Legislative Budget and Finance Committee

A JOINT COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

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Motorcyclist Injuries and Fatalities Since the 2003 Repeal of the Mandatory Helmet Law
(2008 Update)

Pursuant to HR 349 of 2003

June 2008

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Report Summary

Study Background

Effective September 4, 2003, Pennsylvania's 1968 mandatory helmet law was repealed for motorcyclists 21 years of age or older who have either been licensed to operate a motorcycle for not less than two full calendar years or have completed an approved motorcycle rider safety course. Also, any person 21 or older can ride as a passenger without wearing a helmet if the driver meets the above requirements.

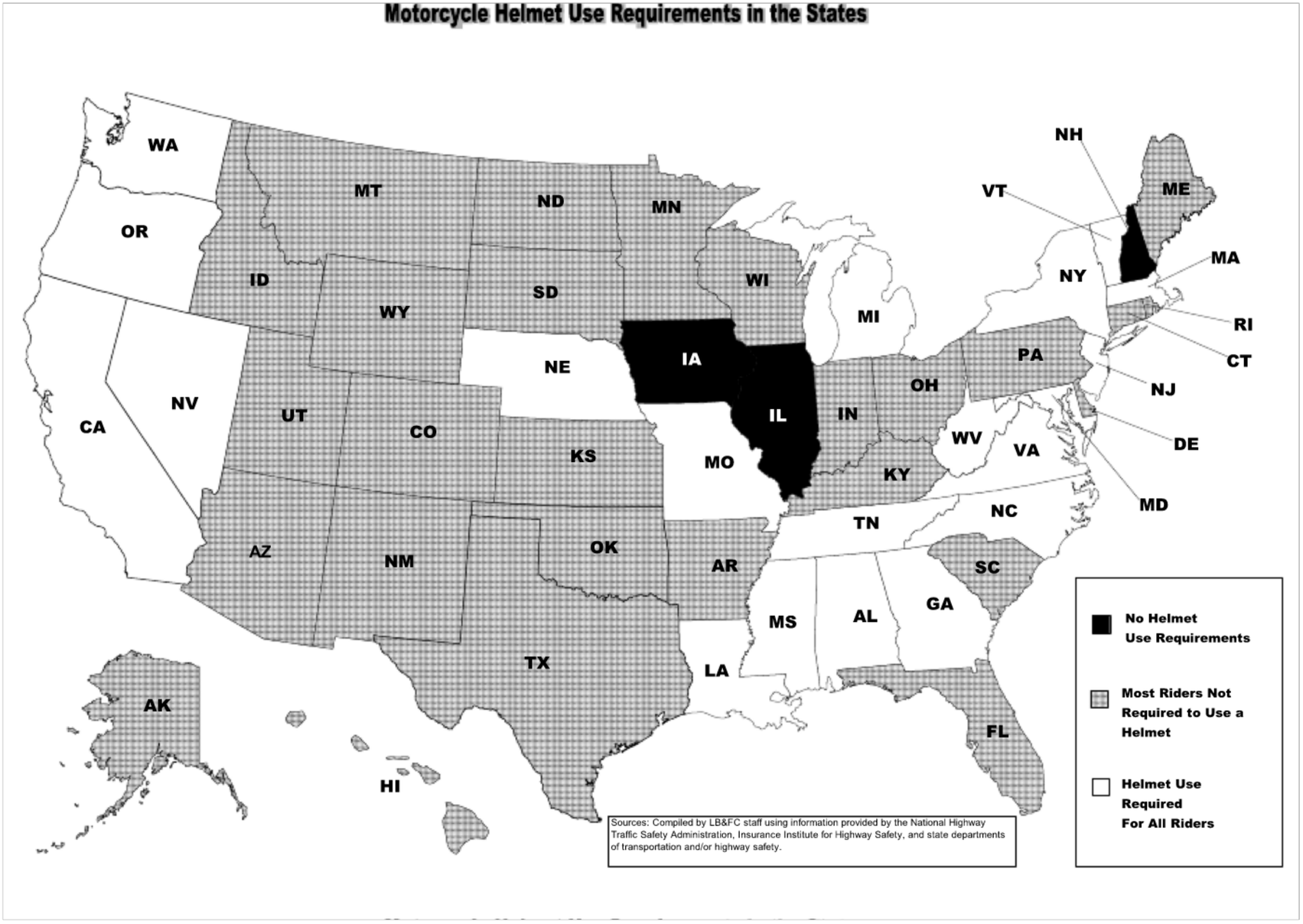
These changes resulted from the passage of Act 2003-10, commonly referred to as the Helmet Repeal Law. At the same time, the House of Representatives adopted House Resolution 349 directing the Legislative Budget and Finance Committee (LB&FC) to conduct a study of reported motorcycle crashes and associated injuries and fatalities following passage of the Helmet Repeal Law. Specifically, the resolution requires the Legislative Budget and Finance Committee report to include, but not be limited to, the following:

1. the number of reported motorcycle crashes for the first two years after the adoption of this resolution and every subsequent two years thereafter;
2. the number of individuals wearing helmets involved in reported motorcycle crashes; and
3. the increase, if any, in injuries and fatalities specifically due to head trauma that may be attributed to individuals not wearing helmets.

The LB&FC was to report its findings to the Transportation Committee of the House of Representatives within three years of the adoption of the resolution (i.e., by July 1, 2006), and then issue a subsequent report within two years of its initial report (i.e., by July 1, 2008). The Committee issued its first report covering the period CY 2000 through CY 2005 in June 2006. This, the second report required by the resolution, updates the initial report with data from CY 2006 and CY 2007.

Study Results

Pennsylvania is one of 27 states that permit most motorcyclists to ride without a helmet. As shown on the map on the following page, these states require only a certain segment of motorcycle riders, usually those with less experience, to use a helmet. Of the remaining states, 20 require everyone who rides a motorcycle to wear a helmet while three states (Illinois, Iowa, and New Hampshire) have no helmet requirements.


Motorcycle Helmet Use Requirements in the States
WA
OR
CA
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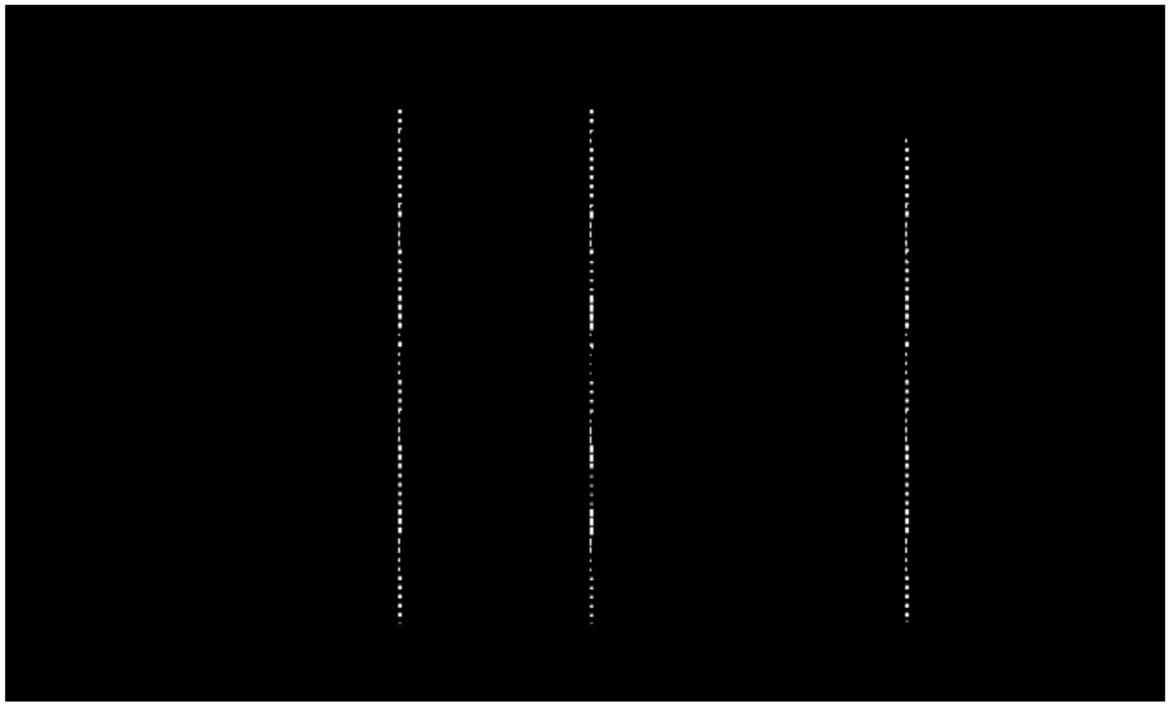
DE
NJ
CT
RI
MA
VT
NH
ME
AK
HI
No Helmet Use Requirements
Most Riders Not Required to Use a Helmet
Helmet Use Required For All Riders
Sources: Compiled by LB&FC staff using information provided by the National Highway Traffic Safety Administration, Insurance Institute for Highway Safety, and state departments of transportation and/or highway safety.

House Resolution 349 directed the LB&FC to report on the number of reported motorcycle crashes for the first two years following the repeal of the Helmet Law and in the subsequent two years. While not in itself an indicator of the impact of the Helmet Repeal Law, this information (shown below), along with data on the number of motorcyclists involved and motorcycle registrations, serves as a baseline upon which further analysis of helmet usage and non-usage trends, as well as motorcyclist injury and fatality statistics can proceed.



As shown, the number of crashes involving motorcycles has been trending upward over the eight-year period examined. Such crashes numbered 4,109 in CY 2007, a 44.6 percent increase over the CY 2000 level. At the same time, a substantial growth in motorcycle registrations is evident, increasing by 69.2 percent from 214,629 in 2000 to 363,109 in CY 2007. Due to the substantial increase in motorcycle registration, the rate of crashes per 10,000 motorcycle registrations actually declined from 132.4 in CY 2000 to 113.2 crashes per 10,000 motorcycle registrations in CY 2007.

[redacted]

House Resolution 349 also sought information on the number of individuals wearing helmets in reported motorcycle crashes. PennDOT's Crash Reporting System provides information on helmet usage by motorcycle drivers and passengers involved in crashes. In CY 2004, the first full year following the Helmet Law repeal, there were 3,636 crashes involving 4,183 motorcyclists. During the most recent full calendar year, 2007, there were 4,109 crashes involving 4,716 motorcyclists. The following table shows the percentages of persons who were helmeted and non-helmeted (as well as those who were using a bicycle helmet, wearing a helmet improperly, or whose helmet status was unknown) for the period CY 2000 through CY 2007.

The percentage of individuals involved in motorcycle crashes who were wearing helmets declined from a three-year "pre-repeal" average of 70.9 percent to a four-year "post-repeal" average of 55.7 percent.

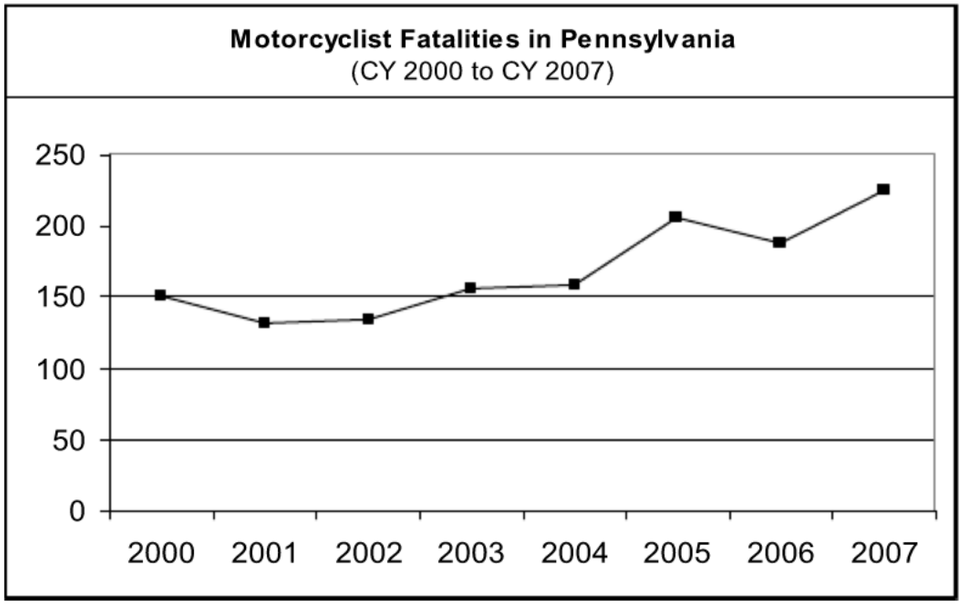
added] that may be attributed to individuals not wearing helmets." We found that the linkages between existing data sources that are necessary to specifically determine the relationship between helmet usage and head trauma-related injuries and fatalities are currently not in place. A joint project involving the Pennsylvania Department of Health, PennDOT, the Pennsylvania Health Care Cost Containment Council, and the Pennsylvania State Police was underway to develop such linkages when we last reported motorcycle crash data in 2006.

This project, known as the Crash Outcome Data Evaluation System, or CODES, is designed to electronically track individuals injured or killed due to being involved in motor vehicle crashes. Tracking is to occur from the scene of the crash through the health care system to determine crash outcome in terms of mortality, injury, severity, and health care costs. The Department of Health reports that, to date, a CODES database has been established for a portion of the records pertaining to CYs 2004 and 2005.

Because the pertinent data sources are not yet completely linked, we obtained information from PennDOT and the Pennsylvania Trauma Systems Foundation pertinent to motorcycle crashes and related fatality and injury trends since repeal of the Helmet Law. This information is summarized below along with a brief description of the two data collection systems.

A. PennDOT Motorcycle Crash Data. The PennDOT Crash Reporting System compiles data from Pennsylvania's "Police Crash Reporting Form" that is completed by the investigating law enforcement officers at the scene of a motor vehicle crash. The reporting form provides for coded entries necessary for the analysis of crashes involving motorcycles, including a series of "injury severity" codes which include specific designations such as "killed," "major injury," "moderate injury," or "minor injury." The form does not allow for coding of the specific nature of injuries, such as whether the crash victim suffered head trauma, but does require that the investigating officer indicate whether the motorcyclist was wearing a helmet and the type worn.

Fatalities. According to PennDOT crash records, motorcyclist fatalities increased by only two, from 156 in 2003 to 158 during 2004, the first full year following repeal of the Helmet Law. As shown on the next page, motorcyclist fatalities then increased by nearly 30 percent to 205 in CY 2005. This was followed in CY 2006 by an 8.8 percent decline in motorcyclist fatalities to 187 and a subsequent increase to 225 fatalities in CY 2007.



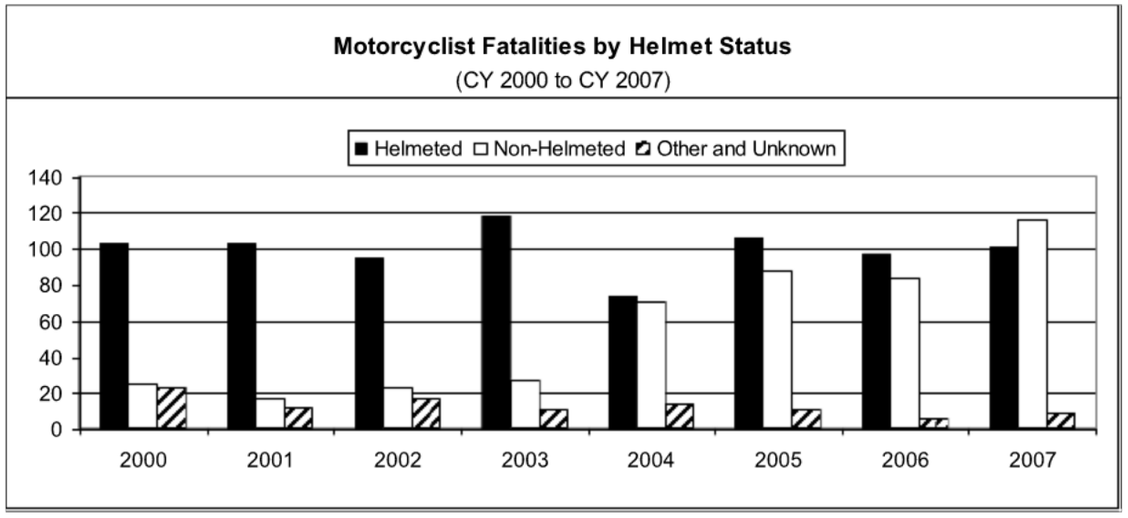
However, to place these statistics in proper perspective, it is necessary to view both fatality and injury data in the context of vehicle miles traveled (VMT) and/or motorcycle registrations. Because VMT is not available for motorcycles in Pennsylvania, we focused our analysis on fatalities and injuries relative to the number of motorcycles registered.

As shown below, 266 persons died in motorcycle crashes in the two years prior to 2003 (the transition year) compared to 363 persons in the first two years after repeal, an increase of 36.5 percent. However, when the number of registered motorcycles is taken into consideration, the average annual fatality rate for the four years after repeal of the Helmet Law (5.9 fatalities per 10,000 registered motorcycles) is virtually identical to the average annual fatality rate for the three years prior to repeal (5.9 fatalities per 10,000 registered motorcycles).

Total Motorcyclist Fatalities and Number Per 10,000 Registrations
(CY 2000 Through CY 2007)

CY	Total Fatalities	Helmet Status			Per 10,000 Registered Motorcycles
		Helmeted	Non-Helmeted	Other and Unknown[a]	
[redacted]					

PennDOT crash reports provide information on helmet usage by individuals involved in motorcycle crashes. The chart below shows helmet usage in cases of motorcyclist fatalities for the period 2000 through 2007.



Injuries. PennDOT's Crash Reporting System relies upon the judgment of police officers responding to the scene of a crash to assess the severity of injuries sustained by individuals involved in a crash. PennDOT's Police Crash Reporting form utilizes the following classifications for injury severity: (a) not injured, (b) killed, (c) major injury, (d) moderate injury, (e) minor injury, (f) injury of unknown severity, and (g) unknown if injured. This classification may not necessarily concur with responding EMS personnel's assessment of injuries sustained.

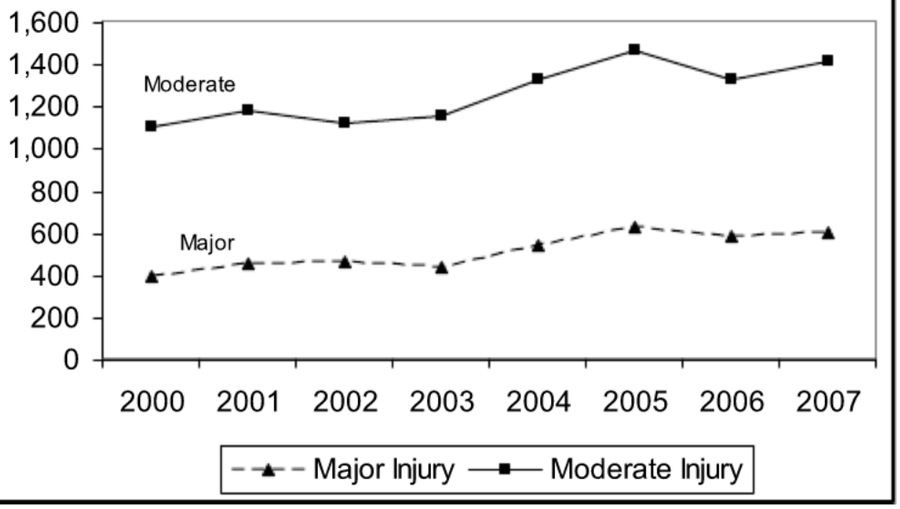
The table below shows motorcyclist injuries, by severity level reported by the investigating law enforcement officer, for the period 2000 to 2007.

Motorcyclist Injuries, by Reported Severity
(CY 2000 to CY 2007)

CY	Major Injury	Moderate Injury	Minor Injury	Unknown Severity	Total Injuries

Major injuries, as defined in the PennDOT Crash Reporting System, are "incapacitating injuries, including bleeding wounds and distorted members (amputations or broken bones), and requires transport of the patient from the scene." Moderate injuries are defined as non-incapacitating injuries that may require some form of medical treatment or hospitalization. The trend in major and moderate injuries among motorcyclists is shown below:

Major and Moderate Injuries in Motorcycle Crashes
(CY 2000 to CY 2007)



The tables that follow show the trend in major and moderate motorcyclist injuries for the period 2000 to 2007 both in absolute numbers and per 10,000 registered motorcycles.

Reported Helmet Usage in Crashes Involving "Major Injury" to Motorcyclists
(CY 2000 to CY 2007)

CY	Helmeted	Non-Helmeted	Improper Use	Bicycle Helmet	Unknown If Used	Unknown	Total Major Injuries	Per 10,000 Registered Motorcycles
[redacted]								

A total of 904 persons sustained a major injury as a result of a motorcycle crash in the two years prior to the Helmet Law repeal (2001 and 2002) compared to 1,157 major injuries in the first two years after repeal (2004 and 2005). This translates to an average annual injury rate of 18.6 major injuries per 10,000 registered motorcycles in 2001 and 2002 compared to 19.0 major injuries per 10,000 registered motorcycles in 2004 and 2005. In CY 2006 and CY 2007, the comparable rate was 16.7 major injuries per 10,000 registered motorcycles.

Before the repeal in 2001 and 2002, 2,296 persons sustained a moderate injury as a result of a motorcycle crash. This compares to 2,787 in 2004 and 2005. This translates to an average annual injury rate of 47.2 per 10,000 registered motorcycles in 2001 and 2002 compared to an average annual injury rate of 45.7 per 10,000 registered motorcycles in 2004 and 2005. In CY 2006 and CY 2007, the comparable rate was 38.8 moderate injuries per 10,000 registered motorcycles.

B. Data From the Pennsylvania Statewide Trauma Registry. The Pennsylvania Trauma Systems Foundation is a private, non-profit organization statutorily recognized in the Emergency Medical Services Act to accredit and monitor the Commonwealth's trauma centers. The state's 28 accredited trauma centers are required to submit various data, including injury data for vehicle crash victims they treat. This information is transmitted to the Trauma Systems Foundation's statewide trauma registry (known as the Pennsylvania Trauma Outcome Study, or PTOS).

This system provides information about various types of motor vehicle crashes (including motorcycles) and isolates the nature of injuries, medical diagnoses, and injury severity scores. Additionally, information regarding the presence or use of protective devices such as helmets is recorded.

Motorcycle Crash Patients Admitted to Trauma Centers

Total Number Admitted. "Major trauma patients" are admitted to Pennsylvania's accredited trauma centers. A major trauma patient is one "with severe multisystem or major unisystem injury, the extent of which may be difficult to ascertain, but which has the potential for producing mortality or major disability."

During CY 2004, the first full year of the helmet law repeal, the number of motorcycle crash patients admitted to a trauma center increased by 29.5 percent. A further increase of 24.4 percent occurred in the following year. This translates to an average annual trauma center admission rate of 33.2 per 10,000 registered motorcycles in 2001 and 2002 compared to 39.9 motorcyclist trauma center admissions per 10,000 registered motorcycles in 2004 and 2005. In the subsequent two years, the rate decreased to 37.7 motorcyclist admissions per 10,000 registered motorcycles.

tion on the number of motorcyclist injuries and fatalities specifically due to "head trauma." Because PennDOT crash records do not contain data on head trauma injuries, we accessed records available from the statewide trauma registry for this measure.

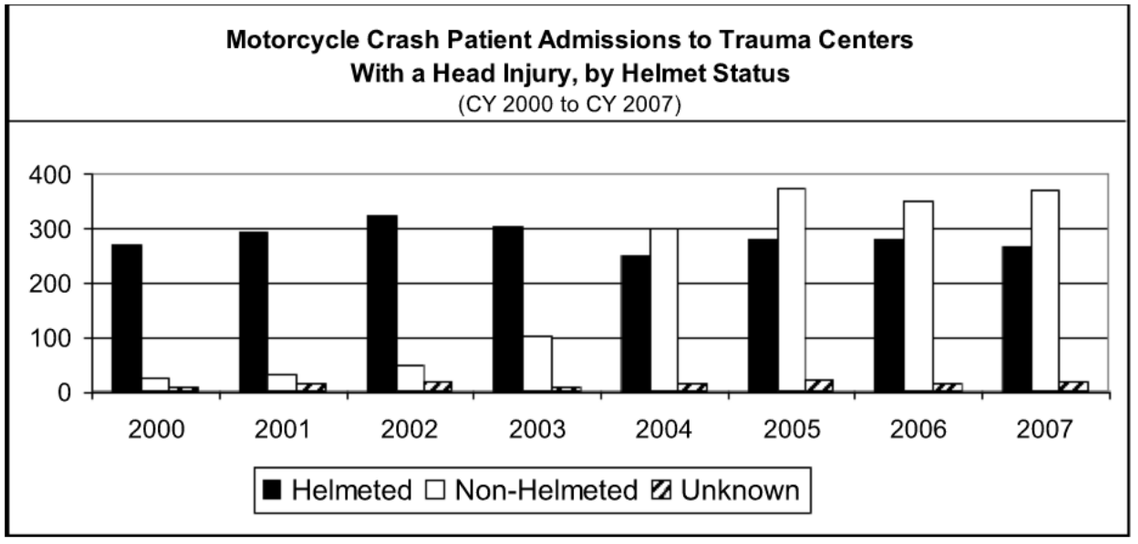
The extent of injuries sustained by motorcycle crash patients admitted to a trauma center is classified according to what is referred to as the "Abbreviated Injury Scale," or AIS. The AIS coding system classifies any injury to the cranium or brain to be a "head injury." Therefore, for purposes of this study, only those injuries sustained by motorcyclists to their heads (i.e., to the cranium and brain) are reported as "head trauma." These totals do not include injuries to the face or neck. Such injuries constitute separate and distinct body injury regions under the AIS system.

In 2004, there was an increase of 38.0 percent in the number of motorcyclists admitted to trauma centers with an AIS head injury. Between 2004 and 2005,

motorcyclists admitted to trauma centers with an AIS head injury increased by 19.2 percent.

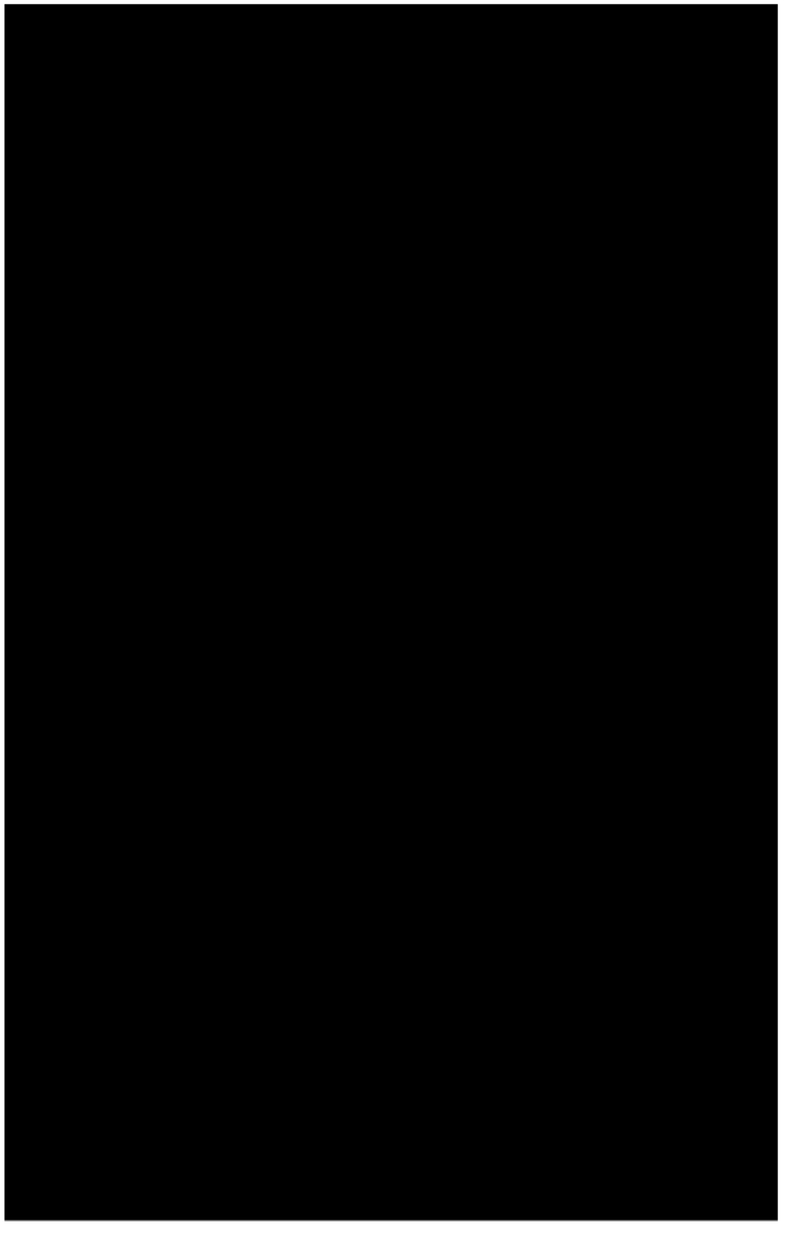
When viewed in terms of motorcycle registrations, the average number of motorcyclists admitted to trauma centers with an AIS head injury was approximately 15.0 per 10,000 motorcycle registrations in 2001 and 2002 prior to the Helmet Law repeal. This average increased to 20.4 per 10,000 motorcycle registrations in 2004 and 2005 following the repeal but declined to 18.5 per 10,000 motorcycle registrations in 2006 and 2007.

The statewide trauma registry provides information on helmet usage by individuals involved in motorcycle crashes who are admitted to a trauma center. The chart below shows helmet usage for motorcyclist admissions to trauma centers with a head injury for the period CY 2000 through CY 2007.



Motorcyclist Head Injury Admissions to a Trauma Center, by AIS Severity

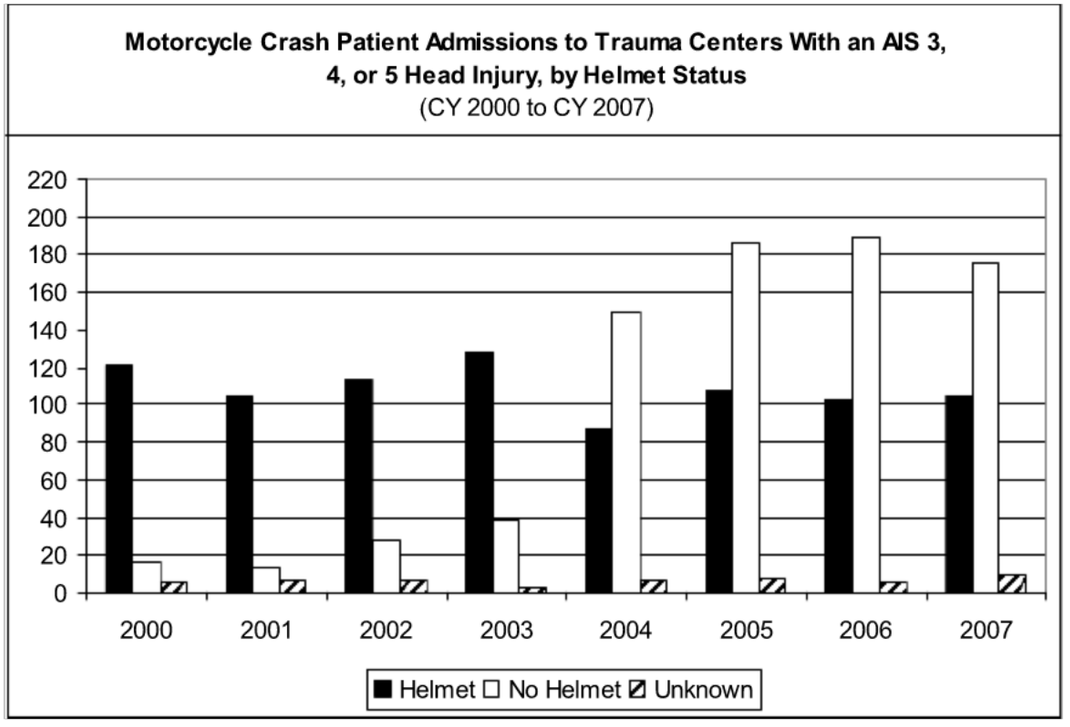
[redacted](minor); "AIS 2" (moderate); "AIS 3" (serious); "AIS 4" (severe); "AIS 5" (critical); to "AIS 6" (maximum). Detail on the number of motorcycle crash patients admitted to trauma centers who sustained a head injury or injuries in AIS codes 3 (serious), 4 (severe), and 5 (critical) for Calendar Years 2000-2007 is provided below.



As shown above, 269 persons sustained AIS 3, 4, or 5 head injuries in the two years prior to 2003 (the year in which the Helmet Law was repealed) compared to

542 persons in 2004 and 2005, the first two years after repeal, an increase of about 100 percent. When the number of registered motorcycles is taken into consideration, the overall average annual AIS 3, 4, or 5 injury rate for the four years after repeal of the Helmet Law was 8.6 head injuries per 10,000 registered motorcycles. This compares to the three-year pre-repeal (2000, 2001, and 2002) overall average annual AIS 3, 4, or 5 injury rate of 5.9 head injuries per 10,000 registered motorcycles.

The chart below shows helmet usage for motorcyclist admissions to trauma centers with an AIS 3, 4, or 5 head injury for the period CY 2000 through CY 2007.



I. Introduction

House Resolution 349, adopted on July 1, 2003, requires the Legislative Budget and Finance Committee to conduct two studies of reported motorcycle crashes and associated injuries and fatalities following the passage of Act 2003-10, commonly known as the Helmet Repeal Law. The Committee issued its first report under this mandate in June 2006. This is the second report issued by the LB&FC on this topic.

Study Objectives

1. To review accident reports and compile and analyze data on motorcycle crashes occurring in the Commonwealth as reported through the Department of Transportation's Crash Information Systems and Analysis Division.
2. To compare the number of injuries, by type and severity, and fatalities associated with motorcycle crashes both before and following the enactment of Act 2003-10, Pennsylvania's Helmet Repeal Law.
3. To determine the number of individuals involved in reported motorcycle crashes who were wearing helmets and the increase, if any, in injuries and fatalities specifically due to head trauma that may be attributed to individuals not wearing helmets.
4. To review pertinent statistical data and similar studies done at the national level or in other states of the relationship, if any, of the use of motorcycle helmets and injuries and fatalities associated with motorcycle crashes.

Scope and Methodology

Act 2003-10, enacted in July and taking effect in September 2003, repealed a 1968 law requiring helmet use for all motorcyclists operating in Pennsylvania. Known as the Helmet Repeal Law, Act 10 effectively eliminated the need for persons (motorcycle operators or passengers) age 21 and over to wear a helmet (except in certain circumstances) while operating a motorcycle in the Commonwealth. This report is the second of two required by HR 349, focusing on the four years following its passage and providing data and information on the number of reported motorcycle crashes, the number of involved persons wearing helmets, and the increase, if any, in injuries and fatalities specifically due to "head trauma" that may be attributed to individuals not wearing helmets.

HR 349 does not define the term "head trauma." For purposes of this study, we found that health experts generally use the term "Traumatic Brain Injury" or

simply "TBI" to describe head trauma. The definition we employ in this report is derived from the National Institute of Neurological Disorders and Stroke (NINDS) and can be found in Section II of this report. To paraphrase, traumatic brain injury involves a sudden trauma to the head causing brain damage. As such, head trauma or TBI as defined does not include injuries to the face or neck, even if they are severe, unless those injuries also result in a disruption in brain function. TBI can result when the head suddenly and violently hits an object, or when an object pierces the skull and enters brain tissue. The symptoms of TBI can range from mild to severe, and can be of short duration, long-term, or can lead to death.

As the agency responsible for maintaining an information repository on reportable traffic crashes, the PA Department of Transportation (PennDOT) was the initial point of contact for motorcycle registration, licensing, and crash data, as well as Commonwealth policy and regulations on motorcycle safety and helmet use. Following orientation to PennDOT's Crash Reporting System (CRS), the LB&FC staff submitted a written request to the Crash Information Systems and Analysis Division for specific crash data to address a portion of the objectives expressed in HR 349. For comparative purposes, the request focused on an eight-year period, Calendar Years 2000 through 2007. PennDOT data for CY 2002 that was unavailable at the time of our initial study (due to a backlog in data entry by a contracted vendor) is now in the system and is presented in this report.

In addition to requesting the LB&FC to report on motorcycle crashes and the number of individuals wearing helmets that were involved in motorcycle crashes, House Resolution 349 also called upon the LB&FC to determine the "increase, if any, in injuries and fatalities specifically due to head trauma that may be attributed to individuals not wearing helmets." This aspect of the resolution required us to examine additional databases that integrated crash data with medical diagnosis and outcome information for persons involved in motorcycle crashes.

To this end, we worked extensively with the PA Trauma Systems Foundation and its Pennsylvania Trauma Outcome Study (PTOS), also known as the Trauma Registry. We reviewed various data outputs and obtained a basic understanding of the PTOS, its capabilities and quality control systems. We then worked with Foundation staff to obtain and analyze PTOS data pertinent to HR 349 (e.g., information on motorcycle crash patients admitted to trauma centers and motorcycle crash patients for whom a head trauma diagnosis was made).

The Pennsylvania Trauma Systems Foundation requires that the following statement accompany any publicly released data derived from the PTOS:

> These data were provided by the Pennsylvania Trauma Systems Foundation, Mechanicsburg, PA. The Foundation specifically disclaims responsibility for any analysis, interpretations, or conclusions. Credit

must be given to the Pennsylvania Trauma Outcome Study (PTOS) as the source of data.

When analyzing the PennDOT and PTOS data, it is necessary to view it in the context of vehicle miles traveled (VMT) and/or motorcycle registrations. Because VMT is not available for motorcycles in Pennsylvania; we analyzed fatalities and injuries in relation to the number of motorcycles registered. The resolution did not request and we did not research medical and rehabilitation cost data associated with reported motorcycle crashes.

We also surveyed studies conducted by other states and by the National Highway Traffic Safety Administration (NHTSA). Recent information pertaining to the helmet laws in all 50 states was also obtained and is presented as an appendix to this report.

Acknowledgements

The LB&FC staff wishes to acknowledge the excellent cooperation and assistance provided by William G. Hunter, Manager, and staff of the Crash Information Systems and Analysis Division of the PA Department of Transportation. Invaluable assistance was also provided by Nathan McWilliams, RHIA, Director of MIS/Trauma Registry, of the Pennsylvania Trauma Systems Foundation. The information presented in this report would not have been possible without their efforts.

Important Note

This report was developed by Legislative Budget and Finance Committee staff. The release of this report should not be construed as an indication that the Committee or its individual members necessarily concur with the report's findings and recommendations.

Any questions or comments regarding the contents of this report should be directed to Philip R. Durgin, Executive Director, Legislative Budget and Finance Committee, P.O. Box 8737, Harrisburg, Pennsylvania 17105-8737.

II. Background Information

A. The Evolution of State Motorcycle Helmet Use Laws

No state enacted a motorcycle helmet use law before 1966. The federal Highway Safety Act of 1966 required the Secretary of Transportation to set uniform standards for state highway safety programs. In 1967, a standard was issued that required states to enact universal motorcycle helmet use laws (covering all riders) in order to qualify for federal-aid highway construction funds and certain federal safety programs. By the end of 1967, 22 states enacted universal helmet use laws, and 14 additional states adopted universal helmet use laws in 1968. By 1975, 47 states and the District of Columbia adopted universal helmet use laws.

In 1975, Congress amended the Highway Safety Act to eliminate the requirement that states enact universal helmet use laws to receive federal-aid highway construction funds. Subsequently, many states repealed their universal helmet use laws. By 1978, 25 states repealed their universal helmet laws or amended them to cover only riders below a specified age. By 1980, two additional states followed suit, reducing the total number of states with universal helmet use laws to 19 and the District of Columbia.

Between 1980 and 1991, several states proceeded to reenact universal helmet use laws. In 1991, the General Accounting Office (GAO) released a report entitled *Motorcycle Helmet Laws Save Lives and Reduce Costs to Society*, which concluded in part that, "helmet use reduces fatality rates and reduces injury severity among survivors of motorcycle accidents, because it sharply reduces the number of severe, serious, and critical head injuries."

The federal Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) provided special "incentive" grants to states with both universal helmet use laws and passenger vehicle safety belt use laws. States qualified for first-year grants by having both laws in effect, but grants in subsequent years required motorcycle helmet and safety belt use levels to exceed a minimum level. ISTEA also mandated that states without both a universal helmet use law and a safety belt use law by October 1, 1993, would have a portion of their fiscal year 1995 federal-aid highway funds transferred to their highway safety programs.

In November 1995, Congress repealed the transfer provision for states lacking universal helmet use laws as part of the National Highway System Designation Act of 1995. Many states subsequently amended or repealed their universal helmet use laws.

As of January 2008, 20 states and the District of Columbia had universal helmet use laws, and 27 states, including Pennsylvania, had helmet use laws which cover a specific segment of riders. Three states (Illinois, Iowa, and New Hampshire) had no helmet use law. (See Appendix A for a breakdown of individual state requirements.)

B. Legal Background on Pennsylvania's Helmet Use Law Requirements

Between 1968 and September 2003, helmets were required for motorcyclists in Pennsylvania. Section 3525 of the Vehicle Code provided only one exception to this requirement, i.e., those riding in or operating a three-wheeled motorcycle equipped with an enclosed cab were not required to wear a helmet. The Department of Transportation had the authority to approve or disapprove protective headgear and eye-protective devices and had the authority to issue and enforce regulations establishing standards for such devices. The Department was required to publish a list of all headgear and eye-protective devices that were approved by name and type of device.

Act 2003-10, commonly known as the Helmet Repeal Law, amended §3525 of the Vehicle Code to repeal the requirement that all motorcyclists wear protective headgear. Specifically, as a result of Act 10, beginning on September 4, 2003, the following persons are no longer required to wear protective headgear:

- A person 21 years of age or older who has been licensed to operate a motorcycle for not less than two full calendar years.
- A person 21 years of age or older who has completed a motorcycle rider safety course approved by the Department of Transportation or the Motorcycle Safety Foundation.
- The passenger of a person exempt if the passenger is 21 years of age or older.

Under Act 10, the Department retains the authority to approve or disapprove protective headgear and eye-protective devices and also the authority to issue and enforce regulations establishing standards for such devices. The Department also continues to be required to publish a list of all approved headgear and eye-protective devices, by name and device type.

C. Motorcycle Registration and Licensing in Pennsylvania

Statistics on motorcycle registrations and licensing in Pennsylvania are available from PennDOT's Bureau of Motor Vehicles and Bureau of Driver Licensing. We examined registration and licensing data for the period of Calendar Years 2000 through 2007.

As shown on Table 1, the number of motorcycle registrations grew by 148,480 or 69.2 percent, over the eight-year period examined. As defined by PennDOT, this figure includes regular motorcycles, motorized pedalcycles, and motor-driven cycles. During the same period, the number of licensed motorcyclists increased by 8.0 percent.

Table 1

Pennsylvania Motorcycle Registrations and Licensed Motorcyclists
(CY 2000 Through CY 2007)

Calendar Year	Motorcycle Registrations[a]	% Change	Licensed Motorcyclists[b]	% Change
2000.....	214,629	--	741,750	--
2001.....	237,276	+10.6%	739,192	-0.3%
2002.....	248,775	+4.8	749,071	+1.3
2003.....	267,826	+7.7	755,068	+0.8
2004.....	291,015	+8.7	762,271	+1.0
2005.....	318,283	+9.4	772,201	+1.3
2006.....	341,217	+7.2	788,018	+2.0
2007.....	363,109	+6.4	801,141	+1.7

[a]Figures shown include registrations for regular motorcycles, motorized pedalcycles (mopeds), and motor-driven cycles.

[b]Under Pennsylvania law, licensed motorcyclists under the age of 21 are required to wear protective headgear. As of CY 2007, approximately 0.7 percent of total motorcyclists licensed by PennDOT were in the under age 21 category.

Source: The Bureau of Motor Vehicles and the Bureau of Driver Licensing, PA Department of Transportation.

D. Definitions of Key Terms

The following is a listing of definitions of key terms pertinent to this study:

Abbreviated Injury Scale (AIS) – An anatomic scale designed by the American Association of Automotive Medicine (AAAM). The AIS was originally designed to rate and compare injuries in motor vehicle accidents. Scores for penetrating injuries were first provided in the AIS-85 Revision. For each injury, the scale ranges from "1" (minor) to "6" (maximum injury virtually unsurvivable).

Class M Driver License – Persons who have demonstrated their qualifications to operate a motorcycle or motor-driven cycle. (A driver may have a Class M License in combination with a Class A, B, or C.) Class M is not a commercial license.

Cranium – The portion of the skull enclosing the brain.

Crash – A crash is the result of an un-stabilized situation which includes at least one incident of personal injury or vehicular damage that is not a direct result of a cataclysm or deliberate intent.

- Cataclysm [redacted] e, flood, hurricane, light- nic eruption, etc. Crashes
- [redacted]
  The classification given to the cause of an event which occurs when a person acts deliberately to cause the event or deliberately refrains from prudent acts, which would prevent occurrence of the event. Includes suicide, self-inflicted injury, homicide, or injury or damage purposely inflicted. Crashes that result from deliberate intent are not reportable.

Eye Protective Devices – 75 Pa.C.S. §3525(b) states that*: No person shall operate or ride upon a motorcycle (other than a motorized pedalcycle or a three-wheeled motorcycle equipped with an enclosed cab) unless he is wearing an eye-protective device of a type approved by the department.*

Motorcycle operators and passengers are not exempt from wearing protective eye gear. However, unlike the case with headgear (helmets), the PA Department of Transportation has not promulgated regulations establishing standards and specifications for protective eye gear. A PennDOT "Fact Sheet" on Pennsylvania's Motorcycle Helmet Law states that: "While any type of protective eye wear will keep you in compliance with the law, it is highly recommended that you wear shatter-proof eye protection."

Head Trauma – (See Traumatic Brain Injury)

Helmet (or Protective Headgear) – 75 Pa.C.S §3525(a) states that: *Except as provided in subsection (d), no person shall operate or ride upon a motorcycle or a motor-driven cycle (other than a motorized pedalcycle) unless he is wearing protective headgear which complies with standards established by the department.*

In response to the law, the Pennsylvania Department of Transportation developed regulations for the minimum performance requirements for helmets designed for use by motorcyclists. Additionally, the regulations specify how the helmet shall be labeled to help identify a helmet that meets both the Federal Motor Vehicle Safety Standards (FMVSS 218) and Pennsylvania regulations (67 Pa.Code 107) for helmets.

To comply with the Pennsylvania Motorcycle Helmet Law, motorcycle helmets must meet the standards approved by the United States Department of Transportation. This is indicated by the "DOT" sticker on the helmet.

Some helmets may also have been affixed with a label from the Snell Memorial Foundation, which gives the wearer an added assurance of quality.

PennDOT's supplemental police crash reporting form, AA 500 M, provides police investigating the motorcycle crash the ability to indicate the type of helmet (whether no helmet, full helmet, ¾ style helmet, half helmet style, or unknown), whether the helmet stayed on, and whether the helmet has a DOT or Snell designation.

Injury Severity – PennDOT motorcycle crash reporting forms include a series of "injury severity codes" that include specific designations such as "killed," "major injury," "moderate injury," "minor injury," as well as undifferentiated codes such as "injury-unknown severity." (See pages 12 and 13 for these definitions.)

Injury Severity Score (ISS) – An anatomic score of multiple injuries which is based on the AIS. The ISS uses the AIS values for the three most significant injuries suffered in different body regions. The ISS is calculated by summing the squares of the AIS values for the three injuries. The ISS ranges from 1 to 75. The higher the score, the poorer the patient's condition.

Major Trauma – Major multi-system or major unisystem injury, the extent of which may be difficult to ascertain, but which has the potential of producing mortality or major disability.

Motorcycle – A motorcycle is any motor vehicle having a seat or saddle for the use of its operator and designed to travel on not more than three wheels in contact with the ground. This definition includes mopeds, motor-driven cycles, and motor scooters. However, the definition does not include all-terrain vehicles (ATVs).

- **MOPED** – A moped is a motor-driven cycle equipped with operable pedals, a motor rated no more than 1.5 brake horsepower, a cylinder capacity not exceeding 50 cubic centimeters, an automatic transmission, and a maximum design speed of no more than 25 miles per hour, or an electric motor-driven cycle equipped with operable pedals and powered by an electric battery.
- **Motor-Driven Cycle** – A motor-driven cycle is a motorcycle, including a motor scooter, with a motor which produces horsepower not to exceed 5 brake horsepower.
- **Motorized Scooter** – A motorized scooter is a two wheeled vehicle that is powered by an engine or an electric motor and does not have a seat or saddle for the driver.

Non-Reportable Crash – A non-reportable crash involves a crash with no injury or death of any person, in which there is no towing due to the damage to the vehicle at the time of the crash. Furthermore, if the incident occurred on private property or was a result of deliberate intent or cataclysm, the crash is non-reportable. A non-reportable crash does not require a Police Crash Report Form to be completed or submitted to PennDOT.

Reportable Crash – The incident must occur on a highway or trafficway that is open to the public by right or custom and involve at least one motor vehicle in transport.

The definition for a reportable crash can be found in the Vehicle Code at 75 Pa.C.S. §3746(a). It states a crash is reportable if it involves:

- injury to or death of any person; or
- damage to any vehicle to the extent that it can not be driven under its own power in its customary manner without further damage or hazard to the vehicle, other traffic elements, or the roadway, and therefore requires towing.

Trafficway – A trafficway is any land way open to the public as a matter of right or custom for moving persons or property from one place to another.

Traumatic Brain Injury (TBI) – Traumatic brain injury (TBI), also called acquired brain injury or, simply, head injury, occurs when a sudden trauma causes damage to the brain. TBI can result when the head suddenly and violently hits an object, or when an object pierces the skull and enters brain tissue. Symptoms of a TBI can be mild, moderate, or severe, depending on the extent of the damage to the brain. A person with a mild TBI may remain conscious or may experience a loss of consciousness for a few seconds or minutes. Other symptoms of mild TBI include headache, confusion, lightheadedness, dizziness, blurred vision or tired eyes, ringing in the ears, bad taste in the mouth, fatigue or lethargy, a change in sleep patterns, behavioral or mood changes, and trouble with memory, concentration, attention, or thinking. A person with a moderate or severe TBI may show these same symptoms, but may also have a headache that gets worse or does not go away, repeated vomiting or nausea, convulsions or seizures, an inability to awaken from sleep, dilation of one or both pupils of the eyes, slurred speech, weakness or numbness in the extremities, loss of coordination, and increased confusion, restlessness, or agitation.

Trauma Center – A facility that is accredited by the Pennsylvania Trauma Systems Foundation to provide systemized medical and nursing care to the trauma patient. (Either Regional Resource Trauma Center, Regional Trauma Center, or Pediatric Regional Resource Trauma Center.)

Trauma Registrar – The person who has the authority, responsibility, and accountability for directing and maintaining the trauma registry and its data submission to the Pennsylvania Trauma Systems Foundation in a timely manner.

Trauma Registry – Contains data on demographic information, traumatic injuries sustained, treatment modalities, occurrences, and other pertinent factors. Reports may be written based on the data in the registry such as the frequency of occurrence of a specific injury (blunt or penetrating trauma), safety devices utilized, cost factors, mortality, etc.

III. Motorcycle Crash Data From PennDOT's Crash Reporting System, CY 2000 Through CY 2007

A. A Description of PennDOT's Crash Reporting System

The Vehicle Code, at 75 Pa.C.S. §3746, requires police agencies to investigate, upon notification, all crashes involving death, injury, and/or damage to any one vehicle to such an extent that it cannot be driven from the scene without further damage and therefore requires towing. Also, the Vehicle Code, at §3753(b), requires the Department of Transportation to establish and have primary responsibility for a central accident records agency to be the repository for all reportable traffic accidents. This repository is maintained by the Crash Information Systems and Analysis Division of the Bureau of Highway Safety and Traffic Engineering.

The Police Crash Reporting Form (AA-500)

Form AA-500 Development and Features. Crash data in this report is derived from the Crash Reporting System (CRS). The starting point for this data is the *Commonwealth of Pennsylvania Police Crash Reporting Form* (AA-500) that is to be completed by the investigating law enforcement officer at the scene of the crash. In accordance with 75 Pa.C.S. §3751(a), the investigating agency must submit the report to PennDOT's Bureau of Highway Safety and Traffic Engineering, within 15 days of the date of the crash. The AA-500 consists of six standard pages plus additional pages for special situations. Each page is in two parts, the top portion goes to PennDOT and the bottom part stays with the police agency investigating the crash.

Over the past decade, many changes have occurred with the PennDOT crash reporting system. The AA-500, introduced in January 2003, is a re-engineered form of prior versions, one of which was eight pages in length. With the form's implementation, the name of the system was also changed from the Accident Reporting System (ARS) to the Crash Reporting System (CRS).

During the 1990s, police officers were instructed to use a two-part form, a key section of which was the crash event narrative. When this document was submitted to PennDOT, it underwent substantial scrutiny and analysis by staff of the Crash Information Systems and Analysis Division before being recorded. Specially trained analysts interpreted and coded information from the crash report. Some degree of subjective judgment was required, as great reliance was placed on the narrative section completed by the officer.

Beginning in 2000, PennDOT initiated substantial changes to the crash reporting system, including automated software system modifications, as well as

changes to the forms and procedures used by the investigating officers at the scene of a crash. A major goal of these changes was to reduce the reliance on written narrative and hence reduce reporting subjectivity by providing the police with exact coding upon which to develop their reports.

Another significant change resulting from the AA-500 implementation is the greatly reduced role which PennDOT employees now have in the identification of key crash elements based on their interpretation of the crash report narratives. As the key official at the scene of the crash, an investigating officer, rather than a remote interpreter, should, PennDOT officials believe, be making declarative decisions regarding the crash event. Although the narrative has not been entirely eliminated, police officers are now required to identify certain specific key elements of a reportable crash, such as "the first harmful event," "most harmful event," and the "primary contributing factor" by entering specific codes on the crash form.

Another innovation with regard to police crash reporting is permitting investigating officers to now report electronically. Police agencies may choose to send in crash reports to PennDOT in two different electronic formats, the File Transfer Protocol (FTP) file and Internet e-Forms. If a police agency has computerized software that they use to record crashes and it can generate Extensible Markup Language (XML) files, then they may sign up for PennDOT's file transfer program.

PennDOT also provides another type of computerized mechanism for police officers to capture crash data. Internet data entry screens (Internet e-forms) record the same information that is required on the paper forms. However, there are some additional help functions in the Internet e-forms that make completing and submitting the report easier. One function is the ability to access driver licensing information. Another is the ability to access geographic information maps to quickly identify crash locations.

Form AA-500 Features Specifically Related to Motorcycle Crashes. The AA-500 provides for certain coded entries that are necessary for the analysis of crashes involving motorcycles, including the identification of "motorcycle" as a vehicle type, whether persons involved are "passenger" or "driver," as well as a series of "injury severity" codes which include specific designations such as "killed," "major injury," "moderate injury," "minor injury," as well as undifferentiated codes such as "injury-unknown severity."

Injury Severity – For purposes of PennDOT's Crash Reporting System, describes the extent of injury of an involved person as follows:

0 = **Not Injured**

1 = **Killed** – The person dies as a result of injuries sustained in the crash (within 30 days of the crash).

2 = **Major Injury** – Incapacitating injury, including bleeding wounds and distorted members (amputations or broken bones), and requires transport of the patient from the scene.

3 = **Moderate Injury** – Non-incapacitating injury, including bruises, abrasions, swelling, and limping. This is an injury that may require some form of medical treatment or hospitalization.

4 = **Minor Injury** – Possible injury, although there may be no visible injuries, and the patient complains of pain. This is an injury that can be treated by first-aid application whether at the scene or in medical facilities.

8 = **Injured – but unknown severity** – This value is used if the investigating officer knows that an occupant or pedestrian was injured, but is not sure of the severity.

9 = **Unknown** – This value is used if the investigating officer does not know if an occupant or pedestrian was injured. This value is not to be used if the officer knows the person was injured but does not know how severely. (In this case, value "8" from above is to be used.)

There are, of course, many other coded sections dealing with the nature of the harmful event, weather and road conditions, and driver actions. For purposes of this report, we focused our analysis primarily on the vehicle type, whether victims were passengers or drivers, and severity of injuries. The AA-500 does not allow for coding of the specific nature of injuries, such as whether the crash victim suffered head trauma.

However, as previously indicated, in addition to the AA-500, there are additional pages for special situations. A supplemental page, the AA-500-M has specific questions or entries for motorcycles and for motorcycle drivers and passengers. For example, the form provides for indicating the "helmet type" as follows: No Helmet, Full Helmet, ¾ style, Half Helmet Style, and Unknown.

The form also asks the officer to identify whether the helmet stayed on and whether the helmet has a DOT or Snell designation. The additional information specific to motorcycles on this form provides for the classification of motorcycle crashes in a manner useful for assessing the impact of helmet use on injury severity.

B. Categories of Reported Motorcycle Crash Data

PennDOT's Bureau of Highway Safety and Traffic Engineering (Crash Information Systems and Analysis Division) compiles data pertaining to crashes in which a motorcycle was involved. According to PennDOT, a *motorcycle* is defined as a motor vehicle with a seat or saddle designed to travel on not more than three

wheels. It includes "traditional" motorcycles, motor scooters, and mopeds. It does not, however, include ATVs. (See page 8 for further information.)

We obtained data from the Crash Information Systems and Analysis Division (compiled from Police Crash Reporting Forms and supplemental "Form M") pertaining specifically to motorcycle crashes for the years 2000 through 2007. The following is a summary and analysis of the data available from the PennDOT database as of May 2008.[1]

1. Number of Motorcycle Crashes

The total number of crashes in which a motorcycle was involved in Pennsylvania increased by 44.6 percent between CY 2000 and CY 2007. During the same period, the total number of motorcycle registrations increased by 69.2 percent while the number of motorcycle licenses issued grew by 8.0 percent. Despite the increase in the total number of motorcycle crashes, the number of crashes per 10,000 registrations actually declined by 14.5 percent from 132.4 crashes per 10,000 motorcycle registrations in CY 2000 to 113.2 in CY 2007. (See Table 2.) This data is not directly linked to helmet use by motorcycle operators and passengers.

Table 2

Number of Motorcycle Crashes in Pennsylvania
(CY 2000 to CY 2007)

CY	Total Crashes
2000	2,842
2001	2,984
2002	3,053
2003	3,061
2004	3,636
2005	4,052
2006	3,893
2007	4,109

Source: Commonwealth of Pennsylvania Police Crash Reporting System, PennDOT Crash Information Systems and Analysis Division.

[redacted]

PennDOT's crash database is dynamic. It receives new cases and updates from investigating police officers every day. Consequently, similar future requests may not result in exactly the same totals as presented here based upon this 'new' information. But the overall analysis and findings should remain the same."

2. Number of Motorcyclists Killed and Injured

As shown on Table 3, fatalities among motorcyclists rose from 150 in CY 2000 to 225 in CY 2007, a 50.0 percent increase, while injuries grew by 57.8 percent, from 2,577 in CY 2000 to 4,066 in CY 2007. In the table below, the category "other" includes those "not injured" as well as those whose injury status is "unknown." This figure remained above 500 per year through CY 2002 and above 400 in CY 2003 through CY 2007.

Table 3

Number of Motorcyclists Killed and Injured
(CY 2000 to CY 2007)

CY	Total	Killed	% Inc. (+) Dec. (-)	Injured	% Inc. (+) Dec. (-)	Other
2000.....	3,235	150	--	2,577	--	508
2001.....	3,436	132	-12.0%	2,800	+8.7%	504
2002.....	3,502	134	+1.5	2,819	+0.7	549
2003.....	3,553	156	+16.4	2,938	+4.2	459
2004.....	4,183	158	+1.3	3,541	+20.5	484
2005.....	4,657	205	+29.7	3,969	+12.1	483
2006.....	4,386	187	-8.8	3,759	-5.3	440
2007.....	4,716	225	+20.3	4,066	+8.2	425

Source: Commonwealth of Pennsylvania Police Crash Reporting System, PennDOT Crash Information Systems and Analysis Division.

During CY 2004, the first full year following repeal of the helmet law, the number of motorcyclists killed increased by two over CY 2003 (158 deaths in CY 2004 compared to 156 in CY 2003). In CY 2005, however, the number of motorcyclist deaths rose by nearly 30 percent over the CY 2004 level to 205. Since then, motorcyclist deaths dropped by 8.8 percent to 187 in CY 2006 before then increasing by 20.3 percent in CY 2007 to 225.

During the first full year following the Helmet Law repeal, the number of motorcyclists injured increased by 603, or 20.5 percent, to 3,541. The number of injuries increased by another 12.1 percent in CY 2005 to 3,969 before declining to 3,759 in CY 2006 (a decrease of 5.3 percent). Injuries then increased by 8.2 percent in CY 2007 to 4,066. As shown on Tables 4 and 5, however, the number of registered motorcycles has also been increasing, so the fatality and injury rates per 10,000 registered motorcycles have been more stable.

3. Motorcyclist Fatalities Among Operators and Passengers

During the eight-year period we examined, 1,266, or 94.0 percent of all 1,347 motorcyclist fatalities involved the motorcycle operator/driver. In CY 2004, the first full year after repeal of the Helmet Law, fatalities among motorcycle operators declined from 147 to 143 before rising to 195 in CY 2005. After dropping to 179 in

CY 2006, fatalities among motorcycle drivers increased to 210 in CY 2007. The annual number of fatalities among passengers remained in the 7 to 10 range with the exceptions being CY 2004 and CY 2007 when passenger deaths increased to 15 each year.

Table 4

Motorcyclist Fatalities, Drivers and Passengers
(CY 2000 to CY 2007)

CY	Driver	Passenger	Other	Total Fatalities	Per 10,000 Registered Motorcycles
2000	143	7	--	150	7.0
2001	125	7	--	132	5.6
2002	124	10	--	134	5.4
2003	147	9	--	156	5.8
2004	143	15	--	158	5.4
2005	195	9	1	205	6.4
2006	179	8	--	187	5.5
2007	210	15	--	225	6.2

Source: Commonwealth of Pennsylvania Police Crash Reporting System, PennDOT Crash Information Systems and Analysis Division.

4. Motorcyclist Injuries Among Operators and Passengers

During the eight-year period we examined, 23,669, or 89.4 percent of all 26,469 motorcyclist injuries involved the motorcycle operator/driver.

Table 5

Motorcyclist Injuries, Drivers and Passengers
(CY 2000 to CY 2007)

CY	Driver	Passenger	Other	Unknown	Total Injuries	Per 10,000 Registered Motorcycles
2000	2,300	242	0	35	2,577	120.1
2001	2,500	289	0	11	2,800	118.0
2002	2,517	292	1	9	2,819	113.3
2003	2,584	344	0	10	2,938	109.7
2004	3,174	361	3	3	3,541	121.7
2005	3,538	425	1	5	3,969	124.7
2006	3,416	341	0	2	3,759	110.2
2007	3,640	424	1	1	4,066	112.0

Source: Commonwealth of Pennsylvania Police Crash Reporting System, PennDOT Crash Information Systems and Analysis Division.

In 2004, the first full year after repeal of the Helmet Law, injuries among motorcycle operators increased by 23 percent, from 2,584 in CY 2003 to 3,174 in CY 2004. From CY 2004 to CY 2005, injuries rose another 11.5 percent. The number of injuries among passengers also rose in CY 2004, but not as much as injuries to drivers. Passenger injuries increased by 4.9 percent in CY 2004 and by another 17.7 percent in CY 2005. Table 5 also shows that over the eight-year period examined, injury rates per 10,000 registered motorcycles has ranged from a low of 109.7 per 10,000 motorcycle registrations in CY 2003 to a high of 124.7 per 10,000 registrations in CY 2005. Motorcyclist injuries per 10,000 registrations were at 112.0 in CY 2007.

5. Motorcycle Helmet Usage in Fatal and Injury Crashes

PennDOT's Crash Information Systems and Analysis Division relies upon the judgment of police officers responding to the scene of a crash to determine severity of injuries sustained by individuals involved in a crash. This classification may not necessarily concur with responding EMS personnel's assessment of injuries sustained as reflected on EMS "Patient Care Reports."

As previously defined, PennDOT's Police Crash Reporting form utilizes the following classifications for injury severity: (a) not injured, (b) killed, (c) major injury, (d) moderate injury, (e) minor injury, (f) injury of unknown severity, and (g) unknown if injured.

PennDOT crash reports also provide information on fatalities involving both helmeted and non-helmeted drivers, passengers, and individuals who could not be identified conclusively as a driver or a passenger. Data is available in the following categories as determined by an investigating police officer at the scene of a crash: (a) helmeted, (b) non-helmeted, (c) wearing a helmet improperly, (d) bicycle helmet used, (e) unknown use (cases in which a police investigator could not find a helmet at the scene of a crash), and (f) other unknown.

a. Helmet Usage in Fatal Crashes. In total, 1,347 motorcyclists died in crashes during the eight-year period we examined. As Table 6 shows, 266 persons died in motorcycle crashes in the two years for which information is available (2001 and 2002) prior to repeal compared to 363 persons in the first two years after repeal. However, when the number of registered motorcycles is taken into consideration, the average annual fatality rate when helmets were required is not substantially different than following the repeal (5.5 fatalities per 10,000 registered motorcycles in 2001 and 2002 compared to 5.9 fatalities per 10,000 registered motorcycles in both 2004-2005 and 2006-2007).

Table 6

Reported Helmet Usage in Motorcycle Crashes Resulting in Fatalities
(CY 2000 to CY 2007)

CY	Helmeted	Non-Helmeted	Improper Use	Bike Helmet	Unknown Use	Unknown	Total Killed
20[redacted]		24	0	0	0	23	150
20[redacted]		17	0	0	3	9	132
2002.....	95	23	5	1	1	9	134
2003.....	118	27	3	2	0	6	156
2004.....	74	70	6	2	0	6	158
2005.....	106	88	3	1	0	7	205
2006.....	97	84	2	0	0	4	187
2007.....	101	116	3	0	0	5	225

Source: Commonwealth of Pennsylvania Police Crash Reporting System, PennDOT Crash Information Systems and Analysis Division.

b. Helmet Usage in Injury Crashes. In total, 26,469 motorcyclists were injured in crashes during the eight-year period we examined. As previously noted, police officers who respond to the scene of a crash classify the severity of injuries sustained by the individuals involved as follows: (a) not injured, (b) major injury, (c) moderate injury, (d) minor injury, (e) injury of unknown severity, and (f) unknown if injured.

This portion of the analysis begins with a review of the total number of injuries sustained by operators/drivers and passengers, by injury severity, as reported in PennDOT records. As shown on Table 7, over the eight-year period, police officers classified 4,055 or 15.3 percent of the total as "major," 10,058 or 38.0 percent as "moderate," and 9,729 or 36.8 percent as "minor."

Table 7

Motorcyclist Injuries, by Reported Severity
(CY 2000 to CY 2007)

CY	Major Injury	Moderate Injury	Minor Injury	Unknown Severity	Total Injuries	Unknown If Injured	Not Injured
2000.....	392	1,095	1,089	1	2,577	189	319
2001.....	447	1,178	1,175	0	2,800	104	400
2002.....	457	1,118	1,136	108	2,819	114	435
2003.....	429	1,148	1,263	98	2,938	99	360
2004.....	535	1,324	1,259	423	3,541	89	395
2005.....	622	1,463	1,264	620	3,969	76	407
2006.....	576	1,324	1,229	630	3,759	63	377
2007.....	597	1,408	1,314	747	4,066	52	373

Source: Commonwealth of Pennsylvania Police Crash Reporting System, PennDOT Crash Information Systems and Analysis Division.

(1) Major Injuries. As Table 8 shows, 904 persons sustained a major injury as a result of a motorcycle crash in the two years for which information is available (2001 and 2002) prior to the repeal compared to 1,157 major injuries in the first two years after repeal (2004 and 2005). When the number of registered motorcycles is taken into account, the average annual injury rate is 18.6 per 10,000 registered motorcycles in 2001 and 2002 compared to an average annual rate of 19.0 per 10,000 registered motorcycles in 2004 and 2005 and 16.7 in 2006 and 2007.

Table 8

Reported Helmet Usage in Crashes
Involving "Major Injury" to Motorcyclists
(CY 2000 to CY 2007)

CY	Helmeted	Non-Helmeted	Improper Use	Bicycle Helmet	Unknown If Used	Unknown	Total Major Injuries	Per 10,000 Registered Motorcycles
2000.....	269	64	NA	NA	0	59	392	18.3
2001.....	345	57	7	0	1	37	447	18.8
2002.....	343	73	10	2	0	29	457	18.4
2003.....	302	103	6	1	0	17	429	16.0
2004.....	250	248	8	1	0	28	535	18.4
2005.....	273	303	6	3	1	36	622	19.5
2006.....	272	278	4	0	0	22	576	16.9
2007.....	284	288	6	0	0	19	597	16.4

Source: Commonwealth of Pennsylvania Police Crash Reporting System, PennDOT Crash Information Systems and Analysis Division.

[redacted]

injury as a result of a motorcycle crash in 2001 and 2002 prior to the repeal compared to 2,787 following the repeal in 2004 and 2005 and 2,732 in 2006 and 2007. This translates to an average annual injury rate of 47.2 per 10,000 registered motorcycles in 2001 and 2002 compared to an average annual injury rate of 45.7 per 10,000 registered motorcycles in 2004 and 2005 and 38.8 per 10,000 registered motorcycles in 2006 and 2007.

Table 9

Reported Helmet Usage in Crashes Involving "Moderate Injury" to Motorcyclists
(CY 2000 to CY 2007)

CY	Helmeted	Non-Helmeted	Improper Use	Bicycle Helmet	Unknown If Used	Unknown	Total Moderate Injuries	Per 10,000 Registered Motorcycles
2000	753	163	NA	NA	1	178	1,095	51.0
2001	897	170	13	2	4	92	1,178	49.6
2002	875	158	21	6	1	57	1,118	44.9
2003	822	236	10	4	2	74	1,148	42.9
2004	779	472	5	10	1	57	1,324	45.5
2005	813	584	11	3	0	52	1,463	46.0
2006	783	489	11	1	0	40	1,324	38.8
2007	844	510	7	1	0	46	1,408	38.8

Source: Commonwealth of Pennsylvania Police Crash Reporting System, PennDOT Crash Information Systems and Analysis Division.

[redacted]

as a result of a motorcycle crash in 2001 and 2002 prior to the repeal compared to 2,523 persons following the repeal in 2004 and 2005 and 2,543 in 2006 and 2007. This translates to an average annual injury rate of 47.5 per 10,000 registered motorcycles in 2001 and 2002 compared to 41.4 per 10,000 registered motorcycles in 2004 and 2005 and 36.1 per 10,000 registered motorcycles in 2006 and 2007.

Table 10

Reported Helmet Usage in Crashes Involving "Minor Injury" to Motorcyclists
(CY 2000 to CY 2007)

CY	Helmeted	Non-Helmeted	Improper Use	Bicycle Helmet	Unknown If Used	Unknown	Total Minor Injuries	Per 10,000 Registered Motorcycles
2000	754	145	NA	NA	0	190	1,089	50.7
2001	870	167	12	3	10	113	1,175	49.5
2002	870	171	9	3	5	78	1,136	45.7
2003	883	283	7	10	0	80	1,263	47.2
2004	732	437	19	7	2	62	1,259	43.3
2005	771	415	11	4	0	63	1,264	39.7
2006	775	401	17	3	0	33	1,229	36.0
2007	813	438	15	0	0	48	1,314	36.2

Source: Commonwealth of Pennsylvania Police Crash Reporting System, PennDOT Crash Information Systems and Analysis Division.

[redacted]

met repeal law was in effect, the numbers of injuries of unknown severity among

both helmeted and non-helmeted riders have increased steadily. (See Table 11.) According to PennDOT staff, crash injuries are typically coded into this category by responding police officers when it is known that a vehicle operator or passenger was injured but there is uncertainty regarding the severity.

Table 11

Reported Helmet Usage in Crashes Involving Injuries of "Unknown Severity" to Motorcyclists
(CY 2000 to CY 2007)

CY	Helmeted	Non-Helmeted	Improper Use	Bicycle Helmet	Unknown If Used	Unknown	Total
2000	0	1	0	0	0	0	1
2001	0	0	0	0	0	0	0
2002	65	21	0	1	0	21	108
2003	70	16	1	0	0	11	98
2004	226	157	4	4	1	31	423
2005	322	228	6	4	1	59	620
2006	338	241	8	0	0	43	630
2007	433	249	4	0	0	61	747

Source: Commonwealth of Pennsylvania Police Crash Reporting System, PennDOT Crash Information Systems and Analysis Division.

[redacted]

in this category when the investigating officer is unable to determine whether a vehicle operator or passenger was injured. (See Table 12.) There is no discernible pattern here that would appear to relate to the pre-helmet law repeal period versus the post helmet law repeal time frame.

Table 12

Reported Helmet Usage in Crashes Involving Motorcyclists With Unknown Injury Status
(CY 2000 to CY 2007)

CY	Helmeted	Non-Helmeted	Improper Use	Bicycle Helmet	Unknown If Used	Unknown	Total
2000	107	32	0	0	0	50	189
2001	51	13	0	0	0	40	104
2002	62	24	0	0	0	28	114
2003	40	31	0	0	0	28	99
2004	19	33	0	0	0	37	89
2005	26	28	0	0	0	22	76
2006	18	26	0	0	0	19	63
2007	10	15	0	0	1	26	52

Source: Commonwealth of Pennsylvania Police Crash Reporting System, PennDOT Crash Information Systems and Analysis Division.

(6) Not Injured. As shown on Table 13, persons involved in motorcycle crashes, but not injured, numbered 3,066 over the period we examined. In 2001 and 2002, 835 persons were reported as not injured compared to 802 in 2004 and 2005 and 750 in 2006 and 2007.

Table 13

Reported Helmet Usage in Crashes Involving Motorcyclists Who Were "Not Injured"
(CY 2000 to CY 2007)

CY	Helmeted	Non-Helmeted	Improper Use	Bicycle Helmet	Unknown If Used	Unknown	Total Not Injured	Per 10,000 Registered Motorcycles
2000	190	56	0	0	0	73	319	14.9
2001	224	52	0	0	39	85	400	16.9
2002	245	87	5	1	13	84	435	17.5
2003	220	83	4	1	2	50	360	13.4
2004	187	145	5	1	4	53	395	13.6
2005	214	152	1	0	2	38	407	12.8
2006	216	132	2	1	0	26	377	11.0
2007	222	120	3	0	0	28	373	10.3

Source: Commonwealth of Pennsylvania Police Crash Reporting System, PennDOT Crash Information Systems and Analysis Division.

6. Motorcyclist Fatalities and Injuries, by Age Group

The largest number of motorcyclist fatalities each year between Calendar Years 2002 through 2007 occurred in the age range 30-45 (See Table 14). Motorcyclist fatalities in the age range 46-65 represented the second-highest proportion of fatalities in four of the seven years between CY 2002 and CY 2007, with fatalities among motorcyclists between 21-29 second-highest in two Calendar Years between 2002 and 2007 and third-highest in the other four remaining Calendar Years in this period. Motorcyclists between 16-20 years of age generally constituted the fourth-highest proportion of annual fatalities, while a small number of riders over the age of 65, under the age of 15, and of unknown age together equaled less than 7 percent of total fatalities in each year between CY 2002 and CY 2007.

Table 14

Motorcyclist Fatalities, by Age Group

(CY 2002-2007)

CY	Less Than 15	% of Total	16-20	% of Total	21-29	% of Total	30-45	% of Total	46-65	% of Total	Over 65	% of Total	Unknown	% of Total	Totals
2002	0	0.0%	9	6.7%	36	26.9%	58	43.3%	30	22.4%	1	0.7%	0	0.0%	134
2003	2	1.3	12	7.7	37	23.7	58	37.2	39	25.0	6	3.8	2	1.3	156
2004	2	1.3	12	7.6	36	22.8	66	41.8	39	24.7	2	1.3	1	0.6	158
2005	2	1.0	16	7.8	49	23.9	69	33.7	59	28.8	10	4.9	0	0.0	205
2006	2	1.1	19	10.2	48	25.7	75	40.1	41	21.9	2	1.1	0	0.0	187
2007	0	0.0	21	9.3	55	24.4	74	32.9	68	30.2	6	2.7	1	0.4	225

[redacted]

Motorcyclist Injuries, by Age Group

(CY 2002-2007)

CY	Less Than 15	% of Total	16-20	% of Total	21-29	% of Total	30-45	% of Total	46-65	% of Total	Over 65	% of Total	Unknown	% of Total	Totals
2002	47	1.7%	238	8.4%	675	23.9%	1,052	37.3%	727	25.8%	50	1.8%	30	1.1%	2,819
2003	83	2.8	241	8.2	654	22.3	1,073	36.5	810	27.6	49	1.7	28	1.0	2,938
2004	93	2.6	310	8.8	846	23.9	1,245	35.2	957	27.0	58	1.6	32	0.9	3,541
2005	91	2.3	378	9.5	898	22.6	1,377	34.7	1,107	27.9	90	2.3	28	0.7	3,969
2006	71	1.9	354	9.4	880	23.4	1,231	32.7	1,124	29.9	76	2.0	23	0.6	3,759
2007	55	1.4	371	9.1	920	22.6	1,304	32.1	1,289	31.7	103	2.5	24	0.6	4,066

[redacted]

Relatively stable patterns emerged of the proportion of injured motorcyclists by age group between CY 2002 and CY 2007. As shown in Table 15, in each year between CY 2002 and CY 2007, the highest proportion of injured motorcyclists were in the age group 30-45, followed by injured motorcyclists in the age group 46-65. Injured motorcyclists in the age group 21-29 constituted the third-highest number of injuries as a proportion of all injuries in each year between CY 2002 and 2007, followed distantly by the 16-20 age group. Injured motorcyclists over the age of 65, under the age of 15, and of unknown age together represented below 6 percent of all injured motorcyclists in each year during the period CY 2002 to CY 2007.

7. Motorcycles From Adjacent States Involved in PA Crashes

We obtained information from the CRS indicating the registration states of motorcycles involved in crashes during calendar years 2003 through 2007. Approximately 93 percent of the involved motorcycles were registered in Pennsylvania. We then examined motorcycle registrations involved in crashes from states contiguous to Pennsylvania. New Jersey was the highest (1.7 percent), followed by New York (1 percent), Maryland (1 percent), Ohio (0.8 percent), Delaware (0.4 percent), and West Virginia (0.3 percent).

We also examined these six states for possible crash involvement trends during the five-year period. We found that Delaware was the only state of the six which had the same number of motorcycles involved in Pennsylvania crashes in 2007 as in 2003 (18). West Virginia, having the fewest overall motorcycles involved in PA crashes, experienced an increase from 7 West Virginia-registered motorcycles involved in PA crashes in 2006 to 16 in 2007. Ohio, which averaged 25 motorcycles involved in PA crashes from 2003 through 2005, saw that number increase to 35 for both 2006 and 2007. New Jersey, the state with the greatest overall involvement in PA motorcycle crashes, fluctuated from 50 to 70 between 2003 and 2004, was 62 and 60 respectively during 2005 and 2006, then increased again to 70 for 2007.

Two states, New York and Maryland, experienced large increases in the number of motorcycles registered in their states that were involved in Pennsylvania crashes between 2006 and 2007: New York from 34 to 57 (68 percent increase) and Maryland from 31 to 66 (113 percent increase). The average number of New York-registered motorcycles involved in PA crashes from 2003 through 2006 was about 34. Maryland's average for the same period was 29.

IV. Motorcyclist Head Trauma Data From the Statewide Trauma Registry

A. A Description of the Pennsylvania Statewide Trauma Registry

The PA Trauma Outcome Study

The Pennsylvania Trauma Systems Foundation (PTSF) is a private, non-profit organization statutorily recognized in the Emergency Medical Services Act (Act 1985-45) and charged with developing and carrying out a process to accredit trauma centers in the Commonwealth of Pennsylvania.

In connection with its mandate, the PTSF maintains a statewide trauma registry known as the Pennsylvania Trauma Outcome Study (PTOS). Among the standards required for accreditation as a trauma center is the requirement to submit data to the PTOS. The PTOS began operation on October 1, 1986, and contains data on over 460,000 trauma cases. The trauma registry serves several purposes. It provides:

- A basis for the trauma center accreditation process.
- A mechanism for the review of the quality of care provided by the state's trauma system and trauma centers.
- Uniform, consistent data for systems and clinical research.

Data submitted by participating hospitals are returned in the form of reports and analyses, which compare the outcomes of that institution's patients with those of comparable institutions in Pennsylvania. The analyses are useful for quality assurance, education, and research. All data received from participating hospitals and analysis results are treated as strictly confidential by the PTSF.

PTSF coordinates data collection for the Pennsylvania trauma outcome study from the 16 Level I, 11 Level II, and one Level III trauma centers in Pennsylvania. The database contains information in the following areas:

- demographics;
- injury data including date, time, cause, location, and use of protective devices;
- pre-existing diseases;
- use of life support;
- ambulance transport information;
- emergency department care;
- clinical data and procedures;

- alcohol/drug involvement;
- anatomical diagnoses and injury severity score; and
- outcome data including disposition.

Patients Included in the PA Trauma Outcome Study

Patients admitted for treatment of a diagnosis of trauma (ICD-9-CM injury codes 800-995)[1] are included in PTOS if they meet any of the following criteria:

- All Intensive Care Unit (ICU) admissions (2:1 ratio) – Excluding ICU used as a Post-Anesthesia Care Unit (PACU)
- All step-down unit admissions (4:1)
- All Dead on Arrivals (DOA), pronounced dead after arrival
- All Trauma Deaths
- All trauma patient admissions over 48 hours, beginning from the time of arrival to the Emergency Department. Trauma patient admissions are defined as inpatient admission for the treatment or diagnosis of trauma.
- All Admitted Transfers In
  e.g., Transfer In: Patient seen at another facility and transferred to a Trauma Center, including patients transferred from another accredited Trauma Center. Patients transferred into a Trauma Center and then discharged home from the emergency department should not be included in the PTOS.
- All Transfers Out
  e.g., Transfer Out: Patient seen in the Emergency Department of the Trauma Center and admitted either to the Operating Room for emergency surgery or to the inpatient nursing unit. Then, due to a deteriorating condition, patient requires transfer to another accredited Trauma Center or Burn Center. Those patients must be included, as well as those patients who are admitted to the Emergency Department and then transferred to another accredited Trauma Center or Burn Center. Patients transferred to any other hospital should not be included.
- Cases meeting any of the above criteria, but having no documented injuries
- Burn cases meeting certain specified criteria

Optional: Elective admissions (patients not admitted through the Emergency Department and not transferred from another facility) with an injury date greater than 72 hours prior to admission and an Injury Severity Score greater than or equal to 13 may be submitted to PTOS. Elective admissions with injury greater than 72 hours prior to admission and ISS less than 13 need not be submitted.

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[1]The International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) is based on the World Health Organization's Ninth Revision, International Classification of Diseases (ICD-9). ICD-9-CM is the official system of assigning codes to diagnoses and procedures associated with hospital utilization in the United States.

Excluding: Patients who only suffer a solitary hip fracture, with no other injuries (contusions and abrasions of skin should not be considered other injuries) as a result of a fall on the same level. The intent is to exclude solitary hip fractures that are pathological or osteopenic in nature.

- Asphyxiation with no other injuries
- Drowning
- Poisonings (chemical ingestion, including internal organ burns from chemical ingestion, classifiable to the ICD-9-CM code 947)
- Admitted patients injured while in a trauma center (e.g., a patient who fell out of bed)
- Patients only having a hypothermia or hyperthermia diagnosis with no other injuries

Classifying Injuries by Type and Severity in the PTOS

The PTOS is an incident-based data system comprising approximately 250 data elements, including demographic, pre-hospital/emergency medical, acute care and clinical data, and final outcome diagnosis information, etc. For purposes of this study, the system can be queried to produce information about various types of motor vehicle crashes (including motorcycles) and to isolate the nature of injury, medical diagnosis, and severity of injury. Additionally, information regarding the presence or use of protective devices such as helmets is recorded. Furthermore, the data is up-to-date through 2007. The database is, therefore, potentially useful in determining the impact of motorcycle crashes on head trauma cases and the relationship between helmet use and head trauma.

The PTOS uses the Association for the Advancement of Automotive Medicine's Abbreviated Injury Scale to enable classification of injuries by type and severity. The Abbreviated Injury Scale (AIS) is an anatomically based system that classifies individual injuries by body region on a 6-point ordinal severity scale ranging from AIS 1 (minor) to AIS 6 (currently untreatable). The AIS was originally developed to be used by crash investigators to standardize data on the frequency and severity of motor vehicle related injuries. Its use has been extended to epidemiological research, trauma center studies to predict survival probability, patient outcome evaluation, and health care systems research. It also factors into studies to assess societal costs of injuries.

There are, however, several limitations inherent in the database. For example, the PTOS does not contain information on all persons who died or were injured in motorcycle crashes. Patients in the PTOS generally constitute the "most severely injured," and include only those who were either taken directly to a trauma center or were transferred from another hospital or medical facility to a trauma center for treatment. Individuals who were treated for minor or moderate injuries in emergency departments in community hospitals, for example, and discharged or admitted to the

hospital would not be included unless at some point they were transferred to a trauma center. Furthermore, the PTOS does not include data on patients who may have been pronounced dead at the scene of the accident by a coroner and taken directly to a morgue. Also, the PTOS does not track treatment of patients subsequent to discharge from a trauma center.

Although the PTOS does not contain information on the identical population of individuals involved in motorcycle crashes that is reported in the PennDOT Crash Reporting System, it does contain specific information on a substantial portion of that same population. The descriptive elements provide the ability to describe diagnostic changes in specific sub-populations (such as persons involved in motorcycle crashes) and compare changes from year to year.

B. Pertinent Categories of Reported Data

This section presents data from the Pennsylvania Trauma Systems Foundation's statewide trauma registry, the Pennsylvania Trauma Outcome Study. The following data from the PTOS represent motorcycle crash patients 21 years of age or older involved in traffic crashes (occurring on public trafficways).[2]

Motorcycle Crash Patients[3] Admitted to Trauma Centers

"Major trauma patients" are admitted to Pennsylvania's 28 accredited trauma centers. As defined by the PTSF, a major trauma patient is one with severe multisystem or major unisystem injury, the extent of which may be difficult to ascertain, but which has the potential for producing mortality or major disability. According to PTSF staff, this definition is meant to describe the typical entry into the Trauma Center Registry. Table 16 shows the total number of motorcycle crash patients admitted to the state's trauma centers during each year between 2000 and 2007.

[2]PTOS data presented in this section covers Calendar Years 2000 through 2007. Some data appearing for these years in this report may not necessarily match data for the same period presented in the LB&FC's 2006 report due to the Registry's receipt of additional records from trauma centers following completion of the 2006 report attributable to routine backlogs in the submission of records and, in the case of one trauma center, a sizable backlog in the submission of prior-year records.

[3]Denotes all patients who met the criteria for inclusion in the PTOS as defined in this section.

Table 16

Motorcycle Crash Patients Admitted to Trauma Centers
(CY 2000 to CY 2007)

CY	Number Admitted to Trauma Centers[a]	Percent Change	Per 10,000 Motorcycle Registrations
2000	665	--	31.0
2001	748	12.5	31.5
2002	868	16.0	34.9
2003	837	(3.6)	31.3
2004	1,084	29.5	37.2
2005	1,348	24.4	42.4
2006	1,281	(5.0)	37.5
2007	1,371	7.0	37.8

[a]Includes cases in which sports equipment was coded as a protective device, fields were incorrectly blank, or in which trauma center registrars inappropriately coded a field for protective devices.

Source: Pennsylvania Trauma Outcome Study (PTOS), Pennsylvania Trauma Systems Foundation.

The number of motorcycle crash patients admitted to a trauma center increased by 12.5 percent and 16 percent in Calendar Years 2001 and 2002, respectively. The number of motorcycle crash patients admitted to a trauma center increased by 29.5 percent in CY 2004 and 24.4 percent in CY 2005, the first two years of the helmet law repeal. The number of motorcycle crash patient admissions to a trauma center then declined by 5 percent in CY 2006 before increasing by 7 percent in CY 2007.

When viewed in relation to motorcycle registrations both before and after the helmet law repeal, the number of motorcyclists admitted to a trauma center per 10,000 motorcycle registrations increased from 34.9 per 10,000 registrations in CY 2002 to 37.2 per 10,000 registrations in CY 2004. This figure then increased to 42.4 per 10,000 registrations in CY 2005 before falling to 37.5 in CY 2006 and increasing slightly to 37.8 per 10,000 registrations in CY 2007.

Table 17 provides the number of motorcycle crash patients admitted to Pennsylvania trauma centers for Calendar Years 2000 through 2007 by helmet use status. As shown, the number of helmeted motorcyclists greatly exceeded the number of non-helmeted motorcyclists admitted to trauma centers for calendar years 2000 through 2002. In CY 2003, the number of non-helmeted admissions more than doubled from the CY 2002 total, increasing from 69 in CY 2002 to 150 in CY 2003, despite the total number of trauma center admissions decreasing by 31 from the CY 2002 total. The number of helmeted admissions simultaneously began to decrease in CY 2003, from a total of 746 in CY 2002 to 638 in CY 2003.

Table 17

Helmet Usage Among Motorcycle Crash Patients Admitted to Trauma Centers
(CY 2000 to CY 2007)

CY	Total[a]	Patients Helmeted During Crash	% of Total	Patients With No Helmet During Crash	% of Total	Patients With Unknown Helmet Usage	% of Total
2000	665	591	88.9%	42	6.3%	28	4.2%
2001	748	633	84.6	65	8.7	46	6.1
2002	868	746	85.9	69	7.9	45	5.2
2003	837	638	76.2	150	17.9	46	5.5
2004	1,084	606	55.9	435	40.1	36	3.3
2005	1,348	705	52.3	570	42.3	61	4.5
2006	1,281	690	53.9	525	41.0	51	4.0
2007	1,371	733	53.5	581	42.4	43	3.1

[a]Totals equal more than the sum of the helmet use status figures in each year due to the inclusion of cases in which sports equipment was coded as a protective device, fields were incorrectly blank, or in which trauma center registrars inappropriately coded a field for protective devices. Such responses at the time of diagnosis of a motorcycle crash patient's injuries prevent the accurate determination of helmet use status.

Source: Pennsylvania Trauma Outcome Study (PTOS), Pennsylvania Trauma Systems Foundation.

Proportionately, the number of helmeted motorcycle crash patients admitted to trauma centers decreased from above 80 percent in Calendar Years 2000 through 2002 to above 50 percent in Calendar Years 2004 through 2007. Conversely, while the proportion of non-helmeted motorcycle crash patients admitted to a trauma center was in the single digits in Calendar Years 2000 through 2002, this population increased to at or above 40 percent in Calendar Years 2004 through 2007. The number of motorcycle crash patients admitted to trauma centers with unknown helmet usage as a proportion of all motorcyclists admitted remained in the single digits in each of the eight years examined.

In CY 2004, the number of helmeted admissions decreased by 32 over the prior year. During the same period, the number of non-helmeted admissions nearly tripled; increasing from 150 in CY 2003 to 435 in CY 2004. This occurred as the total number of motorcyclists admitted to Pennsylvania trauma centers increased by 247 between CY 2003 and CY 2004.

In CY 2005, the number of non-helmeted admissions increased by 135, or 31 percent, from the CY 2004 total, while helmeted admissions increased by 99, or 16.3 percent over CY 2004. In CY 2006, the total number of motorcycle crash patients admitted to a trauma center decreased by 67, or nearly 5 percent. In that year, the number of helmeted admissions decreased by 2.1 percent and the number of non-helmeted admissions decreased by 7.9 percent. The number of both helmeted and

non-helmeted patients all increased in CY 2007, with helmeted admissions increasing by 6.2 percent and non-helmeted admissions increasing by 10.7 percent over the prior year.

Table 18 provides data from the PTOS showing the number and percentage of motorcycle crash patients admitted to a trauma center by age group and helmet use status. In Calendar Years 2000 through 2002, in which the universal helmet law was in effect, helmet usage among motorcycle crash patients admitted to a trauma center was above 80 percent among all age groups except patients age 65 and older, which had helmet use rates of 71.4 percent, 76.9 percent, and 85.7 percent in Calendar Years 2000, 2001, and 2002, respectively.

In CY 2003, the year in which the helmet repeal law took effect, helmet usage rates among motorcyclists admitted to a trauma center in the age groups 21-29, 30-45, and 46-65 declined by just below or above 10 percent from CY 2002 usage rates. Helmet usage rates among motorcycle crash patients admitted to a trauma center ages 65 and older stood at 84 percent in that year.

Motorcycle crash patients admitted to a trauma center in the age group 30-45 showed the lowest rate of helmet usage in each of the four Calendar Years from 2004 through 2007. Proportionately, non-helmeted patients exceeded helmeted patients in this age group in Calendar Years 2005, 2006, and 2007.

In CY 2004, the first full year of the helmet repeal law, helmet usage among motorcycle crash patients admitted to a trauma center declined among all age groups. Patients between the ages of 30-45 had the highest proportion of non-helmet usage, with 43.9 percent of admissions in this age range not wearing a helmet at the time of a crash. Patients in the age group 20-29 had the second highest proportion of non-helmeted crashes, at 39.4 percent of all admissions in CY 2004. Patients ages 46-65 closely followed, with 37.2 percent of patients in this age group not wearing a helmet at the time of a crash. Patients ages 65 and older had the highest helmet usage rate at 77.8 percent in CY 2004.

In CY 2005, 48.7 percent of motorcycle crash patients admitted to a trauma center in the age group 30-45 were not wearing a helmet at the time of a crash; proportionately more than the percentage wearing a helmet in that age group (45.4 percent) and representing the lowest helmet usage rate among all age groups in that year. Patients ages 46-65 and 21-29 had the second and third lowest helmet use rates in CY 2005, respectively. Patients ages 65 and older had the highest rate of helmet usage in CY 2005, with 70 percent of all motorcycle crash patients in that age group wearing a helmet at the time of a crash.

This trend largely continued in CY 2006, with motorcycle crash patients between the ages of 30-45 wearing a helmet in 46.8 percent of crashes versus non-helmet

Table 18

Motorcycle Crash Patients Admitted to Trauma Centers by Age Group
(CY 2000 to CY 2007)

		Age Groups							
		21-29	% of Total	30-45	% of Total	46-65	% of Total	65+	% of Total
2000	Helmet	143	83.1%	285	88.5%	158	96.3%	5	71.4%
	No Helmet	22	12.8	17	5.3	2	1.2	1	14.3
	Unknown	7	4.1	16	5.0	4	2.4	1	14.3
	Totals[a]	172	100.0	322	100.0	164	100.0	7	100.0
2001	Helmet	156	81.3%	299	84.9%	168	88.0%	10	76.9%
	No Helmet	25	13.0	27	7.7	12	6.3	1	7.7
	Unknown	10	5.2	23	6.5	11	5.8	2	15.4
	Totals[a]	192	100.0	352	100.0	191	100.0	13	100.0
2002	Helmet	182	85.0%	320	84.0%	226	89.7%	18	85.7%
	No Helmet	18	8.4	39	10.2	10	4.0	2	9.5
	Unknown	12	5.6	17	4.5	15	6.0	1	4.8
	Totals[a]	214	100.0	381	100.0	252	100.0	21	100.0
2003	Helmet	154	74.4%	265	76.1%	198	77.0%	21	84.0%
	No Helmet	38	18.4	64	18.4	46	17.9	2	8.0
	Unknown	14	6.8	18	5.2	13	5.1	2	8.0
	Totals[a]	207	100.0	348	100.0	257	100.0	25	100.0
2004	Helmet	141	57.3%	248	51.3%	196	59.8%	21	77.8%
	No Helmet	97	39.4	212	43.9	122	37.2	4	14.8
	Unknown	6	2.4	19	3.9	9	2.7	2	7.4
	Totals[a]	246	100.0	483	100.0	328	100.0	27	100.0
2005	Helmet	168	57.1%	263	45.4%	239	56.2%	35	70.0%
	No Helmet	113	38.4	282	48.7	163	38.4	12	24.0
	Unknown	13	4.4	25	4.3	20	4.7	3	6.0
	Totals[a]	294	100.0	579	100.0	425	100.0	50	100.0
2006	Helmet	181	62.6%	237	46.8%	249	55.0%	23	69.7%
	No Helmet	96	33.2	245	48.4	175	38.6%	9	27.3
	Unknown	9	3.1	16	3.2	25	5.5%	1	3.0
	Totals[a]	289	100.0	506	100.0	453	100.0	33	100.0
2007	Helmet	157	57.5%	253	46.5%	290	57.4%	33	67.3%
	No Helmet	105	38.5	271	49.8	193	38.2	12	24.5
	Unknown	7	2.6	13	2.4	20	4.0	3	6.1
	Totals[a]	273	100.0	544	100.0	505	100.0	49	100.0

[a]Totals equal more than the sum of the helmet use status figures in each year due to the inclusion of cases in which sports equipment was coded as a protective device, fields were incorrectly blank, or in which trauma center registrars inappropriately coded a field for protective devices. Such responses at the time of diagnosis of a motorcycle crash patient's injuries prevent the accurate determination of helmet use status.

Source: Pennsylvania Trauma Outcome Study (PTOS), Pennsylvania Trauma Systems Foundation.

usage in 48.4 percent of all crashes. Second-lowest helmet usage was among crash patients ages 46-65 in CY 2006, in which only 55 percent of patients wore a helmet at the time of a crash, followed by patients ages 21-29 at 62.6 percent helmet usage and patients ages 65 and older at 69.7 percent helmet usage.

In CY 2007, helmet usage was again proportionately lowest among motorcycle crash patients in the age group 30-45, with only 46.5 percent of patients in this age group wearing a helmet at the time of a crash. This was followed by patients ages 46-65 and 21-29 with the second and third lowest helmet usage rates, respectively. Patients ages 65 and older had the highest helmet usage rate at 67.3 percent.

Motorcycle Crash Patients for Whom a Head Trauma Diagnosis Was Made

The extent of injuries sustained by motorcycle crash patients admitted to a trauma center is classified according to what is referred to as the Abbreviated Injury Scale, or AIS (1990 Revision). This is an anatomic score designed by the American Association of Automotive Medicine. The AIS was originally developed to rate and compare injuries in motor vehicle accidents.

The AIS coding system classifies any injury to the cranium or brain to be a head injury. These totals do not include injuries to the face or neck. Totals are given in the aggregate, and include those sustaining AIS head injuries including "AIS 1" (minor); "AIS 2" (moderate); "AIS 3" (serious); "AIS 4" (severe); "AIS 5" (critical); to "AIS 6" (maximum). AIS injury severity scores of 4-6 are considered to be the "most severe" brain injuries.

Table 19 provides detail on the number of motorcycle crash patients who sustained an Abbreviated Injury Scale head injury for calendar years 2000 to 2007.

Table 19

Motorcycle Crash Patients Admitted to Trauma Centers With an AIS Head Injury
(CY 2000 to CY 2007)

CY	Number Admitted to Trauma Centers	% Change	Per 10,000 Motorcycle Registrations
2000	303	--	14.1
2001	340	12.2%	14.3
2002	390	14.7	15.7
2003	411	5.4	15.3
2004	567	38.0	19.5
2005	676	19.2	21.2
2006	644	(4.7)	18.9
2007	657	2.0	18.1

Source: Pennsylvania Trauma Outcome Study (PTOS), Pennsylvania Trauma Systems Foundation.

The number of motorcycle crash patients admitted to trauma centers with an AIS head injury increased at steady rates between Calendar Years 2000 through 2002, before increasing at a lesser rate of 5.4 percent in CY 2003. An increase of 38 percent in motorcycle crash patients admitted to trauma centers sustaining an AIS head injury then occurred in CY 2004, before increasing at a reduced rate of 19.2 percent between Calendar Years 2004 and 2005. The first between-year decline in the number of motorcycle crash patients admitted to a trauma center with an AIS head injury occurred in CY 2006, in which 4.7 percent fewer patients were admitted. In CY 2007, the number of motorcyclist admissions with an AIS head injury increased by 2 percent over the prior year.

In Calendar Years 2000 and 2001, the number of motorcyclists admitted to trauma centers with an AIS head injury per 10,000 motorcycle registrations remained relatively constant at approximately 14 per 10,000 registrations. A slight increase occurred in CY 2002 and CY 2003 (the year of the helmet law repeal), with 15.7 and 15.3 motorcyclists admitted to trauma centers with an AIS head injury per 10,000 motorcycle registrations in those two years, respectively.

In CY 2004, the first full year following the repeal of the universal helmet use law, the number of motorcyclists admitted to trauma centers with an AIS head injury increased to about 19.5 per 10,000 motorcycle registrations, and again increased in CY 2005 to about 21.2 motorcyclists per 10,000 motorcycle registrations. Concurrent with the decrease in the number of motorcyclists admitted to a trauma center with an AIS head injury, the number admitted per 10,000 motorcycle registrations decreased to 18.9 per 10,000 registrations in CY 2006. This figure decreased further to 18.1 motorcyclists admitted to trauma centers with an AIS head injury per 10,000 registrations in CY 2007.

Table 20

Helmet Usage Among Motorcycle Crash Patients Who Suffered an AIS Head Injury
(2000 to 2007)

Year	Total[a]	Helmeted	% of Total	Non-Helmeted	% of Total	Patients With Unknown Helmet Use	% of Total
2000	303	268	88.4%	25	8.3%	9	3.0%
2001	340	291	85.6	33	9.7	15	4.4
2002	390	324	83.1	48	12.3	16	4.1
2003	411	302	73.5	100	24.3	9	2.2
2004	567	250	44.1	301	53.1	14	2.5
2005	676	279	41.3	374	55.3	15	2.2
2006	644	278	43.2	351	54.5	12	1.9
2007	657	264	40.2	370	56.3	13	2.0

[a]Totals may not match the sum of the helmet use status figures in each year due to the inclusion of cases in which sports equipment was coded as a protective device, fields were incorrectly blank, or in which trauma center registrars inappropriately coded a field for protective devices. Such responses at the time of diagnosis of a motorcycle crash patient's injuries prevent the accurate determination of helmet use status.

Source: Pennsylvania Trauma Outcome Study (PTOS), Pennsylvania Trauma Systems Foundation.

The number of helmeted and non-helmeted patients with an AIS head injury each increased yearly between Calendar Years 2000 through 2002 (See Table 20). The proportion of motorcycle crash patients with an AIS injury who were helmeted during the crash remained above 80 percent in these three years in which the universal helmet law was in effect, while non-helmeted motorcycle crash patients with an AIS head injury represented between 8 and 12 percent in these years. In CY 2003, the year in which the universal helmet law was repealed, the proportion of helmeted motorcyclists with an AIS head injury decreased from above 80 percent (CY 2002) to 73.5 percent, while the proportion of non-helmeted AIS head injury motorcycle crash patients nearly doubled to 24.3 percent.

In Calendar Years 2004 through 2007, the number of non-helmeted patients sustaining an AIS head injury exceeded the number of helmeted patients sustaining an AIS head injury. During these four years, the proportion of motorcycle crash patients admitted to a trauma center with an AIS head injury who were helmeted during a crash remained between 40 and 44 percent, while the proportion of motorcyclist AIS head injury admissions that were non-helmeted ranged between 53 and 56 percent of the total.

AIS injury severity scores are determined for each PTOS patient at the time of discharge.[4] Trauma registrars in each of the state's 28 accredited trauma centers are responsible for ensuring the integrity and accuracy of data entered into its trauma registry, and for timely submission of data to the Pennsylvania Trauma Systems Foundation.

Data is entered on each patient at the time of discharge through the use of descriptive text of injuries sustained. Based on the description of each injury, an encoding program converts the description first to an AIS code; including level of severity. Based on this AIS code, the encoding program uses a mapping technique which converts the AIS code into an ICD-9-CM injury code (800-995).[5]

The AIS uses the following body regions when assigning specific injury descriptions:

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[4]The patient population in the PTOS includes individuals who are pronounced dead after arrival to a trauma center and those who die during the course of treatment at a trauma center. For such patients, determination of AIS severity for all injuries would occur at the time of death. The PTSF also maintains data on motorcycle crash patients who die while in a Pennsylvania trauma center, delineated by AIS head injury severity level. While these data may provide insight as to the region and severity of injuries which are most prevalent among motorcycle crash patient fatalities, they have not been included in this report due to the amount of time required to query the data from the PTOS database and the need to determine conclusively which injury was the primary factor in causing the death of the patient. For example, while a motorcycle crash patient who dies in a trauma center may have a serious, severe, or critical AIS head injury, such an injury may not necessarily be the main cause of death of the patient.

[5]The International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM) is based on the World Health Organization's Ninth Revision, International Classification of Diseases (ICD-9). ICD-9-CM is the official system of assigning codes to diagnoses and procedures associated with hospital utilization in the United States.

1. Head
2. Face
3. Neck
4. Thorax
5. Abdomen
6. Spine
7. Upper Extremity
8. Lower Extremity
9. Unspecified

The Abbreviated Injury Scale (AIS) assigns a unique 7-digit numerical code to describe the location and severity of injuries sustained. The first digit identifies the body region; the second digit identifies the type of anatomic structure; the third and fourth digits identify the specific anatomic structure or, in the case of injuries to the external region, the specific nature of the injury. The fifth and sixth digits identify the level of injury within a specific body region and anatomic structure. A final digit identifies the AIS injury severity score.

Pennsylvania Trauma Systems Foundation officials indicated that both AIS codes as well as a measure known as the patient's Injury Severity Score (ISS) are valid measures of injury severity. While the AIS measures injury severity in each of eight body regions (with an additional code for "unspecified"), the ISS represents the sum of the squares of the highest AIS code in each of the three most severely injured ISS body regions.

The ISS ranges from 1 to 75. As the ISS score increases, the patient's overall condition worsens. The six body regions of injuries used in the ISS are:

1. Head or Neck
2. Face
3. Chest
4. Abdominal or pelvic contents
5. Extremities or pelvic girdle
6. External

The ISS body regions do not necessarily coincide with the regions used by the AIS coding system. For example, the AIS assigns head (cranium or brain) injuries as a specific region, while the ISS combines head and neck injuries into one region.

While the PTOS maintains data on the ISS scores for motorcycle crash patients, this data has not been included in this report due to the combination of head and neck injuries in the first ISS body region.

Any injury coded as an AIS 6 is automatically assigned an ISS score of 75. However, coders are instructed to code all injuries in that patient even though the ISS

will not be altered by additional injuries. ISS scores over 15 are considered to be severe injuries.

Table 21 provides the number of motorcycle crash patients admitted to trauma centers, by AIS head injury level, for calendar years 2000 through 2007. Admissions are provided by the highest AIS score[6] recorded for each patient for injuries sustained to the head. Totals do not include patients sustaining injuries to the neck or face. AIS injury severity scores of 4-6 are considered to be the "most severe" brain injuries. Exhibit 1 provides a listing of examples of the most commonly occurring AIS injuries, by severity level, for motorcycle crash patients.

Exhibit 1

Examples of Motorcyclist Head Trauma Injuries, by AIS Severity Score

Score	Classification	Injury Examples
AIS 1	Minor	Scalp Contusion/Laceration/Abrasion
AIS 2	Moderate	Cerebral Concussion Unconsciousness for less than one hour Skeletal bone (vault) fracture
AIS 3	Serious	Cerebrum: – subarachnoid hemorrhage – contusion – hemorrhage Base (basilar) skull fracture
AIS 4	Severe	Cerebrum: – subdural hematoma – hematoma – intraventricular hemorrhage/intracerebral hematoma
AIS 5	Critical	Cerebrum: – diffuse axonal injury (white matter shearing) Brain stem injury involving hemorrhage Unconsciousness for more than 24 hours
AIS 6	Maximum	Massive destruction (crush) of both cranium (skull) and brain; brain stem laceration; brain stem massive destruction (crush); and brain stem penetrating injury.

Source: Pennsylvania Trauma Outcome Study (PTOS), Pennsylvania Trauma Systems Foundation.

Additionally, Table 21 provides a category of patients sustaining head injuries entitled "CHI or TBI"; representing "Closed Head Injury" or "Traumatic Brain Injury." Both CHI and TBI are non-specific head injury diagnoses which are used in cases in which a patient appears to have sustained a head injury, but there are insufficient clinical symptoms for a conclusive diagnosis of head injury severity on which to base an AIS severity score. Injuries of this type may range from the relatively minor to severe.

[6]For example, if a patient sustained multiple injuries to the head (cranium and/or brain), the patient is classified according to the AIS score for the most severe head injury.

Table 21

Motorcycle Crash Patients Admitted to Trauma Centers With Head Injuries, by AIS Severity
(CY 2000 to CY 2007)

[a]Includes CHI=Closed Head Injury, and TBI=Traumatic Brain Injury in which patients appear to have a head injury, but insufficient clinical symptoms are available for diagnosis on the AIS severity scale.

[b]Totals exclude cases in which sports equipment was coded as a protective device, fields were incorrectly blank, or in which trauma center registrars inappropriately coded a field for protective devices. Such responses at the time of diagnosis of a motorcycle crash patient's injuries prevent the accurate determination of helmet use status.

Source: Pennsylvania Trauma Outcome Study (PTOS), Pennsylvania Trauma Systems Foundation.

In some cases, however, the CHI or TBI diagnosis is used when a patient is pronounced dead after arrival at a trauma center and no diagnostic evaluations of the patient's head have been completed. PTSF instructs registrars not to code injuries to the head or brain as CHI or TBI when more specific information is available. In Table 21, PTOS patients whose only documented head injury diagnosis was CHI or TBI are included as a separate category. Patients with a different head injury have been included in the appropriate AIS severity category.

In Calendar Years 2000 through 2002, the number of helmeted motorcyclist patients exceeded the number of non-helmeted motorcyclist patients in each AIS injury severity level. In each of these years, the largest numerical difference of helmeted versus non-helmeted motorcyclist patients occurred among patients with a moderate AIS head injury (AIS-2); which was also the AIS injury severity level with the highest number of PTOS patients in each of the eight years examined.

In Calendar Year 2003, the year in which the universal helmet law was repealed, the number of helmeted riders with a moderate AIS head injury decreased by 20.2 percent from the CY 2002 total, while the number of non-helmeted riders with a moderate AIS head injury nearly tripled from the prior year total. The number of non-helmeted motorcyclist patients with a critical head injury (AIS-5) also nearly tripled in CY 2003, increasing from 6 in CY 2002 to 17 in CY 2003. As a combined proportion of all motorcycle crash patients admitted to a trauma center with an AIS head injury in CY 2003, the number of non-helmeted patients represented nearly 25 percent of all cases; approximately double the proportion of non-helmeted AIS head injury patients in CY 2002.

As discussed previously, CY 2004 was the first year in which the total number of non-helmeted motorcyclists with an AIS head injury exceeded helmeted PTOS patients with an AIS head injury. With the exception of injuries of maximum severity (AIS-6), there was an increase in non-helmeted motorcyclists with an AIS head injury in each of the severity levels in CY 2004. Injuries of moderate severity and closed head injuries/traumatic brain injuries were the only severity levels in which helmeted motorcyclist patients exceeded non-helmeted motorcyclist patients in CY 2004.

The largest increase occurred in serious head injuries (AIS-3), in which the number of non-helmeted PTOS patients was over six times greater in CY 2004 than in CY 2003. The number of non-helmeted motorcyclist patients with a severe AIS head injury (AIS-4) in CY 2004 was more than five times greater than the CY 2003 total within that injury severity level. Additionally, the number of non-helmeted motorcycle crash patients with a critical head injury increased by 76.5 percent, from 17 in CY 2003 to 30 in CY 2004. The CY 2004 increases in non-helmeted motorcyclist patients with serious, severe, and critical AIS head injuries occurred in a year

in which the number of helmeted PTOS patients sustaining these injuries decreased from CY 2003 figures.

Non-helmeted motorcycle patients continued to exceed helmeted motorcycle crash patients with serious, severe, and critical AIS head injuries in Calendar Years 2005 and 2006. The number of non-helmeted motorcyclist patients sustaining critical head injuries doubled, increasing from 30 in CY 2004 to 60 in CY 2005, while the number of helmeted motorcycle crash patients with a critical head injury increased from 24 in CY 2004 to 25 in CY 2005.

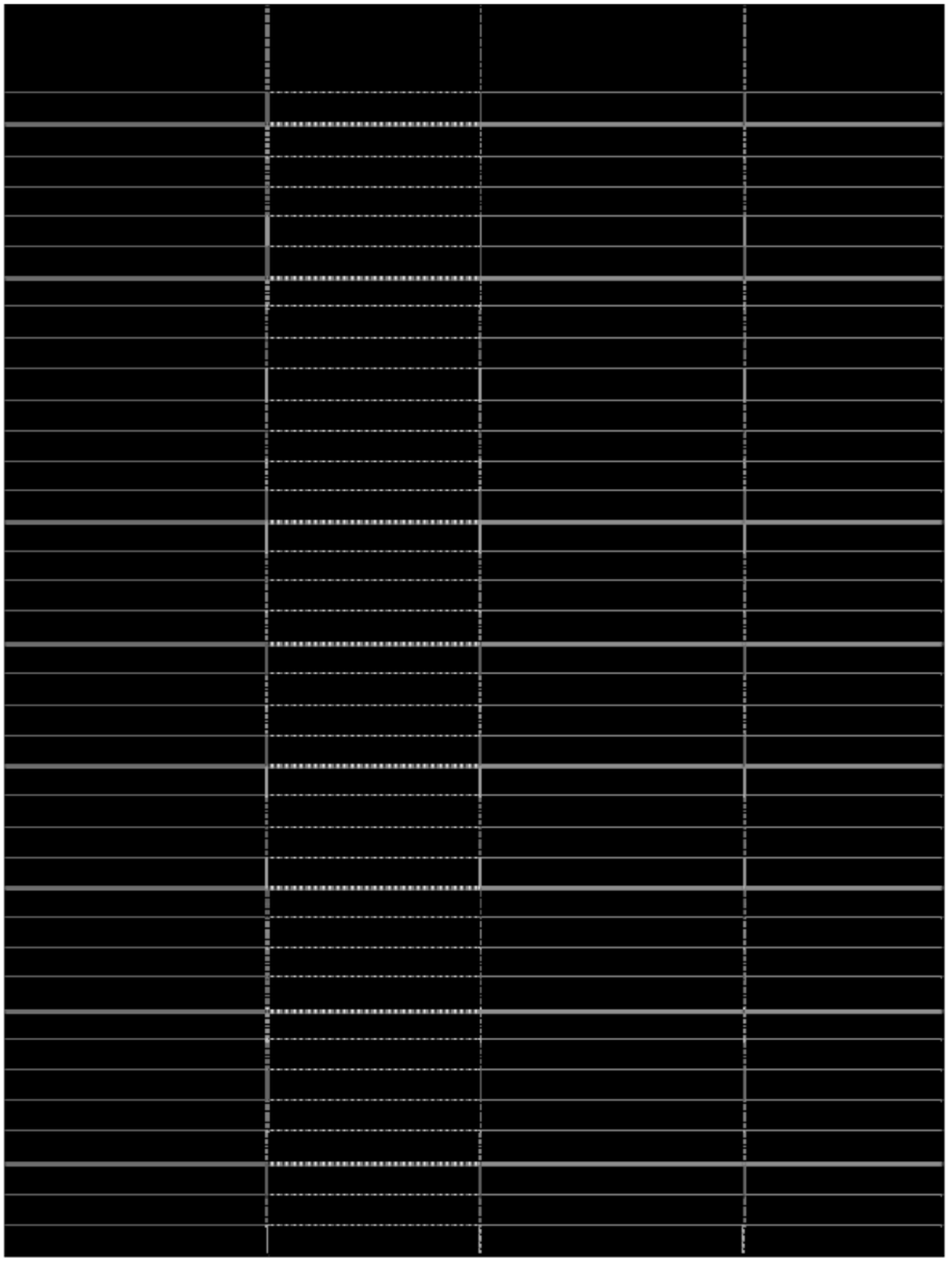
In CY 2006, the number of serious AIS head injuries decreased among helmeted patients and increased among non-helmeted patients, the number of severe AIS head injuries increased among both populations, and the total number of patients with critical head injuries decreased by 25 from the CY 2005 total. While the number of helmeted motorcycle crash patients with a minor (AIS 1) and moderate AIS head injury both increased, the number of non-helmeted patients with injuries of these severity levels as well as the total injuries at these levels decreased in CY 2006.

There was a decrease in the total number of moderate, serious, and severe AIS head injury patients in CY 2007. However, the total number of critical AIS head injuries increased by 22.7 percent in CY 2007, with an additional 5 helmeted and 8 non-helmeted motorcycle crash patients sustaining injuries of this severity in that year. In addition, there were increases in both helmeted and non-helmeted motorcycle crash patients sustaining minor injuries in CY 2007.

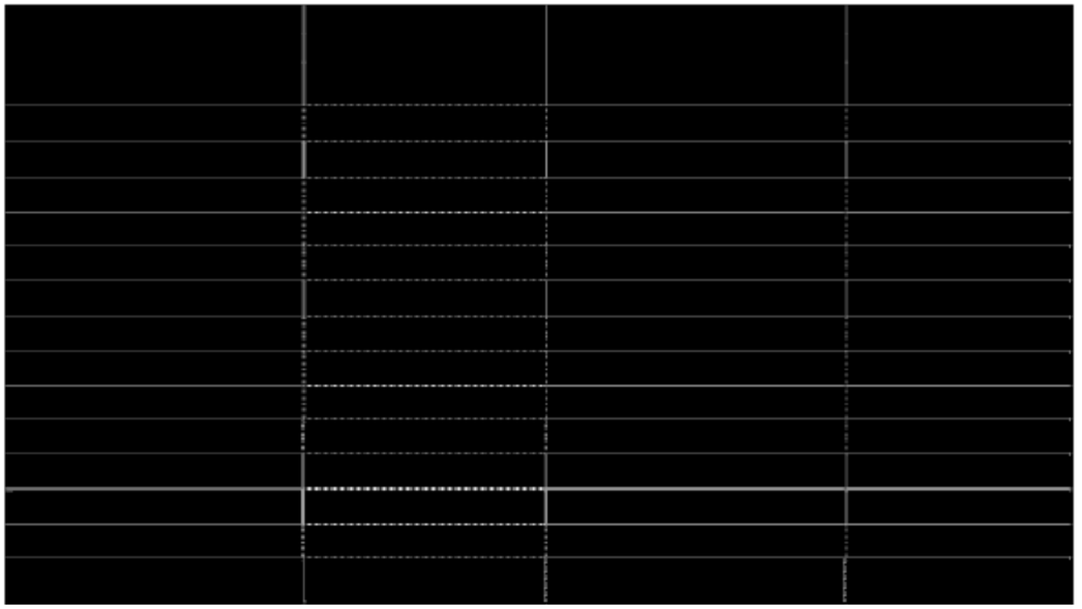
V. Appendices

APPENDIX A

Motorcycle Helmet Use Requirements in the States



Appendix A (Continued)



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[1]Covers passengers of all ages and any operator under age 18.

[2]All riders under age 21 must wear helmets, without exception.

[3]Riders 21 years of age or older may ride without a helmet only if it can be proven that they are covered by a medical insurance policy of at least $10,000.

[4]Helmets also required for all operators with an instructional/learner's permit.

[5]Covers operators possessing a license/endorsement for less than one year; passengers 14 years of age and younger; and passengers of an operator required to wear a helmet.

[6]Covers all passengers traveling with operators who are covered by the law.

[7]Covers all operators during the first year of licensure and all passengers of operators who are covered by the law.

[8]Covers all operators and passengers under 21 years of age. Covers operators 21 years of age or older who have not either been licensed to operate a motorcycle for at least two years or who have not completed a motorcycle safety course approved by the Pennsylvania Department of Transportation or the Motorcycle Safety Foundation. Covers passengers riding with operators who are covered by the law.

[9]Covers all passengers (regardless of age) and all operators during the first year of licensure (regardless of age).

[10]Exempts riders 21 years of age or older if they either 1) can show proof of successfully completing a motorcycle operator training and safety course or 2) can show proof of having a medical insurance policy of at least $10,000.

[11]While New Hampshire's helmet use law covers all riders under age 18, a clause contained in the law stipulating that the requirement is void "if federal law is altered so that the mandatory wearing of protective headgear on motorcycles by persons less than 18 years of age is not required as a condition to the receipt by the state of any federal funds" has been identified as a "sunset" provision by some. The National Highway Traffic Safety Administration classified New Hampshire as having no helmet use law as of January 2008.

[12]Covers all operators who have possessed a motorcycle operator's permit for less than one year.

[13]Operators and passengers 19 years of age and older are required to have a helmet in their possession despite use not being required.

Source: Compiled by LB&FC staff using information provided by the National Highway Traffic Safety Administration (NHTSA), the Insurance Institute for Highway Safety (IIHS), and state departments of transportation and/or highway safety.

APPENDIX B

Listing of Pennsylvania's Accredited Trauma Centers

(As of November 1, 2007)

Abington Memorial Hospital	Level II
Albert Einstein Medical Center	Level I
Allegheny General Hospital	Level I
Altoona Regional Health System	Level II
The Children's Hospital of Philadelphia	Pediatric Level I
The Children's Hospital of Pittsburgh	Pediatric Level I
Community Medical Center	Level II
Conemaugh Memorial Medical Center	Level I
Crozer-Chester Medical Center[a]	Level II
Frankford Hospital Torresdale Campus	Level II
Geisinger Medical Center	Level I With Additional Qualifications in Pediatric Trauma
Good Samaritan Regional Medical Center	Level III
Hahnemann University Hospital	Level I
Hamot Medical Center	Level II
The Milton S. Hershey Medical Center	Level I With Additional Qualifications in Pediatric Trauma
Lancaster General Hospital	Level II
Lehigh Valley Hospital[a]	Level I With Additional Qualifications in Pediatric Trauma
The Mercy Hospital of Pittsburgh[a]	Level I
The Reading Hospital and Medical Center	Level II
Robert Packer Hospital	Level II
St. Christopher's Hospital for Children[a]	Pediatric Level I
St. Luke's Hospital	Level I
St. Mary Medical Center	Level II
Temple University Hospital[a]	Level I With Additional Qualifications in Pediatric Trauma
Thomas Jefferson University Hospital	Level I
University of Pennsylvania Medical Center	Level I
University of Pittsburgh Medical Center Presbyterian	Level I
York Hospital	Level II

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[a]Also provide burn services.

Note: The Regional Resource (Level I) Trauma Center is required to have the following additional capabilities which are not required at a Regional (Level II) Trauma Center although many Level II centers do have these capabilities: fully approved general surgery residency program; cardiac surgery, hand surgery, microsurgery, pediatric surgery, family medicine, psychiatry, infectious diseases, neurology on call and promptly available in-house from inside or outside the hospital; acute hemodialysis capability at the receiving facility; nuclear scanning available 24 hours a day; cardiopulmonary bypass capability; operating microscope; trauma research; external continuing education programs; a minimum of 600 PTOS qualified patients per year (350 PTOS cases per year are required for the Regional (Level II) Trauma Center; and surgically directed ICU.

Source: Pennsylvania Trauma Outcome Study (PTOS), Pennsylvania Trauma Systems Foundation.

APPENDIX C

Information on Other Pennsylvania-Specific Studies

Conemaugh and Geisinger Health Systems

The Conemaugh Health System's Memorial Medical Center in Johnstown, Pennsylvania, in collaboration with Geisinger Medical Center in Danville, Pennsylvania, the Pennsylvania Trauma Systems Foundation, the Coroners Association of Pennsylvania, and multiple Pennsylvania police departments are conducting a study examining the incidences of head and face injuries, the extent and costs of medical care, and the amount of time required to return to full duty employment among both helmeted and non-helmeted motorcyclists involved in crashes in Pennsylvania.

The study is entitled *Financial and Clinical Impact of Repeal of the Pennsylvania Helmet Law: A Multi-Center Prospective Study Comparing Helmeted and Non-Helmeted Motorcycle Accident Victims*. Its primary objective is to determine if the financial charges and ratio of cost to charges (RCC), including acute hospitalization, rehabilitation or skilled care, outpatient care, and time to return to work (implying lost wages) is different between helmeted versus non-helmeted motorcyclists with head or face injuries.

The study began seeking patients for enrollment in early 2005. As of June 2008, a member of the study team reported that the study is ongoing and is still enrolling patients. The spokesperson stated that they have encountered some reluctance on the part of potential study participants and that there are no results to report at this time.

University of Pittsburgh

Summary of Study by Kristen J. Mertz, M.D., MPH and Harold B. Weiss, PhD, MPH

Changes in Motorcycle-Related Head Injury Deaths, Hospitalizations, and Hospital Charges Following Repeal of Pennsylvania's Mandatory Motorcycle Helmet Law (June 2008)[1]

This study examined changes in incidences of head injury and nonhead injury motorcycle-related deaths, hospitalizations, and total acute care hospital charges in the two years prior (2001-2002) and following (2004-2005) the repeal of Pennsylvania's universal helmet law. The study was supported in part by the Centers for Disease Control and Prevention, National Center for Injury Prevention and Control.

Principally, the study found that helmet use among motorcycle riders in reported crashes decreased from 82 percent in the two years prior to the repeal (2001-2002) to 58 percent in the two years following the repeal (2004-2005). A 32.3 percent increase in head injury deaths per 10,000 motorcycle registrations and a 42.2 percent increase in head injury hospitalizations per 10,000 motorcycle registrations between the periods 2001-2002 and 2004-2005 were found using DOH death certificate data and PHC4-compiled hospital discharge data, respectively. Nonhead injury deaths per 10,000 registrations decreased by 0.1 percent and nonhead injury hospitalizations increased by 2 percent per 10,000 registrations between the periods 2001-2002 and 2004-2005.

Appendix C (Continued)

Moreover, the study found that total acute care hospital charges (in 2005 dollars) for motorcycle-related head injuries increased by 132 percent between 2001-2002 and 2004-2005, while total acute care hospital charges for motorcycle-related nonhead injuries increased by 69 percent between these periods. The study also found that the number of head-injured hospitalized motorcyclists requiring further care at other facilities (largely for rehabilitation and long-term care) increased by 87 percent between 2001-2002 and 2004-2005, while there was a 16 percent increase in the number of nonhead-injured hospitalized motorcyclists requiring further care at other facilities between these periods.

While the study noted pre- and post-repeal changes in helmet use among riders in reported crashes, it did not determine incidences of helmet usage in motorcycle head injury deaths and hospitalizations. In lieu of this determination, the study indicates that "the large postrepeal increases in head injuries relative to nonhead injuries, both for statewide deaths and hospital discharges, indicate that lower helmet use was most likely responsible."

The study concludes in part that data analyzed "strongly suggest that Pennsylvania's mandatory helmet law was effective in preventing traumatic brain injury, given that its repeal led to disproportionate increases in head injuries."

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[1]The study is scheduled for publication in the *American Journal of Public Health* (August 2008, Vol. 98, No. 8).

Source: Developed by LB&FC staff.