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2012 Annual Report of ATV-Related Deaths and Injuries

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John Topping, M.S. and
Sarah Garland, Ph.D.
Directorate for Epidemiology
Division of Hazard Analysis
U.S. Consumer Product Safety Commission
4330 East West Highway
Bethesda, MD 20814

Executive Summary

ATV-Related Fatalities

- As of December 31, 2012, CPSC staff received reports of 12,391 ATV-related fatalities occurring between 1982 and 2012. CPSC staff received reports of 353 ATV-related fatalities occurring in 2012, 554 occurring in 2011, 657 occurring in 2010, and 718 occurring in 2009. Reporting for the years 2009 through 2012 is ongoing; these numbers are expected to increase in future reports.[1]

- From 1982 through 2012, CPSC staff received reports of 2,944 ATV-related fatalities of children younger than 16 years of age. This represents 24 percent of the total number of reported ATV-related fatalities (12,391).

- Of the 2,944 ATV-related fatalities of children younger than 16 years of age, 1,267 (43 percent) were younger than 12 years of age.

- In 2008, the most recent year where reporting is considered complete, 109 (14 percent) of the reported 755 ATV-related fatalities were children younger than 16 years of age.

- The estimated number of ATV-related fatalities is 684 for 2011, 771 for 2010, and 795 for 2009. Reporting for 2009 through 2011 is ongoing; thus, these numbers are expected to change in future reports.

- In 2008, the most recent year where reporting is considered complete, the estimated number of ATV-related fatalities is 845. The estimated number of four-wheel ATV-related fatalities in 2008 is 826. The corresponding estimated risk of death per 10,000 four-wheel ATVs in use is 0.8 for 2008, decreasing from 0.9 for 2007.

ATV-Related Emergency Department-Treated Injury Estimates

- In 2012, there were an estimated 107,900 ATV-related, emergency department-treated injuries in the United States. An estimated 26,500 (25 percent) of these were children younger than 16 years of age.

- The increase in the estimated number of ATV-related, emergency department-treated injuries from 2011 to 2012 (107,500 in 2011 to 107,900 in 2012) is not statistically significant.

- No linear trend was detected in the number of ATV-related emergency department-treated injuries from 2001 to 2012. However, there is a statistically significant quadratic term when fitting a curve to the estimated injuries from this timeframe (p-value =0.0032), indicating a statistically significant rise in injuries, followed by a statistically significant decrease.

[1] To illustrate the increase in the number of reported deaths over time, at the time of data collection cut off for the 2011 report (December 31, 2011), 327 ATV-related deaths had been reported for 2011. Similarly for the 2010 report, 317 ATV-related deaths had been reported for 2010 at the time of data collection cutoff (December 31, 2010).

- After a statistically significant increase from 2001 to 2007, the number of injuries per year has gone through a statistically significant decline in recent years (2007 through 2012). This shows a change in the trend direction for ATV-related injury estimates.

- From 2011 to 2012, the 8.5 percent decrease in the estimated number of ATV-related, emergency department-treated injuries for children younger than 16 years of age (29,000 in 2011 to 26,500 in 2012) is not statistically significant.

- Estimated injuries across most age groups (<16, 16−24, 25−34, 34−44, and 45−54) display a statistically significant increase followed by decreases within the years analyzed (2001−2012). These age groups all have statistically significant quadratic terms.

- For the oldest age group, 55+, there is a statistically significant increasing linear trend from 2001 to 2012. This age group does not have a statistically significant quadratic term.

- Of the 107,900 estimated ATV-related, emergency department-treated injuries for all ages in 2012, a majority are categorized as treated and released (85 percent).

- The plurality of the 2012 estimated ATV-related, emergency department-treated injuries were diagnosed as contusions/abrasions or fractures (24 percent each).

- The 2012 estimated ATV-related, emergency-department treated injuries primarily affected these parts of the body: the arm (the shoulder down), the head or neck, the torso, and the leg (29, 27, 22, and 21 percent, respectively).

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Introduction

This report presents the 2012 annual update of information collected by U.S. Consumer Product Safety Commission (CPSC) staff on deaths and injuries related to the use of all-terrain vehicles (ATVs). The update includes information on ATV-related deaths, based on data available to CPSC staff as of December 31, 2012, as well as information on ATV-related injuries treated in hospital emergency departments from January 1, 2012 through December 31, 2012.

The report begins with a brief background section. This is followed by a summary of ATV-related fatality counts (reports) derived from CPSC staff data and a discussion of reported ATV-related deaths involving children younger than 12 and 16 years of age. Then, based on the counts of ATV-related fatalities reported to CPSC staff, annual estimates of ATV-related deaths are presented, together with estimates of the annual risk of death per 10,000 four-wheel ATVs in use. Next, the report provides estimates of ATV-related, hospital emergency department-treated injuries, along with estimates of the annual risk of injury per 10,000 four-wheel ATVs in use. The report concludes with a short discussion of the observed patterns of ATV-related deaths and injuries over time.

Background

CPSC staff considers an ATV to be an off-road, motorized vehicle having three or four low-pressure tires, a straddle seat for the operator, and handlebars for steering control. CPSC staff does not categorize off-road motor vehicles having steering wheels and either bench or bucket seats (*e.g.*, golf carts, dune buggies, recreational off-highway vehicles (ROVs), and certain types of utility vehicles) as ATVs. Consequently, fatalities and injuries associated with these types of vehicles are not addressed in this report.

CPSC staff first began analyzing ATV-related incident data in the early 1980s to provide information on the numbers of deaths and injuries associated with three-wheel ATVs. In the late 1980s, the major ATV distributors agreed to stop distributing three-wheel ATVs (U.S. CPSC, 2006). Consequently, although some older three-wheel ATVs continue to be used by consumers, nearly all ATVs in use today are four-wheel ATVs. In 2005, the CPSC issued an advance notice of proposed rulemaking followed by a notice of proposed rulemaking in 2006, for ATVs. Section 232 of the Consumer Product Safety Improvement Act of 2008 (CPSIA) included provisions that directed the CPSC to make the voluntary standard a mandatory standard. The mandatory standard was published in late 2008, and the mandatory standard became effective in April 2009. The CPSIA imposed certain additional requirements on ATVs through ATV action plans, and the statute prohibited the importation and distribution of three-wheel ATVs.[2]

ATV-Related Fatalities

This section provides details on the numbers of ATV-related death reports received by CPSC staff on or before December 31, 2012, and this section discusses the estimates associated with ATV-related deaths. The reported numbers of deaths are totaled in Table 1, listed by state in Table 2, and categorized by age group in Table 3. The estimated numbers of deaths associated with ATVs having three, four, or an unknown number of wheels are reported in Table 4, along with the estimated numbers of four-wheel ATV-related fatalities, the estimated number of four-wheel ATVs in use, and the estimated risk of death per 10,000 four-wheel ATVs in use.

[2] The provisions relating to ATVs are at 16 C.F.R. part 1420. See: http://www.ecfr.gov/cgi-bin/text-idx?SID=dbc1bddfdc8b6fa15f91bd3bda47acd6&tpl=/ecfrbrowse/Title16/16cfr1420_main_02.tpl.

Reported Deaths

By December 31, 2012, CPSC staff had received reports of 12,391 ATV-related deaths that occurred between 1982 and 2012 (Table 1). The number of fatality reports increased by 703 since the December 31, 2011 tabulation CPSC staff prepared (U.S. CPSC, February 2013). Data collection for the years 2009 through 2012 is ongoing. As a result, the numbers of reported deaths for 2009 through 2012 are expected to increase before the next annual report is prepared.

Table 1
Reported ATV-Related Fatalities (by Year)
ATVs with 3, 4, or Unknown Number of Wheels
Reported for the Period January 1, 1982 through December 31, 2012

Year	Reported Number of Deaths	Difference Since Last Update* (12/31/2012)
Total	***12,391***	***+703***
2012	*353*	*+353*
2011	*554*	*+227*
2010	*657*	*+67*
2009	*718*	*+34*
2008	755	+14
2007	831	+9
2006	832	-1
2005	799	0
2004	754	0
2003	653	0
2002	550	0
2001	520	0
2000	447	0
1999	397	0
1998	252	0
1997	240	0
1996	249	0
1995	200	0
1994	198	0
1993	183	0
1992	220	0
1991	230	0
1990	235	0
1989	230	0
1988	250	0
1987	264	0
1986	300	0
1985	250	0
1984	156	0
1983	85	0
1982	29	0

Source: U.S. Consumer Product Safety Commission: Directorate for Epidemiology/Division of Hazard Analysis.
Note: Italics indicate that reporting is ongoing for the years 2009–2012
Note: The heavy line marks the change from death certificate mortality coding under the Ninth Revision of the International Classification of Diseases (ICD-9) to coding under the Tenth Revision (ICD-10)
Note: Further analysis of incidents in 2006 revealed duplication of two fatalities for one particular incident, Correction for that duplication reduces the 2006 count by one reported fatality and further affects the resulting estimates.

In Table 1, the counts presented for 1999 and later (*i.e*., the values above the heavy line) reflect a revised mortality data classification system from the system used prior to 1999. Specifically, the heavy line marks the change from death certificate mortality coding under the Ninth Revision of the International Classification of Diseases (ICD-9), to coding under the Tenth Revision (ICD-10), a transition that allows CPSC staff to gather more accurate mortality data for a number of consumer products, including ATVs. This change was implemented by the National Center for Health Statistics (NCHS) in January 1999 (NCHS, 2007). Since the implementation of ICD-10 coding, all ATV-related fatalities, including incidents involving traffic accidents on public roads, are grouped under a single set of mortality codes. Because of the use of different coding systems between the two periods (*i.e*., prior to 1999, versus 1999 and later), comparisons of numbers between these periods should be undertaken with caution. The ICD-10 transition and related methodological issues are discussed more fully in Appendix A.

Reported Deaths by State

Table 2 gives the numbers of reported ATV-related deaths for each state, the District of Columbia, and Puerto Rico. States are listed in descending order of the number of ATV-related fatalities reported for the years 1982 through 2008 (*i.e*., the years for which data collection is considered complete). Reported deaths that occurred during these years are tabulated in the second column. The following states had the highest numbers of reported ATV-related deaths occurring in this period: California (547), Texas (535), Pennsylvania (494), West Virginia (481), and Kentucky (459). Together, these five states accounted for 2,516 deaths or 25 percent of all reported ATV-related deaths in the United States for the years 1982 through 2008 (n =10,109), as shown in the third column of Table 2.

When reviewing state death counts for the period 1982 through 2008, two points deserve note:

- Consistent with CPSC staff's previous annual reports on ATV-related deaths and injuries, the counts shown in Table 2 have not been adjusted for demographic characteristics (*e.g*., total population, age structure of population).

- Also consistent with previous CPSC staff reports, these counts reflect the state in which the death occurred, rather than the state where the ATV incident occurred. This approach allows the most accurate matching of death certificates to other types of incident reports received by CPSC staff. As medical transport capabilities (*e.g*., helicopter transport) and trauma care have advanced in recent years, some states with major trauma centers have ATV-related fatalities included in their reported counts for incidents that did not occur within their state boundaries. Similarly, some states have reported counts that do not fully capture all of the ATV-related fatality incidents that occurred within their state boundaries.

The fourth column of Table 2 presents, by state, the number of ATV-related deaths reported to CPSC staff as of December 31, 2012, for the period 2009 through 2012. These counts should not be used for comparisons between states because data collection for this period is ongoing and because data collection for some states is more complete than for other states for these years.

Each state's total number of reported deaths since 1982 is listed in the fifth column. These counts include information for the years that have ongoing reporting, as well as information for the years where data collection is considered complete.

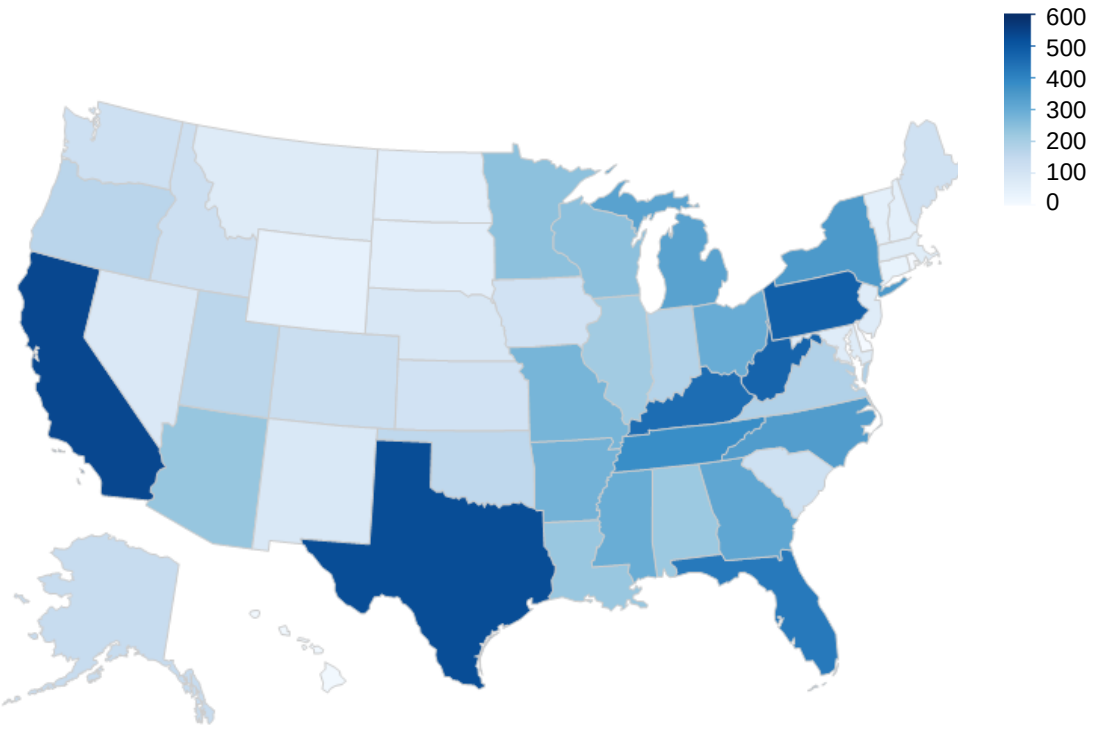
Table 2
Reported ATV-Related Fatalities (by State)
ATVs with 3, 4, or Unknown Number of Wheels
Reported for the Period January 1, 1982 through December 31, 2012

State	Reported Deaths 1982–2008	Cumulative Percent of U.S. Reported Deaths 1982–2008	*Reported Deaths (Ongoing Reporting) 2009-2012**	*Total Reported Deaths* (Including Ongoing Reporting)*
CALIFORNIA	547	5%	*93*	*640*
TEXAS	535	11%	*114*	*649*
PENNSYLVANIA	494	16%	*128*	*622*
WEST VIRGINIA	481	20%	*160*	*641*
KENTUCKY	459	25%	*119*	*578*
FLORIDA	432	29%	*74*	*506*
TENNESSEE	386	33%	*101*	*487*
NEW YORK	359	37%	*60*	*419*
NORTH CAROLINA	348	40%	*78*	*426*
MICHIGAN	333	43%	*69*	*402*
GEORGIA	322	46%	*74*	*396*
OHIO	306	49%	*76*	*382*
MISSISSIPPI	304	52%	*41*	*345*
ARKANSAS	289	55%	*52*	*341*
MISSOURI	282	58%	*79*	*361*
WISCONSIN	252	61%	*54*	*306*
MINNESOTA	251	63%	*45*	*296*
ARIZONA	236	65%	*23*	*259*
LOUISIANNA	233	68%	*45*	*278*
ALABAMA	228	70%	*63*	*291*
ILLINOIS	218	72%	*54*	*272*
VIRGINIA	189	74%	*46*	*235*
INDIANA	184	76%	*48*	*232*
OREGON	173	78%	*31*	*204*
UTAH	171	79%	*46*	*217*
OKLAHOMA	162	81%	*50*	*212*
ALASKA	148	82%	*14*	*162*
COLORADO	138	84%	*31*	*169*
IDAHO	133	85%	*59*	*192*
WASHINGTON	127	86%	*32*	*159*
SOUTH CAROLINA	124	87%	*34*	*158*
MAINE	120	89%	*22*	*142*
IOWA	117	90%	*40*	*157*
KANSAS	116	91%	*32*	*148*
NEBRASKA	92	92%	*31*	*123*
NEW MEXICO	90	93%	*6*	*96*
NEVADA	87	94%	*17*	*104*
MONTANA	75	94%	*25*	*100*
MARYLAND	72	95%	*16*	*88*
NEW JERSEY	71	96%	*15*	*86*
MASSACHUSETTS	68	96%	*7*	*75*
SOUTH DAKOTA	60	97%	*12*	*72*
NORTH DAKOTA	59	98%	*25*	*84*
VERMONT	58	98%	*7*	*65*
NEW HAMPSHIRE	57	99%	*7*	*64*
WYOMING	46	99%	*12*	*58*
CONNECTICUT	39	100%	*7*	*46*
HAWAII	15	100%	*3*	*18*
DELAWARE	8	100%	*2*	*10*
RHODE ISLAND	8	100%	*1*	*9*
WASHINGTON, D.C.	5	100%	*0*	*5*
PUERTO RICO	2	100%	*2*	*4*

Source: U.S. Consumer Product Safety Commission: Directorate for Epidemiology/Division of Hazard Analysis.
Note: State rankings are based on ATV-related fatality counts for the period 1982–2008.
*Italicized data (columns 4 and 5) denote the years for which reporting is ongoing (2009-2012).

Figure 1 represents the first two columns of Table 2. The intensity of the color in each state represents the number of reported ATV-related fatalities from 1982 through 2008.

Figure 1: Number of Reported ATV-Related Fatalities by State (1982–2008)



Source: U.S. Consumer Product Safety Commission: Directorate for Epidemiology/Division of Hazard Analysis. Graph generated using JMP9®.
Note: This figure corresponds to the first two columns of Table 2. Reporting for 2009–2012 is ongoing, and Figure 1 does not include data for these years.

Reported Deaths of Children

A review of the reported ATV-related fatalities indicates that 2,944 decedents (24 percent of the 12,391 total) between 1982 and 2012 were younger than 16 years of age, and 1,267 (10 percent) were younger than 12 years of age. Forty-three percent of ATV-related child fatalities (*i.e.*, children under 16 years of age) were children younger than 12 years of age. Table 3 gives the total number of reported fatalities, by year, of children younger than 16 years of age; the corresponding percentage of the total number of reported fatalities, by year; the total numbers of fatalities by year for children younger than 12 years of age; and the corresponding percentage relating to all ATV-related fatalities of children younger than 16 years of age. Figure 2 displays the total number of reported ATV-related fatalities, by year and age group, from 2001 to 2008.

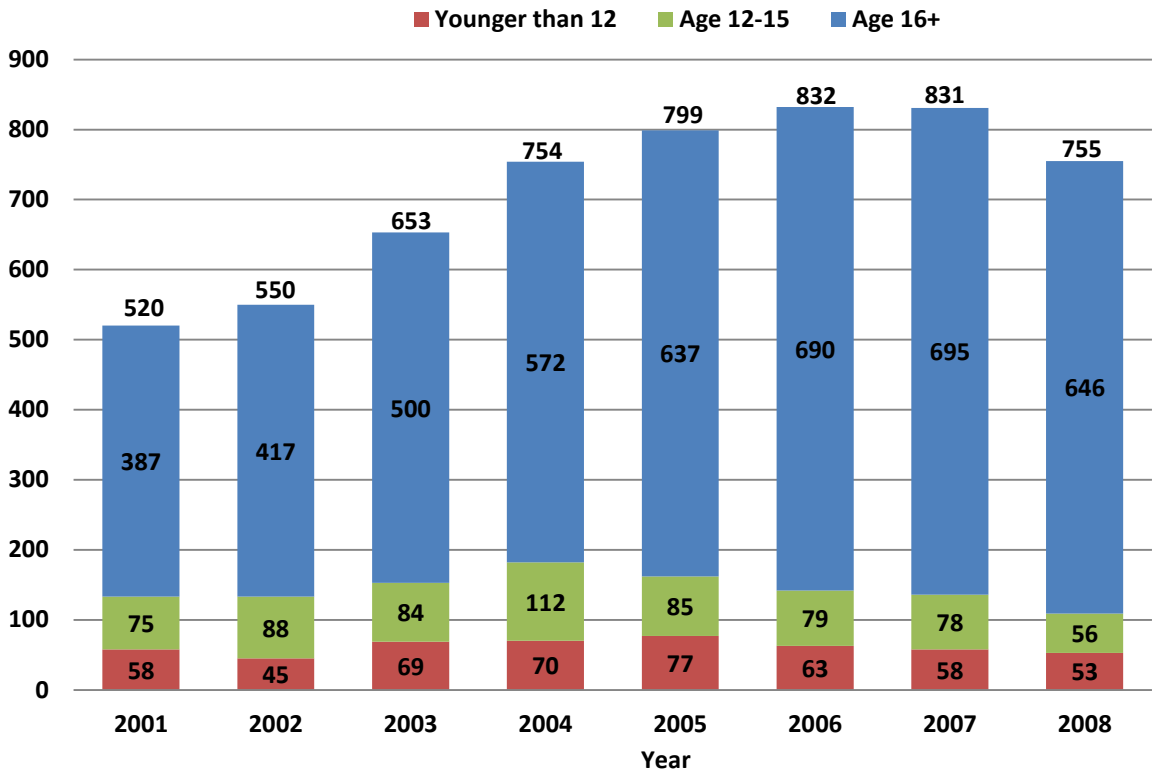
Table 3
Reported ATV-Related Fatalities for Children Younger than 16 and 12 Years of Age
ATVs with 3, 4, or Unknown Number of Wheels
Reported for the Period January 1, 1982 through December 31, 2012

Year	Younger Than 16	Younger Than 16: Percent of Total	Younger Than 12	Younger Than 12: Percent of Children*
Total	***2,944***	***24%***	***1,267***	***43%***
2012	*54*	*15%*	*31*	*57%*
2011	*73*	*13%*	*34*	*47%*
2010	*88*	*13%*	*38*	*43%*
2009	*95*	*13%*	*40*	*42%*
2008	109	14%	53	49%
2007	136	16%	58	43%
2006	142	17%	63	44%
2005	162	20%	77	48%
2004	182	24%	70	38%
2003	153	23%	69	45%
2002	133	24%	45	34%
2001	133	26%	58	44%
2000	123	28%	50	41%
1999	90	23%	34	38%
1998	82	33%	30	37%
1997	79	33%	38	48%
1996	87	35%	40	46%
1995	64	32%	26	41%
1994	54	27%	20	37%
1993	59	32%	18	31%
1992	71	32%	32	45%
1991	68	30%	40	59%
1990	81	34%	27	33%
1982-1989	627	40%	276	44%

Source: U.S. Consumer Product Safety Commission: Directorate for Epidemiology/Division of Hazard Analysis.
Note: Italics denote the period for which reporting is ongoing.
*Percent of total ATV-related fatalities of children younger than 16 years of age.
Note: Reporting is ongoing for 2009–2012. Percentages for these years should be interpreted with caution because the rate at which deaths are reported may not be consistent for each of the years indicated.

While the percentage of victims younger than 16 years of age appears to have had a large decline from 1998 to 1999, it is possible that adult deaths were underreported during the period 1982 to 1998. Because of coding limitations for ATV-related fatalities under the old ICD-9 system (see Appendix A), CPSC staff generally was not able to gather reports of deaths on public roads during those years. If adults were more likely than children to have been involved in ATV-related fatality incidents on public roads, then, for the years prior to 1999, the calculated percentages of deaths involving children, shown in Table 3, may be higher than the true proportion of ATV-related fatalities involving children.

Figure 2: Reported ATV-Related Fatalities by Age Group (2001–2008)



Source: U.S. Consumer Product Safety Commission: Directorate for Epidemiology/Division of Hazard Analysis.
Note: This figure corresponds to the data reported in Tables 1 and 3. Reporting for 2009–2012 is ongoing; thus, Figure 2 does not display these years.

Three-Wheel Versus Four-Wheel ATVs

As noted in the Background section above, CPSC staff began tabulating reports of ATV-related deaths and injuries in the early 1980s, to assess incidents associated with three-wheel ATVs. However, in the late 1980s, the major distributors agreed to stop distributing three-wheel ATVs; and currently, the ATVs distributed in the United States are nearly all four-wheel models (U.S. CPSC, 2006). The percentage of reported fatalities involving four-wheel ATVs increased from 7 percent or less, prior to 1985, to 97 percent in 2012, based on 2012 fatalities reported to CPSC staff as of December 31, 2012. Although data collection for 2012 is ongoing, this percentage is not expected to change greatly as additional reports of 2012 fatalities are received.

From the incident reports, it is not always possible to ascertain whether the ATV involved in the incident has three wheels or four wheels. In these cases, the vehicle is coded as an ATV having an unknown number of wheels. For the estimates of ATV-related deaths described below, ATVs having an unknown number of wheels were apportioned between three-wheel and four-wheel ATVs, using the methods described in Appendix A.

Estimated ATV-Related Deaths and Risk of Death, 1985 to 2011

Death reports received by CPSC staff represent a minimum count of ATV-related deaths because not all ATV-related fatalities may be reported. To account for unreported deaths, CPSC staff estimated annual ATV-related fatalities for the period 1985 to 2011, using a statistical estimation method (Hook and Regal, 2004). See Appendix A for details on this estimation method. Table 4 shows both the

annual reported counts and the estimated number of ATV-related deaths involving ATVs having three, four, or an unknown number of wheels. Table 4 also presents the annual estimated risk of death per 10,000 four-wheel ATVs in use for this period. Due to the low data collection completion rate (23%) as of December 31, 2012, estimates for 2012 were not calculated for this report but will be estimated in future reports.

Again, the heavy line between 1998 and 1999 in Table 4 demarcates the switch from mortality data collection under ICD-9, to collection under ICD-10. Because mortality coding under ICD-10 allows CPSC staff to gather more complete data on ATV-related deaths, some of the increase in estimated deaths observed between 1998 and 1999 is probably a result of the ICD-9 to ICD-10 transition. Although the magnitude of the effect of the coding change is unknown, it follows that the death estimates and risks calculated for the years prior to 1999 may have been underestimated.

Column 5 of Table 4 gives annual estimates of the number of four-wheel ATVs in use. According to CPSC staff's *All-Terrain Vehicle 2001 Injury and Exposure Studies*, in 2001, about 5.6 million three- and four-wheel ATVs were in use, and about 86 percent of these were four-wheel ATVs (Levenson, 2003a). Since that study, CPSC staff has relied on annual ATV sales information, together with survival analysis models, to derive estimates of the number of four-wheel ATVs in use each year.

A discussion of the methodologies used to estimate ATV-related deaths and the risk of death per 10,000 four-wheel ATVs in use is given in Appendix A.

Table 4
Annual Estimates of ATV-Related Fatalities and Risk of Death per 10,000 4-Wheel ATVs in Use
1985–2011
Based on Fatality Data Available as of December 31, 2012

Year[3]	Reported Deaths	Estimated Deaths Associated with ATVs with 3, 4, or Unknown Wheels	Estimated Deaths Involving 4-Wheel ATVs	Estimated 4-Wheel ATVs in Use (millions)[4]	Estimated Risk of Death per 10,000 4-Wheel ATVs in Use
2011	*554*	*684*	*666*	*10.7*	*0.6*
2010	*657*	*771*	*758*	*10.6*	*0.7*
2009	*718*	*795*	*774*	*10.5*	*0.7*
2008	755	845	826	10.2	0.8
2007	831	896	866	9.5	0.9
2006	832	901	874	8.6	1.0
2005	799	924	883	7.8	1.1
2004	754	854	815	7.0	1.2
2003	653	762	726	6.3	1.2
2002	550	609	571	5.6	1.0
2001	520	598	553	4.9	1.1
2000	447	547	498	4.2	1.2
1999	397	534	485	3.6	1.4
1998	252	289	247	3.1	0.8
1997	240	290	236	2.7	0.9
1996	249	268	209	2.4	0.9
1995	200	273	210	2.2	1.0
1994	198	243	167	2.0	0.8
1993	183	210	143	1.9	0.7
1992	220	242	159	1.9	0.8
1991	230	254	151	1.8	0.8
1990	235	252	152	1.8	0.9
1989	230	257	152	1.6	0.9
1988	250	285	151	1.4	1.1
1987	264	282	126	1.1	1.1
1986	300	348	95	0.7	1.3
1985	250	293	55	0.4	1.5

Source: U.S. Consumer Product Safety Commission: Directorate for Economic Analysis and Directorate for Epidemiology/Division of Hazard Analysis.
Note: Italics denote the period for which reporting is ongoing.

[3] Reporting is ongoing for 2009–2011.
[4] Estimates have been rounded.

ATV-Related Injuries

ATVs with Three, Four, and Unknown Numbers of Wheels

Table 5 shows estimates of ATV-related injuries treated in hospital emergency departments nationwide between January 1, 2001, and December 31, 2012. These estimates were generated based on the CPSC's National Electronic Injury Surveillance System (NEISS), a probability sample of U.S. hospitals with 24-hour emergency departments with more than six beds. In this analysis, the current estimates were compared to the estimates from the previous year (2011), as well as to a base year. The base year chosen for comparison was 2001.[5] The existence of a possible trend in injuries associated with ATVs with three, four, or an unknown number of wheels is also considered, using trend analysis methods developed by CPSC staff (Schroeder, 2000). For historical estimates of the number of ATV-related, emergency department-treated injuries, see Appendix B.

Also included in Table 5 are the estimated number of ATV-related, emergency department-treated injuries for children younger than 16 years, with the corresponding percent of total injuries. Estimates for those younger than 12 years are provided; these estimates are a subset of the younger than 16 age group. That is, the estimated injuries for those younger than 12 years are also included in the younger than 16 years age group estimates. Figure 3 displays the information for the estimated injuries for all ages and for the younger than 16 age group.

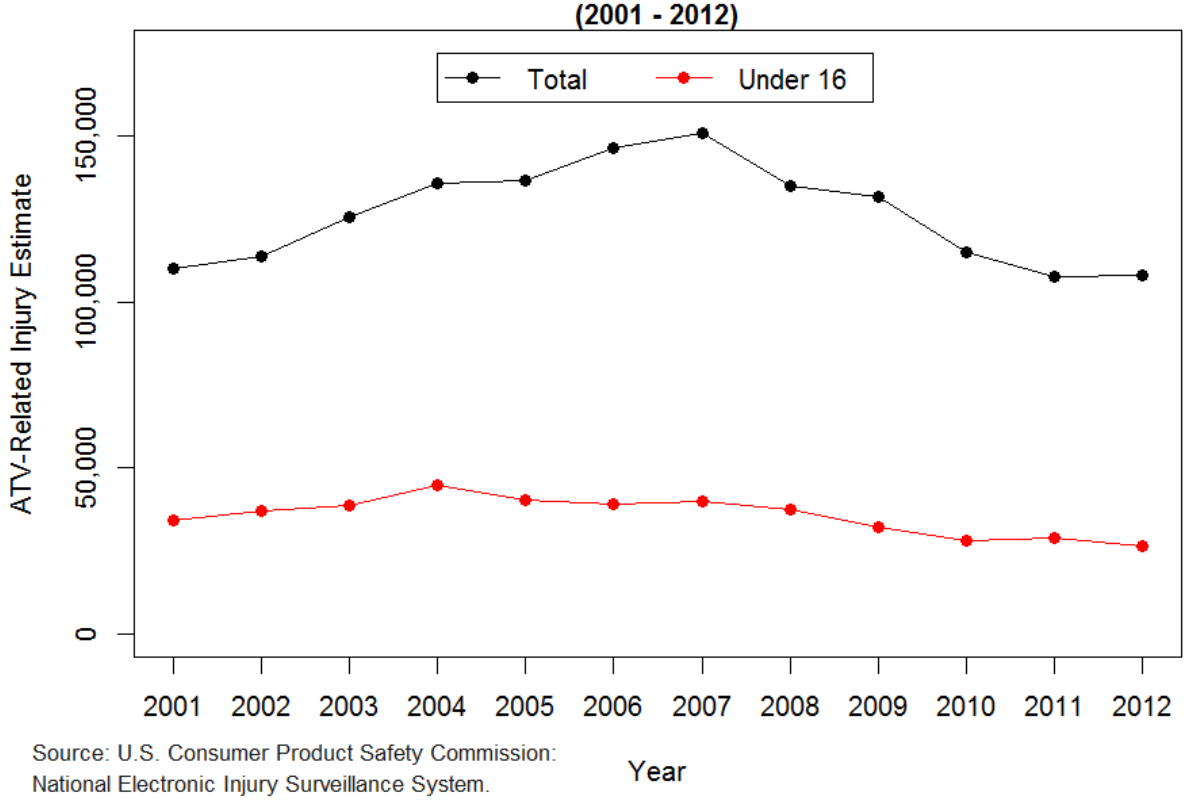
Table 5
Annual Estimates[6] of ATV-Related, Emergency Department-Treated Injuries
ATVs with 3, 4, or Unknown Number of Wheels
January 1, 2001 through December 31, 2012

Year	Estimated Number of Injuries: All Ages	Younger than 16 Years: Estimated Number of Injuries	Younger than 16: Percent of Total (All-Ages) Injuries	Younger than 12 Years: Estimated Number of Injuries	Younger than 12 Years: Percent of Injuries to All Children Younger than 16 Years
2012	107,900	26,500	25%	12,200	46%
2011	107,500	29,000	27%	15,100	52%
2010	115,000	28,300	25%	14,100	50%
2009	131,900	32,400	25%	15,500	48%
2008	135,100	37,700	28%	19,800	53%
2007	150,900	40,000	27%	19,800	50%
2006	146,600	39,300	27%	19,200	49%
2005	136,700	40,400	30%	18,900	47%
2004	136,100	44,700	33%	19,300	43%
2003	125,500	38,600	31%	16,300	42%
2002	113,900	37,100	33%	14,100	38%
2001	110,100	34,300	31%	15,700	46%

Source: U.S. Consumer Product Safety Commission: National Electronic Injury Surveillance System.
Note: The coefficients of variation (CVs) for the all-ages injury estimates range from 9 percent to 11 percent. During this same time period, CVs for injury estimates among the younger than 16 age group range from 9 percent to 13 percent. See Appendix A for an explanation of the use and calculation of CVs.

[5] See the methodology section in Appendix A for a discussion of the rationale for choosing 2001 as the base year.
[6] Estimates have been adjusted to reflect NEISS Coding Manual changes and sampling frame updates. Estimates have also been adjusted to account for cases that are out of scope for this report. See Appendix A for additional discussion.

Figure 3
Annual ATV-Related, Hospital Emergency Department-Treated Injury Estimates for ATVs with 3, 4 or Unknown Number of Wheels (2001 - 2012)



Source: U.S. Consumer Product Safety Commission: National Electronic Injury Surveillance System.

The 2012 emergency department-treated injury estimate for all ages reflects an increase of 0.4 percent over the 2011 estimate. However, this increase is not statistically significant (p-value = 0.95).[7] The overall decrease of 2.0 percent between the estimated number of injuries in 2001 and 2012 is not statistically significant (p-value = 0.58). In addition, trend analysis (Schroeder, 2000) indicates that for ATVs having three, four, or an unknown number of wheels, there is not a statistically significant trend in emergency department-treated injuries for all ages, collectively, during the years 2001 through 2012 (p-value = 0.17). However, note that there is an increase from 2001 through 2007, and thereafter, the estimates generally decrease. Considering this pattern and fitting a curve to the estimates from 2001 to 2012, there is a statistically significant curvature (quadratic term p-value=0.0034), indicating that there is a statistically significant increase followed by a statistically significant decrease for all ages. One can also consider it this way: from 2001 through 2007, there was a statistically significant increase in the estimated number of ATV-related, emergency department-treated injuries (p-value=0.0015, linear trend analysis), while the decrease from 2007 through 2012 is also statistically significant (p-value=0.0105, linear trend analysis). This shows that considering only the linear trend for the years 2001 through 2012 does not portray what has occurred in this time period with respect to ATV-related injury estimates. To understand how the estimates are changing across time requires the consideration of the change in the trend of injuries surrounding the year 2007. This can be accomplished by separating the trend for the years 2001 through 2007, and the years 2007 through 2012. However, the same results can be found by analyzing the quadratic term of the fitted line, which finds the change in the direction of the trend of injuries prior to and after the year 2007.

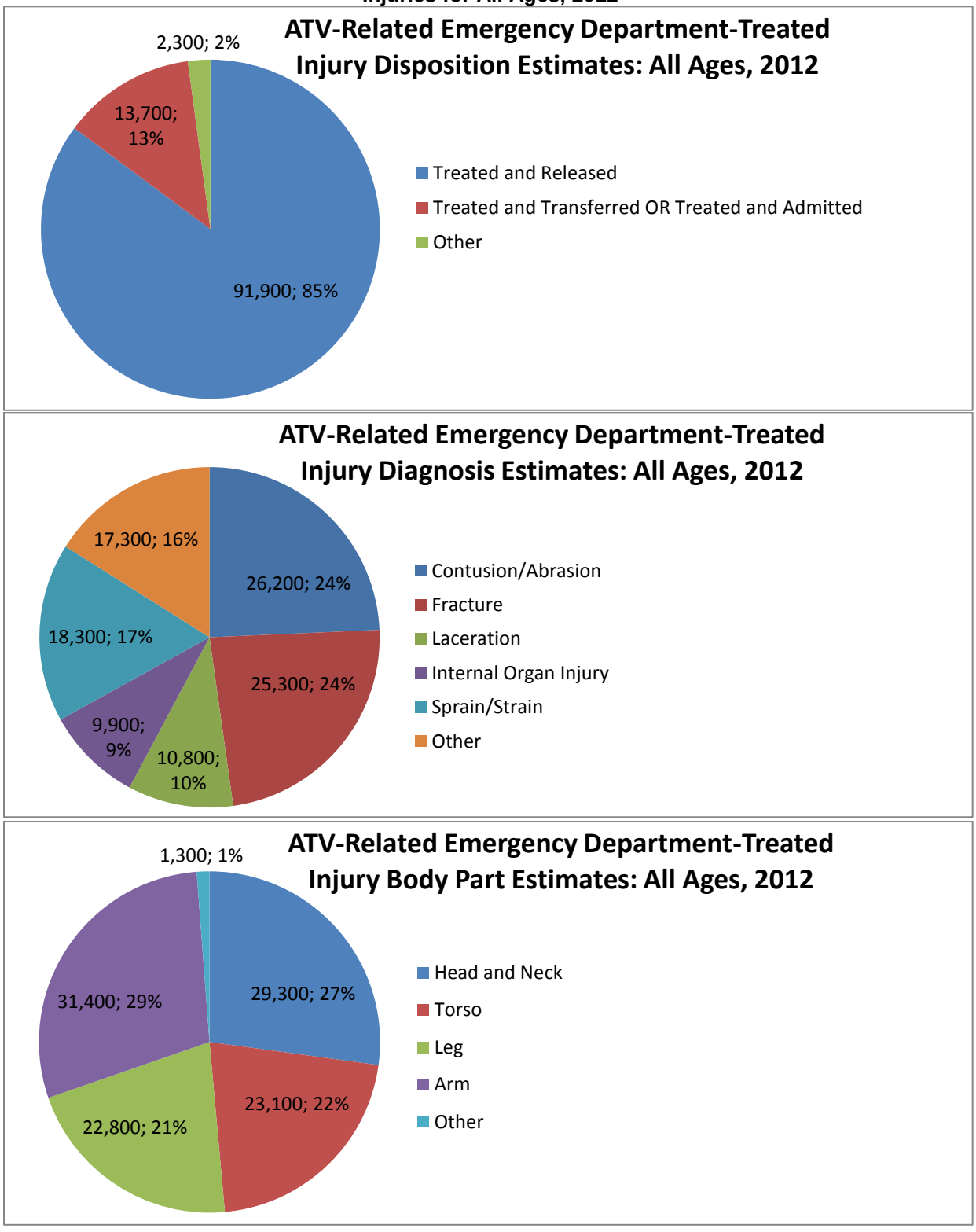
[7] The p-value represents the probability of observing results as extreme as, or more extreme than, the results obtained if there is no difference in the two reported estimates. A small p-value (*e.g.*, p-value < 0.05) suggests that an observed difference is likely to reflect a difference between the two estimates that is associated with some factor or factors beyond the inherent variability in the estimates themselves. P-values listed in this report have not been corrected for multiple comparisons.

The 2012 emergency department-treated injury estimate for children younger than 16 years of age represents an 8.6 percent decrease over the 2011 estimate, although this is not a statistically significant decrease (p-value =0.18). The comparison of the 2001 to the 2012 estimated numbers of emergency department-treated injuries for children younger than 16 years of age shows a 22.7 percent decrease; these two estimates are statistically different (p-value = 0.0012). There is also a statistically significant quadratic term when fitting a curve to the injuries (p-value =0.0018), indicating a significant rise in injuries, followed by a significant decrease.

When taking into account only children younger than 12 years of age, 11 percent (12,200) of the estimated number of ATV-related, emergency department-treated injuries for all ages occurred in 2012. Considering the years 2001 to 2012, children younger than 12 years of age represent 13 percent of estimated emergency department-treated injuries for all ages (*i.e*., 200,000/1,517,200) and 47 percent of the estimated number of emergency department-treated injuries for children younger than 16 (*i.e*., 200,000/428,300).

Figure 4 provides the 2012 estimated number of ATV-related, emergency department-treated injuries broken down by disposition, diagnosis, and body part for all ages. Of the 107,900 estimated ATV-related, emergency department-treated injuries for all ages in 2012, a majority are categorized as treated and released (85 percent). Thirteen percent of the estimated emergency department-treated injuries for all ages are categorized as either treated and admitted or treated and transferred. The remaining percentages of treatments are spread across several categories, such as left without being seen, held for observation, fatalities, and unknown. The plurality of the 2012 estimated ATV-related, emergency department-treated injuries for all ages were diagnosed as contusions/abrasions or fractures (24 percent each). The remaining diagnoses are distributed into categories such as lacerations, sprains/strains, internal organ injuries, and concussions. The majority of the 2012 estimated ATV-related, emergency-department treated injuries for all ages were injuries of the arm (the shoulder down) or the head or neck (29 and 27 percent, respectively).

Figure 4: Disposition, Diagnosis, and Body Part ATV-Related Emergency Department-Treated Injuries for All Ages, 2012[8]



[8] Totals may not sum to the 2012 annual estimate due to rounding. Percentages are based on the rounded estimates.

For the 26,500 estimated ATV-related emergency department-treated injuries in 2012 for children younger than 16 years of age, the majority are treated and released (83 percent). Fifteen percent of children younger than 16 years of age are either treated and admitted or treated and transferred. The remaining percentages of treatments are spread across several categories, such as left without being seen, held for observation, fatalities, and unknown.

In 2012, children younger than 16 years of age were diagnosed with contusions/abrasions 29 percent of the time for ATV-related, emergency-department treated injuries and 24 percent of the time with fractures. The remaining diagnoses are distributed into categories such as lacerations, sprains/strains, internal organ injuries, and concussions.

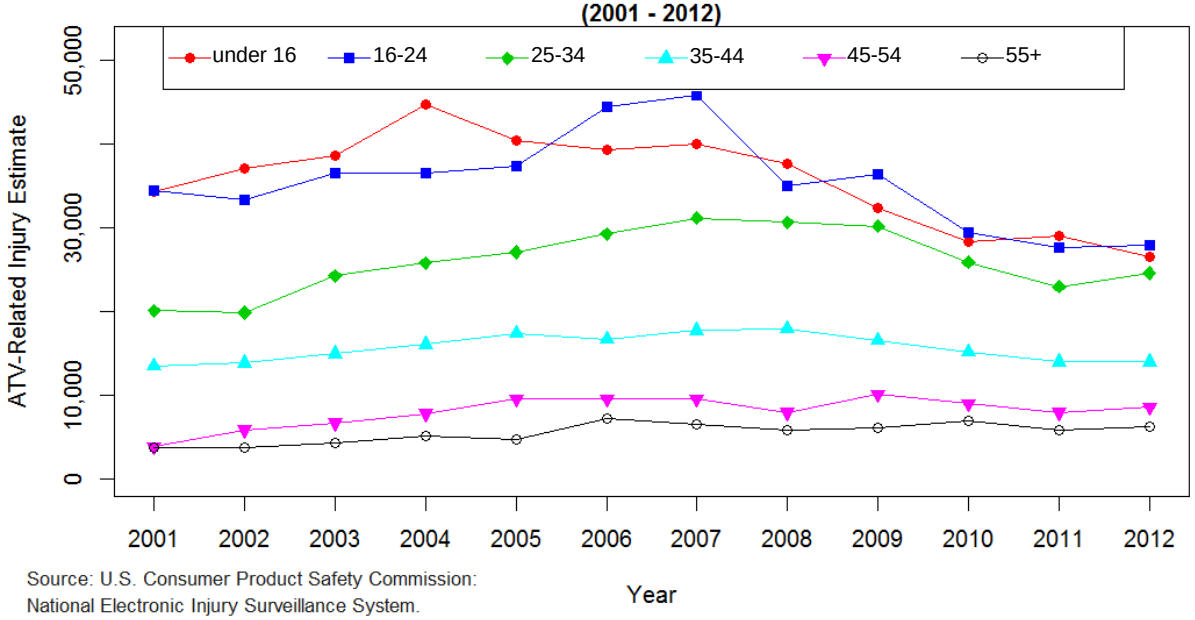
Table 6 breaks down the estimated numbers of ATV-related, emergency department-treated injuries from 2001 to 2012 by age group, while Figure 5 gives the corresponding graph of Table 6.

Table 6
Annual Estimates of ATV-Related, Emergency Department-Treated Injuries by Age Group
2001–2012

	Age Group						
Year	**Under 16**	**16–24**	**25–34**	**35–44**	**45–54**	**55 +**	**Total**
2012	26,500	28,000	24,600	14,000	8,600	6,300	108,000
2011	29,000	27,700	23,000	14,000	8,000	5,900	107,600
2010	28,300	29,500	25,900	15,200	9,000	7,000	114,900
2009	32,400	36,400	30,200	16,600	10,100	6,200	131,900
2008	37,700	35,000	30,700	18,000	8,000	5,800	135,200
2007	40,000	45,800	31,200	17,800	9,600	6,500	150,900
2006	39,300	44,500	29,300	16,700	9,600	7,200	146,600
2005	40,400	37,400	27,100	17,400	9,600	4,800	136,700
2004	44,700	36,500	25,800	16,100	7,800	5,100	136,000
2003	38,600	36,600	24,300	15,000	6,700	4,300	125,500
2002	37,100	33,300	19,900	13,900	5,900	3,700	113,800
2001	34,300	34,500	20,100	13,500	3,900	3,800	110,100

Source: U.S. Consumer Product Safety Commission: National Electronic Injury Surveillance System.
Note: Rows may not sum to the annual totals presented elsewhere in this report due to rounding.

Figure 5
Annual ATV-Related Hospital Emergency Department-Treated Injury Estimates by Age Group
ATVs with 3, 4 or Unknown Number of Wheels
(2001 - 2012)



Source: U.S. Consumer Product Safety Commission: National Electronic Injury Surveillance System.

Analysis of information in Table 6 (see page 18) and Figure 5 supports the following:

- The decrease from 2011 to 2012 for the younger than 16-year-old age group is not statistically significant also (p-value= 0.18). The increases from 2011 to 2012 for the 16-24, 25-34, 45-54, and 55+ year-old age groups are not statistically significant (p-value = 0.76, 0.28, 0.52, and 0.70, respectively). For the 35-44 age group, there is no statistically significant difference (p-value = 0.98).

- When comparing the 2001 and 2012 estimated injuries for each age group, the difference in estimated injuries for the <16, 16−24, 25-34, 45−54, and 55+ age groups are statistically significantly different (p-value= 0.0166, 0.0118, 0.0001, <0.0001, and 0.0154, respectively). This comparison shows a decrease in injuries among the youngest two age groups (<16 and 16-24) and an increase in injuries among the 25-34, 45-54, and 55+ age groups. The 35-44 age group did not have a statistically significant difference when comparing 2001 to 2012 (p-value = 0.74).

- When considering Figure 5, it appears that most age groups have seen increases in injury estimates followed by decreases. Analysis to determine if this pattern is significant for each age group shows that the <16, 16-24, 25−34, 34−44, and 45−54 age groups have a statistically significant quadratic term for a fitted curve (quadratic term p-value =0.0059, 0.0125, 0.0151, 0.0121, and 0.0007, respectively for the period 2001-2012). Thus, injuries in these age groups have increased significantly but are followed by significant decreases in the years analyzed.

- The oldest age group, 55+, does not have a statistically significant quadratic term for a fitted curve (quadratic term p-value = 0.17). From 2001 to 2012, the estimated number of injuries for the 55+ age group has a statistically significant increasing linear trend (p-value= 0.0304). This indicates that injury estimates associated with this oldest age group have increased significantly on average in these years.

Four-Wheel ATVs

Table 7 shows estimates of four-wheel ATV-related, emergency department-treated injuries and the risk of injury per 10,000 four-wheel ATVs in use for the years 2001 to 2012. In 2012, four-wheel ATV injuries constituted 97.3 percent of the total injury estimate for ATVs having three, four, or an unknown number of wheels (*i.e*., 105,000/107,900). The four-wheel ATV emergency department-treated injury estimate for 2012 represents a 0.5 percent decrease over the 2011 estimate; however, this decrease is not statistically significant (p-value =0.92). Neither is there a statistically significant change over the 2001 estimate (p-value =0.11). There is no statistically significant linear trend in emergency department-treated injuries associated with four-wheel ATVs from 2001 to 2012 (p-value = 0.54). However, since 2001, injury estimates increased until 2007 and decreased thereafter. This indicates that a linear trend across 2001−2012 may not be capturing what is occurring with four-wheel ATV-related, emergency department-treated injuries. When fitting a curve into the estimates, the quadratic term is statistically significant (p-value < 0.0001). Until 2007, there is a statistically significant increase in estimated injuries. And in the years since 2007, there is a significant decrease in estimated injuries. This shows a change in direction of the trend of injury estimates before and after 2007.

In Table 7, "risk" is defined as the estimated number of emergency department-treated injuries per 10,000 four-wheel ATVs in use. From 2001 to 2012, there is a statistically significant downward trend in injury risk per 10,000 four-wheel ATVs in use (p-value = 0.0003).

Table 7
Estimated Number of 4-Wheel ATV-Related Emergency Department-Treated Injuries and Risk of Emergency Department-Treated Injury per 10,000 4-Wheel ATVs in Use
January 1, 2001 through December 31, 2012

Year	4-Wheel ATV-Related Injury Estimate[9, 10]	Estimated 4-Wheel ATVs in Use (millions)	Risk Estimate per 10,000 4-Wheel ATVs in Use
2012	105,000	10.7	98.4
2011	105,500	10.7	98.8
2010	111,900	10.6	105.3
2009	128,600	10.5	122.9
2008	131,700	10.2	129.7
2007	146,500	9.5	153.9
2006	140,900	8.6	163.0
2005	130,000	7.8	167.2
2004	129,500	7.0	185.4
2003	116,600	6.3	186.3
2002	104,800	5.6	188.5
2001	98,200	4.9	200.3

Sources: U.S. Consumer Product Safety Commission: National Electronic Injury Surveillance System, the Directorate for Economic Analysis, and the Directorate for Epidemiology/Division of Hazard Analysis.
Note: The coefficients of variation (CVs) for four-wheel ATV injury estimates (column 2) all range from 8 to about 9 percent. For these same years, the CVs for the estimates of the number of four-wheel ATVs in use (column 3) range from 3 percent to 4 percent, and the CVs for the risk estimates (column 4) range from 9 percent to 10 percent (see Levenson, 2005a, 2005b, and 2005c for discussion of the methods used to estimate these CVs).

[9] Estimates have been adjusted to reflect NEISS Coding Manual changes and sampling frame updates. Estimates have also been adjusted by factors to account for cases that are out of scope for this report. Appendix A provides further detail.
[10] Estimates have been rounded.

Discussion

In analyzing deaths and injuries associated with ATVs, it is useful to consider three distinct periods, the boundaries of which are determined primarily by fatality data availability and by the completeness of the available data. By considering these three periods separately, we can compare years within periods, and thereby control, at least in part, for changes in fatality data availability, as well as for possible changes in the ATV marketplace (see Appendix A). While the boundaries of the periods considered here are defined by factors involving the collection of mortality data, it is also useful to consider the injury estimates within the same periods.

The periods selected for discussion were defined as follows:

- The first period, from 1982 to 1998, begins with the first year of CPSC staff's reported ATV-related death counts (see Table 1), and the first period ends with the ICD-9 to ICD-10 transition for classification of mortality data.

- The second period, from 1999 to 2008, begins with the transition to ICD-10 coding and ends with the most recent complete year of death data collection.

- The third period, from 2009 to 2012, spans the period of ongoing mortality data collection by CPSC staff.

ATV-related deaths and injuries occurring in each of these three periods are reviewed below.

1982–1998

In the first period (1982–1998), reported deaths reached a high of 300 in 1986 (Table 1). These reported deaths were largely associated with three-wheel ATVs, which were still being manufactured and sold. During the mid-1980s, three-wheel ATVs were still heavily in use, and four-wheel ATVs were only beginning to gain in popularity.

As previously noted, CPSC staff's ability to gather death reports during the first period (1982–1998) was limited by the ICD-9 reporting codes and by ICD-9 reporting requirements, which made it difficult for CPSC staff to obtain death certificates for ATV-related fatality incidents occurring on public roads (see Appendix A). Consequently, the death estimates for this period are likely to be underestimated. However, because data collection methodologies were substantially consistent throughout the first period, general comparisons among the annual death estimates within the first period may still be made, if the degree of underestimation is similar from year to year. Other than the ICD-9 coding, CPSC staff is not aware of any factors that would have contributed to an underestimation of ATV-related fatalities in this period. CPSC staff is also not aware of any factors that would have caused differences in the degree of ICD-9-related underestimation in different years.

With these cautions in mind, a review of Table 4 suggests that, during the first period, the estimated number of deaths associated with all ATVs (*i.e.*, ATVs having three, four, or an unknown number of wheels) likely peaked around 1986. This peak was followed by a decline in estimated ATV-related fatalities until the early-to-mid-1990s. Then, a general increase in the estimated deaths appears to have occurred from the mid-1990s to the end of the 1982−1998 period. As previously mentioned, this reporting period used the ICD-9 reporting requirements, and thus, the death estimates for this period are likely to be underestimated. The reader should use caution when generalizing in this period, due to the impact of this underestimation on the magnitude of the estimates. The reader is cautioned against making similar generalizations over this same time period regarding the estimated risk of death per 10,000 four-wheel ATVs in use because these latter measures may be subject to other sources of variability.

A similar pattern can be observed in the estimated number of emergency department-treated injuries associated with ATVs having three, four, or an unknown number of wheels (see Table 8, page 29 for injury estimates for this period). That is, the estimated number of ATV-related, emergency department-treated injuries appeared to peak during the years 1985 and 1986, when injuries were above 100,000. This was followed by a decline in injury estimates until the early-to mid-1990s, and then by an increase in estimated injuries until the end of the period. The similarities between death and injury data suggest that the pattern seen in the estimated number of deaths is not simply an artifact of the fatality data.

1999–2008

Because of the transition to ICD-10 mortality coding, the second period (1999–2008) reflects several years during which CPSC staff had a greater opportunity to collect comprehensive data on ATV-related fatalities than had been possible prior to 1999. ATV-related regulatory activity began in this reporting period. Consequently, any effect of heightened media exposure on data collection began to be a factor in this period. This effect could have started in 2002, with a petition submitted to the CPSC, which requested the Commission to issue a rule banning the sale of adult-size four-wheel ATVs sold for the use of children under the age of 16 years. This effect could have continued throughout this time period due to the exposure resulting from the issuance of an advance notice of proposed rulemaking in 2005, and a notice of proposed rulemaking in 2006, by the CPSC. Comparing the estimated numbers of deaths associated with ATVs having three, four, or an unknown number of wheels from 1999 through 2008, there is an increase of 58 percent (Table 4). The estimated numbers of emergency department-treated injuries associated with ATVs having three, four, or an unknown number of wheels increased 65 percent from the 1999 estimate of 82,000, to the 2008 estimate of 135,100 (Table 8 in Appendix B, page 29).

2009–2012

The third period (2009–2012) contains 4 years of incomplete death data. As of December 31, 2012, death certificate completion was 94 percent for 2009, 87 percent for 2010, 65 percent for 2011, and 33 percent for 2012. (This is not a percentage of death certificates versus actual deaths; rather, it is the percentage of the combination of states and months where CPSC staff has received at least one death certificate.) It is likely that the number of reported deaths for these years will increase as CPSC staff receives additional reports. For this reason, the 2009 through 2011 estimated numbers of deaths and estimated risks of death per 10,000 four-wheel ATVs in use will likely require revision for these years in future CPSC staff reports.

During the third period, emergency department-treated injury estimates for all ages generally decreased each year, both for ATVs having three, four, or an unknown number of wheels (Table 5), and for four-wheel ATVs alone (Table 7). Although the estimate for ATV's having three, four, or an unknown number of wheels did increase slightly between 2011 and 2012 that increase was not statistically significant (p-value = 0.97). For ATVs having three, four, or an unknown number of wheels, the overall decrease from 2009 to 2012 is statistically significant (131,900 and 107,900, respectively; p-value < 0.0001). A statistically significant decrease is also seen when comparing the estimated number of injuries associated with four-wheel ATVs from 2009 to 2012 (128,600 and 105,000, respectively; p-value< 0.0001). It should be noted that the data collection process supporting the derivation of the injury estimates is complete for all reported years, including this period (2009–2012). Thus, the injury estimates for 2009 through 2012 are not expected to require revision in future CPSC staff reports.

Prior to this period, the CPSC issued both an advance notice of proposed rulemaking (2005) and a notice of proposed rulemaking (2006) for ATVs. In 2008, the Consumer Product Safety Improvement Act (CPSIA) became law. Section 232 of the CPSIA included provisions directing the CPSC to make the voluntary standard, the *American National Standard for Four Wheel All-Terrain Vehicles,* developed

by the Specialty Vehicle Institute of America (American National Standard ANSI/SVIA 1 – 2007), a mandatory standard. The mandatory standard was published in late 2008, and became effective in April 2009. In addition, all companies importing and distributing ATVs in the United States were required by the CPSIA to have action plans approved by, and on file with, the Commission. The CPSIA also banned the importation and distribution of three-wheel ATVs. One likely result of the recent regulatory focus on ATVs may have been an increase in media attention on ATV-related fatalities; and this, in turn, may have resulted in the collection of more complete and timelier death reports during these periods.

Additionally, just prior to and continuing into this time period, the CPSC launched a campaign to increase awareness of ATV safety via television and radio public service announcements (PSAs), created www.ATVSafety.gov, and partnered with organizations and officials dedicated to promoting ATV safety. In 2006, the CPSC's website, www.ATVSafety.gov, was launched and includes information on ATV safety, state laws and regulations for ATVs, and fatality and injury data. The CPSC's Office of Information and Public Affairs (OIPA), now the Office of Communications (OCM), initiated a Rapid Response program in April 2007, to respond to ATV-related deaths and injuries. The Rapid Response program is triggered when there is a report of an ATV death or injury. Working with media in the affected area, the CPSC's OCM publishes information on ATV safety via radio and television PSAs, or through news stories. By raising awareness of ATV safety, this campaign was designed to reduce the number of deaths and serious injuries associated with ATVs (U.S. CPSC OIPA, 2006).

Appendix A: Estimation Methodologies

This appendix describes the methodologies used to estimate ATV-related deaths and injuries and other information used in developing the report analyses.

ATV-Related Deaths

In-Scope ATV-Related Fatalities

ATV-related fatalities considered in scope in this report include any unintentional incident involving an ATV, whether or not the ATV was in operation at the time of the incident. Because of the difficulties inherent in distinguishing between occupational and nonoccupational use, occupational fatalities are included in both the death counts and the death estimates. For example, it may be difficult to classify a fatality that occurs when a victim is riding next to a fence on a ranch to examine the fence, and subsequently is involved in an ATV-related fatality incident while deviating from his work to take a recreational ride up a nearby hill.

ICD-9 Versus ICD-10 Coding

In 1999, CPSC staff began collecting death certificates for all fatalities where an external cause of death listed on the death certificate was reported to involve an ATV, as coded under ICD-10. ICD-10 marks the first revision where all ATV-related fatalities are grouped under a single code (V86.X), thereby facilitating more complete collection of these incidents by CPSC staff than was accomplished prior to 1999.

It should be noted that the ICD-10 codes (V86.X) characterizing the external cause of death as "ATV-related," include fatalities resulting from all specialty motor vehicles intended primarily for off-road use (World Health Organization, 2007). Thus, other types of off-road vehicles are captured in this set of codes, such as dune buggies, ROVs, UTVs, and dirt bikes. By conducting in-depth investigations (IDIs), CPSC staff attempts to verify that the vehicles involved in these incidents were ATVs, as defined by CPSC staff (*i.e*., an ATV is a motorized vehicle intended for off-road use and having three or four low pressure tires, a straddle seat for the operator, and handlebars for steering control). In cases where the specific type of off-road vehicle cannot be ascertained, CPSC staff counts the death report as an ATV-related fatality. This assumption may result in an overestimation of ATV-related deaths.

Estimation of ATV-Related Fatalities (1999–Present)

CPSC staff estimates the number of deaths associated with ATVs by use of a capture-recapture approach. This approach involves examining the numbers of reports of ATV-related fatalities gathered via two different avenues:

- The first avenue is the collection of death certificates obtained by CPSC staff,[11] where the death is deemed by the medical examiner to be ATV-related. These incidents are entered into CPSC staff's death certificate database (DTHS).

- The second avenue involves the collection of reports of fatal ATV-related incidents by any other means available to CPSC staff (denoted non-DTHS). Sources of these types of reports include news clips; reports from the Medical Examiners and Coroners Alert Project (MECAP); reports from consumers or their representatives via telephone or the Internet (www.SaferProducts.gov);

[11] CPSC staff purchases death certificates from the 50 states, the District of Columbia, Puerto Rico, and New York City for fatalities involving selected consumer products, including ATVs. Determination of the association between a fatality and a consumer product is based on the external cause of death code(s) reported on the death certificate. Since 1999, the external causes of death reported on death certificates have been coded in accordance with ICD-10 (National Center for Health Statistics, 2007).

and hospital reports from the National Electronic Injury Surveillance System (NEISS). As for NEISS reports, it should be noted that the NEISS database primarily includes product-related injuries rather than fatalities. However, all ATV-related NEISS cases are reviewed to identify incidents where an emergency department-treated, ATV-related injury was reported to result in death; and these deaths are included in the ATV-related fatality reports available to CPSC staff.

In many cases, CPSC staff receives fatality reports for the same incident from multiple sources. The reports are either about deaths counted in a previous annual report, or deaths reported for the first time in this annual report. For example, CPSC staff may receive a MECAP report for a fatality that previously was reported to CPSC staff via a news clip. Reports from non-DTHS sources are reviewed carefully to match multiple source reports about the same incident for both the current reporting year and for previous years. Incidents that have been reported in multiple sources are counted only once in Table 1.

The calculation of the capture-recapture estimate entails the matching of fatality reports from DTHS and non-DTHS sources. Then, for each year of interest, CPSC staff determines the total number of fatalities included in DTHS, the total number of fatalities included in non-DTHS sources, and the total number of deaths included in both sources (*i.e*., DTHS and non-DTHS). Thereafter, the estimate is calculated using the following equation (Hook and Regal, 1992; Morrison and Stone, 2000; Hook and Regal, 2004):

$$estimate = \frac{(M+1)(N+1)}{n+1} - 1 \qquad \textit{Equation 1}$$

where

M is the number of incidents captured by purchase of death certificates from the states (DTHS);
N is the number of incidents collected by other means (non-DTHS);

and

n is the number of incidents captured by both death certificate purchase and at least one other source.

Estimates of fatalities that occurred on or after January 1, 1999, and that are associated with ATVs having three, four, or an unknown number of wheels are calculated using equation 1.

Estimation of ATV-Related Fatalities (1985–1998)

Prior to 1999, CPSC staff received death certificates for only two types of ATV-related fatality incidents: (1) ATV-related fatalities occurring in places other than public roads, and (2) ATV-related fatalities occurring on public roads that were erroneously reported as nonpublic roads. Because of this, the capture-recapture procedure for estimating pre-1999 ATV-related deaths had two parts:

- For public road fatalities, the estimates were based solely on the number of fatalities reported to CPSC staff. Reports of these fatalities were largely contained in CPSC staff's Injury or Potential Injury Incident file (IPII). As noted, death certificates generally were not received for these fatalities.

- For incidents occurring in other places, the capture-recapture approach was applied.

Using equation 2, these two parts (*i.e.*, incidents occurring on public roads and incidents occurring in other places) were combined to derive the pre-1999 annual estimates of ATV-related deaths for ATVs having three, four, or an unknown number of wheels.

$$estimate = \frac{(M_{NP}+1)(N_{NP}+1)}{n_{NP}+1} - 1 + C_P \qquad \textit{Equation 2}$$

where

M_{NP} is the number of reports of nonpublic-road fatalities captured by purchase of death certificates from the states;

N_{NP} is the number of reports of nonpublic-road fatalities collected by other means;

n_{NP} is the number of reports of nonpublic-road fatalities captured by both death certificate purchase and at least one other source;

and

C_P is the count of reports of ATV-related fatalities occurring on public roads from any source.

CPSC staff believes that the ATV-related fatality estimates for the years prior to 1999 were likely to be underestimated because the pre-1999 estimates used only the available counts of public road fatalities and did not account for missing reports in these types of incidents. As noted previously, CPSC staff now receives death certificates for ATV-related incidents occurring on public roads. Consequently, since 1999, the capture-recapture approach has been applied fully to both components (*i.e*., incidents occurring on public roads and incidents occurring in other locations) of the annual estimates of ATV-related deaths. For this reason, CPSC staff expects that the annual death estimates for 1999 and later represent better estimates of ATV-related fatalities than were possible in the years before 1999.

Estimation of Fatalities Associated with Four-Wheel ATVs

A number of incidents reported to CPSC staff involve ATVs for which the number of wheels is unknown. Because some of these likely involve four-wheel ATVs, the unknowns are apportioned in the calculation of the estimated number of deaths associated with four-wheel ATVs. This estimate is calculated by first dividing the reported number of deaths for four-wheel ATVs by the combined reported number of deaths for three- and four-wheel ATVs, and then multiplying this quotient by the estimated number of deaths for all ATVs (three, four, or unknown number of wheels). Thus, the estimate of deaths associated with four-wheel ATVs is given by equation 3.

$$estimate_{4W} = \frac{rep_{4W}}{rep_{3W+4W}} est_{3W+4W+UW} \qquad \textit{Equation 3}$$

where

$estimate_{4W}$ is the estimated number of fatalities associated with four-wheel ATVs;

rep_{4W} is the reported number of fatalities associated with four-wheel ATVs;

rep_{3W+4W} is the reported number of fatalities associated with three- and four-wheel ATVs;

and

$est_{3W+4W+UW}$ is the estimated number of fatalities associated with ATVs having three, four, or an unknown number of wheels. [Note: this is the "estimate" derived in equations 1 and 2].

Risk of Death per 10,000 Four-Wheel ATVs in Use

The risk of death associated with four-wheel ATVs in use is calculated by dividing the annual estimate of fatalities associated with four-wheel ATVs ($estimate_{4W}$) by the estimated number of four-wheel ATVs in use in a given year. Annual estimates of the numbers of four-wheel ATVs in use are determined from four-wheel ATV sales and operability rates based on CPSC staff studies (Levenson, 2003a; Levenson, 2003b) and on information compiled by the CPSC's Directorate for Economic Analysis. Annual four-wheel ATVs-in-use estimates for 1994 and prior years are computed from a survival model derived from 1994 data. Annual four-wheel ATVs-in-use estimates for years 2001 and after are computed from a survival model derived from 2001 data. Estimates of the annual numbers of in-use, four-wheel ATVs for the intervening years come from a model that provides a smooth transition between the 1994 and the 2001 survival models. The estimated numbers of four-wheel ATVs in use in Tables 4, 7, and 8 are

rounded figures. As a result, risk estimates calculated using these rounded figures may not match the estimates presented in the tables.

Because reliable operability rate data are not available for three-wheel ATVs, this report presents only the risk of death per 10,000 four-wheel ATVs in use.

Note that the operability rate for the years 2001 through the most recent year are based on a 2001 special study, as mentioned above. From 2001 through 2007, the number of import ATV sales and overall ATV sales increased dramatically. ATV sales have decreased substantially since 2007. It is unknown if these imports to the market follow the same survival rates as the others on the market. It is also unknown if the product survival time has remained the same for newer ATVs on the market, either import or not. The 2001 survival model continues to be used in producing this report. This should be noted when considering the estimated number of four-wheel ATVs in use, and in turn, the risk estimates for the more recent years.

ATV-Related Injuries

Estimation of Emergency Department-Treated Injuries Associated with ATVs

All injury estimates in this report have been derived from data collected through the CPSC's National Electronic Injury Surveillance System, a probability sample of U.S. hospitals with 24-hour emergency departments with more than six beds (Schroeder and Ault, 2001a and 2001b). Thus, ATV-related injury estimates in this report represent hospital emergency department-treated injuries only. ATV-related injuries that were not treated in hospital emergency departments are not included in these estimates.

Injury estimates have been adjusted to reflect revisions in the NEISS Coding Manual in 1985, as well as to account for NEISS sampling frame updates (Marker *et. al.*, 1988; Marker and Lo, 1996). Estimates for 1982 through 1985 also were adjusted based on a review of NEISS comments to exclude dune buggies and include ATVs that had been misclassified as mini or trail bikes.

Injury estimates for 1985, 1989, 1997, and 2001 are based on injury surveys using NEISS cases. Injury estimates for 2010 are based on a partial-year study of surveys of NEISS cases. Injury estimates for other years have been adjusted by factors to account for out-of-scope (occupational, intentional, and/or non-ATV) cases based on injury studies in these years (Garland, 2011; Levenson, 2003c; Rodgers and Zamula, 1986; Rodgers, 1990; U.S. CPSC, 1998). An in-scope injury case is defined to be any nonoccupational, unintentional case involving an ATV, whether or not the victim was operating the ATV at the time of the incident, *i.e.*, the victim could have been a passenger or a bystander. Note that NEISS does not collect occupational injuries; and, thus, the definition of in-scope, ATV-related injuries, differs slightly from the definition of in-scope, ATV-related fatalities. The applied adjustment factors were as follows: 0.93 for 1986 through 1988, 0.95 for 1990 through 1996, 0.903 for 1998 through 2000 (amended from 0.935), 0.922 for 2001 through 2009, and 0.899 for 2010.

As the market and ridership changes for off-road vehicles, including the substantial increase of ROVs in-use, the adjustment factors may not be reflecting the changes in injuries due to different types of vehicles as time progresses. Each adjustment factor is calculated based on a special study performed in the NEISS (Levenson, M. (2003c), Garland, S. (2011)). Each adjustment factor reflects the year in which the special study was performed, and each is applied in subsequent years until another special study is performed. Thus, if there have been substantial changes to the records that would be considered out of scope, this cannot be reflected on a year-to-year basis, nor can it be determined if this is occurring. For example, if the increase in the number of ROVs in use is impacting the injury estimates, specifically if records coded in the NEISS as ATVs are increasingly actually related to ROVs, then ATV-related injuries are being overestimated. Again, it is unknown if this is occurring in the data; however, this is a possibility with using an adjustment factor that cannot be updated yearly, but only periodically.

Coefficients of Variation

A coefficient of variation (or CV) is an expression of the standard deviation relative to the estimate itself. In this report, CVs for injury estimates are given as percentages. The adjustment factors discussed above are also estimated and have associated variability. This variability (along with the variability of the injury estimates) affects significance tests and tests for trends. Calculation of NEISS estimates and their variances is discussed in Schroeder and Ault (2001a) and Schroeder and Ault (2001b). Adjustment factors and other concepts specific to variability associated with ATV estimates are discussed more fully in Levenson (2003c, 2005b, 2005c) and Garland (2011). Alternative models for covariance were used in modelling trend as determined most appropriate by analyst.

Estimation of Emergency Department-Treated Injuries Associated with Four-Wheel ATVs

NEISS includes injuries that are associated with ATVs for which the number of wheels is unknown. Because of this, the estimated injuries associated with ATVs having an unknown number of wheels are apportioned in the calculation of the estimated injuries associated with four-wheel ATVs, using equation 4.

$$total\ estimate_{4W} = \frac{est_{4W}}{est_{3W}+est_{4W}}(est_{3W} + est_{4W} + est_{UW}) \qquad \textit{Equation 4}$$

where

$total\ estimate_{4W}$ is the total estimated injuries associated with four-wheel ATVs with unknowns apportioned;
est_{4W} is the injury estimate associated with four-wheel ATVs (excluding unknowns);
est_{3W} is the injury estimate associated with three-wheel ATVs (excluding unknowns);
and
est_{UW} is the injury estimate associated with ATVs with an unknown number of wheels.

Risk of Injury per 10,000 Four-Wheel ATVs in Use

The risk of injury per 10,000 four-wheel ATVs in use is calculated as the total estimated number of hospital emergency department-treated injuries associated with four-wheel ATVs ($total\ estimate_{4W}$), divided by the number of four-wheel ATVs in use, and then multiplied by 10,000. Annual ATV population estimates are the same as those used in the calculation of risk of death and are discussed on page 24 in this appendix. Trend analysis of the risk of injury follows the methodology discussed in section 4 of Levenson 2005b.

Changes in Injury Estimates and Risk of Injury per 10,000 Four-Wheel ATVs in Use

Consistent with the previous ATV Annual Report (U.S. CPSC, December 2011), relative changes in the annual injury estimates shown in Table 5 through Table 7 are assessed using 2001 as the base year There have been changes in the ATV market in more recent years (*e.g.*, 2001−2012), including an increase in sales of new-entrant import model ATVs from 2001 through 2007, and an overall decrease in sales between 2008 and 2012.

Appendix B

Table 8
Historical ATV-Related Emergency Department Treated Injury Estimates for ATVs with 3, 4, or Unknown Number of Wheels and for 4-wheel ATVs from 1985 to 2012

Year	Estimated Number of Injuries: All Ages (3, 4, and unknown number of wheels)	Estimated number of Injuries: Under 16 years (3, 4, and unknown number of wheels)	Estimated Number of Injuries: All Ages (4-wheel ATVs)	Estimated 4-Wheel ATVs in Use (millions)	Risk Estimate per 10,000 4-Wheel ATVs in Use (All Ages)
2012	107,900	26,500	105,000	10.7	98.4
2011	107,500	29,000	105,500	10.7	98.8
2010	115,000	28,300	111,900	10.6	105.3
2009	131,900	32,400	128,600	10.5	122.9
2008	135,100	37,700	131,700	10.2	129.7
2007	150,900	40,000	146,500	9.5	153.9
2006	146,600	39,300	140,900	8.6	163.0
2005	136,700	40,400	130,000	7.8	167.2
2004	136,100	44,700	129,500	7.0	185.4
2003	125,500	38,600	116,600	6.3	186.3
2002	113,900	37,100	104,800	5.6	188.5
2001	110,100	34,300	98,200	4.9	200.3
2000	92,200	32,000	82,300	4.2	197.2
1999	82,000	27,700	68,900	3.6	193.0
1998	67,800	25,100	57,100	3.1	184.7
1997	52,800	20,600	39,700	2.7	146.1
1996	53,600	20,200	40,700	2.4	168.1
1995	52,200	19,300	36,200	2.2	165.7
1994	50,800	21,400	33,300	2.0	165.4
1993	49,800	17,900	32,000	1.9	164.9
1992	58,200	22,000	33,000	1.9	175.1
1991	58,100	22,500	34,400	1.8	188.1
1990	59,500	22,400	30,800	1.8	175.1
1989	70,300	25,700	35,700	1.6	217.8
1988	74,600	28,500	39,400	1.4	276.1
1987	93,600	38,600	33,900	1.1	305.9
1986	106,000	47,600	23,400	0.7	319.2
1985	105,700	42,700	14,700	0.4	391.1

Sources: U.S. Consumer Product Safety Commission: National Electronic Injury Surveillance System, the Directorate for Economic Analysis and the Directorate for Epidemiology/Division of Hazard Analysis.

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