



# Legislative Budget and Finance Committee

A JOINT COMMITTEE OF THE PENNSYLVANIA GENERAL ASSEMBLY

Offices: Room 400 • Finance Building • Harrisburg • Tel: (717) 783-1600

Mailing Address: P.O. Box 8737 • Harrisburg, PA 17105-8737

Facsimile (717) 787-5487

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## Motorcyclist Injuries and Fatalities Since the 2003 Repeal of the Mandatory Helmet Law

Pursuant to HR 349 of 2003

June 2006

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## Report Summary

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Effective September 4, 2003, Pennsylvania's 1968 mandatory helmet law was repealed for motorcyclists 21 and older who either have been licensed to operate a motorcycle for not less than two years or have completed an approved safety program. 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, 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 accidents 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.
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 is 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).

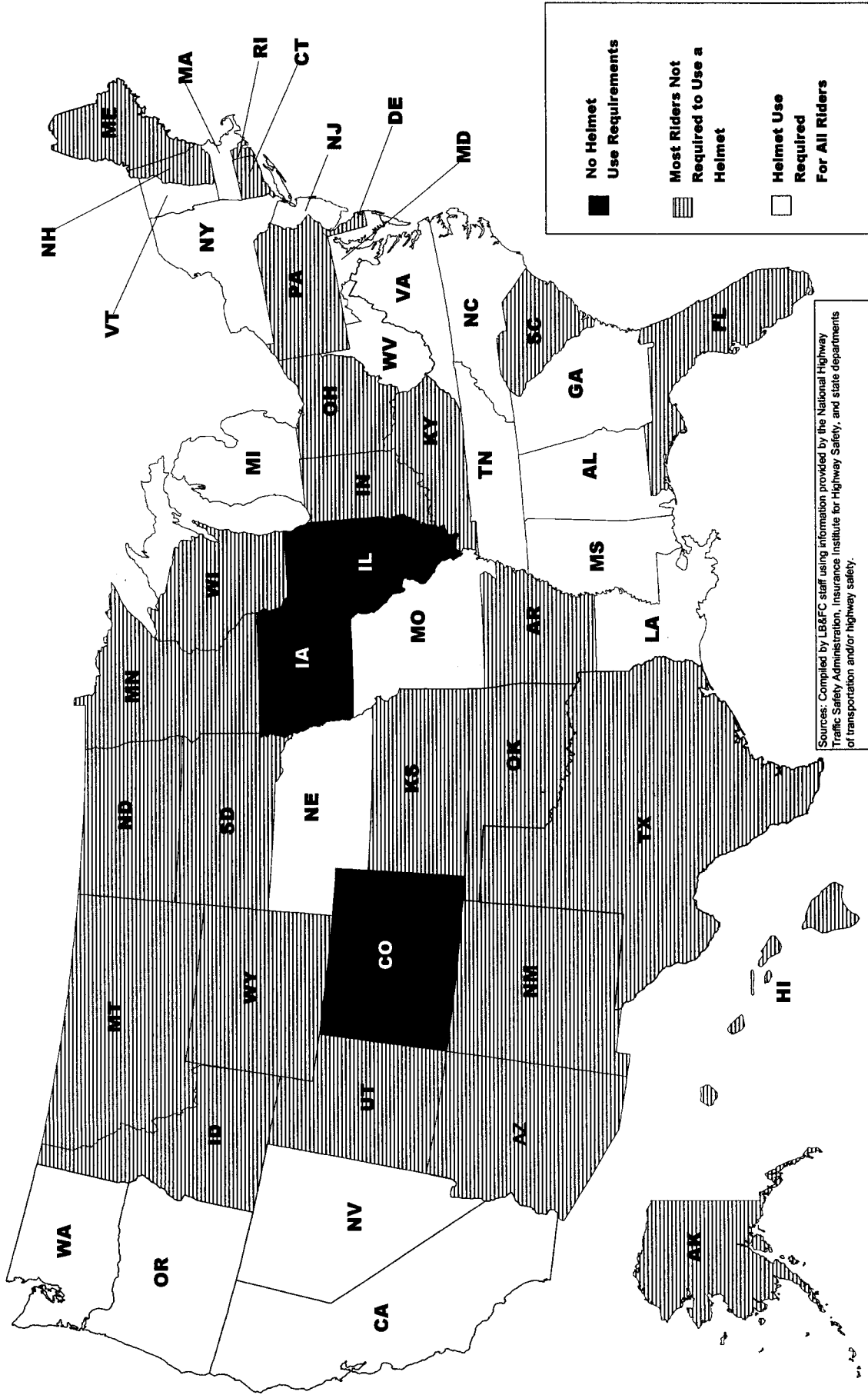
### Study Findings

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 (Colorado, Illinois, and Iowa) have no helmet requirements.




***HR 349 Question #1. How many motorcycle crashes were reported in Pennsylvania during the first two years following repeal of the Helmet Law?***

**During 2004 and 2005, the first two full calendar years following the repeal of the Helmet Law, the total number of motorcycle crashes in Pennsylvania increased by nearly one-third while motorcycle registrations rose by nearly 20 percent. In 2004, the number of crashes involving motorcycles totaled 3,621. In 2005, this number increased to 4,039.**

# Motorcycle Helmet Use Requirements in the States



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.

	No Helmet Use Requirements
	Most Riders Not Required to Use a Helmet
	Helmet Use Required For All Riders

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. While not in itself an indicator of the impact of the Helmet Repeal Law, this information (as 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.

<b>Number of PA Motorcycle Crashes and Registrations</b> (CY 2000 Through CY 2005)				
<u>CY</u>	<u># Crashes Involving Motorcycles</u>	<u># of Motorcyclists Involved</u>	<u># of Motorcycle Registrations</u>	<u>Crashes Per 10,000 Motorcycle Registrations</u>
2000 .....	2,842	3,235	214,629	132.4
2001 .....	2,984	3,436	237,276	125.8
2002 .....	NA <sup>b</sup>	NA <sup>b</sup>	248,775	NA
2003 <sup>a</sup> .....	3,057	3,546	267,826	114.1
2004 .....	3,621	4,165	291,015	124.4
2005 .....	4,039	4,641	318,283	126.6

<sup>a</sup>Helmet Law repealed effective September 6, 2003.  
<sup>b</sup>PENNDOT data entry incomplete.

The number of motorcycle crashes reported through PENNDOT's Crash Reporting System increased markedly in both CY 2004 and CY 2005. As shown below, a substantial growth in motorcycle registrations was also evident in those years:

	<u>2003</u>	<u>2004</u>	<u>2005</u>
Motorcycle Crashes			
Number .....	3,057	3,621	4,039
Percent Change.....	--	+18.4%	+11.5%
Motorcycle Registrations ..			
Number .....	267,826	291,015	318,283
Percent Change.....	--	+8.7%	+9.4%

***HR 349 Question #2. How many of the individuals involved in reported motorcycle crashes in Pennsylvania in the first two years following repeal of the Helmet Law in 2003 were wearing helmets?***

**The percentage of individuals involved in motorcycle crashes who were wearing helmets declined from 73 percent in CY 2001 (2002 data not available) to about 54 percent in both calendar years 2004 and 2005.**

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, there were 3,621 crashes including 4,165 motorcyclists while 4,039 crashes involved 4,641 motorcyclists in CY 2005. The following table shows the percentages of those 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).

<b>Helmet Usage by Individuals Involved in PA Motorcycle Crashes</b> (Pre- and Post-Helmet Law Repeal)						
	<u>2001<sup>a</sup></u>	<u>% of Total</u>	<u>2004</u>	<u>% of Total</u>	<u>2005</u>	<u>% of Total</u>
Helmeted .....	2,490	72.5%	2,258	54.2%	2,517	54.2%
Non-Helmeted .....	476	13.9	1,553	37.3	1,791	38.6
Helmet Used Improperly ....	32	0.9	47	1.1	38	0.8
Bicycle Helmet Used .....	5	0.1	26	0.6	15	0.3
Unknown If Used .....	57	1.7	8	0.2	4	0.1
Unknown .....	<u>376</u>	<u>10.9</u>	<u>273</u>	<u>6.6</u>	<u>276</u>	<u>5.9</u>
Totals.....	3,436	100.0%	4,165	100.0%	4,641	100.0%

<sup>a</sup>2001 is the last full year prior to 2003 (the year the Helmet Law was repealed) for which this data is available.

***HR 349 Question #3. What was the increase, if any, in motorcyclist injuries and fatalities specifically due to head trauma when not wearing a helmet?***

**From existing data systems, it is not possible to link specific motorcycle crash events (and helmeted/non-helmeted status) with specific medical outcomes for involved motorcycle drivers and passengers. A multi-agency attempt to establish such linkages through the Pennsylvania Crash Outcome Evaluation System (CODES) is currently underway. In the interim, certain trend data is available pertinent to the question of helmet usage and injuries and fatalities related to head trauma.**

House Resolution 349 specifies that the LB&FC shall determine “the increase, if any, in injuries and fatalities specifically due to head trauma [emphasis 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. However, a joint project involving the Pennsylvania Department of Health, PENNDOT, the Pennsylvania Health Care Cost Containment Council, the Pennsylvania State Police, and the Pennsylvania Trauma Systems Foundation is currently underway to develop such linkages.

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 occurs 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. Individuals are tracked by linking crash

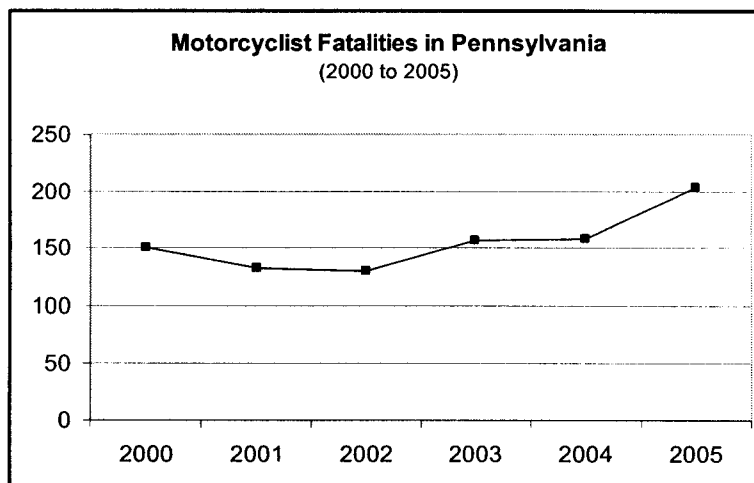
records (PENNDOT), EMS reports (Department of Health), and hospital discharge data (PHC4) to track fatalities and identify the types of injuries and the costs that result from specific driver, vehicle, and crash characteristics.

As of June 2006, CODES data linkage for calendar years 2003 and 2004 was in process. As the lead agency, the Health Department's intent is to complete CODES linkage on a continuous basis beginning with 2005 data. As a CODES network state, Pennsylvania plans on establishing the capability to analyze motorcycle crash data (as well as specialized data on rural crashes and fatalities among teenage drivers) on an ongoing basis in the future.

Although the pertinent data sources are not currently linked, we were able to obtain 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 officer 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, fatalities then increased by nearly 30 percent to 204 in CY 2005.



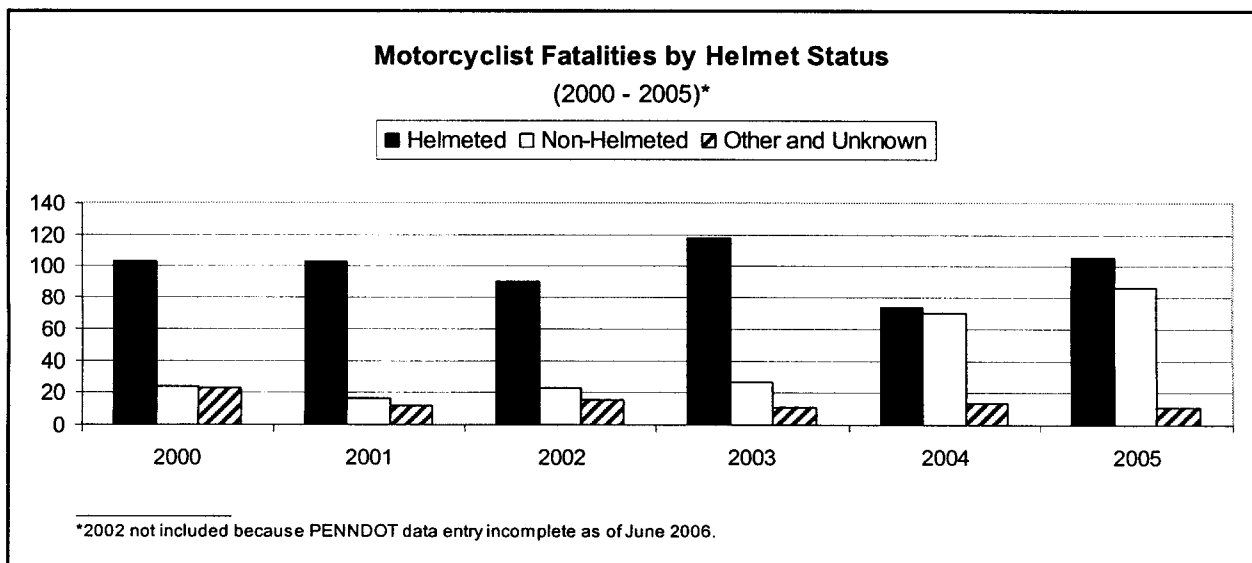


It is necessary, however, to view both fatality and injury data in the context of vehicle miles traveled (VMT) and/or motorcycle registrations. Because VMT is not available for motorcycles in Pennsylvania, we focused our analysis on fatalities and injuries relative to the number of motorcycles registered.

As shown below, 261 persons died in motorcycle crashes in the two years prior to 2003 (the transition year) compared to 362 persons in the first two years after repeal, an increase of 38.7 percent. However, when the number of registered motorcycles is taken into consideration, the average annual fatality rate after repeal of the Helmet Law (5.9 fatalities per 10,000 registered motorcycles in 2004 and 2005) was not substantially higher than the pre-repeal (2001 and 2002) average annual fatality rate of 5.4 fatalities per 10,000 registered motorcycles.

<b>Total Motorcyclist Fatalities and Number Per 10,000 Registrations (CY 2000 Through CY 2005)</b>					
<u>CY</u>	<u>Total Fatalities</u>	<u>Helmet Status</u>			<u>Per 10,000 Registered Motorcycles</u>
		<u>Helmeted</u>	<u>Non-Helmeted</u>	<u>Other and Unknown</u>	
2000 .....	150	103	24	23	7.0
2001 .....	132	103	17	12	5.6
2002 .....	129	90	23	16	5.2
2003 .....	156	118	27	11	5.8
2004 .....	158	74	70	14	5.4
2005 .....	204	106	87	11	6.4

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 2005.

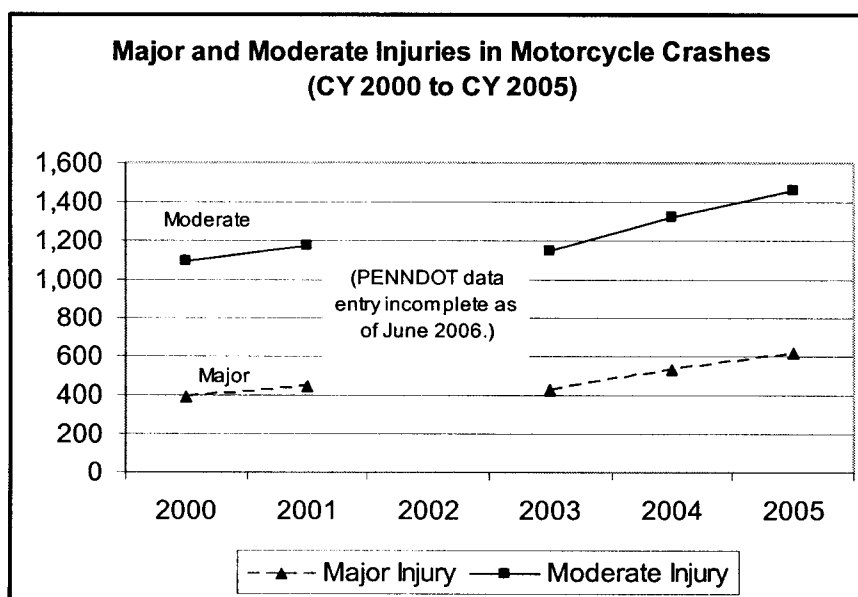


**Injuries.** PENNDOT's Crash Reporting System relies upon the judgment of police officers responding to the scene of a crash to assess the severity of injuries sustained by individuals involved in a crash. PENNDOT's Police Crash Reporting form utilizes the following classifications for injury severity: (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 2005.

<b>Motorcyclist Injuries, by Reported Severity</b> (CY 2000 to CY 2005)					
<u>CY</u>	<u>Major Injury</u>	<u>Moderate Injury</u>	<u>Minor Injury</u>	<u>Unknown Severity</u>	<u>Total Injuries</u>
2000.....	392	1,095	1,089	1	2,577
2001.....	447	1,178	1,175	0	2,800
2002.....	(PENNDOT data entry incomplete as of June 2006.)				
2003.....	429	1,144	1,261	97	2,931
2004.....	534	1,318	1,251	420	3,523
2005.....	618	1,460	1,260	616	3,954

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:



The table below shows the trend in major and moderate motorcyclist injuries for the period 2000 to 2005 both in absolute numbers and per 10,000 registered motorcycles.

Reported Helmet Usage in Crashes Involving "Major Injury" and "Moderate Injury" to Motorcyclists (CY 2000 to CY 2005)								
<u>Major Injury:</u>								
<u>CY</u>	<u>Helmeted</u>	<u>Non-Helmeted</u>	<u>Improper Use</u>	<u>Bicycle Helmet</u>	<u>Unknown If Used</u>	<u>Unknown</u>	<u>Total Major Injuries</u>	<u>Per 10,000 Registered Motorcycles</u>
2000.....	269	64	NA	NA	0	59	392	18.3
2001.....	345	57	7	0	1	37	447	18.8
2002.....	(PENNDOT data entry incomplete as of June 2006.)							NA
2003.....	302	103	6	1	0	17	429	16.0
2004.....	250	247	8	1	0	28	534	18.3
2005.....	270	302	6	3	1	36	618	19.4
<hr/>								
<u>Moderate Injury:</u>								
<u>CY</u>	<u>Helmeted</u>	<u>Non-Helmeted</u>	<u>Improper Use</u>	<u>Bicycle Helmet</u>	<u>Unknown If Used</u>	<u>Unknown</u>	<u>Total Moderate Injuries</u>	<u>Per 10,000 Registered Motorcycles</u>
2000.....	753	163	NA	NA	1	178	1,095	51.0
2001.....	897	170	13	2	4	92	1,178	49.6
2002.....	(PENNDOT data entry incomplete as of June 2006.)							NA
2003.....	819	235	10	4	1	75	1,144	42.7
2004.....	776	468	5	11	1	57	1,318	45.3
2005.....	810	584	11	3	0	52	1,460	45.9

When considering major injuries, 839 persons sustained a major injury as a result of a motorcycle crash prior to the Helmet Law repeal (2000 and 2001) compared to 1,152 major injuries in the first two years after repeal. This translates to an average annual injury rate of 18.6 major injuries per 10,000 registered motorcycles in 2000 and 2001 compared to 18.9 major injuries per 10,000 registered motorcycles in 2004 and 2005.

Before the repeal in 2000 and 2001, 2,273 persons sustained a moderate injury as a result of a motorcycle crash. This compares to 2,778 in 2004 and 2005. This translates to an average annual injury rate of 50.3 per 10,000 registered motorcycles in 2000 and 2001 compared to an average annual injury rate of 45.6 per 10,000 registered motorcycles in 2004 and 2005.

**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 26 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 state-wide 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 40.2 percent. A further increase of 21.1 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 39.3 motorcyclist trauma center admissions per 10,000 registered motorcycles in 2004 and 2005.

<b>Motorcycle Crash Patients Admitted to Trauma Centers (CY 2000-CY 2005)</b>			
<u>CY</u>	<u>Number Admitted</u>	<u>Percent Change</u>	<u>Per 10,000 Motorcycle Registrations</u>
2000.....	665	--	31.0
2001.....	748	+12.5%	31.5
2002.....	868	+16.0	34.9
2003.....	772	-11.1	28.8
2004.....	1,082	+40.2	37.2
2005.....	1,310	+21.1	41.2

*Total Number Admitted With A Head Injury.* HR 349 seeks information 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

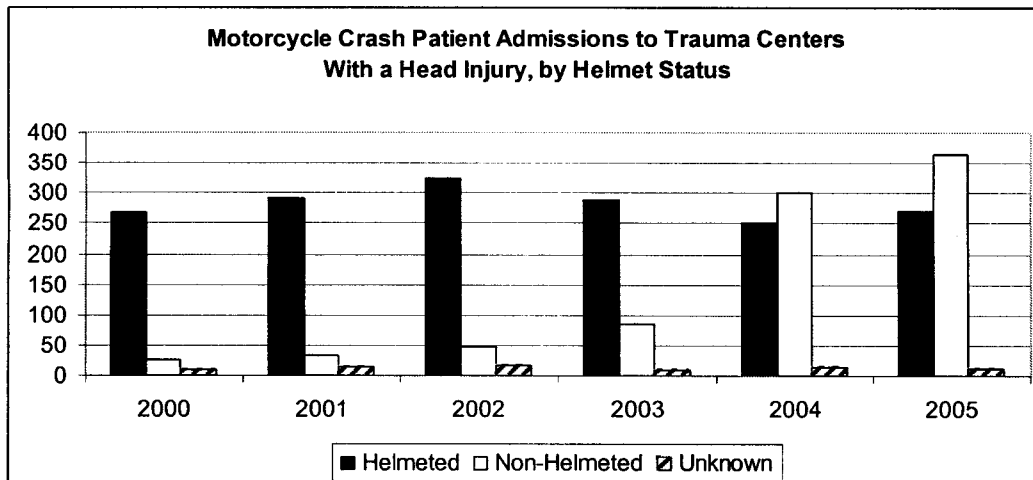
sustained by motorcyclists to their head (i.e., to the cranium and brain) are reported as “head trauma.” These totals do not include injuries to the face or neck. Such injuries constitute separate and distinct body injury regions under the AIS system.

In 2004, there was an increase of 47.6 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 14.7 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 19.9 per 10,000 motorcycle registrations in 2004 and 2005 following the repeal.

<b>Motorcycle Crash Patients Admitted to a Pennsylvania Trauma Center With A Head Injury (CY 2000-CY 2005)</b>			
<u>CY</u>	<u>Number Admitted to Trauma Centers</u>	<u>Percent Change</u>	<u>Per 10,000 Motorcycle Registrations</u>
2000.....	302	--	14.1
2001.....	339	+12.3%	14.3
2002.....	388	+14.5	15.6
2003.....	382	-1.5	14.3
2004.....	564	+47.6	19.4
2005.....	647	+14.7	20.3

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 2005.



Motorcyclist Head Injury Admissions to a Trauma Center, by AIS Severity Score. The AIS coding system uses the following injury severity scores: “AIS 1” (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 2000-2005 is provided below.

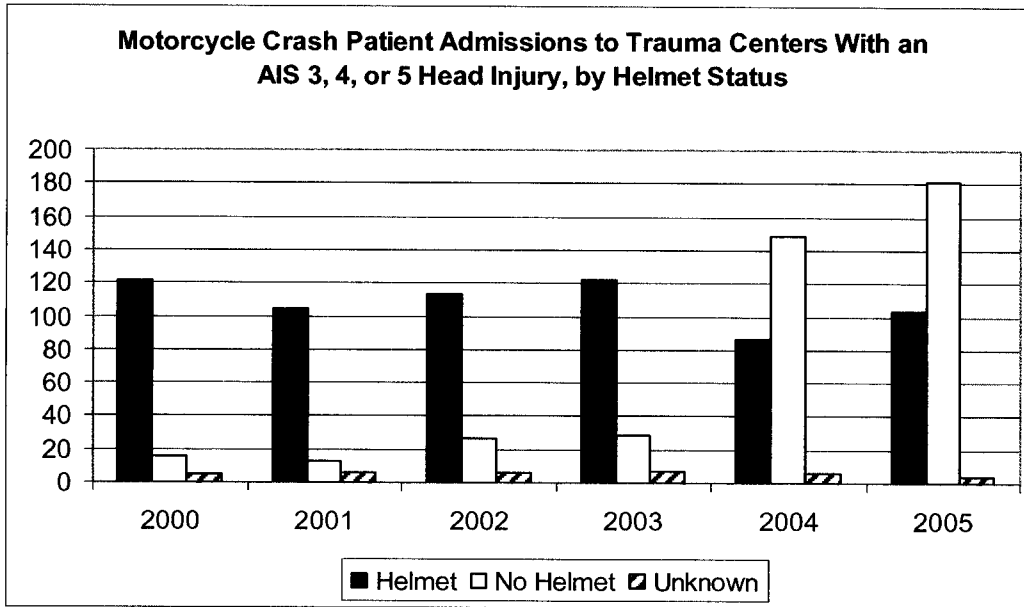
<b>Motorcycle Crash Patient Admissions to a Trauma Center With an AIS 3, 4, or 5 Head Injury</b> (CY 2000 to CY 2005)			
<u>CY</u>		Motorcycle Crash Patients	
		Number With An AIS 3, 4, or 5 Head Injury <sup>a</sup>	Per 10,000 Motorcycle Registrations
2000 .....	Helmet	121	5.6
	No Helmet	16	0.7
	Unknown	5	0.2
	Total	142	6.6
2001 .....	Helmet	104	4.4
	No Helmet	13	0.5
	Unknown	6	0.3
	Total	123	5.2
2002 .....	Helmet	113	4.5
	No Helmet	27	1.1
	Unknown	6	0.2
	Total	146	5.9
2003 .....	Helmet	122	4.6
	No Helmet	29	1.1
	Unknown	3	0.1
	Total	154	5.8
2004 .....	Helmet	87	3.0
	No Helmet	149	5.1
	Unknown	6	0.2
	Total	242	8.3
2005 .....	Helmet	103	3.2
	No Helmet	181	5.7
	Unknown	4	0.1
	Total	288	9.0

<sup>a</sup>AIS 3 (Serious); AIS 4 (Severe); and AIS 5 (Critical)

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 530 persons in 2004 and 2005, the first two years after repeal, an increase of 97 percent. When the number of registered motorcycles is taken into consideration, the overall average annual AIS 3, 4, 5 injury rate after repeal of the Helmet Law in 2004 and 2005 was 8.7 head injuries per 10,000 registered motorcycles. This

compares to the pre-repeal (2001 and 2002) overall average annual AIS 3, 4, 5 injury rate of 5.6 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 2005.



# **I. Introduction**

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House Resolution 349, adopted on July 1, 2003, requires the Legislative Budget and Finance Committee to conduct a study of reported motorcycle crashes and associated injuries and fatalities since the passage of Act 2003-10, commonly known as the Helmet Repeal Law. The first report under this mandate is due by July 1, 2006, with a subsequent report due two years thereafter. (See Appendix A.)

## **Study Objectives**

1. To review accident reports and compile data on motorcycle crashes occurring in the Commonwealth as reported through the Department of Transportation's Crash Reporting System.
2. To compare the number of injuries (by type and severity) and fatalities associated with motorcycle crashes both before and following repeal of the Helmet 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—see legal background in Section II) while operating a motorcycle in the Commonwealth. This report is the first of two required by HR 349, focusing on the two 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 on page 10 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 a six-year period, Calendar Years 2000 through 2005. However, it was determined that PENNDOT data input for CY 2002 was incomplete (due to a backlog in data entry by a contracted vendor) as of June 2006, except for motorcycle crash fatalities. Therefore, considering that the Helmet Law repeal took effect in September 2003, we focused our analysis on the full calendar years of 2004 and 2005 as the "post-repeal" period and on CYs 2000 and 2001 as the "pre-repeal" period, especially when presenting information from the CRS in relation to injury severity levels.

The LB&FC staff also was provided direct on-line read-only access to the CRS and, upon receipt of the Division's response, the LB&FC staff compiled crash data and sampled crash incident record input in order to test data reliability. LB&FC staff interacted extensively with staff of the Crash Information Systems and Analysis Division throughout this project.

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, LB&FC staff met with staff of the Bureau of Emergency Medical Services of the Department of Health to obtain information on the role of emergency services personnel in crash reporting and of the Department in collecting data on patient care and medical outcomes. During these contacts, we obtained information on the Crash Outcome Data Evaluation System (CODES) which is coordinated by the Department of Health but involves several other participating state agencies.

We subsequently contacted one of these agencies, the Pennsylvania Health Care Cost Containment Council, for descriptive information on hospital discharge data.

CODES originates from provisions of the federal Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, which mandated a study of the benefits of safety belts and motorcycle helmets in crashes. CODES is designed to electronically track individuals injured or killed due to being involved in motor vehicle crashes. Specifically, individuals are tracked by linking crash records (from PENNDOT's CRS), EMS reports (maintained by the Department of Health), and hospital discharge data (provided through the Pennsylvania Health Care Cost Containment Council) to track fatalities and identify the types of injuries and the associated costs.

Based on this description, it appears that CODES would be a primary source for the information required to address the relationship between motorcycle crashes, helmet use and head trauma, and respond to the questions posed in HR 349. Department of Health officials indicated, however, that, as of June 2006, CODES data linkages for motorcycle crashes was not yet complete.

In seeking the data necessary to address the questions posed in HR 349, LB&FC staff also conferred with representatives of the Pennsylvania medical community, including persons representing the Pennsylvania Emergency Health Services Council, the Hospital and Healthsystem Association of Pennsylvania (HAP), the Pennsylvania College of Emergency Physicians, and the Pennsylvania Trauma Systems Foundation.

We subsequently 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.

During the course of this project, the LB&FC staff also learned about existing studies or data collection projects taking place in the state, including one at two hospitals within the Conemaugh and Geisinger Health Systems and another at the University of Pittsburgh. The report provides information on the objectives and status of this research. 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, Trauma Registry Coordinator, of the Pennsylvania Trauma Systems Foundation. The information presented in this report would not have been possible without their efforts.

The LB&FC staff also expresses its gratitude to Robert Cooney, EMS Program Specialist, Bureau of Emergency Medical Services, Department of Health, and Joe Martin, Director of Communications and Education, and Joanne Nelson, Supervisor of the Special Request Unit, both of the Pennsylvania Health Care Cost Containment Council.

## **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

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### 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.”<sup>1</sup>

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.

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<sup>1</sup>A selected bibliography of research on motorcycle helmet usage is included in Appendix E.

As of June 2006, 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 had no helmet use law. (See Appendix D for a breakdown of individual state requirements.)

## **B. Legal Background of 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. 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**  
A cataclysm is a cloudburst, cyclone, earthquake, flood, hurricane, lightning, tidal wave, torrential rain, tornado, volcanic eruption, etc. Crashes that result from a cataclysm are not reportable.
- **Deliberate Intent**  
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, (see Appendix B) provides police investigating the motorcycle crash the ability to indicate the type of helmet (whether no helmet, full helmet,  $\frac{3}{4}$  style helmet, half helmet style, or unknown), whether the helmet stayed on, and whether the helmet has a DOT or Snell designation.

***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.)

***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 for 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.

## **D. 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 Calendar Years 2000 through 2005.

As shown on Table 1, the number of registered motorcycles grew by 103,654, or 48.3 percent, over the six-year period examined. As defined by PENNDOT, this figure includes regular motorcycles, motorized pedalcycles, and motor-driven cycles.

Table 1

**Pennsylvania Motorcycle Registrations and Licensed Motorcyclists**  
(CY 2000 Through CY 2005)

<u>Calendar Year</u>	<u>Motorcycle Registrations<sup>a</sup></u>	<u>Licensed Motorcyclists<sup>b</sup></u>
2000.....	214,629	741,750
2001.....	237,276	739,192
2002.....	248,775	749,071
2003.....	267,826	755,068
2004.....	291,015	762,271
2005.....	318,283	772,201

<sup>a</sup>Figures shown include registrations for regular motorcycles, motorized pedalcycles (mopeds), and motor-driven cycles.

<sup>b</sup>Under Pennsylvania law, licensed motorcyclists under the age of 21 are required to wear protective headgear. As of CY 2005, approximately 0.3 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.

### III. Sources of Data on the Incidence, Severity, and Outcomes of Motorcycle Crashes

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#### A. 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 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. (See Appendix B for a copy of the AA-500.)

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 major 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 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." 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,  $\frac{3}{4}$  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. Pennsylvania Department of Health EMS Patient Care Reports**

### **EMS Patient Care Reports**

The Emergency Medical Services Act of 1985 grants authority to the Department of Health to require the collection and maintenance of standardized patient data and information by licensed ambulance services in Pennsylvania. The Act requires ambulance service personnel to complete a summary for each call to which they respond that results in patient care, assessment, or refusal of the patient to be assessed. The Department is to collect data and information regarding patients admitted to a facility through the emergency department, a trauma center, or directly to a special care unit. The Department of Health is also mandated to prescribe information to be included in the reports and to establish data elements included in Patient Care Reports (PCRs).<sup>1</sup>

To this end, the Department of Health developed a standardized PCR to provide data and information relating to patient assessment and care as mandated by the Emergency Medical Services Act of 1985. EMS personnel complete a PCR for every call to which they respond that results in patient care, assessment, or refusal of the patient to be assessed.

According to the Department of Health, there are 16 regional EMS councils serving 983 ambulance services in Pennsylvania.<sup>2</sup> In 2005, over 1.7 million PCRs were submitted by ambulance services licensed in Pennsylvania. The Department of Health’s Bureau of Emergency Medical Services (EMS) compiles over one million PCRs annually from EMS personnel regarding patient transports. EMS Bureau officials indicated that between 4,000 and 5,000 PCRs are processed annually for individuals involved in motorcycle crashes. If practicable given the nature and extent

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<sup>1</sup>The Pennsylvania Emergency Health Services Council (PEHSC) advises the Department of Health on data elements included in Patient Care Reports.

<sup>2</sup>The Department of Health issues ambulance services licenses according to the Emergency Medical Services Act of 1985.

of injuries sustained and considerations of time and distance, EMS personnel transport patients involved in crashes sustaining moderate or life threatening injuries to the nearest of the state's 26 trauma centers accredited by the Pennsylvania Trauma Systems Foundation.

EMS personnel make a determination of the patient's condition both at the scene of the crash and at the receiving facility. The three injury severity levels used at the scene of the crash are "minor," "moderate," and "life threatening." This determination is partially based upon the EMS personnel's evaluation of the patient using the patient's vital signs, including the "Glasgow Coma Scale," which measures eye, verbal, and motor responses of individuals.

Each ambulance service must designate a member of the ambulance crew responsible for completing all PCRs. Within 24 hours following the conclusion of services to the patient, the ambulance service must complete the full PCR and transmit the data to the receiving medical facility. Ambulance services licensed in Pennsylvania are required to file all completed PCRs within 30 days of the incident with the EMS council assigned responsibilities for the region in which the ambulance service is based. Electronic reporting of PCRs is a process conducted in accordance with uniform software requirements established by the Department of Health. According to the Department of Health, approximately 92 percent of Pennsylvania ambulance services used electronic data collection in 2005.

The EMS Bureau's PCR database includes a number of data fields relevant to motorcycle crashes and involved drivers and passengers. As shown on Exhibit 1, relevant data fields in EMS PCRs include the type of incident, safety devices used (of which "helmet" is an option), the location of the incident, the site on the body and type of injury or injuries sustained, the patient condition both at the scene of the crash and at the receiving facility, and the outcome or final disposition of each individual involved in a crash.

PCRs are compiled in a central database maintained by the EMS Bureau, and are then to be linked with PENNDOT crash records and Pennsylvania Health Care Cost Containment Council hospital discharge data as the second data point in Pennsylvania's Crash Outcome Data Evaluation System (CODES) Project.

According to officials in the Department of Health's EMS Bureau, the data set for PCRs will be modified in 2007 to meet the new national standard. Additionally, an integrated system is planned, which will permit real-time electronic data transfer directly from responding EMS vehicles.

Exhibit 1

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**Data Fields in EMS Patient Care Reports  
Relevant to Motorcycle Crash Patients**

1. Incident Type
  - a. Motorcycle
2. Safety Devices
  - a. Helmet
  - b. Not Available/Used
  - c. Unknown
3. Incident Location
  - a. Traffic Way 55+ MPH
  - b. Other Traffic Way
4. Injury Site/Type
  - a. Head
    - i. Amputate
    - ii. Blunt
    - iii. Burn/Elec.
    - iv. Penetrate
    - v. Fracture/Dislocation
    - vi. Soft-Closed
    - vii. Soft-Open
5. Patient Condition
  - a. On Scene
    - i. Life Threatening
    - ii. Moderate
    - iii. Minor
  - b. At Facility
    - i. Improved
    - ii. Stable
    - iii. Unstable
    - iv. Worse
6. Response Outcome
  - a. Transported
  - b. Care Transferred
  - c. Cancelled
  - d. Refused
  - e. False Call
  - f. No Patient Found
  - g. Privately Owned Vehicle (P.O.V.)
  - h. Treatment/No Transport
  - i. Standby
  - j. Dead on Arrival (D.O.A.)
  - k. Other

Source: Developed by LB&FC staff using information obtained from the PA Department of Health.

## **C. Health Care Cost Containment Council Hospital Discharge Data**

The Pennsylvania Health Care Cost Containment Council (PHC4) was statutorily created in 1986 (Act 1986-89) to address rapidly rising health care costs by encouraging competition in the health care market. In this regard, the Council's strategy includes:

- giving comparative information about the most efficient and effective health care providers to individual consumers and group purchasers of health services; and
- giving information to health care providers that they can use to identify opportunities to contain costs and improve the quality of care they deliver.

The Health Care Cost Containment Act (as amended by Act 2003-14) specifically assigns the Council three primary responsibilities:

1. to collect, analyze, and make available to the public data about the cost and quality of health care in Pennsylvania;
2. to study, upon request, the issue of access to care for those Pennsylvanians who are uninsured; and
3. to review and make recommendations about proposed or existing mandated health insurance benefits upon request of the legislative or executive branches of the Commonwealth.

The Council collects over 4.3 million inpatient hospital discharge and ambulatory/outpatient procedure records each year from hospitals and freestanding ambulatory surgery centers in Pennsylvania. This data, which includes facility charge and treatment information, is collected on a quarterly basis and is then verified by PHC4 staff. The Council also collects data from third-party payors on a voluntary basis.

The Council shares this data with the public through free public reports and an interactive database on their website. For a fee, the Council produces customized reports and data sets through its Special Requests Unit for a wide variety of users including hospitals, policy-makers, researchers, physicians, insurers, and other group purchasers. The Health Care Cost Containment Act as well as PHC4 regulations prescribe conditions under which Council data is accessible to the public, especially so as to maintain the confidentiality of patients.

### **PHC4 Involvement With CODES**

The PA Health Care Cost Containment Council is one of the principal data suppliers to the Crash Outcome Data Evaluation System (CODES), by providing hospital discharge data. Hospital discharge data from hospitals (excluding



information from nursing facilities) are linked with crash records supplied by PENNDOT and EMS patient care reports supplied by the Department of Health to track individuals through the health care system from the scene of the crash through outcome, using the technique of “probabilistic linkage.”

PHC4 data becomes available to CODES on a quarterly basis. According to Council officials, current data through the third quarter of 2005 (with the final quarter expected to be available before the end of June 2006) was available as of the end of May 2006. However, the processing of such information through the CODES linkage methodology is time consuming and, as indicated in the CODES section, is currently ongoing for 2003 and 2004.

Nevertheless, hospital discharge records are a key element in the task of determining whether an increase in head trauma deaths and injuries has occurred since the repeal of the Helmet Law in 2003. PHC4 officials were willing to make available data on trauma patients involved in motorcycle crashes. For example, the Council offered to provide information on the number of fatalities that occurred in the hospital and/or information on crash survivors according to principal diagnosis at discharge. Discharge reports, however, do not identify whether patients who had been in motorcycle crashes had worn helmets.

As is the case with other data sources, there are certain limitations regarding the data (in the context of our study data needs) which must be recognized. For example, the PHC4 database will not show data on persons who were discharged from an emergency department, at the crash scene, or in transit to a hospital. Also, outcome assessment concludes at discharge from the hospital; consequently, the death of an individual following discharge (e.g., to hospice care) would not be recorded in the PHC4 database.

## **D. The Crash Outcome Data Evaluation System**

### **System Overview**

The Crash Outcome Data Evaluation System (CODES) is designed to electronically track individuals injured or killed due to being involved in motor vehicle crashes. Tracking occurs 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. Individuals are tracked by linking crash records, EMS reports, and hospital discharge data to track fatalities and identify the types of injuries and the costs that result from specific driver, vehicle, and crash characteristics.

CODES originated from provisions of the federal Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991, which mandated a study of the benefits of safety belts and motorcycle helmets in crashes. The National Highway Traffic

Safety Administration (NHTSA) expanded the scope of the Congressional mandate to include the severity and costs of non-fatal injuries. The original study tracked the medical and financial outcome of individuals involved in crashes through establishing a general link between crash records, EMS records, and hospital discharge information. Congress provided NHTSA \$5 million dollars for the initial study, which was completed in February 1996.

In the initial report, NHTSA combined state-specific information on the benefits of safety belts and helmets. To compile state-specific data, NHTSA administered a grant program to states which “demonstrated the existence of and capability to access computerized state crash, EMS, emergency department, hospital, outpatient, rehabilitative, long term care, and insurance claims data.” States were also required to establish linkage among data sources to track individual cases from a crash through final outcome. Any state agency, non-profit organization, or educational institution was eligible to develop and coordinate a coalition of data owners and users to perform the linkage. Grants were made to a single applicant in a state who would be responsible for obtaining cooperation of the owners and users of the data.

CODES uses the technique of “probabilistic linkage” to connect crash records, EMS records, and hospital discharge data for each individual injured or killed due to being involved in a crash. This method utilizes unique identifiers such as name, age, day and month of birth, social security number, and other data elements that decisively identify a person. States vary in their use of these data elements. Pennsylvania CODES uses the unique identifiers of age, sex, date of crash, and location of crash to identify individuals involved in a crash.

Probabilistic linkage produces an estimate of the probability that a matched pair is a valid match. The probability that two data records pertain to the same individual and event (a true link) can be calculated automatically by comparing fields which are common to the two records. Agreements increase the probability for a true link while disagreements decrease the probability. An attempt is made only to include high-probability linked pairs for analysis and planning purposes.

CODES linked datasets are produced using a special CODES program, Microsoft Access, and SAS software. To compensate for the imperfect data, linkage imputation techniques are implemented to generate sets of data that can be used to statistically fill the gaps. Exact matches using specific join fields select the candidate pairs for linkage. Multiple passes are necessary to ensure the inclusion of as many cases as possible among the candidate pairs. The quality of the linked candidate pairs is then evaluated, and the true matches identified, by using match specification fields that are the same for all passes.

Most of the administrative statewide datasets available to CODES researchers lack common unique personal identifiers, and, because of paper-based data collection and an emergency environment, have missing and/or inaccurate data. As a result, the records that are available and have complete, accurate information are more likely to link, but they can represent only a relatively small and potentially biased sample from the actual population of true record pairs. Eliminating the records with missing data, or guessing what the missing data should be, weakens the data for analysis.

To participate in CODES, states must provide two years of statewide, electronic data pertaining to:

- Crash Records
- Emergency Medical Services (EMS) or Emergency Department Data
- Hospital Discharge Data
- Death Records
- Other State-Specific Traffic Records

NHTSA has funded almost two-thirds of the states to develop linkage capabilities necessary to implement CODES. Technical assistance for states is available from NHTSA through CODES experts, who advise how to obtain state data, resolve barriers related to confidentiality and privacy, prepare the files for linkage, and assist in the development of analytical uses for linked state data.

State advisory committees are also established to perfect data linkage techniques, implement the CODES software, and assist in the development of analytical uses for linked state data. A state board of directors controls access to linked CODES data in compliance with state privacy and confidentiality legislation and regulations.

## **The Pennsylvania CODES**

The Pennsylvania Department of Health has been the lead agency in Pennsylvania's CODES since the program's inception in 1992. Pennsylvania was among the original seven states awarded grants in 1992 to implement CODES. NHTSA funded the development of Pennsylvania's data linkage system for CODES. The Department of Health annually receives a federal grant to fund CODES program operations each fiscal year. Since the implementation of CODES, no direct matching funds have been expended by the Department of Health for CODES implementation. Personnel costs accruing from departmental personnel working on CODES are the only state costs associated with the project.

The Pennsylvania CODES Advisory Committee consists of a series of "data owners" which maintain a segment of CODES program operations. Officials in the

Department of Health's EMS Bureau estimated the number of active data owners to be approximately six to eight.

The following data owners are members of the Pennsylvania CODES Advisory Committee:

- Department of Health (Vital Statistics and EMS Bureau)
- The Pennsylvania Health Care Cost Containment Council (PHC4)
- Pennsylvania State Police
- Pennsylvania Trauma Systems Foundation
- PENNDOT

Officials are not aware of any reports, recommendations, or findings that have been issued by the members in the past two years, nor have there been any reports on CODES outcome data in the past two years.

Pennsylvania's CODES links the following data:

- Crash records from PENNDOT's Bureau of Highway Safety and Traffic Engineering's Crash Reporting System
- EMS Patient Care Reports (PCRs) from the Department of Health's Emergency Medical Services (EMS) Bureau
- Acute care hospital discharge data from PHC4

An official responsible for CODES data linkage in DOH's EMS Bureau further detailed the linkage process used with CODES. The official distinguished between the steps in the linkage process as shown on Exhibit 2.

As of June 2006, CODES data linkage for 2003 was being completed by a contracted vendor and 2004 data linkage was being completed in-house by Department of Health staff. CODES data linkage had not yet begun for 2002 due to a PENNDOT data entry backlog of crash records. Completed CODES data are available for 2000 and 2001; although linkages were completed under a prior method of probabilistic linkage.

It is the intent of the EMS Bureau to complete CODES linkage in-house and on a continuous basis beginning with 2005 data. Bureau personnel have received training on current SAS reporting protocols and have increased staffing to complete CODES linkage in-house. When completed, CODES output will also include total per-patient costs of treatment received in an acute care facility.

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## The CODES Linkage Process

1. Crash Records---EMS Reports
  - a. Under the old standard of “high probability” matching, approximately 60,000 records were successfully matched. Currently, approximately 80,000 records are matched annually (for all motor vehicle crashes statewide).
2. EMS Reports---PHC4 Discharge Data
  - a. Approximately 12,000 records are successfully matched during this linkage phase.
3. Crash Records--EMS Reports--PHC4 Discharge Data (“Triple Imputation”)
  - a. This linkage phase, labeled “triple imputation,” produces a “very small number” of linked records.

Hospital discharge data is reported quarterly from the PHC4. Within 30 days of receipt of these reports, 16 regional councils report all data to DOH’s EMS Bureau. It is necessary to track discharge data through the first quarter of the following year to establish a probabilistic linkage of this information to crash and EMS reports for certain individuals.

Hospital discharge data from PHC4 linked as the third phase of CODES includes only discharge data from acute care facilities.<sup>a</sup> According to officials in DOH, this excludes discharge data from rehabilitation centers and nursing homes.

Linkage of data from the crash reports through treatment and discharge is completed in an SAS database program. A query of information specific to individuals involved in motorcycle crashes is possible when CODES linkage is completed. Attempts are made to exclude any records with low probability matches (outliers).

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<sup>a</sup>Any facility with an emergency department is classified as an acute care facility.

Source: Department of Health.

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Officials in DOH indicated that a large number of variations in coding are used by PENNDOT, DOH, and federal coding systems pertaining to municipality and county identification. Pennsylvania CODES also intends to convert to an improved federal data coding dictionary system by 2007. The revised CODES method now uses an imputation method to compensate for missing variables.

Officials in the EMS Bureau could not comfortably cite a level of reliability for the CODES linked data. However, an official estimated that under the old method of “high probability” matching, the reliability rate was approximately 40 percent. With the current imputation method, the reliability of matching is estimated to be approximately 80 percent. Following completion of improvements being

made in the triple imputation method, the level of reliability will be over 80 percent. In aggregate, officials cited a reliability range of 50-75 percent.

Pennsylvania became a CODES “network state” in 2001. This group of states work collaboratively to develop “standardized processes, in compliance with state confidentiality and data release policies, to facilitate access by NHTSA analysts to the CODES linked data.” Officials in the Department of Health involved with the CODES Project were assigned the responsibility of focusing specifically on injuries and fatalities involving teenage drivers in Pennsylvania. Other CODES “network” states, of which there are 17, will be investigating helmet usage in more detail.

The other areas of concentration (being conducted by other network states) are rural crashes and motorcycle crashes. The network states are working on standardizing reports within each state with the intention of permitting all network states to examine each of these three areas on a continual basis. Additionally, beginning July 1, 2006, all CODES states will be looking more intensively at motorcycle crash data.

### **Limitations of CODES**

According to a CODES linkage manual issued by NHTSA, the following common outcome variations affect the quantity and quality of records available for linkage:

- Some victims may be injured in a crash occurring in a state different from where medical care is subsequently provided.
- Crash victims may be variably declared dead at the scene of the crash, while in transit to a medical facility, or when receiving treatment at an emergency department and may not be included in some state databases.
- Some victims are transported by personal vehicle directly to a medical facility.
- Individuals involved in crashes may be treated by EMS personnel at the scene of a crash and may proceed home, thus bypassing any medical records.
- Only in cases of the most severe injuries may some patients be admitted as inpatients in medical facilities.
- Death may occur as an inpatient, or following discharge home or to another medical facility.
- The date of death may occur beyond the standard 30-day period of reporting a fatality on crash records.

Through discussions with officials responsible for administering CODES in the EMS Bureau, several additional limitations were learned related to identifying motorcyclists killed or injured in crashes.

CODES may be unable to track cases in which individuals may have refused treatment or, following treatment by EMS personnel and from an acute care facility, were determined not to have a head or brain injury but sustained an injury that remained latent and not immediately recognized by medical personnel. Treatment may then later be completed by a primary care physician or other rehabilitation service. Officials responsible for CODES linkage in the EMS Bureau indicated that latent head injury cases remain a “ragged edge” of questionable probability of being included in CODES output. For such cases to have any possibility of linkage through CODES, patient discharge data for treatment of this latent injury would have to indicate that the injury was a direct result of the motorcycle crash and be linked to the original PCR (if completed) at the time of a crash. Cases in which an individual is discharged from an emergency room are not tracked by CODES.

DOH also does not include death records in CODES. As a result, some motorcyclists who are pronounced dead at the scene of a crash may not be included in CODES output if a linkage cannot be established between PENNDOT crash records and a completed EMS PCR. In such cases, CODES may possess no further detail beyond the PENNDOT crash record for the fatal crash.

Finally, officials in the EMS Bureau indicated that some data irregularities may exist due to other safety devices being used by individuals in automobiles (lap belt/shoulder belt, and others) being miscoded as helmet usage.

## **E. The Pennsylvania Statewide Trauma Registry**

### **The PA Trauma Outcome Study (PTOS)**

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 400,000 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 and 10 Level II 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 (PTOS)**

Patients admitted for treatment of a diagnosis of trauma (ICD-9-CM injury codes 800-995)<sup>3</sup> 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

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<sup>3</sup>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.



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 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.

Excluding: Patients who only suffer a solitary hip fracture, with no other injuries (contusion 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, i.e., 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 2005. 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 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.

## F. Special Studies/Data Collection

### 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.

Secondary objectives include:

- To determine if inpatient mean total acute care and downstream charges and RCC are higher for non-helmeted versus helmeted motorcycle victims admitted to two Pennsylvania trauma centers with head and face injuries.
- To determine if the mean time of return to full duty work (at previous level of employment) is shorter for helmeted or non-helmeted motorcycle victims admitted to two Pennsylvania trauma centers with head and face injuries.
- To determine if non-helmeted or helmeted motorcycle victims admitted to two Pennsylvania trauma centers have increased incidence and severity of head and face injuries.
- To determine if the incidence and severity of non-helmeted motorcycle accident victims is higher than helmeted counterparts treated and released from emergency departments for face and head injuries.
- To determine if non-helmeted motorcycle victims die at scene or in emergency departments (from head and face injuries) more often than helmeted motorcycle crash victims.
- To determine if more helmeted or non-helmeted motorcycle accident victims require no immediate medical care for head and face injuries.

The study began seeking patients for enrollment in early 2005. The expected total enrollment for the study is 480 subjects. The study's principal investigator indicated that approximately 55 enrollees were entered into the study as of June 2005. The study is expected to conclude in mid- to late-2007.

Eligible enrollees are English-speaking patients 18 years of age or older involved in motorcycle crashes (drivers and passengers) in which head or face injuries were sustained who are served by trauma centers, emergency departments, or coroners. Also eligible are patients served by Pennsylvania police but not requiring acute care medical services.

The study does not include the following:

- Non-English speaking patients
- Patients served by a trauma center, emergency department, or coroner without head or face injuries
- Patients less than 18 years of age
- Moped crashes
- Motorized bicycle crashes
- Parked motorcycle crashes
- Off-road motorcycle crashes (not occurring on a public street or highway)
- Dirt bike or motor-cross crashes involving vehicles not licensed for highway use

All surviving enrollees sustaining head or facial injuries evaluated at the two participating trauma centers complete an informed consent form prior to entry into the study. As of June 2006, a full-time study coordinator was working on enrollment and preliminary tabulation of injuries and quantification of cost data. Cost data is also planned to include an assessment of the adequacy of medical insurance coverage of motorcyclists involved in crashes to cover total medical costs for the treatment of injuries.

## **University of Pittsburgh**

The University of Pittsburgh's Center for Injury Research and Control is participating in an ongoing "E-Code analysis" project under contract with the Pennsylvania Department of Health. This project utilizes Pennsylvania Health Care Cost Containment Council (PHC4) hospital discharge and medical cost data. Analyses are reportedly being completed of the number of motorcyclists sustaining head injuries (including traumatic brain injuries) discharged from Pennsylvania hospitals, trends in medical costs incurred by motorcyclists sustaining head injuries, and the amount of medical costs incurred by payer source.

## IV. Motorcycle Crash Data From PENNDOT's Crash Reporting System, CY 2000 Through CY 2005

As discussed in Section III, 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 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 9 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, 2001, 2003, 2004, and 2005. Complete crash statistics for CY 2002 were not available at the time of the request due to a data entry backlog involving a vendor contracted by PENNDOT. The following is a summary and analysis of the data available from the PENNDOT database as of March 31, 2006.<sup>1</sup>

### A. Number of Motorcycle Crashes

The total number of crashes in which a motorcycle was involved in Pennsylvania increased by 42.1 percent between CY 2000 and CY 2005. During the same period, the total number of motorcycle registrations increased by 48.3 percent while the number of motorcycle licenses issued grew by 4.1 percent. This data is not directly linked to helmet use by motorcycle operators and passengers.

<b>Number of Motorcycle Crashes in Pennsylvania</b> (CY 2000 to CY 2005)				
<u>CY</u>	<u>Total Crashes</u>	Number of:		
		<u>Motorcycle Registrations</u>	<u>Motorcycle Licenses</u>	<u>Crashes Per 10,000 Registrations</u>
2000.....	2,842	214,629	741,750	132.4
2001.....	2,984	237,276	739,192	125.8
2002.....	NA <sup>a</sup>	248,775	749,071	NA
2003.....	3,057	267,826	755,068	114.1
2004.....	3,621	291,015	762,271	124.4
2005.....	4,039	318,283	772,201	126.9

<sup>a</sup>Not available. PENNDOT data entry incomplete as of June 2006.

<sup>1</sup>**Important Note:** PENNDOT provided the following statement regarding this database: "It should be noted that 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."

## B. Number of Motorcyclists Killed and Injured

Fatalities rose from 150 in CY 2000 to 204 in CY 2005, a 36.0 percent increase, while injuries grew by 53.4 percent, from 2,577 in CY 2000 to 3,954 in CY 2005. In the table below, the category “other” is provided, which includes those “not injured” as well as those whose injury status is “unknown.” This figure remained fairly steady at about 500 each year.

Number of Motorcyclists Killed and Injured (CY 2000 to CY 2005)						
<u>CY</u>	<u>Total</u>	<u>Killed</u>	<u>% Inc. (+) Dec. (-)</u>	<u>Injured</u>	<u>% Inc. (+) Dec. (-)</u>	<u>Other<sup>a</sup></u>
2000 .....	3,235	150	--	2,577	--	508
2001 .....	3,436	132	-12.0%	2,800	+8.7%	504
2002 .....	NA <sup>b</sup>	129	-2.3	NA <sup>b</sup>	NA <sup>b</sup>	NA <sup>b</sup>
2003 .....	3,546	156	+20.9	2,931	+4.7	459
2004 .....	4,165	158	+1.3	3,523	+20.2	484
2005 .....	4,641	204	+29.1	3,954	+12.2	483

<sup>a</sup>Includes “not injured” and whose injury status is “unknown.”  
<sup>b</sup>Not available. Data entry incomplete.

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 204.

During the same period, the number of motorcyclists injured increased by 592 to 3,523, or 20.2 percent in the first full year following the Helmet Law repeal. Injuries increased by another 12.2 percent in CY 2005 to 3,954. As shown below, 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.

## C. Motorcyclist Fatalities Among Operators and Passengers

During the six-year period we examined, 872, or 94 percent of all 929 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 194 in 2005. The number of fatalities among passengers has remained fairly constant with the exception being CY 2004 in which passenger deaths increased to 15.

<b>Motorcyclist Fatalities, Drivers and Passengers</b> (CY 2000 to CY 2005)					
<u>CY</u>	<u>Driver</u>	<u>Passenger</u>	<u>Other</u>	<u>Total Fatalities</u>	<u>Per 10,000 Registered Motorcycles</u>
2000.....	143	7	--	150	7.0
2001.....	125	7	--	132	5.6
2002.....	120	9	--	129	5.2
2003.....	147	9	--	156	5.8
2004.....	143	15	--	158	5.4
2005.....	194	9	1	204	6.4

#### **D. Motorcyclist Injuries Among Operators and Passengers**

During the six-year period we examined, 14,057, or 89 percent of all 15,785 motorcyclist injuries involved the motorcycle operator/driver. In 2004, the first full year after repeal of the Helmet Law, injuries among motorcycle operators increased by 23 percent, from 2,577 in CY 2003 to 3,157 in CY 2004. From CY 2004 to CY 2005, injuries rose another 12 percent. The number of injuries among passengers also rose in CY 2004, but not as much as injuries to drivers. Passenger injuries increased by 5 percent in CY 2004 and by another 18 percent in CY 2005. The table also shows that injury rates per 10,000 registered motorcycles has generally remained relatively stable at about 120 per 10,000 registered motorcycles.

<b>Motorcyclist Injuries</b> (CY 2000 to CY 2005)						
<u>CY</u>	<u>Driver</u>	<u>Passenger</u>	<u>Other</u>	<u>Unknown</u>	<u>Total Injuries</u>	<u>Per 10,000 Registered Motorcycles</u>
2000.....	2,300	242	0	35	2,577	120.1
2001.....	2,500	289	0	11	2,800	118.0
2002.....	(PENNDOT data entry incomplete as of June 2006.)					NA
2003.....	2,577	344	0	10	2,931	109.4
2004.....	3,157	360	3	3	3,523	121.1
2005.....	3,523	425	1	5	3,954	124.2

#### **E. 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 the "Patient Care Reports").

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.

**1. Helmet Usage in Fatal Crashes.** In total, 929 motorcyclists died in crashes during the six-year period we examined. As the table below shows, 261 persons died in motorcycle crashes in the two years for which information is available (2001 and 2002) prior to repeal compared to 362 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 repeal (5.4 fatalities per 10,000 registered motorcycles in 2001 and 2002 compared to 5.9 fatalities per 10,000 registered motorcycles in 2004 and 2005).

<u>CY</u>	<u>Helmeted</u>	<u>Non-Helmeted</u>	<u>Improper Use</u>	<u>Bike Helmet</u>	<u>Unknown Use</u>	<u>Unknown</u>	<u>Total Killed</u>
2000 .....	103	24	0	0	0	23	150
2001 .....	103	17	0	0	3	9	132
2002 .....	90	23	5	1	1	9	129
2003 .....	118	27	3	2	0	6	156
2004 .....	74	70	6	2	0	6	158
2005 .....	106	87	3	1	0	7	204

**2. Helmet Usage in Injury Crashes.** In total, 15,785 motorcyclists were injured in crashes during the six-year period we examined. As noted above, police officers who respond to the scene of a crash classify the severity of injuries sustained by the individuals involved as follows:<sup>2</sup> (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 below, over the six-year period, police officers classified 2,420 or 15.3 percent of the total as “major” 6,195 or 39.2 percent as “moderate,” and 6,036 or 38.7 percent as “minor.”

<sup>2</sup>See page 8 for definitions of injury severity.



<b>Motorcyclist Injuries, by Reported Severity</b> (CY 2000 to CY 2005)							
<u>CY</u>	<u>Major Injury</u>	<u>Moderate Injury</u>	<u>Minor Injury</u>	<u>Unknown Severity</u>	<u>Total Injuries</u>	<u>Unknown If Injured</u>	<u>Not Injured</u>
2000 .....	392	1,095	1,089	1	2,577	189	319
2001 .....	447	1,178	1,175	0	2,800	104	400
2002 .....	(PENNDOT data entry incomplete as of June 2006.)						
2003 .....	429	1,144	1,261	97	2,931	99	360
2004 .....	534	1,318	1,251	420	3,523	90	394
2005 .....	618	1,460	1,260	616	3,954	77	406

(1) **Major Injuries.** As the table below shows, 839 persons sustained a major injury as a result of a motorcycle crash in the two years for which information is available (2000 and 2001) prior to the repeal compared to 1,152 major injuries in the first two years after repeal. When the number of registered motorcycles is taken into account, the average annual injury rate is 18.6 per 10,000 registered motorcycles in 2000 and 2001 compared to an average annual rate of 18.9 per 10,000 registered motorcycles in 2004 and 2005.

<b>Reported Helmet Usage in Crashes Involving "Major Injury" to Motorcyclists</b> (CY 2000 to CY 2005)								
<u>CY</u>	<u>Helmeted</u>	<u>Non-Helmeted</u>	<u>Improper Use</u>	<u>Bicycle Helmet</u>	<u>Unknown If Used</u>	<u>Unknown</u>	<u>Total Major Injuries</u>	<u>Per 10,000 Registered Motorcycles</u>
2000.....	269	64	NA	NA	0	59	392	18.3
2001.....	345	57	7	0	1	37	447	18.8
2002.....	(PENNDOT data entry incomplete as of June 2006.)							NA
2003.....	302	103	6	1	0	17	429	16.0
2004.....	250	247	8	1	0	28	534	18.3
2005.....	270	302	6	3	1	36	618	19.4

(2) **Moderate Injuries.** As the table on the next page shows, 2,273 persons sustained a moderate injury as a result of a motorcycle crash in 2000 and 2001 prior to the repeal compared to 2,778 following the repeal in 2004 and 2005. This translates to an average annual injury rate of 50.3 per 10,000 registered motorcycles in 2000 and 2001 compared to an average annual injury rate of 45.6 per 10,000 registered motorcycles in 2004 and 2005.

**Reported Helmet Usage in Crashes Involving "Moderate Injury" to Motorcyclists**  
(CY 2000 to CY 2005)

<u>CY</u>	<u>Helmeted</u>	<u>Non-Helmeted</u>	<u>Improper Use</u>	<u>Bicycle Helmet</u>	<u>Unknown If Used</u>	<u>Unknown</u>	<u>Total Moderate Injuries</u>	<u>Per 10,000 Registered Motorcycles</u>
2000 .....	753	163	NA	NA	1	178	1,095	51.0
2001 .....	897	170	13	2	4	92	1,178	49.6
2002 .....	(PENNDOT data entry incomplete as of June 2006.)							NA
2003 .....	819	235	10	4	1	75	1,144	42.7
2004 .....	776	468	5	11	1	57	1,318	45.3
2005 .....	810	584	11	3	0	52	1,460	45.9

(3) Minor Injuries. As the table below shows, 2,264 persons sustained a minor injury as a result of a motorcycle crash in 2000 and 2001 prior to the repeal compared to 2,511 persons following the repeal in 2004 and 2005. This translates to an average annual injury rate of 50.1 per 10,000 registered motorcycles in 2000 and 2001 compared to 41.2 per 10,000 registered motorcycles in 2004 and 2005.

**Reported Helmet Usage in Crashes Involving "Minor Injury" to Motorcyclists**  
(CY 2000 to CY 2005)

<u>CY</u>	<u>Helmeted</u>	<u>Non-Helmeted</u>	<u>Improper Use</u>	<u>Bicycle Helmet</u>	<u>Unknown If Used</u>	<u>Unknown</u>	<u>Total Minor Injuries</u>	<u>Per 10,000 Registered Motorcycles</u>
2000.....	754	145	NA	NA	0	190	1,089	50.7
2001.....	870	167	12	3	10	113	1,175	49.5
2002.....	(PENNDOT data entry incomplete as of June 2006.)							
2003.....	882	282	7	10	0	80	1,261	47.1
2004.....	728	435	19	7	2	60	1,251	43.0
2005.....	769	414	11	4	0	62	1,260	39.6

(4) Injuries of Unknown Severity. In the three reporting years in which the helmet repeal law was in effect, the numbers of injuries of unknown severity among both helmeted and non-helmeted riders have increased steadily. 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.

**Reported Helmet Usage in Crashes Involving Injuries of "Unknown Severity" to Motorcyclists**  
(CY 2000 to CY 2005)

<u>CY</u>	<u>Helmeted</u>	<u>Non-Helmeted</u>	<u>Improper Use</u>	<u>Bicycle Helmet</u>	<u>Unknown If Used</u>	<u>Unknown</u>	<u>Total</u>
2000 .....	0	1	0	0	0	0	1
2001 .....	0	0	0	0	0	0	0
2002 .....	(PENNDOT data entry incomplete as of June 2006.)						
2003 .....	70	15	1	0	0	11	97
2004 .....	225	155	4	4	1	31	420
2005 .....	322	224	6	4	1	59	616

(5) Unknown If Injured. Individuals involved in motorcycle crashes are coded in this category when the investigating officer is unable to determine whether a vehicle operator or passenger was injured. 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.

<b>Reported Helmet Usage in Crashes Involving Motorcyclists With Unknown Injury Status</b> (CY 2000 to CY 2005)							
<u>CY</u>	<u>Helmeted</u>	<u>Non-Helmeted</u>	<u>Improper Use</u>	<u>Bicycle Helmet</u>	<u>Unknown If Used</u>	<u>Unknown</u>	<u>Total</u>
2000.....	107	32	0	0	0	50	189
2001.....	51	13	0	0	0	40	104
2002.....	(PENNDOT data entry incomplete as of June 2006.)						
2003.....	40	31	0	0	0	28	99
2004.....	19	33	0	0	0	38	90
2005.....	27	28	0	0	0	22	77

(6) Not Injured. Persons involved in motorcycle crashes, but not injured, numbered 1,879 over the period we examined. In 2000 and 2001, 719 persons were reported as not injured in 2000 and 2001 compared to 800 in 2004 and 2005.

<b>Reported Helmet Usage in Crashes Involving Motorcyclists Who Were "Not Injured"</b> (CY 2000 to CY 2005)								
<u>CY</u>	<u>Helmeted</u>	<u>Non-Helmeted</u>	<u>Improper Use</u>	<u>Bicycle Helmet</u>	<u>Unknown If Used</u>	<u>Unknown</u>	<u>Total Not Injured</u>	<u>Per 10,000 Registered Motorcycles</u>
2000.....	190	56	0	0	0	73	319	14.9
2001.....	224	52	0	0	39	85	400	16.9
2002.....	(PENNDOT data entry incomplete as of June 2006.)							NA
2003.....	219	83	4	1	2	51	360	13.4
2004.....	186	145	5	1	4	53	394	13.5
2005.....	213	152	1	0	2	38	406	12.8

## F. 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 2005. 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 (0.8 percent), Ohio (0.7 percent), Delaware (0.4 percent), and West Virginia (0.2 percent).

We also examined these six states for possible crash involvement trends during the three-year period. We found that crash involvement was relatively stable during this period for the states of Delaware, New York, Ohio, and West Virginia. However, the number of Maryland-registered motorcycles involved in Pennsylvania crashes increased from 15 in 2003 to 36 in 2004 and 35 in 2005. Also, the number of New Jersey-registered motorcycles increased from 50 in 2003 to 70 in 2004 and decreased to 62 for 2005.

## V. Motorcyclist Head Trauma Data From the Statewide Trauma Registry<sup>1</sup>

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

### A. Motorcycle Crash Patients<sup>2</sup> Admitted to Trauma Centers

"Major trauma patients" are admitted to Pennsylvania's 26 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 2 shows the total number of motorcycle crash patients admitted to the state's trauma centers during each year between 2000 and 2005.

Table 2

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#### Motorcycle Crash Patients Admitted to Trauma Centers (2000-2005)

<u>CY</u>	<u>Number Admitted to Trauma Centers</u>	<u>Percent Change</u>	<u>Per 10,000 Motorcycle Registrations</u>
2000.....	665	--	31.0
2001.....	748	+12.5%	31.5
2002.....	868	+16.0	34.9
2003.....	772	-11.1	28.8
2004.....	1,082	+40.2	37.2
2005.....	1,310	+21.1	41.2

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

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 40.2 percent. A further increase of 21.1 percent occurred in the following year. When viewed in

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<sup>1</sup>**Important Note:** The Pennsylvania Trauma Systems Foundation provides the following note to 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."

<sup>2</sup>Denotes all patients who met the criteria for inclusion in the PTOS as defined in Section III.

relation to motorcycle registrations, the number of motorcyclists admitted to a trauma center per 10,000 motorcycle registrations increased from 29 persons per 10,000 registrations in 2003 to 37 in 2004 and 41 in 2005.

Table 3 provides the number of motorcycle crash patients admitted to Pennsylvania trauma centers for calendar years 2000-2005 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 nearly doubled from the CY 2002 total; increasing from 69 in CY 2002 to 131 in CY 2003. This increase in non-helmeted admissions in CY 2003 occurred in a year in which the total number of trauma center admissions fell by 98 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 596 in CY 2003.

Table 3

**Helmet Usage Among Motorcycle Crash Patients  
Admitted to Trauma Centers**

CY	Total	% of Total	Patients Helmeted		Patients With No Helmet During Crash		Patients With Unknown Helmet Usage <sup>a</sup>	
			During Crash	% of Total	Crash	% of Total	Crash	% of Total
2000.....	665	100.0%	591	88.9%	42	6.3%	28	4.2%
2001.....	748	100.0	633	84.6	65	8.7	46	6.1
2002.....	870	100.0	746	85.7	69	7.9	45	5.2
2003.....	772	100.0	596	77.2	131	17.0	43	5.6
2004.....	1,082	100.0	606	56.0	433	40.0	37	3.4
2005.....	1,310	100.0	690	52.7	552	42.1	56	4.3

<sup>a</sup>Includes case in which sports equipment was coded as a protective device and in which trauma center registrars inappropriately coded a field for protective devices.

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

From CY 2003 to CY 2004, the number of helmeted admissions increased by only 10; from 596 in CY 2003 to 606 in CY 2004. During the same period, the number of non-helmeted admissions increased by 302; from 131 in CY 2003 to 433 in CY 2004, representing an increase of 230.5 percent on non-helmeted motorcycle crash patients. This occurred as the total number of motorcyclists admitted to Pennsylvania trauma centers increased by 310 between CY 2003 and CY 2004.

In CY 2005, the number of non-helmeted admissions increased by 119 from the CY 2004 total; from 433 in CY 2004 to 552 in CY 2005. The number of helmeted admissions increased by 84; from 606 in CY 2004 to 690 in CY 2005. This occurred

as the total number of motorcyclists admitted to Pennsylvania trauma centers increased from 1,082 in CY 2004 to 1,310 in CY 2005.

## **B. 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 4 provides detail on the number of motorcycle crash patients who sustained an Abbreviated Injury Scale head injury for calendar years 2000-2005.

Table 4

<b>Motorcycle Crash Patients Admitted to Trauma Centers With an AIS Head Injury (2000-2005)</b>			
<u>CY</u>	<u>Number Admitted to Trauma Centers</u>	<u>% Change</u>	<u>Per 10,000 Motorcycle Registrations</u>
2000.....	302	--	14.1
2001.....	339	+12.3	14.3
2002.....	388	+14.5	15.6
2003.....	382	-1.5	14.3
2004.....	564	+47.6	19.4
2005.....	647	+14.7	20.3

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 yearly between calendar years 2000 through 2002. (See Table 4) While the number of motorcyclists with an AIS head injury admitted to trauma centers fell by 1.5 percent between CY 2002 and CY 2003, an increase of 47.6 percent in admissions to trauma centers occurred in CY 2004. Between CY 2004 and CY 2005, motorcycle crash patient admissions to trauma centers with an AIS head injury increased at a reduced rate of 14.7 percent.

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 about 14 per 10,000 registrations. A slight increase occurred in CY 2002 with about 16 motorcyclists admitted to trauma centers with an AIS head injury per 10,000 motorcycle registrations.

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 per 10,000 motorcycle registrations. This total increased again in CY 2005 to about 20 motorcyclists per 10,000 motorcycle registrations.

Table 5

**Helmet Usage Among Motorcycle Crash Patients  
Who Suffered an AIS Head Injury  
(2000-2005)**

<u>Year</u>	<u>Total</u>	<u>Helmeted</u>	<u>% of Total</u>	<u>Non- Helmeted</u>	<u>% of Total</u>	<u>Patients With Unknown Helmet Use</u>	<u>% of Total</u>
2000 .....	302	268	88.7%	25	8.3%	9	3.0%
2001 .....	339	291	85.8	33	9.7	15	4.4
2002 .....	388	324	83.5	48	12.4	16	4.1
2003 .....	382	288	75.4	85	22.3	9	2.4
2004 .....	564	250	44.3	300	53.2	14	2.5
2005 .....	647	271	41.9	364	56.3	12	1.9

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 5.) The number of helmeted patients with an AIS head injury decreased from 324 in CY 2002 to 288 in CY 2003. During the same period, the number of non-helmeted patients with an AIS head injury increased from 48 in CY 2002 to 85 in CY 2003.

Calendar year 2004 was the first year in which the number of non-helmeted patients sustaining an AIS head injury exceeded the number of helmeted patients sustaining an AIS head injury. In CY 2004, the number of non-helmeted patients with an AIS head injury increased by 215; from 85 in CY 2003 to 300 in CY 2004. The number of helmeted patients with an AIS head injury decreased by 38 from CY 2003.

The number of non-helmeted patients with an AIS head injury again exceeded helmet patients in CY 2005; with an increase from 300 non-helmeted patients in CY 2004 to 364 non-helmeted patients in CY 2005. During the same period, the number of helmeted patients with an AIS head injury increased from 250 in CY 2004 to 271 in CY 2005.

AIS injury severity scores are determined for each PTOS patient at the time of discharge.<sup>3</sup> Trauma registrars in each of the state's 26 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).<sup>4</sup>

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

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.

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<sup>3</sup>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.

<sup>4</sup>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.



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 6 provides the number of motorcycle crash patients admitted to trauma centers, by AIS head injury level, for calendar years 2000 through 2005. Admissions are provided by the highest AIS score<sup>5</sup> 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 3 provides a listing of examples of the most commonly occurring AIS injuries, by severity level, for motorcycle crash patients.

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<sup>5</sup>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 6

**Motorcycle Crash Patients Admitted to Trauma Centers With Head Injuries, by AIS Severity**  
(CY 2000-2005)

	AIS Head Injury Severity							CHI or TBI <sup>a</sup>	Totals
	AIS-1 (Minor)	AIS-2 (Moderate)	AIS-3 (Serious)	AIS-4 (Severe)	AIS-5 (Critical)	AIS-6 (Maximum)			
2000	Helmet	13	121	48	29	44	2	11	268
	No Helmet	1	7	3	7	6	0	1	25
	Unknown	0	4	3	1	1	0	0	9
	Totals	14	132	54	37	51	2	12	302
2001	Helmet	11	167	33	39	32	0	9	291
	No Helmet	5	12	3	8	2	0	3	33
	Unknown	2	7	1	2	3	0	0	15
	Totals	18	186	37	49	37	0	12	339
2002	Helmet	16	173	40	44	29	0	22	324
	No Helmet	4	16	5	16	6	0	1	48
	Unknown	0	8	2	2	2	0	2	16
	Totals	20	197	47	62	37	0	25	388
2003	Helmet	18	131	54	42	26	0	17	288
	No Helmet	11	42	5	11	13	0	3	85
	Unknown	2	4	1	2	0	0	0	9
	Totals	31	177	60	55	39	0	20	382
2004	Helmet	15	135	35	28	24	0	13	250
	No Helmet	50	96	43	76	30	0	5	300
	Unknown	2	6	2	3	1	0	0	14
	Totals	67	237	80	107	55	0	18	564
2005	Helmet	11	144	39	40	24	1	12	271
	No Helmet	61	113	51	72	58	0	9	364
	Unknown	1	5	1	0	3	0	2	12
	Totals	73	262	91	112	85	1	23	647

<sup>a</sup>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.

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

Exhibit 3

**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 6 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.

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 6, 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 difference of helmeted versus non-helmeted motorcyclist patients occurred among patients with a moderate AIS head injury (AIS 2). This injury severity level had the highest total PTOS patients in each of the six 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 42 from the CY 2002 total, while the number of non-helmeted riders with a moderate AIS head injury increased by 26 from the prior year total. Also, the number of non-helmeted motorcyclist patients with a critical head injury (AIS 5) more than doubled, from 6 in CY 2002 to 13 in CY 2003.

As mentioned 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 AIS 6 (“maximum”) head injuries, there was an increase in non-helmeted motorcyclists with an AIS head injury in each of the severity levels. Moderate and closed head 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 eight 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 almost seven times greater than the CY 2003 total within that injury severity level. Additionally, the number of non-helmeted motorcyclist patients with a “critical” head injury (AIS 5) more than doubled from 13 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 motorcyclist crash patients with serious, severe, and critical AIS head injuries in CY 2005. Further, the number of non-helmeted motorcyclist patients sustaining critical head injuries (AIS 5) nearly doubled from 30 in CY 2004 to 58 in CY 2005. This occurred as the number of helmeted motorcyclist patients with a critical head injury remained unchanged from the CY 2004 total of 24.



## **VI. Appendices**

# APPENDIX A

HR 349

PRINTER'S NO. 2330

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THE GENERAL ASSEMBLY OF PENNSYLVANIA

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## HOUSE RESOLUTION

No. 349 Session of  
2003

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INTRODUCED BY MELIO, GEIST, McCALL, BENNINGHOFF, FABRIZIO,  
KOTIK, FRANKEL, DeLUCA AND BIANCUCCI, JULY 1, 2003

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REFERRED TO COMMITTEE ON RULES, JULY 1, 2003

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### A RESOLUTION

1 Directing the Legislative Budget and Finance Committee to  
2 conduct a study of reported motorcycle accidents.

3 WHEREAS, The use of a helmet is a critical factor in the  
4 prevention or reduction of head injuries in motorcycle  
5 accidents; therefore be it

6 RESOLVED, That the General Assembly direct the Legislative  
7 Budget and Finance Committee to conduct a study of reported  
8 motorcycle accidents; and be it further

9 RESOLVED, That the Legislative Budget and Finance Committee  
10 report include, but not be limited to, all of the following:

11 (1) The number of reported motorcycle accidents for the  
12 first two years after the adoption of this resolution and  
13 every subsequent two years thereafter.

14 (2) The number of individuals wearing helmets involved  
15 in reported motorcycle accidents.

16 (3) The increase, if any, in injuries and fatalities  
17 specifically due to head trauma that may be attributed to

## Appendix A (Continued)

1 individuals not wearing helmets;

2 and be it further

3 RESOLVED, That the Legislative Budget and Finance Committee  
4 report its findings to the Transportation Committee of the House  
5 of Representatives within one year of the adoption of this  
6 resolution and shall issue a subsequent report within two years  
7 of its initial report.



# APPENDIX B

## Copy of Pennsylvania Crash Reporting Forms (AA 500 and AA 500M)

**COMMONWEALTH OF PENNSYLVANIA  
POLICE CRASH REPORTING FORM**



Crash Number

AA 500 1

Case Closed  Yes  No      Reportable Crash  Yes  No

Page   

P0938478

1	Police Agency Data	Incident Number <input type="text"/> Agency Name <input type="text"/> Precinct <input type="text"/> Dispatch Time (mil) <input type="text"/> Arrival Time (mil) <input type="text"/> Investigator <input type="text"/> Badge Number <input type="text"/> Reviewer <input type="text"/> Badge Number <input type="text"/> Approval Date (MM-DD-YYYY) <input type="text"/>	Police Agency <input type="text"/> Patrol Zone <input type="text"/> Investigation Date (MM-DD-YYYY) <input type="text"/>
2	Crash Data	County <input type="text"/> County Name <input type="text"/> Municipality <input type="text"/> Municipality Name <input type="text"/> Day of Week <input type="radio"/> Sun <input type="radio"/> Thu <input type="radio"/> Mon <input type="radio"/> Fri <input type="radio"/> Tue <input type="radio"/> Sat <input type="radio"/> Wed <input type="radio"/> Unk Crash Date (MM-DD-YYYY) <input type="text"/> Crash Time (mil) <input type="text"/> No of Units <input type="text"/> People Injured <input type="text"/> Killed* <input type="text"/> *If > 00 complete Form F Workzone (If Yes, Complete Form M, Section 29) <input type="radio"/> Yes <input type="radio"/> No      School Bus Related <input type="radio"/> Yes <input type="radio"/> No      School Zone Related <input type="radio"/> Yes <input type="radio"/> No      Notify PENNDOT Maintenance <input type="radio"/> Yes <input type="radio"/> No	
3	Loc Type	Intersection Type <input type="radio"/> 4 Way Intersection <input type="radio"/> *Y* Intersection <input type="radio"/> Multi-Leg Intersection <input type="radio"/> Off Ramp <input type="radio"/> Railroad Crossing <input type="radio"/> *Special Location <input type="text"/> <input type="radio"/> Midblock <input type="radio"/> *T* Intersection <input type="radio"/> Traffic Circle/ Round About <input type="radio"/> On Ramp <input type="radio"/> Crossover <input type="radio"/> Other <input type="radio"/> * See Overlay	
4	Principal Road	Route Number <input type="text"/> Segment (Optional) <input type="text"/> Travel Lanes <input type="text"/> Speed Limit <input type="text"/> Street Name <input type="text"/> Street Ending <input type="text"/> Orientation <input type="radio"/> North <input type="radio"/> South <input type="radio"/> East <input type="radio"/> West <input type="radio"/> Unknown House Number (if applicable) <input type="text"/> For Mid-block crashes only. Use postal House Number and make sure Principal Roadway Street Name is filled in if using this option Route Signing <input type="radio"/> Interstate (Not Turnpike) <input type="radio"/> Turnpike (East/West) <input type="radio"/> Turnpike Spur <input type="radio"/> State Highway <input type="radio"/> County Road <input type="radio"/> Local Road or Street <input type="radio"/> Private Road <input type="radio"/> Other/ Unknown	
5	Intersecting Road	Route Number <input type="text"/> Segment (Optional) <input type="text"/> Travel Lanes <input type="text"/> Speed Limit <input type="text"/> Street Name <input type="text"/> Street Ending <input type="text"/> Orientation <input type="radio"/> North <input type="radio"/> South <input type="radio"/> East <input type="radio"/> West <input type="radio"/> Unknown Route Signing <input type="radio"/> Interstate (Not Turnpike) <input type="radio"/> Turnpike (East/West) <input type="radio"/> Turnpike Spur <input type="radio"/> State Highway <input type="radio"/> County Road <input type="radio"/> Local Road or Street <input type="radio"/> Private Road <input type="radio"/> Other/ Unknown	
6	Distance from Landmark	Please Enter Information for BOTH Landmarks if Using This Option Landmark 1: Intersecting Rt Num Or Mile Post <input type="text"/> Or Segment Marker <input type="text"/> Feet <input type="text"/> Or Intersecting Street Name <input type="text"/> St Ending <input type="text"/> Or Miles <input type="text"/> Landmark 2: Intersecting Rt Num Or Mile Post <input type="text"/> Or Segment Marker <input type="text"/> Distance From Crash Scene to Landmark 1 (For Crash between Landmark 1 and Landmark 2) <input type="text"/> Or Intersecting Street Name <input type="text"/> St Ending <input type="text"/>	
7	GPS	Latitude: Degrees <input type="text"/> Minutes <input type="text"/> Seconds <input type="text"/> Longitude: Degrees <input type="text"/> Minutes <input type="text"/> Seconds <input type="text"/>	
8	TCD	Traffic Control Device <input type="radio"/> Yield Sign <input type="radio"/> Police Officer or Flagman <input type="radio"/> TCD Functioning <input type="radio"/> No Controls <input type="radio"/> Device Functioning Improperly <input type="radio"/> Emergency Preemptive Signal <input type="radio"/> Not Applicable <input type="radio"/> Traffic Signal <input type="radio"/> Active RR Crossing Controls <input type="radio"/> Other Type TCD <input type="radio"/> Device Not Functioning <input type="radio"/> Device Functioning Properly <input type="radio"/> Unknown <input type="radio"/> Flashing Traffic Signal <input type="radio"/> Stop Sign <input type="radio"/> Passive RR Crossing Controls <input type="radio"/> Unknown	
9	Lane Closure	Lane Closed (If "Not Applicable", skip rest of the Lane Closure section) <input type="radio"/> Not Applicable <input type="radio"/> Partially <input type="radio"/> Fully <input type="radio"/> Unknown      Lane Closure Direction <input type="radio"/> North <input type="radio"/> East <input type="radio"/> North and South <input type="radio"/> All (N,S,E,W) <input type="radio"/> Not Applicable <input type="radio"/> Partially <input type="radio"/> Fully <input type="radio"/> Unknown <input type="radio"/> South <input type="radio"/> West <input type="radio"/> East and West	
		Traffic Detoured Yes <input type="radio"/> No <input type="radio"/> Unknown <input type="radio"/> Est. Time Closed <input type="radio"/> < 30 Min. <input type="radio"/> 30-60 Min. <input type="radio"/> 1-3 hrs <input type="radio"/> 3-6 hrs <input type="radio"/> 6-9 hrs <input type="radio"/> > 9 hours <input type="radio"/> Unknown	





# Appendix B (Continued)

## COMMONWEALTH OF PENNSYLVANIA POLICE CRASH REPORTING FORM



Crash Number

AA 500 4

Police Use Only

Page

P 0938478

General Crash Information <small>(If more than 2 Units, only complete Unit 1)</small>	<b>Crash Description</b>		<input type="checkbox"/> 0=Non-Collision	<input type="checkbox"/> 2=Head On	<input type="checkbox"/> 4=Angle	<input type="checkbox"/> 6=Slideswipe (Opposite Direction)	<input type="checkbox"/> 8=Hit Pedestrian
	<b>Relation to Roadway</b>		<input type="checkbox"/> 1=On Travel Lanes	<input type="checkbox"/> 3=Median	<input type="checkbox"/> 5=Outside Trafficway	<input type="checkbox"/> 7=Gore (Ramp Intersection)	<input type="checkbox"/> 9=Unknown
	<b>Illumination</b>		<input type="checkbox"/> 1=Daylight	<input type="checkbox"/> 3=Dark - Street Lights	<input type="checkbox"/> 5=Dawn	<input type="checkbox"/> 8=Other	
	<b>Weather Conditions</b>		<input type="checkbox"/> 1=No Adverse Conditions	<input type="checkbox"/> 3=Sleet (Hail)	<input type="checkbox"/> 5=Fog	<input type="checkbox"/> 7=Sleet & Fog	<input type="checkbox"/> 9=Unknown
	<b>Road Surface Conditions</b>		<input type="checkbox"/> 0=Dry	<input type="checkbox"/> 2=Sand, Mud, Dirt, Oil	<input type="checkbox"/> 4=Slush	<input type="checkbox"/> 6=Ice Patches	<input type="checkbox"/> 8=Other
		<input type="checkbox"/> 1=Rear End	<input type="checkbox"/> 3=Rear to Rear (Backing)	<input type="checkbox"/> 5=Sideswipe (Same Direction)	<input type="checkbox"/> 7=Hit Fixed Object		<input type="checkbox"/> 9=Other/Unknown
		<input type="checkbox"/> 2=Shoulder	<input type="checkbox"/> 4=Roadside	<input type="checkbox"/> 6=In Parking Lane			
		<input type="checkbox"/> 2=Dark - No Street Lights	<input type="checkbox"/> 4=Dusk	<input type="checkbox"/> 6=Dark - Unknown Roadway Lighting			
		<input type="checkbox"/> 2=Rain	<input type="checkbox"/> 4=Snow	<input type="checkbox"/> 6=Rain & Fog			
		<input type="checkbox"/> 1=Wet	<input type="checkbox"/> 3=Snow Covered	<input type="checkbox"/> 5=Ice	<input type="checkbox"/> 7=Water - Standing or Moving		
Unit(s) Event Information	<b>Harm Event</b>		<b>L/R</b>	<b>Most?</b>	<b>Utility Pole Number</b>		
	<b>Unit No</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Please Put Events in Sequential Order</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
	<b>Harmful Events (Harm Event)</b>	01=Hit Unit 1 02=Hit Unit 2 03=Hit Unit 3 04=Hit Unit 4 05=Hit Unit 5 06=Hit Other Traffic Unit 07=Hit Deer 08=Hit Other Animal 09=Collision With Other Non Fixed Object 11=Struck By Unit 1 12=Struck By Unit 2 13=Struck By Unit 3 14=Struck By Unit 4 15=Struck By Unit 5 16=Struck By Other Traffic Unit 21=Hit Tree Or Shrubbery 22=Hit Embankment 23=Hit Utility Pole 24=Hit Traffic Sign 25=Hit Guard Rail 26=Hit Guard Rail End 27=Hit Curb 28=Hit Concrete Or Longitudinal Barrier 29=Hit Ditch 30=Hit Fence Or Wall 31=Hit Building 32=Hit Culvert 33=Hit Bridge Pier Or Abutment 34=Hit Parapet End 35=Hit Bridge Rail 36=Hit Boulder Or Obstacle On Roadway 37=Hit Impact Attenuator 38=Hit Fire Hydrant 39=Hit Roadway Equipment 40=Hit Mail Box 41=Hit Traffic Island 42=Hit Snow Bank 43=Hit Temporary Construction Barrier 48=Hit Other Fixed Object 49=Hit Unknown Fixed Object 50=Overturn/Roll Over 51=Struck By Thrown Or Falling Object 52=Pot Holes Or Other Pavement Irregularities 53=Jackknife 54=Fire In Vehicle 58=Other Non-Collision 99=Unknown Harmful Event					
<b>First Harmful Event in the Crash</b>		<b>Unit No</b>	<b>Harm Event</b>	<b>Most Harmful Event in the Crash</b>	<b>Unit No</b>	<b>Harm Event</b>	
Do not repeat this information on multiple pages.							
Contributing Information	<b>Environmental / Roadway Potential Factors (E/R)</b>		<input type="checkbox"/> 1	<input type="checkbox"/> 2	<input type="checkbox"/> 3		
	00=None 01=Windy Conditions 02=Sudden Weather Conditions 03=Other Weather Conditions 04=Deer In Roadway 05=Obstacle On Roadway 06=Other Animal In Roadway 07=Glare 08=Work Zone Related		11=Slippery Road Conditions (Ice/Snow) 12=Substance On Roadway 13=Potholes 14=Broken Or Cracked Pavement 15=TCD Obstructed 16=Soft Shoulder Or Shoulder Drop Off 28=Other Roadway Factor 29=Other Environmental Factor 99=Unknown				
	<b>Possible Vehicle Failures (V)</b>		12=Wipers 13=Driver Seating/Control 14=Body, Doors, Hood, Etc 15=Trailer Hitch 16=Wheels 17=Airbags 18=Trailer Overloaded 19=Unsecure/Shifted Trailer Load 20=Improper Towing 21=Obstructed Windshield 99=Unknown				
	<b>Indicated Prime Factor</b>		Do not repeat this information on multiple pages. E/R   V   D   P <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>				
		<b>Unit No</b>	<b>Factor Code</b>				
If E/R is the Prime Factor Type, leave Unit No blank							
<b>Driver Action (D)</b>		00=No Contributing Action 01=Driver Was Distracted 02=Driving Using Hand Held Phone 03=Driving Using Hands Free Phone 04=Making Illegal U-Turn 05=Improper/Careless Turning 06=Turning From Wrong Lane 07=Proceeding W/O Clearance After Stop 08=Running Stop Sign 09=Running Red Light 10=Failure To Respond To Other Traffic Control Device 11=Tailgating 12=Sudden Slowing/Stopping 13=Illegally Stopped On Road 14=Careless Passing Or Lane Change 15=Passing In No Passing Zone 16=Driving The Wrong Way On 1-Way Street					
<b>Pedestrian Action (P)</b>		03=Working 04=Pushing Vehicle 05=Approaching Or Leaving Vehicle 06=Working On Vehicle 07=Standing 98=Other 99=Unknown					
<b>Unit No</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Unit No</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	
<b>Unit No</b>		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	



Appendix B (Continued)

COMMONWEALTH OF PENNSYLVANIA  
POLICE CRASH REPORTING FORM



Crash Number

AA 500 M

Police Use Only

Page

New

Change/  
Continuation

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For Answers to the below (except for Engine Size and Helmet Type) use the following codes: Y = Yes N = No U = Unknown

26 Motorcycle	Unit No [ ][ ]	Engine Size [ ] CC	<b>Driver Protection ?</b>	<b>Helmet Type</b>	<b>Passenger Protection ?</b>	<b>Helmet Type</b>
	Motorcycle Has? The Driver Has?		<input type="checkbox"/> Eye Protection	<input type="checkbox"/> 0 = No Helmet 1 = Full Helmet 2 = 3/4 Style 3 = Half Helmet 9 = Unknown	<input type="checkbox"/> Eye Protection	<input type="checkbox"/> 0 = No Helmet 1 = Full Helmet 2 = 3/4 Style 3 = Half Helmet 9 = Unknown
	<input type="checkbox"/> Passenger <input type="checkbox"/> MC Education		<input type="checkbox"/> Long Sleeves	<input type="checkbox"/> Helmet Stay On?	<input type="checkbox"/> Long Sleeves	<input type="checkbox"/> Helmet Stay On?
	<input type="checkbox"/> Saddle Bag and/or Trunk		<input type="checkbox"/> Long Pants	<input type="checkbox"/> Helmet has DOT or Snell Designation	<input type="checkbox"/> Long Pants	<input type="checkbox"/> Helmet has DOT or Snell Designation
	<input type="checkbox"/> Trailer		<input type="checkbox"/> Over Ankle Boots		<input type="checkbox"/> Over Ankle Boots	

27 Pedestrian	Unit No [ ][ ]	Use Codes Y = Yes N = No U = Unknown	<input type="checkbox"/> Passenger?	<input type="checkbox"/> Helmet?	Unit No [ ][ ]	Use Codes Y = Yes N = No U = Unknown	<input type="checkbox"/> Passenger?	<input type="checkbox"/> Helmet?
			<input type="checkbox"/> Head Lights?	<input type="checkbox"/> Rear Reflectors?			<input type="checkbox"/> Head Lights?	<input type="checkbox"/> Rear Reflectors?

28 Pedestrian	Unit No [ ][ ]	<b>Pedestrian Location</b>	Unit No [ ][ ]	<b>Pedestrian Location</b>
	<b>Pedestrian Signals</b>	01 = Marked Crosswalks at Intersection 02 = At Intersection - No Crosswalks 03 = Non-Intersection Crosswalks 04 = Driveway Access 05 = In Roadway 06 = Not in Roadway 07 = Median 08 = Island 09 = Shoulder 10 = Sidewalk 11 = < 10 Feet Off Road 12 = > 10 Feet Off Road 13 = Outside Trafficway 14 = Shared Paths/Trails 99 = Unknown	<b>Pedestrian Signals</b>	01 = Marked Crosswalks at Intersection 02 = At Intersection - No Crosswalks 03 = Non-Intersection Crosswalks 04 = Driveway Access 05 = In Roadway 06 = Not in Roadway 07 = Median 08 = Island 09 = Shoulder 10 = Sidewalk 11 = < 10 Feet Off Road 12 = > 10 Feet Off Road 13 = Outside Trafficway 14 = Shared Paths/Trails 99 = Unknown
	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not at Intersection		<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Not at Intersection	
	<b>Pedestrian Clothing</b>		<b>Pedestrian Clothing</b>	
	<input type="checkbox"/> Light <input type="checkbox"/> Dark <input type="checkbox"/> Reflective <input type="checkbox"/> Unknown		<input type="checkbox"/> Light <input type="checkbox"/> Dark <input type="checkbox"/> Reflective <input type="checkbox"/> Unknown	

29 Work Zone	<b>Work Zone Type</b>	<b>Where in Work Zone ?</b>	<b>Work Zone Speed or Advisory Limit</b>	<b>Law Enforcement Officer Present</b>	<b>Special Work Zone Characteristics</b>
	<input type="checkbox"/> Construction (Long Term) <input type="checkbox"/> Maintenance (Short Term) <input type="checkbox"/> Utility Company <input type="checkbox"/> Other	<input type="checkbox"/> Before 1st Work Zone Warning Sign <input type="checkbox"/> Advance Warning Area <input type="checkbox"/> Transition Area <input type="checkbox"/> Activity Area <input type="checkbox"/> Termination Area <input type="checkbox"/> Other	[ ][ ] <b>Workers Present</b> <input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Unknown	<input type="checkbox"/> Lane Closure? <input type="checkbox"/> Road Closed with Detour? <input type="checkbox"/> Work on Shoulder or Median? <input type="checkbox"/> Intermittent or Moving Work? <input type="checkbox"/> Flagger Control? <input type="checkbox"/> Other

Additional M-Page Information

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## APPENDIX C

### A List of Pennsylvania’s Accredited Trauma Centers

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 <sup>a</sup> .....	Level II
Frankford Hospital Torresdale Campus.....	Level II
Geisinger Medical Center .....	Level I With Additional Qualifications in Pediatric Trauma
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 <sup>a</sup> .....	Level I With Additional Qualifications in Pediatric Trauma
The Mercy Hospital of Pittsburgh <sup>a</sup> .....	Level I
The Reading Hospital and Medical Center.....	Level II
St. Christopher’s Hospital for Children <sup>a</sup> .....	Pediatric Level I
St. Luke’s Hospital .....	Level I
St. Mary Medical Center .....	Level II
Temple University Hospital <sup>a</sup> .....	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

<sup>a</sup>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 D

### Motorcycle Helmet Use Requirements in the States

<u>State</u>	Universal Law (Covers All Riders)	Partial Law (Covers a Segment of Riders)	No Helmet Use Law
Alabama	X		
Alaska		17 and younger <sup>1, 4</sup>	
Arizona		17 and younger	
Arkansas		20 and younger	
California	X		
Colorado			X
Connecticut		17 and younger	
Delaware		18 and younger <sup>13</sup>	
District of Columbia	X		
Florida		20 and younger <sup>2, 3</sup>	
Georgia	X		
Hawaii		17 and younger	
Idaho		17 and younger	
Illinois			X
Indiana		17 and younger	
Iowa			X
Kansas		17 and younger	
Kentucky		20 and younger <sup>2, 4, 12</sup>	
Louisiana	X		
Maine		14 and younger <sup>5</sup>	
Maryland	X		
Massachusetts	X		
Michigan	X		
Minnesota		17 and younger <sup>4</sup>	
Mississippi	X		
Missouri	X		
Montana		17 and younger	
Nebraska	X		
Nevada	X		
New Hampshire		17 and younger <sup>11</sup>	
New Jersey	X		
New Mexico		17 and younger	
New York	X		
North Carolina	X		
North Dakota		17 and younger <sup>6</sup>	
Ohio		17 and younger <sup>7</sup>	
Oklahoma		17 and younger	
Oregon	X		



## Appendix D (Continued)

<u>State</u>	<u>Universal Law (Covers All Riders)</u>	<u>Partial Law (Covers a Segment of Riders)</u>	<u>No Helmet Use Law</u>
<b>Pennsylvania</b>		<b>20 and younger<sup>8</sup></b>	
Rhode Island		20 and younger <sup>9</sup>	
South Carolina		20 and younger	
South Dakota		17 and younger	
Tennessee	X		
Texas		20 and younger <sup>10</sup>	
Utah		17 and younger	
Vermont	X		
Virginia	X		
Washington	X		
West Virginia	X		
Wisconsin		17 and younger <sup>4</sup>	
Wyoming		17 and younger	
<b>Total</b>	<b>21 (including D.C.)</b>	<b>27</b>	<b>3</b>

<sup>1</sup>Covers passengers of all ages and any operator under age 18.

<sup>2</sup>All riders under age 21 must wear helmets, without exception.

<sup>3</sup>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.

<sup>4</sup>Helmets also required for all operators with an instructional/learner's permit.

<sup>5</sup>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.

<sup>6</sup>Covers all passengers traveling with operators who are covered by the law.

<sup>7</sup>Covers all operators during the first year of licensure and all passengers of operators who are covered by the law.

<sup>8</sup>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.

<sup>9</sup>Covers all passengers (regardless of age) and all operators during the first year of licensure (regardless of age).

<sup>10</sup>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.

<sup>11</sup>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. Officials in Vermont's Department of Safety have declined to make a judgment on the claim of the "sunset" provision nullifying the helmet use law until interpreted by a court of law. The Department of Safety considers the law to be fully enforceable.

<sup>12</sup>Covers all operators who have possessed a motorcycle operator's permit for less than one year.

<sup>13</sup>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 E

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