

The Burden of Unintentional Carbon Monoxide Poisoning in New Mexico

Carbon monoxide (CO) is a poisonous, colorless, non-irritating gas that you cannot see, smell, or taste¹. CO is generated from the combustion of carbon-based fuels, such as gasoline, kerosene, oil, propane, coal, or wood. CO exposure can poison people and animals leading to sudden death or illness when it is built up into high concentrations in enclosed or semi-enclosed spaces. CO poisoning is responsible for approximately 15,000 emergency department visits, and 500 deaths per year nationwide². Residential locations are the most common places for CO poisoning. These poisonings are more common in the winter months and almost half of the victims are sleeping when they are poisoned³.

Although there is no unique list of signs and symptoms of CO poisoning, the most common or typical signs and symptoms of poisoning include headache, dilation of skin blood vessels, weakness/fatigue, dizziness, nausea/vomiting, confusion, shortness of breath, chest pain, and loss of consciousness. The brain and heart are the most sensitive organs to hypoxia and account for most of the health effects resulting from CO exposure. CO produces toxicity by binding tightly to blood hemoglobin to form carboxyhemoglobin and therefore, preventing oxygen transport to tissues throughout the body⁴. It also binds to myoglobin in muscles, which results in exercise intolerance, and this is a common early symptom of CO toxicity. The health effects or signs and symptoms of CO toxicity are characteristic of hypoxia and may vary depending on the magnitude and duration of exposure as well as individual vulnerabilities⁵.

While ambient air may contain high levels of CO especially in close proximity to heavy vehicular traffic, the most hazardous levels of CO may be present in common indoor air sources of exposure such as fuel burning appliances including heaters, stoves, clothes dryers, and water heaters. Other sources include fireplaces,

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wood or charcoal burning stoves and barbecue grills, motor vehicles, lawn mowers, recreational water crafts and boats, propane natural gas burning stoves, kerosene space heaters, generators, power tools with internal combustion engines, and breathing in cigarette smoke either by smoking or via second hand smoke.

The burden of unintentional CO poisoning can be defined by morbidity and mortality. New Mexico Environmental Public Health Tracking (NMEPHT) calculates and presents morbidity and mortality rates for CO poisoning (see https://nmtracking.org/en/data_query/). Morbidity is described by CO poisoning emergency department (ED) visit rates and CO poisoning hospitalization rates. Mortality is provided by CO poisoning death rates.

This report analyzes NMEPHT Network data (2008-2013) on preventable morbidity and mortality due to unintentional CO poisoning in order to: 1) summarize the burden of unintentional CO poisoning in New Mexico, 2) examine trends by New Mexico health regions and counties, and 3) focus public health interventions to prevent potential exposure to CO and reduce the burden of CO poisoning. The parts of the state with the greatest burden of unintentional CO poisoning are identified and prioritized for future public health interventions.

Methods

NMEPHT defines unintentional CO poisoning as unintentional fire-related CO poisoning, unintentional non-fire related CO poisoning, and unintentional unknown

cause of CO poisoning. NMEPHT describes CO poisoning morbidity and mortality by ED visit rates, hospitalization rates, and mortality rates. CO poisonings due to suicide or assault are not included. Age-adjusted rates per 100,000 population from NMEPHT (https://nmtracking.org/en/data_query/) were analyzed by county and health region (Northwest, Northeast, Metro, Southwest and Southeast, <https://ibis.health.state.nm.us/docs/HealthRegions2012.pdf>). Age-adjusted rates were calculated using the direct method for age-adjustment to the U.S. 2000 standard population. The confidence intervals (CI) provide an upper limit (CI UL) and a lower limit (CI LL) on values between which 95% of statistical estimates of rates occur. Population estimates were provided by the Bureau of Business and Economic Research at the University of New Mexico. Counties were ranked from the highest to the lowest rate of CO poisoning for ED visit, hospitalization, and mortality rates.

The ED visit dataset contains counts of unintentional CO poisoning among New Mexicans, using a combination of ICD-9-CM and E-codes: ICD-9-CM 986, E868.2, E868.3, E868.8, E868.9, E982.0, or E982.1. ED visit data were provided by individual non-federal licensed facilities in New Mexico. The ED visit data were reported to the New Mexico Department of Health, Epidemiology and Response Division by 36 of New Mexico's acute care, non-federal hospital facilities. The hospitalization dataset contains counts of unintentional CO poisoning among New Mexicans, using the same combination of ICD-9-CM and E-codes. Admission date was derived from summaries provided by the all non-federal New Mexico hospital inpatient discharge database (HIDD). The hospitalization data were derived from discharge summaries provided by all New Mexico non-federal general and specialty hospitals in participation with the New Mexico Hospital Association. These data are maintained by the New Mexico Department of Health, Epidemiology and Response Division. The mortality dataset contains county-level records for deaths of New Mexico residents due to unintentional CO poisoning, using ICD-10 codes: T58, X00-X09, V01-W99, X10-X59, Y85-Y86, and Y10-Y34. Mortality data were derived from the Multiple Cause of Death file provided by the New Mexico Bureau of Vital Records and Health Statistics (NM-VRHS).

Results

During 2008-2013, there were 1,163 ED visits, 151 hospital admissions, and 55 deaths among New Mexico residents due to unintentional CO poisoning. The Northwest region had the highest rates for ED visits, hospitalization, and CO poisoning deaths for 2008-2013 (Table 1).

San Juan County was consistently represented with high rates for ED visits, hospitalizations, and mortality among all New Mexico counties (Table 2). San Juan County ranked highest in rates of ED visits (26.2 per 100,000 population), ranked fourth in hospitalization rates (3.1 per 100,000 population), and ranked third in mortality (1.3 per 100,000 population).

Other counties that had a high ranking in rates of ED visits were Taos (17.7 per 100,000 population) and Grant (15.0 per 100,000 population). Hospitalization rates were highest in Eddy (4.4 per 100,000 population) and McKinley (3.3 per 100,000 population) counties. Mortality rates were highest in Sierra (3.3 per 100,000 population) and San Miguel (1.8 per 100,000 population) counties.

Conclusions and Recommendations

Almost every case of unintentional CO poisoning is preventable. Steps for prevention include: 1) have a specialist check and maintain furnaces in the home each season, 2) never run vehicles in a garage, 3) inspect chimneys periodically for lodged debris before burning a fire, 4) if using a generator, never run it inside an enclosed space, or near an open window, and 5) do not use appliances such as a propane or natural gas stove to heat a home or enclosed space.

A back up for protection from CO poisoning is to install a CO detector in the home, at work, school, or any other indoor living spaces to include group homes, or daycare centers. Detectors can be a good line of defense in some circumstances of CO exposure. There are many different CO alarms that are available for consumers to choose from. Some detect a broader range of CO in the air than others. There are some that are made with a battery back-up system where others are not. Some double as a smoke alarm. It is recommended to replace the alarm every 5 years.

Improving knowledge and awareness of the dangerous gas sources and exposure prevention measures in com-

munities are strategies to decrease CO morbidity and mortality rates. Knowing geographical locations with the highest CO poisoning morbidity and mortality in the state can help focus prevention efforts to control exposure to CO in indoor/enclosed environments. When conducted fully, analysis of CO poisoning seasonality could provide a clue about potential CO exposure sources. Finally, knowledge of the sources of CO poisoning can help focus and tailor public health interventions to specific needs of a particular community. A properly installed, functioning, and maintained CO detector is key for the prevention of excessive exposure. Future prevention efforts should focus on increasing New Mexico communities' awareness of this hazardous gas and exposure prevention methods.

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Age-adjusted Rates of Unintentional CO Poisoning per 100,000 Population, by County 2008-2013 (Rank Order Included)						
County	Emergency Department Visits		Hospitalizations		Poisoning Deaths	
	Number	Age-adjusted rate per 100,000 population	Number	Age-adjusted rate per 100,000 population	Number	Age-adjusted rate per 100,000 population
State Wide	1163	9.7	151	1.2	55	0.4
Bernalillo	295	7.6	42	1.2	11	0.3
Catron	0	0.0	0	0.0	0	0.0
Chaves	43	11.0	5	1.1	5	1.2 (4)
Cibola	13	8.9	1	0.6	0	0.0
Colfax	8	10.9	0	0.0	0	0.0
Curry	31	10.4	4	1.5	0	0.0
De Baca	1	5.0	0	0.0	0	0.0
Dona Ana	88	6.9	1	0.1	4	0.3
Eddy	27	8.3	14	4.4 (1)	2	0.6
Grant	24	15.0 (3)	2	0.6	0	0.0
Guadalupe	0	0.0	0	0.0	0	0.0
Harding	0	0.0	0	0.0	0	0.0
Hidalgo	0	0.0	1	3.2 (3)	0	0.0
Lea	40	10.0	6	1.4	1	0.3
Lincoln	6	6.4	2	1.7	0	0.0
Los Alamos	4	4.0	2	2.0	1	0.6
Luna	17	12.2 (5)	3	2.0	0	0.0
McKinley	43	10.0	13	3.3 (2)	1	0.2
Mora	0	0.0	0	0.0	0	0.0
Otero	18	4.9	0	0.0	1	0.4
Quay	4	10.3	1	1.7	0	0.0
Rio Arriba	15	6.6	4	1.6	3	1.1 (5)
Roosevelt	4	4.2	0	0.0	0	0.0
San Juan	206	26.2 (1)	24	3.1 (4)	11	1.3 (3)
San Miguel	17	10.2	1	0.4	5	1.8 (2)
Sandoval	64	8.3	7	0.9	1	0.1
Santa Fe	80	10.1	6	0.6	2	0.2
Sierra	4	8.1	1	2.8	2	3.3 (1)
Socorro	3	2.6	0	0.0	0	0.0
Taos	32	17.7 (2)	7	2.9 (5)	0	0.0
Torrance	2	2.0	0	0.0	0	0.0
Union	3	14.3 (4)	1	2.8	0	0.0
Valencia	31	6.7	3	0.8	5	1.0

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Table 1. Unintentional CO Poisoning Rates by New Mexico Health Regions, 2008-2013

Emergency Department (ED) Visits				Hospitalizations				Poisoning Deaths			
Number	Age-adjusted rate per 100,000 population	95% CI LL	95% CI UL	Number	Age-adjusted rate per 100,000 population	95% CI LL	95% CI UL	Number	Age-adjusted rate per 100,000 population	95% CI LL	95% CI UL
262	18.9	16.6	21.3	38	2.8	2.0	3.7	12	0.8	0.4	1.3
159	9.9	8.3	11.5	21	1.1	0.6	1.5	11	0.4	0.2	0.7
392	7.5	6.8	8.3	52	1.0	0.7	1.3	17	0.3	0.2	0.5
108	6.0	4.8	7.1	8	0.3	0.1	0.6	7	0.3	0.1	0.6
154	7.2	6.0	8.3	32	1.8	1.2	2.3	8	0.5	0.1	0.8
1163	9.7	9.1	10.2	151	1.2	1.0	1.4	55	0.4	0.3	0.5