2006 Annual Report of ATV-Related Deaths and Injuries

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INTRODUCTION

This report presents the 2006 annual update of information collected by the U.S. Consumer Product Safety Commission (CPSC) staff on deaths and injuries related to the use of all-terrain vehicles (ATVs). The updates include information on ATV-related deaths based on data available to CPSC staff as of December 31, 2006, as well as information on ATV-related injuries treated in hospital emergency rooms from January 1, 2006 through December 31, 2006.

The report begins with a brief overview of CPSC's ATV-related activities. This is followed by a summary of ATV-related fatality counts derived from CPSC staff data and a discussion of reported ATV-related deaths involving children younger than 16 years of age. Then, using the counts of ATV-related fatalities reported to CPSC staff, annual estimates of ATV-related deaths are presented, together with estimates of the annual risk of death per 10,000 four-wheel ATVs in use. Next, the report provides estimates of ATV-related, hospital emergency room-treated injuries, together with estimates of the annual risk of injury per 10,000 four-wheel ATVs in use. The report concludes with a short discussion of the patterns of ATV-related deaths and injuries over time.

BACKGROUND

CPSC staff considers an ATV to be an off-road, motorized vehicle having three or four low pressure tires, a straddle seat, and handlebars. Off-road motor vehicles having bench seats and/or steering wheels (e.g., golf carts, dune buggies, and certain types of utility vehicles) are not categorized as ATVs by CPSC staff. Consequently, fatalities and injuries associated with these types of vehicles are not included in this report.

CPSC staff first began analyzing ATV product data in the early 1980s in order to provide information on the numbers of deaths and injuries associated with three-wheel ATVs. Triggered in part by the results of CPSC staff's early data collection, CPSC entered into consent decrees in April 1988 with five ATV distributors. Under the consent decrees, the distributors agreed to halt production of three-wheel ATVs, offer rider training to ATV purchasers and members of their immediate families, and recommend adult-sized ATVs only for those 16 years of age and older. These consent decrees expired in April 1998. Following their expiration, the five distributors involved in the consent decrees, together with two others, agreed to continue most of the elements of the consent decrees through voluntary action plans.

On June 28, 2006, the Commission voted to issue a Notice of Proposed Rulemaking on ATVs that would make mandatory many of the provisions in the voluntary action plans. The Commission also proposed to formally ban the manufacture and distribution of three-wheel ATVs. Some older three-wheel ATVs continue to be used by consumers, but nearly all vehicles in use today are four-wheel ATVs, which are available in a range of engine sizes and designs.

ATV-RELATED FATALITIES

Reported Deaths

On December 31, 2006, CPSC staff had reports of 8,104 ATV-related deaths that occurred between 1982 and 2006 (Table 1). The number of new fatality reports increased by 916 since the December 31, 2005 tabulation prepared by CPSC staff (CPSC, February 2007). These 916 additional reports represent ATV-related fatalities that occurred during the years 2002 through 2006.

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, 2006

Year[1]	Number of Deaths	Difference Since Last Update (12/31/2005)
Total	**8,104**	**+916**
2006	*555*	*+555*
2005	*666*	*+199*
2004	*745*	*+136*
2003	*654*	*+18*
2002	548	+8
2001	517	0
2000	451	0
1999[2]	398	0
1998	251	0
1997	241	0
1996	248	0
1995	200	0
1994	198	0
1993	183	0
1992	221	0
1991	230	0
1990	234	0
1989	230	0
1988	250	0
1987	264	0
1986	299	0
1985	251	0
1984	156	0
1983	85	0
1982	29	0

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

[1] Reporting is ongoing for the years 2003-2006.
[2] Beginning in 1999, death certificates were coded under the Tenth Revision of the International Classification of Diseases (ICD-10). See Appendix B for an explanation of the effect of this change.

Data collection for the years 2003 through 2006 is ongoing. Consequently, the numbers of reported deaths for 2003 through 2006 are expected to increase before the next annual report is prepared.

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

Table 2 gives the numbers of reported ATV-related deaths for each state, the District of Columbia, and Puerto Rico. States are listed in descending order of the number of ATV-related fatalities reported for the years 1982 through 2002 (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 ATV-related deaths occurring in this period: California (312 deaths), Pennsylvania (293), Texas (251), New York (231), and Michigan (229). Together, these five states accounted for 24 percent of all reported ATV-related deaths in the U.S. for the years 1982 through 2002 (n = 5,484), as shown in the third column on Table 2.

In comparing state death counts for the period 1982 through 2002, 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, etc.).

- 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. However, as medical transport capabilities (e.g., helicopter transport) and trauma care have advanced in recent years, some states with major trauma centers have ATV-related fatalities included in their reported counts for incidents that did not occur within their state boundaries. Similarly, some states have reported counts that do not fully account for all of the ATV-related fatality incidents that occurred within their state boundaries.

The fourth column of Table 2 presents the state death counts that were reported to CPSC staff as of December 31, 2006 for the period 2003 to 2006. These counts should not be used for between-state comparisons because data collection for this period is ongoing and because data collection from some states is more complete than from other states for these years.

Each state's total number of reported deaths is listed in the fifth column. These counts include information for years that have ongoing reporting.

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, 2006

State	Reported Deaths 1982 - 2002	Cumulative Percent of U.S. 1982 - 2002	*Reported Deaths 2003 - 2006**	*Total Reported Deaths**
CALIFORNIA	312	6%	*106*	*418*
PENNSYLVANIA	293	11	*127*	*420*
TEXAS	251	16	*135*	*386*
NEW YORK	231	20	*72*	*303*
MICHIGAN	229	24	*67*	*296*
KENTUCKY	225	28	*142*	*367*
WEST VIRGINIA	225	32	*173*	*398*
FLORIDA	204	36	*145*	*349*
TENNESSEE	202	40	*120*	*322*
NORTH CAROLINA	197	43	*100*	*297*
ARKANSAS	171	46	*37*	*208*
MISSISSIPPI	171	49	*66*	*237*
GEORGIA	163	52	*77*	*240*
OHIO	158	55	*87*	*245*
WISCONSIN	149	58	*69*	*218*
MISSOURI	145	61	*94*	*239*
MINNESOTA	143	63	*75*	*218*
ALABAMA	132	66	*42*	*174*
LOUISIANA	127	68	*44*	*171*
ILLINOIS	126	70	*38*	*164*
ARIZONA	117	72	*46*	*163*
VIRGINIA	100	74	*53*	*153*
INDIANA	99	76	*56*	*155*
UTAH	98	78	*33*	*131*
ALASKA	93	80	*32*	*125*
OREGON	91	81	*39*	*130*
OKLAHOMA	78	83	*45*	*123*
IOWA	76	84	*31*	*107*
MAINE	72	85	*34*	*106*
KANSAS	69	87	*36*	*105*
IDAHO	65	88	*38*	*103*
COLORADO	64	89	*32*	*96*
WASHINGTON	62	90	*28*	*90*
NEW MEXICO	58	91	*26*	*84*
SOUTH CAROLINA	52	92	*40*	*92*
NEBRASKA	50	93	*23*	*73*
MASSACHUSETTS	45	94	*16*	*61*
NEVADA	45	95	*20*	*65*
NEW HAMPSHIRE	44	95	*10*	*54*
NEW JERSEY	41	96	*19*	*60*
VERMONT	37	97	*10*	*47*
MARYLAND	33	97	*25*	*58*
SOUTH DAKOTA	30	98	*18*	*48*
MONTANA	28	98	*28*	*56*
NORTH DAKOTA	27	99	*23*	*50*
CONNECTICUT	19	99	*16*	*35*
WYOMING	19	100	*13*	*32*
DELAWARE	5	100	*2*	*7*
HAWAII	4	100	*9*	*13*
RHODE ISLAND	4	100	*2*	*6*
DISTRICT OF COLUMBIA	3	100	*1*	*4*
PUERTO RICO	2	100	*0*	*2*

Source: U.S. Consumer Product Safety Commission, Directorate for Epidemiology, Division of Hazard Analysis.
State rankings are based on information for the period 1982 – 2002.
*Italicized data (columns 4 and 5) denote the years for which reporting is ongoing (2003 – 2006).

Reported Deaths of Children Under 16 Years of Age

A review of the reported ATV-related fatalities indicated that 2,342 decedents (29 percent of the 8,104 total) were under 16 years of age, and 987 (12 percent of the total) were under 12 years of age. Table 3 gives the numbers and percentages of reported fatalities by year for individuals younger than 16 years of age. Appendix A contains a more detailed breakdown of the reported deaths in this age group.

Table 3
Reported ATV-Related Fatalities: Children Younger Than 16 Years Old
ATVs with 3, 4 or Unknown Number of Wheels
Reported for the Period January 1, 1982 through December 31, 2006

Year[3]	Younger Than 16	Younger Than 16 Percent of Total
Total	**2,342**	**29%**
2006	*111*	*20*
2005	*145*	*22*
2004	*181*	*24*
2003	*154*	*24*
2002	133	24
2001	132	26
2000	124	27
1999[4]	90	23
1998	82	33
1997	79	33
1996	87	35
1995	64	32
1994	54	27
1993	59	32
1992	71	32
1991	68	30
1990	81	35
1982-1989	627	40

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

While the percentage of victims under age 16 appears to have declined since 1998, it is also probable that adult deaths were under-reported during the period 1982 to 1998. Because of coding limitations for ATV-related fatalities under the old ICD-9 system (see Appendix B), CPSC staff was generally not able to gather reports of deaths on public roads during those years. If adults were more likely than children to use ATVs on public roads, then the percentage of deaths involving children may appear to have been disproportionately high for that time period.

[3] Reporting is ongoing for 2003 – 2006. Percentages for these years should be interpreted with caution because the rate at which deaths are reported may not be consistent across all age groups.
[4] Beginning in 1999, death certificates were coded under the Tenth Revision of the International Classification of Diseases (ICD-10). See Appendix B for a discussion of the effect of this change.

Three-Wheel vs. Four-Wheel ATVs

As noted in the background section, CPSC staff began tabulating reports of ATV-related deaths and injuries in the early 1980s in order to assess incidents associated with three-wheel ATVs. However, production of three-wheel ATVs ceased in the mid- to late-1980s, and, currently, the ATVs distributed in the U.S. are nearly all four-wheel models. The percent of reported fatalities that involved four-wheel ATVs has increased from 7 percent or less prior to 1985 to more than 95 percent in 2006, based on 2006 fatalities reported as of December 31, 2006. (As noted, data collection for 2006 is ongoing. However, it is not expected that this percentage will change greatly as additional reports of 2006 fatalities are received).

Estimated ATV-Related Deaths and Risk of Death, 1985 to 2005

Death reports received by CPSC staff represent a minimum count of ATV-related deaths. To account for unreported deaths, CPSC staff estimated annual ATV-related fatalities for the period 1985 to 2005 using a statistical estimation method (Hook and Regal, 2004). Table 4 shows both the annual reported counts and the derived estimates of ATV-related deaths involving ATVs having three, four or an unknown number of wheels. Table 4 also presents the annual estimated risk of death per 10,000 four-wheel ATVs in use for this period.

The heavy line between 1998 and 1999 in Table 4 again 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 more accurately gather data on ATV-related deaths, some of the increase in estimated deaths observed between 1998 and 1999 is probably a result of the ICD-9/ICD-10 transition. Although the magnitude of the effect of the coding change is unknown, it follows that the death estimates and risks calculated for the years prior to 1999 may have been underestimates.

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

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

Table 4
Annual Estimates of ATV-Related Fatalities and Risk of Death per 10,000 4-Wheel ATVs in Use
1985 – 2005
Based on Fatality Data Available as of December 31, 2006

Year	Reported Deaths[5]	Estimated Deaths Associated with ATVs with 3, 4 or Unknown Wheels	Estimated Deaths Involving 4-Wheel ATVs	Estimated 4-Wheel ATVs in Use (millions)[6, 7]	Estimated Risk of Death per 10,000 4-Wheel ATVs in Use
2005	*666*	*870*	*835*	*7.8*	*1.1*
2004	*745*	*860*	*820*	*7.0*	*1.2*
2003	*654*	*768*	*731*	*6.3*	*1.2*
2002	548	606	570	5.6	1.0
2001	517	593	549	4.9	1.1
2000	451	552	502	4.2	1.2
1999[8]	398	536	488	3.6	1.4
1998	251	287	245	3.1	0.8
1997	241	291	243	2.7	0.9
1996	248	267	208	2.4	0.9
1995	200	276	212	2.2	1.0
1994	198	244	168	2.0	0.8
1993	183	211	144	1.9	0.7
1992	221	241	158	1.9	0.8
1991	230	255	152	1.8	0.8
1990	234	250	151	1.8	0.9
1989	230	258	153	1.6	0.9
1988	250	286	152	1.4	1.1
1987	264	282	126	1.1	1.1
1986	299	347	95	0.7	1.3
1985	251	295	55	0.4	1.5

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

ATV-RELATED INJURIES

Table 5 shows estimates of ATV-related injuries treated in hospital emergency rooms nationwide between January 1, 1982 and December 31, 2006. These estimates were generated from CPSC's National Electronic Injury Surveillance System (NEISS), a probability sample of U.S. hospitals with 24-hour emergency rooms and more than six beds. In this analysis, the current estimates were

[5] Reporting is ongoing for 2003 – 2005.
[6] Rounded.
[7] Based on information received by CPSC's Directorate for Economic Analysis, the 2001 – 2005 estimates of four-wheel ATVs in use have been revised from estimates reported in the 2005 Annual Report of ATV Deaths and Injuries/Amended (CPSC, 2007).
[8] Beginning in 1999, deaths were coded under the Tenth Revision of the International Classification of Diseases (ICD-10). See Appendix B for an explanation of the effect of this change.

compared to the estimates from the immediately previous year (2005), as well as to a base year. The base year chosen for comparison was 2001.[9] The existence of a possible trend in injuries associated with ATVs with three, four or an unknown number of wheels is also considered, using trend analysis methods developed by CPSC staff (Schroeder, 2000).

Table 5
Annual Estimates[10] of ATV-Related Emergency Room-Treated Injuries
ATVs with 3, 4 or Unknown Number of Wheels
January 1, 1982 through December 31, 2006

Year	Estimated Number of Injuries All Ages	Estimated Number of Injuries Ages Younger Than 16 Years	Percent of Total Ages Younger Than 16 Years
2006	146,600	39,300	27%
2005	136,700	40,400	30
2004	136,100	44,700	33
2003	125,500	38,600	31
2002	113,900	37,100	33
2001	110,100	34,300	31
2000	92,200	32,000	35
1999	82,000	27,700	34
1998	67,800	25,100	37
1997	52,800	20,600	39
1996	53,600	20,200	38
1995	52,200	19,300	37
1994	50,800	21,400	42
1993	49,800	17,900	36
1992	58,200	22,000	38
1991	58,100	22,500	39
1990	59,500	22,400	38
1989	70,300	25,700	37
1988	74,600	28,500	38
1987	93,600	38,600	41
1986	106,000	47,600	45
1985	105,700	42,700	40
1984	77,900	[11]	---
1983	32,100	[11]	---
1982	10,100	[11]	---

Source: National Electronic Injury Surveillance System, U.S. Consumer Product Safety Commission.
Note: Coefficients of variation (CVs) for injury estimates for all ages between 2001 and 2006 range from 9 percent to 11 percent. For ages under 16, the CVs of the injury estimates between 2001 and 2006 range from 9 percent to 13 percent. See Appendix B for an explanation of the use and calculation of CVs.

[9] See the methodology section in Appendix B for a discussion of why 2001 was chosen as the base year.
[10] Estimates have been adjusted to reflect NEISS Coding Manual changes and sampling frame updates. Estimates have also been adjusted by factors to account for cases that are out of scope for this report. Appendix B provides further detail.
[11] Adjusted estimates for children under 16 years old were not computed prior to 1985.

The 2006 injury estimate for all ages reflects an increase of 7 percent over the 2005 estimate. This increase was not statistically significant ($p = 0.1115$[12]). However, the increase of 33 percent over the estimated number of injuries in 2001 was statistically significant ($p < 0.0001$). In addition, trend analysis (Schroeder, 2000) indicates that, for ATVs having three or four or an unknown number of wheels, there was a statistically significant upward trend among emergency room-treated injuries for all ages for the years 2001 through 2006 ($p = 0.0056$).

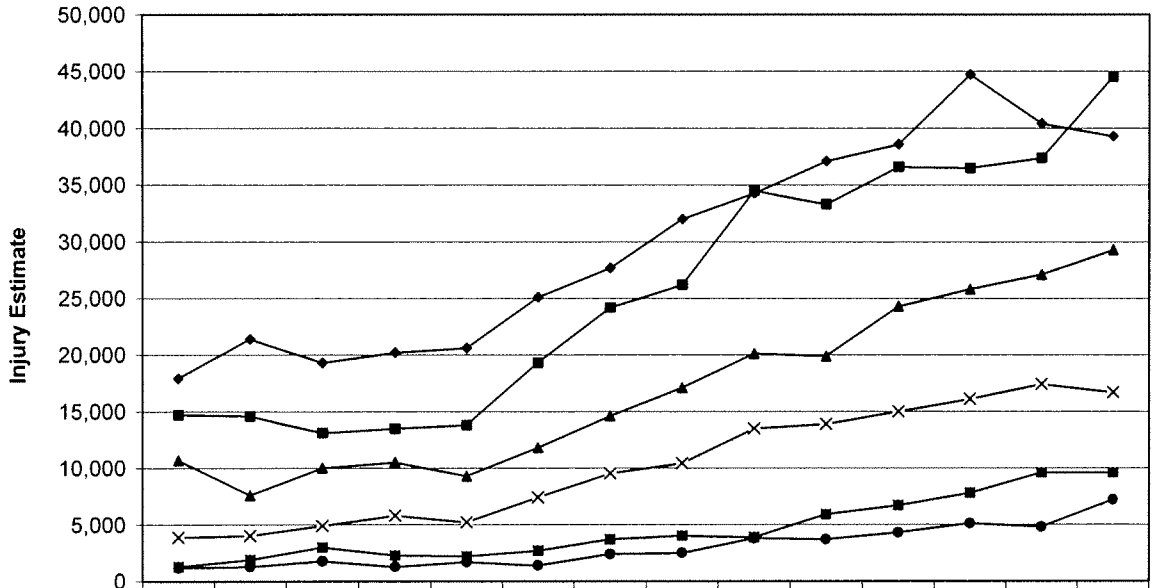
The 2006 estimate for children under 16 represents a 3 percent decrease compared to the 2005 estimate. This decrease was not statistically significant ($p = 0.6799$). The 2006 under-16 estimate represents a 15 percent increase over the 2001 estimate. The increase was not statistically significant ($p = 0.1110$).

Children under 16 years of age accounted for about 27 percent of the estimated number of injuries in 2006. Historically, children under 16 have accounted for about 35 percent of the total estimated number of injuries for the years 1985 through 2006.

Figure 1 presents annual estimates by age group for ATV-related injuries treated in hospital emergency rooms since 1993.

[12] This p value represents the probability of observing results as or more extreme than the results obtained if there is no difference in two reported estimates. A small p value (e.g., $p < 0.05$) suggests that the observed increase is more likely to reflect a difference between the two estimates that is associated with some factor or factors beyond the inherent variability in the estimates themselves.

Figure 1
Annual ATV-Related Hospital Emergency Room-Treated Injury Estimates[13]
ATVs with 3, 4 or Unknown Number of Wheels
1993 – 2006



	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
under 16	17,900	21,400	19,300	20,200	20,600	25,100	27,700	32,000	34,300	37,100	38,600	44,700	40,400	39,300
16-24	14,700	14,600	13,100	13,500	13,800	19,300	24,200	26,200	34,500	33,300	36,600	36,500	37,400	44,500
25-34	10,700	7,600	10,000	10,500	9,300	11,800	14,600	17,100	20,100	19,900	24,300	25,800	27,100	29,300
35-44	3,900	4,000	4,900	5,800	5,200	7,400	9,500	10,400	13,500	13,900	15,000	16,100	17,400	16,700
45-54	1,300	1,900	3,000	2,300	2,200	2,700	3,700	4,000	3,900	5,900	6,700	7,800	9,600	9,600
55 and over	1,200	1,300	1,800	1,300	1,700	1,400	2,400	2,500	3,800	3,700	4,300	5,100	4,800	7,200

Source: National Electronic Injury Surveillance System, U.S. Consumer Product Safety Commission.
Columns may not add to annual totals due to rounding.

Review of the information in Figure 1 indicates the following:

- In 2006, the estimated number of injuries decreased from the preceding year among individuals under 16 years of age (as noted previously) and among individuals 35 to 44 years old. Neither of these changes was statistically significant.

- Between 2005 and 2006, the estimated number of injuries increased in the 16 to 24 age group, the 25 to 34 age group, and the 55 and older age group. Of these increases, only the increases in the 16 to 24 age group and in the 55 and over age group were statistically significant ($p = 0.0247$ and $p = 0.0095$, respectively).

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

- In 2006, the estimated number of injuries was unchanged from the preceding year among individuals 45 to 54 years old.

Table 6 shows estimates of four-wheel ATV-related injuries and risk of injury per 10,000 four-wheel ATVs in use for the years 1985 to 2006. In 2006, four-wheel ATV injuries constituted 96 percent of the total injury estimate for ATVs having three, four or an unknown number of wheels. The four-wheel ATV injury estimate for 2006 represented an increase of 8 percent over the estimate for 2005 and was not statistically significant ($p = 0.0718$). It was, however, a statistically significant increase over the 2001 estimate ($p < 0.0001$). There was also a statistically significant upward trend in emergency room-treated injuries associated with four-wheel ATVs between 2001 and 2006 ($p = 0.0031$).

In Table 6, risk is defined as the estimated number of emergency room-treated injuries per 10,000 four-wheel ATVs in use. From 2001 to 2006, there was a statistically significant downward trend in injury risk per 10,000 four-wheel ATVs in use ($p = 0.0441$).

Table 6
Estimated Number of Emergency Room-Treated Injuries and Risk of Emergency Room-Treated Injury per 10,000 4-Wheel ATVs in Use January 1, 1985 through December 31, 2006

Year	Injury Estimate[14]	Estimated 4-Wheel ATVs in Use (millions)[15, 16]	Risk Estimate per 10,000 4-Wheel ATVs in Use
2006	140,900	8.6	163.0
2005	130,000	7.8	167.2
2004	129,500	7.0	185.4
2003	116,600	6.3	186.3
2002	104,800	5.6	188.5
2001	98,200	4.9	200.3
2000	82,300	4.2	197.2
1999	68,900	3.6	193.0
1998	57,100	3.1	184.7
1997	39,700	2.7	146.1
1996	40,700	2.4	168.1
1995	36,200	2.2	165.7
1994	33,300	2.0	165.4
1993	32,000	1.9	164.9
1992	33,000	1.9	175.1
1991	34,400	1.8	188.1
1990	30,800	1.8	175.1
1989	35,700	1.6	217.8
1988	39,400	1.4	276.1
1987	33,900	1.1	305.9
1986	23,400	0.7	319.2
1985	14,700	0.4	391.1

Source: U.S. Consumer Product Safety Commission, Directorate for Epidemiology, Division of Hazard Analysis; National Electronic Injury Surveillance System; and the Directorate for Economic Analysis.
Note: Coefficients of variation (CVs) for four-wheel ATV injury estimates for the years 2001 to 2006 range from 8.7 percent to 9.4 percent. CVs for estimates in column 3 of this table for the years 2001 to 2006 range from 3.2 percent to 3.9 percent. CVs for estimates in column 4 for the years 2001 to 2006 range from 9.3 percent to 10.0 percent (Levenson, 2005b and 2005c).

DISCUSSION

In analyzing deaths and injuries associated with ATVs, it is useful to consider three distinct time periods, the boundaries of which are determined primarily by fatality data availability and completeness. By considering these three periods separately, we can compare years within periods, and

[14] Estimates have been adjusted to reflect NEISS Coding Manual changes and sampling frame updates. Estimates have also been adjusted by factors to account for cases that are out of scope for this report. Appendix B provides further detail.
[15] Rounded.
[16] Based on information received by CPSC's Directorate for Economic Analysis, the 2001 – 2005 estimates of four-wheel ATVs in use have been revised from estimates reported in the 2005 Annual Report of ATV Deaths and Injuries/Amended (CPSC, 2007).

thereby control, at least in part, for changes in CPSC staff's data collection abilities as well as for possible changes in the ATV marketplace. While the boundaries of the periods considered here are defined by factors involving the collection of mortality data, it is also useful to consider the injury estimates within the same time periods.

The periods selected for discussion were defined as follows:

- The first period, from 1982 to 1998, begins with the first year of CPSC staff's reported ATV-related death counts (see Table 1) and ends with the ICD-9/ICD-10 transition for classification of mortality data. This period includes the years during which the consent decrees were in effect (1988 to 1998).

- The second period, from 1999 to 2002, begins with the transition to ICD-10 and ends with the most recent complete year of death data collection.

- The third period, from 2003 to 2006, spans the period of ongoing death data collection by CPSC staff. During this period, CPSC issued both an Advance Notice of Proposed Rulemaking (2005) and a Notice of Proposed Rulemaking (2006) for ATVs. One likely result of these rulemaking activities has been an increase in media attention to both ATV-related fatalities and ATV-related injuries, and, in turn, this has probably enhanced CPSC staff's ability to gather more complete and more timely death reports.

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

1982 – 1998

During the first period (1982 – 1998), reported deaths reached a high of 299 in 1986 (Table 1). These reported deaths were largely associated with three-wheel ATVs, which were still being manufactured and sold. The estimated number of deaths associated with four-wheel ATVs (Table 4) was relatively low in the mid-1980s. During these years (i.e., the mid 1980s), three-wheel ATVs were still heavily in use, and four-wheel ATVs were only beginning to gain in popularity.

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

With these cautions in mind, 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, just prior to the commencement of the consent decrees. This peak was followed by a decline in estimated ATV-related fatalities until the early- to mid-1990s (Table 4). Then, a general increase in the estimated deaths appears to have occurred from the mid-1990s to the

end of the period (Table 4). Note that these generalizations do not depend upon the magnitude of the estimates.[17]

A similar pattern can be observed in the estimated number of emergency room-treated injuries associated with ATVs with three, four or an unknown number of wheels. That is, the estimated number of emergency room-treated, ATV-related injuries appeared to peak during the years 1985 and 1986 (Table 5), when injuries rose above 100,000. This was followed by a decline in injury estimates until the early- to mid-1990s, and then an increase in injury estimates 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 – 2002

As a result of the transition to ICD-10 mortality coding, the second period (1999 – 2002) reflects four years during which CPSC staff had a much greater opportunity to collect comprehensive data on ATV-related fatalities. This period also predated CPSC's recent rulemaking activities. Consequently, the potential effect of heightened media exposure on data collection was less of a factor during the second period, compared to the third period. Estimated deaths associated with ATVs having three, four or an unknown number of wheels increased by 13 percent during the second period. The estimated numbers of injuries associated with three, four or an unknown number of wheels during this period increased by 39 percent.

2003 – 2006

The third period (2003 – 2006) contains four years of incomplete death data collection. It is likely that the number of reported deaths for these four years will increase, as additional reports are received. Consequently, the estimated numbers of deaths and the estimated risk of death will likely change in future reports. The injury estimates in the third period for both ATVs associated with three, four or an unknown number of wheels and for four-wheel ATVs alone have increased each year. Analysis has demonstrated that, over the past five years,[18] there was a statistically significant upward trend for injuries associated with ATVs having three, four or an unknown number of wheels. Over this same time period, analysis has also shown a statistically significant downward trend in the risk of injury per 10,000 four-wheel ATVs in use ($p = 0.0441$).

[17] The reader is cautioned against making similar generalizations regarding the estimated number of ATVs in use and the estimated risk of death, because these estimates may be subject to sources of error other than those mentioned here.
[18] As explained in Appendix B, trend analyses were conducted using 2001 as the base year.

Appendix A

Table 7
Reported ATV-Related Deaths by Year and Age Group
ATVs with 3, 4 or Unknown Number of Wheels
January 1, 1982 through December 31, 2006

Year[19]	Younger Than 12 Years Old	Younger Than 12 Years Old Percent of Total	Younger Than 16 Years Old	Younger Than 16 Years Old Percent of Total
Total	**987**	**12%**	**2,342**	**29%**
2006	*50*	*9*	*111*	*20*
2005	*67*	*10*	*145*	*22*
2004	*68*	*9*	*181*	*24*
2003	*68*	*10*	*154*	*24*
2002	45	8	133	24
2001	58	11	132	26
2000	50	11	124	27
1999[20]	34	9	90	23
1998	30	12	82	33
1997	38	16	79	33
1996	40	16	87	35
1995	26	13	64	32
1994	20	10	54	27
1993	18	10	59	32
1992	32	14	71	32
1991	40	17	68	30
1990	27	12	81	35
1982-1989	276	18	627	40

Source: U.S. Consumer Product Safety Commission, Directorate for Epidemiology, Division of Hazard Analysis.
Italics denote the period for which reporting is incomplete.

[19] Reporting is ongoing for 2003 – 2006. Percentages for years for which reporting is incomplete should be interpreted with caution because the rate at which deaths are reported may not be consistent across all age groups.
[20] Beginning in 1999, deaths were coded under the Tenth Revision of the International Classification of Diseases (ICD-10). See Appendix B for a discussion of the effect of this change.

Appendix B

Estimation Methodologies

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

ATV-Related Deaths

In-Scope ATV-Related Fatalities

ATV-related fatalities considered in scope in this report include any unintentional incident involving an ATV, whether or not the ATV is 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 when a victim is riding alongside a fence on a ranch for the purpose of checking the fence, and then subsequently overturns his ATV while deviating from his work routine to take a recreational ride up a nearby hill.

ICD-9 versus ICD-10 Coding

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

It should be noted that the ICD-10 codes (V86.X) characterizing the external cause of death as "ATV-related" include fatalities resulting from all specialty motor vehicles intended primarily for off-road use (World Health Organization, 2007). Thus, other types of off-road vehicles, including dune buggies and dirt bikes, are captured in this set of codes. Through the conduct of in-depth investigations (IDIs), CPSC staff attempts to verify that the vehicles involved in these incidents are 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, and handlebars). In cases where the type of vehicle cannot be confirmed, CPSC staff counts the death report as an ATV-related fatality. This assumption may result in an overestimation of ATV-related deaths. The degree of overestimation is expected to be small, based on the small proportion of incidents for which the vehicle type cannot be determined.

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,[21] where the death is deemed to be ATV-related by the medical examiner. These incidents are entered into CPSC staff's death certificate database (DTHS).

[21] CPSC staff purchases death certificates from the 50 states, the District of Columbia, 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 U.S. death certificates have been coded in accordance with ICD-10 (National Center for Health Statistics, 2007).

- The second avenue involves the collection of reports of fatal, ATV-related incidents by any other means available to CPSC staff. Sources for these types of reports include: news clips; reports from the Medical Examiners and Coroners Alert Project (MECAP); reports from consumers or their representatives via telephone or Internet; and hospital reports from the National Electronic Injury Surveillance System (NEISS). With regard to NEISS reports, it should be noted that the NEISS database primarily includes product-related injuries rather than fatalities. However, all ATV-related NEISS cases are reviewed to identify incidents where an emergency room-treated, ATV-related injury was determined to result in death, and these deaths are included in the ATV-related fatality reports available to CPSC staff.

In many cases, CPSC staff receives fatality reports that are duplicates either of deaths counted in a previous annual report or of deaths reported for the first time in this annual report. For example, CPSC staff may receive a MECAP report for a fatality that was previously reported to CPSC staff via a news clip. Reports from non-DTHS sources are carefully reviewed to match duplicate reports for both the current reporting year and for previous years. Counts of these duplicate reports are not included in Table 1.

The calculation of the capture-recapture estimate entails the matching of fatality reports from DTHS and non-DTHS sources. Then, for each year of interest, CPSC staff determines the total number of fatalities included in DTHS, the total number of fatalities included in non-DTHS sources, and the total number of deaths included in both sources (i.e., DTHS and non-DTHS). The estimate is then calculated using the following equation:[22]

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

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 by at least one other source.

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

Estimation of ATV-Related Fatalities (1985 – 1998)

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

[22] 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.

- For public road fatalities, the count was based on the number of unique reports received by CPSC staff. These reports were largely included in CPSC's Injury or Potential Injury Incident file (IPII). As noted, death certificates were generally not received for these fatalities.

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

Using equation 2 (below), these two parts (i.e., incidents occurring on public roads and incidents occurring in other places) were then 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 non-public-road fatalities captured by purchase of death certificates from the states,

N_{NP} is the number of reports of non-public-road fatalities collected by other means,

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

Estimation of Fatalities Associated with Four-Wheel ATVs

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

$$Estimate_{4W} = \frac{rep_{4W}}{rep_{3W+4W}} Est_{3W+4W+UW} \qquad \textit{Equation 3}$$

where

$Estimate_{4W}$ is the estimated number of fatalities associated with four-wheel ATVs,
rep_{4W} is the reported number of fatalities associated with four-wheel ATVs,
rep_{3W+4W} is the reported number of fatalities associated with three- and four-wheel ATVs, and
$Est_{3W+4W+UW}$ is the estimated number of fatalities associated with ATVs with three, four or an unknown number of wheels. [Note: this is the "estimate" derived in Equations 1 and 2].

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

The risk of death associated with four-wheel ATVs in use is calculated by dividing the annual estimate of fatalities associated with four-wheel ATVs ($Estimate_{4W}$) by the estimated number of ATVs in use in a given year. Annual estimates of the numbers of ATVs in use are determined from ATV sales and operability rates based on exposure studies conducted by industry[23] and on information compiled by CPSC's Directorate for Economic Analysis. Annual ATVs-in-use estimates for 1994 and prior years are computed from a survival model derived from 1994 data. Annual ATVs-in-use estimates for years 2001 and after are computed from a survival model derived from 2001 data. Estimates of the annual numbers of in-use ATVs for the intervening years come from a model that provided a smooth transition between the 1994 and the 2001 survival models. The estimated numbers of four-wheel ATVs in use in Tables 4 and 6 are rounded figures. Risk estimates calculated using these rounded figures may not match those in the tables because of this.

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

Estimation of ATV-Related Injuries

All injury estimates in this report have been derived from data collected through CPSC's National Electronic Injury Surveillance System, a probability sample of U.S. hospitals with 24-hour emergency rooms and more than six beds (Schroeder and Ault, 2001a and 2001b). Thus, ATV-related injury estimates in this report represent hospital emergency room-treated injuries only. ATV-related injuries that were not treated in hospital emergency rooms 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 were also adjusted based on a review of NEISS comments to exclude dune buggies and identify ATVs classified as mini or trail bikes.

Injury estimates for 1985, 1989, 1997 and 2001 are based on injury surveys using NEISS cases. Injury estimates for other years have been adjusted by factors to account for out-of-scope (non-ATV) cases based on injury studies in those years (Levenson, 2003c; Rodgers and Zamula, 1986; Rodgers, 1990; U.S. CPSC, 1998). 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. 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); and 0.922 for 2002 and after.

[23] See Levenson, M., 2001 ATV Operability Rate Analysis, memorandum. May 6, 2003. U.S. Consumer Product Safety Commission. Also see Levenson, M. *All-Terrain Vehicle 2001 Injury and Exposure Studies.* January 2003. U.S. Consumer Product Safety Commission.

Coefficients of Variation

A coefficient of variation (or CV) is an expression of the standard deviation relative to the estimate itself. In this report, CVs for injury estimates are given as percents. 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 more fully discussed in Levenson (2003b) and Levenson (2005c).

Estimation of Hospital Emergency Room-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.

$$Total\ Estimate_{4W} = \frac{Estimate_{4W}}{Estimate_{3W+4W}}\left(Estimate_{3W+4W+UW}\right) \qquad \textit{Equation 4}$$

where

Total Estimate$_{4W}$ is the total estimated injuries associated with four-wheel ATVs with unknowns apportioned,

Estimate$_{4W}$ is the estimated injuries associated with four-wheel ATVs not including unknowns,

Estimate$_{3W+4W}$ is the combined estimated injuries associated with three- and four-wheel ATVs (not including unknowns),

Estimate$_{3W+4W+UW}$ is the combined estimated injuries associated with ATVs with three, four or an unknown number of wheels.

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

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

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

Consistent with the 2005 ATV Annual Report (U.S. CPSC, 2007), relative changes in the annual injury estimates shown in Table 5 and Table 6 are assessed using 2001 as the base year (see pages 10 – 14). This base year was selected because data from 2001 are expected to more accurately reflect the current ATV market. Certain features of the current market, including the increase in new-entrant import model ATVs, may make comparisons across recent time spans more meaningful than comparisons using older data. The year 2001 was also chosen to assess changes and trends in injury estimates because it is consistent with the use of 2001 to assess injury risk. The year 2001 is used as a baseline to assess changes in injury risk because of the availability of both sales and operability data for that year.

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