2017 Annual Report of ATV-Related Deaths and Injuries

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Executive Summary

ATV-Related Fatalities

- As of December 31, 2017, CPSC staff received reports of 15,250 ATV-related fatalities occurring between 1982 and 2017. The tally of reported deaths currently includes 295 deaths in 2017, 531 in 2016, and 585 in 2015; however, counts for these years are expected to increase in future reports as death reporting for 2015 through 2017 is still ongoing.[1]

- From 1982 through 2017, CPSC staff received reports of 3,315 ATV-related fatalities of children younger than 16 years of age. This represents 22 percent of the total number of reported ATV-related fatalities (15,250), a decreased proportion.

- In 2014, the most recent year where reporting is considered complete, of the reported 588 ATV-related fatalities 73 (12 percent) were children younger than 16 years of age. Of those 73 children, 41 (56 percent) were under age 12.

- Although the proportion fluctuates from year to year, children under 12 generally represent almost half of all under-age-16 child fatalities reported throughout the period from 1982 through 2017. Of the 3,315 reported ATV-related fatalities of children younger than 16 years of age (from 1982 through 2017), 1,450 (44 percent) were younger than 12 years of age.

ATV-Related Emergency Department-Treated Injury Estimates

- In 2017, there were an estimated 93,800 ATV-related, emergency department-treated injuries in the United States. An estimated 26 percent of these involved children younger than 16 years of age.

- The decrease in the estimated number of ATV-related, emergency department-treated injuries from 2016 to 2017 (101,200 in 2016 to 93,800 in 2017) is not statistically significant.

- None of the injury estimates is significantly different between 2016 and 2017 for the various age groups (under 16, 16 to 24, 25 to 34, 35 to 44, 45 to 54, and 55+).

- Of the 93,800 estimated ATV-related, emergency department-treated injuries for all ages in 2017, most are treated and released (83 percent) or hospitalized (15 percent).

- A plurality of the 2017 estimated ATV-related, emergency department-treated injuries were diagnosed as contusions/abrasions or fractures (20 percent and 27 percent, respectively).

- The 2017 estimated ATV-related, emergency department-treated injuries primarily affected the following body parts: the arm (shoulders to fingertips), the head or neck, leg, and the torso (29, 29, 21, and 20 percent, respectively).

- When considering the entire 11 years together (2007−2017), CPSC staff continues to find a statistically significant overall decreasing linear trend.

[1] To illustrate the increase in the number of reported deaths over time, at the time of data collection, cutoff for the 2016 report (December 31, 2016), 337 ATV-related deaths had been reported for 2016. Similarly for the 2015 report, 340 ATV-related deaths had been reported for 2015, at the time of data collection cutoff (December 31, 2015).

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Introduction

This report presents the 2017 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, 2017, as well as information on ATV-related injuries treated in hospital emergency departments from January 1, 2017 through December 31, 2017.

The report begins with a brief background section followed by a summary of ATV-related fatality counts (reports) and a discussion of reported ATV-related deaths involving children younger than 12 and 16 years of age. The report also provides annual estimates of ATV-related deaths and hospital emergency department-treated injuries based on the available data. The report concludes with a short discussion of the observed patterns of ATV-related deaths and injuries over time.

Background

CPSC staff defines an ATV for purposes of this report 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 as ATVs 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). Consequently, fatalities and injuries associated with these types of vehicles are not addressed in this report.

CPSC staff first began collecting 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 1990, the American National Standard Institute (ANSI) approved a standard developed by the Specialty Vehicle Institute of America (SVIA) for four-wheel all-terrain vehicles. In 2005, the CPSC issued an advance notice of proposed rulemaking, followed by a 2006 notice of proposed rulemaking, for ATVs. Section 232 of the Consumer Product Safety Improvement Act of 2008 (CPSIA) included provisions that directed the CPSC to make the SVIA voluntary standard a mandatory standard. The CPSIA imposed certain additional requirements on ATVs through ATV action plans, and the statute prohibited importing and distributing of three-wheel ATVs.[2] CPSC published the mandatory standard in late 2008, and the mandatory standard became effective in April 2009. In 2012, CPSC revised the mandatory standard to reflect changes in the voluntary standard. On February 27, 2018 the Commission published a final rule updating the mandatory standard to the 2017 version of ANSI/SVIA standard which became effective January 1, 2019.

[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.

ATV-Related Fatalities[3]

This section provides details on the numbers of ATV-related death reports received by CPSC staff on or before December 31, 2017, and 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.

Reported Deaths

By December 31, 2017, CPSC staff had received reports of 15,250 ATV-related deaths that occurred between 1982 and 2017 (Table 1). Including 1 additional year of reporting since the December 31, 2016, tabulation CPSC staff prepared (Topping, December 2017), the number of fatality reports increased by 597. Data collection for the years 2015 through 2017 is ongoing. Consequently, the numbers of reported deaths for 2015 through 2017 are expected to increase before the next annual report is prepared, a phenomenology illustrated by the increase in reported deaths since last year.

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 before 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. The National Center for Health Statistics (NCHS) implemented the change 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*., before 1999, versus 1999 and later), comparisons of numbers between these periods should be undertaken with caution. We discuss the ICD-10 transition and related methodological issues more fully in Appendix A.

[3] All fatality-related statistics presented in this report are derived from the final "2017" version of U.S. Consumer Product Safety Commission's All-Terrain Vehicle Deaths' (ATVD) database maintained by CPSC's Directorate for Epidemiology/Division of Hazard Analysis.

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, 2017

Year	Reported Number of Deaths	Difference Since Last Update (12/31/2016*)
Total	*15,250*	*+597*
2017	*295*	*+295*
2016	*531*	*+194*
2015	*585*	*+101*
2014	588	+7
2013	589	-1
2012	573	0
2011	622	0
2010	650	0
2009	720	0
2008	759	0
2007	832	0
2006	831	0
2005	800	+1
2004	747	0
2003	651	0
2002	547	0
2001	517	0
2000	445	0
1999	396	0
1998	253	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

Note: Italics indicate that reporting is ongoing for the years 2015–2017.
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).
* Comparison is relative to counts of reported death in previous year's report, which was based on incidents reported to CPSC by 12/31/2016.

Reported Deaths by State

Table 2 lists the number 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 2014 (*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: Texas (773), Pennsylvania (702), West Virginia (698), California (694), and Kentucky (629). Together, these five states accounted for 3,496 deaths or 25 percent of the total 13,839 reported ATV-related deaths in the United States for the years 1982 through 2014.

When reviewing state death counts for the period 1982 through 2014, 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. Conversely, 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, 2017, for the period 2015 through 2017. These counts should not be used for comparisons between states because data collection for this period is ongoing and 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.

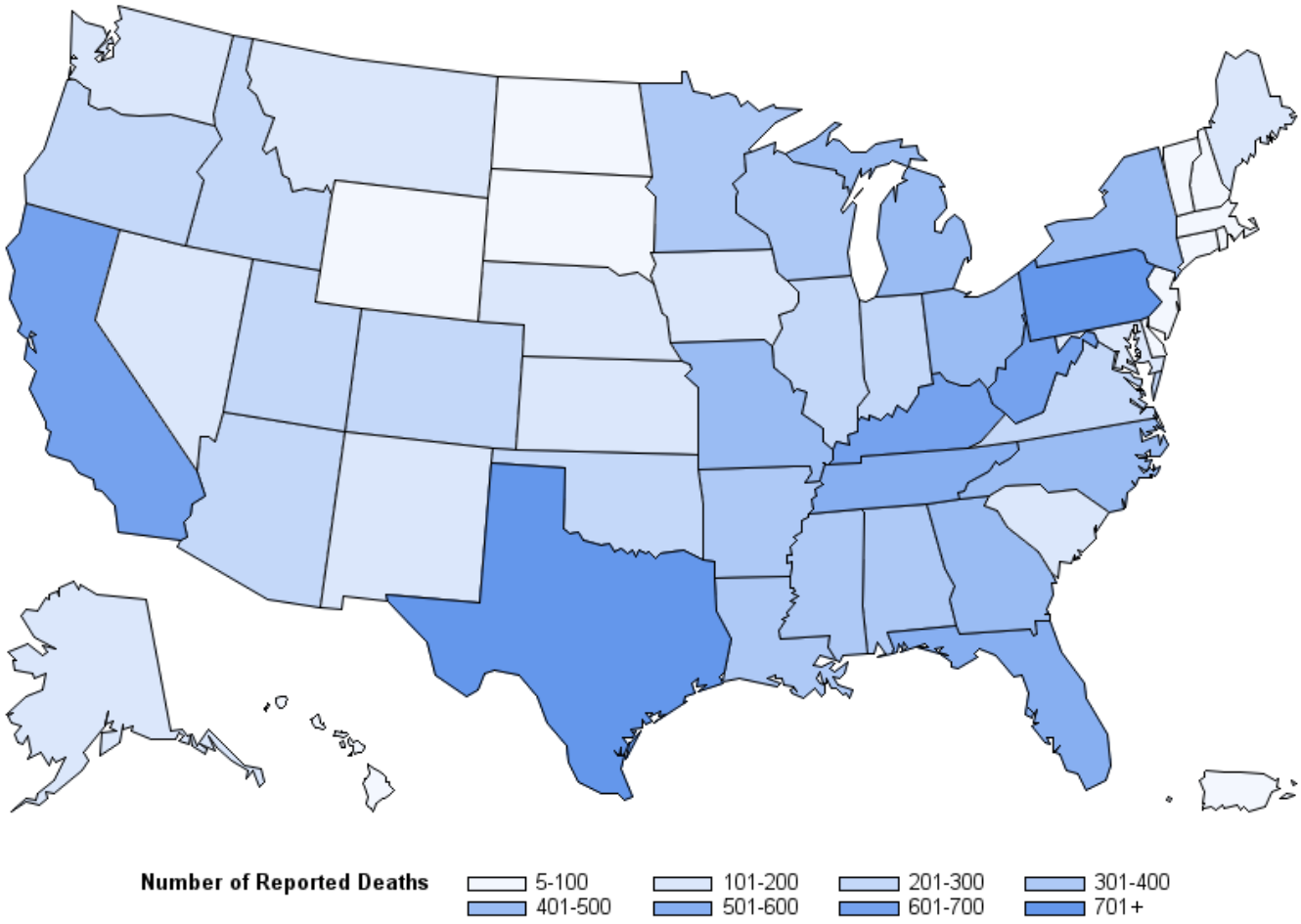
Table 2
Reported ATV-Related Fatalities (by State)
ATVs with 3, 4, or Unknown Number of Wheels
Reported for the Period January 1, 1982 through December 31, 2017

State	Reported Deaths 1982–2014	Cumulative Percent of U.S. Reported Deaths 1982–2014	*Reported Deaths (Ongoing Reporting) 2015-2017**	*Total Reported Deaths* (Including Ongoing Reporting)*
TEXAS	773	6%	*58*	*831*
PENNSYLVANIA	702	11%	*59*	*761*
WEST VIRGINIA	698	16%	*97*	*795*
CALIFORNIA	694	21%	*62*	*756*
KENTUCKY	629	25%	*63*	*692*
FLORIDA	561	29%	*55*	*616*
TENNESSEE	551	33%	*47*	*598*
NEW YORK	476	37%	*34*	*510*
NORTH CAROLINA	458	40%	*46*	*504*
MICHIGAN	436	43%	*34*	*470*
OHIO	425	46%	*47*	*472*
GEORGIA	413	49%	*17*	*430*
MISSOURI	404	52%	*35*	*439*
MISSISSIPPI	393	55%	*35*	*428*
ARKANSAS	384	58%	*21*	*405*
WISCONSIN	358	60%	*48*	*406*
ALABAMA	324	63%	*38*	*362*
LOUISIANA	319	65%	*39*	*358*
MINNESOTA	319	67%	*35*	*354*
ILLINOIS	283	69%	*36*	*319*
ARIZONA	268	71%	*21*	*289*
VIRGINIA	259	73%	*38*	*297*
INDIANA	253	75%	*32*	*285*
OKLAHOMA	249	77%	*34*	*283*
IDAHO	229	78%	*31*	*260*
OREGON	227	80%	*16*	*243*
UTAH	223	82%	*15*	*238*
COLORADO	206	83%	*22*	*228*
ALASKA	186	85%	*24*	*210*
WASHINGTON	186	86%	*22*	*208*
IOWA	178	87%	*19*	*197*
SOUTH CAROLINA	177	88%	*33*	*210*
KANSAS	162	90%	*13*	*175*
MAINE	154	91%	*13*	*167*
NEBRASKA	134	92%	*11*	*145*
NEW MEXICO	133	93%	*15*	*148*
MONTANA	132	94%	*28*	*160*
NEVADA	114	94%	*21*	*135*
MARYLAND	103	95%	*23*	*126*
NEW JERSEY	97	96%	*10*	*107*
SOUTH DAKOTA	89	97%	*18*	*107*
NORTH DAKOTA	88	97%	*10*	*98*
MASSACHUSETTS	82	98%	*9*	*91*
VERMONT	74	98%	*10*	*84*
NEW HAMPSHIRE	71	99%	*4*	*75*
WYOMING	65	99%	*6*	*71*
CONNECTICUT	48	100%	*5*	*53*
HAWAII	21	100%	*1*	*22*
DELAWARE	10	100%	*1*	*11*
RHODE ISLAND	10	100%	*0*	*10*
WASHINGTON, D.C.	6	100%	*0*	*6*
PUERTO RICO	5	100%	*0*	*5*

Note: State rankings are based on ATV-related fatality counts for the period 1982–2014.
*Italicized data (columns 4 and 5) denote the years for which reporting is ongoing (2015-2017).

Figure 1 represents the first two columns of Table 2, such that darkly shaded states had more reported ATV-related fatalities from 1982 through 2014, than states displayed in lighter shades.

Figure 1: Number of Reported ATV-Related Fatalities by State (1982–2014)



Note: This figure corresponds to the first two columns of Table 2. Reporting for 2015–2017 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 3,315 decedents (22 percent of the 15,250 total) between 1982 and 2017 were younger than 16 years of age, and 1,450 (10 percent) were younger than 12 years of age. Forty-four 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 concerning 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 2005 to 2014.

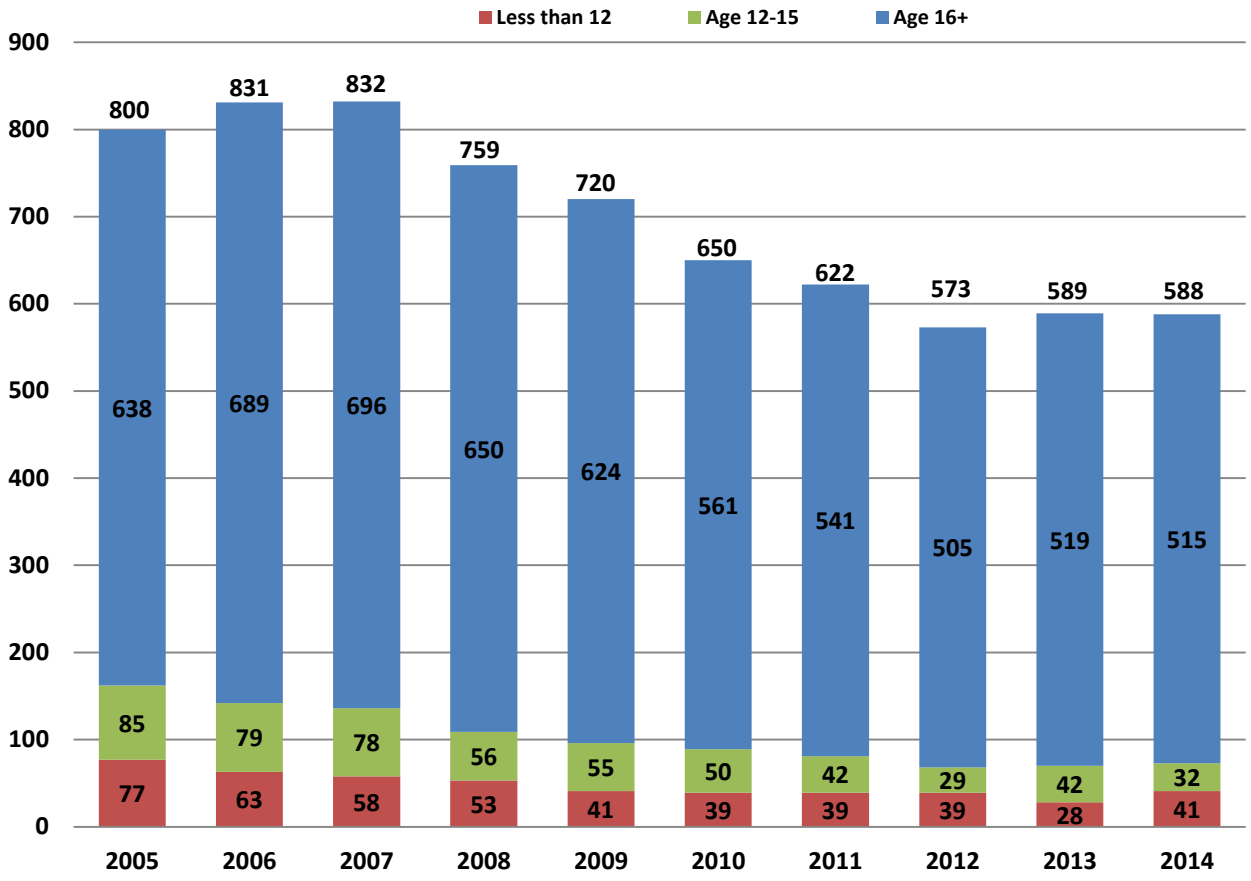
Table 3
Reported ATV-Related Fatalities for Children Younger than 16 and 12 Years of Age
ATVs with 3, 4, or Unknown Number of Wheels
Reported for the Period January 1, 1982 through December 31, 2017

Year	Younger Than 16	Younger Than 16: Percent of All Ages Total from Table 1	Younger Than 12	Younger Than 12: Percent of Child Fatalities
Total	*3,315*	*22%*	*1,450*	*44%*
2017	*59*	*20%*	*26*	*44%*
2016	*63*	*12%*	*28*	*44%*
2015	*85*	*15%*	*46*	*54%*
2014	73	12%	41	56%
2013	70	12%	28	40%
2012	68	12%	39	57%
2011	81	13%	39	48%
2010	89	14%	39	44%
2009	96	13%	41	43%
2008	109	14%	53	49%
2007	136	16%	58	43%
2006	142	17%	63	44%
2005	162	20%	77	48%
2004	179	24%	69	39%
2003	153	24%	69	45%
2002	133	24%	45	34%
2001	133	26%	58	44%
2000	122	27%	50	41%
1999	90	23%	34	38%
1998	82	32%	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%

Note: Italics denote the period for which reporting is ongoing.
Note: Reporting is ongoing for 2015–2017. 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. From past reports, the percentage of child fatalities for a given year tends to be highest when it is the most recent year with incomplete reporting, and declines after reporting for that year is complete. For example, the 2014 report indicated 16 percent of reported fatalities for the year 2014 to involve children, but now that reporting for 2014 is completed the percentage of child fatalities for the year 2014 is only 12 percent. Although reporting is still ongoing for the years 2015 and 2016, the percentage of children for those years was also higher in previous reports. Children represented 17 percent of year 2015 fatalities in the 2015 report, and 16 percent of year 2016 fatalities in the 2016 report (compared with 15 percent for 2015 and 12 percent for 2016 in this year's report).

The percentage of victims younger than 16 years of age appears to have generally declined over time, but it is possible that adult deaths are underreported during the period 1982 to 1998, as well as in the most recent years for which reporting is not complete (2015, 2016, and 2017). As previously discussed, in more recent years, reporting is ongoing. The most recent year, 2017, is especially dependent upon investigations or incidents that were reported from public news sources, and child ATV fatalities may be more likely to be reported in the news than adult fatalities. In future reports, the proportion of child and adult deaths for the most recent year (2017) is anticipated to exhibit a higher proportion of adult deaths as reports of ATV deaths from states and other non-news related sources are provided to CPSC. Nonetheless, between 1999 and 2014, the years with complete reporting and ICD-10 coding, there seems to be a large decrease in the percentage of victims younger than 16 years of age. From 1999 to 2004, the mean percentage of victims younger than 16 was 25 percent, while the mean percentage from 2005 to 2014 was 14 percent. 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 the years 1982 to 1998. If adults were more likely than children to have been involved in ATV-related fatality incidents on public roads, then, for the years before 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. This leaves comparisons among these three periods (pre-1999, 1999-2014, and 2015-2017) limited in nature.

Figure 2: Reported ATV-Related Fatalities by Age Group (2005–2014)



Note: This figure corresponds to the data reported in Tables 1 and 3. Reporting for 2015–2017 is ongoing; thus, Figure 2 does not display these years.

Four-Wheel Versus Three-Wheel ATVs

As discussed in the Background Section, currently, the ATVs distributed in the United States are nearly all four-wheel models (U.S. CPSC, 2006).[4] The percentage of reported fatalities involving four-wheel ATVs increased from 7 percent or less, before 1985, to 98 percent in 2017, based on 2017 fatalities reported to CPSC staff as of December 31, 2017. Although data collection for 2017 is ongoing, this percentage is not expected to change greatly as additional reports of 2017 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, 1985 to 2015

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 2015, using a statistical estimation method called capture-recapture (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. Due to the low data-collection completion rates as of December 31, 2017 for the years 2016 (74%) and 2017 (29%), estimates for recent years were not calculated for this report, but will be estimated in future reports.

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 likely 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 calculated for the years before 1999 may have been underestimated.

[4] There are some six-wheel models available for consumers' use, but the scope of this report does not cover those models.

Table 4
Annual Estimates of ATV-Related Fatalities
1985–2015
Based on Fatality Data Available as of December 31, 2017

Year[5]	*Reported Deaths	Estimated Deaths Associated with ATVs with 3, 4, or Unknown Wheels	Estimated Deaths Involving 4-Wheel ATVs
2015	*585*	*708*	*693*
2014	588	661	648
2013	589	651	636
2012	573	653	636
2011	622	684	663
2010	650	724	712
2009	720	793	772
2008	759	845	826
2007	832	895	865
2006	831	898	871
2005	800	923	883
2004	747	836	798
2003	651	752	717
2002	547	597	560
2001	517	586	542
2000	445	540	491
1999	396	521	473
1998	253	291	248
1997	240	289	235
1996	249	268	209
1995	200	276	213
1994	198	243	167
1993	183	210	143
1992	220	242	159
1991	230	251	150
1990	235	252	152
1989	230	257	152
1988	250	285	151
1987	264	282	126
1986	300	348	95
1985	250	293	55

Note: Italics denote the period for which reporting is ongoing.

[5] Reporting is ongoing for 2015. Reporting for 2016 and 2017 is too preliminary to report estimates of death.

ATV-Related Injuries[6]

ATVs with Three, Four, or Unknown Numbers of Wheels

Table 5 shows estimates of ATV-related injuries treated in hospital emergency departments nationwide between January 1, 2007 and December 31, 2017. We generated these estimates 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, we compared the current estimates to the estimates from the previous year (2016), as well as to a base year. We chose 2007 as the base year for comparison.[7] We also considered the existence of a possible trend in injuries associated with ATVs with three, four, or an unknown number of wheels based on trend analysis methods developed by CPSC staff (Schroeder, 2000). Historical estimates of the number of ATV-related, emergency department-treated injuries, are provided in Appendix B.

Table 5 includes the estimated number of ATV-related, emergency department-treated injuries for children younger than 16 years, with the corresponding percent of total injuries. Estimates along with percentages corresponding to their contribution to the under-16 estimate are provided for children younger than 12. Figure 3 displays the estimated injuries for all ages and for both child age groups.

Table 5
Annual Estimates[8] of ATV-Related Emergency Department-Treated Injuries
ATVs with 3, 4, or Unknown Number of Wheels
January 1, 2007, through December 31, 2017

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
2017	93,800	24,800	26%	11,700	47%
2016	101,200	26,800	26%	13,900	52%
2015	97,200	26,700	28%	13,400	50%
2014	93,700	24,800	26%	11,400	46%
2013	99,600	25,000	25%	13,100	52%
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%

Note: The coefficients of variation (CVs) for the injury estimates in this table range from 9 percent to 15 percent. See Appendix A for an explanation of the use and calculation of CVs.

[6] We base injury statistics in this report on an analysis of data from the U.S. Consumer Product Safety Commission's National Electronic Injury Surveillance System.
[7] See the methodology section in Appendix A for a discussion of the rationale for choosing 2007 as the base year.
[8] We also adjusted estimates to account for cases that are out of scope for this report. See Appendix A for additional discussion.

The 2017 emergency department-treated injury estimate for *all ages* reflects a decrease of 7 percent from the 2016 estimate. However, this decrease is not statistically significant (p-value =0.32). The overall decrease of 38 percent between the estimated number of injuries in 2007 and 2017 is statistically significant (p-value < 0.0001). In addition, trend analysis indicates that for ATVs having three, four, or an unknown number of wheels, there is a statistically significant downward trend in emergency department-treated injuries for all ages, collectively, during the years 2007 through 2017 (p-value = 0.0090).

Similarly, the 2017 emergency department-treated injury estimate for *children under 16* years of age represents a 7 percent decrease over the 2016 estimate, which is not statistically significant (p-value = 0.49). The comparison of the 2007 to the 2017 estimated numbers of emergency department-treated injuries for children younger than 16 years of age shows a 38 percent decrease; these two estimates are statistically different (p-value < 0.0001).

On average, over the period 2007-2017, *children under 12* years of age represent an estimated 13 percent of emergency department-treated injuries of all ages or 47 percent of injuries to children under 16 (*i.e.,* 160,000/1,233,900 and 160,000/322,000, respectively). Similarly, in the most recent year 2017, children younger than 12 represent an estimated 12 percent of all injuries or 47 percent of injuries to children under 16 (*i.e.,* 11,700/93,800 and 11,700/24,800, respectively).

Figure 3
Annual ATV-Related, Hospital Emergency Department-Treated Injury Estimates for ATVs with 3, 4 or Unknown Number of Wheels (2007 - 2017)

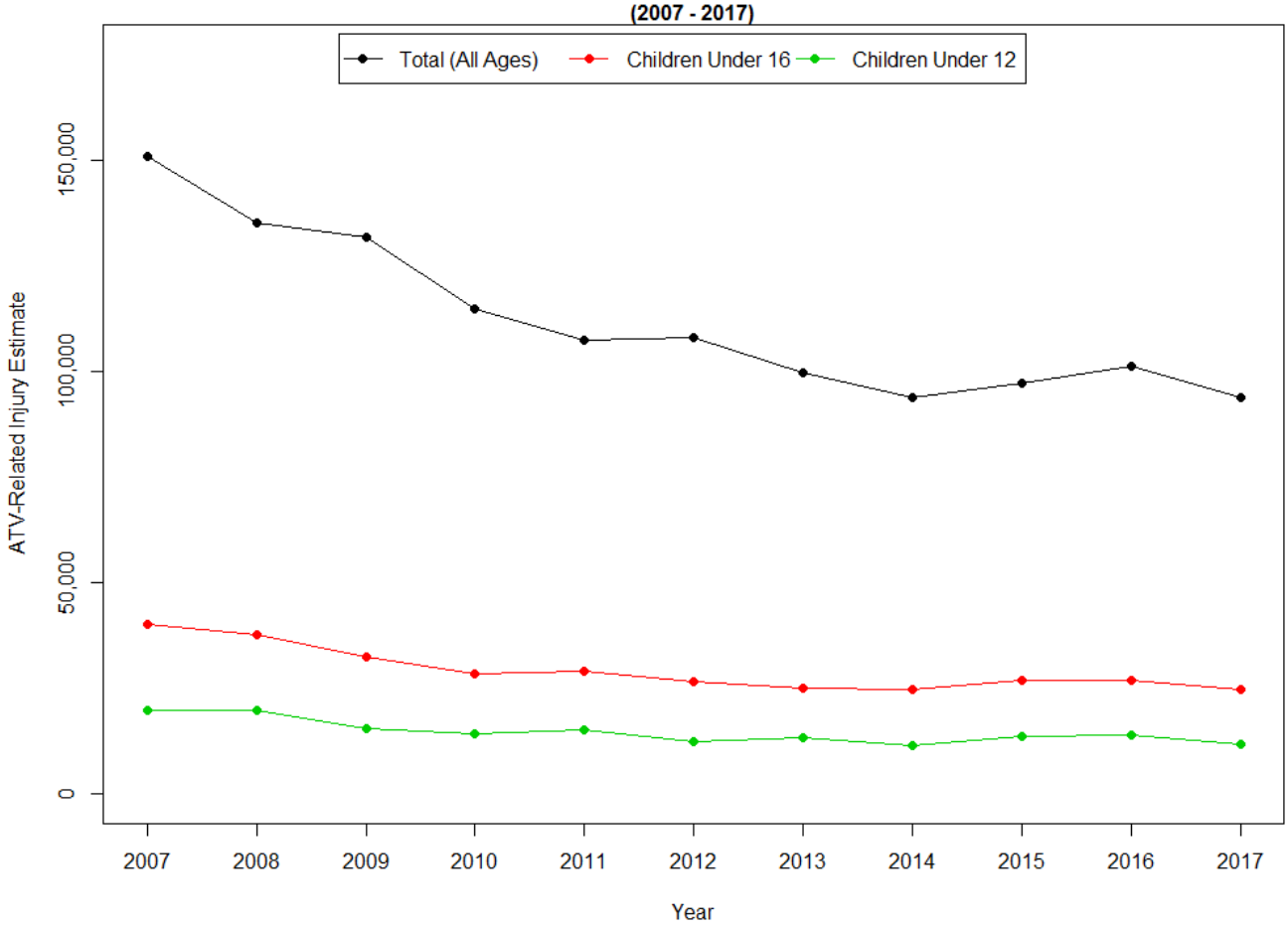


Table 6 breaks down the estimated numbers of ATV-related emergency department-treated injuries from 2007 to 2017 by various age groups, while Figure 4 gives the corresponding graph of Table 6.

Table 6
Annual Estimates of ATV-Related Emergency Department-Treated Injuries by Age Group
2007–2017

	Age Group						
Year	**Under 16**	**16–24**	**25–34**	**35–44**	**45–54**	**55 +**	**Total**
2017	24,800	21,700	19,300	10,900	8,700	8,400	93,800
2016	26,800	23,200	21,900	13,400	8,100	7,800	101,200
2015	26,700	24,200	19,600	11,700	7,700	7,100	97,000
2014	24,800	22,700	19,800	13,700	7,400	5,300	93,800
2013	25,000	26,400	21,600	12,300	8,000	6,500	99,600
2012	26,500	28,000	24,600	14,000	8,600	6,300	107,900
2011	29,000	27,700	23,000	14,000	8,000	5,900	107,500
2010	28,300	29,500	25,900	15,200	9,000	7,000	115,000
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	135,100
2007	40,000	45,800	31,200	17,800	9,600	6,500	150,900

Note: Rows may not sum to the annual totals presented elsewhere in this report due to rounding and the exclusion of cases with unknown victim age.

Analysis of information in Table 6 (above) supports the following:

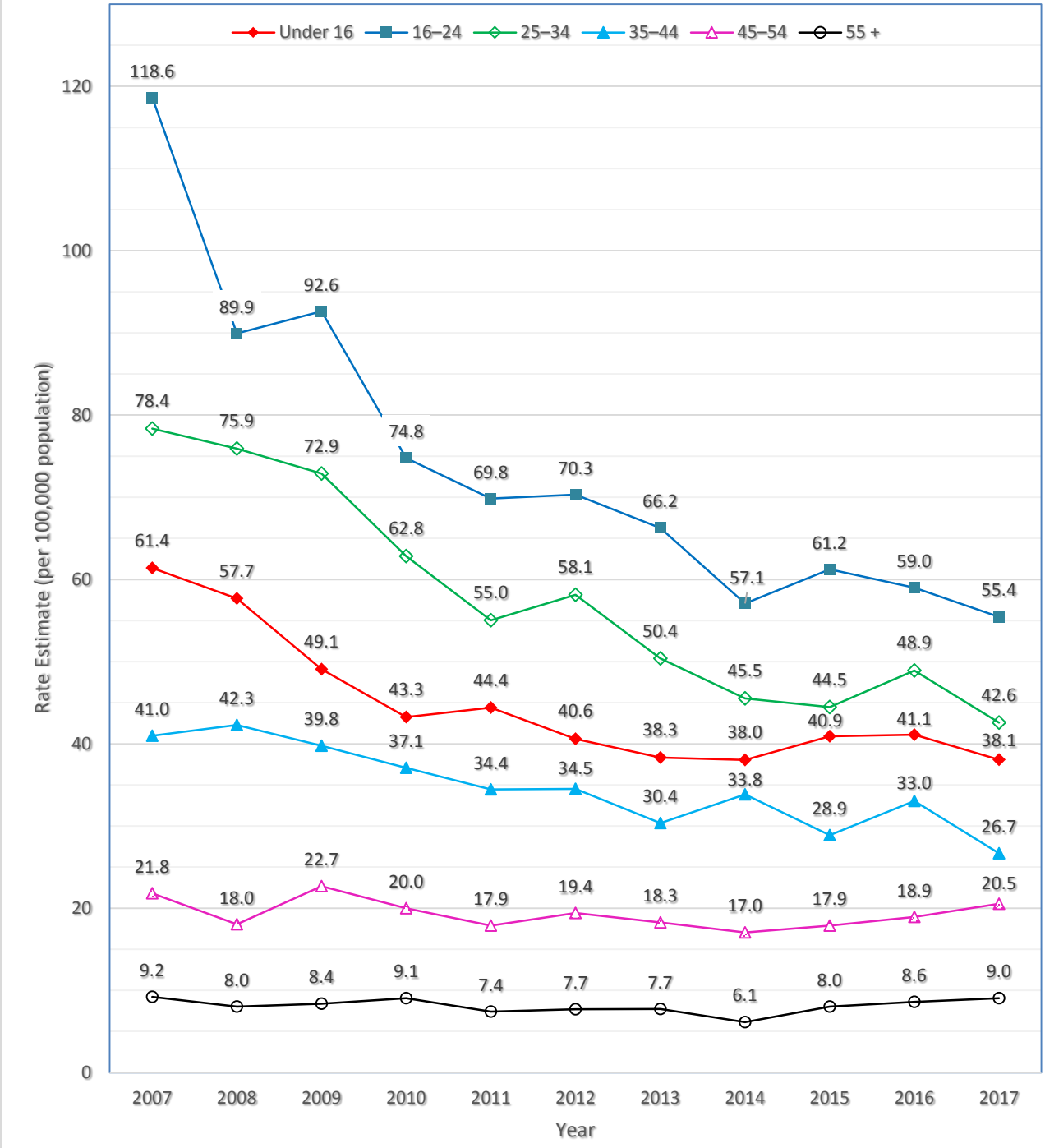
- Between 2016 and 2017, no age group exhibits a statistically significant difference in injuries. The two oldest age groups (45-54 and 55+) have injury estimates that are greater in 2017 than in 2016, but the changes do not reflect significant increases (p-value =0.62 and 0.66, respectively). The injury estimates for all younger age groups (under age 16, 16-24, 25-34, and 35-44) decreased between 2016 and 2017, but none reflects statistically significant decreases (p-value =0.32, 0.49, 0.48, 0.36, and 0.07, respectively).

- When comparing the base year 2007 against the 2017 injury estimates, staff find statistically significant decreases in injuries for all except the eldest two age groups. For each of the youngest four age groups (under 16, 16-24, 25-34, and 35-44) the 2017 estimate is significantly less than the 2007 estimate (p-values < 0.0001 for the under 16, 16-24, and 25-34 age groups and p-value = 0.0013 for the 35-44 age group). Although the 45-54 age group has an injury estimate that is also less in 2017 than in 2007, the difference is not statistically significant (p-value =0.50). The 55+ age group is the only age group for which the injury estimate is greater in 2017 than in 2007; however this is not a statistically significant increase (p-value = 0.13).

Differences in population sizes among age groups and across time likely influence the number of injuries for each age group. According to data from the U.S. Census Bureau, the number of persons age 55 years or older increased from an estimated 71 million to 93 million during this 11-year period. The under-16 age group held steadily, close to about 65 million throughout the period. The remaining age groups were comparably somewhere between about 39 and 45 million, depending on the year and

age group. To facilitate comparisons normalized by population size, Figure 4 (below) presents annual estimated injury rates per 100,000 persons within each age group.

Figure 4
Annual ATV-Related Hospital Emergency Department-Treated Injury Rate Estimates per 100,000 Population by Age Group



Sources: U.S. Census Bureau and NEISS.

Figures 5, 6, and 7 provide the 2017 estimated number of ATV-related, emergency department-treated injuries for *all ages,* broken down, respectively, by disposition, diagnosis, and body part. Of the 93,800 estimated ATV-related, emergency department-treated injuries for all ages in 2017, a majority are categorized as "treated and released" (83 percent). Fifteen 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," "fatality," and "unknown." A plurality of the 2017 estimated ATV-related, emergency department-treated injuries for all ages were diagnosed as contusions/abrasions or fractures (20 percent and 27 percent, respectively). The remaining diagnoses were distributed into categories such as: lacerations, sprains/strains, internal organ injuries, and other (which includes concussions). The majority of the 2017 estimated ATV-related, emergency-department treated injuries were located on the arm (the shoulder down) or the head or neck, or (29 percent and 29 percent, respectively).

Figure 5: Disposition of ATV-Related Emergency Department-Treated Injuries for All Ages, 2017

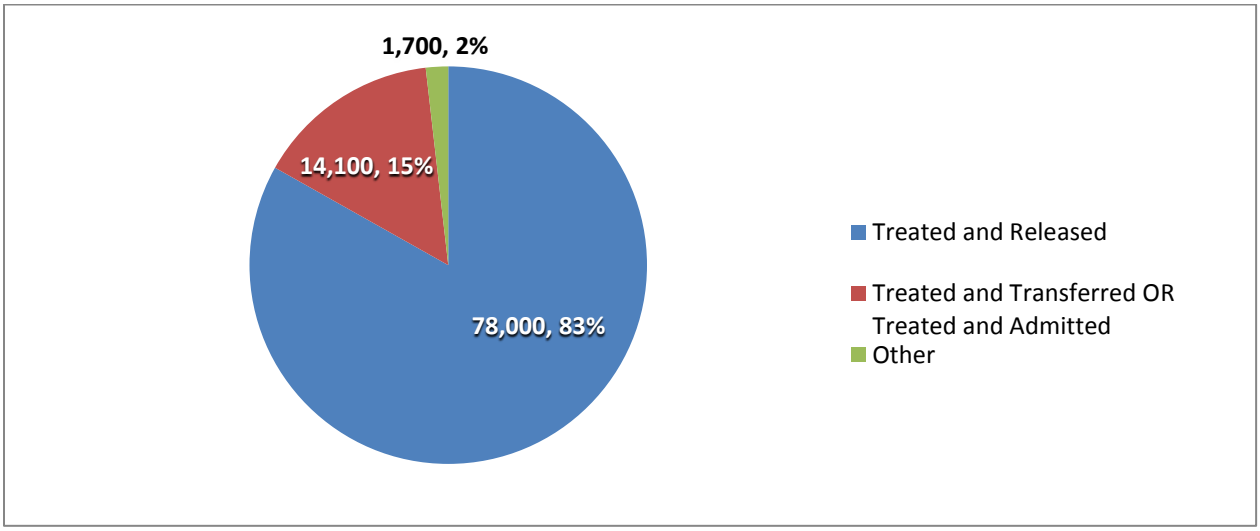
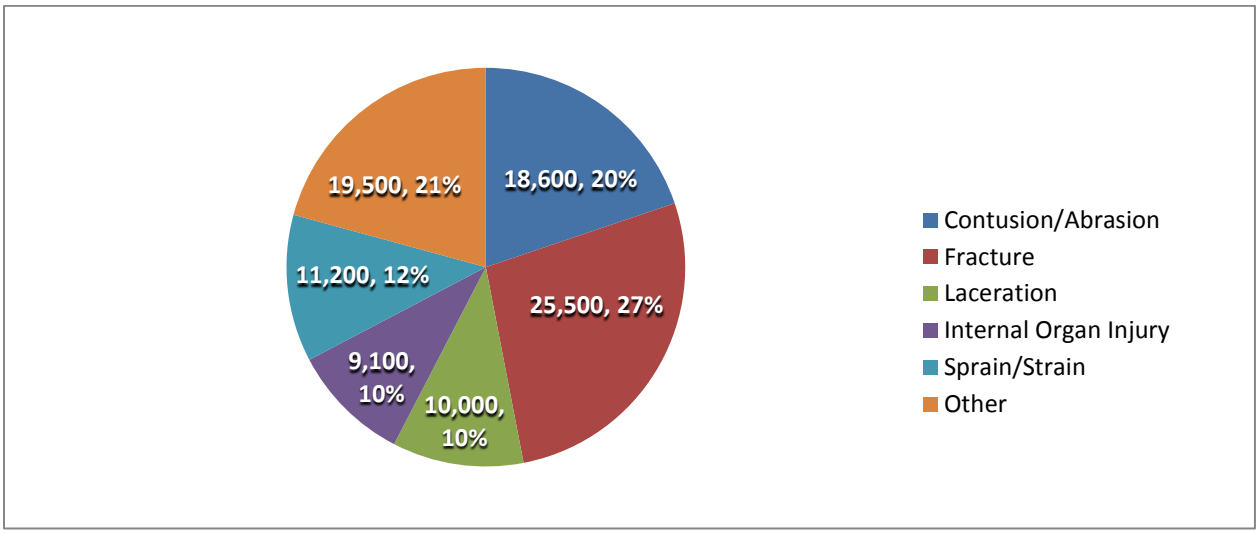
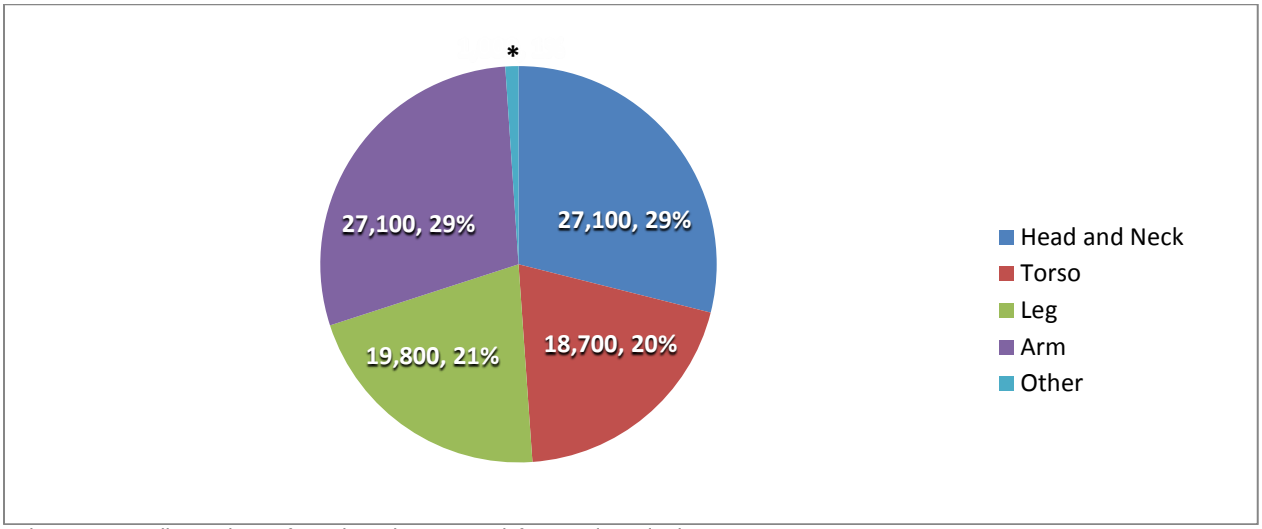


Figure 6: Diagnosis of ATV-Related Emergency Department-Treated Injuries for All Ages, 2017[9]



[9] Percentages are based on the rounded estimates.

Figure 7: Body Part Injured in ATV-Related Emergency Department-Treated Injuries for All Ages, 2017



* The corresponding estimate for "other" does not satisfy reporting criteria.

For the 24,800 estimated ATV-related, emergency department-treated injuries in 2017 for *children younger than 16 years of age*, the majority were treated and released (an estimated 83%). About 15 percent of children younger than 16 years of age were either treated and admitted or treated and transferred. The remaining injuries were spread across several disposition categories, such as left without being seen, held for observation, fatalities, and unknown.

In 2017, children younger than 16 years of age were diagnosed with contusions/abrasions an estimated 21 percent of the time for ATV-related emergency department-treated injuries, and 27 percent of the time with fractures. The remaining diagnoses are distributed into categories such as lacerations, sprains/strains, internal organ injuries, and concussions.

Four-Wheel ATVs

Table 7 shows estimates of four-wheel ATV-related emergency department-treated injuries for the years 2007 to 2017. In 2017, four-wheel ATV injuries constituted 99 percent of the total injury estimate for ATVs having three, four, or an unknown number of wheels (*i.e*., 92,500/93,800). The four-wheel ATV emergency department-treated injury estimate for 2017 represents a 7 percent decrease over the 2016 estimate; however, this is not a statistically significant decrease (p-value = 0.47). There is a statistically significant difference between the 2007 and 2017 estimates (p-value < 0.0001). There is also a statistically significant linear trend in emergency department-treated injuries associated with four-wheel ATVs from 2007 to 2017 (p-value = 0.0066).

Table 7
Estimated Number of 4-Wheel ATV-Related Emergency Department-Treated Injuries
January 1, 2007, through December 31, 2017

Year	4-Wheel ATV-Related Injury Estimate[10, 11]	Estimated Percentage of Total ATV Injuries (with 3, 4, or Unknown Number of Wheels)
2017	92,500	99%
2016	99,600	98%
2015	95,500	98%
2014	92,200	98%
2013	97,600	98%
2012	105,000	97%
2011	105,500	98%
2010	111,900	97%
2009	128,600	97%
2008	131,700	97%
2007	146,500	97%

Note: The coefficients of variation (CVs) for four-wheel ATV injury estimates (column 2) all range from about 8 to 11 percent. (See Levenson, (2005) and Garland (2011) for CVs for ATV-related injury estimates).

[10] Estimates have been adjusted by factors to apportion cases with unknown number of wheels and to account for cases that are out of scope for this report. Appendix A provides additional detail.
[11] 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 control for, at least in part, changes in fatality data availability, as well as for possible changes in the ATV marketplace (see Appendix A). Although 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.

We defined the periods selected for discussion 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 2014, begins with the transition to ICD-10 coding and ends with the most recent complete year-of-death data collection.

- The third period, from 2015 to 2017, spans the period of ongoing mortality data collection by CPSC staff.

We review ATV-related deaths and injuries occurring in each of these three periods 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. CPSC issued an advance notice of proposed rulemaking in May 1985, in response to the marked increase in deaths and injuries associated with ATVs. In December 1987, CPSC filed a lawsuit in federal district court against the five major manufacturers/distributers of ATVs, and the matter was settled with the court's approval of Final Consent Decrees in April 1988. In addition to the Final Consent Decree requirements related to free training, developing a voluntary standard, and marketing of ATVs, and it required companies to stop sale of all new three-wheeled ATVs. Since then, essentially all new ATVs sales have been four-wheelers.

Death estimates for the first period (1982 – 1998) are likely to be underestimated due to ICD 9 reporting codes and requirements. 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 caveats, 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. A general increase in the estimated deaths then appears to have occurred from the mid-1990s to the end of this period (1982−1998). As mentioned, this reporting period used the ICD-9 reporting requirements likely resulting in the underestimation of the death estimates. The reader should

use caution when generalizing in this period, due to the impact of this underestimation on the magnitude of the estimates.

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). 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 per year. 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.

1999–2014

Because of the transition to ICD-10 mortality coding, the second period (1999–2014) reflects years during which CPSC staff had a greater opportunity to collect comprehensive data on ATV-related fatalities than before 1999. ATV-related regulatory activity resumed 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 that 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 period due to the exposure resulting from CPSC issuing an advance notice of proposed rulemaking in 2005, and a notice of proposed rulemaking in 2006. Comparing the estimated numbers of deaths associated with ATVs having three, four, or an unknown number of wheels, there is an increase of about 77 percent between 1999 to 2005, followed by a decrease of about 28 percent between 2005 to 2014 (Table 4). Although this reflects an increase followed by a decrease within the 1999 to 2014 period, there is an overall 27 percent increase between 1999 and 2014 in estimated deaths associated with ATVs having three, four, or an unknown number of wheels.

The estimated numbers of emergency department-treated injuries associated with ATVs having three, four, or an unknown number of wheels increased 84 percent from the 1999 estimate of 82,000, to the 2007 estimate of 150,900, before *generally* declining each year thereafter down to the 2014 estimate of 99,600 (Table 8 in Appendix B, page 29). Although estimates appear to increase between 2011 and 2012 (from 107,500 to 107,900), the change is not statistically significant. The overall decrease of 37 percent from 2007 to 2014 is statistically significant.

In 2008, the 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[12] 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 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 timely death reports during these periods.

During the latter half of this period, and continuing into the next period, the CPSC launched a campaign to increase awareness of ATV safety via television and radio public service announcements (PSAs),

[12] The term "ATV action plan" means a written plan or letter of undertaking that describes actions the manufacturer or distributor agrees to take to promote ATV safety, including rider training, dissemination of safety information, age recommendations, other policies governing marketing and sale of the ATVs, the monitoring of such sales, and other safety-related measures, and that is substantially similar to the plans described under the heading, "The Undertakings of the Companies in the Commission Notice" published in the *Federal Register* on September 9, 1998 (63 FR 48199–48204)."

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 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). In 2013, the ATVSafety.gov website was redirected into CPSC's main website as the "ATV Safety Information Center."

CPSC staff does not have the data to ascertain the causes of any trend in injuries related to ATVs. Thus, no conclusions can be made on the causes of any trends for any period of time.

2015-2017

The third period (2015–2017) contains 3 years of incomplete death data. Some states provide death certificates to CPSC more promptly than others, but it is expected that eventually CPSC will receive at least one death certificate (not necessarily ATV related) for nearly all combinations of state and month for any given year. As of December 31, 2017, death certificate completion was 89 percent for 2015, 74 percent for 2016, and 29 percent for 2017. 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. The number of reported deaths for these years will increase as CPSC staff receives additional reports. For this reason, the 2015 through 2016 estimated numbers of deaths will require revision for these years in future CPSC staff reports. Initial estimates of deaths for 2017 will be provided in next year's report.

During the third period, emergency department-treated injury estimates for all ages did not exhibit significant change, both for ATVs having three, four, or an unknown number of wheels (Table 5), and for four-wheel ATVs alone (Table 7). For ATVs having three, four, or an unknown number of wheels, the overall decrease from 2015 to 2017, is not statistically significant (97,200 and 93,800, respectively; p-value = 0.65). Similarly, the decrease, when comparing the estimated number of injuries associated with four-wheel ATVs from 2015 to 2017, is also not statistically significant (95,500 and 92,500, respectively; p-value =0.72). However, the data-collection process supporting the derivation of the injury estimates is complete for all reported years, including this period (2015–2017). Thus, the injury estimates for 2015 through 2017 are not expected to require revision in future CPSC staff reports.

In the period 2015−2017, CPSC continued maintenance of the ATV Safety Information Center (ATVSafety.gov) and produced a new animated video with ATV safety tips. In addition, CPSC started production and filming for a new PSA and short video series. In the earlier part of this period from 2014-2016, CPSC promoted ATV safety awareness with annual news releases aimed to coincide with the Memorial Day holiday weekend, which has higher rates of ATV-related deaths and injuries and each year marks the beginning of the recreational riding season. In a 2017 blog post, CPSC highlighted the five states that account for 25 percent of all reported ATV-related deaths and conducted targeted media outreach to those states.[13]

[13] Personal communication with OCM staff members (September 2018).

Appendix A: Estimation Methodologies

This appendix describes the methodologies used to estimate ATV-related deaths and injuries and other information to develop 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 while examining 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 in which 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 in which all ATV-related fatalities are grouped under a single code (V86.X), thereby facilitating more complete collection of these incidents by CPSC staff than accomplished before 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, such as dune buggies, ROVs, UTVs, and dirt bikes, are captured in this set of codes.. 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,[14] where the death is deemed by the medical examiner to be an ATV-related death. These incidents are entered into CPSC staff's death certificate database (DTHS).

- The second avenue involves collecting 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

[14] 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).

from consumers or their representatives via telephone or the Internet (www.SaferProducts.gov); and hospital reports from the National Electronic Injury Surveillance System (NEISS). 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 reportedly resulted 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 CPSC staff previously received 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 matching 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)

Before 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 before 1999 were likely 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, 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. Accordingly, 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].

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 NEISS, 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, 2003b; Levenson 2005). 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 through present.

As the market and ridership changes for off-road vehicles, including the substantial increase of ROVs in use, the adjustment factors may not reflect 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. (2003b), 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 (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 (2003b, 2005) and Garland (2011). An alternative heterogeneous autoregressive model for the variance-covariance matrix was used in modelling trends for specific to ATVs with four wheels for the broader category of ATVs having three, four, or an unknown number of wheels for all ages, collectively during the years 2007 through 2017.

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.

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 2017

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)
2017	93,800	24,800	92,500
2016	101,200	26,800	99,600
2015	97,200	26,700	95,500
2014	93,700	24,800	92,200
2013	99,600	25,000	97,600
2012	107,900	26,500	105,000
2011	107,500	29,000	105,500
2010	115,000	28,300	111,900
2009	131,900	32,400	128,600
2008	135,100	37,700	131,700
2007	150,900	40,000	146,500
2006	146,600	39,300	140,900
2005	136,700	40,400	130,000
2004	136,100	44,700	129,500
2003	125,500	38,600	116,600
2002	113,900	37,100	104,800
2001	110,100	34,300	98,200
2000	92,200	32,000	82,300
1999	82,000	27,700	68,900
1998	67,800	25,100	57,100
1997	52,800	20,600	39,700
1996	53,600	20,200	40,700
1995	52,200	19,300	36,200
1994	50,800	21,400	33,300
1993	49,800	17,900	32,000
1992	58,200	22,000	33,000
1991	58,100	22,500	34,400
1990	59,500	22,400	30,800
1989	70,300	25,700	35,700
1988	74,600	28,500	39,400
1987	93,600	38,600	33,900
1986	106,000	47,600	23,400
1985	105,700	42,700	14,700

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

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