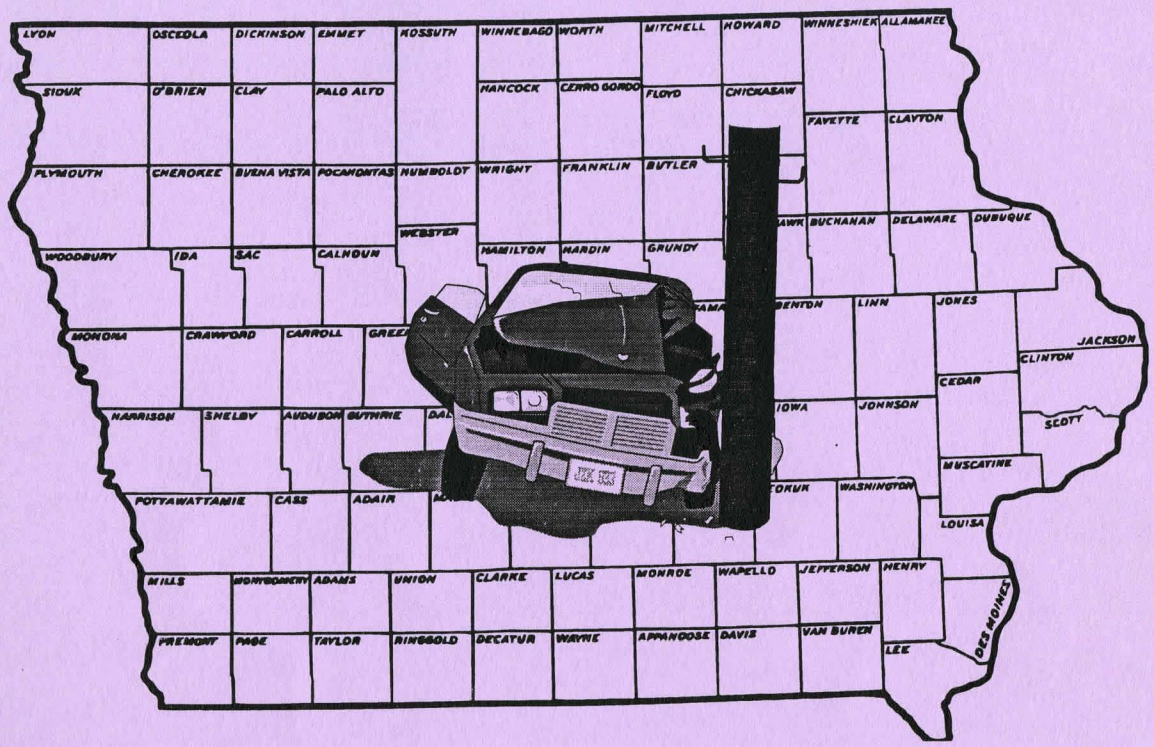
INJURY IN IOWA



A Report by the Iowa Trauma Systems Development Project

April 1996

Iowa Department of Public Health
Bureau of Emergency Medical Services

TERRY E. BRANSTAD
GOVERNOR

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DIRECTOR OF PUBLIC HEALTH

PURPOSE

As part of year III of the Iowa Trauma System Development Project, this summary, ***"Injury in Iowa"***, was developed to describe traumatic injury in Iowa. This document will serve as a resource for future trauma system development activities to address concerns related to traumatic injury this state.

PARTICIPATING GROUPS

RURAL INJURY SURVEILLANCE SYSTEM HOSPITALS

Buena Vista County Hospital - Storm Lake
Dickinson County Hospital - Spirit Lake
Holy Family Hospital - Estherville
Horn Memorial Hospital - Ida Grove
Loring Hospital - Sac City
Osceola Community Hospital - Sibley
Palo Alto County Hospital - Emmetsburg
Pocahontas Community Hospital - Pocahontas
Spencer Municipal Hospital - Spencer
Stewart Memorial Community Hospital - Lake City

HOSPITAL TRAUMA REGISTRY HOSPITALS

Allen Memorial Hospital - Waterloo
North Iowa Mercy Health Center - Mason City
University of Iowa Hospitals & Clinics - Iowa City
St. Luke's Methodist Hospital - Cedar Rapids
Mercy Medical Center - Cedar Rapids
Iowa Methodist Medical Center - Des Moines
Mercy Hospital Medical Center - Des Moines
Marian Health Center - Sioux City
Mercy Health Center - Dubuque
The Finley Hospital - Dubuque

The University of Iowa Injury Prevention Research Center
Iowa City

Iowa Department of Public Health
Des Moines

FUNDING SOURCE

Department of Health and Human Services
Public Health Service
Health Resources and Services Administration
Bureau of Health Resources Development

PROJECT STAFF

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ACKNOWLEDGMENTS

Governor's Traffic Safety Bureau
Iowa Department of Public Safety

State Center for Health Statistics
Iowa Department of Public Health

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EXECUTIVE SUMMARY

Traumatic injury is one of the most serious health problems facing the citizens of this state. Injuries cause over 1500 Iowa deaths annually and result in major economic losses as well as personal tragedy for victims, their families and communities. Injury is the leading cause of death in the first four decades of life and is due to events which are usually preventable.

This report contains descriptive evidence about injuries in Iowa. Morbidity and mortality data in this report have been obtained from the following sources:

-Iowa Vital Records (1994) Death Certificates, **Iowa Department of Public Health** including death data from the entire state.

-Iowa SystemTrauma Registry (1994), **Iowa Department of Public Health** including data from 10 hospitals in urban areas across the state.

-Trauma Injury Surveillance Project (July 1993- June 1994), **University of Iowa Injury Prevention Research Center** including data from 9 rural hospital emergency departments in northwest Iowa.

The following ia a descriptive summary of findings from the above data sources.

DEATHS

- 1,524 due to traumatic injury in Iowa
- 772 (50%) age < 45
- 1,121 unintentional, 403 intentional
- Motor Vehicle Crash is the most frequent cause (518) and represents 46% of the unintentional injuries
- Suicides (322) represent 80% of the intentional injuries

SYSTEM TRAUMA REGISTRY

- 4,943 patients admitted at 10 urban hospitals throughout Iowa
- 66% male, 34% female
- 69% age < 45
- 88% blunt injury, 9% penetrating, 3% burns
- 87% unintentional, 6% intentional (others undetermined)
- 69% major injury, 27% minor, 4% fatal
- 49% motor vehicle/motorcycle/bicycle related
- $7,222 average acute care hospital charges

TRAUMA INJURY SURVEILLANCE PROJECT

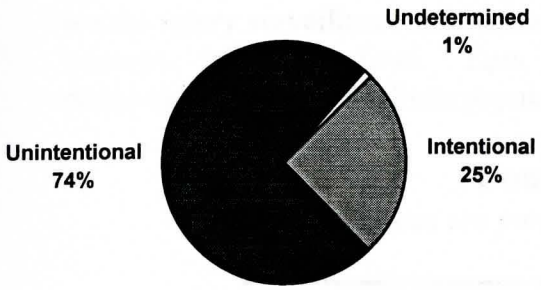
- 28,162 emergency department visits at 9 rural hospitals in Northwest Iowa
- 7,937 (28%) visits due to traumatic injury
  - 58% male, 42% female
  - 74% age < 45
  - 12% work related
  - 2.4% intentional
  - 86% released to go home after treatment
  - 9% admitted to hospital for further care
  - 4% transferred to another facility for further care
  - 27% arrived less than one hour after injury occurrence

Efforts to address injury control must include the three integrated key components of **prevention**, **acute care** and **rehabilitation**. Ongoing data collection, research and system monitoring will direct necessary changes within each key component to systematically address all injuries and thus reduce suffering, disability, death and costs of injury to society.

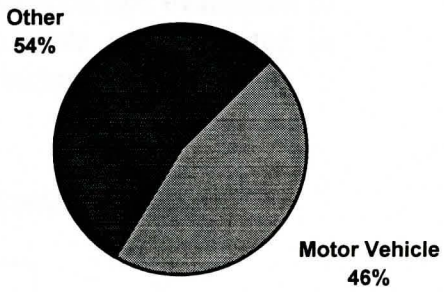
Iowa Vital Statistics Death Data

The Iowa Department of Public Health collects data through the Vital Records Bureau. Data collected by Vital Records is published annually in *Vital Statistics of Iowa.* The following graphs and tables represent injury data as reported by the State Center for Health Statistics for 1994.

Injury Deaths by Type



Unintentional Injury Deaths by Type



Age Group	Unintentional Injuries	Suicides	Homicide	Undetermined	Total Injuries
0-4	40	0	4	1	45
5-9	17	0	1	0	18
10-14	28	3	1	1	33
15-19	80	38	7	1	126
20-24	91	36	8	1	136
25-29	64	33	4	1	102
30-34	70	25	9	2	106
35-39	54	33	7	1	95
40-44	74	25	11	1	111
45-49	56	20	5	1	82
50-54	46	15	1	1	63
55-59	30	21	0	1	52
60-64	38	12	1	1	52
65-69	47	8	1	0	56
70-74	70	11	1	0	82
75-79	78	14	1	1	94
80-84	76	7	1	1	85
85-89	71	16	1	0	88
90-94	62	5	0	2	69
95-99	25	0	0	0	25
100 +	4	0	0	0	4
Total	**1121**	**322**	**64**	**17**	**1524**

TRAUMA INJURY SURVEILLANCE PROJECT

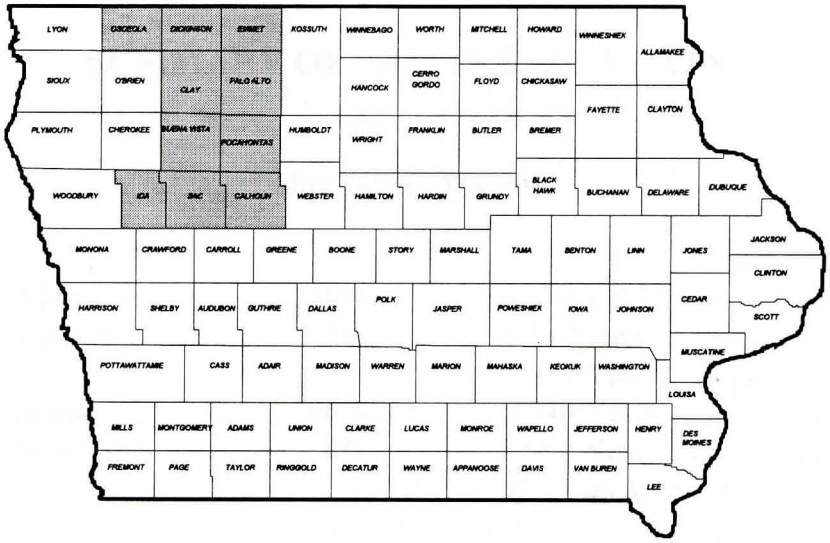
Northwest Iowa - 9 Rural Hospitals
All Emergency Department Visits
July 1993 - June 1994

All Data Collected Using the RISS Software
(Rural Injury Surveillance System)

Currently, Iowa does not have a statewide injury data collection system. The primary grant activity for FY 1992 was the initiation of an emergency department based inclusive trauma injury surveillance mechanism for the identification, collection and evaluation of traumatic injuries in Iowa. Data from nine community hospitals were selected in northwestern Iowa to facilitate population-based analysis of the inclusive injury data.

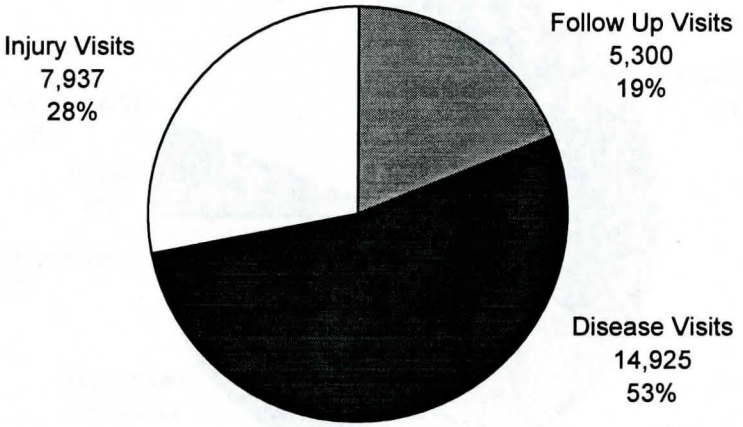
County Map of Iowa

(Shaded counties are part of Trauma Injury Surveillance Project)



TRAUMA INJURY SURVEILLANCE PROJECT

TYPE OF VISIT (28,162 Total Visits)



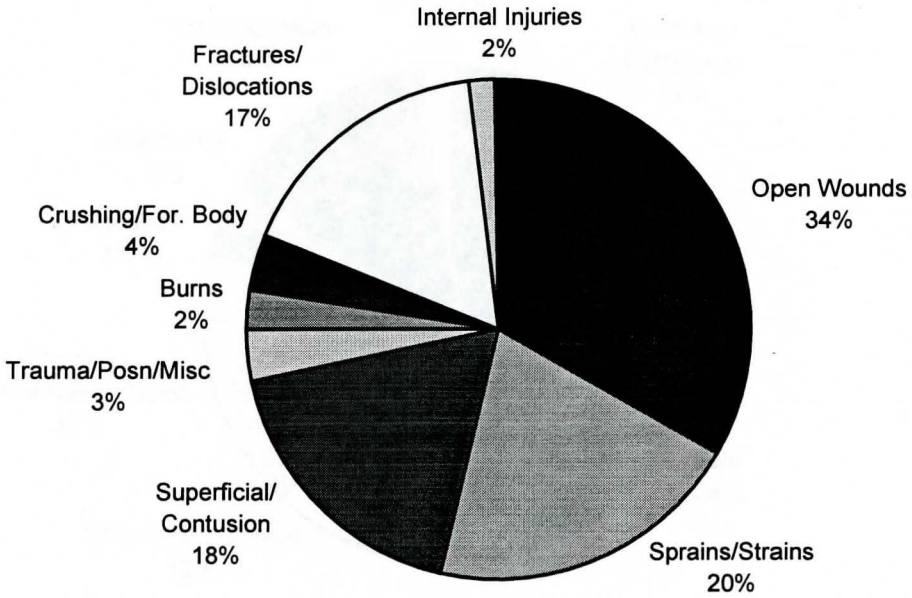
SUMMARY OF 7,937 INJURY VISITS

Patient Demographics

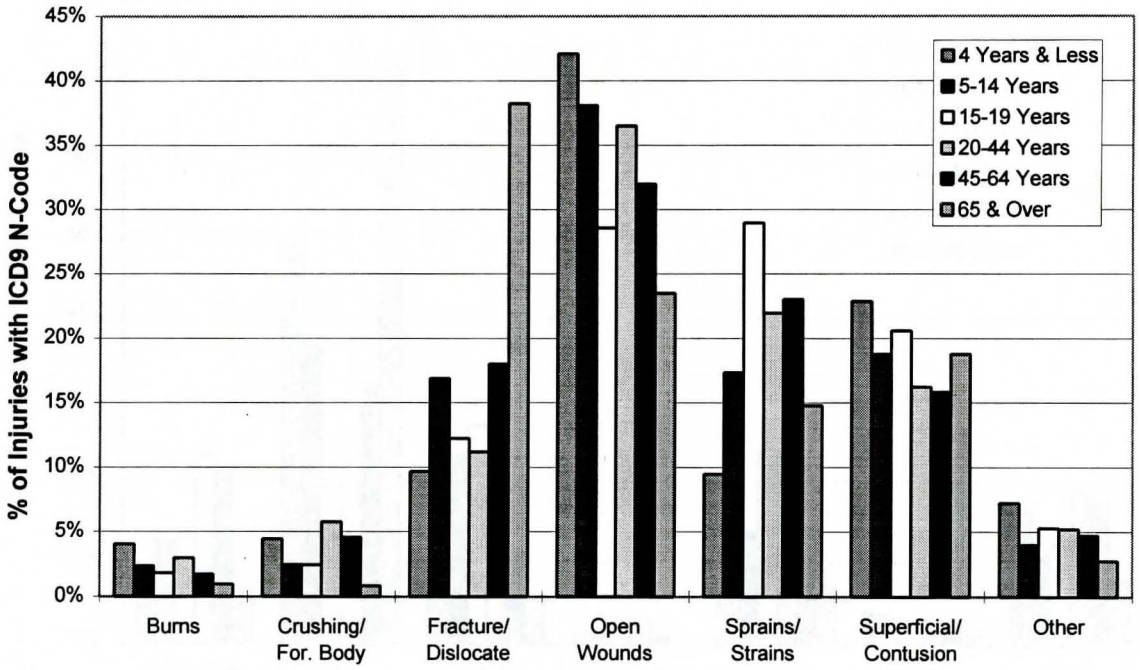
Male	58%
Female	42%
White	96%
Non-White	4%

	Age
4 Years & Under	8%
5-14 Years	18%
15-19 Years	14%
20-44 Years	34%
45-64 Years	11%
65 Years & Older	15%

ICD9 N-CODES*

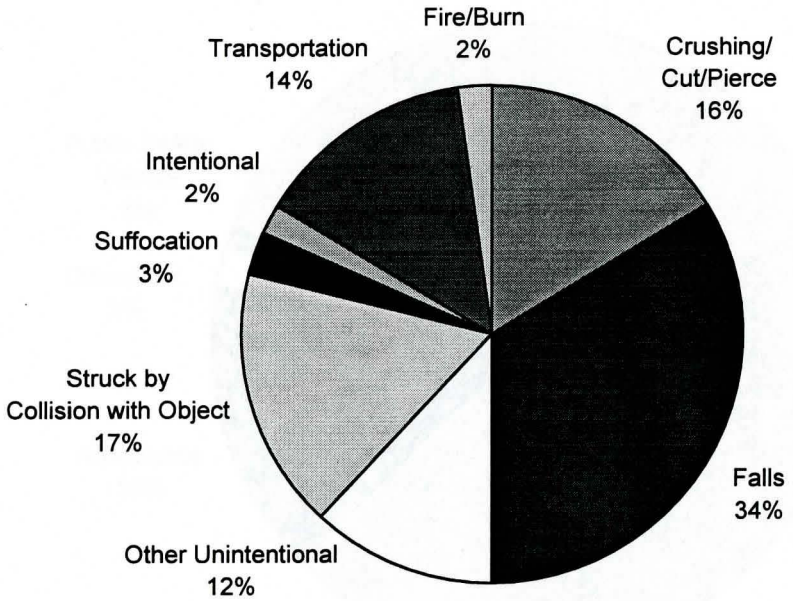


DISTRIBUTION OF ICD9 N-CODES FOR EACH AGE GROUP

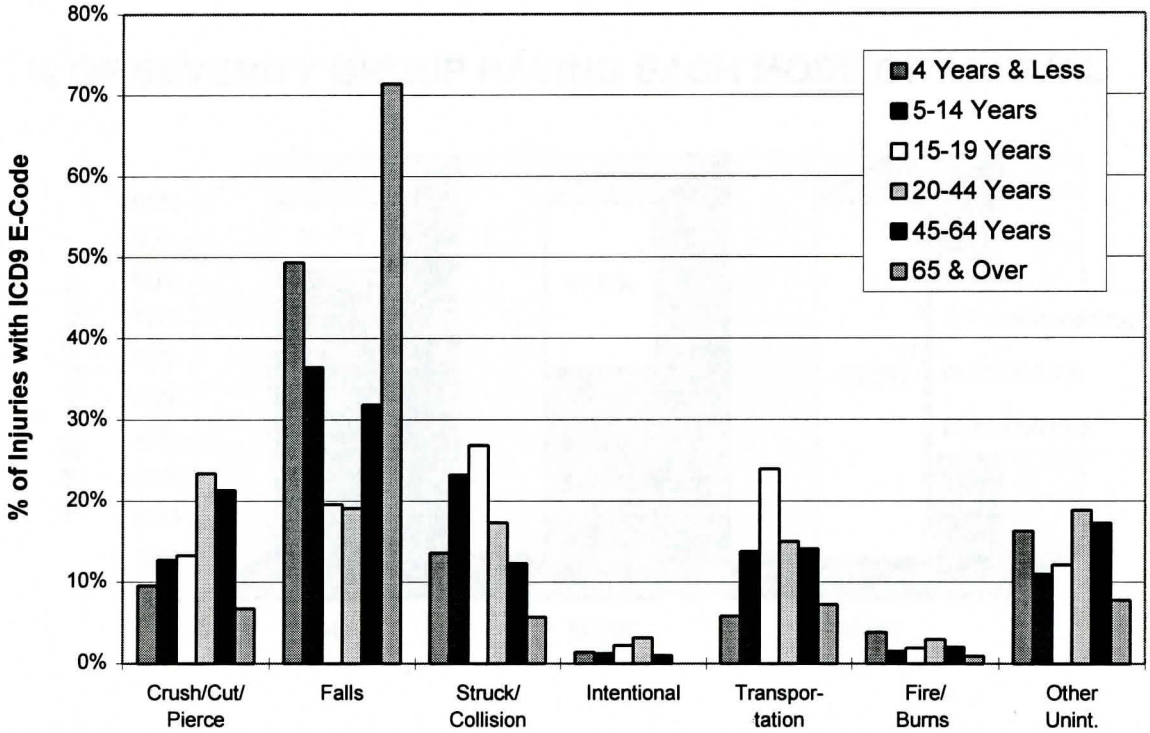


*** ICD-9 N-Codes -** Ninth edition of International Classification of Diseases, a standard coding system that includes all injuries and disease processes.

ICD9 E-CODES*

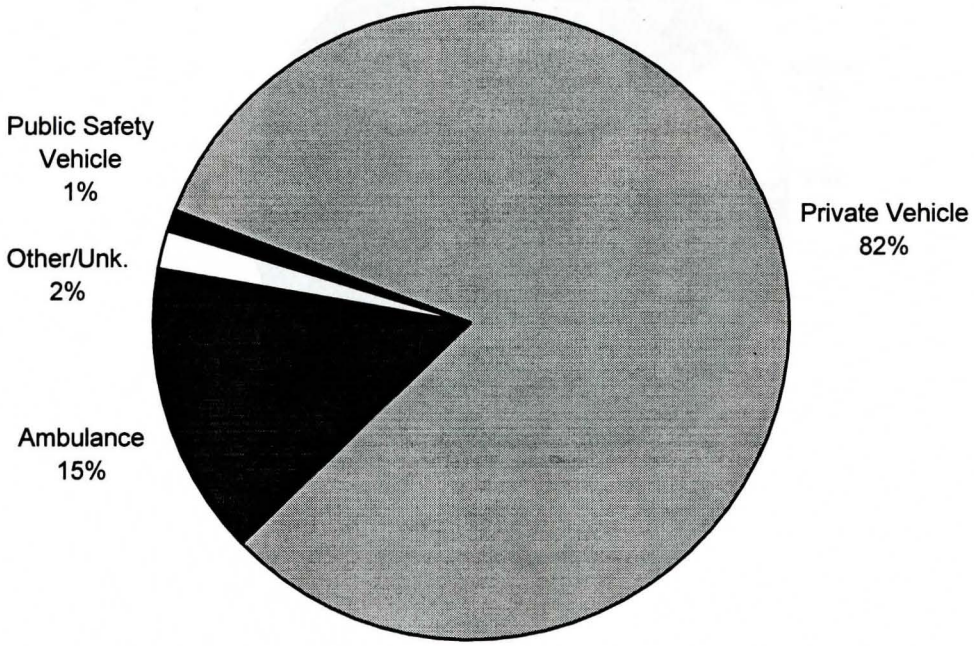


DISTRIBUTION OF ICD9 E-CODES FOR EACH AGE GROUP

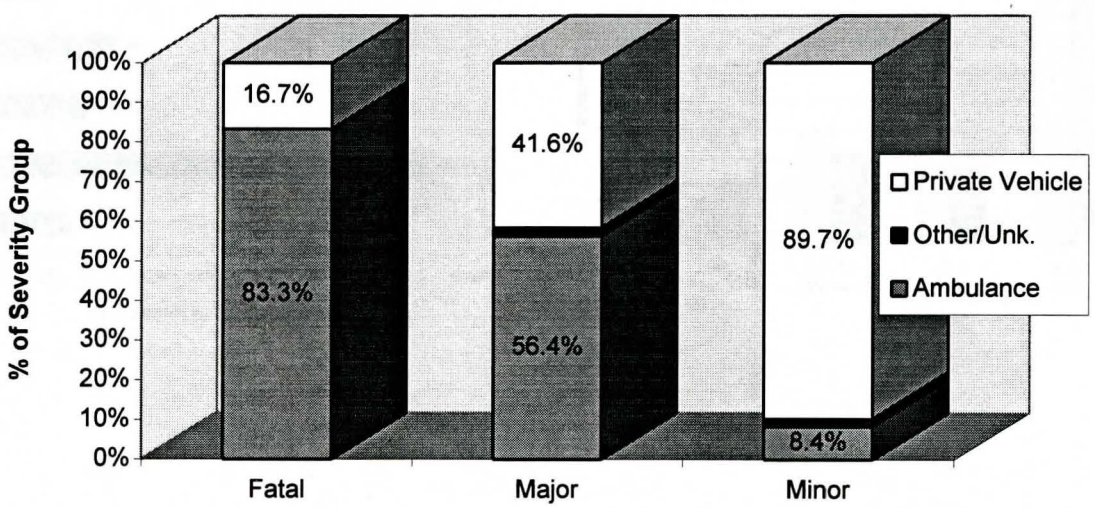


*** ICD-9 E-Codes -** Ninth edition of International Classification of Diseases, a standard coding system that includes causes of all injuries and disease processes.

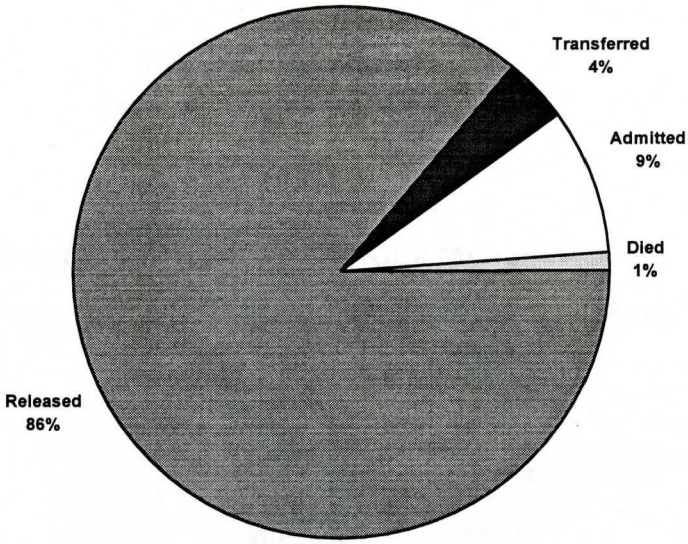
MODE OF ARRIVAL



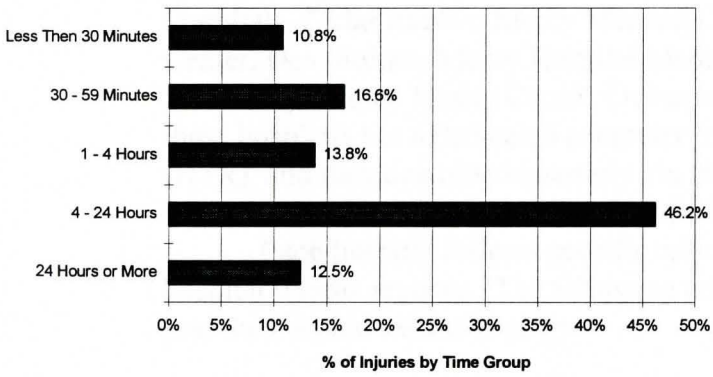
% OF SEVERITY GROUP HAVING EACH MODE OF ARRIVAL



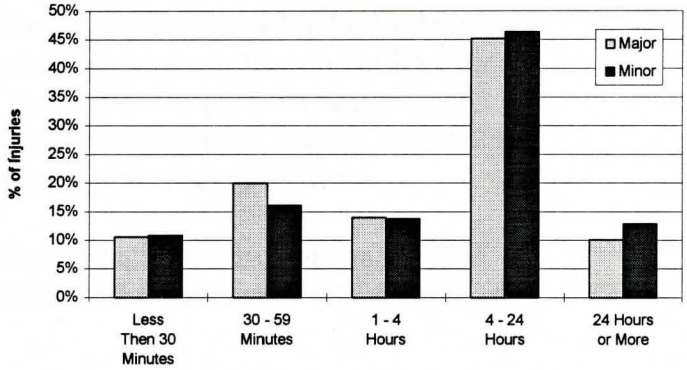
DISPOSITION



TIME TO ARRIVAL
(Time Patient Arrived in ED - Time Injury Occurred)

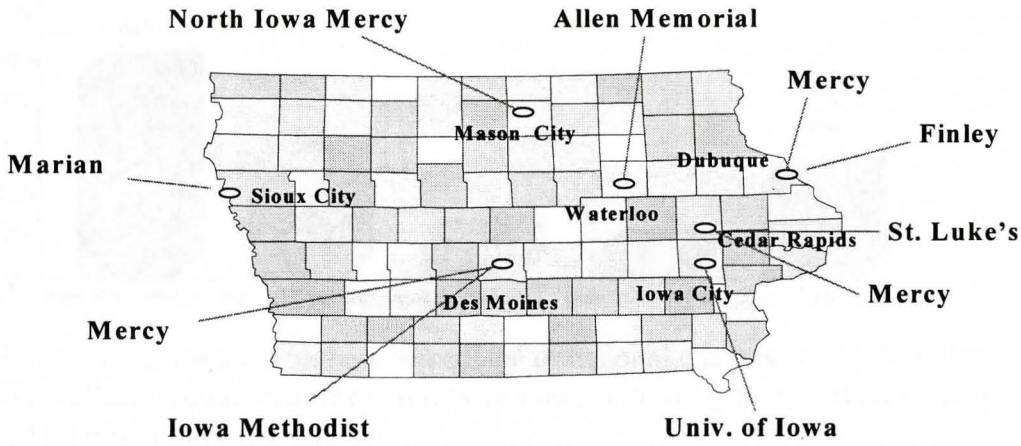


DISTRIBUTION OF TIME TO ARRIVAL FOR MAJOR AND MINOR INJURIES



IOWA SYSTEM TRAUMA REGISTRY

10 Urban Hospitals
January - December 1994



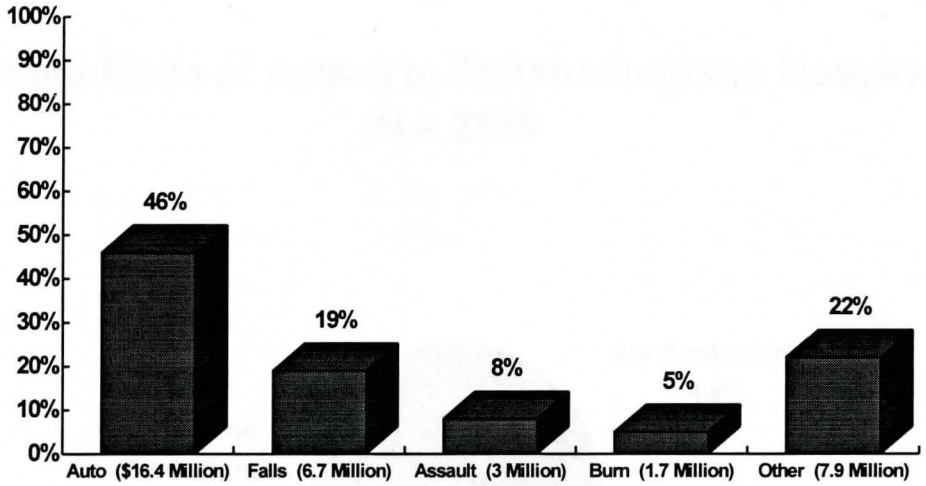
The Iowa System Trauma Registry data are generated by the State System Trauma Register (STR), located within the Iowa Department of Public Health, Bureau of Emergency Medical Services. Ten hospitals currently submit trauma data to the STR. The hospitals are; Allen Memorial Hospital, Waterloo; North Iowa Mercy Health Center, Mason City; University of Iowa Hospitals & Clinics, Iowa City; St. Luke's Methodist Hospitals, Cedar Rapids; Mercy Medical Center, Cedar Rapids; Iowa Methodist Medical Center, Des Moines; Mercy Hospital Medical Center, Des Moines; Marion Health Center, Sioux City; Mercy Health Center, Dubuque; and The Finley Hospital, Dubuque. Each of these hospitals has a dedicated computer for their respective Hospital Trauma Register (HTR), and then download quarterly via diskette the required data to the Iowa Department of Public Health, Bureau of EMS.

Each hospital follows specific criteria to identify patients for inclusion in the hospital trauma registry. The following criteria defines what trauma patients are entered into the hospital trauma registry.

Injury diagnosis (ICD-9-CM N-Code 800.00 through 959.00), excluding isolated hip fractures unrelated to a traumatic event, and one or more of the following:

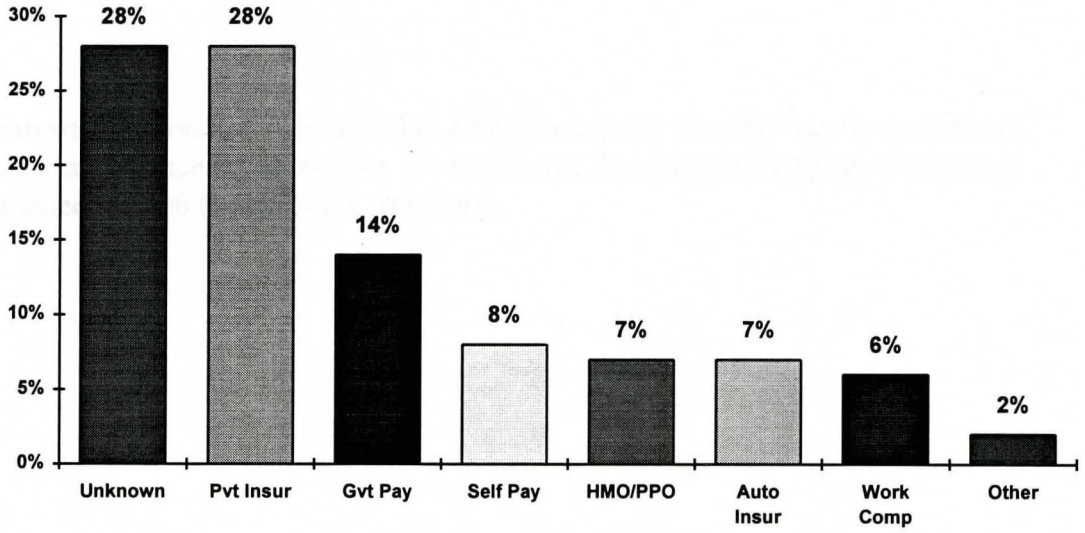
1) injured patients who die;
2) injured patients who are admitted to the hospital for a stay greater than 24 hours;
3) injured patients who are admitted to intensive care units or an operating room;
4) injured patients who are transferred into or out of the hospital;
5) injured patients who are readmitted within 72 hours after discharge from the initial injury.

Hospital Charges by Cause
Total = $35.7 Million



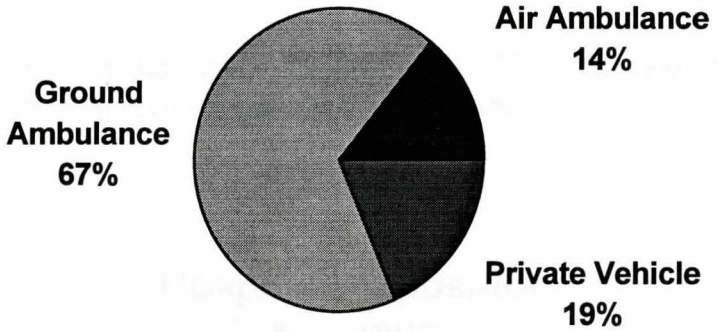
Automobile crashes caused the highest percentage of hospital charges at $16.4 million (46%). This reflects the fact that the majority of injuries in the system trauma registry were caused by ground transportation.

Hospital Charges by Payor
Total = $35.7 Million



Of the known payors, private insurance accounted for the largest percentage (28%).

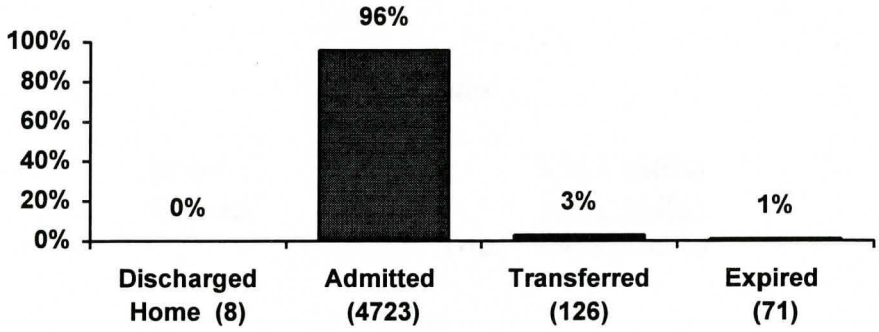
Patient Mode of Arrival to Trauma Registry Hospitals
N = 2846



Air Ambulance	**406**
Private Vehicle	**527**
Ground Ambulance	**1913**

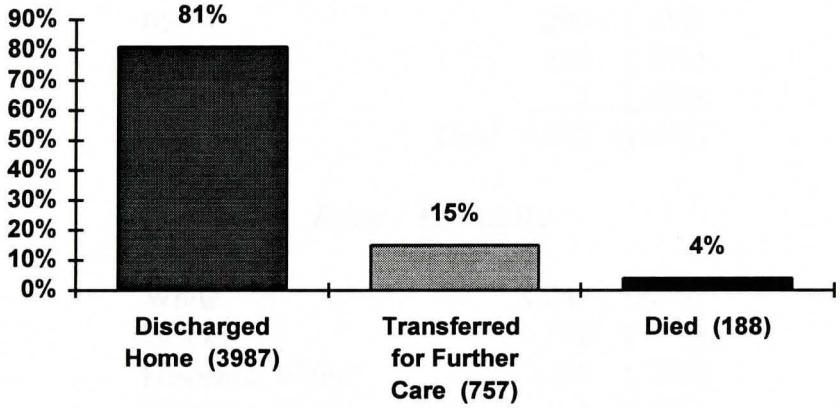
The most common mode of arrival to a trauma registry hospital was by ambulance. Ground ambulance accounted for 1913 (67%) of the transports and air ambulances accounted for 406 (14%) of the transports.

Emergency Department Disposition
N = 4928



Of the known emergency department dispositions, 4,723 (96%) were admitted to the hospital. Only 126 (3%) required transfer to another facility.

Hospital Disposition
N = 4932



Of the 4,932 known hospital dispositions, 3,987 (81%) were discharged home, 757 (15%) were transferred for further care, and 188 (4%) died.

PATIENT DEMOGRAPHICS

(4,943 Injured Patients)

Gender

Male	3,252	(66%)
Female	1,691	(34%)
Total	4,943	(100%)

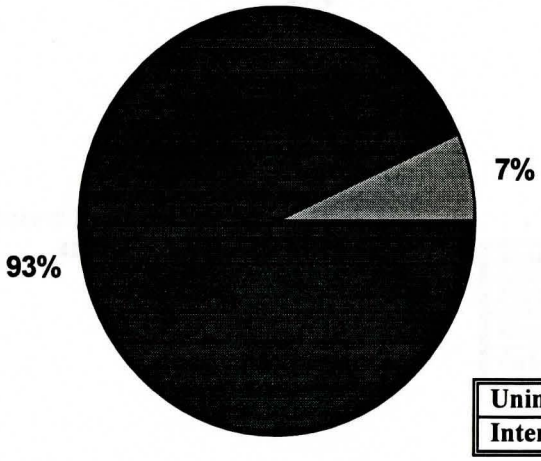
Age

4 Years & Under	242	(5%)
5-9	238	(5%)
10-14	292	(6%)
15-19	589	(11%)
20-24	493	(10%)
25-34	861	(17%)
35-44	702	(14%)
45-54	474	(10%)
55-64	331	(7%)
65-74	290	(6%)
Over 75	430	(9%)
Unknown	1	(0%)
Total	4,943	(100%)

Race / Ethnicity

White	4,247	(86%)
Black	192	(4%)
Hispanic, White	88	(2%)
Hispanic, Black	1	(0%)
American Indian	53	(1%)
Pacific Islander	14	(0%)
Asian	30	(1%)
Other	21	(0%)
Unknown	297	(6%)
Total	4,943	(100%)

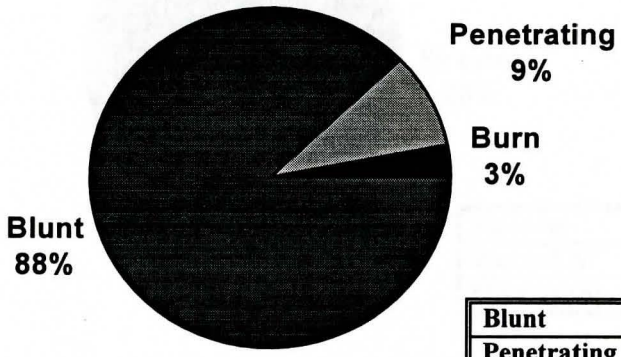
Injury by Intent
N=4561



Unintentional	4224
Intentional	300

Of the 4,943 patients entered into the system trauma registry, 4,524 injury intents could be determined. Unintentional injuries accounted for 4,224 (93%) and intentional injuries accounted for 300 (7%) of the injuries .

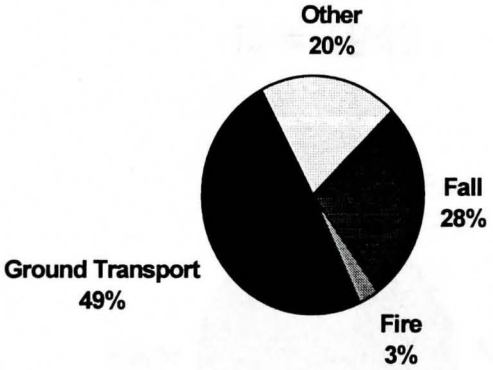
Injury by Etiology
N=4566



Blunt	4016
Penetrating	420
Burn	130

Of the 4,943 patients entered into the system trauma registry, 4,566 injury etiologies could be determined. Of the injury etiologies, blunt injuries accounted for 4,016 (88%) and penetrating injury accounted for 420 (9%) of the injuries. The remaining 130 (3%) resulted from burns.

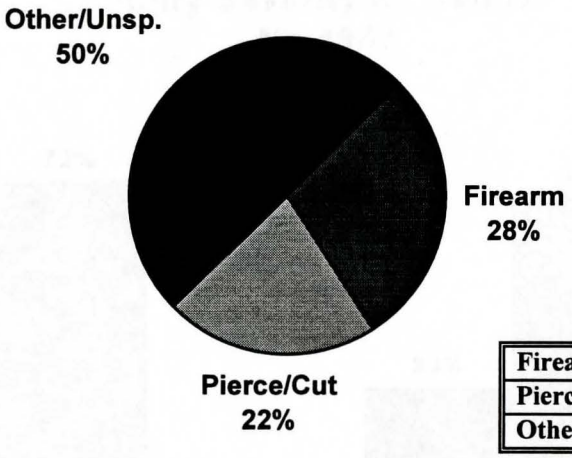
Unintentional Injury By Cause
N = 4224



Fall	1169
Fire	126
Ground	2073
Other	856

Of the 4,224 unintentional injuries, ground transportation accounted for the most injuries at 2,073 (49%).

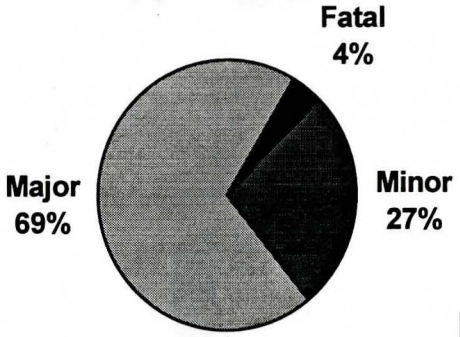
Intentional Injury by Cause
N = 300



Firearm	85
Pierce/Cut	66
Other/Unsp.	149

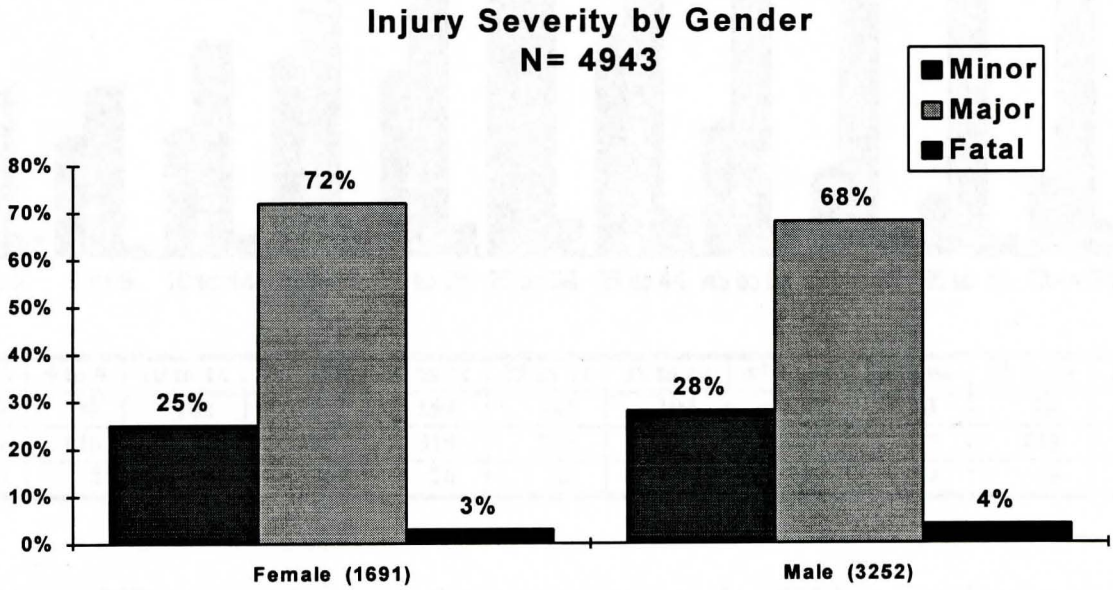
Of the 300 inentional injuries, 149 (50%) were other or unspecified, 85 (26%) were firearms and 66 (22%) were pierce or cut.

Injuries by Severity
N = 4943



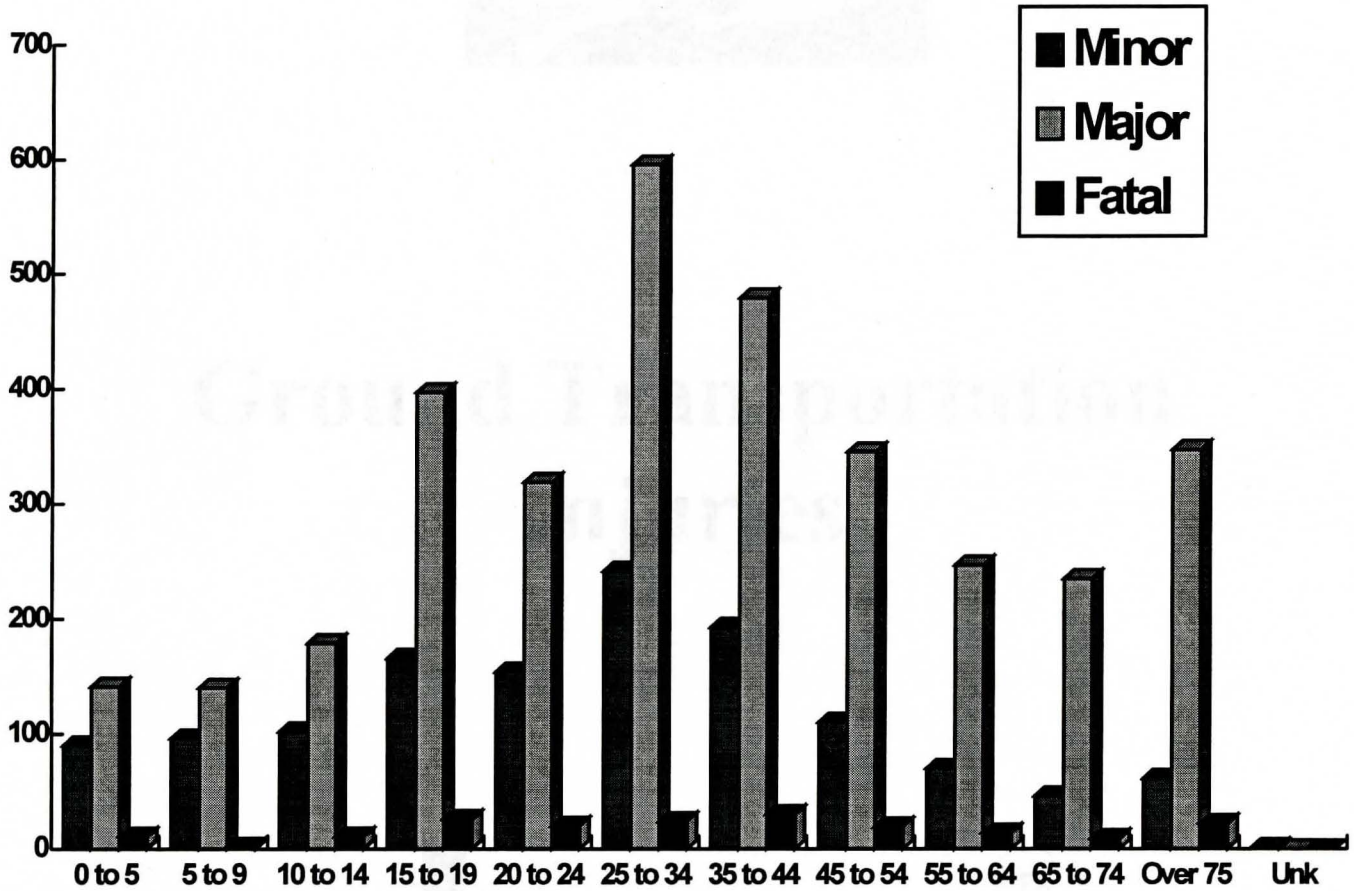
Major	3424
Minor	1331
Fatal	188

The severity mix of injured patients consisted of 3,424 (69%) major injuries, 1331 (27%) minor injuries and 188 (4%) fatal.



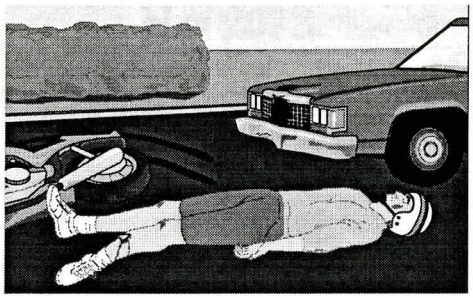
Injury severity by gender demonstrated that a higher percentage of female patients (72%) received major injuries than the male population (68%).

Injury Severity by Age Group
N = 4943

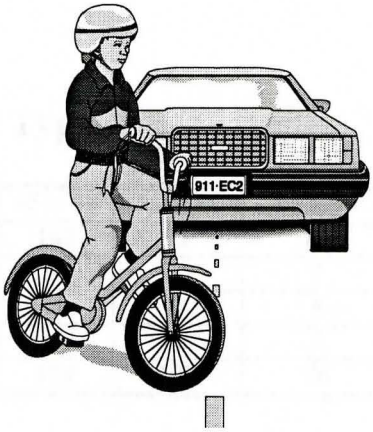


	0 to 5	5 to 9	10 to 14	15 to 19	20 to 24	25 to 34	35 to 44	45 to 54	55 to 64	65 to 74	Over 75	Unk
Minor	90	96	102	166	154	242	193	110	70	46	61	1
Major	141	140	179	397	319	595	479	345	247	235	347	0
Fatal	11	2	11	26	20	24	30	19	14	9	22	0

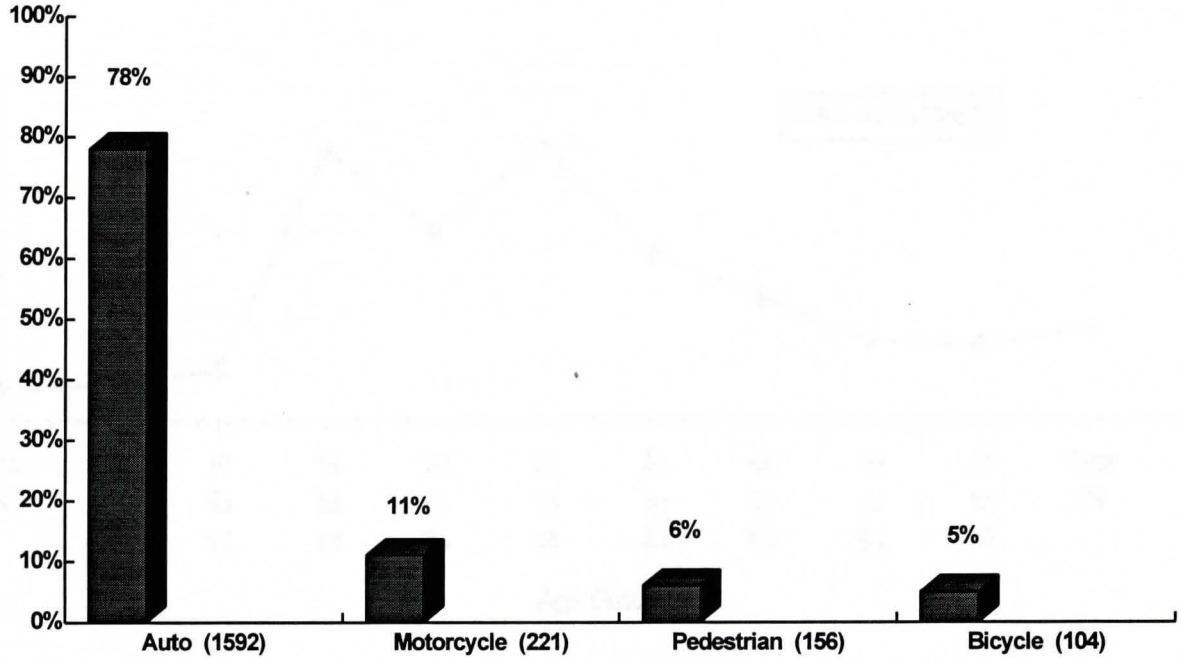
Of the 4,943 trauma patients treated, the majority of injuries (52%) were within the 15-44 age group.



Ground Transportation Injuries



Injuries by Ground Transportation Type
N = 2073



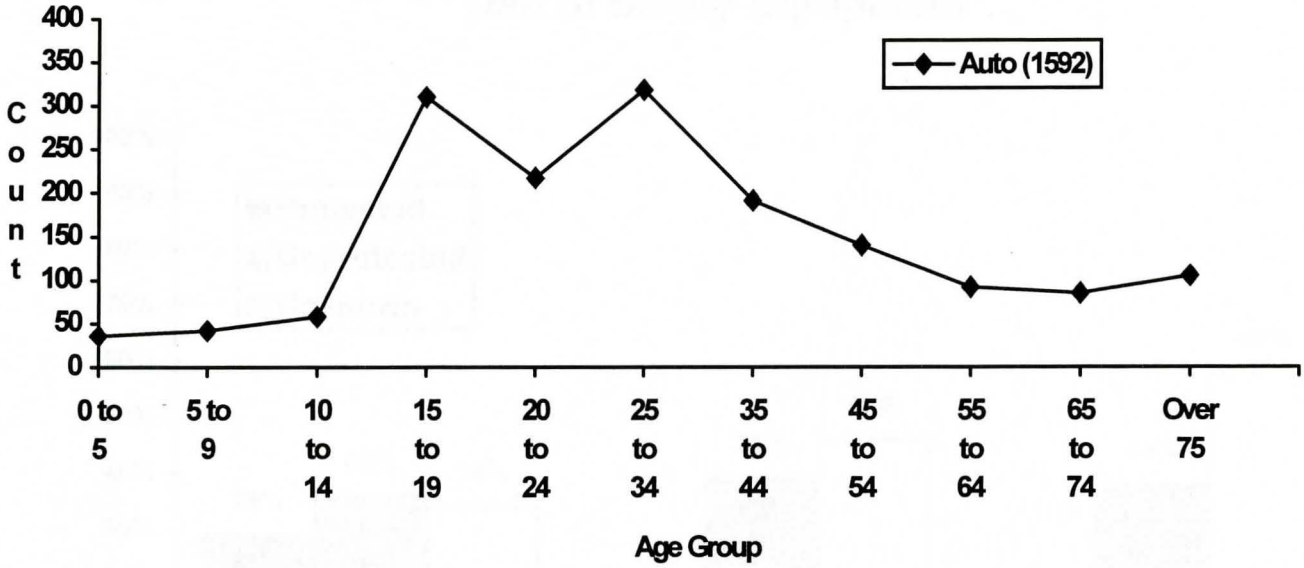
Of the 2,703 injuries resulting from ground transportation, automobile crashes were by far the largest cause. Automobile crashes accounted for 1,592 or 78% of the total ground transportation injuries. Motorcycle injuries were second at 221 (11%) followed by pedestrian at 156 (7%) and bicycle at 104 (5%).

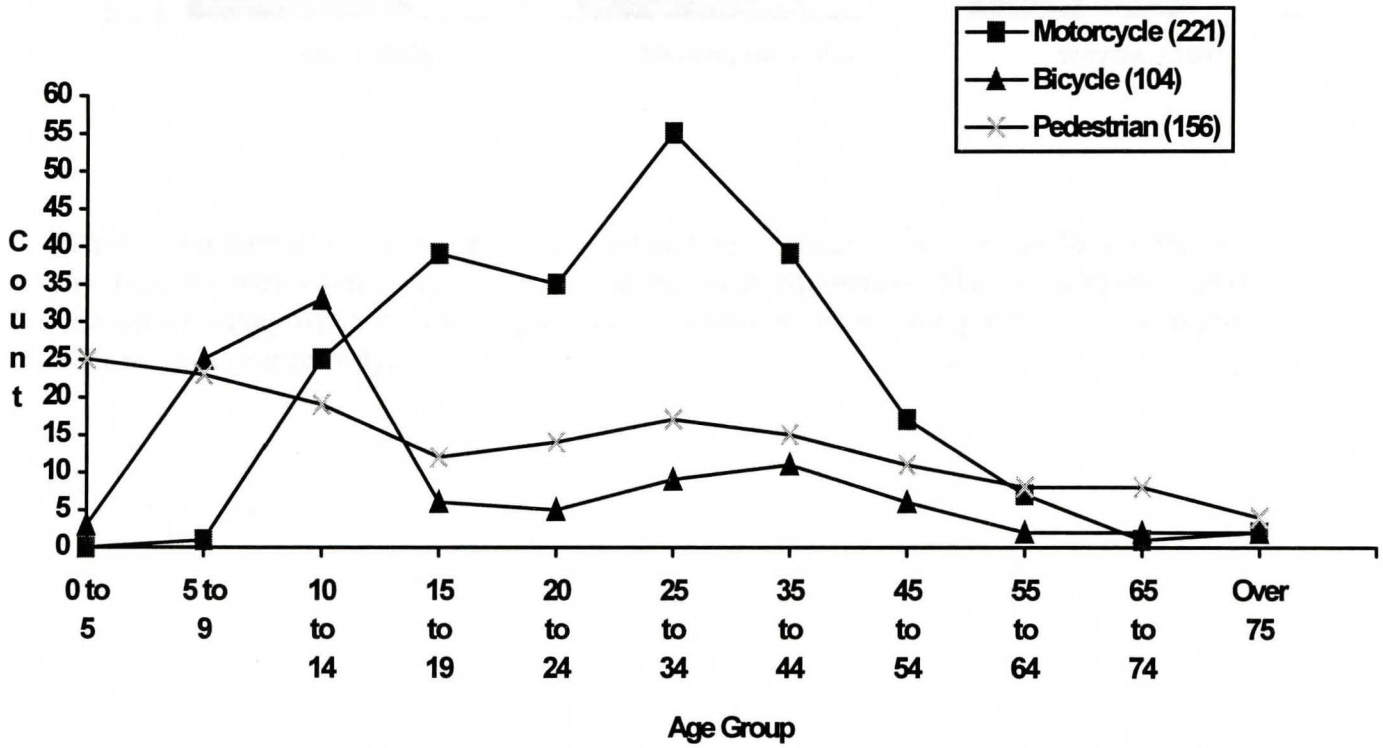
Count of Injuries by Age Group and Type

	0 to 5	5 to 9	10 to 14	15 to 19	20 to 24	25 to 34	35 to 44	45 to 54	55 to 64	65 to 74	Over 75
Automobile	36	42	58	310	217	316	191	140	92	85	105
Motorcycle	0	1	25	39	35	55	39	17	7	1	2
Pedestrian	25	23	19	12	14	17	15	11	8	8	4
Bicycle	3	25	33	6	5	9	11	6	2	2	2
Total	64	91	135	367	271	397	256	174	109	96	113

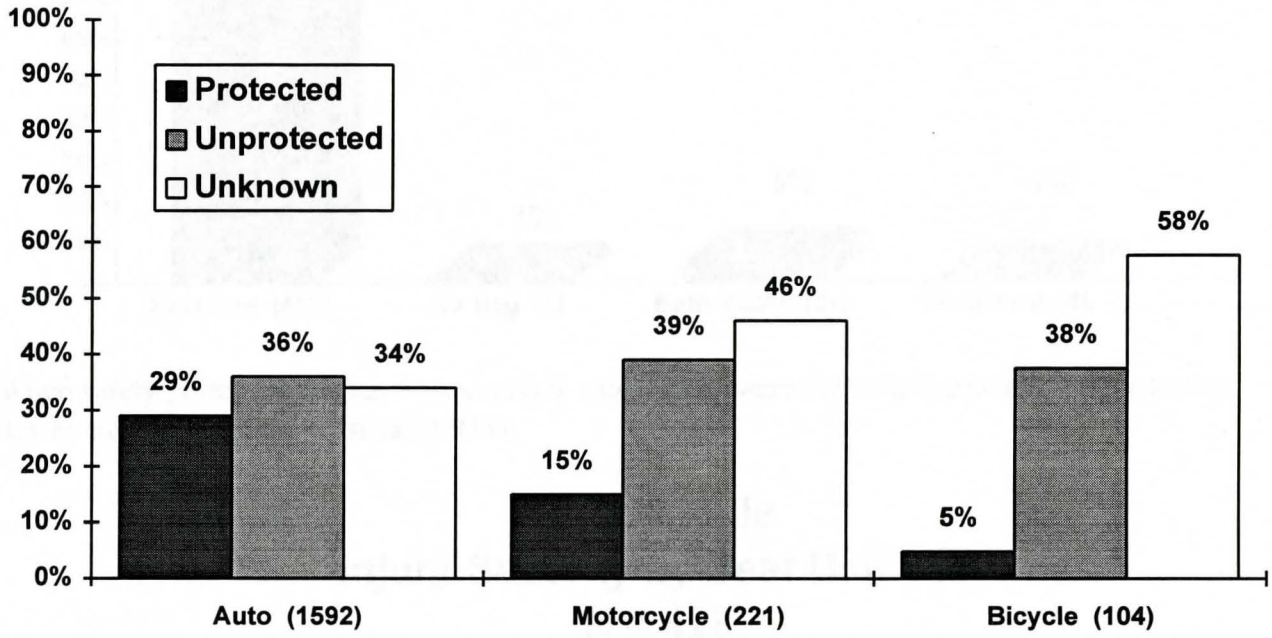
Ground Transportation Injuries by Age Group

N = 2073

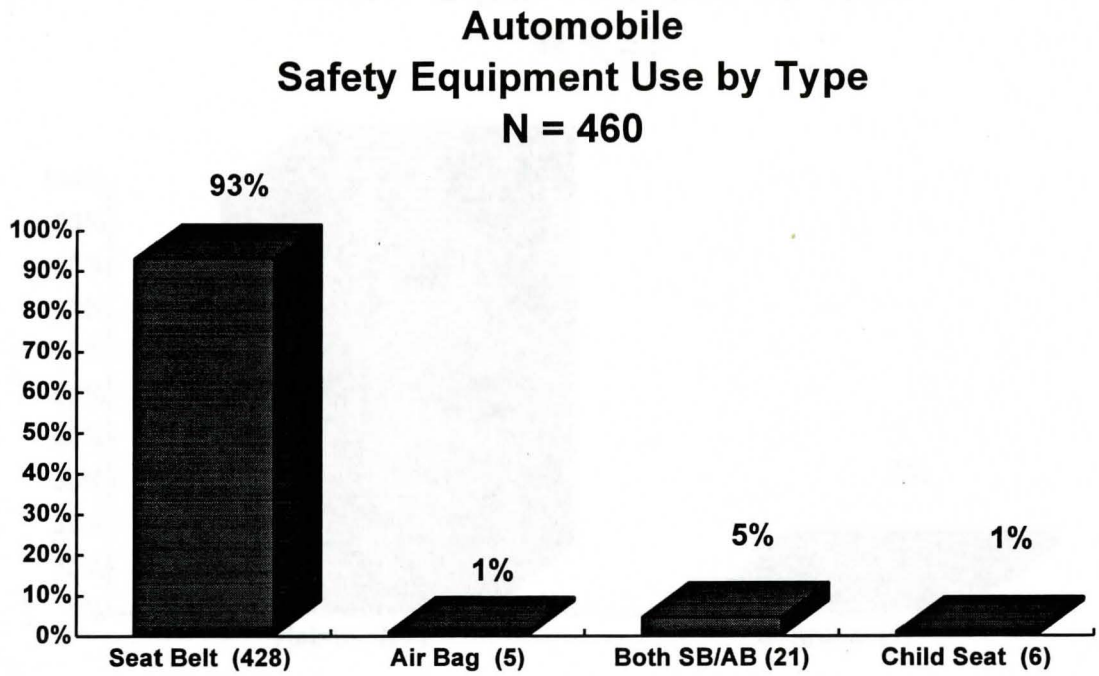




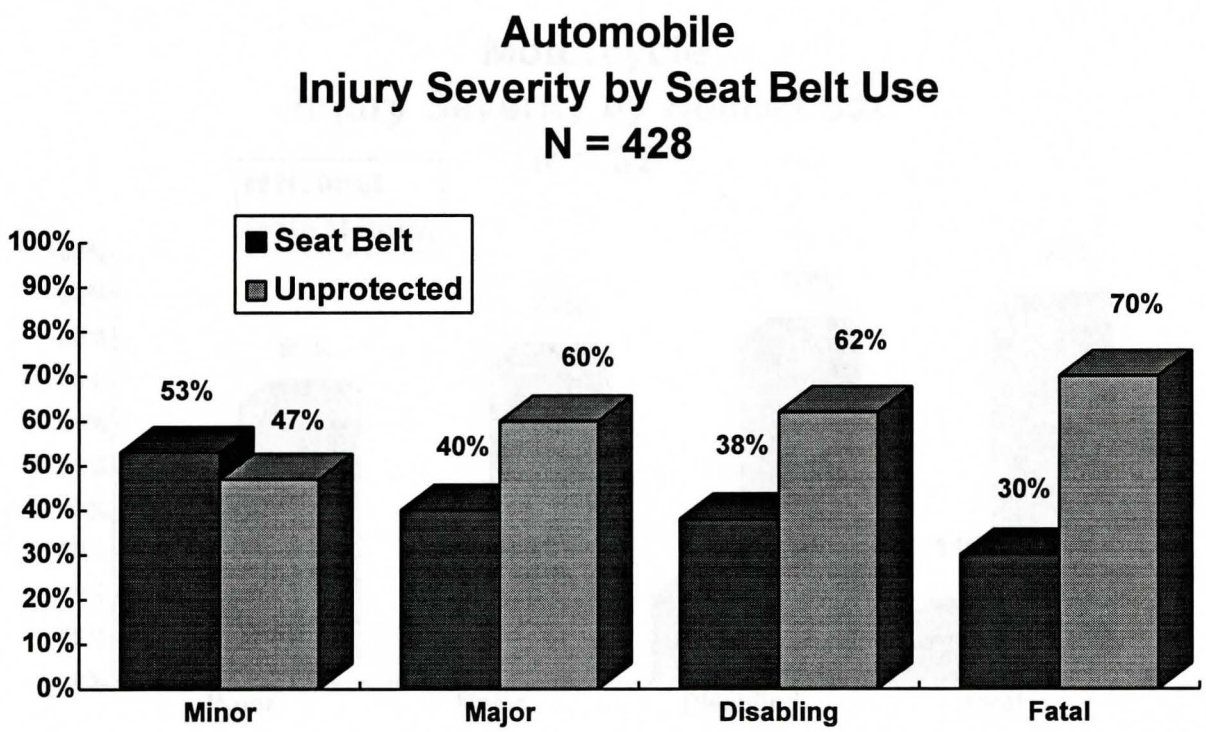
Use of Safety Equipment



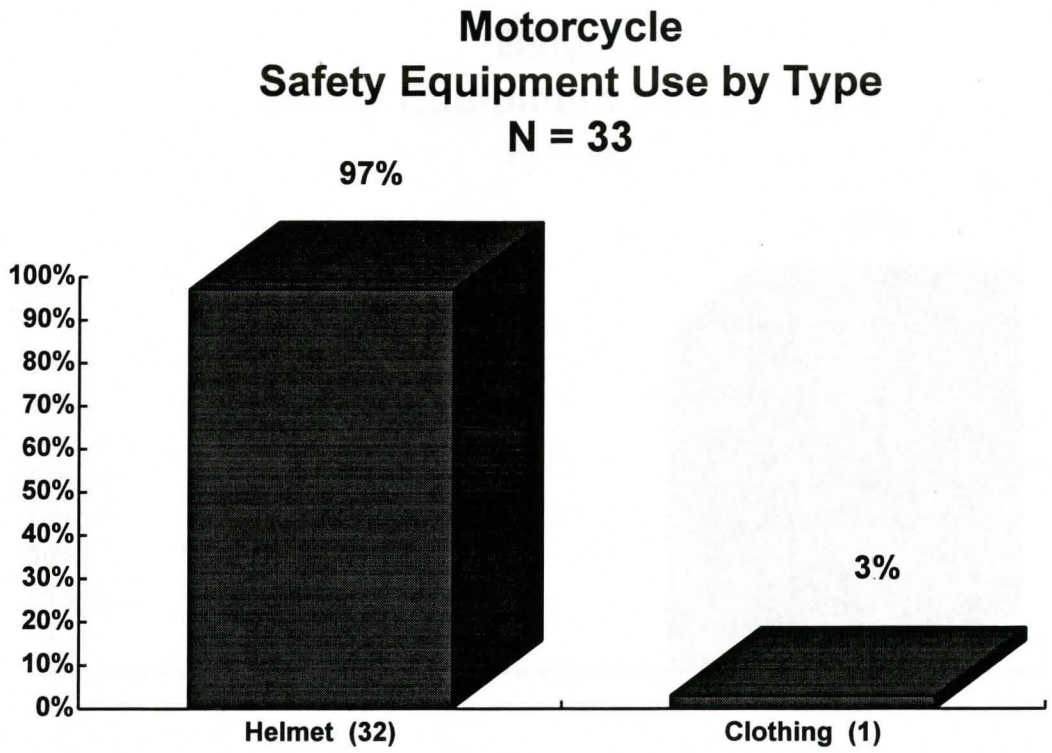
Where the information was recorded, the system trauma registry showed that 36% of those involved in a motor vehicle crash were not using safety equipment. There was an increase in non-use of safety equipment among motorcycle and bicycle related injuries at 39% non use and 38% non-use respectively.



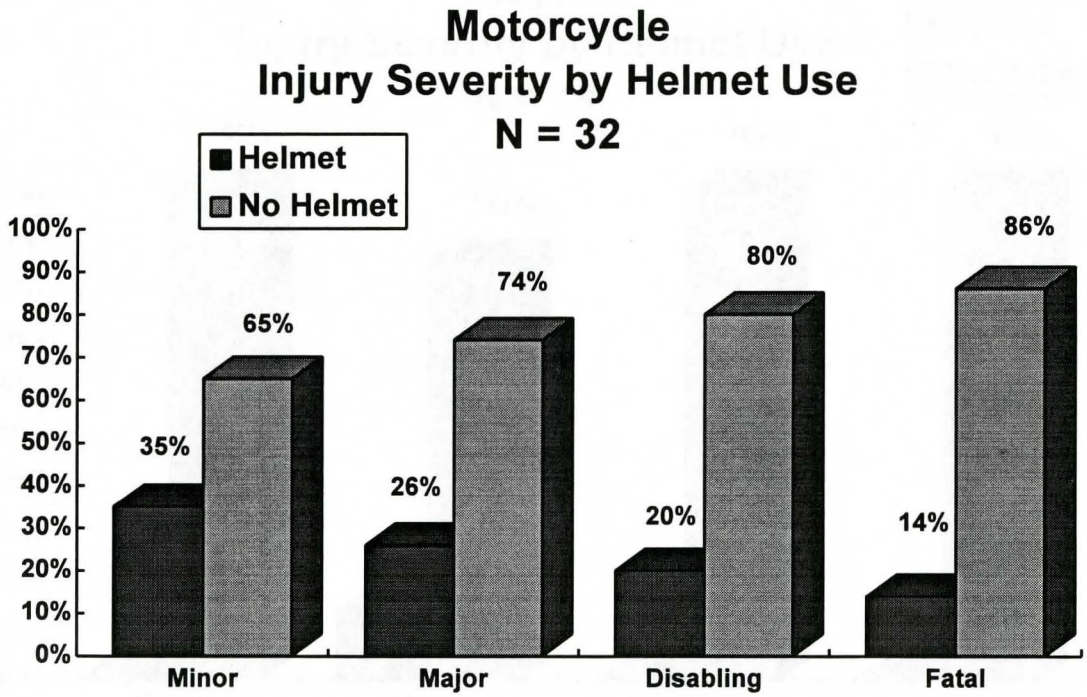
When safety protective device was recorded, safety belts were the most frequent used protective device in motor vehicle crashes, at 93%.



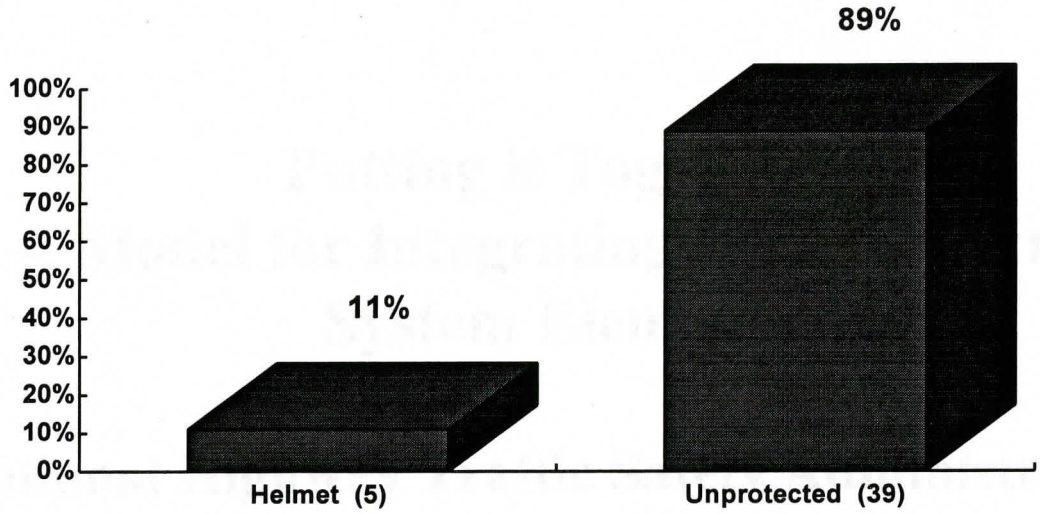
There was an increase in major, disabling and fatal injuries when seat belts were not used.



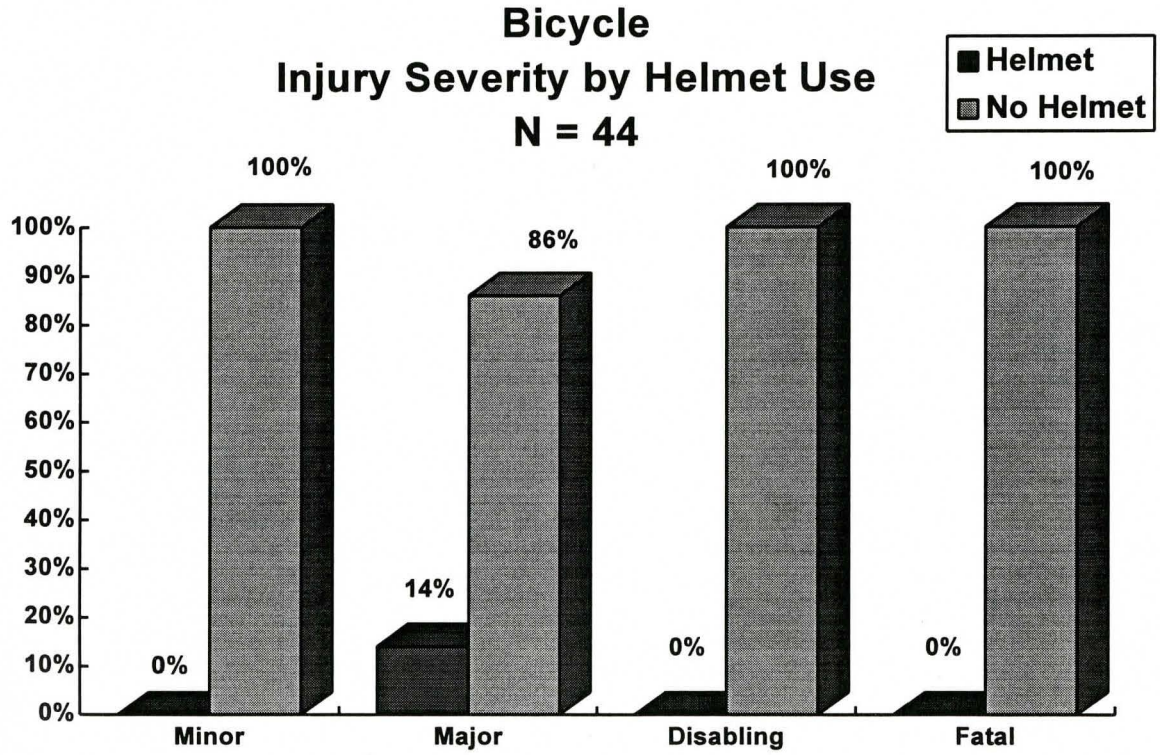
Of the 33 motrocycle accidents where safety equipment was reported, a helmet was by far the most used safety equipment (97%) for motorcycle related injuries.



Non-use of a helmet greatly increased the number of injuries at all levels of severity.



Where information on safety equipment use was recorded on bicycle related injuries, 89% were unprotected.



Non-use of bicycle helmets greatly increases the number of injuries at all levels of severity.

APPENDIX A

Putting it Together: A Model for Integrating Injury Control System Elements

National Highway Traffic Safety Administration

Putting It Together: A Model for Integrating Injury Control System Elements

SUMMARY

Introduction

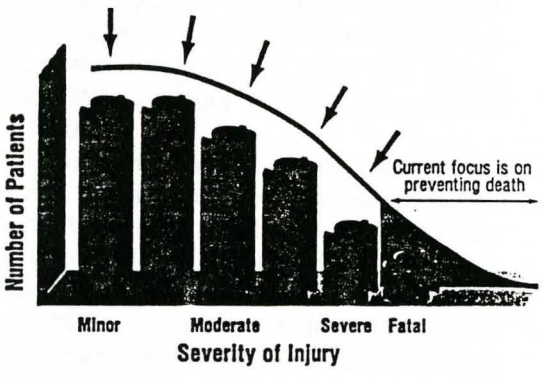
Injury is the leading cause of all death for persons from age 1 to 44 years, as well as the most common cause of hospitalizations for persons under age 40. The financial costs of injuries are staggering: injuries cost billions of dollars in health care and social support resources. In 1990, for example, the lifetime costs of all injuries were estimated at $215 billion annually. These estimates do not include the emotional burden resulting from the loss of a child or loved one or the toll of severe disability on the injured person and his/her family.

Injury control has come a long way in the ten years since the publication of *Injury in America*. Many of the farsighted recommendations of that publication have been implemented. However, injury has not received the same level of public attention and resources as have other health issues, and despite recent progress, injury remains a major public health problem. Resources must be more effectively utilized to meet the challenge posed by injuries.

Vision

Building on past efforts, a new vision for the future of injury control emerges. This vision inspires action towards an integrated injury control system, where linkages and partnerships exist among the system components, as well as with business, government, health care and community groups working together to reduce the toll of injuries. When partners work in concert, the scope of injury control efforts can be broadened to systematically address all injuries, and thus reduce the overall costs of injury to society.

Drive Down the Size of the Curve!



Partners

The injury problem is too large and too complex, and resources too limited, for any one group to solve alone. Potential partners are all those having a stake in reducing injuries. This includes those who are traditional stakeholders — e.g., health care practitioners, emergency medical technicians, public health professionals, safety advocates — as well as those who may not readily identify with the traditional injury control community — law enforcement, business, local government, schools. This new vision for injury control enlightens individuals and groups to the role they play in reducing injury and encourages new coalitions and partnerships.

Community Partners

- **Public Safety: Police, Fire, EMS**
- **Local Government**
- **Schools**
- **Business**
- **Community Groups**
- **Health Care Providers**
- **Public Health Agencies**

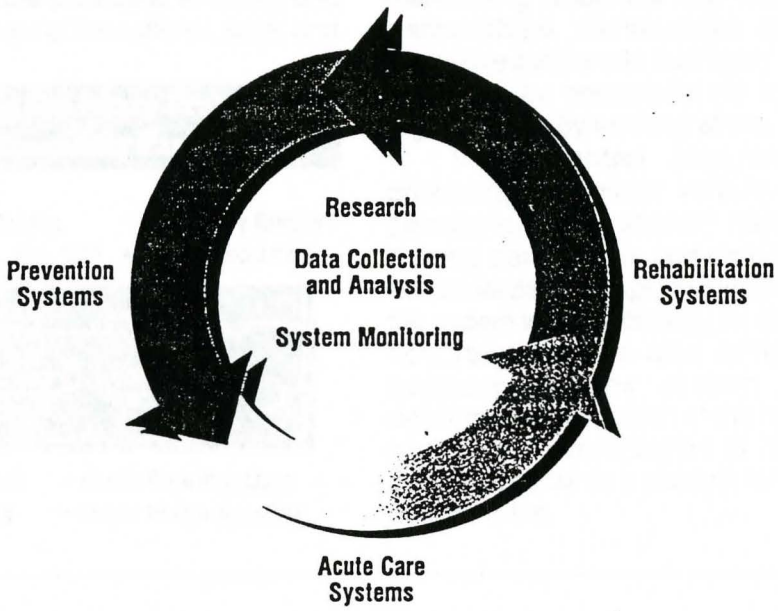
System Components

The injury control system consists of three integrated components: prevention, acute care and rehabilitation. Each of the three components of the injury control system currently operates as an extensive, highly evolved, independent system. To accelerate progress in reducing injuries, the three components must operate as a synergistic system whereby, for example, data from one component is used by another component to identify emerging problems, allocate resources and develop effective interventions.

Prevention approaches seek to avert injury. This is accomplished by identifying the causes of injury and those at risk for different types of injury; developing and implementing effective interventions; and monitoring and evaluating the effectiveness of the interventions on the population at risk. Prevention programs reduce injuries by *changing behavior* (wearing a safety belt, not drinking and driving, lowering household water temperatures), *making a safer product* (air bags, anti-lock brakes, using materials that absorb energy) or *creating a safer environment* (fencing around pools, smoke detectors, improved roadway lighting and markings). Over the long term, prevention approaches are more cost-effective than treatment.

Acute care systems provide accessible and appropriate care to all patients regardless of the nature and severity of the injury. As some injuries will occur despite the best prevention efforts, an integrated injury control system must include approaches for dealing with an injury once it occurs. The outcome of an injury depends not only on its severity, but also on the speed and appropriateness of medical treatment. The goal of the acute care system is to ensure that every patient receives optimal care from the initial recognition of injury through return to the community.

Injury Control System Elements



Rehabilitation systems help the injured patient return to the home and work environment. Rehabilitation is the process by which biological, psychological and social functions are restored or developed to permit the injured person to be integrated back into society and lead a productive and independent life. Early and aggressive rehabilitation can reduce long-term costs to employers and society by returning injured workers to the workforce, decreasing disability and workers compensation costs, and increasing overall productivity.

In addition, data collection and analyses, research, and system monitoring serve as the critical links among the three system components. Data document what occurs. Research uses data to identify injury mechanisms and develop strategies — both preventative and treatment-based — for reducing injuries. System monitoring provides an index of how the injury control systems perform.

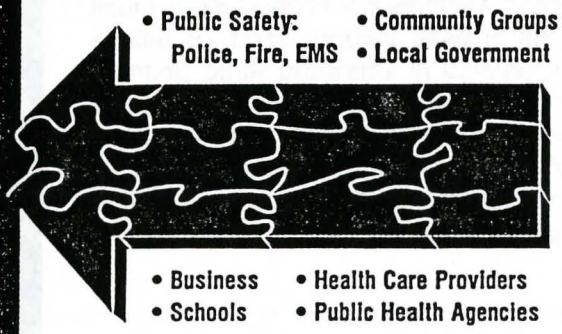
The System in Action

Partnerships and leadership are the foundation for making the injury control system work. Linkage must occur among the system components as well as among potential partners. Given the cost of injury to society and the consequences of injury on human lives, more widespread and innovative efforts must emerge to reduce injury. Business, government, law enforcement, health care providers, and civic and advocacy groups at the national, state, and local levels must join forces and work together across the injury control system. Leadership is required to coalesce these divergent groups and interests in a comprehensive approach to injury.

By working in partnership, injury control stakeholders can avoid fragmentation and duplication of efforts and reinforce each other's programs and messages. By marshalling resources and data through partnerships, communities can create innovative solutions to their injury problems. More can be accomplished by working together than by working alone.

Injury control programs (e.g., drowning, falls, motor vehicle, violence, poisoning, occupational) must explore existing partnerships and decide whether additional partnerships are needed to make the system work. A strategy for establishing new relationships and bringing new partners into the system must be developed. Recognition of the high cost of injury and its contribution to health care costs can serve as a catalyst for engaging new partners.

Attacking the Injury Problem Through Community Partnerships



System Implementation

Often, it seems difficult to improve health and safety because the problems seem so complex, and intervention strategies have too many implications. So people sometimes wait for others to take the first step, or for an event to propel them to action. Implementing a comprehensive injury control model clearly requires leadership and an ability to bring together many diverse interests. Leadership can come from different sources — government, the health care community, civic groups, and employers. Once a commitment is made to focus on injury, the stakeholders must decide what problems need to be addressed, what resources they bring to possible solutions, what role they will play in controlling injury, and how they will work together to reduce injury.

Leadership in reducing death and injury from traffic crashes has traditionally come from *federal government, state highway safety offices, law enforcement, advocacy groups, and emergency medical services.* These groups have long recognized the toll of traffic crashes in terms of pain, suffering and costs. However, these traditional traffic safety partnerships must be expanded to include new and emerging partners and to better integrate health and medical providers, business, and local government into comprehensive traffic safety-injury control efforts.

Government can take a leadership role in injury control by galvanizing partners such as the media, law enforcement, courts, civic organizations, employers, and health care providers to support injury control activities, establish policies, and initiate environmental changes to reduce injury in the community. Government can also provide the leadership needed to identify problems, determine priorities, and design prevention programs that will reduce the incidence of injuries.

Health care providers see first-hand the effects of injuries — especially in terms of human pain and suffering. Moreover, the current focus on reducing health care costs by changing financing incentives is shifting the focus of care from treatment to prevention. Involving health care providers in preventing and mitigating injuries can help communities redirect scarce resources from treatment and care of injured persons into community health promotion and wellness programs.

Business has an increasing role in injury control. Injuries — both on- and off-the-job — not only cost employers in terms of outlays for health insurance and workers compensation, but also result in lost productivity and work days, and increased insurance premiums. Long-term disability is extremely costly, and business bears not only the costs of rehabilitation, but costs associated with backfilling positions and training replacement employees. Business can examine internal data to track the incidence and costs of injuries, establish policies for on-the-job safety, and form partnerships to reduce injuries, lost work days, and lost productivity.

Efforts to implement an integrated injury control system will employ strategies similar to those models used in implementing other programs in communities and organizations. There are many program implementation models; most share similar elements. What is important to keep in mind is that new partnerships provide fertile ground for exploring innovative ways to approach old, as well as emerging, problems.

Stakeholders can use this new conceptual framework to align partners and move forward with a consolidated approach to injury control. The injury control community must now further refine these concepts and develop additional strategies for implementing these ideas.

Implementation Steps

1. **Build an injury control coalition with relevant stakeholders.**
2. **Use community data to identify injury problems and causes.**
3. **Develop and test solutions and interventions based on consensus.**
4. **Implement interventions.**
5. **Evaluate intervention process and outcomes using coalition-generated targets.**

For additional information, contact:

Health Care Task Force (NOA-01)
National Highway Traffic Safety Administration
400 Seventh St., S.W., Washington, DC 20590
Tel: (202) 366-2105 • Fax: (202) 366-2106

U.S. Department of Transportation
National Highway Traffic Safety Administration

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APPENDIX B

System Trauma Register Summary

SYSTEM TRAUMA REGISTER

IOWA DEPARTMENT OF PUBLIC HEALTH (BUREAU OF EMS)

TRAUMA SYSTEM SUMMARY
Dates: 01/01/94 through 12/31/94
[4943 Records]

PATIENT ORIGIN

Not Transported			0 (0%)
From Injury Scene			4198 (85%)
To Nondesignated Hospital		0 (0%)	
Minor	0 (***%)		
Major	0 (***%)		
Fatal	0 (***%)		
To Trauma Hospital		4198 (100%)	
Minor	1331 (32%)		
Major	2726 (65%)		
Fatal	141 (3%)		
From Another Facility			745 (15%)
To Nondesignated Hospital		0 (0%)	
Minor	0 (***%)		
Major	0 (***%)		
Fatal	0 (***%)		
To Trauma Hospital		745 (100%)	
Minor	0 (0%)		
Major	698 (94%)		
Fatal	47 (6%)		
		Total Origins ===>	4943

PATIENT DISPOSITION

Not Transported			0 (0%)
To Nondesignated Hospital			0 (0%)
Prehospital Arrest		0 (***%)	
Not Transferred Out		0 (***%)	
Minor	0 (***%)		
Major	0 (***%)		
Fatal	0 (***%)		
Transferred Out		0 (***%)	
Minor	0 (***%)		
Major	0 (***%)		
Fatal	0 (***%)		
To Another Facility			4943 (100%)
Prehospital Arrest		28 (1%)	
Not Transferred Out		4695 (95%)	
Minor	1264 (27%)		
Major	3266 (70%)		
Fatal	165 (4%)		
Transferred Out		220 (4%)	
Minor	67 (30%)		
Major	153 (70%)		
Fatal	0 (0%)		
		Total Dispositions ===>	4943

PATIENT DESIGNATION

Prospective:	Prehospital Triage	2915	(59%)
	Interhospital Transfer	745	(15%)
Concurrent:	Trauma Team Mobilization	395	(8%)
	Intrahospital Transfer	3	(0%)
Retrospective:	Discharge Review	885	(18%)
	Medical Examiner	0	(0%)
	Total Designations ===>		4943

AGE

	Minor	Major	Fatal			
Under 25	608	1176	70		1854	(38%)
Under 5	[90	141	11]	242 (13%)		
5 - 9	[96	140	2]	238 (13%)		
10 - 14	[102	179	11]	292 (16%)		
15 - 19	[166	397	26]	589 (32%)		
20 - 24	[154	319	20]	493 (27%)		
25 - 34	242	595	24		861	(17%)
35 - 44	193	479	30		702	(14%)
45 - 54	110	345	19		474	(10%)
55 - 64	70	247	14		331	(7%)
65 - 74	46	235	9		290	(6%)
75 and Over	61	347	22		430	(9%)
Unknown	1	0	0		1	(0%)
Subtotals	1331	3424	188			
					Total ===>	4943

GENDER

	Minor	Major	Fatal		
Female	424	1211	56	1691	(34%)
Male	907	2213	132	3252	(66%)
Unknown	0	0	0	0	(0%)
Subtotals	1331	3424	188		
				Total ===>	4943

RACE

	Minor	Major	Fatal		
White	1110	2974	163	4247	(86%)
Black	72	113	7	192	(4%)
Hispanic, White	20	66	2	88	(2%)
Hispanic, Black	1	0	0	1	(0%)
American Indian	6	43	4	53	(1%)
Pac. Islander	6	8	0	14	(0%)
Asian	12	16	2	30	(1%)
Other	7	12	2	21	(0%)
Unknown	97	192	8	297	(6%)
Subtotals	1331	3424	188		
				Total ===>	4943

ETIOLOGY [Blunt 4016 (88%); Penetrating 420 (9%); Burn 130 (3%)]

UNINTENTIONAL						4224 (87)
Fall				1169 (28)		
Fire				126 (3)		
Transport				2128 (50)		
Air			3 (0)			
Ground			2075 (98)			
Auto	1592 (77)					
M/C	221 (11)					
P/C	104 (5)					
Ped	156 (8)					
Train	2 (0)					
Water			5 (0)			
Other/Unsp			45 (2)			
Other/Unsp				801 (19)		
INTENTIONAL						300 (6)
Vs. Another				234 (78)		
Firearm			52 (22)			
Pierce/Cut			49 (21)			
Other/Unsp			133 (57)			
Legal Interv.				3 (1)		
Vs. Self				63 (21)		
Firearm			33 (52)			
Pierce/Cut			17 (27)			
Other/Unsp			13 (21)			
Other/Unsp				0 (0)		
UNDETERMINED						37 (1)
Firearm				17 (46)		
Pierce/Cut				2 (5)		
Other/Unsp				18 (49)		
					Total ===>	4880

TRANSPORTATION

Not Transported						0 (0%)
Prehospital Transport						4198 (85%)
Ground				1924 (46%)		
Private		424 (22%)				
Pub safety		3 (0%)				
Ambulance		1497 (78%)				
Air				303 (7%)		
Non-ambul		0 (0%)				
Fixed-wing		0 (0%)				
Rotor-wing		303 (100%)				
Other/Unk				1971 (47%)		
Interhospital Transfer						745 (15%)
Ground				516 (69%)		
Private		103 (20%)				
Pub safety		11 (2%)				
Ambulance		402 (78%)				
Air				103 (14%)		
Non-ambul		6 (6%)				
Fixed-wing		7 (7%)				
Rotor-wing		90 (87%)				
Other/Unk				126 (17%)		
					Total ===>	4943

ADMISSION TIME

	Sun	Mon	Tue	Wed	Thu	Fri	Sat	Shift Totals	
0001-0800	204	90	70	76	94	102	159	795	(16%)
0801-1600	258	228	267	251	248	246	298	1796	(36%)
1601-2400	367	324	314	291	313	346	397	2352	(48%)
Day Totals	829	642	651	618	655	694	854	4943	
(Pct.)	17%	13%	13%	13%	13%	14%	17%		

EMERGENCY DEPARTMENT RESPONSE

Trauma Team		0 (0%)	
Consult Only	0 (***%)		
Partial Team	0 (***%)		
Regular Team	0 (***%)		
None		0 (0%)	
Unknown		4943 (100%)	
		Total ===>	4943

EMERGENCY DEPARTMENT DISPOSITION

Not Treated		0 (0%)	
Discharged Home		7 (0%)	
Left Against Medical Advice		1 (0%)	
Admitted to This Hospital		4723 (96%)	
Directly to Observation	77 (2%)		
Directly to Floor	2578 (55%)		
Directly to Stepdown	37 (1%)		
Directly to Intensive Care	996 (21%)		
Directly to Operating Room	1035 (22%)		
Transferred to Another Hospital		126 (3%)	
Expired (Including DOA)		71 (1%)	
Not Applicable		14 (0%)	
		Total Dispositions ===>	4942

REHABILITATION

	None	Outpt	Inpt		
Poor Potential	14	0	2	16 (3%)	
Fair Potential	42	0	19	61 (13%)	
Good Potential	143	0	71	214 (46%)	
Unknown Potential	86	0	92	178 (38%)	
Subtotal	285	0	184		
			Total Referrals ===>		469

ORGAN DONATION

Heart	1 (1%)	
Liver	1 (1%)	
Kidney	0 (0%)	
Cornea	2 (1%)	
Pancreas	0 (0%)	
Heart/Lung	0 (0%)	
Skin	0 (0%)	
Bone	1 (1%)	
Multiple/Other	35 (19%)	
Not Requested	4 (2%)	
Refused	14 (7%)	
Unsuitable/Not Transported	43 (23%)	
Unknown	87 (46%)	
	Total Requests ===>	188

HOSPITAL DISCHARGE DISPOSITION

Not Treated		0 (0%)	
Discharged Home		3969 (80%)	
Left Against Medical Advice		18 (0%)	
Transferred to		757 (15%)	
Acute Care Hospital	223 (29%)		
Rehabilitation Facility	252 (33%)		
Skilled Nursing Facility	202 (27%)		
Inter/Residential Facility	80 (11%)		
Expired		188 (4%)	
	Total Discharges ===>		4932

LENGTH OF STAY

INTENSIVE CARE [4.3 Average Days=5459 Days/1271 Patients]			
Admitted		1271 (26%)	
0- 7 Days	1086 (85%)		
<1	90 (8%)		
1	432 (40%)		
2	259 (24%)		
3	136 (13%)		
4	65 (6%)		
5	56 (5%)		
6	33 (3%)		
7	15 (1%)		
8-14 Days	94 (7%)		
8- 9	33 (35%)		
10-11	34 (36%)		
12-14	27 (29%)		
15-21 Days	51 (4%)		
22-28 Days	17 (1%)		
>28 Days	23 (2%)		
Not Admitted		3665 (74%)	
Unknown		7 (0%)	
HOSPITAL [6.6 Average Days=31504 Days/4753 Patients]			
Admitted		4753 (96%)	
0- 7 Days	3603 (76%)		
<1	252 (7%)		
1	1034 (29%)		
2	715 (20%)		
3	519 (14%)		
4	386 (11%)		
5	294 (8%)		
6	234 (6%)		
7	169 (5%)		
8-14 Days	628 (13%)		
8- 9	259 (41%)		
10-11	189 (30%)		
12-14	180 (29%)		
15-21 Days	239 (5%)		
22-28 Days	118 (2%)		
>28 Days	165 (3%)		
Not Admitted		190 (4%)	
Unknown		0 (0%)	

APPENDIX C

Injury Control Summary

SYSTEM TRAUMA REGISTER

IOWA DEPARTMENT OF PUBLIC HEALTH (BUREAU OF EMS)

INJURY CONTROL SUMMARY
Dates: 01/01/94 through 12/31/94
[4943 Records]

ETIOLOGY

	Subt. (%)	Subt. (%)	Subt. (%)	Total (%)
UNINTENTIONAL				4224 (87)
Fall			1169 (28)	
Diff. Level		357 (31)		
Building	67 (19)			
Ladder	116 (32)			
Stair	174 (49)			
Same Level		377 (32)		
Other/Unsp		435 (37)		
Fire			126 (3)	
Clothing		2 (2)		
Residence		12 (10)		
Other/Unsp		112 (89)		
Transportation			2128 (50)	
Air		3 (0)		
Ground		2075 (98)		
Automobile	1592 (77)			
Motorcycle	221 (11)			
Pedalcycle	104 (5)			
Pedestrian	156 (8)			
Train	2 (0)			
Water		5 (0)		
Other/Unsp		45 (2)		
Other			801 (19)	
Bite		58 (7)		
Caught/Crush		57 (7)		
Collision		143 (18)		
Cut/Pierce		180 (22)		
Explosion		0 (0)		
Firearm		41 (5)		
Lightning		0 (0)		
Machinery		190 (24)		
Natural Dis.		1 (0)		
Struck, Obj.		63 (8)		
Other/Unsp		68 (8)		

	Subt. (%)	Subt. (%)	Total (%)
INTENTIONAL			300 (6)
Vs. Another		234 (78)	
Firearm	52 (22)		
Pierce/Cut	49 (21)		
Strangle	0 (0)		
Other/Unsp	133 (57)		
Legal Interv.		3 (1)	
Vs. Self		63 (21)	
Firearm	33 (52)		
Pierce/Cut	17 (27)		
Hang	0 (0)		
Jump	5 (8)		
Other/Unsp	8 (13)		
War		0 (0)	
UNDETERMINED			37 (1)
Fall		9 (24)	
Firearm		17 (46)	
Pierce/Cut		2 (5)	
Other/Unsp		9 (24)	

AGENT

	Subt. (%)	Subt. (%)	Total (%)
FIREARM			145 (3)
Intentional		87 (60)	
Vs. Another	54 (62)		
Vs. Self	33 (38)		
Unintentional		41 (28)	
Undetermined		17 (12)	
CUT/PIERCE			254 (5)
Intentional		66 (26)	
Vs. Another	49 (74)		
Vs. Self	17 (26)		
Unintentional		186 (73)	
Undetermined		2 (1)	
FALL			1185 (24)
Intentional		6 (1)	
Vs. Another	1 (17)		
Vs. Self	5 (83)		
Unintentional		1169 (99)	
Undetermined		10 (1)	

MITIGATION

PROTECTIVE DEVICE

AUTOMOBILE			1592 (69.8%)
Protected		460 (28.9%)	
Seat Belt	428 (93.0%)		
Air Bag	5 (1.1%)		
Both	21 (4.6%)		
Child Seat	6 (1.3%)		
Unprotected		581 (36.5%)	
Unknown		551 (34.6%)	
MOTORCYCLE			221 (9.7%)
Protected		33 (14.9%)	
Helmet	32 (97.0%)		
Clothing	1 (3.0%)		
Unprotected		86 (38.9%)	
Unknown		102 (46.2%)	
PEDALCYCLE			104 (4.6%)
Helmet		5 (4.8%)	
Unprotected		39 (37.5%)	
Unknown		60 (57.7%)	
ASSAULT			237 (10.4%)
Clothing		0 (0.0%)	
Unprotected		4 (1.7%)	
Unknown		233 (98.3%)	
BURN			127 (5.6%)
Clothing		1 (0.8%)	
Unprotected		17 (13.4%)	
Unknown		109 (85.8%)	

RISK FACTOR

	(N)	Alcohol >=100	(%)	Alcohol <100	(%)	Drugs Present	(%)	Drugs Absent	(%)
Automobile	1592	172	(11)	551	(35)	76	(5)	179	(11)
Motorcycle	221	21	(10)	51	(23)	13	(6)	18	(8)
Pedalcycle	104	4	(4)	8	(8)	1	(1)	4	(4)
Pedestrian	156	19	(12)	23	(15)	7	(4)	9	(6)
Fall	1179	29	(2)	55	(5)	4	(0)	24	(2)
Assault	237	57	(24)	49	(21)	25	(11)	18	(8)
Self-Infl.	63	7	(11)	23	(37)	11	(17)	8	(13)
Burn	127	1	(1)	16	(13)	2	(2)	8	(6)
Other	1201	28	(2)	87	(7)	20	(2)	32	(3)
Unknown	63	3	(5)	0	(0)	0	(0)	1	(2)
Total	4943	341	(7)	863	(17)	159	(3)	301	(6)

OUTCOME

PROTECTIVE DEVICE

	(N)	Minor	(%)	Major	(%)	Disab	(%)	Fatal	(%)
Automobile									
Seat Belt	428	124	(29)	286	(67)	37	(9)	18	(4)
Air Bag	5	2	(40)	3	(60)	1	(20)	0	(0)
Both	21	10	(48)	11	(52)	0	(0)	0	(0)
Child Seat	6	3	(50)	2	(33)	1	(17)	1	(17)
None	581	109	(19)	430	(74)	62	(11)	42	(7)
Unknown	551	103	(19)	425	(77)	16	(3)	23	(4)
Total	1592	351	(22)	1157	(73)	117	(7)	84	(5)
Motorcycle									
Helmet	32	6	(19)	25	(78)	2	(6)	1	(3)
Clothing	1	0	(0)	1	(100)	0	(0)	0	(0)
None	86	11	(13)	69	(80)	8	(9)	6	(7)
Unknown	102	21	(21)	80	(78)	2	(2)	1	(1)
Total	221	38	(17)	175	(79)	12	(5)	8	(4)
Pedalcycle									
Helmet	5	0	(0)	5	(100)	0	(0)	0	(0)
None	39	6	(15)	32	(82)	1	(3)	1	(3)
Unknown	60	22	(37)	37	(62)	1	(2)	1	(2)
Total	104	28	(27)	74	(71)	2	(2)	2	(2)
Assault									
Clothing	0	0	(***)	0	(***)	0	(***)	0	(***)
None	4	0	(0)	2	(50)	1	(25)	2	(50)
Unknown	233	68	(29)	155	(67)	13	(6)	10	(4)
Total	237	68	(29)	157	(66)	14	(6)	12	(5)
Burn									
Clothing	1	1	(100)	0	(0)	0	(0)	0	(0)
None	17	7	(41)	10	(59)	1	(6)	0	(0)
Unknown	109	37	(34)	63	(58)	11	(10)	9	(8)
Total	127	45	(35)	73	(57)	12	(9)	9	(7)

RISK FACTOR

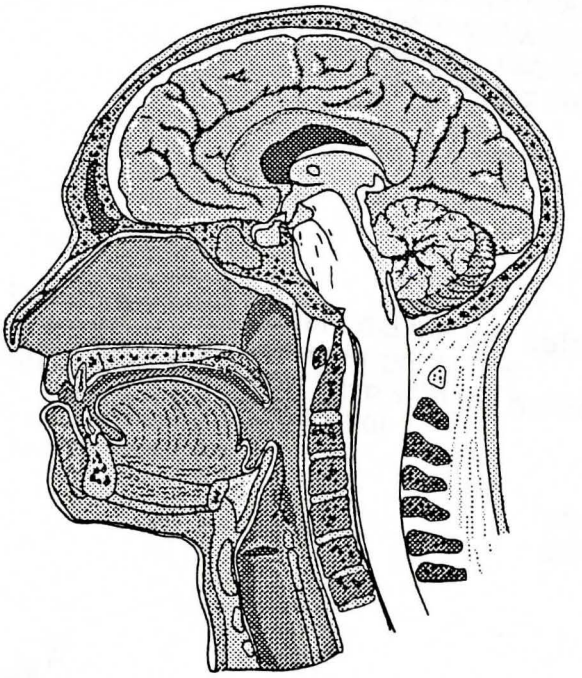
	(N)	Minor	(%)	Major	(%)	Disab	(%)	Fatal	(%)
Alcohol									
>=100mg/dl	341	74	(22)	244	(72)	33	(10)	23	(7)
<100mg/dl	863	152	(18)	633	(73)	107	(12)	78	(9)
Unknown	3739	1105	(30)	2547	(68)	162	(4)	87	(2)
Total	4943	1331	(27)	3424	(69)	302	(6)	188	(4)
Drugs									
Positive	159	21	(13)	126	(79)	12	(8)	12	(8)
Negative	301	54	(18)	217	(72)	44	(15)	30	(10)
Unknown	4483	1256	(28)	3081	(69)	246	(5)	146	(3)
Total	4943	1331	(27)	3424	(69)	302	(6)	188	(4)

APPENDIX D

Severe Traumatic Brain Injuries in Iowa

Severe Traumatic Brain Injuries In Iowa

Annual Report Of The Iowa Central Registry For Brain And Spinal Cord Injuries
1993



Iowa Department Of Public Health

Bureau Of Disability And Injury Prevention

Mario Schootman, Ph.D.
Epidemiologist

Mary Harlan, M.S., M.A.
Coordinator

Terry E. Branstad, Governor **Christopher G. Atchison, Director**

How Life Changes ...

"After my injury, my friends stopped calling and my grilfriend broke up with me. I felt abandoned, lonely, and scared"
Survivor

"Our relationship changed so dramatically. I didn't feel I had a choice but to stay married to him. He is my husband. But it's been so exhausting trying to support the both of us and make sure that he has the 24 hour care that he needs"
Spouse

"I am depressed a lot because I can't remember what I did the day before and I can't keep a job. I don't think that it will ever get better. I'm 35, since my injury I've been divorced and now I live with my mother."
Survivor

"Frustration, irritation, anger, and helplessness, makes me want to scream - NO ONE UNDERSTANDS!"
Spouse

"Constant change, be flexible, ignore it, listen, encourage, back off. Will I ever be able to plan, be organized, know what to expect again?"
Spouse

"Because I was injured as an adult there are no services or programs to help me. I go to a support group but it only meets once a month. I wish more people understood what a brain injury can do to a person's life. Maybe then there would be more for us and people would be more careful to prevent them"
Survivor

Some Facts About Severe Traumatic Brain Injuries

- A total of 2,559 severe traumatic brain injuries were reported in 1993
- 274 Iowans died from traumatic brain injuries
- Persons aged 15-24 and those 85+ are most likely to sustain severe traumatic brain injuries
- Males are 70 % more likely than females to sustain these injuries
- Almost 40 % of injuries are motor vehicle-related
- An estimated $ 26 million was charged by hospitals for acute care alone
- 38 % of the acute care cost was charged to tax payers

Table Of Contents

INTRODUCTION

Injuries have become an increasingly important cause of death especially since the occurrence and death from infectious and cardiovascular diseases are declining. Traumatic brain injuries (TBI) are of particular importance because of their magnitude and resulting disability. Injuries to the brain can range from mild, which may result in headaches, to severe, which leaves the person in a coma. Depending on severity, consequences may be physical impairment, changes in behavior and cognition, and decline in quality of life.

The purpose of this report is to provide information about severe (hospitalized or fatal) traumatic brain injuries that occurred in Iowa during 1993.

METHODOLOGY

Traumatic brain injuries (TBI) are identified through the use of the International Classification of Diseases (9th edition). For this report, traumatic brain injuries are identified using ICD-9 codes 800-801, 803-804, and 850-854 which include all head injuries likely to involve brain injuries (Kraus et al.,1984; Jennett and MacMillan, 1982; Torner and Schootman, in press).

ICD9 code	Description
800	Fracture of the vault of the skull
801	Fracture of the base of the skull
803	Other and unqualified skull fractures
804	Multiple fractures involving skull or face with other bones
850	Concussion
851	Cerebral laceration and contusion
852	Subarachnoid, subdural, and extradural hemorrhage following injury
853	Other and unspecified intracranial hemorrhage following injury
854	Intracranial injury of other and unspecified nature

This report combines data from three data sources: 1) the Iowa Central Registry for Brain and Spinal Cord Injury, located in the Department of Public Health; 2) death certificates obtained from the Bureau of Vital Records, also located in the Department of Public Health; and 3) hospital discharge data (UB92) acquired by the Department from the Health Data Commission. These three data sources are combined to more accurately describe the occurrence and types of traumatic brain injuries that occur in Iowa. Each data source will be briefly described.

Iowa Central Registry for Brain and Spinal Cord Injuries

During 1993, the Registry operated under section 135.22 of the Iowa Code where authority was given to the Department to collect data from private physicians and hospitals about brain and spinal cord injuries. The definition of TBI included fractures of the base and vault of

the skull, cerebral lacerations and contusions, concussion with loss of consciousness, and intracranial hemorrhage. Data were also collected about nonfacial skull fractures, anoxia due to external causes, infections of the central nervous system and injuries to blood vessels of the neck and head.

Because this report focuses predominantly on *traumatic* brain injuries, data on nonfacial skull fractures, anoxia, brain infections, and brain damage due to injuries to blood vessels are excluded from the final analysis. Further, the main body of this annual report focuses only on patients who have been hospitalized as inpatients or died from traumatic brain injuries, since it is expected that information for these patients is more accurate than for patients treated and released from hospital emergency departments.

Information collected during 1993 includes the patient name, date of birth, gender, and residence; date, type and cause of injury based on the 9th edition of the International Classification of Diseases (ICD-9); type of care provided; and the presence of alcohol and drugs. A total of 7,044 reports were entered in the Registry in 1993 containing persons admitted inpatients and those treated and released from emergency department.

Death certificates

Death certificates are routinely filed with the Bureau of Vital Records of the Department of Public Health. They provide valuable information about injuries that result in death before hospitalization since these deaths are not identified by any other data source used in this report.

Death certificates are a rich source of information. They contain data on the name, residence, date of birth, gender, industry and occupation of the deceased; location, type, and external cause of injury; and other demographic information.

Hospital discharge data

Every Iowa hospital is required to submit claims information about patients hospitalized for any type of disease or injury to the Iowa Hospital Association. The Department obtains this data base annually from the Health Data Commission. Hospital discharge data are a valuable source of information about traumatic brain injuries since they contain information not collected by the Registry or on death certificates, such as hospitalization charges.

Information contained in this data base includes patient demographics (race, gender, date of birth, and county of residence), admission information (date, type and source), discharge information (date and disposition), clinical information (diagnoses and procedures), and cost information (payment source and hospital charges). Notably absent is the external cause of injury contained in both other data sources used in this report. Traumatic brain injuries were identified using the first and second ICD-9 diagnostic codes listed. These codes are most likely to identify new traumatic brain injuries.

Linkage of data sources

To avoid counting injuries more than once, we linked the three data sources using information common to all three data sources. Linkage variables that were used are combinations of patient date of birth, gender, and date of injury/admission/death.

Using the three data sources, 2,559 new traumatic brain injuries were identified. A total of 1,624 injuries were identified through the Registry, 1,371 through the hospital discharge data, and 274 through death certificates. Forty-nine percent (669/1,371) of brain injuries identified

through the hospital discharge data base were also reported to the Registry. Forty-one percent (669/1,624) of brain injuries reported to the Registry were also included in the hospital discharge data base.

Statistical Analysis

We have used frequencies and rates to describe the traumatic brain injury occurrence in Iowa during 1993. We calculated rates by age groups, gender, and age-gender subgroups. Rates consist of a numerator and a denominator. The numerator is the number of injuries among a particular age-gender subgroup. The denominator is the population size for the same subgroup among which these injuries occurred. For example, a rate of 200 per 100,000 population means that an average of 200 injuries occurred among 100,000 Iowans during 1993. The population consists of the 1993 population estimates as released by the Bureau of the Census. The Statistical Analysis System (SAS) was used to perform all the analyses.

We have excluded non-Iowa residents who died in Iowa from the analyses to calculate rates. However, non-Iowa residents admitted to Iowa hospitals are included in the non-fatal cases because we do not have information on the number of injuries that are sustained by Iowans treated in other states. By including non-Iowa residents who sustained non-fatal injuries in Iowa, the assumption is that the number and types of injuries sustained by Iowa residents in other states approximates the number and types of injuries sustained by non-Iowans in Iowa. This is a relatively good approximation and can be used to calculate rates (MacKenzie et al.,1988).

In addition to several graphical presentations of the 1993 traumatic brain injury data, we have included various tables containing the actual number, percentages, and injury rates for each. They can be found in appendix A.

The table below lists the external cause codes (E-codes) by category used in this report.

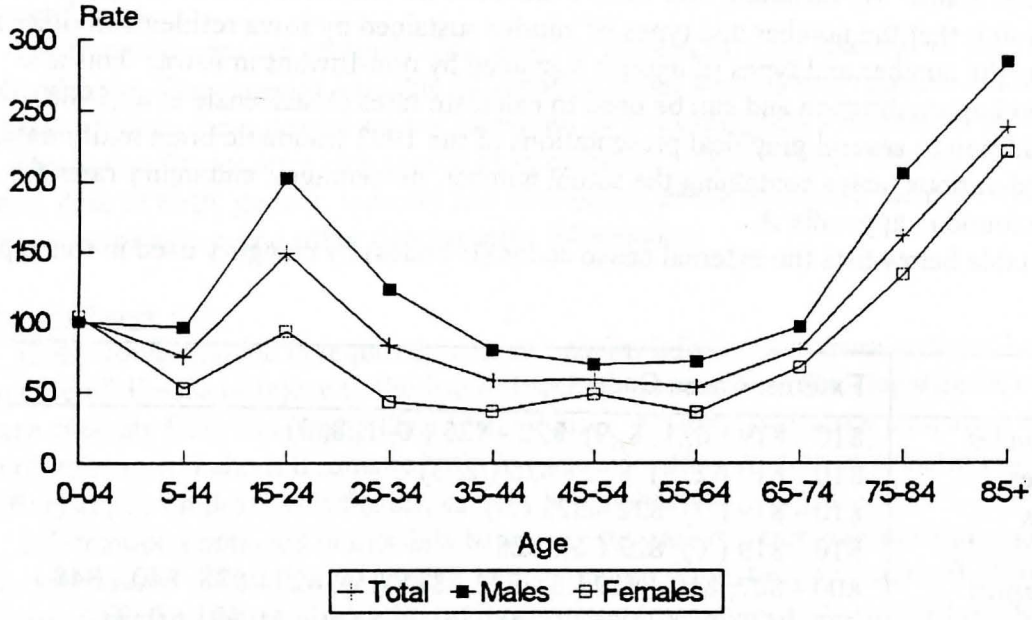
Category	External Cause Code
Motor Vehicles	810 - 819 (.0,.1,.8,.9), 822 - 825 (.0,.1,.8,.9)
Motorcycles	810 - 819 (.2,.3), 822 - 825 (.2,.3)
Pedestrians	810 - 819 (.7), 822 - 825 (.7)
Bicycles	810 - 819 (.6), 822 (.6), 826
Other transport	800 - 807, 810 - 819 (.5), 822 - 825 (.5), 827 - 838, 840 - 848
Firearms	922, 955 (.0-.4), 965 (.0-.4), 970, 985 (.0 - .4), 991 (.0,.2)
Assaults	960 - 964, 966 - 969
Falls	880 - 882, 883.1 - 885, 866.9 - 888
Animals	905.3, 906
Other/Unknown	Other codes

FINDINGS

Incidence of traumatic brain injuries

Using all three data sources, 2,559 new traumatic brain injuries were identified during 1993 for an incidence rate of 90.9 per 100,000 population. Males sustained 1,584 (61.9 %) injuries for a rate of 115.9 injuries per 100,000 population. Females sustained 975 (38.1 %) injuries for a rate of 67.4 injuries per 100,000 population.

Figure 1. Incidence rates (per 100,000 population) of traumatic brain injuries by gender and age, Iowa, 1993



Source: Registry, hospital discharge and death certificate data

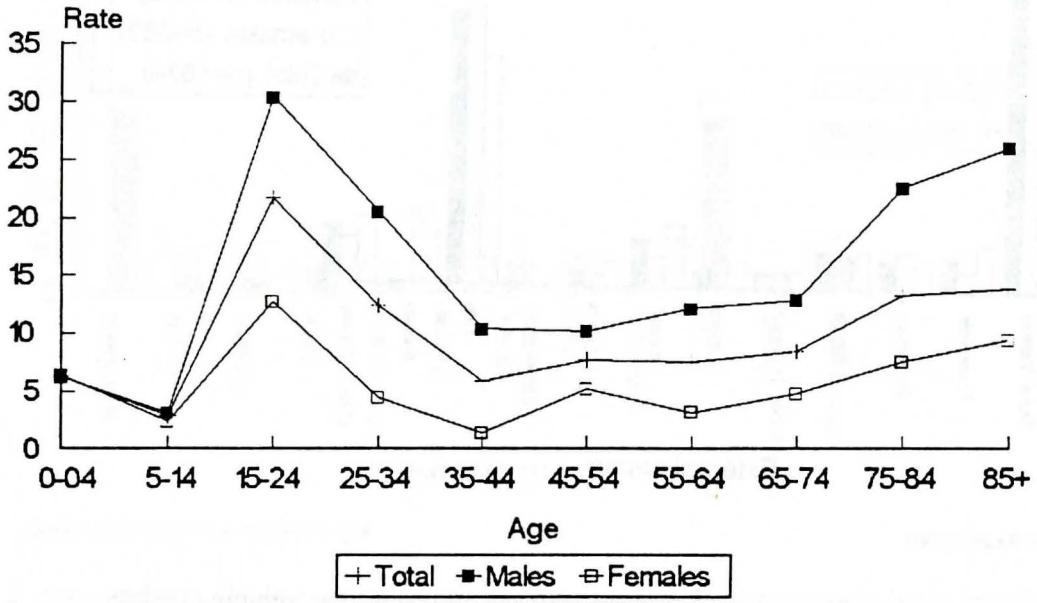
- Iowans aged 15-34 and 65+ are more likely to sustain traumatic brain injuries than any other age group.

- Males are 1.7 (115.9/67.4) times more likely to sustain traumatic brain injuries than females.

Mortality from traumatic brain injuries

A total of 274 Iowans died from traumatic brain injuries in 1993 for a mortality rate of 9.7 per 100,000 population. A total of 197 males (71.9 %) died for a rate of 14.4 per 100,000 population. A total of 77 females died (28.1 %) for a rate of 5.3 per 100,000 population. This means that males are 2.7 (14.4/5.3) times more likely to die from traumatic brain injuries than females.

Figure 2. Mortality rates (per 100,000 population) of traumatic brain injuries by age and gender, Iowa 1993 (n=274)

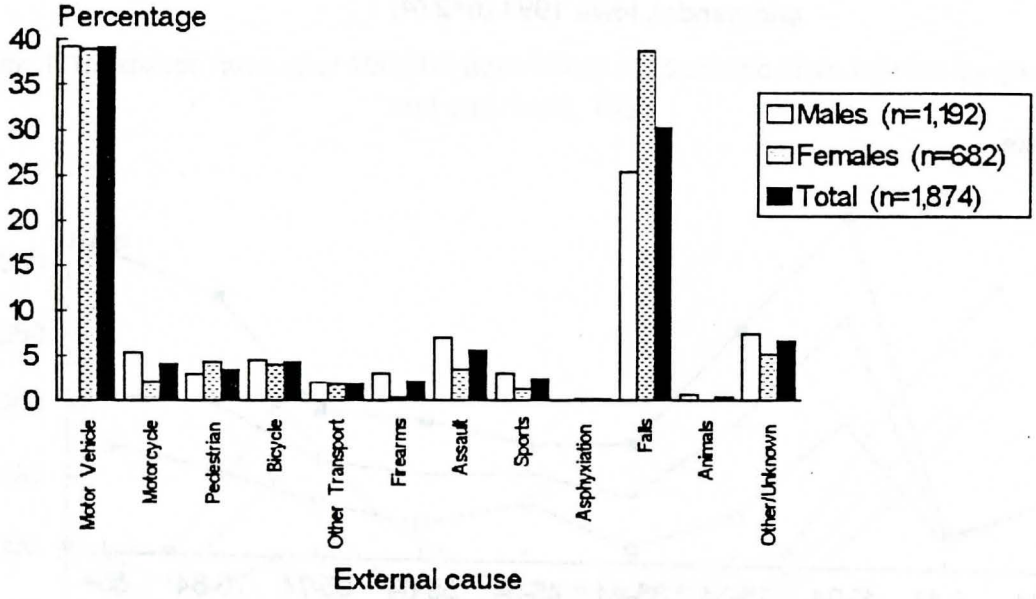


Source: Death certificates

- The mortality rate is highest among Iowans aged 15-24.
- The mortality rate is increased among Iowans aged 75+.
- Except for age 0-14, males are more likely to die from traumatic brain injuries than females.
- 10.7 percent of new traumatic brain injuries resulted in the patient's death.

External causes of injury: Males and females

Figure 3. Percentage of traumatic brain injuries by external cause and gender (n=1,874), Iowa 1993

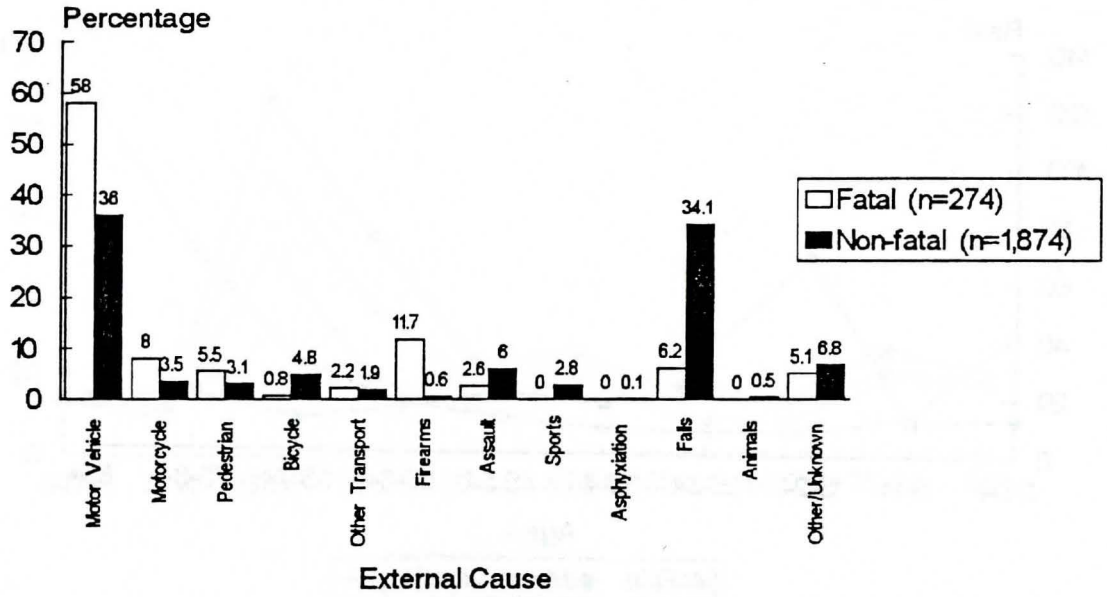


Source: Registry data

- Almost 40 percent of traumatic brain injuries are due to motor vehicle crashes.
- Falls are the second leading cause of traumatic brain injuries at 30 percent.
- Males are more likely to sustain traumatic brain injuries from motorcycles, firearms, assaults, and sports.
- Females are more likely to sustain traumatic brain injuries from falls and as pedestrians.

External causes of injury: Fatal and non-fatal

Figure 4. Percentage of fatal and of non-fatal traumatic brain injuries by external cause, Iowa 1993

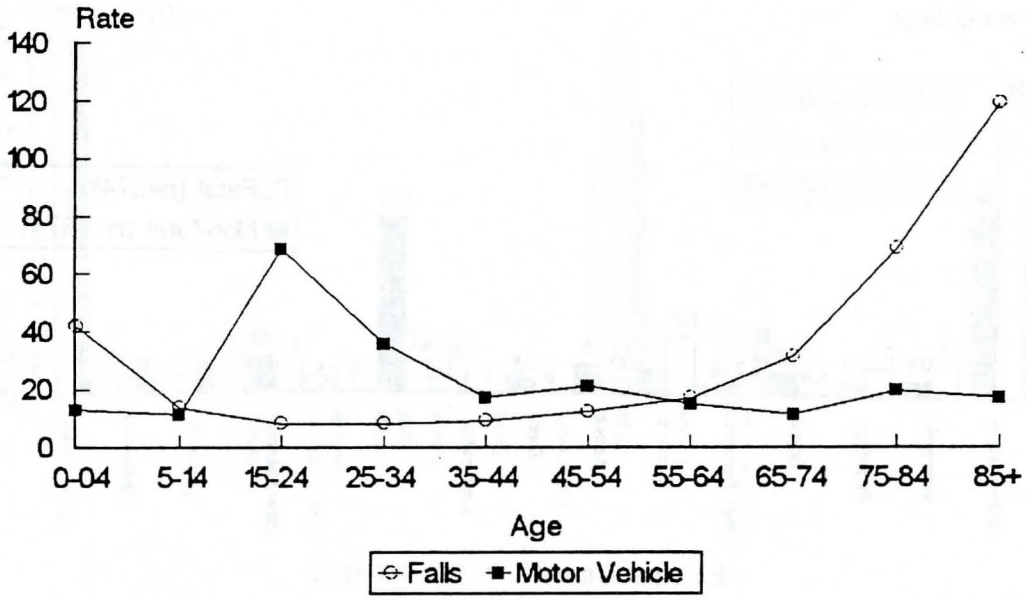


Source: Registry and death certificates

- A different cause distribution results in fatal and non-fatal traumatic brain injuries.
- Fatal traumatic brain injuries are more likely caused by motor vehicles, motorcycles, and firearms.
- The vast majority of fatal injuries are caused by motor vehicle crashes.
- Non-fatal injuries are more likely due to bicycles, assaults, sports, and falls in addition to motor vehicle crashes.
- Motor vehicle crashes and falls are the two most frequent causes of non-fatal injuries.

Falls and motor vehicles

Figure 5. Incidence rates (per 100,000 population) of traumatic brain injuries from falls and motor vehicle crashes by age, Iowa 1993

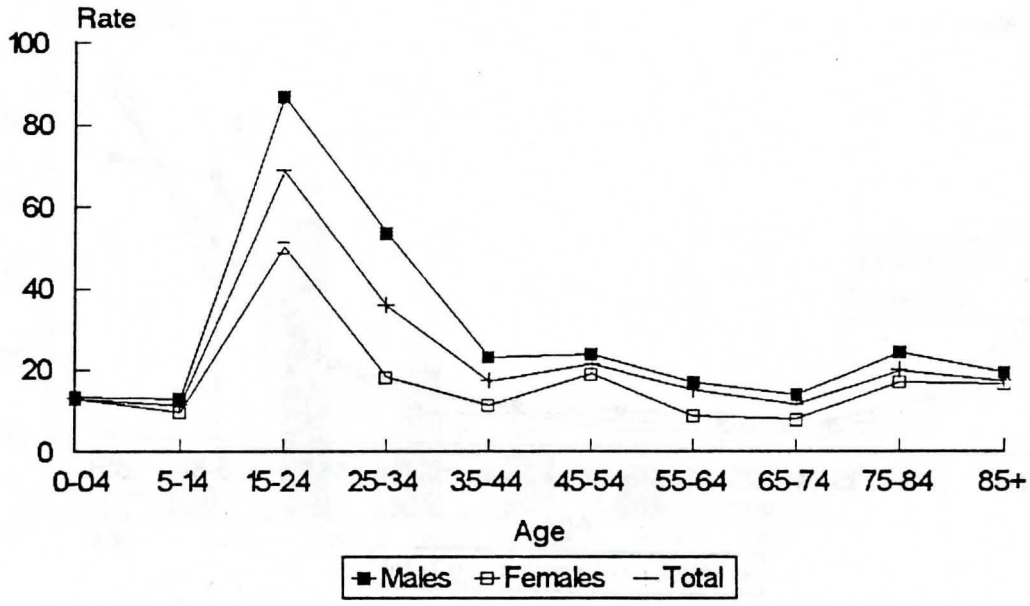


Source: Registry and death certificates

- Iowans age 15-34 are at increased risk for motor vehicle-related traumatic brain injuries.
- Falls occur more commonly among age groups 0-4 and 55+.
- The occurrence of fall-related traumatic brain injuries increases dramatically with age.
- The occurrence of falls surpasses motor vehicles for those aged 0-4 and 55+.

Motor vehicle crashes

Figure 6. Incidence rates (per 100,000 population) of traumatic brain injuries from motor vehicle crashes by age and gender, Iowa 1993

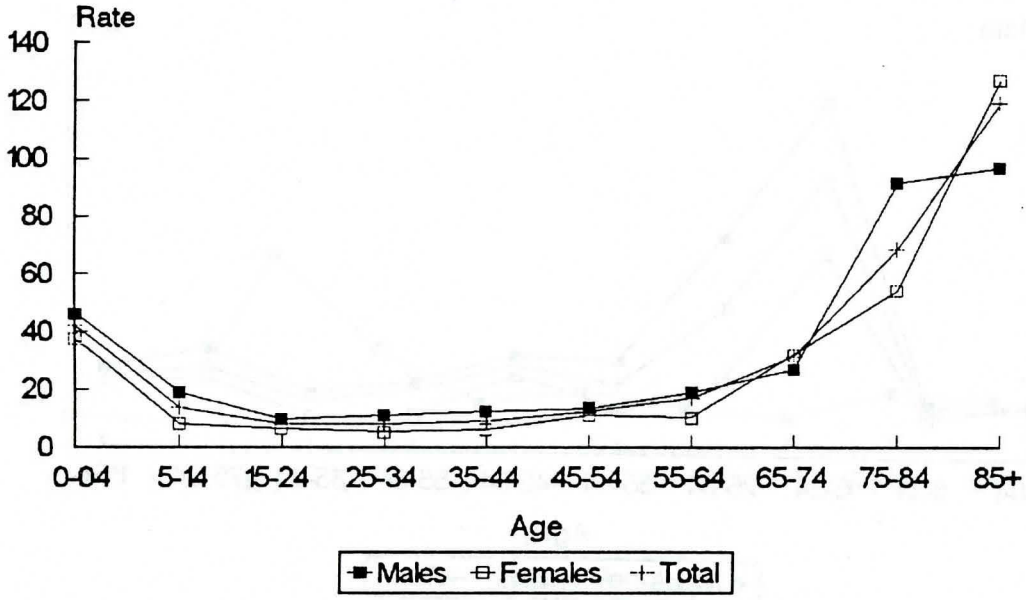


Source: Registry and death certificates

- Iowans aged 15-34 are most likely to sustain traumatic brain injuries from motor vehicles.
- Except for age 0-4, males are more likely than females to sustain motor vehicle-related traumatic brain injuries.

Falls

Figure 7. Incidence rates (per 100,000 population) of traumatic brain injuries from falls by age and gender, Iowa 1993



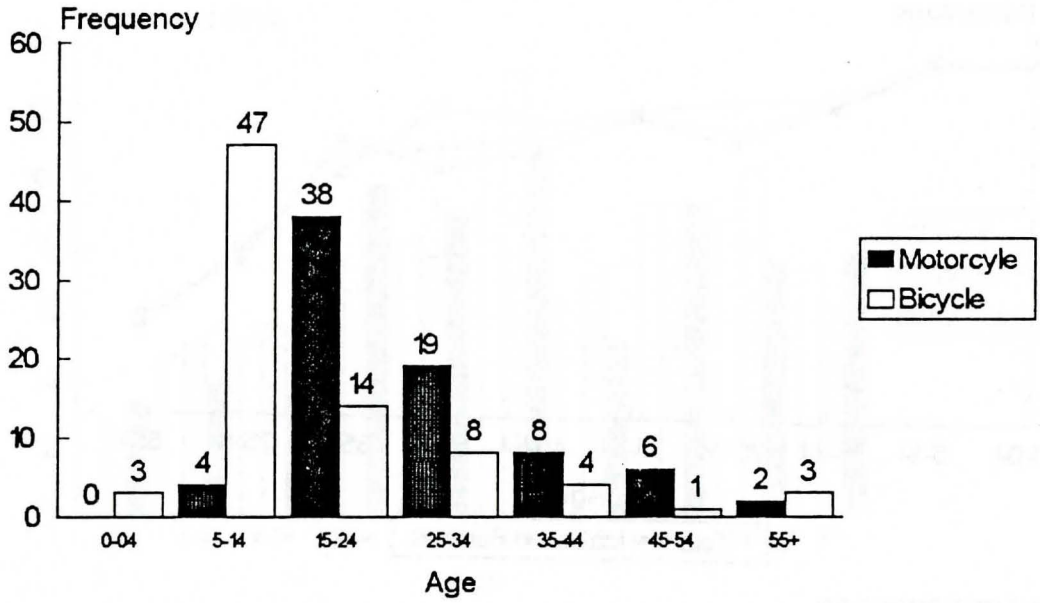
Source: Registry and death certificates

- The youngest age group and the three oldest age groups are at increased risk of fall-related traumatic brain injuries.

- Except for age 75 and older, males and females are about equally likely at risk for traumatic brain injuries resulting from falls.

Motorcycles and bicycles

Figure 8. Frequency of motorcyle and bicycle-related traumatic brain injuries by age, Iowa 1993



Source: Registry and death certificates

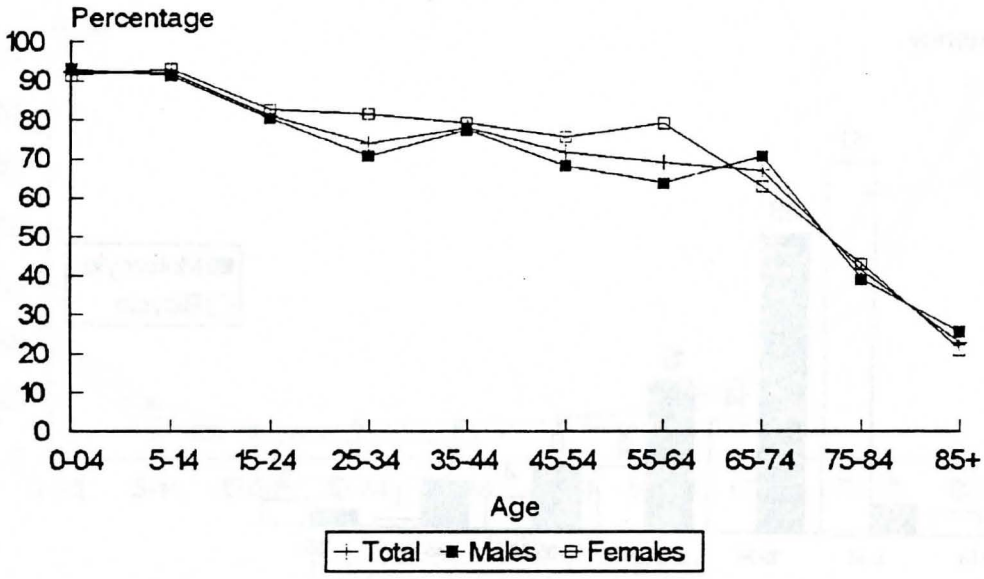
- The number of motorcycle injuries is highest for age 15-24, after which it declines substantially.

- The number of bicycle-related traumatic brain injuries is highest among age 5-14.

Outcomes of injuries: Discharged home

Using the 1993 hospital discharge data, of 1,371 injury visits, 970 patients were discharged home (70.8 %). This was very similar for males and females.

Figure 9. Percentage of patients with traumatic brain injuries discharged home by age and gender, Iowa 1993 (n=970)

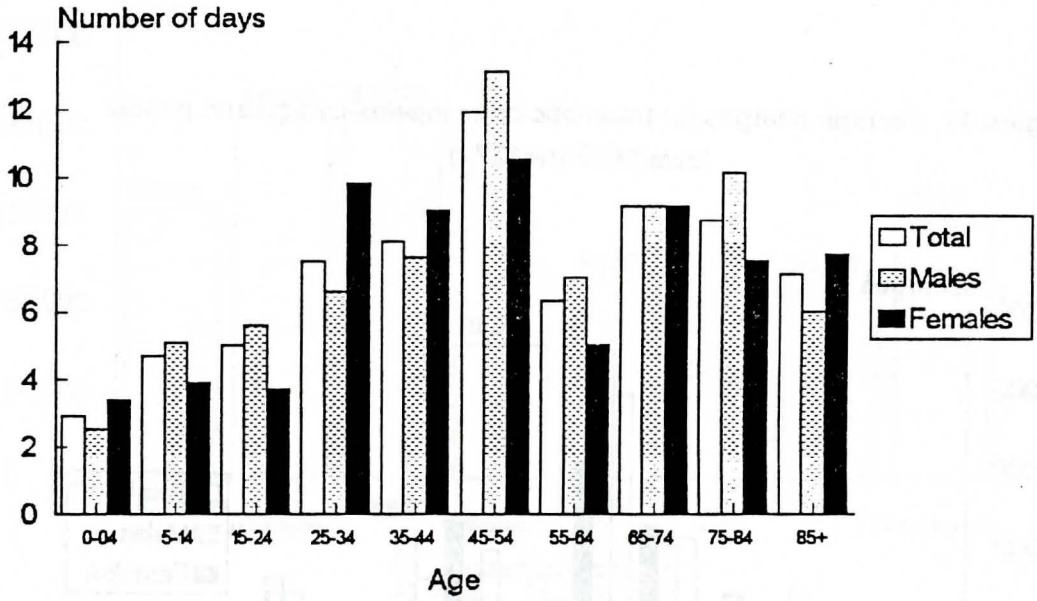


Source: Hospital discharge data

- Patients were sent home in 71 percent of hospitalizations.
- There was a steady decline in the percentage of patients sent home up to age 74.
- Among age 75+, a lower percentage of patients was sent home following traumatic brain injuries.

Outcomes of injuries: Length of hospitalization

Figure 10. Average length of hospitalization for traumatic brain injuries by age and gender, Iowa 1993



ICD-9: 800-801, 803-804, 850-854; Using hospital discharge data

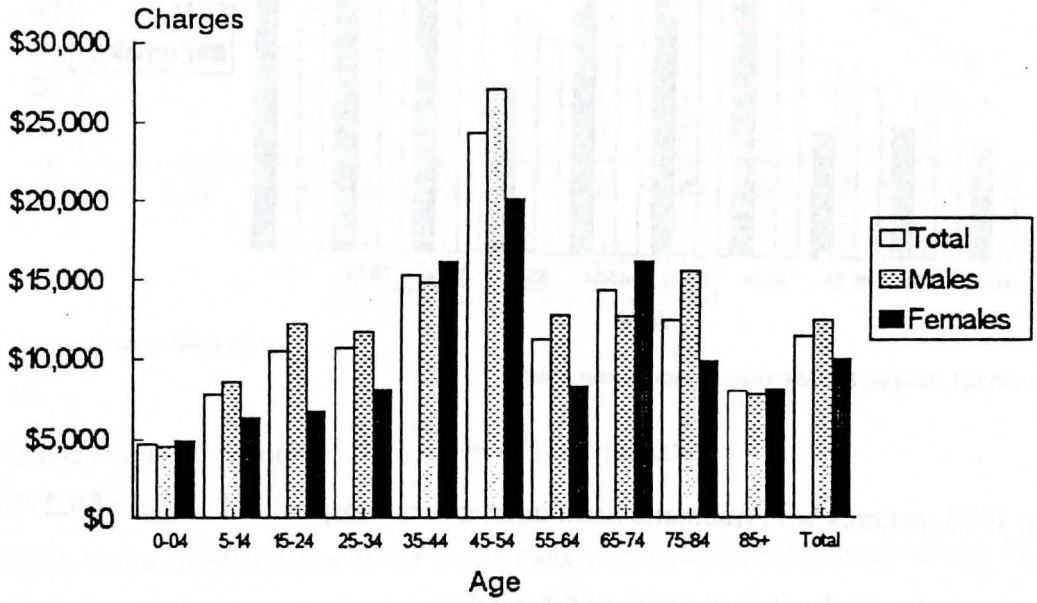
- During 1993, patients with traumatic brain injuries were hospitalized a total of 9,274 days.
- Patients were hospitalized an average of 6.8 days.
- Patients age 45-54 had the highest length of stay of any age group.

Charges: Males and females

Using hospital discharge data, a total of $15,583,403 was charged by Iowa hospitals to provide acute care for hospitalized persons with traumatic brain injuries in 1993. Males accounted for 64.1 percent of these charges ($9,993,113) and females 35.9 percent ($5,590,295).

Because the hospital discharge data base did not identify all traumatic brain injuries (as described later in this report), the total charges are underestimated. By extrapolating to all traumatic brain injuries sustained in 1993 using age-specific average charges based on the hospital discharge data base, the total hospital charges are estimated at $26,526,595 ($17,666,199 for males (66.6%) and $8,860,396 for females (33.4%).

Figure 11. Average charges for traumatic brain injuries by age and gender, Iowa 1993 (n=1371)

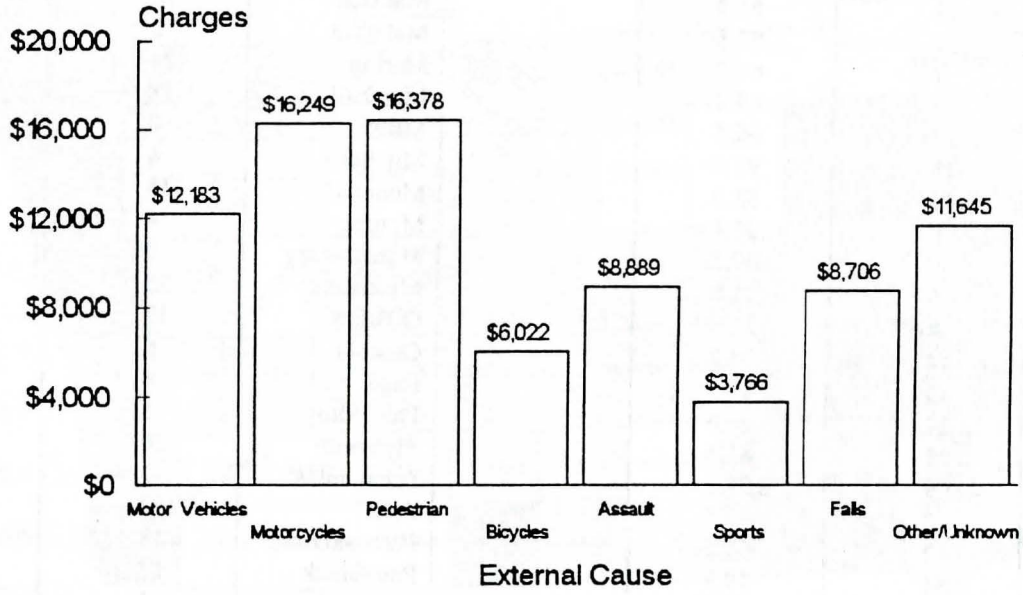


Source: hospital discharge data

- The highest average hospital charge was for Iowans 45-54.
- Some differences in charges can be seen between males and females.

Charges: Cause of injury

Figure 12. Average charges for traumatic brain injury visits (n=686) by external cause
Iowa 1993



Source: Registry and hospital discharge data

- The highest average hospital charge was for pedestrians who sustained traumatic brain injuries. Motorcycle crashes were a close second.

- Less than $4,000 was charged for the average sports-related traumatic brain injury.

- A total of $8,706 was charged for an average fall.

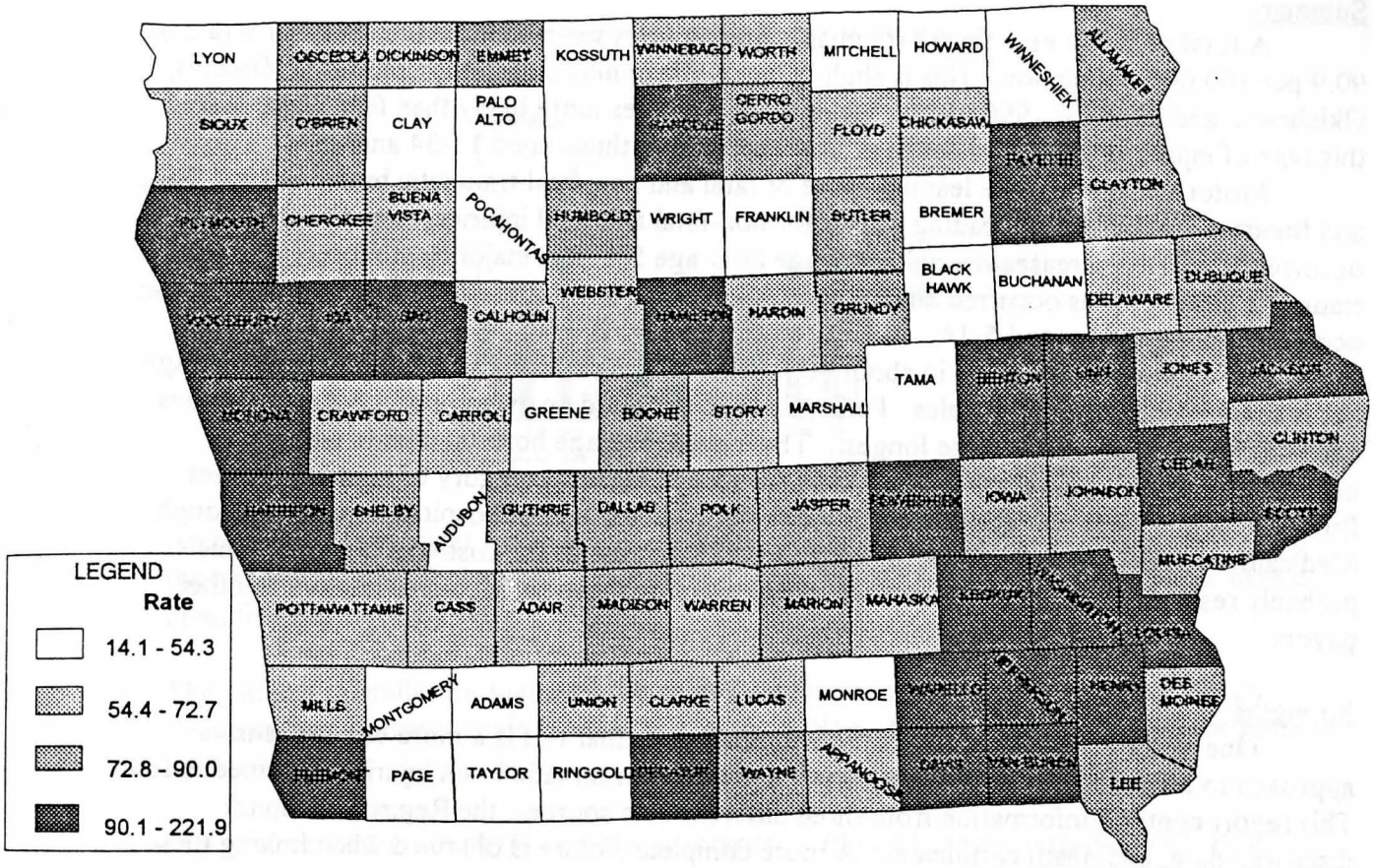
Number and rate (per 100,000 population) of severe traumatic brain by county of residence, 1993*

County	Number	Rate
Adair	5	59.3
Adams	2	43.5
Allamakee	11	78.8
Appanoose	10	72.2
Audubon	3	42.8
Benton	23	98.5
Black Hawk	57	45.8
Boone	21	83.2
Bremer	11	47.5
Buchanan	9	42.6
Buena Vista	11	54.3
Butler	13	82.8
Calhoun	7	60.7
Carroll	15	69.4
Cass	10	66.5
Cedar	17	97.0
Cerro Gordo	41	88.0
Cherokee	8	57.4
Chickasaw	9	67.5
Clarke	6	71.8
Clay	4	22.6
Clayton	14	74.2
Clinton	43	83.9
Crawford	11	66.6
Dallas	27	85.5
Davis	9	107.2
Decatur	8	99.3
Delaware	12	65.5
Des Moines	34	79.3
Dickinson	10	64.9
Dubuque	67	76.1
Emmet	9	78.9
Fayette	27	123.0
Floyd	10	59.5
Franklin	5	44.5
Fremont	9	110.3
Greene	3	29.6
Grundy	3	24.9
Guthrie	10	89.2
Hamilton	19	118.3
Hancock	12	98.5
Hardin	13	69.8
Harrison	24	161.9
Henry	25	127.9
Howard	2	20.2
Humboldt	8	76.4
Ida	10	120.3
Iowa	11	74.0
Jackson	29	144.2
Jasper	29	82.9

County	Number	Rate
Jefferson	21	125.2
Johnson	72	72.7
Jones	15	75.6
Keokuk	17	146.2
Kossuth	9	49.6
Lee	33	84.9
Linn	181	103.5
Louisa	13	110.8
Lucas	6	66.3
Lyon	4	33.4
Madison	10	77.6
Mahaska	12	55.5
Marion	24	78.9
Marshall	18	47.5
Mills	8	59.8
Mitchell	4	36.4
Monona	18	179.1
Monroe	4	49.0
Montgomery	5	41.5
Muscatine	35	85.0
O'Brien	13	84.4
Osceola	6	83.4
Page	4	24.0
Palo Alto	5	48.0
Plymouth	26	109.0
Pocahontas	3	32.7
Polk	259	75.6
Pottawatamie	48	57.4
Poweshiek	17	90.0
Ringgold	1	18.6
Sac	12	99.5
Scott	143	91.9
Shelby	10	76.0
Sioux	20	64.9
Story	50	66.7
Tama	8	45.4
Taylor	1	14.1
Union	9	71.6
Van Buren	15	193.1
Wapello	37	102.6
Warren	22	58.0
Washington	45	221.9
Wayne	6	85.8
Webster	27	67.7
Winnebago	7	59.1
Winneshiek	9	42.8
Woodbury	120	119.0
Worth	5	62.8
Wright	6	42.3

* Because of the small number of injuries in certain counties, rates may be unstable.
Total number of injuries = 2,229 (135 out-of-state residents, 195 county of residence unknown)

Severe traumatic brain injury rate (per 100,000 population) by county of residence, 1993



Discussion

Summary

A total of 2,559 new severe traumatic brain injuries were identified in 1993 for a rate of 90.9 per 100,000 population. This is slightly below the combined rate of Colorado, Missouri, Oklahoma, and Utah for 1990-1993. Males were 1.7 times more likely than females to sustain this type of injury in Iowa. Incidence is increased among those aged 15-34 and 65+.

Motor vehicles are the leading cause of fatal and non-fatal traumatic brain injuries. Falls and firearms are the second leading causes for non-fatal and fatal injuries, respectively. The occurrence of falls increases strongly with age after age 55. The majority of motorcycle-related traumatic brain injuries occurred among ages 15-24 while the majority of bicycle-related injuries occurred among those aged 5-14.

Patients were sent home in about 90 percent of hospitalizations which declines with age but is similar for males and females. Patients are hospitalized an average of 6.8 days. Persons aged 45-54 were hospitalized the longest. The highest average hospital charge was for pedestrians. Motorcycle crashes resulted in the second highest category of hospital charges. Private insurance was charged for the hospital bill in almost half of hospitalizations. Although Medicaid was charged in 8 percent of admission, 16 percent of the cost was charged. This probably resulted from injuries that were more severe by those on Medicaid relative to other payors.

Strengths

One of the strengths of the performed analyses is that this is a more comprehensive approach to assessing the magnitude, cause, and cost of traumatic brain injuries sustained in Iowa. This report contains information from three different data sources: the Registry, hospital discharge data, and death certificates. A more complete picture is obtained when linking these data sources.

Second, this report constitutes a more in-depth look at traumatic brain injuries by comparing males and females and various ages with regard to average length of hospitalization and charges. Injury rates can be effectively used to identify populations at increased risk and to target interventions aimed at reducing the occurrence and severity of the injuries.

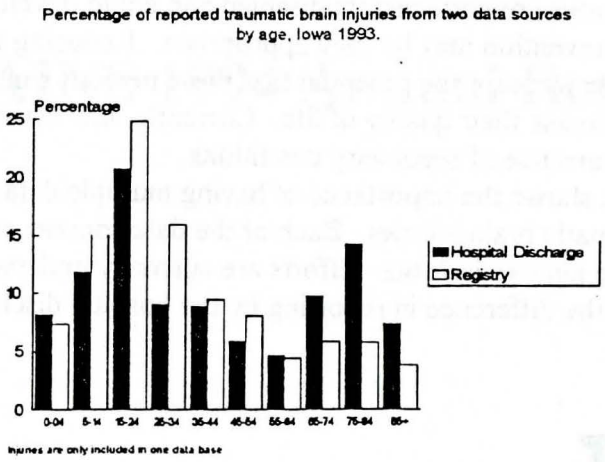
Limitations

Limitations of the performed analyses can also be identified. First, since unique identifiers (e.g., social security number) were not available on the hospital discharge data base, linkage was performed using combinations of date of birth, gender, and date of injury/admission/death. A very small percentage of the linked records may be linked incorrectly due to data coding errors beyond our control.

Second, not all data elements were available in all data bases. The hospital discharge data base did not contain external cause codes. Thus, by linking with Registry data to determine hospital charges by cause of injury, only matched records are included in this analysis, which may be a selective subgroup of all traumatic brain injuries.

Underreporting

The following three figures display the percentage of traumatic brain injuries by age group that were reported to the Registry and not the hospital discharge data base and vice versa..



- Among Iowans younger than age 55, the Registry identified more traumatic brain injuries than the hospital discharge data base. However, among age 65+, the hospital discharge data base identified more injuries.

- The pattern is similar for males and females for Iowans less than age 75. The Registry underreports traumatic brain injuries among males 85+. Little difference is seen for females the same age.

- Males were 1.32 times (95% confidence interval: 1.08-1.61) more likely to be identified only through the Registry compared to the hospital discharge data base. $\chi 2 = 7.71$ ($p = 0.006$).

The average age of patients identified only through the Registry was 33.1 years (standard deviation = 29.4) while those only identified through the hospital discharge data base were on average 41.7 years old (standard deviation = 29.4) which was statistically significant (T-test = -6.46; $p < 0.001$).

What can we learn from the data?

The previously described data can be used to identify populations at increased risk of sustaining severe traumatic brain injuries. First, persons aged 15-24 are at increased risk based on their incidence rate (figure 1). This age group also has the greatest likelihood of dying from these injuries (figure 2). Both are mainly the result of the large percentage of motor vehicle crashes (figures 5 and 6). Currently, a wide variety of prevention activities are conducted aimed at reducing their occurrence. An example of such an effort in the Iowa Department of Public Health is the Safe Kids project being implemented throughout the state.

A second potential target group are the elderly (figure 5). Falls constitute a significant portion of all severe traumatic brain injuries. They are the second leading cause of non-fatal traumatic brain injuries (figure 4). Among females, the number of fall-related traumatic brain

injuries equals the number of motor vehicle-related brain injuries. More than $ 2 million was charged to pay for the acute care of falls alone.

Data described in this report can also be the starting point of secondary prevention. That is, prevention of conditions among persons with disabilities. Since in many cases, persons with severe traumatic brain injuries are permanently disabled and could develop secondary conditions, strategies aimed at their prevention may be very appropriate. Reducing the occurrence of these conditions can substantially increase the potential that these persons can be active participants in society. This may also increase their quality of life. Currently, few activities are specifically aimed at reducing the occurrence of secondary conditions.

Finally, this report shows the importance of having multiple data sources for describing the magnitude of severe traumatic brain injuries. Each of the data sources contributes significantly to the understanding of these injuries in Iowa. Efforts are currently underway to perform more detailed investigations of the difference in reporting by the hospital discharge and Registry databases.

Acknowledgment

We wish to thank all hospitals who provided us with valuable information about brain and spinal cord injuries. We also wish to thank Susan Staple for entering most of the data and providing clerical support and Roger Chapman for providing direction to the Disability Prevention Program. This work was supported in part by the US Public Health Service, Centers for Disease Control and Prevention (U17/CCU711028-01).

Where To Obtain Additional Information?

Please contact Mary Harlan, coordinator, at 515/242-6336, or Mario Schootman, Ph.D., epidemiologist, at 515/281-3205, for additional information or questions regarding this report.

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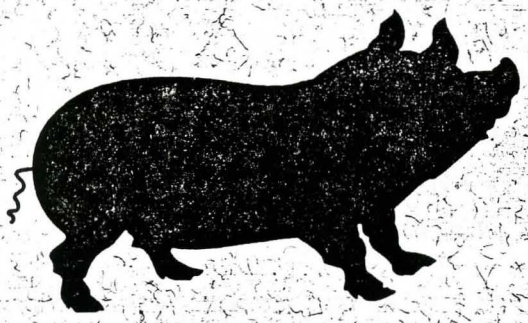
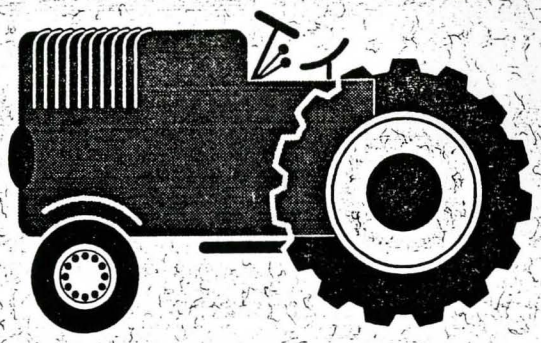
APPENDIX E

SPRAINS 1994 Annual Report

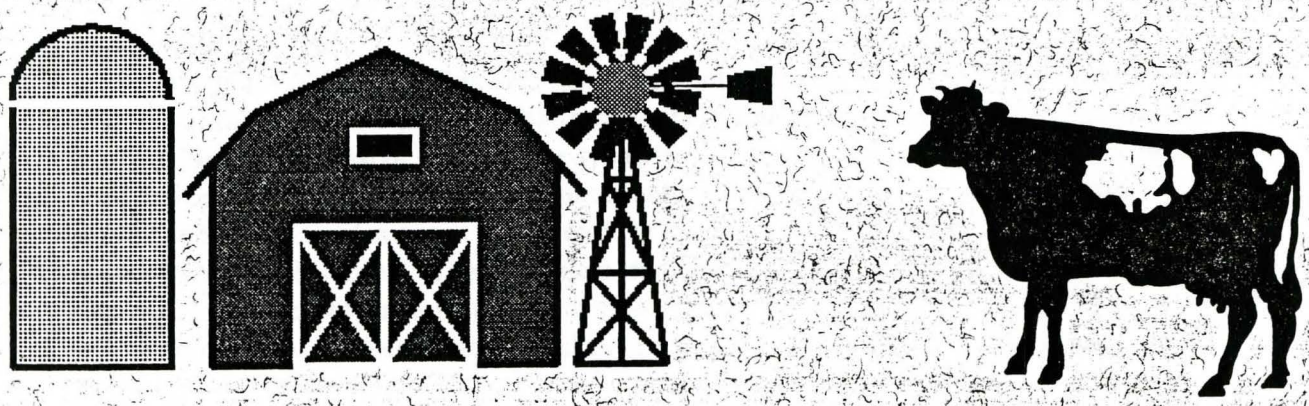




Sentinel Project Researching

SPRAINS 1994 Annual Report

Agricultural Injury Notification Systems



Iowa Department of Public Health
Terry E. Branstad - Governor Christopher G. Atchison - Director

1994 ANNUAL REPORT

SENTINEL PROJECT RESEARCHING AGRICULTURAL INJURY NOTIFICATION SYSTEMS (SPRAINS)

Prepared by E. Jude Igbokwe, Ph.D and Pierce Wilson, MSW.

Introduction:
It has been documented by writers and researchers such as James Dosman (1989), and the National Safety Council (NSC) that "agriculture is the single most dangerous major occupation in the United States." Iowa is not an exception to this trend. According to the National Safety Council, occupational injury is the major cause of years of productive life lost in the United States and has a high priority for public health prevention activities. Agriculture is one of the occupations that have an affinity for a high rate of injury. The death rate estimated for such injury by the National Safety Council is four to five times the national average of all other industries.

Although job-site injury and illness have been declining since 1990 both nationally and for Iowa in particular, the rate of decline still puts agricultural injury and illness in the top five industries with high rates. According the 1994 Condition of Employment Report by the Iowa Department of Employment Services, agricultural injury and illness rates in the U.S. declined from 11.6 percent per 100 full-time workers in 1990 to 10.8 percent in 1991 and increased again to 11.6 percent in 1992. The Iowa rate declined from 9.1 percent per 100 full-time workers in 1990 to 7.7 percent in 1991 and jumped back to 12.2 percent in 1992. These rapid fluctuations in agricultural-related injury rates have intensified calls for a more interventionist approach to agricultural-related injury problems.

Objectives of the SPRAINS Project:
The Sentinel Project Researching Agricultural Injury Notification Systems (SPRAINS) has four basic objectives. The first objective is to provide descriptive epidemiologic association for contemporary agricultural injury. The second objective is to identify high-risk groups and high-risk circumstances for injury. The third objective is to identify potential educational, regulatory and engineering interventions to prevent farm injury. The fourth and final objective is to evaluate the effectiveness of established injury control measures.

Methodology:
Surveillance in the SPRAINS project is carried out primarily through passive reporting by Iowa hospitals and Iowa primary health care practitioners who treat agricultural-related injuries. Note that passive surveillance systems may undercount incidence depending on how active and vigilant system participants are. However, both active and passive surveillance were implemented in some of the counties in the state by occupational health nurses to lessen this effect. The 1993 data might not be a typical trend because of decreased field activity as a result of adverse weather conditions. This means less reporting might have been done as well as less injury because of the decreased activity.

Some of the variables monitored include gender, agricultural-related role, age, site of injury, type of injury, location of injury, severity of injury, type of tool, chemical, machinery, animal or other agent involved in the injury. General and specialized follow-up questionnaires were mailed to all reported injured. Deaths were followed by staff to obtain the additional information to complete the follow-up questionnaires. Total reports and return rate of questionnaires gradually increased over the first three years of the project, going from 55 percent to about 70 percent and stabilized at this rate in the last year.

Definitions:

Some of the variables used in this study needs to be clarified because of how they were derived. Included among these are two special variables namely "struck by" and "struck against". In the initial phase of this study, these two variables were classified as "other" category. Soon it became apparent that so many types of injuries fell under this category. It then became necessary to try to identify and individually isolate these types of injuries.

Struck By - These are minor injuries, not machinery related where the force is initiated by something else. For example: A hog feeder lid blown off by the wind and hitting someone on the head or catching someone's fingers. Wind flipping open an unlatched farm door and catching someone in the process and others.

Struck Against - These are minor injuries, not machinery related where the force is initiated by the individual. For example: stepping on a board with nails, running into something, caught in a barbed wire fence, and others.

Although these are minor injuries, they have occasionally led to fatalities which have caused them to be reclassified as they are in this study.

Findings/Results:

Since this is a surveillance program, descriptive analysis is used here to summarize the findings of the surveillance effort. A total of 10,184 injury reports were received during the four years of the SPRAINS project. This figure includes 1,648 hospitalizations and 8,536 who were treated as outpatients. There were 288 fatalities for the entire period.

An examination of comparable data for 1990 and 1993 (Table 1) shows the following trends. There were a total of 2,166 agricultural-related injuries, 84 fatalities, 375 hospitalizations, and 1,791 non-hospitalized events in 1990. In 1993, there were 2,307 agricultural-related injuries, 52 fatalities, 359 hospitalizations and 1,948 were not hospitalized. However, for the entire four year period of this project , agricultural-related injuries increased by 6.5 percent overall and the number of hospitalizations related to this problem decreased by approximately 4.3 percent. Machinery and animals seem to be the most frequent cause of these injuries, contributing 22 percent and 17 percent respectively in 1990 and 19 percent and 22 percent respectively in 1993. The data indicate that animal

caused-injury is gradually edging out machinery as the leading cause of agricultural injury in Iowa.

Table 1: Trend in Agricultural-Related Injury - Iowa 1990 and 1993

		1990				1993		
Injury Causing Event	**Total**	**Fatalities**	**Hospitalized**	**Not Hospitalized**	**Total**	**Fatalities**	**Hospitalized**	**Not Hospitalized**
Motor Vehicle	39	7	14	25	29	2	9	20
Recreational Vehicle	55	4	11	44	71	2	13	58
Drowning	2	2	1	1	8	7	0	8
Fall/Slip	247	4	47	200	297	0	59	238
Heat/Cold/Radiati on	14	0	5	9	6	0	2	4
Electric Shock	5	1	2	3	4	1	3	1
Chemical Exposure	36	0	7	29	34	0	5	29
Ingestion/Inhalati on	16	4	3	13	26	1	5	21
Submersion/Suffo cation	6	6	0	6	10	8	1	9
Improper Motion	33	7	4	29	27	0	2	25
Animal	360	3	51	309	511	0	57	454
Machinery	476	8	116	360	427	7	86	341
Tools	110	0	10	100	154	1	15	139
Neddle Sticks	28	0	1	27	44	0	4	40
Struck Against	174	0	3	171	169	2	9	160
Struck By	302	6	32	270	234	2	21	213
Tractor	227	29	65	162	250	18	68	182
Other	36	3	3	33	6	1	0	6
TOTAL	**2166**	**84**	**375**	**1791**	**2307**	**52**	**359**	**1948**

Source: Iowa Department of Public Health, 1994

Note: Fatalities, Hospitalized and Not-Hospitalized are not mutually exclusive.(i.e., fatalities are counted in the hospitalized and not-hospitalized categories).

In fact, a close examination of the five agents that cause the most agricultural injury (Table 2) , shows that the rate of injury by animals increased by 42 percent from 1990 to 1993, injuries from falls/slips increased by 20 percent, and injuries by tractors increased by 10 percent. On the other hand, injuries by machinery decreased by 10.3 percent and injuries associated with "struck by" decreased by 23 percent during the same time period.

Table 2: Comparison of the five most frequent causes of agricultural-related injury 1990 and 1993 Data

Cause	1990	Rank	1993	Rank	Difference	Percent Change
Machinery	476	1	427	2	-49	-10.3%
Animal	360	2	511	1	151	42%
Struck By	302	3	234	5	-68	-23%
Fall/Slip	247	4	297	3	50	20%
Tractor	227	5	250	4	23	10%

Figure 1 documents the cause of injury for all the injury types by gender, showing that males are at higher risk. Of all injuries, 84 percent were to males and 16 percent were to females. For individuals that were hospitalized as a result of these injuries, 85.5 percent were males and 14.5 percent were females. The trend from 1990 to 1993 (Figure 2) shows almost an identical pattern for the causes of the injuries, especially for the five most prevalent causes of injury.

Figure 1: 1993 CAUSE OF INJURY BY FREQUENCY AND GENDER

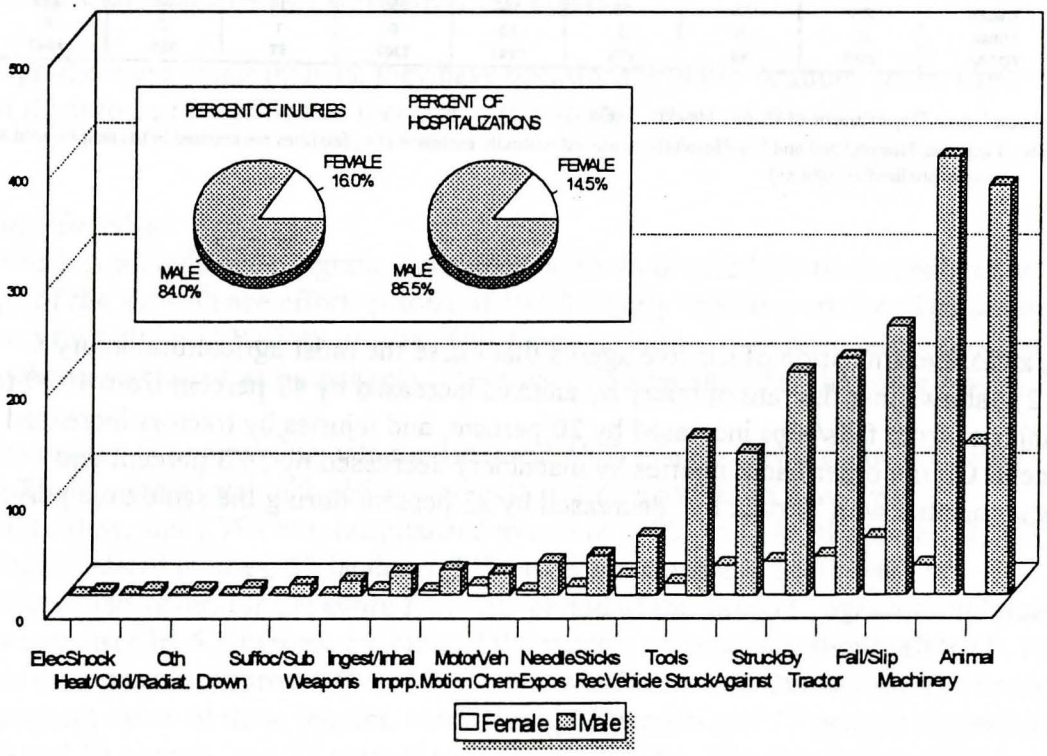
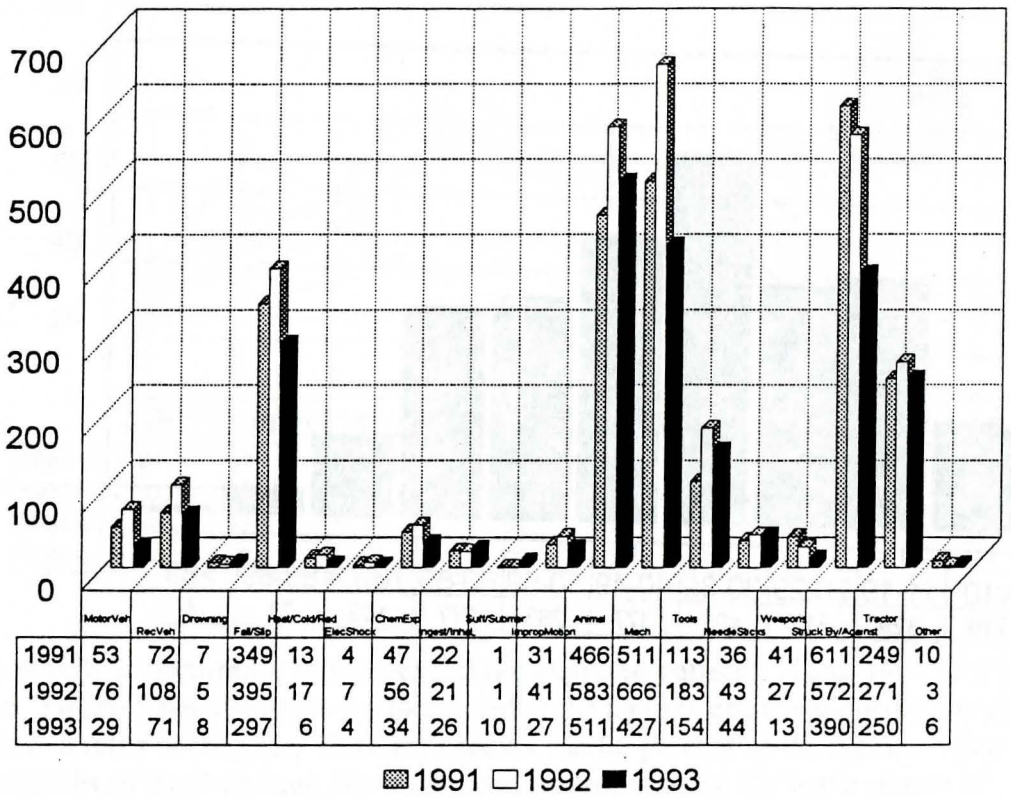


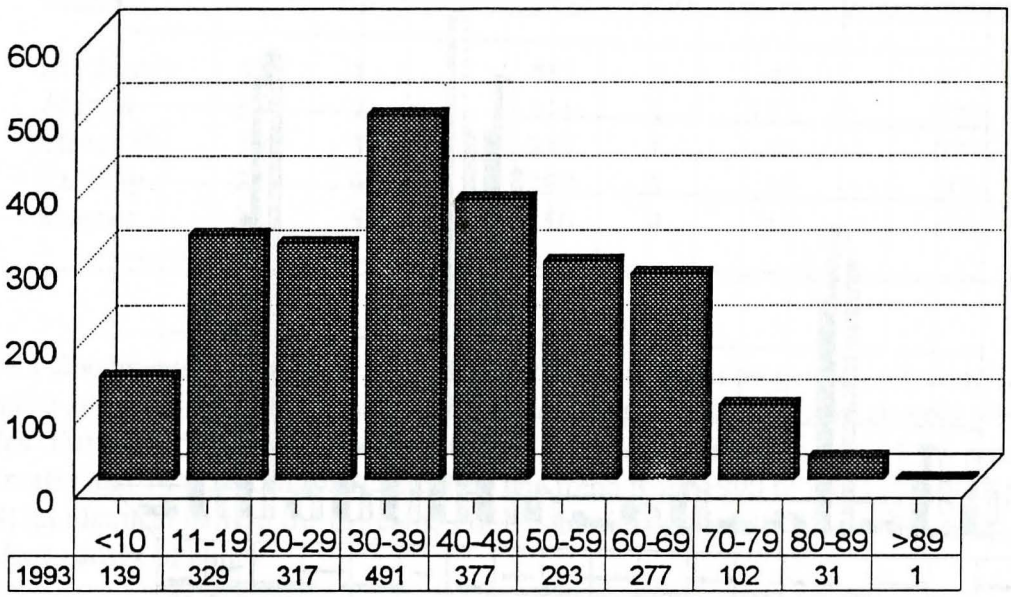
Figure 2: CAUSE OF INJURY
1991-1993



	MotorVeh	RecVeh	Drowning	Fall/Slip	Heat/Cold/Rad	ElecShock	ChemExp	Ingest/Inhal	Suff/Submer	ImpropMotion	Animal	Mach	Tools	NeedleSticks	Weapons	Struck By/Against	Tractor	Other
1991	53	72	7	349	13	4	47	22	1	31	466	511	113	36	41	611	249	10
1992	76	108	5	395	17	7	56	21	1	41	583	666	183	43	27	572	271	3
1993	29	71	8	297	6	4	34	26	10	27	511	427	154	44	13	390	250	6

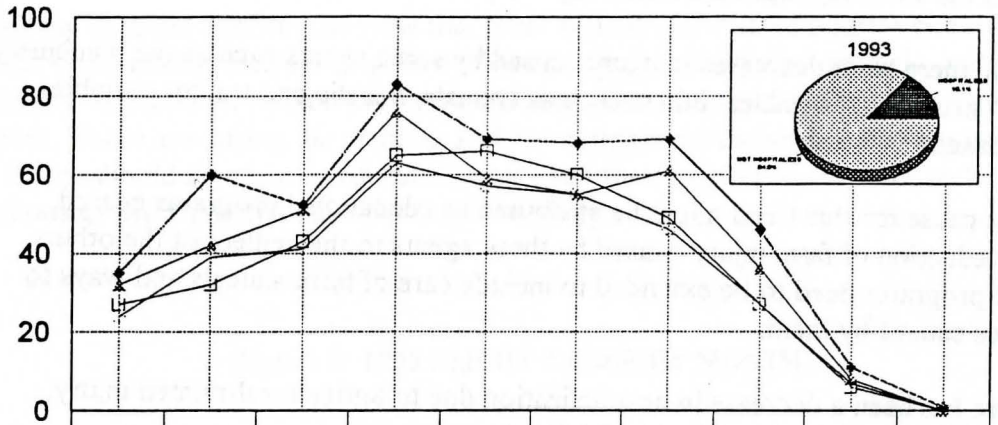
Looking at the total population at risk for these types of injuries for 1993, people aged 11 years to 69 years are more likely to sustain agricultural-related injury (Figure 3) than any other group in the population. This situation is not unusual because that is the age group actively involved in agricultural-related activities in the state.

Figure 3: 1993 TOTAL FREQUENCY OF INJURY BY AGE



Although the 30 - 39 year olds were more at risk, the rate for children and teenagers (age <10 to 19) raises some primary concern for public health officials. In fact, the distribution of injury frequency seems to be skewed to the left, indicating more injuries for youngsters. The trend for 1990 through 1993 (Figure 4) also indicates a high rate and incidence for people aged 11 years to 69 years. However, the figure does show that the rate and incidence have started to decline for all the age groups.

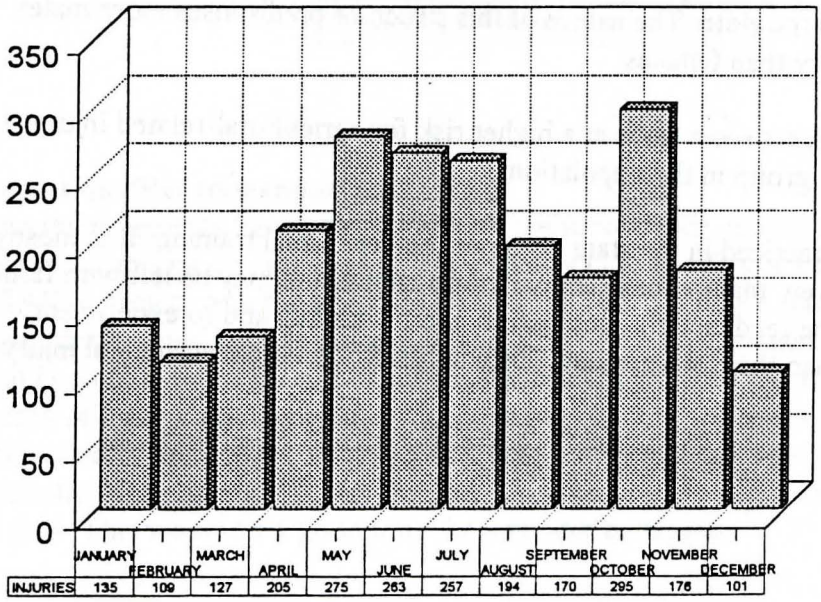
Figure 4: HOSPITALIZED INJURIES
FREQUENCY BY AGE
1990-1993



	<10	11-19	20-29	30-39	40-49	50-59	60-69	70-79	80-89	>89
1993	24	39	41	63	57	55	46	27	7	0
1992	35	60	52	83	69	68	69	46	11	1
1991	32	42	51	76	59	55	61	36	8	0
1990	27	32	43	65	66	60	49	27	6	0

The month of occurrence of injuries follows expected patterns. Using 1993 as a reference point, Figure 5 demonstrates the likelihood of the injuries occurring during any of the twelve months of the year. The figure shows that 80 percent of the injuries occur during the months of April through November, with October being the worst month of occurrence with 13 percent of the injuries.

Figure 5: 1993 TOTAL INJURIES BY MONTH



Analysis/Interpretations:
The data and the study highlight the following key points:

1. While there were decreases in injury caused by some agents such as the machinery and "struck-by" variables, others such as animals, fall/slip and tractor variables increased.

The possible cause for this trend might be attributed to educational programs geared toward the reduction of farm injury caused by these agents to the neglect of the others. Educational programs need to be extended to include care of farm animals and ways to avoid injuries caused by them.

2. There has been a decrease in hospitalization due to agricultural-related injury.

This is as a result of the types of injury received as well as the agent causing the injury. The data confirmed the view that injury caused by machinery and the "struck by" category led to more hospitalizations than other types of injury. However, now that these types of injuries have decreased, it is expected that hospitalizations will also decrease. The trend from the data confirmed this theory. Product safety has been nationally promoted in all industry sectors for some years. It is possible that some of the lowering of injury incidence is also a product of safety improvements in farm equipment.

3. Males are more at risk for agricultural-related injury than females.

Proportionally in Iowa, more males are involved in the agricultural industry than females. This might be due to the type of agricultural business most Iowans are involved in. Specifically, Iowa is known for its comparative advantage in the production of corn and hogs. Even when both full-time and part-time farm activity is considered, males dominate the agricultural industry in the state. The nature of this structure predisposes more males to agricultural-related injury than females.

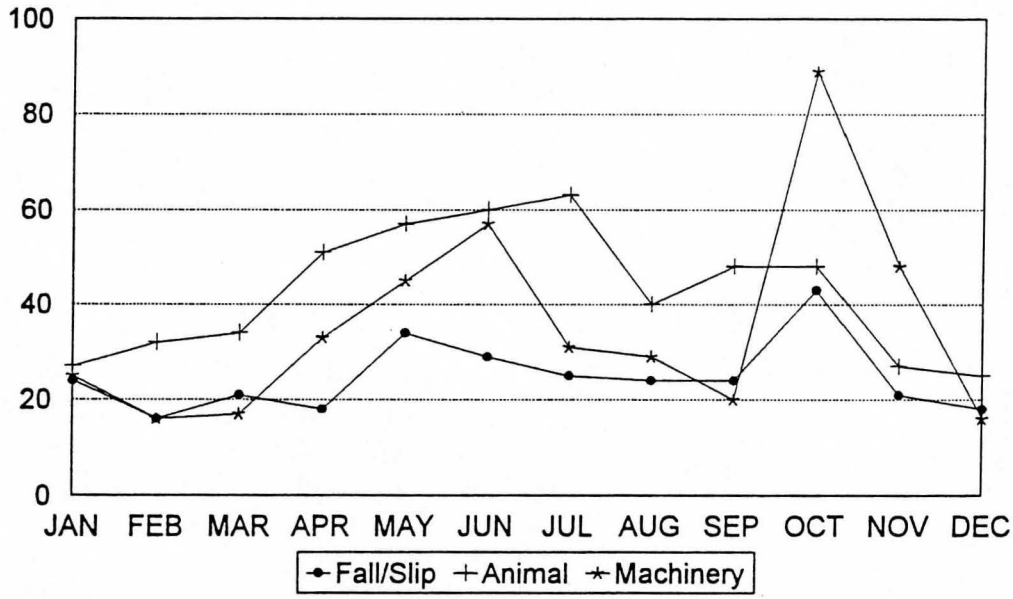
4. Children and teenagers seem to be at a higher risk for agricultural-related injury than any other age group in the population.

Much of the agriculture practiced in the state does not require formal training. It is mostly on-the-job training. Children many times help with farm chores and may be left with farm equipment unattended. The tendency for youngsters is to be curious and to experiment with things. The farm is also their playground. The end result is possible accidental injury.

5. Agricultural-related injury is prevalent at all times during the year but more injuries occur during planting and harvesting seasons, as is expected.

Again, the data did confirm the view that most agricultural-related injuries occur at specific times during the year (Figure 6). Specifically, the falls/slips, animals, and machinery variables all peaked during April, May, June, July and again in September and October. These are during the planting and harvesting seasons when heavy equipment is in use. Effort should be made to educate farmers and their helpers on the need to be conscious of practices that have potential for injury.

Figure 6: 1993 INJURY CAUSE BY MONTH



Conclusions/Recommendations:

Some improvements have been made with the surveillance, monitoring and educational programs focusing on agricultural-related injury in Iowa. This is a direct result of the SPRAINS project which started in 1990. Public health officials should continue to monitor agricultural-related injuries especially where children and teenagers are involved. Effort should continue to emphasize educational programs to reach the affected population. The efficacy of intervention techniques needs to be constantly re-evaluated to ensure the justification of their continued use. Most farm safety messages should be directed seasonally to spring and fall months. Fall is particularly a problem for machinery, tractors and falls. This would be a good time for reminder messages.

In interpreting the results of this study, care should be taken in dealing with the 1993 data because of possible undercount which might have resulted because of the 1993 adverse weather conditions. Specifically the flood of 1993 might have caused a decrease in farm activities, hence a decrease in injuries reported. It might also be that the massive educational efforts by the state public health department and others have started to pay off by reducing the number of agricultural-related injuries in the state. This situation can be verified with the 1994 data collection and comparative analysis of each of the subsequent years data.

Further study is encouraged to examine any difference in injury rates by roles (i.e., farmer/operator versus children and hired employees). It might also be helpful to examine any geographical differences in injury rates, as this might bring a more direct focus to counties affected. In order to undertake this study, an expanded data collection effort needs to be carried out.