



2018 Annual Report of ATV-Related Deaths and Injuries



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Executive Summary

ATV-Related Fatalities

- As of December 31, 2018, CPSC staff received reports of 15,744 ATV-related fatalities occurring between 1982 and 2018. The tally of reported deaths currently includes 264 deaths in 2018, and 463 in 2017. However, counts for these years are expected to increase in future reports, because death reporting for 2017 and 2018 is ongoing.¹
- From 1982 through 2018, CPSC staff received reports of 3,353 ATV-related fatalities of children younger than 16 years of age. This represents 21 percent of the total number of reported ATV-related fatalities (15,744).
- In 2016, the most recent year where reporting is considered complete, of the reported 591 ATV-related fatalities, 65 (11 percent) were children younger than 16 years of age. Of those 65 children, 29 (45 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 2018. Of the 3,353 reported ATV-related fatalities of children younger than 16 years of age (from 1982 through 2018), 1,465 (44 percent) were younger than 12 years of age.

ATV-Related Emergency Department-Treated Injury Estimates

- In 2018, there were an estimated 81,800 ATV-related emergency department-treated injuries in the United States. An estimated 26 percent of these injuries involved children younger than 16 years of age.
- The decrease in the estimated number of ATV-related emergency department-treated injuries from 2017 to 2018 (93,800 in 2017, to 81,800 in 2018) *is* statistically significant.
- However, for the various age groups (under 16, 16 to 24, 25 to 34, 35 to 44, 45 to 54, and 55+), the differences in injury estimates between 2017 and 2018 are *not* statistically significant
- Of the 81,800 estimated ATV-related emergency department-treated injuries for all ages in 2018, most were treated and released (81 percent) or hospitalized (17 percent).
- A plurality of the 2018 estimated ATV-related emergency department-treated injuries were diagnosed as contusions/abrasions or fractures (22 percent and 30 percent, respectively).
- The 2018 estimated ATV-related emergency department-treated injuries primarily affected these body parts: the arm (shoulders to fingertips), the head or neck, leg, and the torso (29, 29, 22, and 21 percent, respectively).
- Assessing the entire 10-year period (2009–2018), 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 [2017 report](#) (December 31, 2017), 295 ATV-related deaths had been reported for 2017. Similarly for the [2016 report](#), 337 ATV-related deaths had been reported for 2016, at the time of data collection cutoff (December 31, 2016).

Table of Contents

| | |
|---|----|
| Executive Summary | 2 |
| Introduction | 4 |
| Background..... | 4 |
| ATV-Related Fatalities..... | 5 |
| Reported Deaths | 5 |
| Reported Deaths by State | 7 |
| Reported Deaths of Children..... | 9 |
| Estimated ATV-Related Deaths, 1985 to 2017 | 12 |
| ATV-Related Injuries..... | 14 |
| ATVs with Three, Four, and Unknown Number of Wheels | 14 |
| Other Off-Road Vehicles (specifically Utility and Recreational Off-Road Vehicles)..... | 20 |
| Appendix A: Estimation Methodologies..... | 21 |
| ATV-Related Deaths..... | 22 |
| In-Scope ATV-Related Fatalities | 22 |
| ICD-9 Versus ICD-10 Coding..... | 22 |
| Estimation of ATV-Related Fatalities (1999–Present) | 22 |
| Estimation of ATV-Related Fatalities (1985–1998)..... | 23 |
| Estimation of Fatalities Associated with Four-Wheel ATVs | 24 |
| ATV-Related Injuries | 25 |
| Estimation of Emergency Department-Treated Injuries Associated with ATVs..... | 25 |
| Coefficients of Variation | 25 |
| Estimation of Emergency Department-Treated Injuries Associated with Four-Wheel ATVs..... | 26 |
| Appendix B: Historical Estimated Number of Emergency Department-Treated Injuries 1985–2018..... | 27 |
| References | 28 |

List of Tables

| | |
|---|----|
| Table 1: Reported Fatalities by Year 1982–2018..... | 6 |
| Table 2: Reported Fatalities by State 1982–2018..... | 8 |
| Table 3: Reported ATV-Related Fatalities for Children Younger than 16 and 12 Years of Age 1982–2018..... | 10 |
| Table 4: Annual Estimated ATV-Related Fatalities 1985-2017 | 13 |
| Table 5: Annual Estimates of ATV-Related, Emergency Department-Treated Injuries 2007–2018 | 14 |
| Table 6: Estimated Number of Emergency Department-Treated Injuries by Age Group 2007–2018..... | 16 |
| Table 7: Reported Deaths and Estimates of Emergency Department-Treated Injuries Associated with Product Code 5044 (Utility Vehicles)..... | 21 |
| Table 8: Historical ATV-Related Emergency Department-Treated Injuries Estimates for ATVs with 3,4, or Unknown Number of Wheels and Four-Wheel ATVs from 1985 to 2018..... | 27 |

List of Figures

| | |
|---|----|
| Figure 1: Number of Reported ATV-Related Fatalities by State (1982–2015)..... | 9 |
| Figure 2: Reported ATV-Related Fatalities by Age Group (2009–2018)..... | 11 |
| Figure 3: Annual ATV-Related Hospital Emergency Department-Treated Injury Estimates for All Ages, Less Than 16 Years, and Less than 12 Years (2009–2018)..... | 15 |
| Figure 4: Annual ATV-Related Hospital Emergency Department-Treated Injury Rate Estimates by Age Group (2009–2018)..... | 17 |
| Figure 5: Disposition of ATV-Related Emergency Department-Treated Injuries for All Ages, 2018..... | 18 |
| Figure 6: Diagnosis of ATV-Related Emergency Department-Treated Injuries for All Ages, 2018..... | 18 |
| Figure 7: Body Part Injured in ATV-Related Emergency Department-Treated Injuries for All Ages, 2018..... | 19 |

Introduction

This report presents the 2018 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, 2018, as well as information on ATV-related injuries treated in hospital emergency departments from January 1, 2018, through December 31, 2018.

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

For this report, CPSC staff defines an “ATV” as 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 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 the focus of this report, but are addressed in a later section titled “Other Off-Road Vehicles (specifically Utility and Recreational Off-Road Vehicles).”

CPSC staff 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 consumers continue to use some older three-wheel ATVs, 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 for ATVs, followed by a 2006 notice of proposed rulemaking.

Section 232 of the Consumer Product Safety Improvement Act of 2008 (CPSIA) included provisions directing 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 three-wheel ATVs.² CPSC published a mandatory standard that made the SVIA voluntary standard a mandatory standard, which 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 (with effective date of January 1, 2019), updating the mandatory standard to the 2017 version of ANSI/SVIA standard.

² The provisions relating to ATVs are at 16 CFR part 1420. See:

http://www.ecfr.gov/cgi-bin/text-idx?SID=dbc1bdfdc8b6fa15f91bd3bda47acd6&tpl=/ecfrbrowse/Title16/16cfr1420_main_02.tpl.

ATV-Related Fatalities³

This section details the numbers of ATV-related death reports received by CPSC staff on or before December 31, 2018, and discusses the estimates associated with ATV-related deaths. The reported numbers of deaths, by year of death, are presented 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, 2018, CPSC staff had received reports of 15,744 ATV-related deaths that occurred between 1982 and 2018 (Table 1). Including one additional year of reporting since the December 31, 2017 tabulation CPSC staff prepared (Topping, February 2019), the number of fatality reports increased by 494. Data collection for the years 2017 and 2018 is ongoing. Consequently, we expect the numbers of reported deaths for 2017 and 2018 to increase before we prepare our next annual report.

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.*, pre- and post-1999), undertake with caution, the comparisons of numbers between these periods. We discuss ICD-10 transition and related methodological issues more fully in Appendix A.

As discussed in the Background Section, currently, nearly all ATVs distributed in the United States are 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 2018, based on 2018 fatalities reported to CPSC staff as of December 31, 2018. Although data collection for 2018 is ongoing, this percentage is not expected to change substantially as we receive additional reports of 2018 fatalities.

It is not always possible to ascertain from the incident reports whether the ATV involved in the incident has three wheels or four wheels. In these cases, we code the vehicle as an ATV with an unknown number of wheels. Most of the statistics presented in this report group all three classifications together (ATVs with 3, 4, or Unknown Number of Wheels).

³ All fatality-related statistics presented in this report are derived from the final "2018" 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.

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

Table 1
Reported ATV-Related Fatalities (by Year)
Reported for the Period January 1, 1982, through December 31, 2018

| Year | Reported Number of Deaths | Difference Since Last Update (12/31/2017*) |
|---------------------|------------------------------|---|
| <i>Total</i> | 15,744 | +494 |
| <i>2018</i> | 264 | +264 |
| <i>2017</i> | 463 | +168 |
| <i>2016</i> | 591 | +60 |
| <i>2015</i> | 593 | +8 |
| <i>2014</i> | 588 | 0 |
| <i>2013</i> | 589 | 0 |
| <i>2012</i> | 572 | -1 |
| <i>2011</i> | 622 | 0 |
| <i>2010</i> | 650 | 0 |
| <i>2009</i> | 720 | 0 |
| <i>2008</i> | 759 | 0 |
| <i>2007</i> | 831 | -1 |
| <i>2006</i> | 831 | 0 |
| <i>2005</i> | 798 | -2 |
| <i>2004</i> | 745 | -2 |
| <i>2003</i> | 651 | 0 |
| <i>2002</i> | 547 | 0 |
| <i>2001</i> | 517 | 0 |
| <i>2000</i> | 445 | 0 |
| <i>1999</i> | 396 | 0 |
| <i>1998</i> | 253 | 0 |
| <i>1997</i> | 240 | 0 |
| <i>1996</i> | 249 | 0 |
| <i>1995</i> | 200 | 0 |
| <i>1994</i> | 198 | 0 |
| <i>1993</i> | 183 | 0 |
| <i>1992</i> | 220 | 0 |
| <i>1991</i> | 230 | 0 |
| <i>1990</i> | 235 | 0 |
| <i>1989</i> | 230 | 0 |
| <i>1988</i> | 250 | 0 |
| <i>1987</i> | 264 | 0 |
| <i>1986</i> | 300 | 0 |
| <i>1985</i> | 250 | 0 |
| <i>1984</i> | 156 | 0 |
| <i>1983</i> | 85 | 0 |
| <i>1982</i> | 29 | 0 |

Note: Italics indicate that reporting is ongoing for the years 2017–2018.

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 deaths in previous year's report, which was based on incidents reported to CPSC by December 31, 2017. Recent findings regarding vehicle type, duplications, etc., resulted in reductions for some prior years (2004, 2005, 2007, and 2012).

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 2016 (*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 (845), West Virginia (775), Pennsylvania (762), California (748), and Kentucky (684). Together, these five states accounted for 3,814 deaths or 25 percent of the total 15,017 reported ATV-related deaths in the United States for the years 1982 through 2016.

When reviewing state death counts for the period 1982 through 2016, 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.

The fourth column of Table 2 presents, by state, the number of ATV-related deaths reported to CPSC staff as of December 31, 2018, for the period 2017 through 2018. These counts should not be used for comparisons among 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)
Reported for the Period January 1, 1982 through December 31, 2018

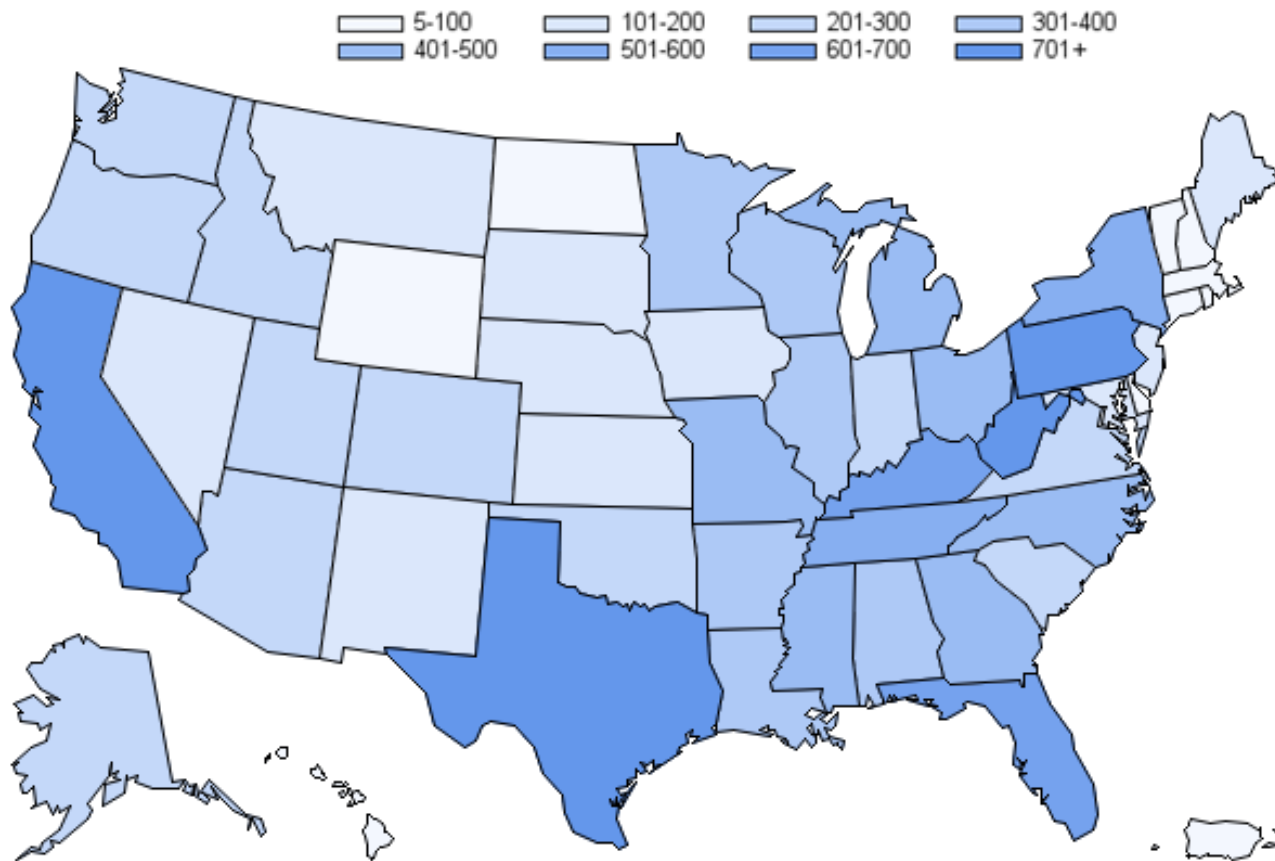
| State | Reported Deaths (Reporting Complete) | Percent of U.S. Reported Deaths 1982–2016 | Reported Deaths (Ongoing Reporting) | Total Reported Deaths* (Including Ongoing Reporting) |
|------------------|---|---|--|--|
| | 1982–2016 | | 2017-2018* | |
| TEXAS | 845 | 5.6% | 48 | 893 |
| WEST VIRGINIA | 775 | 5.2% | 28 | 803 |
| PENNSYLVANIA | 762 | 5.1% | 27 | 789 |
| CALIFORNIA | 748 | 5.0% | 28 | 776 |
| KENTUCKY | 684 | 4.6% | 27 | 711 |
| FLORIDA | 601 | 4.0% | 28 | 629 |
| TENNESSEE | 592 | 3.9% | 13 | 605 |
| NEW YORK | 505 | 3.4% | 23 | 528 |
| NORTH CAROLINA | 487 | 3.2% | 39 | 526 |
| OHIO | 471 | 3.1% | 14 | 485 |
| MICHIGAN | 463 | 3.1% | 21 | 484 |
| MISSOURI | 432 | 2.9% | 23 | 455 |
| MISSISSIPPI | 427 | 2.8% | 12 | 439 |
| GEORGIA | 423 | 2.8% | 16 | 439 |
| ARKANSAS | 400 | 2.7% | 8 | 408 |
| WISCONSIN | 395 | 2.6% | 27 | 422 |
| ALABAMA | 353 | 2.4% | 26 | 379 |
| LOUISIANA | 353 | 2.4% | 17 | 370 |
| MINNESOTA | 335 | 2.2% | 38 | 373 |
| ILLINOIS | 309 | 2.1% | 20 | 329 |
| VIRGINIA | 291 | 1.9% | 22 | 313 |
| ARIZONA | 282 | 1.9% | 15 | 297 |
| INDIANA | 277 | 1.8% | 17 | 294 |
| OKLAHOMA | 276 | 1.8% | 16 | 292 |
| IDAHO | 258 | 1.7% | 15 | 273 |
| OREGON | 244 | 1.6% | 8 | 252 |
| UTAH | 237 | 1.6% | 4 | 241 |
| COLORADO | 223 | 1.5% | 16 | 239 |
| WASHINGTON | 206 | 1.4% | 6 | 212 |
| ALASKA | 203 | 1.4% | 16 | 219 |
| SOUTH CAROLINA | 202 | 1.3% | 20 | 222 |
| IOWA | 194 | 1.3% | 6 | 200 |
| KANSAS | 169 | 1.1% | 9 | 178 |
| MAINE | 164 | 1.1% | 10 | 174 |
| MONTANA | 157 | 1.0% | 3 | 160 |
| NEW MEXICO | 147 | 1.0% | 6 | 153 |
| NEBRASKA | 143 | 1.0% | 7 | 150 |
| NEVADA | 134 | 0.9% | 6 | 140 |
| MARYLAND | 124 | 0.8% | 4 | 128 |
| SOUTH DAKOTA | 105 | 0.7% | 3 | 108 |
| NEW JERSEY | 104 | 0.7% | 7 | 111 |
| NORTH DAKOTA | 95 | 0.6% | 9 | 104 |
| MASSACHUSETTS | 88 | 0.6% | 5 | 93 |
| VERMONT | 82 | 0.5% | 4 | 86 |
| WYOMING | 74 | 0.5% | 1 | 75 |
| NEW HAMPSHIRE | 73 | 0.5% | 3 | 76 |
| CONNECTICUT | 51 | 0.3% | 4 | 55 |
| HAWAII | 22 | 0.1% | 0 | 22 |
| DELAWARE | 11 | < 0.1% | 0 | 11 |
| RHODE ISLAND | 10 | < 0.1% | 2 | 12 |
| WASHINGTON, D.C. | 6 | < 0.1% | 0 | 6 |
| PUERTO RICO | 5 | < 0.1% | 0 | 5 |

Note: State rankings are based on ATV-related fatality counts for the period 1982–2016.

*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. As the legend shows, the darker-shaded states had more reported ATV-related fatalities from 1982 through 2016, than states displayed in lighter shades.

Figure 1: Number of Reported ATV-Related Fatalities by State (1982–2016)



Note: This figure corresponds to the first two columns of Table 2. Reporting for 2017–2018 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 3,353 decedents (21 percent of the 15,744 total) between 1982 and 2018, were younger than 16 years of age, and 1,465 (9 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 shows the total number of reported fatalities, by year, among children younger than 16 years; the corresponding percentage of the total number of reported fatalities for the year; the total numbers of fatalities by year for children younger than 12 years of age; and the corresponding percentage for all ATV-related fatalities of children younger than 16 years of age.

Table 3
Reported ATV-Related Fatalities for Children Younger than 16 and 12 Years of Age
Reported for the Period January 1, 1982 through December 31, 2018

| 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 |
|--------------|------------------------|--|------------------------|---|
| <i>Total</i> | 3,353 | 21% | 1465 | 44% |
| <i>2018</i> | 27 | 10% | 13 | 48% |
| <i>2017</i> | 67 | 14% | 28 | 42% |
| 2016 | 65 | 11% | 29 | 45% |
| 2015 | 88 | 15% | 47 | 53% |
| 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 | 161 | 20% | 76 | 47% |
| 2004 | 178 | 24% | 68 | 38% |
| 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 2017–2018. 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.

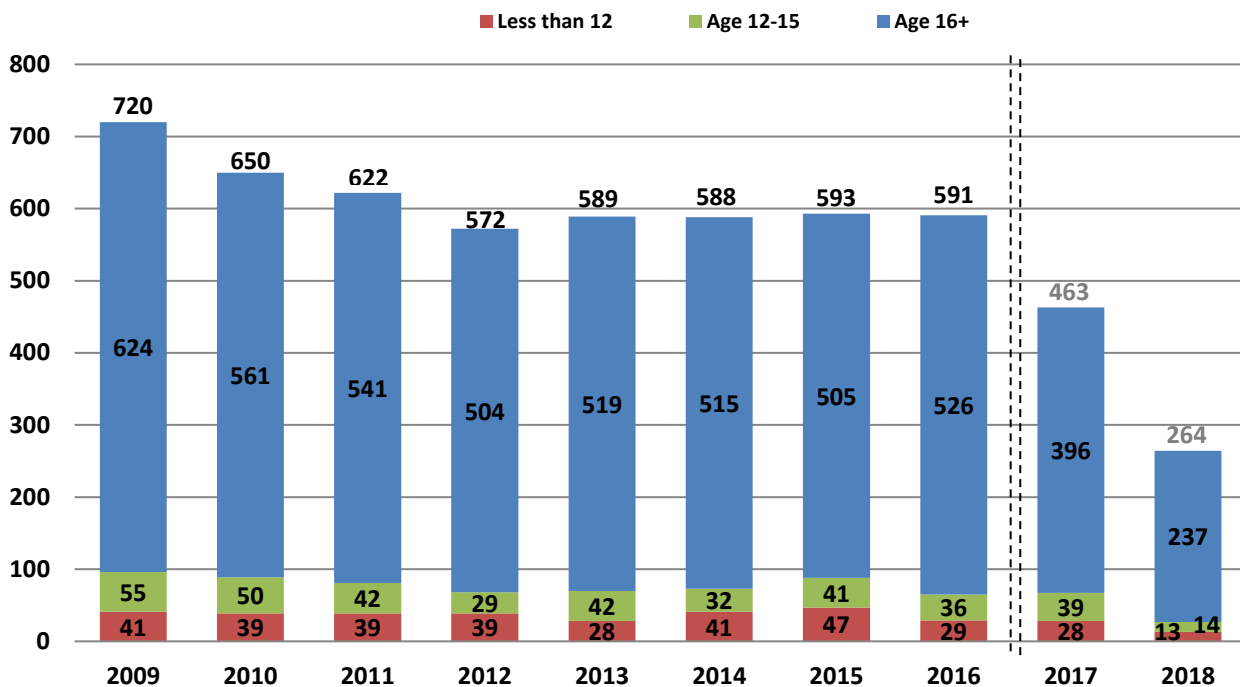
As previously discussed, in more recent years, reporting is ongoing. The most recent year especially, 2018, depends upon investigations or incidents reported from public news sources. Child ATV fatalities may be more likely to be reported in the news than adult fatalities. In future reports, we expect the proportion of child versus adult deaths for the most recent years (2017 and 2018) to exhibit a higher proportion of adult deaths as reports of ATV deaths from states and other non-news-related sources come to CPSC’s attention.

Between 1999 and 2015, the years with complete reporting and ICD-10 coding, there seems to be a large decrease in the percentage of ATV fatalities for victims younger than 16 years of age. From 1999 to 2005, the mean percentage of ATV fatality victims younger than 16 was 24 percent, while the mean percentage from 2006 to 2015 was 14 percent.

Due to 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, 1999-2016, and 2017-2018) limited in nature. With these factors in mind, one can observe that the percentages of *reported* fatalities involving victims younger than 16 has generally declined.

Focusing on the most recent 10-year period, Figure 2 displays the total number of reported ATV-related fatalities, by age group for each year (2009-2018). The most recent 2 years (2017 and 2018) are separated by dashed lines, because the data are incomplete, and therefore, they are of limited comparability to prior years.

Figure 2: Reported ATV-Related Fatalities by Age Group (2009–2018)



Note: This figure corresponds to the data reported in Tables 1 and 3. Reporting for 2017–2018 is ongoing; and counts for those last 2 years are expected to increase in future reports.

Estimated ATV-Related Deaths, 1985 to 2017

Death reports that CPSC staff receives 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 2017, using a statistical estimation method called capture-recapture (Hook and Regal, 2004). In addition, ATVs having an unknown number of wheels were apportioned between three-wheel and four-wheel ATVs. See Appendix A for details on these estimation methods.

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 a low data-collection completion rate for the most recent year 2018 as of December 31, 2018, fatality estimates are not calculated for 2018 in this report. Data for years before 1985 are not sufficient to estimate fatalities.

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 likely results from the ICD-9 to ICD-10 transition. Although the magnitude of the coding change is unknown, it follows that the death estimates calculated for the years before 1999 may have been underestimated.

Table 4
Annual Estimates of ATV-Related Fatalities
1985–2017
Based on Fatality Data Available as of December 31, 2018

| Year⁵ | *Reported Deaths | Estimated Deaths Associated with ATVs with 3, 4, or Unknown Wheels | Estimated Deaths Involving 4-Wheel ATVs |
|-------------------------|-------------------------|---|--|
| <i>2017</i> | <i>463</i> | <i>658</i> | <i>645</i> |
| <i>2016</i> | <i>591</i> | <i>743</i> | <i>727</i> |
| 2015 | 593 | 688 | 676 |
| 2014 | 588 | 658 | 645 |
| 2013 | 589 | 651 | 636 |
| 2012 | 572 | 652 | 635 |
| 2011 | 622 | 684 | 663 |
| 2010 | 650 | 724 | 712 |
| 2009 | 720 | 793 | 772 |
| 2008 | 759 | 845 | 827 |
| 2007 | 831 | 893 | 864 |
| 2006 | 831 | 898 | 871 |
| 2005 | 798 | 921 | 881 |
| 2004 | 745 | 835 | 797 |
| 2003 | 651 | 752 | 717 |
| 2002 | 547 | 597 | 560 |
| 2001 | 517 | 586 | 543 |
| 2000 | 445 | 540 | 491 |
| 1999 | 396 | 520 | 473 |
| 1998 | 253 | 291 | 249 |
| 1997 | 240 | 289 | 235 |
| 1996 | 249 | 268 | 209 |
| 1995 | 200 | 276 | 214 |
| 1994 | 198 | 243 | 169 |
| 1993 | 183 | 210 | 143 |
| 1992 | 220 | 242 | 163 |
| 1991 | 230 | 251 | 150 |
| 1990 | 235 | 252 | 152 |
| 1989 | 230 | 257 | 153 |
| 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 2017. Reporting for 2018 is too preliminary to report estimates of death.

ATV-Related Injuries⁶

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, 2009 and December 31, 2018. These estimates are based on the CPSC’s National Electronic Injury Surveillance System (NEISS), a probability sample of U.S. hospitals with 24-hour emergency departments with six or more beds. In this analysis, staff compared the current estimates to the estimates from the previous year (2017), as well as to a base year. Staff chose 2009 as the base year for comparison.⁷ Staff 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). Throughout this period, 4-wheelers represent between 97 percent and 99 percent of the injury estimates. 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 estimates 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 Estimates⁸ of ATV-Related Emergency Department-Treated Injuries
January 1, 2009, through December 31, 2018

| 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 Children Younger than 16 Years |
|------|--|---|---|---|--|
| 2018 | 81,800 | 21,700 | 26% | 11,300 | 52% |
| 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% |

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 Based on analysis of data from the U.S. CPSC’s NEISS.

⁷ See the methodology section in Appendix A for a discussion of the rationale for choosing 2009 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 2018 emergency department-treated injury estimate for *all ages* reflects a decrease of 13 percent from the 2017 estimate, which is statistically significant (p -value = 0.0197). The overall decrease of 38 percent between the estimated number of injuries in 2009 and 2018 is also statistically significant (p -value < 0.0001). Linear trend analysis additionally indicates a statistically significant downward trend in ATV-related emergency department-treated injuries for all ages, collectively, during the years from 2009 through 2018 (p -value = 0.0073).

The 2018 emergency department-treated injury estimate for *children under 16* years of age also represents a 13 percent decrease over the 2017 estimate; however, this is *not* a statistically significant difference (p -value = 0.08). The comparison of the 2009 to the 2018 estimated numbers of emergency department-treated injuries for children younger than 16 years of age shows a 33 percent decrease; these two estimates are statistically different (p -value = 0.0002).

On average, over the period 2009-2018, *children under 12* years of age represent an estimated 13 percent of emergency department-treated injuries for all ages, or 50 percent of injuries to children under 16 (*i.e.*, 131,700/1,029,600, and 131,700/266,000, respectively).

Figure 3: Annual ATV-Related, Hospital Emergency Department-Treated Injury Estimates (2009–2018)

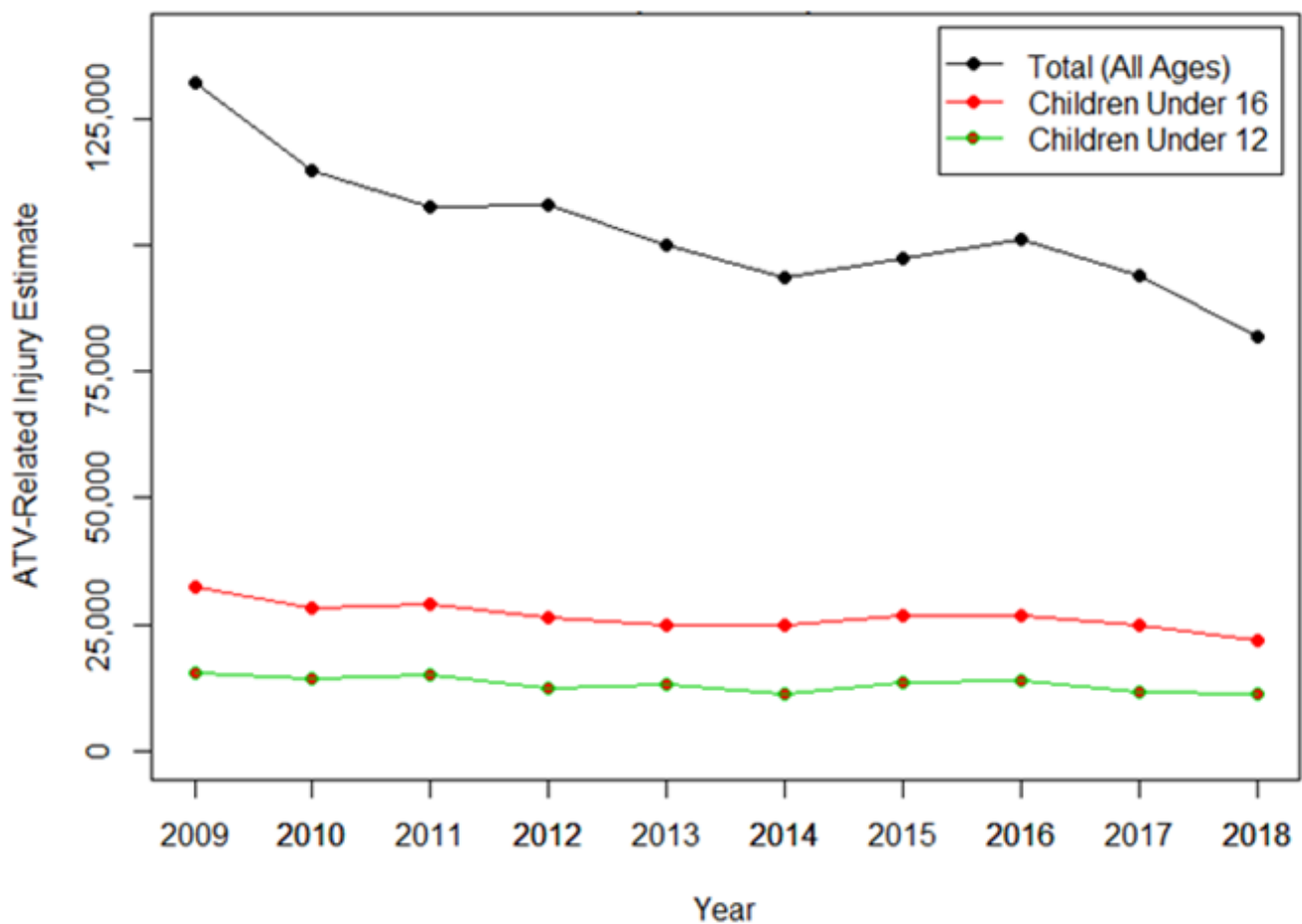


Table 6 breaks down the estimated numbers of ATV-related, emergency department-treated injuries by age groups, from 2009 to 2018, while Figure 4 gives the corresponding graph of Table 6.

Table 6
Annual Estimates of ATV-Related Emergency Department-Treated Injuries by Age Group
2008 – 2018

| Year | Age Group | | | | | | Total |
|------|-----------|--------|--------|--------|--------|-------|---------|
| | Under 16 | 16–24 | 25–34 | 35–44 | 45–54 | 55 + | |
| 2018 | 21,700 | 18,500 | 16,100 | 11,000 | 7,500 | 7,100 | 81,800 |
| 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 |

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.

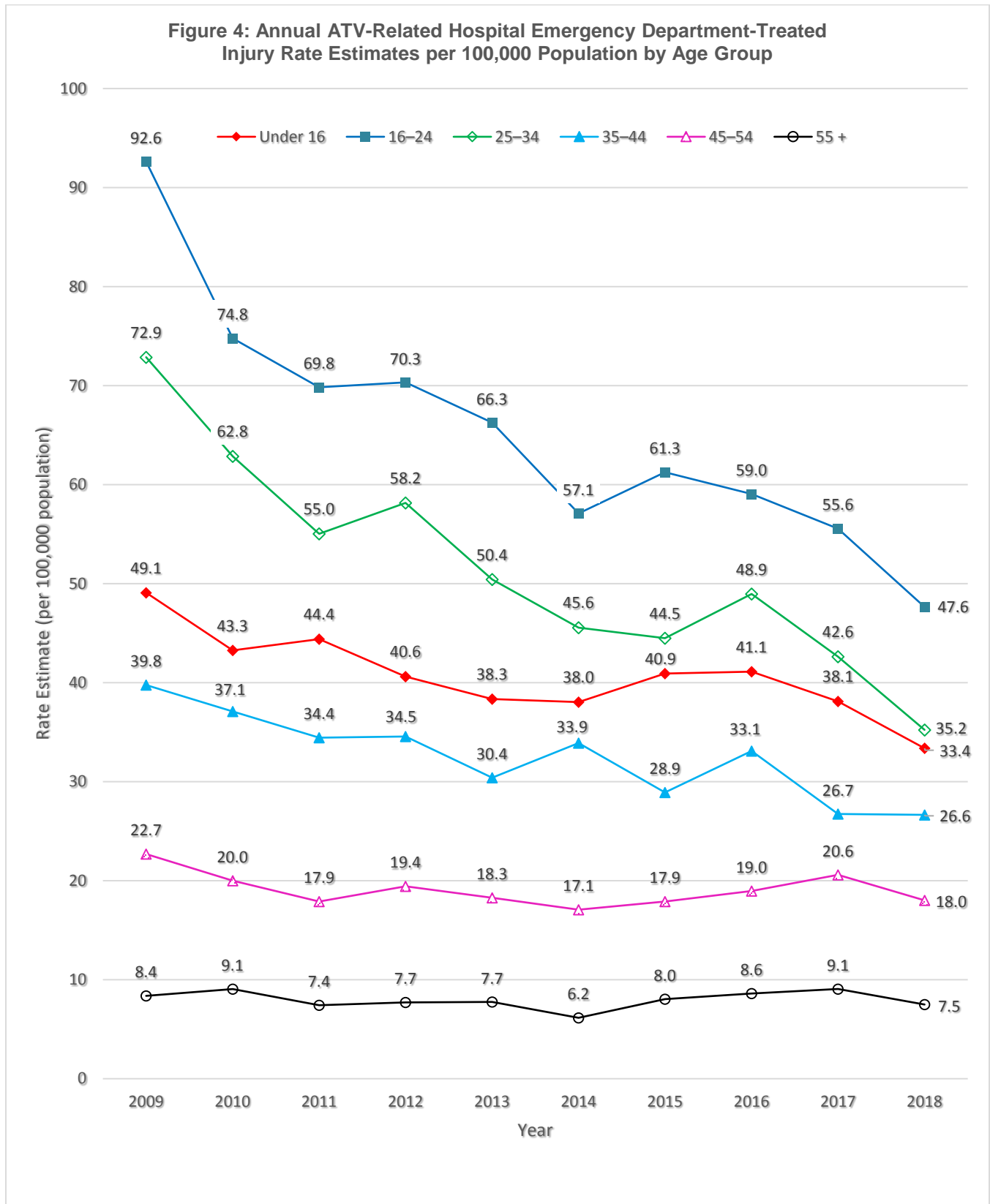
Analysis of information in Table 6 (above) supports the following:

- Between 2017 and 2018, *none* of the age groups exhibits a statistically significant difference in injuries. Although the injury estimate for the 35-44 age group is slightly greater in 2018 than in 2017, the increase is *not* statistically significant. All of the other age groups (under 16, 16-24, 25-34, 45-54, and 55+) have injury estimates that are less in 2018 than in 2017, but none of the changes reflects statistical significance.
- When comparing the base year 2009 against the 2018 injury estimates, staff finds statistically significant decreases in injuries for all except the eldest age group (55+). For each of the younger age groups (under 16, 16-24, 25-34, 35-44, and 45-54) the 2018 estimate is significantly less than the 2009 estimate (p-value < 0.0001 for the 16-24 and 25-34 age groups and p-value = 0.0002, 0.0046, and 0.0413 for the under 16, 35-44, and 45-54 age groups, respectively). The 55+ age group is the only age group for which the injury estimate is greater in 2018 than in 2009; however, this is not a statistically significant increase (p-value = 0.41).

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 Bureau⁹, the number of persons age 55 years or older increased from an estimated 74 million to 95 million during this 10-year period. The under-16 age group held steady, close to about 65 million throughout the period. The remaining age groups were comparable, somewhere between about 39 and 46 million, depending on the year and

⁹ U.S. Census Bureau. <https://www.census.gov/>.

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.



Sources: U.S. Census Bureau and NEISS.

Figures 5, 6, and 7 provide the 2018 estimated number of ATV-related, emergency department-treated injuries for *all ages*, broken down, respectively, by disposition, diagnosis, and body part. Of the 81,800 estimated ATV-related, emergency department-treated injuries for all ages in 2018, a majority are categorized as “treated and released” (81 percent). Sixteen percent of the estimated emergency department-treated injuries for all ages are categorized as “treated and admitted” or “treated and transferred.” The remaining treatment percentages are spread across several categories, such as “left without being seen,” “held for observation,” “fatality,” and “unknown.” A plurality of the 2018 estimated ATV-related, emergency department-treated injuries for all ages were diagnosed as contusions/abrasions or fractures (22 percent and 30 percent, respectively). The remaining diagnoses were distributed into several categories, such as: lacerations, sprains/strains, internal organ injuries, and other (which includes concussions). The majority of the 2018 estimated ATV-related, emergency department-treated injuries were located on the arm (the shoulder down) or the head or neck (29 percent and 29 percent, respectively).

Figure 5: Disposition of ATV-Related Emergency Department-Treated Injuries for All Ages, 2018

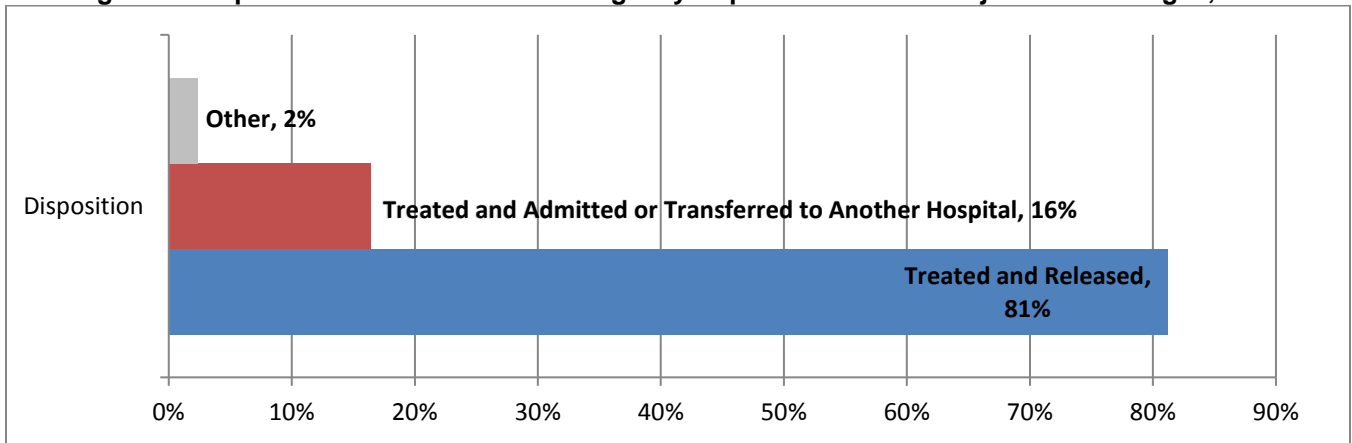


Figure 6: Diagnosis of ATV-Related Emergency Department-Treated Injuries for All Ages, 2018

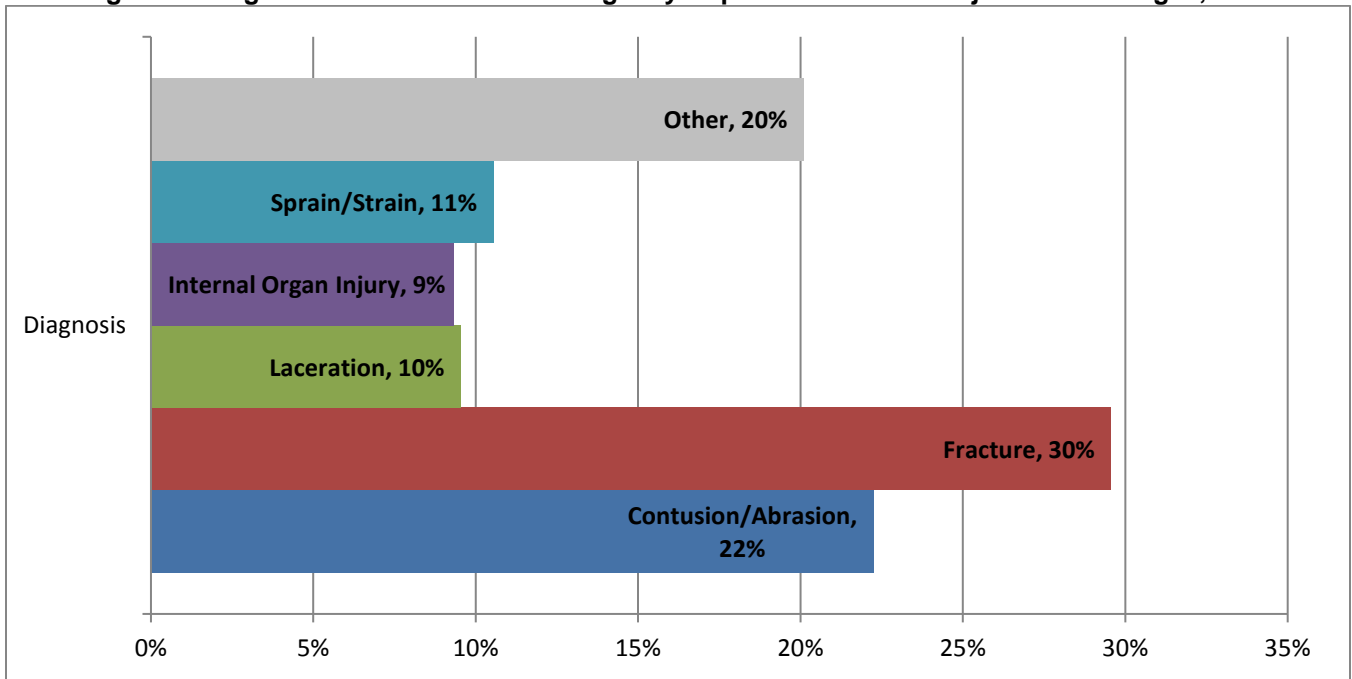
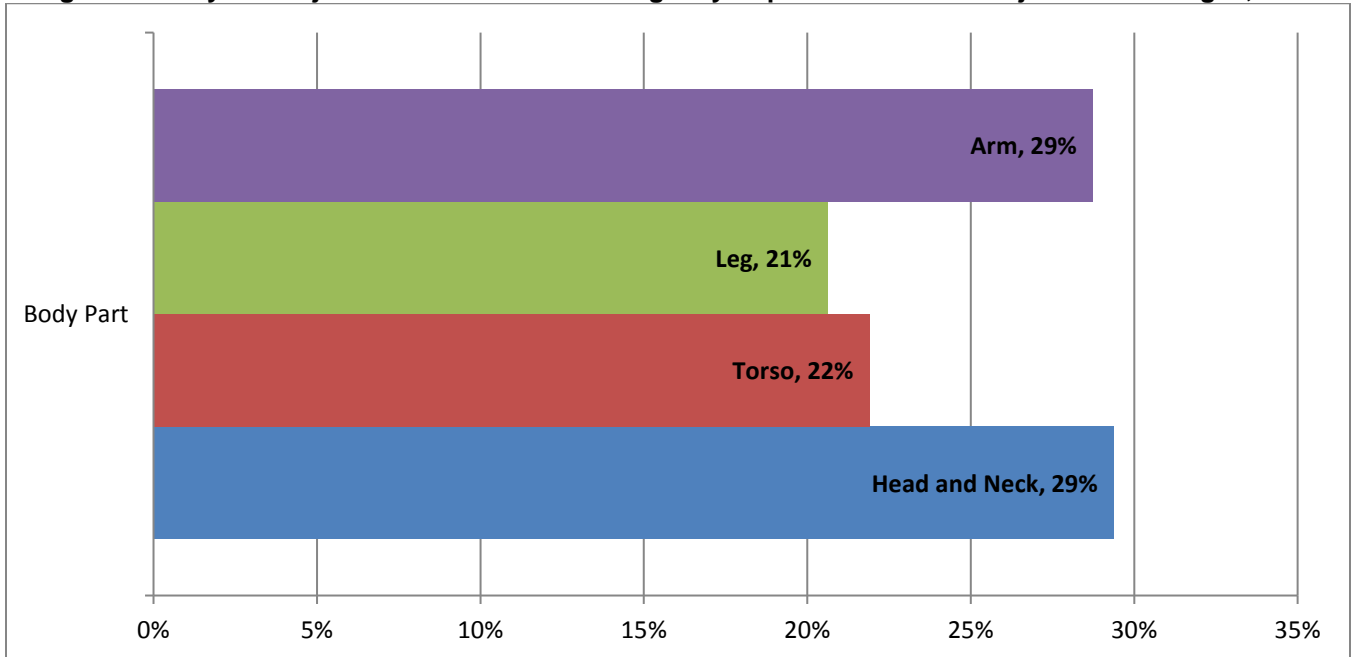


Figure 7: Body Part Injured in ATV-Related Emergency Department-Treated Injuries for All Ages, 2018



Note: The "other" category is omitted from Figure 7, because corresponding estimate for "other" body parts does not satisfy reporting criteria.

For the 21,700 estimated ATV-related, emergency department-treated injuries in 2018 for *children younger than 16 years of age*, the majority (88%) were treated and released. About 12 percent of children younger than 16 years of age were 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, and unknown.

In 2018, children younger than 16 years of age were diagnosed with contusions/abrasions an estimated 25 percent of the time for ATV-related emergency department-treated injuries, and 31 percent of the time with fractures. The remaining diagnoses are distributed into other categories, such as lacerations, sprains/strains, internal organ injuries, and concussions.

Other Off-Road Vehicles (specifically Utility and Recreational Off-Road Vehicles)

As previously noted CPSC staff does not categorize off-road motor vehicles that have steering wheels and bench or bucket seats as ATVs. Such vehicles, to the extent that they can be identified based on the data collected, are excluded from the statistics cited earlier in this report. Thus golf carts and dune buggies are excluded as are more recently popular recreational off-highway vehicles (ROVs), and certain types of utility vehicles (UTVs). CPSC uses various product codes to classify these other kinds of products separately from ATVs, which have a straddle seat and handle bars for steering control.

Over the years, with increasing frequency, incident reports initially classified as involving an ATV (based upon a description such as “ATV”s or “all-terrain vehicles”) later were found, reported by other sources, or determined from investigation, to involve some other type of vehicle. For example, staff has occasionally observed that a term such as “ATV” or “all-terrain vehicle” is used for a two-wheeled, off-road motorcycle, dune buggy, go-cart, golf cart, or even a car with off-road capabilities. However, the frequency with which such misclassifications have been observed has increased for UTVs and ROVs. This is likely because of increasing popularity of UTVs and ROVs as well as the fact that they are often described simply as “ATVs.” Even when CPSC Field staff conduct investigations and receive information from police and medical examiner reports, the category of what type of off-road vehicle may still be undeterminable. Some reports merely have a check box for “ATV” without any additional description.

In 2005, CPSC created a new product code for the classification of UTVs (separately from various codes for handlebar-operated ATVs with 3, 4, 6, or an unknown number of wheels). ROVs, which are generally more powerful than other UTVs, are also classified under this category. Often, the distinction between ROVs and other UTVs is not explicitly reported, but the same product code is used as long as the data supports a finding that one of these two subtypes was involved.

Based on the NEISS data, using only product code 5044 (“*Utility Vehicles*”), staff finds a statistically significant increase in overall UTV/ROV injuries when comparing 2018 against 2015 ($p\text{-val}=0.036$) or against any of earlier years 2005-2013. See Table 7. Although it is plausible that a small proportion of the injuries involved in the sample cases supporting these estimates were not really UTVs or ROVs, it is also plausible that these estimates are conservative without apportioning at least some of the many thousands of injuries associated with ATV product codes for the same year. At this time, staff can only speculate that the estimates in Table 7 do not accurately reflect the scale of such injuries and are underestimates. Accordingly, a follow-up special study of the NEISS injuries would likely allow for the calculation of the appropriate adjustment factors and arrive at more accurate estimates.

For fatalities, which are based on anecdotal data that do not allow for statistical inference, there is a noticeable change in the number of reported incidents involving at least one or more death. Table 7 presents the number of incidents, not the number of deaths, where each incident may involve more than one death. Because a full analysis of these reports was not the focus of previous ATV reports, staff did not identify the exact number of deaths involved each year. Regardless, as shown in the table, staff was aware of about 20 such fatal incidents in the earliest years 2005 and 2006, increasing to 64 to 74 such incidents per year between 2008 to 2011. In the years 2012 to 2016, there were between about 117 and 161 incidents per year. Although 2017 reporting is ongoing, 171 such fatal incidents have been reported in 2017. Reporting for the year 2018 is far from complete; it appears plausible that the number will increase in the future. A more comprehensive analysis of the reported fatal incidents in future reports may allow for a more detailed picture of the fatalities associated with this class of vehicles beyond what is presented in Table 7.

Table 7
Reported Deaths and Estimates of Emergency Department-Treated Injuries
Associated with Product Code 5044 (Utility Vehicles)

| Year | Reported Fatal Incidents | <i>Unadjusted</i> Estimated Number of Injuries | Number of Cases from NEISS (Sample Size) |
|-------------|---------------------------------|---|---|
| 2018 | 112 | 3,500 | 61 |
| 2017 | 171 | 3,200 | 48 |
| 2016 | 161 | 2,500 | 39 |
| 2015 | 143 | 1,600 | 26 |
| 2014 | 132 | 2,300 | 39 |
| 2013 | 117 | 1,500 | 34 |
| 2012 | 121 | 1,400 | 47 |
| 2011 | 74 | 1,300 | 39 |
| 2010 | 69 | * | 22 |
| 2009 | 64 | 1,600 | 30 |
| 2008 | 64 | 1,200 | 30 |
| 2007 | 36 | * | 17 |
| 2006 | 19 | * | 17 |
| 2005 | 22 | * | 8 |

* Estimates below 1,200 or sample size below 20 are not reportable.

Other Notes: Estimates are rounded to the nearest hundred.

Fatal incident counts are not comparable to counts of deaths presented elsewhere in this report.

Reporting is considered incomplete for 2018 and 2017; incident counts are expected to increase in future reports.

Sources: U.S. CPSC: NEISS and CPSRMS as of September 2019.

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 non-occupational 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 as 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 on a work break 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 staff 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 collection of death certificates obtained by CPSC staff,¹⁰ 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).
- 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 from consumers or their

¹⁰ 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).

representatives via telephone or the Internet (www.SaferProducts.gov); and hospital reports from 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 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 of 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 the current reporting year and 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):

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

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 on public roads, and (2) ATV-related fatalities occurring on public roads that were erroneously reported as nonpublic roads. Therefore, 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 were combined to derive the pre-1999 annual estimates of ATV-related deaths for ATVs having three, four, or an unknown number of wheels.

$$estimate = \frac{(M_{NP} + 1)(N_{NP} + 1)}{n_{NP} + 1} - 1 + C_p \quad \text{Equation 2}$$

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 with an unknown number of wheels. Because some of these incidents likely involved 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.

$$estimate_{4W} = \frac{rep_{4W}}{rep_{3W+4W}} est_{3W+4W+UW} \quad \text{Equation 3}$$

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 non-occupational, 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 of off-road vehicles changes, including the substantial increase in the number of ROVs in use, as time progresses, the adjustment factors may not reflect the changes in injuries due to different types of vehicles. 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, and more specifically, if records coded in the NEISS as ATVs are increasingly actually related to ROVs, then ATV-related injuries are being overestimated. Again, whether this is occurring is unclear 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 are 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.

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

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 2018

| 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 Percentage of Injuries Involving ATVs with 4 Wheels |
|-------------|--|--|--|--|
| 2018 | 81,800 | 21,700 | 80,000 | 97% |
| 2017 | 93,800 | 24,800 | 92,500 | 99% |
| 2016 | 101,200 | 26,800 | 99,600 | 98% |
| 2015 | 97,200 | 26,700 | 95,500 | 98% |
| 2014 | 93,700 | 24,800 | 92,200 | 98% |
| 2013 | 99,600 | 25,000 | 97,600 | 98% |
| 2012 | 107,900 | 26,500 | 105,000 | 97% |
| 2011 | 107,500 | 29,000 | 105,500 | 98% |
| 2010 | 115,000 | 28,300 | 111,900 | 97% |
| 2009 | 131,900 | 32,400 | 128,600 | 97% |
| 2008 | 135,100 | 37,700 | 131,700 | 97% |
| 2007 | 150,900 | 40,000 | 146,500 | 97% |
| 2006 | 146,600 | 39,300 | 140,900 | 96% |
| 2005 | 136,700 | 40,400 | 130,000 | 95% |
| 2004 | 136,100 | 44,700 | 129,500 | 95% |
| 2003 | 125,500 | 38,600 | 116,600 | 93% |
| 2002 | 113,900 | 37,100 | 104,800 | 92% |
| 2001 | 110,100 | 34,300 | 98,200 | 89% |
| 2000 | 92,200 | 32,000 | 82,300 | 89% |
| 1999 | 82,000 | 27,700 | 68,900 | 84% |
| 1998 | 67,800 | 25,100 | 57,100 | 84% |
| 1997 | 52,800 | 20,600 | 39,700 | 75% |
| 1996 | 53,600 | 20,200 | 40,700 | 76% |
| 1995 | 52,200 | 19,300 | 36,200 | 69% |
| 1994 | 50,800 | 21,400 | 33,300 | 66% |
| 1993 | 49,800 | 17,900 | 32,000 | 64% |
| 1992 | 58,200 | 22,000 | 33,000 | 57% |
| 1991 | 58,100 | 22,500 | 34,400 | 59% |
| 1990 | 59,500 | 22,400 | 30,800 | 52% |
| 1989 | 70,300 | 25,700 | 35,700 | 51% |
| 1988 | 74,600 | 28,500 | 39,400 | 53% |
| 1987 | 93,600 | 38,600 | 33,900 | 36% |
| 1986 | 106,000 | 47,600 | 23,400 | 22% |
| 1985 | 105,700 | 42,700 | 14,700 | 14% |

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

References

- Garland, S. (2011) 2010 ATV Injury Adjustment Factor, 2010 Adjustment Factor Standard Error, and 2010 Adjustment Factor Implementation in ATV-related Injury Analyses, memorandum. June 16, 2011. U.S. Consumer Product Safety Commission.
- Hook, E.B. and Regal, R.R. The Value of Capture-Recapture Methods Even for Apparent Exhaustive Surveys. *American Journal of Epidemiology*. 1992; 135(9):1060–1067.
- Hook, E.B. and Regal, R.R. Completeness of Reporting: Capture-Recapture Methods in Public Health Surveillance. From: *Monitoring the Health of Populations: Statistical Principles and Methods for Public Health Surveillance*, Brookmeyer, R. and Stroup, D. F., eds. 2004. Oxford University Press, New York.
- Levenson, M. (2003a) [All-Terrain Vehicle 2001 Injury and Exposure Studies](#). January 2003. U.S. Consumer Product Safety Commission.
- Levenson, M. (2003b) ATV Injury Adjustment Factors for 1997 and 2001, memorandum. September 12, 2003. U.S. Consumer Product Safety Commission.
- Levenson, M. (2005) Uncertainty Estimates of ATV Adjusted Injury Estimates, memorandum. August 22, 2005. U.S. Consumer Product Safety Commission.
- Marker, D., Waksberg, J., and Braden, J. *NEISS Sample Update*. June 3, 1988. Westat, Inc.
- Marker, D. and Lo, A. *Update of the NEISS Sampling Frame and Sample*. October 11, 1996. Westat, Inc.
- Morrison, A. and Stone, D.H. Capture-Recapture: A Useful Methodological Tool for Counting Traffic-Related Injuries? *Injury Prevention*. 2000; 6:299–304.
- National Center for Health Statistics (NCHS) “About the International Classification of Diseases/Clinical Modification (ICD-10-CM).” August 2007. <http://www.cdc.gov/nchs/icd.htm>.
- Schroeder, T. *Trend Analysis of NEISS Data*. February 2000. U.S. Consumer Product Safety Commission.
- Schroeder, T. and Ault, K. (2001a) [The NEISS Sample \(Design and Implementation\) from 1979 to 1996](#). June 2001. U.S. Consumer Product Safety Commission.
- Schroeder, T. and Ault, K. (2001b) [The NEISS Sample \(Design and Implementation\) from 1997 to the Present](#). June 2001. U.S. Consumer Product Safety Commission.
- Topping, J. (February 2019) [2017 Annual Report of ATV Deaths and Injuries](#). U.S. Consumer Product Safety Commission.
- U.S. Census Bureau. <https://www.census.gov/>
- U.S. Consumer Product Safety Commission. [Standards for All-Terrain Vehicles and Ban of Three-Wheeled All-Terrain Vehicles; Notice of Proposed Rulemaking](#). Federal Register, Volume 71, Number 154, Pages 45904–45962. August 10, 2006.

U.S. Consumer Product Safety Commission, Office of Information and Public Affairs (OIPA) (September 21, 2006). [*CPSC Launches Major Campaign to Drive Down Deaths and Serious Injuries Associated with All-Terrain Vehicles*](#). Press Release. Retrieved September 16, 2009.

World Health Organization (WHO), "International Classification of Diseases." Retrieved December 4, 2007 from: <http://www.who.int/classifications/icd/en/>.