to budget constraints. It is anticipated that analyses will be conducted on the data that have been collected, but it is unclear how data on injuries treated in emergency departments will be ascertained beyond what is currently available.

* The ICD-9-CM code range used in the NHAMCS to define injury (800-999) was slightly broader than the definition used in the MEDCIIN system.

Because falls are the leading cause of injuries seen in emergency departments, it is important that prevention efforts be directed toward reducing the risk factors associated with this cause. Most research has focused on preventing falls in older adults, however, children are another at-risk population. More needs to be known about the risk factors and best practices for prevention in this younger age group.

Overexertion, struck by/against, and cut by a sharp object are unique cause categories that together account for about 40% of all injuries seen in emergency departments. Because the resulting injuries are usually less severe, these causes do not emerge as leading causes in analyses of hospitalization and death certificate databases. However, these categories are quite generic and do not provide detailed cause of injury information needed for development of prevention interventions. While it would be possible to break down slightly more specific information on cut by sharp object and struck by/against categories, more research is needed to tease out specific causes toward which prevention efforts can be directed.

APPENDIX A

Data Tables for All Injury Emergency Department Visits

TABLE A-1
Emergency department injury patient volume
by day of week, Michigan residents, 2001

Day of Week of ED Visit	Estimated Number of Injury Visits	Standard Error of Estimate	Percent of Visits	Standard Error of Percent
Sunday	151,291	20,514	15.1	0.330
Monday	146,122	17,141	14.6	0.168
Tuesday	139,229	16,957	13.9	0.163
Wednesday	137,616	17,011	13.7	0.101
Thursday	139,367	16,837	13.9	0.180
Friday	137,754	18,468	13.8	0.199
Saturday	150,289	18,384	15.0	0.204
Total	1,001,668	124,690	100.0	-----

Source: Michigan Emergency Department Community Injury Information Network

TABLE A-2
Emergency department injury patient volume
by month, Michigan residents, 2001

Month of ED Visit	Estimated Number of Injury Visits	Standard Error of Estimate	Percent of Visits	Standard Error of Percent
January	79,126	10,766	7.9	0.142
February	65,548	8,106	6.5	0.101
March	72,286	8,767	7.2	0.090
April	80,506	10,339	8.0	0.106
May	94,332	11,647	9.4	0.064
June	93,663	11,206	9.4	0.112
July	101,150	11,846	10.1	0.241
August	97,724	11,465	9.8	0.145
September	89,244	11,699	8.9	0.160
October	83,862	9,529	8.4	0.121
November	75,673	9,129	7.6	0.076
December	68,554	11,176	6.8	0.341
Total	1,001,668	124,690	100.0	-----

Source: Michigan Emergency Department Community Injury Information Network

TABLE A-3

Number and percentage of ED visits with dispositions of death or hospital admission
by age and sex, Michigan residents, 2001

Age	Male			Female		
	All visits	Admissions & deaths	%	All visits	Admissions & deaths	%
<1	4,571	177	3.9	3,960	108	2.7
1-4	42,436	436	1.0	31,852	341	1.1
5-14	98,951	1,293	1.3	66,903	842	1.3
15-24	112,718	3,071	2.7	77,134	1,662	2.2
25-34	82,914	2,664	3.2	64,950	1,488	2.3
35-44	79,484	3,068	3.9	69,022	1,896	2.7
45-54	50,129	2,686	5.4	52,098	2,225	4.3
55-64	24,052	1,493	6.2	29,811	2,072	7.0
65-74	15,001	1,743	11.6	22,098	2,025	9.2
75-84	14,193	2,386	16.8	26,849	4,824	18.0
85+	5,502	1,249	22.7	17,069	4,800	28.1
Total	529,952	20,267	3.8	461,759	22,281	4.8

Table excludes visits with unknown patient age, sex or disposition from the ED.

Cells may not sum to totals due to rounding.

Source: Michigan Emergency Department Community Injury Information Network

TABLE A-4
 Estimated number, percentage, and rate of ED visits for injury
 by age group, Michigan residents, 2001
 (excluding deaths and hospital admissions)

Age	Estimated Number of Injury Visits	Standard Error of Estimate	Percent of Visits	Standard Error of Percent	Estimated Rate	Standard Error of Rate
<1	8,343	1,014	0.9	0.035	62.7	7.6
1-4	74,104	7,929	7.7	0.306	140.0	15.0
5-9	71,039	7,955	7.4	0.241	98.8	11.1
10-14	94,019	10,718	9.8	0.283	124.4	14.2
15-19	103,070	12,281	10.7	0.201	142.8	17.0
20-24	83,431	9,253	8.7	0.237	123.3	13.7
25-29	71,413	7,487	7.4	0.254	114.2	12.0
30-34	73,526	8,390	7.7	0.218	103.5	11.8
35-39	73,269	10,283	7.6	0.252	95.1	13.3
40-44	71,689	11,866	7.5	0.408	87.8	14.5
45-49	57,173	8,573	6.0	0.227	75.6	11.3
50-54	41,694	4,542	4.3	0.112	61.7	6.7
55-59	28,964	3,387	3.0	0.072	57.9	6.8
60-64	22,068	3,621	2.3	0.128	56.9	9.3
65-69	16,587	2,431	1.7	0.105	51.1	7.5
70-74	17,479	2,824	1.8	0.118	57.1	9.2
75-79	19,187	3,872	2.0	0.200	73.0	14.7
80-84	15,301	2,754	1.6	0.135	84.5	15.2
85+	16,748	2,706	1.7	0.125	110.3	17.8
Total	959,115	117,868	100.0	-----	95.9	11.8

Rate is the number of ED visits per 1,000 population.

Total includes cases with unknown/unspecified age.

Sources: Michigan Emergency Department Community Injury Information Network
 U.S. Census Bureau, Population Estimates Branch

TABLE A-5
 Estimated number, percentage, and rate of ED visits for injury
 by age group, male Michigan residents, 2001
 (excluding deaths and hospital admissions)

Age	Estimated Number of Injury Visits	Standard Error of Estimate	Percent of Visits	Standard Error of Percent	Estimated Rate	Standard Error of Rate
<1	4,461	541	0.9	0.031	65.5	7.9
1-4	42,280	4,321	8.2	0.330	156.1	16.0
5-9	41,637	4,513	8.1	0.265	113.0	12.2
10-14	56,838	6,499	11.0	0.295	146.6	16.8
15-19	62,570	7,355	12.1	0.247	168.8	19.8
20-24	47,932	5,161	9.3	0.317	140.2	15.1
25-29	40,152	4,178	7.8	0.197	127.9	13.3
30-34	40,788	4,547	7.9	0.239	114.5	12.8
35-39	39,302	5,297	7.6	0.261	102.2	13.8
40-44	37,885	6,139	7.4	0.435	93.7	15.2
45-49	28,689	3,936	5.6	0.170	76.7	10.5
50-54	19,592	2,025	3.8	0.123	58.9	6.1
55-59	13,273	1,590	2.6	0.045	54.2	6.5
60-64	9,724	1,320	1.9	0.063	52.1	7.1
65-69	6,314	814	1.2	0.132	42.2	5.4
70-74	7,311	1,494	1.4	0.160	54.3	11.1
75-79	6,956	1,359	1.4	0.140	63.5	12.4
80-84	5,141	1,189	1.0	0.140	77.2	17.9
85+	4,321	753	0.8	0.074	97.0	16.9
Total	515,166	60,441	100.0	-----	104.9	12.3

Rate is the number of ED visits per 1,000 population.

Total includes visits with unknown age.

Sources: Michigan Emergency Department Community Injury Information Network
 U.S. Census Bureau, Population Estimates Branch

TABLE A-6
 Estimated number, percentage, and rate of ED visits for injury
 by age group, female Michigan residents, 2001
 (excluding deaths and hospital admissions)

Age	Estimated Number of Injury Visits	Standard Error of Estimate	Percent of Visits	Standard Error of Percent	Estimated Rate	Standard Error of Rate
<1	3,878	487	0.9	0.045	59.7	7.5
1-4	31,817	3,631	7.2	0.292	123.2	14.1
5-9	29,403	3,458	6.6	0.257	83.9	9.9
10-14	37,175	4,244	8.4	0.311	100.9	11.5
15-19	40,494	4,960	9.1	0.195	115.3	14.1
20-24	35,499	4,283	8.0	0.182	106.1	12.8
25-29	31,258	3,378	7.0	0.328	100.3	10.8
30-34	32,738	3,928	7.4	0.216	92.3	11.1
35-39	33,959	5,054	7.7	0.257	88.0	13.1
40-44	33,801	5,774	7.6	0.384	82.0	14.0
45-49	28,476	4,748	6.4	0.322	74.5	12.4
50-54	22,102	2,563	5.0	0.132	64.4	7.5
55-59	15,691	1,810	3.5	0.144	61.5	7.1
60-64	12,344	2,359	2.8	0.216	61.3	11.7
65-69	10,273	1,874	2.3	0.168	58.7	10.7
70-74	10,168	1,369	2.3	0.112	59.4	8.0
75-79	12,231	2,530	2.8	0.262	79.7	16.5
80-84	10,161	1,613	2.3	0.150	88.8	14.1
85+	12,427	1,959	2.8	0.171	115.8	18.2
Total	443,908	57,882	100.0	-----	87.1	11.4

Rate is the number of ED visits per 1,000 population.

Total includes visits with unknown age.

Sources: Michigan Emergency Department Community Injury Information Network
 U.S. Census Bureau, Population Estimates Branch

APPENDIX B

Data Tables for Work-related Injury Emergency Department Visits

TABLE B-1
 Number and rate of work-related injuries treated in emergency departments
 by age and sex, Michigan residents, 2001
 (excluding hospital admissions and deaths)

Total				
Age	Estimated Number of Injury Visits	Standard Error of Estimate	Rate	Standard Error of Rate
16-19	4,171	591	13.7	1.9
20-24	9,153	1,000	19.0	2.1
25-34	15,273	2,102	14.7	2.0
35-44	14,930	1,852	11.1	1.4
45-54	9,927	1,352	8.8	1.2
55-64	3,477	446	7.5	1.0
65+	675	106	4.9	0.8
Total	57,607	6,705	11.8	1.4
Male				
16-19	2,850	410	18.5	2.7
20-24	6,422	727	25.5	2.9
25-34	10,696	1,465	19.2	2.6
35-44	10,060	1,277	13.7	1.7
45-54	6,009	746	10.4	1.3
55-64	1,947	264	7.7	1.0
65+	396	80	4.8	1.0
Total	38,381	4,272	14.7	1.6
Female				
16-19	1,321	209	8.9	1.4
20-24	2,731	355	11.9	1.6
25-34	4,577	680	9.5	1.4
35-44	4,870	747	8.0	1.2
45-54	3,917	629	7.1	1.1
55-64	1,530	200	7.1	0.9
65+	279	41	4.9	0.7
Total	19,225	2,553	8.4	1.1

Rate is the number of ED visits per 1,000 workers.

Sources: Michigan Emergency Department Community Injury Information Network

Bureau of Labor Statistics, U.S. Department of Labor, Local Area Unemployment Statistics

TABLE B-2
 Month of work-related injury visit
 Michigan residents, 2001
 (excluding hospital admissions and deaths)

Month of Visit	Estimated Number of Injury Visits	Standard Error of Estimate	Percent of Visits	Standard Error of Percent
January	5,315	655	9.2	0.687
February	4,144	531	7.2	0.317
March	4,732	655	8.2	0.553
April	4,307	503	7.5	0.135
May	4,805	645	8.3	0.359
June	5,409	798	9.4	0.519
July	5,554	525	9.6	0.368
August	5,675	840	9.9	0.802
September	4,398	528	7.6	0.196
October	5,252	644	9.1	0.416
November	4,379	563	7.6	0.470
December	3,636	468	6.3	0.309
Total	57,607	6,705	100.0	-----

Source: Michigan Emergency Department Community Injury Information Network

APPENDIX C

Barell Injury Diagnosis Matrix



The Barell Injury Diagnosis Matrix, Classification by Body Region and Nature of the Injury

based on 5 digit icd-9 CM codes

		A	B	C	D	E	F	G	H	I	J	K	L					
		ICD-9-CM codes	FRACTURE	DISLOCATION	SPRAINS & STRAINS	INTERNAL	OPEN WOUND	AMPUTATIONS	BLOOD VESSELS	CONTUSION / SUPERFICIAL	CRUSH	BURNS	NERVES	UNSPECIFIED				
			800-829	830-839	840-848	850-854,860-869 952, 995.55	870-884, 890-894	885-887, 895-897	900-904	910-924	925-929	940-949	950-951 953-957	959				
37	Traumatic Brain Injury	1 Type 1 TBI	800,801,803,804(.1-.4,.6-.9), (.03-.05,.53-.55) 850(.2-.4), 851-854, 950(.1-.3), 995.55	800,801,803,804(.1-.4,.6-.9) 800,801,803,804(.03-.05,.53-.55)	/	/	850(.2-.4) 851-854*, 995.55	/	/	/	/	/	950.1-3	/				
		2 Type 2 TBI	800,801,803,804(.00,.02,.06,.09) (.50,.52,.56,.59) , 850(.0,.1,.5,.9)	800,801,803,804(.00,.02,.06,.09), 800,801,803,804(.50,.52,.56,.59)	/	/	850(.0,.1,.5,.9)	/	/	/	/	/	/	/				
		3 Type 3 TBI	800,801,803,804(.01, .51)	800,801,803,804(.01,.51)	/	/	/	/	/	/	/	/	/	/	/			
	38	Other head, face and neck	4 Other Head	873(.0-.1,.8-.9), 941.x6, 951, 959.01	/	/	/	873.0-.1,.8-.9	/	/	/	/	941.x6	951	959.01*			
			5 Face	802, 830, 848.0-1, 872, 873.2-7, 941(.x1,.x3-.x5,.x7)	802	830	848.0-1	/	872, 873.2-7	/	/	/	941.x1,.x3-.x5,.x7	/	/			
			6 Eye	870-871, 918, 921, 940, 941.x2, 950(.0,.9)	/	/	/	/	870-871	/	/	918, 921	/	940, 941.x2	950(.0,.9)	/		
			7 Neck	807.5-6, 848.2, 874, 925.2, 941.x8, 953.0, 954.0	807.5-6	/	848.2	/	874	/	/	/	925.2	941.x8	953.0, 954.0	/		
			8 Head, Face and Neck Unspecified	900, 910, 920, 925.1, 941.x0, .x9, 947.0, 957.0, 959.09	/	/	/	/	/	/	900	910, 920	925.1	941.x0,.x9, 947.0	957.0	959.09		
40	Spinal Cord (SCI)	9 Cervical SCI	806(.0-.1), 952.0	806.0-1	/	/	952.0	/	/	/	/	/	/	/				
		10 Thoracic/ Dorsal SCI	806(.2-.3), 952.1	806.2-3	/	/	952.1	/	/	/	/	/	/	/				
		11 Lumbar SCI	806(.4-.5), 952.2	806.4-5	/	/	952.2	/	/	/	/	/	/	/				
		12 Sacrum Coccyx SCI	806(.6-.7), 952(.3-.4)	806.6-7	/	/	952.3-4	/	/	/	/	/	/	/	/			
		13 Spine+ Back unspecified SCI	806(.8-.9), 952(.8-.9)	806.8-9	/	/	952.8-9	/	/	/	/	/	/	/	/			
		41	Vertebral Column (VCI)	14 Cervical VCI	805(.0-.1), 839(.0-.1), 847.0	805.0-1	839.0-1	847.0	/	/	/	/	/	/	/	/		
				15 Thoracic /Dorsal VCI	805(.2-.3), 839(.21,.31), 847.1	805.2-3	839.21,.31	847.1	/	/	/	/	/	/	/	/		
				16 Lumbar VCI	805(.4-.5), 839(.20,.30), 847.2	805.4-5	839.20,.30	847.2	/	/	/	/	/	/	/	/		
				17 Sacrum Coccyx VCI	805(.6-.7), 839(.41-.42), 839(.51-.52), 847.3-4	805.6-7	839(.41-.42, .51-.52)	847.3-4	/	/	/	/	/	/	/	/	/	
	18 Spine+ Back unspecified VCI			805(.8-.9), 839(.40,.49), 839(.50,.59)	805.8-9	839(.40,.49,.50,.59)	/	/	/	/	/	/	/	/	/	/		
	42			Torso	19 Chest (Thorax)	807(.0-.4), 839(.61,.71), 848(.3-.4), 860-862, 875, 879(.0-.1), 901, 922(.0-.1,.33), 926.19, 942.x1-.x2 953.1	807.0-4	839.61,.71	848.3-4	860-862	875, 879.0-.1	/	901	922(.0,.1,.33)	926.19	942.x1-x2	953.1	/
					20 Abdomen	863-866, 868, 879(.2-.5), 902(.0-.4), 922.2,942.x3, 947.3, 953(.2,.5)	/	/	/	863-866, 868	879.2-5	/	902.0-4	922.2	/	942.x3, 947.3	953.2, 953.5	/
					21 Pelvis & Urogenital	808, 839(.69,.79), 846, 848.5, 867,877-878 902(.5,.81-.82), 922.4, 926(.0,.12), 942.x5,947.4, 953.3	808	839.69,.79	846, 848.5	867	877-878	/	902(.5, .81-.82)	922.4	926(.0, .12)	942.x5, 947.4	953.3	/
					22 Trunk	809, 879(.6-.7), 911, 922(.8-.9), 926(.8-.9), 942(.x0,.x9), 954(.1,.8-.9), 959.1	809	/	/	/	879.6-7	/	/	911, 922.8-9	926.8-9	942.x0, 942.x9	954.1, .8-.9	959.1
		23 Back and Buttock	847.9, 876, 922(.31-.32), 926.11, 942.x4		/	/	847.9	/	876	/	/	922.31-.32	926.11	942.x4	/	/		
		43	Upper		24 Shoulder & upper arm	810-812, 831, 840, 880, 887(.2-.3), 912,923.0, 927.0, 943(.x3-.x6) ,959.2	810-812	831	840	/	880	887.2-.3	/	912, 923.0	927.0	943.x3-.x6	/	959.2
	25 Forearm & elbow			813, 832, 841, 881(.x0-.x1), 887(.0-.1), 923.1, 927.1, 943(.x1-x2)	813	832	841	/	881.x0-x1	887.0-1	/	923.1	927.1	943.x1-x2	/	/		
	26 Wrist, hand & fingers			814-817, 833-834, 842,881.x2, 882, 883, 885-886, 914-915, 923(.2-.3) ,927(.2-.3), 944, 959(.4-5)	814-817	833, 834	842	/	881.x2,882, 883	/	/	914-915, 923.2-3	927.2-3	944	/	959.4-5		
27 Other & unspecified	818, 884, 887(.4-.7), 903, 913, 923(.8-.9), 927(.8-.9), 943(.x0,.x9), 953.4, 955, 959.3			818	/	/	/	884	887.4-7	903	913,923.8,.9	927.8-9	943.x0,.x9	953.4, 955	959.3			
28 Hip	820, 835, 843, 924.01, 928.01			820	835	843	/	/	/	/	924.01	928.01	/	/	/			
29 Upper leg & thigh	821, 897(.2-.3), 924.00, 928.00, 945.x6			821	/	/	/	/	897.2-.3	/	924.00	928.00	945.x6	/	/			
30 Knee	822, 836, 844.0-3, 924.11, 928.11, 945.x5			822	836	844.0-3	/	/	/	/	924.11	928.11	945.x5	/	/			
31 Lower leg & ankle	823-824, 837, 845.0, 897(.0-.1), 924(.10,.21), 928(.10,.21), 945(.x3-x4)			823-824	837	845.0	/	/	897.0-1	/	924.10,.21	928.10,.21	945.x3-x4	/	/			
32 Foot & toes	825-826, 838, 845.1, 892-893, 895-896, 917, 924(.3,.20), 928 (.3,.20), 945 (.x1-x2)			825-826	838	845.1	/	/	892-893	895-896	/	917, 924.3,.20	928.3,.20	945.x1-x2	/	/		
33 Other & unspecified	827,844(.8-.9), 890-891, 894, 897(.4-.7), 904(.0-.8), 916, 924(.4-5), 928(.8-.9), 945(.x0,.x9), 959.6-7	827	/	844.8,.9	/	/	890-891,894	897.4-7	904.0-8	916, 924.4-5	928.8,.9	945.x0-.x9	/	959.6-7				
44	Lower	34 Other/ multiple	819, 828, 902(.87,.89), 947(.1-2), 953.8, 956	819, 828	/	/	/	/	/	902.87,.89	/	947.1-2	953.8, 956	/				
		35 Unspecified site	829, 839(.8-.9), 848(.8-.9), 869, 879(.8-.9), 902.9, 904.9, 919, 924(.8,.9), 928(.8,.9), 946, 947(.8,.9), 948, 949, 953.9, 957(.1,.8,.9), 959(.8,.9)	829	839.8-.9	848.8-.9	869	879(.8-.9)	/	902.9, 904.9	919, 924.8,.9	929	946, 947.8,.9	953.9, 957.1,.8,.9	959.8,.9			
		36 System-wide & late effects	905-908, 909 (.0,.1,.2,.4,.9), 930-939,958, 960-994, 995.50-.54,.59, 995(.80-.85)	Foreign body (930-939), Early complications of trauma (958), Poisoning (960-979), Toxic Effects (980-989), Other and unspecified effects of external cause (990-994) Child and adult maltreatment (995.50-.54,.59, 995.80-.85) Late effects of injuries, poisonings, toxic effects and other external causes (905-909) excluding 909(.3, .5)														

Special diagnostic codes for trauma: Flail Chest (807.4) Pneumothorax (860)

For purposes of classification, head injuries are labeled as **Type 1 TBI** if there is recorded evidence of an intracranial injury or a moderate or a prolonged loss of consciousness (LOC), Shaken Infant Syndrome (SIS), or injuries to the optic nerve pathways.

Type 2 TBI includes injuries with no recorded evidence of intracranial injury, and LOC of less than one hour, or LOC of unknown duration, or unspecified level of consciousness. **Type 3 TBI** includes patients with no evidence of intracranial injury and no LOC.

* **Note from CDC:** 959.01 (added to ICD-9-CM in 1997) is not intended to be assigned to TBI cases; however, in the USA it has been assigned incorrectly to a substantial proportion of cases previously coded 854.

The Matrix is available on the net at www.cdc.gov/nchs/about/otheract/ice/barellmatrix.htm

Table C-2
 Specific injury types comprising
 Barell Injury Diagnosis Matrix categories used in Table 5 and Table 13

Body Region	Injury Types Comprising Category
Brain/Skull	<ul style="list-style-type: none"> • Type 1¹ Traumatic Brain Injury • Type 2² Traumatic Brain Injury • Type 3³ Traumatic Brain Injury
Other Head, Face, Neck	<ul style="list-style-type: none"> • Other Head • Face, Eye, Neck • Head, Face and Neck, Unspecified
Spinal Cord	<ul style="list-style-type: none"> • Cervical Spinal Cord Injury • Thoracic/Dorsal Spinal Cord Injury • Lumbar Spinal Cord Injury • Sacrum Coccyx Spinal Cord Injury • Spine & Back, Unspecified Spinal Cord Injury
Vertebral Column	<ul style="list-style-type: none"> • Cervical Vertebral Column Injury • Thoracic/Dorsal Vertebral Column Injury • Lumbar Vertebral Column Injury • Sacrum Coccyx Vertebral Column Injury • Spine & Back, Unspecified Vertebral Column Injury
Torso	<ul style="list-style-type: none"> • Chest (Thorax) • Abdomen • Pelvis & Urogenital • Trunk • Back and Buttock
Upper Extremity	<ul style="list-style-type: none"> • Shoulder & Upper Arm • Forearm & Elbow • Wrist, Hand & Fingers • Other & Unspecified Upper Extremity
Lower Extremity	<ul style="list-style-type: none"> • Hip • Upper Leg & Thigh • Knee • Lower Leg & Ankle • Foot & Toes • Other and Unspecified Lower Extremity
Other & Unspecified	<ul style="list-style-type: none"> • Other/multiple • Unspecified Site
System-wide & Late Effects	<ul style="list-style-type: none"> • System-wide & Late Effects

1. Recorded evidence of an intracranial injury or a moderate or prolonged loss of consciousness (LOC), Shaken Infant Syndrome (SIS), or injuries to the optic nerve pathways.
2. No recorded evidence of intracranial injury, and LOC of less than one hour, or LOC of unknown duration, or unspecified level of consciousness.
3. No evidence of intracranial injury and no LOC.

APPENDIX D

Cause and Manner/Intent of Injury and Corresponding E-codes

ICD-9-CM codes defining cause and manner/intent of injury categories
(Page 1 of 2)

Mechanism	Manner/Intent				
	Unintentional	Intentional Self-harm	Assault	Undetermined	Other
Cut/pierce	E920	E956	E966	E986	E974
Drowning/submersion	E830, E832, E910	E954	E964	E984	
Boat-related	E830, E832				
Non-boat-related	E910				
Boat-related non-drowning*	E831				
Fall	E880-E886, E888	E957	E968.1	E987	
Fire/hot objects or substances	E890-E899, E924	E958.1,.2,.7	E961, E968.0,.3	E988.1,.2,.7	
Fire/flame	E890-E899	E958.1	E968.0	E988.1	
Hot object/substance	E924	E958.2,.7	E961, E968.3	E988.2,.7	
Firearm	E922.0-.3, .8, .9	E955.0-.4	E965.0-.4	E985.0-.4	E970
Machinery	E919				
Motor vehicle traffic	E810-E819	E958.5	E968.5	E988.5	
Occupant	E810-E819(.0,.1)				
Motorcycle	E810-E819(.2,.3)				
Pedalcyclist	E810-E819(.6)				
Pedestrian	E810-E819(.7)				
Other specified	E810-E819(.4,.5,.8)				
Unspecified	E810-E819(.9)				
Pedalcyclist, other	E800-E807(.3), E820-E825(.6), E826.1,.9,E827-E829(.1)				
Pedestrian, other	E800-E807(.2), E820-E825(.7), E826-E829(.0)				

* This cause is contained within "Other Transport" in the framework provided by the U.S. Centers for Disease Control and Prevention.¹¹ It was separated out for this report due to state-specific interest in boat-related non-drowning injuries.

ICD-9-CM codes defining cause and manner/intent of injury categories
(Page 2 of 2)

Mechanism	Manner/Intent				
	Unintentional	Intentional Self-harm	Assault	Undetermined	Other
Snowmobile, non-traffic*	E820				
Transport, other**	E800-E807(.0,.1,.8,.9), E821-E825(.0-.5,.8,.9), E826.2-.8, E827-E829(.2-.9), E833-E845	E958.6		E988.6	
Natural/environmental	E900-E909, E928.0-.2	E958.3		E988.3	
Bites & stings	E905(.0-.6,.9), E906(.0-.5,.9)				
Other	E900-E904, E905.7,.8, E906(.6-.8), E907-E909, E928.0-.2				
Overexertion	E927				
Poisoning	E850-E869	E950-E952	E962	E980-E982	E972
Struck by, against	E916-E917		E960.0, E968.2		E973, E975
Suffocation, strangulation	E911-E913	E953	E963	E983	
Other specified & classifiable	E846-E848, E914-E915, E918, E921, E922.4, E923, E925-E926, E928.3, E929.0-.5	E955.5, .6, .9, E958.0,.4	E960.1, E965.5-.9, E967, E968.4, .6, .7	E985.5, .6, E988.0,.4	E971, E978, E990-E994, E996, E997.0-.2
Other specified, not elsewhere classifiable	E928.8, E929.8	E958.8, E959	E968.8, E969	E988.8, E989	E977, E995, E997.8, E998, E999
Unspecified	E887, E928.9, E929.9	E958.9	E968.9	E988.9	E976, E997.9
Adverse effects/events***					E870-E879, E930-E949
Medical care					E870-E879
Drugs					E930-E949

* This cause is contained within "Other Transport" in the framework provided by the U.S. Centers for Disease Control and Prevention.¹¹ It was separated out for this report due to state-specific interest in snowmobile injuries.

** The framework provided by the U.S. Centers for Disease Control and Prevention includes boat-related non-drownings and snowmobile, non-traffic incidents in this category. These injury causes have been separated out for this report.

APPENDIX E

Description of the Development of the MEDCIIN Sample and Derivation of Hospital Weights

DESCRIPTION OF THE SAMPLING OF HOSPITALS AND THE WEIGHTING OF DATA FOR THE MICHIGAN EMERGENCY DEPARTMENT COMMUNITY INJURY INFORMATION NETWORK (MEDCIIN)

SUMMARY

This document describes the impetus for the development of the Michigan Emergency Department Community Injury Information Network (MEDCIIN), the justification for the sampling system used to select hospitals, the sampling process, changes to the sample subsequent to the original selection, and the development of appropriate statistical measures (e.g., weights) that are necessary for analyzing the data.

OVERVIEW OF SYSTEM DEVELOPMENT

As of the mid-1990's, Michigan had the ability to collect, analyze and disseminate data on injury deaths and hospitalizations. However, most injuries do not result in these serious outcomes; many are treated in hospital emergency departments. Collecting information on individuals treated for injury in emergency departments greatly supplements injury surveillance.

In 1998, the idea of collecting emergency department data on injuries from a sample of hospitals originated. While collecting data from a census of hospitals had many advantages, this approach was cost prohibitive. Funding for the MEDCIIN system was made available from the former Childhood and Unintentional Injury Prevention Section and the Violence Prevention Section of the Michigan Department of Community Health (later combined into the Injury Prevention Section).

A sample of twenty-five hospitals was selected in November 1998. The sampling design sought to ensure geographical diversity and include a range of hospital sizes. Sample hospitals were then recruited to participate in this voluntary data collection project. There were two requirements for participation: 1) the hospital must regularly assign cause of injury codes (E-codes) to injury patients treated in the ED; and 2) the hospital must participate in the surveillance of cases of intimate partner violence.

To help offset costs and provide incentive for participation, hospitals are provided an annual stipend, ranging from \$3,000 to \$6,000 depending on their patient volume. Hospitals also receive annual hospital-specific reports characterizing their injury patients. Lastly, each hospital provides a representative to an oversight committee which allows them input to the management of the system.

Due to refusals and inability to meet criteria, the final sample was reduced to twenty-three hospitals. Agreements to participate were obtained from all twenty-three hospitals in May 2001. Over the next few years, several hospitals discontinued participation and were replaced. The first year of complete data submission by all twenty-three hospitals was 2001.

DEVELOPMENT OF SAMPLING FRAME

The sample design was formulated based on the need to meet several criteria. The system had to optimize representativeness, ensure large enough numbers to allow for meaningful analyses at a

regional level, and minimize costs. In addition, it was determined to be advantageous to ensure the inclusion of hospitals which had been working with MDCH on emergency department injury surveillance prior to MEDCIIN. It was felt that this would create momentum for the project thereby facilitating the recruitment of other hospitals.

To minimize costs, the sample had to include only as many hospitals as was necessary to meet the other two criteria. Including additional hospitals would increase cost unnecessarily.

Several factors could influence the representativeness of the sample. Certain causes of injury (e.g., snowmobiling) are more prevalent in some areas of the state than others. Hospitals that are trauma centers tend to receive patients that are more seriously injured and may treat injuries caused by particular causes (e.g., motor vehicle crashes) than non-trauma center hospitals. The racial distribution is not equivalent across the state – while the state overall is 82% white and 15% black, Detroit’s population is 12% white, 84% black.

To ensure that the sample included hospitals of various sizes (hospital size, as measured by the number of patient visits, is crudely correlated with trauma center status) and that all areas of the state were represented, hospitals were stratified by size and geography prior to being randomly selected. Geographic strata were based on the regions used by the Michigan Health and Hospital Association. These eight regions correspond to hospital catchment areas. The City of Detroit was made a unique region within Southeast Michigan thereby resulting in nine regions for sampling. Within each region, hospitals were categorized as “large” or “non-large” depending upon the estimated annual number of injury visits to emergency departments. These estimates were based on assuming that 36%* of all ED visits were for the treatment of an injury. The total number of ED visits per hospital and the county where the hospital was located was provided by the Bureau of Health Policy, Planning and Access, MDCH through its Annual Hospital Statistical Questionnaire.

Statistical analyses known as power calculations were performed to determine the sample size (i.e., number of injury patients) required in each region to allow estimates to have a specified level of precision. In the power analysis, a one sample, two-tailed binomial distribution was used with alpha set at .05, power at 80 percent, and a Bonferoni correction factor of 2. The arcsin approximation to the distribution was used. Then, a range of sample sizes were calculated based on specifying a variety of estimates and their corresponding margins of error (e.g., a sample size of 1,507 would have been required to have a margin of error of 1.5% for an estimate of 3.0%). Additional sample sizes were generated by modifying alpha and power. According to these calculations, a sample of about 2,000 injury cases was required to provide reasonably accurate estimates. To allow for these estimates to be made for sub-groups comprising 15% of the population (e.g., children under age 10), this number was multiplied by 6.67 (1/.15). Thus, a total sample size of 13,333 was sought in each region.

The number of visits used to categorize large and non-large hospitals was determined for each region. Because the distribution of number of visits per hospital differed significantly by region, the definition of large and non-large was not uniform across all regions. For example, in Detroit, about half of the hospitals had more than an estimated 12,000 injury visits, while in the North

* This figure was selected as an approximate midpoint of the range of results found in various studies.^{17,18}

Central and Upper Peninsula regions, no hospital had this many injury visits. For the Detroit and Southeast regions, large hospitals were those having an estimated 20,000 or more injury visits. This level was selected as it defined “large” as hospitals in the top-third of patient volume. For the Mid-South, West, GLS, and East Central regions, large hospitals were those with at least 12,000 visits. This figure was selected as it would ensure that there would be more than one hospital in the large stratum (a sampling requirement) while guaranteeing that the region would meet the target of 13,333 visits. In the North Central region, the lower bound defining large hospitals was 7,000 visits. This relatively low volume was selected as it would ensure that the large stratum would be comprised of more than one hospital. For the same reason, the lower bound in the Upper Peninsula region was 5,000 visits. It was acknowledged that these two regions could have fewer than 13,333 cases but it was felt they would have enough cases given their overall injury volume. Finally, the Southwest region included five forced-in hospitals. Because these hospitals included a range of hospital sizes, there was no need to stratify the remainder into large and non-large: all of the remaining hospitals comprised one stratum.

SAMPLING

Once the seventeen strata were defined, hospitals were randomly selected using Epi Info. First, a large hospital was selected within a region. Then, in order to further ensure geographical diversity, all non-large hospitals located in the same county as the selected large hospital were removed, and a non-large hospital was randomly selected. The seventeen randomly selected and the eight forced-in hospitals resulted in the initial hospital sample size of 25.

CHANGES TO THE ORIGINAL SAMPLE

Two hospitals that had been forced into the sample were dropped. One declined participation while the other had inadequate E-coding rates. The non-large hospital selected in the Detroit region declined participation. Due to the characteristics of hospitals in Detroit (e.g., hospital closures, specialty hospitals), the only feasible replacement was another large hospital. Lastly, after a few years of participation, two East Central hospitals opted out of MEDCIIN and were subsequently replaced.

PREPARING MEDCIIN DATA FOR ANALYSIS

Several steps were required to prepare the data for analysis by SUDAAN. First, the appropriate sample design had to be specified. This is essential in SUDAAN in order for estimates to be computed. Taylor linearization with replacement was selected as the model. This was the simplest design specification and mirrored the model specified by Consumer Product Safety Commission for its National Electronic Injury Surveillance System (NEISS). Note that this specification was conservative; more complicated models would result in smaller variance estimations.

The original nine regions were collapsed into five (Detroit, Southeast, West, Central, North) in order to reduce variance estimates. For non-forced in hospitals, a sample weight was calculated for each person treated at the hospital on the basis of the inverse of the probability of selection of the hospital (each forced-in hospital had a weight of 1.0[†]). Sample weights were post-stratified using information on the number of all ED visits to the sample hospital compared to the total

[†] One forced-in hospital submitted data that covered only 50 weeks. Thus, the weight assigned to that hospital was 1.04 (52/50).

number seen at all similarly-sized (i.e., large, non-large) hospitals in the region.[‡] To determine the post-stratification weights in the North and West regions, all forced-in hospitals were first removed. The one hospital that was randomly selected in the original Southwest region was treated as a non-large hospital as were all of the hospitals from which it was selected.

The number of emergency department visits hospitals had in 2001 differed from what they had in 1996, which was the data that was used in originally categorizing hospitals as large or non-large. Some hospitals that had originally been classified as non-large had sufficient number of visits in 2001 to move them into the large category. The weighting process assumed hospitals were large or non-large based on the number of visits in 2001. Applying this assumption was straightforward for hospitals that were not in the sample. However, one hospital in the West region, which had been selected from among non-large hospitals originally, had more than 12,000 visits in 2001, moving it into the large group. To keep this hospital in the non-large group, the lower bound for large hospitals was increased to 14,000 visits.

Hospitals that were forced into the sample were considered separate strata. Thus, there were a total of 11 strata: five comprised of the regions and six comprised of the forced in hospitals.

Lastly, primary sampling units (PSU's) had to be defined. PSU's for hospitals that were randomly selected were the hospitals themselves. PSU's for forced-in hospitals were the individual emergency department injury visits.

[‡] While it would have been more accurate to limit the calculation to ED visits for injury, this information was unknown. It was assumed that the proportion of all ED visits to sample hospitals in a stratum among all visits to all the hospitals in that stratum was equal to the proportion of injury visits to the sample hospitals among all injury visits to that stratum's hospitals.

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