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MEMORANDUM

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SUBJECT: Estimates of Non-fire Carbon Monoxide Poisoning Deaths and Injuries

The attached report provides estimates of non-fire CO poisoning deaths (1996) and reported injuries (1998) associated with the use of non-vehicular consumer products for the latest years data are available and gives an overview of the problem of CO poisoning.



Non-Fire Carbon Monoxide Deaths and Injuries Associated with the Use of Consumer Products: Annual Estimates

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Executive Summary

The U.S. Consumer Product Safety Commission (CPSC) is concerned about the number of unintentional non-fire deaths and injuries attributed to carbon monoxide (CO) poisoning associated with the use of consumer products within the jurisdiction of CPSC.

Between 1992 and 1996, the total number of unintentional non-fire CO poisoning deaths, including both deaths associated with consumer products under the jurisdiction of CPSC and deaths associated with motor vehicle exhaust averaged 544 annually. During this time, the annual average number of CO poisoning deaths attributed to motor vehicle exhaust was 331 or about 60 percent of all unintentional non-fire CO poisoning deaths. The remaining 213 (40%) deaths were associated with consumer products. Most of the non-fire consumer product-related CO poisoning deaths were associated with the use of heating systems. Other consumer products associated with these poisoning deaths included charcoal grills, gas water heaters, camping equipment, and gas ranges and ovens.

On average, between 1994 and 1998, approximately 10,600 people were treated annually in hospital emergency rooms for non-fire, non-fatal CO poisoning injuries associated with consumer products, excluding incidents involving auto exhaust. As with deaths, most injuries were associated with heating systems.

Introduction

Carbon monoxide (CO) is a colorless, odorless, and poisonous gas that results from the incomplete combustion of fuels such as natural or liquefied propane (LP) gas, oil, wood, coal, and other fuels. The health effects related to CO depend upon its concentration in air, the duration of exposure, and its concentration in blood, as well as 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 of 10 percent. Symptoms at blood levels 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. At around 3 percent COHb, a decrease in time to onset of angina in exercising individuals with ischemic heart disease, electrocardiographic changes, and neurobehavioral effects in healthy individuals have been recorded (Long & Saltzman, 1995; Burton, 1996).

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 & Saltzman, 1995). Patients are frequently unaware of exposures, and health care providers are not always aware of the symptoms of CO poisoning. 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 liquid propane (LP) gas, kerosene, oil, gasoline, coal, and wood can produce large amounts of CO when there is insufficient oxygen available for combustion. Consumer products that burn kerosene, oil, gasoline, 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. Other products, such as charcoal briquettes and pressed wood-chip logs, produce relatively smokeless fires, even at times of inefficient combustion. Victims receive no obvious sensory warning that high CO levels are present. A different 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 defective 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.

Non-fire Carbon Monoxide Poisoning Deaths

During 1996, the most recent year for which complete death certificate data are available, there were an estimated 217 non-fire CO poisoning deaths associated with the use of consumer products, excluding motor vehicles. Table 1 relates the distribution of estimated non-fire CO poisoning deaths attributed to consumer products and the various fuel types involved which was derived using methodology described in Appendix 1. Of the 217 deaths, heating systems were involved in 163 of the fatalities. In many incidents, limited information was available about the type of fuel used. The estimates presented in the table below are based on reported information about the various types of fuels. Among the specified heating system fuel types, LP gas heating was associated with 54 deaths, natural gas heating was associated with 19 deaths, and unspecified gas heating systems were associated with 22 deaths. Other heating system fuel types reported included kerosene and oil (15) and coal and wood (7). Unspecified fuel type heating systems were reported in 47 of the fatalities. These 163 deaths associated with heating systems total almost 75 percent of all consumer product-related CO poisoning deaths reported in 1996. Other consumer products reported to have been involved in CO poisoning deaths were charcoal grills (19), gas ranges and ovens (15), gas water heaters (8), and camp cooking stoves and lanterns (3). Other appliances, such as propane refrigerators and fuel-powered tools, were reportedly associated with 8 deaths. Other deaths associated with fuel-powered, “motor/engine” type appliances, such as generators, pumps, lawn mowers, and snow blowers have been reported to CPSC; however, comparable estimates of these poisoning deaths are not available. (See Appendix 2.)

Table 1
Estimated Non-Fire Carbon Monoxide Poisoning Deaths
by Type of Consumer Product Reported, 1992 - 1996

Consumer Product	Average Percent	1992	1993	1994	1995	1996
Total Deaths	100%	211	214	223	201	217
Heating Systems	74%	139	152	177	159	163
Unspecified Gas Heating	16%	24	44	59	26	22
LP Gas Heating	20%	43	27	35	51	54
Natural Gas Heating	10%	22	14	24	31	19
Coal/Wood Heating	3%	9	7	6	6	7
Kerosene/Oil Heating	4%	6	10	9	5	15
Heating Systems, Not Specified	20%	35	50	44	40	47
Charcoal Grills	10%	27	27	15	14	19
Gas Water Heaters	3%	6	11	7	5	8
Camp Stoves, Lanterns	5%	17	10	12	15	3
Gas Ranges/ Ovens	4%	13	6	9	5	15
Other Appliances	3%	9	7	3	3	8

Source: U.S. Consumer Product Safety Commission / EHHA.

CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1992 - 1996.

Note1: Detail may not add to total due to rounding.

Note 2: The p-value for the regression analysis F-test statistic was 0.975. A significant value is a value less than 0.05 for a 95% confidence test.

Additionally, Table 1 shows the estimated number of deaths for 1992 to 1996. On average, the annual number of non-fire CO poisoning deaths for this period is 213 (with a standard deviation of 8.14). The 95 percent confidence interval for the five-year average ranges from 203 to 223 deaths. A regression analysis did not show a significant increase or decrease in the estimated total number of non-fire CO poisoning deaths during this period. However, a regression analysis showed a significant decrease in the estimated CO poisoning deaths between 1980 and 1996. Appendix 3 shows the annual estimated CO poisoning deaths between 1980 and 1996. (See note in Appendix 3 for p-value.) Table 1 also shows the average percentage of deaths associated with the various reported products. On average, about 74 percent of the deaths involved heating systems and 10 percent involved charcoal grills. The remaining deaths were associated with other consumer products including gas water heaters, camp stoves and lanterns, gas ranges/ovens, and other fuel-powered tools and appliances. Each of these products was associated with 5% or less of the five-year average number of deaths.

Table 2 shows that, from 1992 to 1996, on average, children under 15 years of age accounted for about 9 percent of the deaths, and persons 65 and over accounted for about 22 percent. Deaths among the other age groups ranged between 19 and 27 percent of the total number of CO poisoning deaths. On average about 70 percent of these victims were males and 30 percent were females. Most of the deaths (75%) occurred from October through March, the primary months when heating appliances are used.

Table 2
Estimated Non-Fire Carbon Monoxide Poisoning Deaths by Age of Victim, 1992 - 1996

Age	Average Percent	1992	1993	1994	1995	1996
Total	100%	211	214	223	201	217
Under 5	4%	6	7	10	7	8
5 - 14	5%	10	12	7	15	12
15 - 24	19%	45	40	50	40	23
25 - 44	27%	56	64	55	51	66
45 - 64	23%	50	52	50	51	45
65 and over	22%	44	39	51	37	62

Source: U.S. Consumer Product Safety Commission / EHHA.

CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1992 - 1996.

Note1: Detail may not add to total due to rounding.

Table 3 shows that almost 80 percent of the fatal incidents involved only one person, but about 20 percent of the incidents involved two or more persons.

Table 3
Number of Reported Non-Fire Carbon Monoxide Poisoning Incidents, 1992 - 1996

Number of Deaths in Incident	Average Percent	1992	1993	1994	1995	1996
Total Incidents	100%	123	120	123	104	122
1	79%	90	96	102	84	93
2	17%	27	18	17	17	24
3	2%	3	6	2	1	3
4	1%	3	0	1	1	2
5 or more	0%	0	0	1	1	0

Source: U.S. Consumer Product Safety Commission / EHHA.
CPSC Death Certificate File, 1992 - 1996.

Note 1: Detail may not add to total due to rounding.

Note 2: Data in Table 3 do not add to totals presented in Table 1. Data presented in Table 3 are not estimated deaths, but instead reported deaths in the CPSC death certificate file. NCHS data do not contain enough detail to identify CO poisoning multiple-victim death incidents.

Table 4 shows that two-thirds of deaths occurred in homes, including mobile homes and garages. The remaining incidents occurred in locations such as sport or recreational areas, streets or highways, and other remote areas, where the victims were spending the night in automobiles or trucks and/or camping. In some of the “camping” incidents, the victims were burning charcoal inside automobiles and tents to keep warm. Many incidents occurred in sheds or other such outbuildings, in “make-shift” temporary shelters, in trucks with “caps”, and campers or trailers. Some of the deaths involved victims who were staying at a work site overnight, using portable gas heaters to keep warm.

Table 4
Estimated Non-Fire Carbon Monoxide Poisoning Deaths by Location of Death 1992 - 1996

Location of Death	Average Percent	1992	1993	1994	1995	1996
Total	100%	211	214	223	201	217
Home	66%	120	147	161	119	159
Camper / Tent	15%	45	11	22	40	38
Auto	6%	14	17	15	11	7
Other	6%	9	10	12	23	11
Unknown	7%	24	29	13	8	1

Source: U.S. Consumer Product Safety Commission / EHHA.

CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1992 - 1996.

Note: Detail may not add to total due to rounding.

Non-Fire Carbon Monoxide Non-Fatal Poisonings

Non-fatal poisonings from CO exposure are difficult to estimate. Many victims do not seek medical attention or, when they do seek medical attention, may be misdiagnosed, since symptoms can be similar to those associated with colds and the flu. Carbon monoxide victims entering emergency rooms typically complain of fatigue, headache, nausea, dizziness, shortness of breath, chest pain, diarrhea, and other symptoms. In the ideal cases, the physician quickly recognizes the possibility of CO poisoning and the victim's COHb is measured as soon as possible after suspected CO exposure. However, in many cases the victim is misdiagnosed and recognition of CO poisoning is delayed or does not occur.

In 1998, the latest year for which emergency room data are available, an estimated 7,700 people were treated in hospital emergency rooms for suspected non-fire CO poisoning. Table 5 shows a distribution of these incidents by the kind of product reported to be involved in the incident. In 1998, heating systems, primarily furnaces and heaters, contributed to an estimated 3,700 poisonings. The types of heating systems associated with these injuries included natural gas or LP gas heating appliances (400), kerosene or oil heating systems (100), coal or wood heating systems (400), other fuel-powered heating systems (700), and unspecified fuel-type heating systems (2,100). Other products reported as being involved in a CO poisoning incident included gas ranges and ovens (500), grills (300), portable generators and pumps, fuel-powered tools, and gas water heaters. Often, gas ranges and ovens were inappropriately used for heating purposes. The portable generators and pumps were typically used to remove floodwater from homes. Fuel-powered tools included floor waxers or buffers, power saws, welding equipment, snow blowers, lawn mowers, and lanterns. The remaining 2,500 poisonings shown in Table 5 in the "No Product Specified" category were reported as incidents involving CO alarms without mention of a fuel-burning appliance, incidents where there was no consumer product reported, and incidents where fuel storage tanks and pipes were reported as the product involved.

Table 5 also shows the estimated number of non-fatal CO poisonings for 1994 to 1998. The annual average number of non-fire CO poisonings for this period is 10,600 (with a standard deviation of 2,802). The 95 percent confidence interval for the five-year average ranges from 7,081 to 14,039 estimated injuries. Table 5 also shows the annual average percentage of injuries by type of consumer product involved in the incident. Heating systems, primarily furnaces and heaters, contributed to 61 percent of all poisonings. Where fuel type was specified, natural gas and/or LP gas heating appliances contributed to 21 percent; kerosene, oil, coal and wood heating systems contributed to 12 percent. On average, gas ranges and ovens contributed to 7 percent of the poisonings; grills contributed to 3 percent; and other products combined contributed to 10 percent. (For a more detailed breakdown of other products, see Appendix 4.) The poisoning incidents where no fuel-burning product was reported contributed to 19 percent of the average total.

A regression analysis of estimated poisonings between 1994 and 1998 showed no significant increase or decrease in the total number of non-fire, non-fatal CO poisoning injuries during this period. (See note below Table 5 for p-value.)

Table 5
Estimated Non-Fire, Non-Fatal Carbon Monoxide Poisonings by
Type of Consumer Products Reported, 1994 – 1998

Type of Product	Average Percent	1994	1995	1996	1997	1998
Total Non-Fatal Poisonings	100%	9,800	9,200	15,100	11,000	7,700
Heating Systems	61%	7,800	7,000	9,100	4,600	3,700
Natural Gas / LP Heating	21%	3,100	2,600	3,200	2,300	400*
Kerosene / Oil Heating	7%	1,400	1,200*	600*	200*	100*
Coal / Wood Heating	5%	600	800*	400*	100*	400*
Other Heating	2%	200	0	0	100*	700*
Heating Systems, Not Specified	26%	2,600	2,500	4,900	1,900	2,100
Gas Ranges / Ovens	7%	600	900	900	500	500*
Grills	3%	0	100*	600*	700	300*
Other Products	10%	1200*	500*	1700*	1300*	700*
Portable Generators and Pumps						
Fuel-Powered Tools						
Gas Water Heaters						
Gas Clothes Dryers						
No Product Specified	19%	400*	800	2,800	3,700	2,500
Sample Size		230	235	334	273	210
Coefficient of Variation		.18	.16	.18	.15	.20

Source: U.S. Consumer Product Safety Commission / EHHA.
National Electronic Injury Surveillance System, 1994 - 1998.

Note 1: Detail may not add to total due to rounding.

Note 2: Estimates noted by an asterisk are based on sample sizes less than 20 and may have large variances. A more detailed product-specific table is included in Appendix 4.

Note 3: Due to the NEISS sample change in 1997, prior year estimates have been adjusted to account for the sample change. Appendix 1 lists the adjustment factors used.

Note 4: The p-value for the estimated non-fire poisonings by year regression analysis F-test statistic was 0.828. A significant value is a value less than 0.05 for a 95% confidence test.

Table 6 shows that, from 1994 to 1998, on average children less than 5 years of age accounted for about 15 percent of the non-fatal CO poisonings and persons over 65 accounted for 5 percent. Non-fatal CO poisonings among the other age groups ranged between 13 and 31 percent of the total number of CO poisonings.

Table 6
Estimated Non-fire Carbon Monoxide Poisonings by Age of Victim, 1994 - 1998

Age	Average Percent	1994	1995	1996	1997	1998
Total	100%	9,800	9,200	15,100	11,000	7,700
Under 5	15%	1,500	1,500	2,200	1,400	1,300
5 – 14	23%	1,800	2,000	3,900	1,900	2,300
15 – 24	14%	1,400	1,400	2,000	1,600	1,000
25 – 44	31%	3,000	3,200	4,300	4,400	1,700
45 – 64	13%	1,600	800	2,000	1,500	900
65 and over	5%	700*	400*	800*	200*	500*

Source: U.S. Consumer Product Safety Commission / EHHA.
National Electronic Injury Surveillance System, 1994 - 1998.

Note 1: Detail may not add to total due to rounding.

Note 2: Estimates noted by an asterisk are based on sample sizes less than 20 and may have large variances.

Note 3: Due to the NEISS sample change in 1997, prior year estimates have been adjusted to account for the sample change. Appendix 1 lists the adjustment factors used.

Table 7 shows that, from 1994 to 1998, on average 97% of the victims of non-fatal CO poisonings were examined or treated in the hospital emergency room and then released. Three percent of the poisonings required admission for hospitalization.

Table 7
Estimated Non-Fire Carbon Monoxide Poisonings by Disposition of Victim, 1994 - 1998

Disposition	Average Percent	1994	1995	1996	1997	1998
Total	100%	9,800	9,200	15,100	11,000	7,700
Treated & Released	97%	9,400	9,000	14,800	10,700	7,400
Hospitalized	3%	500*	200*	300*	300*	400
Unknown	0%	**	**	100*	0	0

Source: U.S. Consumer Product Safety Commission / EHHA.
National Electronic Injury Surveillance System, 1994 -1998.

Note 1: Detail may not add to total due to rounding.

Note 2: The double asterisk denotes that the estimate is less than 50.

Note 3: Estimates noted by an asterisk are based on sample sizes less than 20 and may have large variances.

Note 4: Due to the NEISS sample change in 1997, prior year estimates have been adjusted to account for the sample change. Appendix 1 lists the adjustment factors used.

Table 8 shows the distribution of the number of persons injured in each CO poisoning incident. Fifty-nine percent of the incidents involved only one person, 19 percent of the incidents involved two persons, 10 percent involved three persons, 6 percent involved four persons, and the remaining 5 percent involved more than five persons.

Table 8
Number of Persons Injured Per Non-Fatal Carbon Monoxide Poisoning Incident, 1994 - 1998

Number of People in Incident	Average Percent	1994	1995	1996	1997	1998
Total Incidents	100%	119	122	168	204	126
1	58%	60	67	86	134	87
2	19%	29	21	38	37	17
3	11%	16	17	24	11	9
4	7%	7	12	9	9	9
5 or more	5%	7	5	11	13	4

Source: U.S. Consumer Product Safety Commission / EHHA.
National Electronic Injury Surveillance System, 1994 - 1998.

Discussion

About two-thirds of all consumer product-related non-fire CO poisoning deaths and injuries were associated with some type of heating system. Each of the CO poisoning hazard scenarios reflects either product malfunction resulting in high CO emissions and/or some failure to adequately remove CO from the living or recreational environment. To prevent CO poisoning incidents, consumers need to make sure their appliances are properly installed, maintained, and used. Additionally, consumers should install a CO alarm that meets requirements of the most current Underwriters Laboratories (UL) standard 2034 or the International Approval Services (IAS) 6-96 standard near all sleeping areas.

Appendix 1 - Methodology

Non-fire Carbon Monoxide Deaths

All death certificates filed in the U.S. are compiled by the National Center for Health Statistics (NCHS) into multiple cause of mortality data files. The mortality data files contain demographic and geographic information as well as the International Classification of Diseases codes for the underlying cause of death and up to 20 contributing conditions. The 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, Injuries, and Causes of Death. The International Classification of Diseases, Ninth Revision was implemented in 1979 and was in effect between 1992 and 1996, the years for which data are presented in this report.

The following methodology was used to determine non-fire CO poisoning deaths associated with the use of consumer products. The first step in the estimation process is searching the NCHS data for the following external cause of death codes (Ecodes):

- 867.0 (Accidental poisoning by gas distributed by pipeline),
- 868.0 (Accidental poisoning by liquidified petroleum distributed in mobile containers),
- 868.1 (Accidental poisoning by other and unspecified utility gas),
- 868.3 (CO from incomplete combustion of other domestic fuels).

These deaths were combined for the total known consumer product-related, non-fire CO poisoning death count (n_1), excluding motor vehicle exhaust. The deaths of unknown origin are found in the Ecodes 868.8 (CO from other sources) and 868.9 (Unspecified CO). A relative proportion (n_2) of these unknown deaths was added to the known consumer product-related death count. The proportion was based on a ratio of the known count (n_1) to the known count (n_1) plus the death count for motor vehicle exhaust (n_3). (The death count for motor vehicle exhaust is found in Ecode 868.2). The ratio was then applied to the unknown CO poisoning deaths (n_2). The adjusted total count of consumer product-related CO poisoning deaths is the sum of the total known consumer product-related CO poisoning death count plus the proportion of CO poisoning deaths of unknown origin. [$N = n_1 + ((n_1 / (n_1 + n_3)) * n_2)$]. The table below shows the allocated totals by E-code for both auto exhaust deaths and consumer product-related CO deaths for the 1992 - 1996 estimates.

Accidental Non-Fire Carbon Monoxide Poisoning Deaths by Ecode

Adjusted E code Totals	Year				
	1992	1993	1994	1995	1996
867.0	30	19	35	38	33
868.0	67	73	85	81	84
868.1	17	16	16	19	26
868.2 (Auto Exhaust)	316	335	359	333	316
868.3	98	105	87	63	74
Total Accidental CO Deaths	527	549	582	533	531
Consumer Product Total	211	214	223	201	217

Source: National Center for Health Statistics Mortality File, 1992 - 1996.

Note: Detail may not add to total due to rounding.

The next step in the process is to search CPSC's Death Certificate File for the same Ecodes as used above (867.0, 868.0, 868.1, 868.3, 868.8 and 868.9). The number of deaths retrieved from the CPSC Death Certificate File is used in combination with the estimated consumer product-related CO deaths from the NCHS mortality data to compute a weighting factor to make consumer product-specific CO death estimates. In order to project product-specific estimates of CO poisoning deaths, the weighting factor defined by the NCHS total CO Deaths (step 1) divided by the CPSC Death Certificate File count was applied to the consumer product-specific counts from the CPSC Death Certificate File. The table below shows the weighting factors used for the 1992 - 1996 estimates.

Each death certificate was reviewed and assigned a code based on the product and type of fuel involved, whenever possible. The incidents were grouped into the following fuel categories: unspecified gas, LP gas, natural gas, coal, wood, kerosene, oil, and unspecified. The heating systems category combined wall heaters and furnaces, floor furnaces, boilers, space heaters, heating stoves, and other miscellaneous heating systems.

Year	Consumer Product Total	CPSC Death Certificate Count	Weighting Factor
1992	211	165	1.28
1993	214	150	1.43
1994	223	151	1.48
1995	201	130	1.55
1996	217	158	1.37

Source: U.S. Consumer Product Safety Commission / EHHA.
National Center for Health Statistics Mortality File, CPSC Death Certificate File, 1992 - 1996.

Non-fire Carbon Monoxide Poisonings Treated in Hospital Emergency Rooms

The estimated number of CO non-fatal poisonings treated in hospital emergency rooms is based on the National Electronic Injury Surveillance System (NEISS). The NEISS is a probability sample of hospitals selected from the population of all hospitals with emergency rooms (ERs) in the U.S. and its territories. The hospitals in the sampling frame are stratified by size (number of emergency room visits) into four groups based on emergency room visits and one additional stratum of children's hospitals. Within each stratum, hospitals are sorted by a serpentine ordering of states by ZIP code. A systematic sample of hospitals is selected from each stratum. Currently 101 hospitals are included in the NEISS sample that produces national estimates (Marker, 1996). Injuries associated with consumer products and recreational activities are collected on a daily basis via a computer from each participating hospital. Because of the properties of a probability sample, the number of reported injuries is weighted to represent all similar injuries in the U.S. and its territories. In addition to this capability for making estimates for the entire population based on sample data, probability samples also permit computation of confidence intervals around the estimates. The confidence intervals are derived from the statistical variability associated with the sample or the sampling error (Kessler, 1995).

Estimates provided in a previous memorandum (Ault, 1997) have been revised to account for the NEISS sample change in 1997. The prior year adjustment factors are listed below.

1996 Adjustment Factor = 0.983236

1995 Adjustment Factor = 0.983236

1994 Adjustment Factor = 0.984912

The non-fatal, non-fire, consumer product-related CO poisonings were retrieved from the NEISS system based on the following criteria: diagnosis codes – anoxia (65) and poisonings (68) and a text string search – “carbon mono”, “CO”. After the initial selection from NEISS, the cases were reviewed by hand to exclude any miscoded cases.

Appendix 2

In the NCHS data, the Ecode 868.2 is used for reporting non-fire CO deaths associated with motor vehicle (not in transit) exhaust and CO deaths associated with the use of farm tractors, gas engines, motor pumps, and any other type of combustion engine not in watercraft. CPSC does not routinely collect death certificates for Ecode 868.2, since most motor vehicles are not within the jurisdiction of CPSC; thus appropriate weighting factors (as discussed in Appendix 1) are not available to make estimates associated with these products. Based on the methodology described in Appendix 1, the five year average proportion of actual non-fire CO poisoning deaths reported to CPSC, relative to the NCHS national count, is about 70% of all consumer product-related non-fire CO poisoning deaths (or a weighting factor of 1.42). Appendix 1 shows the CPSC Death Certificate File counts and the associated weighting factors for available years. If this factor is applied to the counts below, the five-year average estimate of non-fire CO poisoning deaths associated with generators and other motor-type products is 18. The table below shows the number of reported non-fire CO poisoning deaths associated with generators and other “motor/engine” appliances, such as pumps, lawn mowers, and snow blowers.

Reported Non-Fire CO Poisoning Deaths Associated with Generators and Other Appliances

Appliance	1992	1993	1994	1995	1996
Total	7	13	11	13	20
Generators	7	10	7	12	17
Other Products	0	3	4	1	3

Source: U.S. Consumer Product Safety Commission / EHHA.
CPSC Death Certificate File, 1992-1996.

Appendix 3

Estimated Non-Fire Carbon Monoxide Poisoning Deaths Associated with Consumer Products, 1980-1996

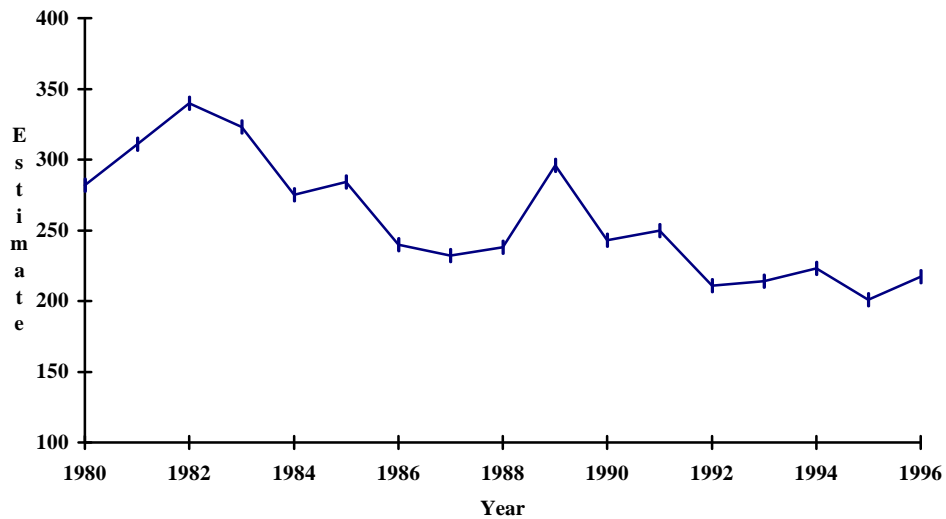
Year	Estimate
1980	282
1981	311
1982	340
1983	323
1984	275
1985	284
1986	240
1987	232
1988	238
1989	296
1990	243
1991	250
1992	211
1993	214
1994	223
1995	201
1996	217

Source: U.S. Consumer Product Safety Commission / EHHA.

CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1980 - 1996.

Note: The p-value for the regression analysis F-test statistic was less than 0.01. A significant value is a value less than 0.05 for a 95% confidence test.

Figure 1
Estimated Non-Fire CO Poisoning Deaths Associated with
Consumer Products, 1980 - 1996



Source: U.S. Consumer Product Safety Commission / EHHA.

CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1980 - 1996.

Appendix 4

The table below contains a more detailed breakdown of Table 5. The estimates denoted by an asterisk in the table are based on small samples and may have large variances. Caution must be used when citing these estimates.

Estimated Non-Fire Carbon Monoxide Poisonings by Type of Consumer Products Reported, 1994 – 1998

Type of Product	Average Percent	1994	1995	1996	1997	1998
Total Non-Fatal Poisonings	100%	9,800	9,200	15,100	11,000	7,700
Heating Systems	61%	7,800	7,000	9,100	4,600	3,700
Gas / LP Heating	21%	3,100	2,600	3,200	2,300	400*
Kerosene / Oil Heating	7%	1,400	1,200*	600*	200*	100*
Coal / Wood Heating	5%	600	800*	400*	100*	400*
Other Heating	2%	200	0	0	100*	700*
Heating Systems, Not Specified	26%	2,600	2,500	4,900	1,900	2,100
Gas Ranges / Ovens	7%	600	900	900	500	500*
Grills	3%	0	100*	600*	700	300*
Charcoal Grills	1%	0	0	300*	200	100*
Other Grills	2%	0	100*	300*	500	200*
Portable Generators and Pumps	3%	500*	100*	700*	400*	200*
Fuel-Powered Tools	3%	400*	200*	500*	400*	300*
Gas Water Heaters	3%	300*	300*	100*	400*	200*
Gas Clothes Dryers	1%	100*	0	400*	0	0
No Product Specified	19%	400*	800	2,800	3,700	2,500

Source: U.S. Consumer Product Safety Commission / EHHA.
National Electronic Injury Surveillance System, 1994 - 1998.

Note 1: Detail may not add to total due to rounding.

Note 2: Estimates noted by an asterisk are based on sample sizes less than 20 and may have large variances.

Note 3: Due to the NEISS sample change in 1997, prior year estimates have been adjusted to account for the sample change. Appendix 1 lists the adjustment factors used.

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