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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 (1995) and reported injuries (1997) 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

For more than a decade, the U.S. Consumer Product Safety Commission (CPSC) has been 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 1991 and 1995, 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 annually about 560. During this time, the annual average number of CO poisoning deaths attributed to motor vehicle exhaust was about 340 or about 60 percent of all unintentional non-fire CO poisoning deaths. The remaining 220 (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 1993 and 1997, approximately 10,700 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. The estimated poisonings treated in hospital emergency rooms have increased between 1993 and 1997. Some of the increase in reports of non-fatal CO poisonings could be attributed to increased awareness of CO poisoning by both consumers and the medical community. The presence of CO detectors in the marketplace and recent public educational efforts might have helped consumers recognize symptoms of CO poisoning and encouraged them to seek treatment at local hospitals.

Introduction

Carbon monoxide 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 with prolonged unconsciousness may not be reversible. Prompt medical attention is important to reduce the risk of permanent damage.

Any fuel-burning appliance can potentially be a source of fatal or hazardous CO levels. Fuels, such as natural and 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 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 1995, the most recent year for which complete death certificate data are available, there were an estimated 201 non-fire CO poisoning deaths associated with the use of consumer products, excluding motor vehicles. Table 1 relates the distribution of non-fire CO poisoning deaths attributed to consumer products and the various fuel types involved. Of these 201 deaths, heating systems were involved in 159 of the fatal incidents. 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 51 deaths, natural gas heating was associated with 31 deaths, and unspecified gas heating systems were associated with 26 deaths. Other heating system fuel types reported included kerosene and oil (5) and coal and wood (6). Unspecified fuel type heating systems were reported in 40 of the fatal incidents. These 159 deaths associated with heating systems total almost 80 percent of all consumer product-related CO poisoning deaths reported in 1995. Other consumer products reported to have been involved in CO poisoning deaths were charcoal grills (14), camp cooking stoves and lanterns (15), gas ranges and ovens (5), and gas water heaters (5). Other appliances, such as propane refrigerators and fuel-powered tools, were reportedly associated with 3 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 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, 1991 - 1995

Consumer Product	Average Percent	1991	1992	1993	1994	1995
Total Deaths	**100%**	**250**	**211**	**214**	**223**	**201**
Heating Systems	**74%**	**186**	**139**	**152**	**177**	**159**
Unspecified Gas Heating	19%	53	24	44	59	26
LP Gas Heating	17%	35	43	27	35	51
Natural Gas Heating	11%	34	22	14	24	31
Coal/Wood Heating	3%	8	9	7	6	6
Kerosene/Oil Heating	4%	17	6	10	9	5
Heating Systems, Not Specified	19%	39	35	50	44	40
Charcoal Grills	**10%**	**25**	**27**	**27**	**15**	**14**
Gas Water Heaters	**4%**	**13**	**6**	**11**	**7**	**5**
Camp Stoves, Lanterns	**6%**	**10**	**17**	**10**	**12**	**15**
Gas Ranges/ Ovens	**4%**	**14**	**13**	**6**	**9**	**5**
Other Appliances	**2%**	**3**	**9**	**7**	**3**	**3**

Source: U.S. Consumer Product Safety Commission / EHHA.
CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1991 - 1995.
Note1: Detail may not add to total due to rounding.
Note 2: The p-value for the regression analysis F-test statistic was 0.161. 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 1991 to 1995. On average, the annual number of non-fire CO poisoning deaths for this period is approximately 220 (with a standard deviation of 18.6). The 95 percent confidence interval for the five-year average ranges from 197 to 243 deaths. The average annual estimated deaths have decreased by 20 percent from 1991 to 1995. A regression analysis did not show a significant 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 1995. Appendix 3 shows the annual estimated CO poisoning deaths between 1980 and 1995. (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 6% or less of the five-year average number of deaths.

Table 2 shows that, from 1991 to 1995, on average, children under 15 years of age accounted for about 9 percent of the deaths, and persons 65 and over accounted for about 20 percent. Deaths among the other age groups ranged between 20 and 30 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, 1991 - 1995

Age	Average Percent	1991	1992	1993	1994	1995
Total	**100%**	**250**	**211**	**214**	**223**	**201**
Under 5	4%	9	6	7	10	7
5 - 14	5%	15	10	12	7	15
15 - 24	20%	50	45	40	50	40
25 - 44	27%	72	56	64	55	51
45 - 64	23%	52	50	52	50	51
65 and over	20%	52	44	39	51	37

Source: U.S. Consumer Product Safety Commission / EHHA.
CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1991 - 1995.

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 Deaths per Non-Fire Carbon Monoxide Poisoning Incident, 1991 - 1995

Number of People in Incident	Average Percent	1991	1992	1993	1994	1995
Total Incidents	**100%**	**128**	**123**	**120**	**123**	**104**
1	78%	95	90	96	102	84
2	18%	26	27	18	17	17
3	3%	4	3	6	2	1
4	1%	1	3	0	1	1
5 or more	1%	2	0	0	1	1

Source: U.S. Consumer Product Safety Commission / EHHA.
CPSC Death Certificate File, 1991 - 1995.
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 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 1991 - 1995

Location of Death	Average Percent	1991	1992	1993	1994	1995
Total	**100%**	**250**	**211**	**214**	**223**	**201**
Home	66%	175	120	147	161	119
Camper / Tent	14%	36	45	11	22	40
Auto	7%	15	14	17	15	11
Other	6%	13	9	10	12	23
Unknown	8%	11	24	29	13	8

Source: U.S. Consumer Product Safety Commission / EHHA.
CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1991 - 1995.
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 1997, the latest year for which emergency room data are available, an estimated 11,000 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 1997, heating systems, primarily furnaces and heaters, contributed to an estimated 4,600 poisonings. Gas or LP gas heating appliances (2,300) and unspecified fuel-type heating systems (1,900) were the two types of heating systems that contributed to most of the product-specific poisonings. Other types of heating systems, including kerosene or oil heating systems and coal or wood heating systems contributed to the remaining heating system-related poisonings. Other products reported as being involved in a CO poisoning incident included gas ranges and ovens (500), grills (700), 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 3,700 poisonings shown in Table 5 in the "No Product Specified" category were reported as incidents involving CO detectors 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. Of these poisonings, 800 were reported as involving CO detectors without any source of CO mentioned. In about half of these CO detector incidents, the victims reported CO poisoning symptoms and the remaining half did not report any symptoms. In the incidents where no symptoms were reported, victims were often referred to the emergency room by the fire department or visited the hospital after repeated alarms from their CO detector. A CO detector is required to sound before any noticeable symptoms occur in healthy individuals. Therefore, some of the incidents can be attributed to asymptomatic people visiting the hospital emergency room after their CO detector sounded. Additionally, false positive or nuisance alarms triggered by low level CO exposures might have contributed to these incidents.

Table 5 also shows the estimated number of non-fatal CO poisonings for 1993 to 1997. The annual average number of non-fire CO poisonings for this period is 10,700 (with a standard deviation of 2,658). The 95 percent confidence interval for the five-year average ranges from 7,375 to 13,985 estimated injuries. Table 5 also shows the average percentage of injuries by type of consumer product involved in the incident. Heating systems, primarily furnaces and heaters, contributed to 64 percent of all poisonings. Where fuel type was specified, gas and/or LP gas heating appliances contributed to 24 percent; kerosene, oil, coal and wood heating systems contributed to 12 percent. On average, gas ranges and ovens contributed to 6 percent of the poisonings; grills contributed to 4 percent; and other products combined contributed to 11 percent. The poisoning incidents where no fuel-burning product was reported contributed to 16 percent of the average total.

Table 5
Estimated Non-Fire, Non-Fatal Carbon Monoxide Poisonings by Type of Consumer Products Reported, 1993 – 1997

Type of Product	Average Percent	1993	1994	1995	1996	1997
Total Non-Fatal Poisonings	**100%**	**8,300**	**9,800**	**9,200**	**15,100**	**11,000**
Heating Systems	**64%**	**5,700**	**7,800**	**7,000**	**9,100**	**4,600**
Gas / LP Heating	24%	1,900	3,100	2,600	3,200	2,300
Kerosene / Oil Heating	12%	900*	2,100	1,900	1,000*	500*
Coal / Wood Heating						
Other Heating						
Heating Systems, Not Specified	28%	3,000	2,600	2,500	4,900	1,900
Gas Ranges / Ovens	**6%**	**500**	**600**	**900**	**900**	**500**
Grills	**4%**	**700***	**0**	**100***	**600***	**700**
Other Products:	**11%**	**900**	**1,200**	**500**	**1,700**	**1,300**
Portable Generators and Pumps						
Fuel-Powered Tools						
Gas Water Heaters						
Gas Clothes Dryers						
No Product Specified	**16%**	**600***	**400***	**800**	**2,800**	**3,700**
Sample Size		**192**	**230**	**235**	**334**	**273**
Coefficient of Variation		**0.17**	**0.18**	**0.16**	**0.18**	**0.15**

Source: U.S. Consumer Product Safety Commission / EHHA.
National Electronic Injury Surveillance System, 1993 - 1997.

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 regression analysis F-test statistic was 0.268. A significant value is a value less than 0.05 for a 95% confidence test.

Although estimates of poisonings have increased from 8,300 in 1993 to 11,000 in 1997, a regression analysis shows no significant increase in the total number of non-fire, non-fatal CO poisoning injuries during this period. (See note below Table 5 for p-value.) Some of the increase in the non-fatal CO poisonings could be attributed to increased awareness of CO poisoning by both consumers and the medical community. The presence of a CO detector in the marketplace and recent public information efforts by CPSC and other organizations may have helped consumers recognize symptoms of CO poisoning leading them to seek treatment at local hospitals. CO detectors may have contributed to the increased injury estimates due to false positive alarms resulting from oversensitive CO detectors.

Table 6 shows that, from 1993 to 1997, 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 6 percent. Non-fatal CO poisonings among the other age groups ranged between 10 and 30 percent of the total number of CO poisonings.

Table 6
Estimated Non-fire Carbon Monoxide Poisonings by Age of Victim, 1993 - 1997

Age	Average Percent	1993	1994	1995	1996	1997
Total	**100%**	**8,300**	**9,800**	**9,200**	**15,100**	**11,000**
Under 5	15%	1,400	1,500	1,500	2,200	1,400
5 – 14	21%	1,500	1,800	2,000	3,900	1,900
15 – 24	13%	900	1,400	1,400	2,000	1,600
25 – 44	32%	2,200	3,000	3,200	4,300	4,400
45 – 64	14%	1,500	1,600	800	2,000	1,500
65 and over	6%	900*	700*	400*	800*	200*

Source: U.S. Consumer Product Safety Commission / EHHA.
National Electronic Injury Surveillance System, 1993 - 1997.
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 most victims of non-fatal CO poisonings were examined or treated in the hospital emergency room and then released. Less than 10 percent of the poisonings required admission for hospitalization.

Table 7
Estimated Non-Fire Carbon Monoxide Poisonings by Disposition of Victim, 1993 - 1997

Disposition	Average Percent	1993	1994	1995	1996	1997
Total	**100%**	**8,300**	**9,800**	**9,200**	**15,100**	**11,000**
Treated & Released	95%	7,100	9,400	9,000	14,800	10,700
Hospitalized	5%	1,200*	500*	200*	300*	300*
Unknown	0%	0	**	**	100*	0

Source: U.S. Consumer Product Safety Commission / EHHA. National Electronic Injury Surveillance System, 1993 -1997.
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. Over fifty percent of the incidents involved only one person, 21 percent of the incidents involved two persons, 11 percent involved three persons, 6 percent involved four persons, and the remaining 6 percent involved more than five persons.

Table 8
Number of Persons Injured Per Non-Fatal Carbon Monoxide Poisoning Incident, 1993 - 1997

Number of People in Incident	Average Percent	1993	1994	1995	1996	1997
Total Incidents	**100%**	**108**	**119**	**122**	**168**	**204**
1	57%	64	60	67	86	134
2	21%	25	29	21	38	37
3	11%	9	16	17	24	11
4	6%	6	7	12	9	9
5 or more	6%	4	7	5	11	13

Source: U.S. Consumer Product Safety Commission / EHHA.
National Electronic Injury Surveillance System, 1993 - 1997.

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 detector that meets requirements of the most current Underwriters Laboratories (UL) standard 2034 or the International Approval Services (IAS) 6-96 standard.

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 1991 and 1995, 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 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 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 CO poisoning deaths is the sum of the total known CO poisoning deaths count plus the proportion of CO poisoning deaths of unknown origin. $[N = n_1 + ((n_1 / (n_1 + n_3)) * n_2)]$ This total is used to weight the death counts from the CPSC Death Certificate File. The table below shows the above computations for the 1991 - 1995 estimates.

Accidental Non-Fire Carbon Monoxide Poisoning Deaths by Ecode

Adjusted E code Totals	Year				
	1991	**1992**	**1993**	**1994**	**1995**
867.0	26	30	19	35	38
868.0	63	67	73	85	81
868.1	24	17	16	16	19
868.2	369	316	335	359	333
868.3	138	98	105	87	63
Total Accidental CO Deaths	619	527	549	582	533
Consumer Product Total	**250**	**211**	**214**	**223**	**201**

Source: National Center for Health Statistics Mortality File, 1991 - 1995.
Note: Detail may not add to total due to rounding.

The next step in the process is to search the 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). 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. In order to project a national estimate of CO poisoning deaths from the CPSC death certificate file, product-specific percentages were applied to the NCHS estimate previously derived in step one. The result is an estimate of non-fire CO poisoning deaths associated with the use of consumer products. The table below shows the weighting factors used for the 1991 - 1995 estimates.

Year	Consumer Product Total	CPSC Death Certificate Count	Weighting Factor
1995	201	130	1.55
1994	223	151	1.48
1993	214	150	1.43
1992	211	165	1.28
1991	250	179	1.40

Source: U.S. Consumer Product Safety Commission / EHHA.
National Center for Health Statistics Mortality File, CPSC Death Certificate File, 1991 - 1995.

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 five groups based on the number of emergency room visits. (Marker, 1996) The hospitals are organized geographically within strata; substrata of equal number of hospitals are then formed, and a simple random sample of primary and alternate hospitals is selected from each stratum. Injuries associated with consumer products and recreational activities are collected on a daily basis via a computer from each participating hospital. Data in this report were based on a sample of 101 hospitals that provides approximately 300,000 product-related injury reports each year. 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
1993 Adjustment Factor = 0.986589

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 1.43). 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 15. 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.

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

Appliance	1991	1992	1993	1994	1995
Total	**8**	**7**	**13**	**11**	**13**
Generators	7	7	10	7	12
Other Products	1	0	3	4	1

Source: U.S. Consumer Product Safety Commission / EHHA.
CPSC Death Certificate File, 1991-1995.

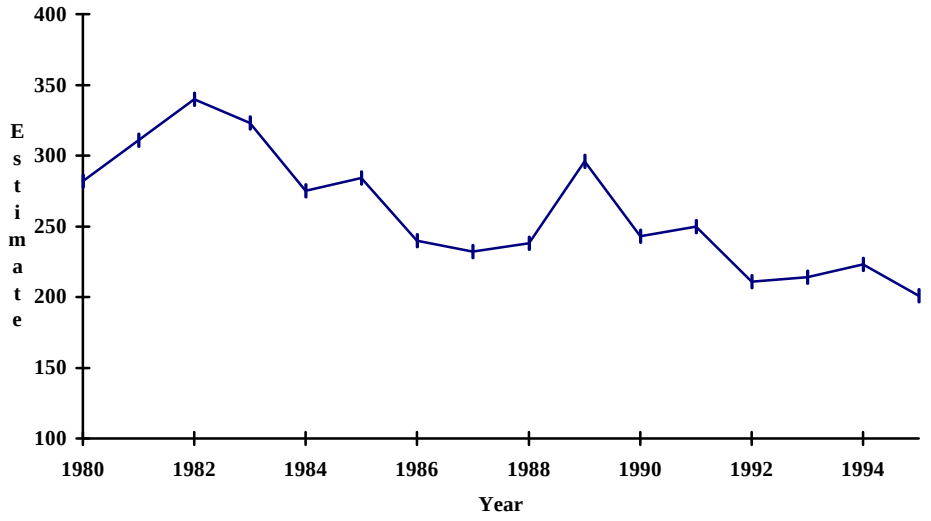
Appendix 3

Estimated Non-Fire Carbon Monoxide Poisoning Deaths Associated with Consumer Products, 1980-1995

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

Source: U.S. Consumer Product Safety Commission / EHHA.
CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1980 - 1995.
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
Non-Fire CO Poisoning Deaths Associated with Consumer Products, 1980 - 1995



Source: U.S. Consumer Product Safety Commission / EHHA.
CPSC Death Certificate File, National Center for Health Statistics Mortality File, 1980 - 1995.

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, 1993 – 1997

Type of Product	Average Percent	1993	1994	1995	1996	1997
Total Non-Fatal Poisonings	**100%**	**8,300**	**9,800**	**9,200**	**15,100**	**11,000**
Heating Systems	**64%**	**5,800**	**7,800**	**7,000**	**9,100**	**4,600**
Gas / LP Heating	24%	1,900	3,100	2,600	3,200	2,300
Kerosene / Oil Heating	7%	600*	1,400	1,200*	600*	200*
Coal / Wood Heating	4%	0	600	800*	400*	100*
Other Heating	1%	300*	200	0	0	100*
Heating Systems, Not Specified	28%	3,000	2,600	2,500	4,900	1,900
Gas Ranges / Ovens	**6%**	**500**	**600**	**900**	**900**	**500**
Grills	**4%**	**700***	**0**	**100***	**600***	**700**
Charcoal Grills	2%	700*	0	0	300*	200
Other Grills	2%	0	0	100*	300*	500
Portable Generators and Pumps	**4%**	**400***	**500***	**100***	**700***	**400***
Fuel-Powered Tools	**3%**	**100***	**400***	**200***	**500***	**400***
Gas Water Heaters	**3%**	**400***	**300***	**300***	**100***	**400***
Gas Clothes Dryers	**1%**	**0**	**100***	**0**	**400***	**0**
No Product Specified	**16%**	**600***	**400***	**800**	**2,800**	**3,700**

Source: U.S. Consumer Product Safety Commission / EHHA.
National Electronic Injury Surveillance System, 1993 - 1997.

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 list the adjustment factors used.

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