Non-Fire Carbon Monoxide Deaths Associated with the Use of Consumer Products
2005 Annual Estimates

Matthew V. Hnatov
U.S. Consumer Product Safety Commission
Directorate for Epidemiology
Division of Hazard Analysis
4330 East West Highway
Bethesda, MD 20814
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Executive Summary

This report provides information about the estimated number of unintentional non-fire deaths attributed to carbon monoxide (CO) poisoning that were associated with the use of consumer products in 2005 and summary information of consumer product CO fatalities from 1999 through 2004. The U.S. Consumer Product Safety Commission (CPSC) established a strategic goal to reduce the CO poisoning mortality rate associated with the use of consumer products by 20 percent from the 1999-2000 average rate by the year 2013. It should be noted that CPSC staff continue to receive reports of CO poisoning fatalities and the estimates may change in subsequent reports. Some of the key findings in this report are:

- In 2005 there were an estimated 195 unintentional non-fire CO poisoning deaths associated with consumer products under the jurisdiction of the U.S. Consumer Product Safety Commission. The estimated annual average from 2003-2005 was 171 deaths.

- Engine driven tools were associated with the largest percentage of non-fire CO poisoning fatalities in 2005 at 56 percent (109 deaths). Heating system-related CO fatalities were associated with 27 percent (52 deaths) of all consumer product-related CO poisoning fatalities. The remaining six product categories [*Charcoal Grills or Charcoal* (6 deaths), *Gas Water Heaters* (6 deaths), *Gas Grills, Camp Stoves, Lanterns* (6 deaths), *Gas Ranges/Ovens* (6 deaths), *Other Appliances* (2 deaths), and *Multiple Appliances* (9 deaths)] combined were associated with a total of 17 percent of the non-fire CO fatalities.

- Of the estimated 109 CO fatalities in 2005 that were associated with engine-driven tools, 88 percent involved generators. Additionally, generator usage was associated with six of the estimated nine multiple appliance CO poisoning fatalities.

- The estimated number of generator-related CO fatalities more than doubled in 2005 from the previous year with an estimated 96 fatalities in 2005 compared to 41 in 2004.

- The statistically significant increasing trend in consumer product-related non-fire CO fatalities from 1999 to 2005 is attributable to generators.

- A major factor in the increase in generator-related CO fatalities in 2005 was generator use after loss of power caused by unusually severe weather activity. Forty-eight of the estimated 96 fatalities (50%) were directly linked to hurricanes or ice-storms. In 2004, an estimated nine of 41 CO generator-related fatalities (22%) were associated with generator usage after a storm-caused power outage.

- Of the estimated 52 heating system-related fatalities in 2005, 63 percent involved gas heating. Liquefied petroleum (LP or propane) gas heating accounted for 37 percent, natural gas heating accounted for 15 percent of heating system-related fatalities, and an additional 12 percent could only be identified as unspecified gas heating.

- For 2005, adults between 45 and 64 years of age represented 44 percent of the estimated number of CO poisoning deaths and adults over 25 years of age represented 86 percent.

Five percent of the estimated CO fatalities were children under 15 years old. There were no reported deaths for children under the age of five years in 2005.

- Sixty-nine percent of the estimated number of CO deaths in 2005 occurred in the home, while deaths in tents, campers and other temporary shelters accounted for an estimated 16 percent of deaths.

- The CO poisoning three-year average mortality rate associated with consumer products has increased 33 percent from the 1999/2000 average baseline for the CPSC strategic goal. However, for non-engine-driven tool products, the mortality rate has decreased by 10 percent since 1999/2000.

Introduction

Carbon monoxide (CO) is a colorless, odorless, and poisonous gas that results from the incomplete combustion of fuels such as natural or liquefied petroleum (LP) gas, gasoline, oil, wood, coal, and other fuels. The health effects related to CO depend upon its concentration in blood, which in turn depends on its concentration in air, the duration of exposure, and each individual's general health. Carbon monoxide combines with hemoglobin (Hb) with an affinity about 250 times that of oxygen, forming carboxyhemoglobin (COHb) and interfering with oxygen transport, delivery, and utilization. Generally, there are no perceptible health effects or symptoms in healthy individuals at COHb levels below 10 percent. Symptoms associated with blood levels at or above 10 percent COHb include headache, fatigue, nausea, and cognitive impairment. Loss of consciousness, coma, and death can occur at COHb levels greater than 20 percent, although for healthy adults CO fatalities typically require levels above 50 percent COHb[1].

Some symptoms of CO poisoning may mimic common illnesses, such as influenza or colds; thus, there likely is a high incidence of initial misdiagnosis by physicians and victims (Long and Saltzman, 1995). Patients are frequently unaware of exposures, and health care providers may not always consider CO poisoning as a cause of such non-specific symptoms. COHb formation is reversible, as are some clinical symptoms of CO poisoning. However, some delayed neurological effects that develop following severe poisonings, especially those involving prolonged unconsciousness, may not be reversible. Prompt medical attention is important to reduce the risk of permanent damage.

Any fuel-burning appliance can be a potential source of fatal or hazardous CO levels. Fuels, such as natural and LP gas, kerosene, oil, coal, and wood can produce large amounts of CO when there is insufficient oxygen available for combustion. Consumer products that burn kerosene, oil, coal or wood (such as wood stoves, oil boilers, and kerosene heaters) produce an irritating smoke that can alert the victim to a potentially hazardous situation. Engine-driven tools powered by gasoline engines produce large amounts of CO even when they are run where there is sufficient oxygen available for combustion yet they may not emit an irritating exhaust smoke. Other fuels, such as charcoal briquettes and pressed wood-chip logs, produce relatively smokeless fires, even at times of inefficient combustion. In these cases, victims receive no obvious sensory warning that high CO levels are present. Another hazard scenario is present when gas appliances are not vented properly or are malfunctioning. Natural and LP gas burn more efficiently and cleanly compared with other forms of fuel. In circumstances of poor maintenance, inadequate ventilation, or faulty exhaust pathways, natural and LP gas appliances may emit potentially lethal amounts of CO without any irritating fumes. Again, many victims may be unaware of a potential problem.

[1] Inkster S.E. *Health hazard assessment of CO poisoning associated with emissions from a portable, 5.5 kilowatt, gasoline-powered generator.* Washington, D.C.: U.S. Consumer Product Safety Commission. 2004.

National Estimates of Non-Fire CO Poisoning Deaths Associated with Consumer Products

During 2005, there were an estimated 195 carbon monoxide (CO) poisoning deaths associated with the use of a consumer product under the jurisdiction of the U.S. Consumer Product Safety Commission (CPSC). The estimates presented in this report are based on nearly complete reporting of consumer product-related CO poisoning fatalities which occurred in 2005. The National Center for Health Statistics (NCHS) has records of every death certificate filed in the United States and its territories. A comparison of CPSC records to NCHS records indicates that CPSC records have data on approximately 97 percent of all the CO poisoning cases which occurred in 2005 in the United States. Therefore, CPSC staff anticipates data obtained in the future may change the estimates, but are not likely to have a large impact. In 2005, all CPSC records of non-fire consumer CO poisoning fatalities were contained within the NCHS records. This indicates that the differences in the number of fatalities between the two databases are due to a small number of records missing from the CPSC database. Carbon monoxide poisonings referred to in this report do not include those where the CO gas resulted from a fire or a motor vehicle, were intentional in nature, or were directly work-related.

Although there can be multiple factors contributing to a CO poisoning fatality, the source of CO is virtually always a fuel-burning product. As mentioned earlier, poor product maintenance by professionals or consumers, inadequate ventilation, faulty exhaust pathways, and poor user judgment in operating these products can result in fatal scenarios. It should be noted that CPSC staff produces the CO estimates by associated consumer products in order to identify product groups involved in fatal CO scenarios and to monitor this distribution over time. It is within the individual, product-specific CPSC projects that further analysis is done to consider whether improvements are warranted in the areas of product design, ventilation safeguards, or user information and education.

The annual CO estimates for the years 1999 through 2005 are presented in two formats: by product type (Table 1) and by product within fuel type (Table 2). The data are presented as yearly estimates for each of the seven years covered by this report and as an average of the most recent three year period (2003 through 2005). Data collection is nearly complete for 2005 at this time. Estimates for this year may change in the future if additional data become available and are, therefore, reported using italic font in the tables.

Table 1 presents the consumer product distribution of CO poisoning deaths. The estimate for *Heating Systems*, historically a large percentage of the consumer product estimate, is further distributed among the various fuel types. Fatality estimates for the *Engine-Driven Tools* category were further distributed between generators and other engine-driven tools. The consumer product estimate and product distributions were derived using the methodology described in Appendix A.

Of the estimated 195 CO poisoning deaths associated with a consumer product that occurred between January 2005 and December 2005, heating systems were associated with 52 deaths (27% of the total consumer product estimate). Of the 52 deaths associated with heating systems, the majority (63% or 33 fatalities) involved gas heating systems. Among gas heating systems, natural gas heating was associated with an estimated eight deaths (15% of heating

system-related deaths), LP gas heating was associated with an estimated 19 deaths (37% of heating system-related deaths) and unspecified gas heating was associated with an estimated six deaths (12% of heating system-related deaths). Coal/wood heating systems and kerosene/oil heating were associated with an estimated three deaths (6% of heating system-related deaths) and an estimated four deaths (8% of heating system-related deaths), respectively. There are no reported diesel-fueled heating systems fatalities in the 2005 data. An additional estimated 12 deaths were associated with a heating system, not specified (23% of heating system-related deaths).

Table 1
Estimated Non-Fire Carbon Monoxide Poisoning Deaths
By Associated Fuel-Burning Consumer Product, 1999-2005.

Consumer Product	2003 - 2005+		Annual Estimate						
	Average Estimate	Average Percent	1999	2000	2001	2002	2003	2004	2005+
Total Deaths	*171*	*100%*	109	137	122	181	154	164	*195*
Heating Systems	*68*	*40%*	50	81	72	97	66	85	*52*
Unspecified Gas Heating	*8*	*5%*	5	1	5	2	4	14	*6*
LP Gas Heating	*23*	*13%*	22	28	24	41	22	27	*19*
Natural Gas Heating	*22*	*13%*	20	42	28	32	27	30	*8*
Coal/Wood Heating	*3*	*2%*	*	2	6	4	2	4	*3*
Kerosene/Oil Heating	*5*	*3%*	2	8	6	8	6	4	*4*
Diesel Fuel	*	*	*	*	*	1	*	*	*
Heating Systems, Not Specified	*8*	*5%*	1	*	3	9	5	6	*12*
Charcoal Grills or Charcoal	*6*	*4%*	17	8	10	11	8	3	*6*
Gas Water Heaters	*5*	*3%*	1	3	1	1	7	2	*6*
Gas Grills, Camp Stoves, Lanterns	*5*	*3%*	14	4	1	5	2	8	*6*
Gas Ranges/Ovens	*4*	*2%*	6	12	9	3	3	4	*6*
Other Appliances	*2*	*1%*	1	0	0	0	2	1	*2*
Multiple Appliances	*7*	*4%*	6	2	7	12	8	4	*9*
Engine-Driven Tools	*74*	*43%*	13	27	22	51	57	56	*109*
Generators	*62*	*36%*	7	19	21	41	50	41	*96*
Other Engine-Driven Tools	*12*	*7%*	6	8	1	10	7	15	*13*

\+ Data collection for 2005 is nearly complete. Italicized estimates may change in the future if more reports of fatalities are received.

* No reports received by CPSC staff.

Source: U.S. Consumer Product Safety Commission / EPHA.
CPSC Death Certificate File, CPSC Injury or Potential Injury Incident File, CPSC In-Depth Investigation File, National Center for Health Statistics Mortality File, 1999 - 2005.

Note: Reported averages and percentages may not add to total due to rounding.

Of the estimated 19 deaths in 2005 that were associated with LP gas heating systems, 17 (89%) involved unvented portable propane heaters. These unvented portable propane heaters were fueled by a propane tank and were not a component of an installed heating system. Unvented portable propane heaters were either camping heaters that used disposable propane tanks, one pound propane bottles, or tank top heaters that used bulk tanks larger than one pound.

In 2005, an estimated six CO deaths (3% of the 195 total consumer product estimate) were associated with charcoal or charcoal grills; an estimated six deaths (3% of the total consumer product estimate) were associated with gas water heaters; gas grills, camp stoves and lanterns were associated with an estimated six deaths (3% of the total consumer product estimate); gas ranges and ovens were associated with an estimated six deaths (3% of the total consumer product estimate); and two deaths were either associated with consumer products that did not fit into the categories given above or there was insufficient detail to categorize the appliance involved. One fatality was associated with a propane-fueled refrigerator and another with an indoor pool heater. These incidents were categorized as *Other Appliances*. Additionally, in 2005, an estimated nine deaths were associated with multiple appliances (5% of the total consumer product estimate). The *Multiple Appliances* category included all incidents where multiple fuel-burning products were used simultaneously such that a single source of the CO could not be determined. Of the nine multiple appliance fatalities, six were associated with a generator and another product. These other products were a propane camp stove or cooker (three deaths), a natural gas stove, and the fifth case involved both a propane fueled torpedo heater (a portable forced air heater intended for outdoor use) and a kerosene heater in addition to a generator.

An estimated 109 CO poisoning deaths (56% of the estimated total from 2005) were associated with engine-driven tools, which includes generators, riding mowers or garden tractors, power washers, a snow blower and an ATV. Generator associated deaths comprise the majority of this category. There were an estimated 96 generator-related CO poisoning deaths in 2005 (88% of all engine-driven tool fatalities and nearly half (49%) of the total consumer product estimate). This is the first year since the implementation of the International Classification of Diseases, Tenth Revision (ICD-10) in 1999 that there were more CO fatalities associated with engine-driven tools than with heating systems.

Table 1 shows the estimated average annual number of CO poisoning deaths associated with a consumer product for 2003-2005. The average yearly total number of CO deaths for this three-year period is estimated to be 171 (with a standard error of approximately 12.3). The 95 percent confidence interval[+] for this estimated average ranged from 118 to 224 deaths. Appendix B contains a graph and the data point values for the annual estimates of CO poisoning deaths associated with a consumer product for 1980 through 2005.

Detailed information regarding the conditions of products associated with fatalities could not be reliably collected, and the availability of such information in the CPSC's files varied widely. However, information collected often did describe conditions regarding compromised vent systems, flue passageways and chimneys for furnaces, boilers, and other heating systems.

[+] Confidence interval based on a t-distribution with two degrees of freedom.

Vent systems include the portion of piping that connects the flue outlet of the appliance and exhausts air to the outside through a ceiling or sidewall, or connects to a chimney. Some vented products had vents that became detached or were improperly installed or maintained. Vents were also sometimes blocked by soot caused by inefficient combustion, which in turn may have been caused by several factors, such as leaky or clogged burners, an over-firing condition, or inadequate combustion air.

Other conditions related to furnaces included compromised heat exchangers or filter doors or covers that were removed or not sealed. Some products were old and apparently poorly maintained such that there were several factors involved in generating and exacerbating the amount of CO produced. Other incidents mentioned a backdraft condition, large amounts of debris in the chimney, and the use of a product that was later red-tagged by the utility company (taken out of commission by the utility company and not to be turned on until repaired).

Table 2 organizes the estimates by product within fuel type. The three major fuel types include *Gas Fueled Appliances* (natural gas and liquid petroleum [LP or propane] gas); *Solid Fueled Appliances* (charcoal, coal, and wood); and *Liquid Fueled Appliances* (gasoline, kerosene, and oil). Of these fuel types, *Gas Fueled Appliances* were associated with 63 of the 195 (32%) estimated CO fatalities in 2005. *Solid Fueled Appliances* and *Liquid Fueled Appliances* were associated with 10 (5%) and 113 (58%) estimated fatalities in the same time period, respectively. An additional nine (5%) fatalities were associated with multiple products.

In the *Gas Fueled Appliances* category, the vast majority of CO fatalities in 2005 were associated with heating-related products. Of the estimated 63 gas fueled appliance fatalities in 2005, 43 (68%) were associated with heating systems or heaters. In the *Solid Fueled Appliances* category, six of the estimated 10 CO fatalities (60%) in 2005 were associated with charcoal or charcoal grills. Of the 113 liquid fueled appliance-related fatalities in 2005, 109 (96%) were associated with all engine-driven tools (generators, lawn mowers/garden tractors, power washers, etc.). Generators accounted for 96 of the estimated 113 fatalities (85%) in the *Liquid Fueled Appliances* category for 2005.

Table 2
Estimated Non-Fire Carbon Monoxide Poisoning Deaths
Associated with Consumer Products Organized by Fuel Type, 1999-2005.

Consumer Product	2003-2005+		Annual Estimate						
	Average Estimate	Average Percent	1999	2000	2001	2002	2003	2004	2005+
Total Deaths	*171*	*100%*	109	137	122	181	154	164	*195*
Gas Fueled Appliances	*76*	*44%*	67	91	71	92	72	92	*63*
Room / Space Heater	*31*	*18%*	20	39	23	35	30	35	*28*
Natural Gas Fueled	*6*	*4%*	3	17	5	9	8	8	*3*
Propane Fueled	*19*	*11%*	16	21	17	21	19	19	*18*
Other / Unspecified	*6*	*4%*	1	1	1	5	3	8	*7*
Furnace	*29*	*17%*	25	33	37	48	28	44	*15*
Natural Gas Fueled	*15*	*9%*	16	25	23	24	19	23	*4*
Propane Fueled	*4*	*2%*	6	8	7	20	3	8	*1*
Other / Unspecified	*10*	*6%*	3	*	7	4	6	13	*10*
Range, Oven	*4*	*2%*	6	12	9	3	3	4	*6*
Water Heater	*5*	*3%*	1	3	1	1	7	2	*6*
Refrigerator	*1*	*1%*	1	*	*	*	1	*	*1*
Lantern	*4*	*2%*	8	3	*	2	1	4	*6*
Gas Grill, Camp Stove	*1*	*1%*	5	1	1	3	1	2	*
Other	*1*	*1%*	1	*	*	*	1	1	*1*
Solid Fueled Appliances	*9*	*5%*	17	10	16	15	10	7	*10*
Charcoal / Charcoal Grill	*6*	*4%*	17	8	10	11	8	3	*6*
Wood / Coal Heater	*3*	*2%*	*	2	6	4	2	4	*4*
Coal Furnace	*< 1*	*< 1%*	*	1	1	1	*	1	*
Wood / Coal Stove	*2*	*1%*	*	1	5	1	2	1	*3*
Chimney / Fireplace	*1*	*1%*	*	*	*	2	*	2	*1*
Liquid Fueled Appliances	*79*	*46%*	16	34	28	59	63	61	*113*
Oil Heater / Heating	*1*	*1%*	*	4	5	3	1	*	*2*
Kerosene Heater / Heating	*4*	*2%*	2	3	1	4	5	5	*2*
Generators	*62*	*36%*	7	19	21	41	50	41	*96*
Other Engine-Driven Tools	*12*	*7%*	6	8	1	10	7	15	*13*
Lantern / Product / Appliance	*	*	1	1	*	1	*	*	*
Multiple Products Involved	*7*	*4%*	7	2	8	13	8	5	*9*

\+ Data collection for 2005 is nearly complete. Italicized estimates may change in the future if more reports of fatalities are received.

* No reports received by CPSC staff.

Source: U.S. Consumer Product Safety Commission / EPHA.
CPSC Death Certificate File, CPSC Injury or Potential Injury Incident File, CPSC In-Depth Investigation File, National Center for Health Statistics Mortality File, 1999 - 2005.

Note: Reported averages and percentages may not add to total due to rounding.

Table 3 shows a break-down of the fatalities estimates for the seven year period from 1999 through 2005 in the Engine-Driven Tools category. During 2005, engine-driven tools were associated with an estimated 109 carbon monoxide poisoning deaths (56% of the total consumer product estimate). Ninety-six of these 109 engine-driven tool-related CO poisoning deaths (88%) were associated with generators, and the remaining 13 were associated with the classification *Other Engine-Driven Tools*. In 2005, the other engine-driven tools-related fatalities included an estimated eight deaths that were associated with lawn mowers (this includes riding mowers, garden tractors, and gas-fueled powered push mowers), three deaths associated with power washers, and one death each associated with a snow blower and an ATV.

Table 3
Estimated Non-Fire Carbon Monoxide Poisoning Deaths Associated with Engine-Driven Tools, 1999-2002 vs. 2003-2005.

	1999-2002	2003-2005+	Annual Estimate						
Engine-Driven Tools	**Average Estimate**	**Average Estimate**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	***2005+***
Total	**28**	***74***	**13**	**27**	**22**	**51**	**57**	**56**	***109***
Generators	**22**	***62***	**7**	**19**	**21**	**41**	**50**	**41**	***96***
Other Engine-Driven Tools	**6**	***12***	**6**	**8**	**1**	**10**	**7**	**15**	***13***
Lawn Mowers[1]	5	*8*	6	7	1	5	6	9	*8*
Gas Welder	< 1	*< 1*	*	*	*	2	1	*	*
Concrete Saw	< 1	*< 1*	*	*	*	1	*	1	*
Power Washer	*	*3*	*	*	*	*	*	2	*3*
ATV	< 1	*1*	*	*	*	1	*	1	*1*
Snow Blower	< 1	*< 1*	*	1	*	*	*	*	*1*
Air Compressor	*	*< 1*	*	*	*	*	*	1	*
Water Pump	*	*< 1*	*	*	*	*	*	1	*

[1] Lawn Mowers includes riding mowers, garden tractors and gas-fueled powered push mowers.

\+ Data collection for 2005 is nearly complete. Italicized estimates may change in the future if more reports of fatalities are received.

* No reports received by CPSC staff.

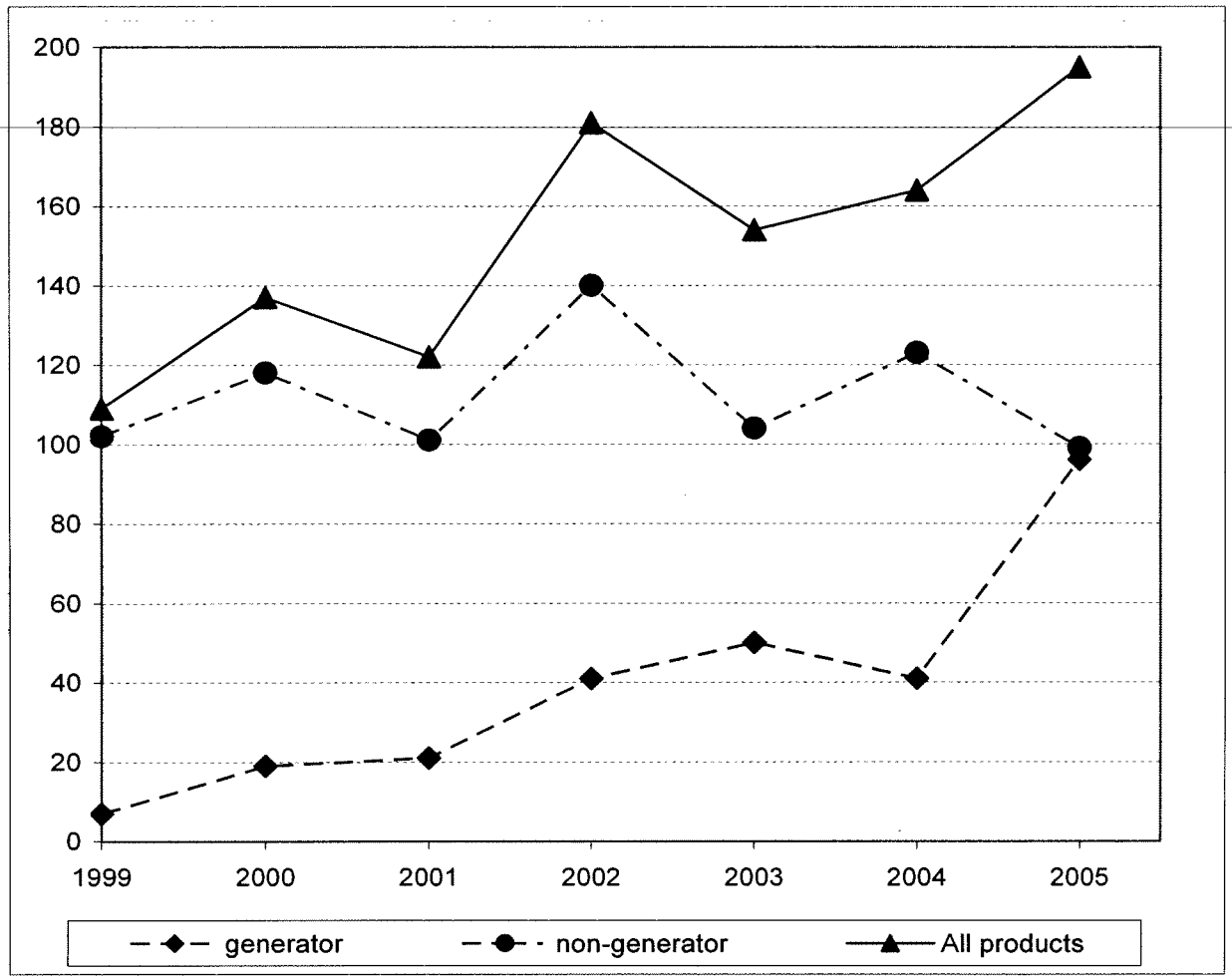
Source: U.S. Consumer Product Safety Commission / EPHA.
CPSC Death Certificate File, CPSC In-Depth Investigation File, CPSC Injury or Potential Injury Incident File, National Center for Health Statistics Mortality File, 1999 - 2005.

Note: Reported averages and percentages may not add to total due to rounding.

As can be seen in Table 3, the estimated numbers of fatalities associated with engine-driven tools increased dramatically from 1999 to 2005. The estimated annual average number of CO deaths from generators for the period of 2003-2005 is nearly triple that of the annual average from 1999-2002 and has doubled for other engine-driven tools. From 1999 to 2005, the number of CO fatalities associated with consumer products appears to be increasing. Regression analysis confirms this observation (p-value = 0.0150). Yet, if the generator fatalities are removed from the totals, the apparent trend disappears (regression analysis p-value = 0.9393). When looked at

separately, a regression analysis confirms a statistically significant upward trend in generator-related CO fatalities (p-value = 0.0055). In 1999, generator-related CO fatalities accounted for only six percent (7 of 109 estimated fatalities) of all consumer product-related CO fatalities. In 2005, the percentage had risen to 49 percent (96 of 195). Figure 1 provides a graphic representation of the CO fatalities trends related to all consumer products, related to generators alone, and related to non-generator products.

Figure 1: Comparison of Trends in Consumer Product-Related Deaths – 1999 to 2005



The number of CO fatalities associated with the use of generators more than doubled in 2005 over the previous year, increasing from an estimated 41 fatalities in 2004 to 96 in 2005. Much of this increase may be attributable to the unusually severe weather in 2005 which knocked out power to a large number of consumers who then turned to generators as an alternative power source. Half of the generator-related CO fatalities (an estimated 48 of 96) were associated with severe weather conditions. An estimated 27 generator-related CO fatalities were associated with five hurricanes which affected primarily Florida, Louisiana, and Texas (Hurricanes Katrina, Rita, Wilma, Dennis, and Isabelle). In addition to the severe hurricane season, there were also an estimated 21 generator-related CO fatalities associated with ice storms, including major storms in the Midwest (January) and the Carolinas and Georgia (December). An additional CO fatality in

the ice-storm in Georgia was associated with multiple products including a generator. By contrast, in 2004 there were an estimated nine CO fatalities associated with the use of generators following severe weather-caused power outages.

Lawnmowers were associated with the majority of the deaths in the *Other Engine-Driven Tools* category for the seven-year period. There was an estimated average of eight lawnmower-related CO fatalities in 2003-2005 and five in 1999-2002. Power washer-related CO fatalities was the next largest subcategory with an estimated average of three deaths per year from 2003-2005 while there were no reports of CO fatalities from this product in the 1999-2002 period.

Table 4 shows the estimated number of CO poisoning fatalities categorized by age for the seven most recent years of data (1999-2005). For the three most recent years (2003-2005), children less than 15 years of age accounted for an annual average of eight percent of yearly CO poisoning deaths. In 2003-2005, adults aged 25 years and older accounted for an average of approximately 85 percent of yearly CO poisoning deaths. The annual average percentage of deaths represented by adults 45 years and older was 58 percent in 2003-2005. In 2003-2005, adults aged 65 years and older accounted for an average annual percentage of 18 percent of CO poisoning fatalities.

In 2005, 72 percent of CO poisoning victims were males and 28 percent were females. This percentage has varied slightly from year to year but was relatively consistent in recent years. Over the 1999-2005 time span, the average percentage of male CO victims was 73 percent and the average percentage of female victims was 27 percent.

Table 4
Estimated Non-Fire Carbon Monoxide Poisoning Deaths by Age of Victim, 1999-2005.

Age	2003-2005+		Annual Estimate						
	Average Estimate	Average Percent	1999	2000	2001	2002	2003	2004	*2005+*
Total	*171*	*100%*	**109**	**137**	**122**	**181**	**154**	**164**	*195*
Under 5	*3*	*2%*	*	3	3	2	6	3	*0*
5 – 14	*10*	*6%*	7	3	6	9	9	11	*10*
15 – 24	*13*	*8%*	8	10	16	11	17	4	*17*
25 – 44	*46*	*27%*	32	42	23	57	47	43	*48*
45 – 64	*68*	*40%*	45	56	40	51	55	64	*85*
65 and over	*31*	*18%*	16	23	33	51	20	39	*35*

+ Data collection for 2005 is nearly complete. Italicized estimates may change in the future if more reports of fatalities are received.

* No reports received by CPSC staff.

Source: U.S. Consumer Product Safety Commission / EPHA.
CPSC Death Certificate File, CPSC In-Depth Investigation File, CPSC Injury or Potential Injury Incident File, National Center for Health Statistics Mortality File, 1999 - 2005.

Note: Reported averages and percentages may not add to total due to rounding.

Table 5 shows that in 2005, 83 percent of fatal CO incidents reported to the CPSC involved a single death. Table 5 accounts for only the fatally injured victims in each CO poisoning incident. It is not uncommon for CO incidents involving one or more fatalities to also result in one or more non-fatal CO poisoning injuries, but they were not quantified for analysis in this report. It should be noted that these are the incidents reported in CPSC databases and do not represent the national estimates of fatalities per CO incident. Death certificates do not include information about other fatalities for the same incident. The number of fatalities for a particular incident are based on CPSC In-Depth Investigation files and may include fatalities for which CPSC does not have death certificates. Some additional multiple fatality incidents were identified by matching date of death and location of death on death certificates.

Table 5
Number of Carbon Monoxide Poisoning Incidents Reported to CPSC
By Number of Deaths Per Incident, 1999-2005.

Number of Deaths Reported in Incident	2003-2005+		Annual Incidents						
	Annual Average	Average Percent	1999	2000	2001	2002	2003	2004	2005+
Total Incidents	*132*	*100%*	**79**	**104**	**89**	**131**	**122**	**125**	*145*
1	*107*	*81%*	64	82	72	103	97	103	*120*
2	*19*	*14%*	14	19	15	23	22	14	*20*
3	*4*	*3%*	*	2	2	1	2	7	*4*
4	*1*	*< 1%*	1	*	*	2	*	1	*0*
5 or more	*1*	*1%*	*	1	*	2	1	*	*1*

\+ Data collection for 2005 is nearly complete. Italicized estimates may change in the future if more reports of fatalities are received.

* No incident reports received by CPSC staff for this time period.

Source: U.S. Consumer Product Safety Commission / EPHA.
CPSC Death Certificate File, CPSC In-Depth Investigation File, CPSC Injury or Potential Injury Incident File, 1999 - 2005.

Note 1: Reported averages and percentages may not add to total due to rounding.

Note 2: Data in Table 5 do not add to totals presented in Table 1. Data presented in Table 5 are not national estimates derived from the NCHS totals, but reported deaths contained in the CPSC files. NCHS data do not contain enough detail to identify multiple victims of the same CO poisoning incident. These figures include fatalities reported in CPSC In-Depth Investigation files for which CPSC may not have a death certificate.

Table 6 shows that in 2005, an estimated 134 CO poisoning deaths occurred in homes, including manufactured and mobile homes. From 2003-2005, an annual average of 122 CO poisoning deaths (71%) occurred in homes, including manufactured and mobile homes. In 2005, an estimated 31 deaths took place in temporary shelters, such as tents, recreational vehicles, cube vans, seasonal cabins, and trailers (including horse trailers). For 2003-2005, an annual average of 25 CO poisoning deaths (15%) took place in temporary shelters. In 2005, CO deaths in temporary shelters were most commonly associated with portable gas or LP gas heating or with generators. An estimated 10 of 31 CO deaths in temporary shelters were associated with portable LP heaters while another 12 were associated with generator usage in 2005. Other scenarios included charcoal and charcoal grills (two deaths), LP gas lanterns (three deaths), a gas stove, a propane-fueled refrigerator, and an unspecified fueled space heater.

A consistently small percentage of deaths occurred in passenger vans, trucks, or automobiles in which victims were spending the night. In 2005, there were an estimated 11 CO fatalities in this category. These fatalities were associated with either portable LP gas heaters, generators, propane lanterns, or involved multiple products.

Table 6
Estimated Non-Fire Carbon Monoxide Poisoning Deaths by Location of Death, 1999-2005

Location of Death	2003-2005+		Annual Estimate						
	Average Estimate	Average Percent	1999	2000	2001	2002	2003	2004	*2005+*
Total	*171*	*100%*	**109**	**137**	**122**	**181**	**154**	**164**	*195*
Home	*122*	*71%*	60	88	85	128	110	121	*134*
Temporary Shelter	*25*	*15%*	35	34	24	39	23	22	*31*
Auto	*8*	*5%*	7	2	10	8	8	6	*11*
Other	*15*	*9%*	7	13	3	5	10	15	*19*
Unknown	*1*	*1%*	*	*	*	2	2	*	*0*

\+ Data collection for 2005 is nearly complete. Italicized estimates may change in the future if more reports of fatalities are received.

* No reports received by CPSC staff.

Source: U.S. Consumer Product Safety Commission / EPHA.
CPSC Death Certificate File, CPSC In-Depth Investigation File, CPSC Injury or Potential Injury Incident File, National Center for Health Statistics Mortality File, 1999 - 2005.

Note: Reported averages and percentages may not add to total due to rounding.

CPSC data indicate that there were more CO fatalities in the colder months than there were in the warmer months. This is most likely because of the use of furnaces and portable heaters in the colder months. Additionally, generators are often used in the winter months because of power outages due to snow and ice storms. Table 7 shows the annual estimated CO fatalities categorized by month of death for the seven years covered by this report. In 2005, 96 of the 195 estimated CO fatalities (49%) occurred during the colder months of November, December, January, and February. In the transition months of March, April, September, and October, an estimated 69 fatalities occurred (35%); and in the warmer months of May, June, July, and August, an estimated 31 fatalities occurred (16%).

Table 7
Estimated Non-Fire Carbon Monoxide Poisoning Deaths by Month of Year of the Fatality, 1999-2004.

Location of Death	2003-2005+		Annual Estimate						
	Average Estimate	Average Percent	1999	2000	2001	2002	2003	2004	2005+
Total	*171*	*100%*	**109**	**137**	**122**	**181**	**154**	**164**	*195*
Cold Months	*98*	*57%*	**60**	**88**	**87**	**93**	**95**	**102**	*96*
November	*24*	*14%*	7	28	14	27	32	24	*17*
December	*29*	*17%*	16	32	23	26	29	26	*32*
January	*31*	*18%*	28	17	28	20	22	33	*38*
February	*13*	*8%*	9	11	22	20	12	19	*9*
Transition Months	*50*	*29%*	**31**	**31**	**30**	**69**	**37**	**43**	*69*
March	*13*	*8%*	17	9	5	30	8	11	*20*
April	*10*	*6%*	2	3	13	9	12	9	*10*
September	*15*	*9%*	6	7	5	4	8	14	*23*
October	*11*	*6%*	6	12	7	26	9	9	*16*
Warm Months	*24*	*14%*	**18**	**18**	**7**	**19**	**20**	**20**	*31*
May	*3*	*2%*	3	7	5	4	3	3	*4*
June	*8*	*5%*	5	3	*	5	7	8	*9*
July	*7*	*4%*	5	5	*	2	6	5	*11*
August	*5*	*3%*	5	3	2	8	4	4	*7*

+ Data collection for 2005 is nearly complete. Italicized estimates may change in the future if more reports of fatalities are received.

* No reports received by CPSC staff.

Source: U.S. Consumer Product Safety Commission / EPHA.
CPSC Death Certificate File, CPSC In-Depth Investigation File, CPSC Injury or Potential Injury Incident File, National Center for Health Statistics Mortality File, 1999 - 2005.

Note: Reported averages and percentages may not add to total due to rounding.

Appendix A: Methodology

This appendix describes the data sources and methodology used to compute the national estimate of non-fire carbon monoxide (CO) poisoning deaths associated with the use of consumer products and the estimates by product, victim age, and incident location.

All death certificates filed in the United States are compiled by the National Center for Health Statistics (NCHS) into a multiple cause of mortality data file. The NCHS Mortality File contains demographic and geographic information, as well as the International Statistical Classification of Diseases and Related Health Problems codes for the underlying cause of death. Data are compiled in accordance with the World Health Organization instructions, which request that member nations classify causes of death by the current Manual of the International Statistical Classification of Diseases and Related Health Problems. The International Classification of Diseases, Tenth Revision (ICD-10) was implemented in 1999. Although the NCHS data contain cause of death codes that are helpful in identifying deaths due to CO poisoning, the data do not contain any narrative information that might indicate the involvement of a consumer product.

To complement the NCHS mortality data, the CPSC staff purchases death certificates from the 50 states, the District of Columbia, and New York City. Specifically, the CPSC staff purchases death certificates with certain cause of death codes for which there is a high probability that consumer products are involved. In addition to the cause of death codes and demographic and geographic information, the death certificate contains information about the incident location and a brief narrative describing the incident. Any references to consumer products are usually found in these narratives. The CPSC staff conducts follow-up in-depth investigations on selected deaths to confirm and expand upon the involvement of consumer products, as resources allow.

ICD-10 classifies deaths associated with CO poisoning with the codes listed below. The focus of this report is unintentional CO poisoning deaths and concentrates on those deaths coded as X47 and Y17. That is, code X67 records of intentional CO poisonings are excluded from this analysis.

ICD-10 Code	Definition
X47	**Accidental** Poisoning by and exposure to other gases and vapors. Includes: carbon monoxide, lacrimogenic gas, motor (vehicle) exhaust gas, nitrogen oxides, sulfur dioxide, utility gas
X67	**Intentional** Poisoning by and exposure to other gases and vapors. Includes: carbon monoxide, lacrimogenic gas, motor (vehicle) exhaust gas, nitrogen oxides, sulfur dioxide, utility gas
Y17	**Undetermined intent** Poisoning by and exposure to other gases and vapors. Includes: carbon monoxide, lacrimogenic gas, motor (vehicle) exhaust gas, nitrogen oxides, sulfur dioxide, utility gas

The first step in compiling the annual estimates is computing the total estimates of CO poisoning deaths associated with consumer products. The CPSC's Death Certificate (DTHS) File and the CPSC's Abbreviated Death Certificate (ABDT) File were both searched for cases associated with ICD-10 codes X47 and Y17.

Each death found in the CPSC's Death Certificate File and coded as X47 and Y17 was reviewed by an analyst and categorized as in-scope, out-of-scope, or whether the source of the CO was unknown or questionable. In-scope cases are unintentional non-fire CO poisoning deaths associated with a consumer product under the jurisdiction of the CPSC. Out-of-scope cases are cases that involve CO sources that are not under the jurisdiction of the CPSC (including motor vehicle exhaust cases), fire or smoke-related exposures, or intentional CO poisonings. Examples of out-of-scope cases include poisonings due to gases other than CO (i.e., natural gas, ammonia, butane), motor vehicle exhaust- or boat exhaust-related poisonings, and work-related exposures. The source of CO was classified as unknown or questionable in cases where a consumer product was possibly associated with the incident but the exact source of CO was unknown.

Deaths found in the CPSC's Abbreviated Death Certificate (ABDT) File are categorized as out-of-scope cases. The ABDT File contains death certificates for CO poisonings (X47 and Y17) that involve motor vehicle exhaust, cases where the source of the CO is unknown, or where the death certificate does not mention a consumer product. Other examples of out-of-scope cases that may appear in the abbreviated file are cases associated with farm accidents, smoke inhalation from a structural fire, or other gas poisonings. Occasionally, newer information from CPSC In-Depth Investigations may be matched with ABDT cases which were classified as having no known source or did not mention a consumer product. In the cases where the CPSC IDIs indicate the CO source was from a consumer product and should be considered in-scope, it was assumed that the death certificate was misclassified and the ABDT File was included with the DTHS database files.

In previous years, a small number of cases in the ABDT File were identified as in-scope based on further information collected during in-depth investigations. The method used to identify three deaths in 1999 and two deaths in 2000 is found in Appendix A of the 1999 and 2000 Annual Estimate Report (Vagts, 2001). For 2001 data, no ABDT File cases were reclassified as in-scope based on additional information. For the 2002 data, additional information on one incident in the ABDT File resulted in the incident being reclassified as in-scope. This fatality was not included in the NCHS file. Since the incident was not included in the NCHS data, it was also removed from the ABDT File and thus not used in calculations for the weights. For the 2003 data, there were seven reclassified in-scope cases in the ABDT File and five in 2004. For the 2005 data, one case from the ABDT File was reclassified as an in-scope case. The results of the initial categorization for 2005 data are found in Table A.1.

Table A.1
Initial categorization for 2005 data

ICD-10 Code	NCHS Total	DTHS File				Total in ABDT File	Total in CPSC Database[1]	Number of Cases to be Imputed[2]
		In-Scope	Unknown Source	Out-of-Scope	Total			
X47	650	175	23	233	431	179	610	63
Y17	92	1	2	37	40	31	71	23
Total	**742**	**176**	**25**	**270**	**471**	**210**	**681**	**86**

1 "Total in ABDT File" cases plus "Total" from DTHS File
2 "NCHS Total" cases minus "Total in CPSC Database" plus "Unknown Source Cases" from DTHS
Source: U.S. Consumer Product Safety Commission / EPHA.
CPSC Death Certificate File, CPSC In-Depth Investigation File, Abbreviated Death Certificate File, National Center for Health Statistics Mortality File, 2005.

The proportion of death certificates found in the CPSC database associated with non-fire unintentional X47 or Y17 deaths and associated with consumer products was applied to the NCHS totals to calculate the total estimated number of non-fire CO poisoning deaths associated with consumer products. In theory, the NCHS totals comprise all death certificates in the U.S. and the same proportion of in-scope cases should exist in the death certificates that are missing from the combined CPSC Death Certificate and Abbreviated Death Certificate files or are from an unknown source. Applying the proportion of in-scope cases to the NCHS database totals should, therefore, provide an estimate on in-scope cases nationwide. This was done in the following way and was done for ICD-10 codes X47 and Y17 separately.

1. The number of in-scope deaths in the CPSC's Death Certificate File coded as X47 and Y17 separately that were associated with an accidental non-fire CO poisoning and a consumer product were identified (n_1).

2. The total number of deaths in the CPSC's Death Certificate File and the Abbreviated Death Certificate File coded as X47 and Y17 were summed separately excluding cases with an unknown or highly questionable source (n_2).

3. The total number of deaths in the NCHS data associated with X47 and Y17 was counted (n_3).

4. The estimate of the number of non-fire CO poisoning deaths associated with consumer products in codes X47 and Y17 was calculated separately using the formula:

$$N = (n_1 / n_2) * n_3$$

The proportion (n_1 / n_2) represents the number of in-scope cases found in the CPSC's files divided by the total of in-scope and out-of-scope cases.

5. The estimates of the number of non-fire CO poisoning deaths associated with consumer products in codes X47 and Y17 were summed to calculate the total estimate of non-fire CO poisoning deaths.

$$\text{Total Estimate} = N_{X47} + N_{Y17}$$

The ratio (n_3 / n_2) represents the weighting factor used to calculate the annual estimates. The CPSC's Death Certificate File does not contain death certificates for all deaths listed in the NCHS file; therefore a weighting factor was calculated to account for those death certificates that are missing. The weighting factor allows the computation of national estimates of CO deaths by consumer products and by other characteristics collected by CPSC about each death.

Table A.2 contains the values for the variables used in the calculation as well as the final computed 2005 estimate of CO poisoning deaths.

Table A.2
Calculation Detail of the Final Computed 2005 Estimate of Non-Fire CO Poisoning Deaths Associated with Consumer Products

Variable	ICD-10 Code X47	ICD-10 Code Y17
n_1	175	1
n_2	610-23 = 587	71-2 = 69
n_3	650	92
Weighting Factor *(n_3 / n_2)*	*1.1073*	*1.3333*
N	193.7819	1.3333
Total Estimate	**193.7819 + 1.3333 = 195.1153 ~ 195**	

Source: U.S. Consumer Product Safety Commission / EPHA.
CPSC Death Certificate File, CPSC In-Depth Investigation File, Abbreviated Death Certificate File, National Center for Health Statistics Mortality File, 2005.

Table A.3 shows the weighting factors used to calculate the estimates for the years 1999-2005. It should be noted that the 2004 data and weighting factor have been updated to reflect additional cases that have become available to CPSC staff since the publication of last year's CO fatalities report.

Table A.3
CO Fatality Cases and Weighting Factors Used to Calculate the Estimates for the Years 1999-2005

Year	NCHS Total	Total in CPSC Databases*	In-Scope Cases	Weighting Factor
1999				
X47	542	469	93	1.1557
Y17	80	66	1	1.2121
2000				
X47	600	551	125	1.0889
Y17	76	70	1	1.0857
2001				
X47	596	520	103	1.1462
Y17	79	62	3	1.2742
2002				
X47	642	599	169	1.0718
Y17	71	61	0	1.1639
2003				
X47	633	625	152	1.0128
Y17	89	75	0	1.1867
2004				
X47	566	527	152	1.0740
Y17	86	72	1	1.1944
2005				
X47	650	587	175	1.1073
Y17	92	69	1	1.3333

* This is the total number of deaths in the Death Certificate File and Abbreviated Death Certificate File, excluding deaths associated with an unknown or questionable source of CO. Totals for 2004 have been updated.

Source: U.S. Consumer Product Safety Commission / EPHA.
CPSC Death Certificate File, CPSC In-Depth Investigation File, Abbreviated Death Certificate File, National Center for Health Statistics Mortality File, 1999-2005.

Incidents with unknown or highly questionable CO sources were excluded from the denominator of the weighting factor. The group of cases with unknown or highly questionable sources was assumed to contain the same proportion of cases associated with a consumer product as the group of cases within the CPSC database with known CO sources (this is the same assumption that is made for those cases where the death certificate is missing). To include these cases within the denominator assumes that these cases can be classified as in-scope or out-of-scope when actually their scope status is unknown. Therefore, for weighting purposes, cases where the source was unknown or highly questionable were treated in the same way as missing cases were treated.

In-scope cases were further examined to determine which product was associated with the incident. Further information on the CO deaths was obtained from review of the CPSC's In-Depth Investigation File.

Reports of non-fire CO poisoning deaths were retrieved from the DTHS and ABDT files based on the following criteria: date of death between 1/1/1999 and 12/31/2005 and ICD-10 code of X47 or Y17. Death certificates entered into CPSC's database prior to April 30, 2008 were included in this analysis. Each CO death was reviewed and coded by the author according to the consumer product and type of fuel involved, incident location, and whether multiple deaths resulted in the same incident, whenever possible. If information about the product's condition, venting system, or installation environment was provided in the in-depth investigation report, this information was coded for informational purposes.

In Table 1 of this report, the heating systems category combined CO poisoning fatalities from furnaces, boilers, vented floor and wall heaters, unvented space heaters, camping heaters, and other miscellaneous heating systems. Deaths associated with charcoal being burned alone and in the absence of an appliance (e.g., in a pail or in the sink) were presented with charcoal grills, even though this practice was usually done for heating purposes. Examples of products historically included in the *Other Appliances* category include LP gas refrigerators and gas pool heaters. LP gas grill, LP fish cooker, and other LP gas portable cooking appliance incidents are classified in the camp stove and lanterns category from 1999 to 2005. Deaths where multiple fuel-burning products were used simultaneously such that a single source of the fatal CO could not be determined were classified under *Multiple Appliances*. *Engine-Driven Tools* included generators and power gardening equipment, such as power lawn mowers, garden tractors, concrete cutters, and snowblowers. Generators that were original equipment installed on a recreational vehicle (RV), trailer, camper, or boat were considered out-of-scope, as they are outside the jurisdiction of the CPSC.

Appendix B: National Estimates of Consumer Product-Related CO Poisoning Deaths, 1980 – 2005

Figure B.1 below graphically shows the trend of the estimated CO fatalities from 1980 to 2005. Before the implementation of the ICD-10 coding in 1999, the estimated number of non-fire consumer product-related CO poisoning deaths decreased from the early 1980's to the late 1990's from a high of 340 in 1982 to a low of 180 in both 1997 and 1998. In 1999 there were an estimated 109 consumer product-related CO fatalities, well below the estimated 180 deaths in each of the two previous years. The difference may be due in part to the change from ICD-9 coding to ICD-10 coding where product identification could be more accurately assessed. Since 1999, though, there has been an upward trend in CO fatalities to the 2005 estimated 195 deaths.

Figure B.1: Estimated Non-Fire CO Poisoning Deaths Associated with Consumer Products 1980-2005

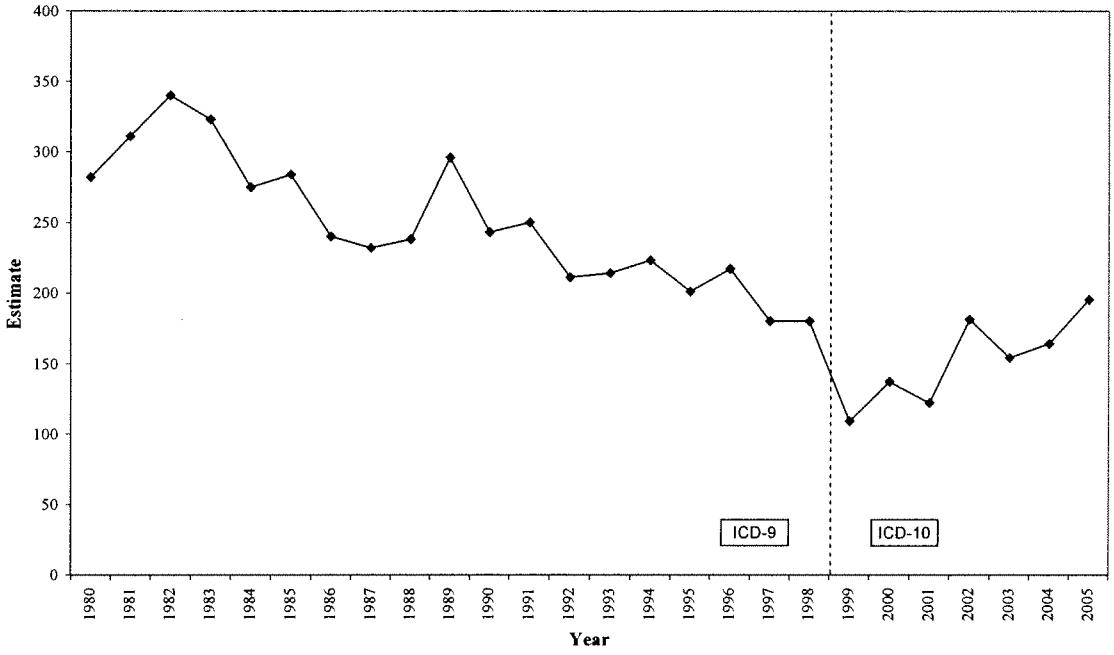


Table B.1 presents the annual estimate data from 1980 to 2005 and the three-year average mortality rates associated with each year where three years of data were available. The three-year average mortality rate is presented in the table for the mid-point year. The three-year average mortality rate decreased from the 1981-1983 high of 13.98 per ten million population to a three-year average rate of 7.05 per ten million in 1996-1998 time span, a reduction of approximately 50 percent. The average mortality rate continued to decrease to a low of 4.34 per ten million population in 1999-2001. Subsequently, the three-year average rate has been increasing and is currently estimated at 5.83 for the years 2003-2005.

The Consumer Product Safety Commission established a Strategic Goal to reduce the CO poisoning mortality rate associated with the use of consumer products by 20 percent from the 1999/2000 average rate[2]. The 1999/2000 average CO fatality mortality rate was 4.38 per ten

[2] U.S. Consumer Product Safety Commission – Strategic Plan, September 2003.

million population. The 2003-2005 average mortality rate is 5.83, an increase of approximately 33 percent.

Table B.1: Estimated Non-Fire Carbon Monoxide Poisoning Deaths Associated with Consumer Products, 1980-2005

Year	Estimate	U.S. Population (thousands)	3-Year Average Mortality Rate per 10 Million Population
1980	282	227,726	
1981	311	229,966	13.52
1982	340	232,188	13.98
1983	323	234,307	13.35
1984	275	236,348	12.44
1985	284	238,466	11.17
1986	240	240,651	10.48
1987	232	242,804	9.75
1988	238	245,021	10.41
1989	296	247,342	10.47
1990	243	250,132	10.51
1991	250	253,493	9.26
1992	211	256,894	8.77
1993	214	260,255	8.30
1994	223	263,436	8.08
1995	201	266,557	8.02
1996	217	269,667	7.39
1997	180	272,912	7.05
1998	180	276,115	5.67
1999*	109	279,295	5.09
2000	137	282,217	4.34
2001	122	285,226	5.14
2002	181	288,126	5.29
2003	154	290,796	5.72
2004	164	293,638	5.83
2005	195	295,507	

Note: The three-year average mortality rate is reported at the mid year.
* The Tenth Revision of the International Statistical Classification of Diseases and Related Health Problems (ICD-10) was implemented.
Source: U.S. Consumer Product Safety Commission / EPHA.
U.S. Census Bureau, Statistical Abstract of the United States: 2006 (population figures for 1980-2004)
U.S. Census Bureau , GCT-T1. Population Estimates, 2006 Population Estimates (population for 2005)

Prior to 1999 with the implementation of ICD-10, it was not possible to generate estimates for an important category of products: generators and other engine-driven tools[3]. With the advent of ICD-10 coding, it is now possible to generate estimates of fatalities associated with generators and other engine-driven tools. This category has been observed to have a statistically significant upward trend in the estimated number of associated CO poisoning fatalities since 1999. This increasing trend appears to be having an impact on the mortality rate of consumer product-related CO poisoning fatalities. Table B.2 shows that the three-year average mortality rate for generators alone was more than four times greater in 2003-2005 (2.12) than for 1999-2000 (0.46), and the three-year average rate has increased each year in that time span.

[3] See Appendix B of Mah (2001) for details.

Table B.2: Estimated Non-Fire Carbon Monoxide Poisoning Deaths Associated with Generators, 1999-2005

Year	Estimate	U.S. Population (thousands)	3-Year Average Mortality Rate per 10 Million Population
1999	7	279,295	0.46*
2000	19	282,217	
2001	21	285,226	0.94
2002	41	288,126	1.29
2003	50	290,796	1.51
2004	41	293,638	2.12
2005	96	295,507	

* Two-year average of 1999 and 2000 based on the strategic goal.

Note: The three-year average mortality rate is reported at the mid year.

Table B.3 shows the CO poisoning mortality rates associated with all consumer products excluding generators. The data indicate that, with the exclusion of generators, there does not appear to be an upward trend in the mortality rate for consumer products. The 1999-2000 annual average mortality rate was 3.92. The 2003-2005 three-year average mortality rate was 3.71, a decrease of five percent. With generators included, the mortality rate increased from 4.38 per ten million to 5.83 in the same time span, an increase of 33 percent.

Table B.3: Estimated Non-Fire Carbon Monoxide Poisoning Deaths Associated with Consumer Products, 1999-2005 (excluding Generator-Related Deaths)

Year	Estimate	U.S. Population (thousands)	3-Year Average Mortality Rate per 10 Million Population
1999	102	279,295	3.92*
2000	118	282,217	
2001	101	285,226	4.19
2002	140	288,126	3.99
2003	104	290,796	4.21
2004	123	293,638	3.71
2005	99	295,507	

* Two-year average of 1999 and 2000 based on the strategic goal.

Note: The three-year average mortality rate is reported at the mid year.

The data presented in the body of the report (see Table 3) also indicate that there appears to be an increase in the number of CO poisoning fatalities associated with other engine-driven tools like lawn tractors and power washers. Table B.4 shows the increase in mortality rates of all engine-driven tools, including generators. It can be seen in the table that the average mortality rate has more then tripled from 1999-2000 to the three-year average for 2003-2005.

Table B.4: Estimated Non-Fire Carbon Monoxide Poisoning Deaths Associated with Generators and Other Engine-Driven Tools, 1999-2005

Year	Estimate	U.S. Population (thousands)	3-Year Average Mortality Rate per 10 Million Population
1999	13	279,295	0.71*
2000	27	282,217	
2001	22	285,226	1.17
2002	51	288,126	1.50
2003	57	290,796	1.88
2004	56	293,638	2.52
2005	109	295,507	

* Two-year average of 1999 and 2000 based on the strategic goal.

Note: The three-year average mortality rate is reported at the mid year.

Table B.5 shows the CO mortality rates associated with all consumer products excluding generators and other engine-driven tools. The data indicate that the mortality rate decreased by 10 percent, with the exclusion of all engine-driven tools, with a mortality rate of 3.67 in 1999-2000 and 3.31 in 2003-2005 (compared to the 33 percent increase with all products included). Engine-driven tools and generators in particular had an impact on the CO poisoning mortality rate involving consumer products.

Table B.5: Estimated Non-Fire Carbon Monoxide Poisoning Deaths Associated with Consumer Products, 1999-2005 (excluding Generator- and Other Engine-Driven Tool-Related Deaths)

Year	Estimate	U.S. Population (thousands)	3-Year Average Mortality Rate per 10 Million Population
1999	96	279,295	3.67*
2000	110	282,217	
2001	100	285,226	3.97
2002	130	288,126	3.78
2003	97	290,796	3.84
2004	108	293,638	3.31
2005	86	295,507	

* Two-year average of 1999 and 2000 based on the strategic goal.

Note: The three-year average mortality rate is reported at the mid year.

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