

CARBON MONOXIDE ALARMS

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Testimony of:

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Carbon monoxide (CO) is a colorless, invisible, odorless, tasteless, non-irritating and poisonous gas that is produced whenever carbon-based fuels (e.g., natural gas, propane, gasoline, fuel oil, kerosene, wood, charcoal) undergo combustion. Due to its physical properties, CO is often referred to as the 'silent killer' since its victims are unaware of its presence. Consequently, tragic headlines in the media ('Family of 6 Perish from Carbon Monoxide Poisoning') are a sober reminder of what a sinister and indiscriminate poison CO can be.

CO poisoning is one of the leading causes of accidental death in the United States and Pennsylvania is not immune from the wrath of CO. Data from the National Center for Health Statistics report that approximately 5,600 CO-related fatalities annually in the U.S. and the Centers for Disease Control statistics reveal that nearly 450 individuals perish each year from unintentional, non-fire related CO poisoning. Alarmingly, Pennsylvania leads the country in the number of preventable CO poisoning fatalities. Additional data from the American Association of Poison Control Centers tell us that CO exposures rank among the most common calls to U.S. poison centers, that 87% of the exposures occur in the home, that 36% of people require hospitalization, and that it is one of the leading causes of accidental death in the pediatric population. The Pittsburgh Poison Center provides 24/7/365 emergency poison information services to the residents of 44 PA counties and in 2010 managed nearly 400 calls involving CO exposures. The statistical portrayal of CO poisoning is impressive, but for a number of reasons these data represent the proverbial 'tip of the iceberg'.

Called the 'great imitator', CO poisoning often goes unrecognized by its victims and even by health care professionals. Frequent symptoms associated with CO poisoning include headache, nausea, vomiting, drowsiness, and weakness; therefore, CO poisoning mimics common maladies such as influenza and food poisoning which may be dismissed by the both the victims and their caregivers. If the symptoms are not recognized, the poisoning may progress to cardiac problems, delayed emergence of problems in the nervous system, coma and death.

When inhaled, CO is absorbed rapidly from the lungs into the bloodstream and distributed throughout the body. It produces toxicity through three mechanisms. First, when oxygen is replaced by CO, our body's cells suffocate due to the lack of oxygen. Secondly, CO binds to the hemoglobin molecule in our red blood cells and prevents hemoglobin from releasing oxygen to our tissues (e.g., nervous system and heart). Lastly, CO is a cellular poison and interferes with the basic functioning of nearly every cell in the body. These mechanisms make everyone, including the healthiest among us and the most vulnerable (children and the elderly), susceptible to the ravages of this devastating poison. For example, an elderly individual with pre-existing heart disease is reliant upon the limited supply of blood to deliver oxygen to their fragile hearts. When CO enters the body, it deprives the heart muscle of oxygen by preventing oxygen

release from hemoglobin, often resulting in a debilitating or fatal heart attack. The unborn and children are particularly vulnerable since they have maturing brains that require oxygen and properly functioning cells within their nervous system to allow growth and normal development. CO poisoning in children can produce lifelong debilitation or the inability to allow them to reach their full potential as adults. Even previously healthy adult survivors of CO poisoning may have apparent recovery and then suffer an unpredictable and prolonged or lifelong affliction called delayed neuropsychiatric sequelae. The symptom onset may be delayed for days to weeks and begin as subtle changes in behavior, mental deterioration, persistent headaches, personality changes, confusion, memory loss, irritability and even incontinence of urine and feces. The majority of these individuals recover within one to two years, but some take longer or never recover entirely.

Unintentional CO poisoning is a preventable disease. CO exposure often occurs because fuel-burning heating systems are not maintained properly. For example, a chimney flue may become blocked due the presence of a bird nest, allowing CO to accumulate; a cracked heat exchanger in a furnace goes unrepaired and CO seeps into the house; the hot water heater flue may become corroded and leak CO; the gas clothes dryer flue may become blocked by excessive lint or the presence of a bees nest. These problems may develop slowly and the insidious gas makes a presence in the home causing minor symptoms that disappear when the residents leave the home, yet to redevelop intermittently as the appliances are used. Proper maintenance and annual service checks will usually identify these issues and prevent a slowly emerging problem from becoming a tragedy. Lack of awareness of the dangers and sources of CO is common. During power outages, people may use gasoline powered generators to restore electrical power, while operating them in the garage or near the home and allowing CO to gain entry into the home. Using a charcoal grill in the garage, even with the garage door open, to avoid a rain downpour may result in severe CO poisoning. Improperly vented or malfunctioning space heaters or fireplaces may also cause CO poisoning. Using a gas-fired kitchen oven to heat the home may result in CO poisoning. CO is a ubiquitous gas and if all other measures fail to prevent the proper ventilation of CO from a residence, then individuals need to be warned of its presence before adverse health effects develop or a tragedy occurs.

Since CO is invisible and odorless, the only way to identify the presence of CO in a residence is if it is equipped with a UL approved CO alarm. In the presence of CO, an 85 decibel alarm will sound and alert the residents to the presence of highly poisonous CO. This will provide the residents with a warning signal and indicate the importance of vacating the residence immediately. In 1996 we published the first paper that demonstrated the value of CO alarms (Krenzelok EP, Roth R, Full R. Carbon monoxide...The silent killer with an audible solution. *Am J Emerg Med*, 1996;14:484-86)

through an analysis of all calls regarding a CO exposure or CO alarm activation received by the City of Pittsburgh 911 Emergency Response Center over a three month period in 1995. An advanced life support paramedic unit was dispatched to investigate each episode. In the CO alarm group (n = 60) only 11.7% of the residents were symptomatic and only two (2) required hospitalization, compared to the no CO alarm group (n = 41), where 63.4% were symptomatic and 24 required hospitalization. While this was a small study, the results support the value of CO alarms in every residence. Optimally, every home should have multiple CO alarms, but if it is possible to have only one CO alarm, it should be installed outside of the sleeping area so that the residents can be awakened should CO intrude while the residents are sleeping. It is clear that CO alarms save lives, but they also save money.

The staggering costs associated with contemporary health care are well known to all. The treatment of CO poisoning is through the administration of oxygen to provide it to oxygen deprived cells and to help the body rid itself of CO. In cases of significant poisoning, oxygen alone may be insufficient and hyperbaric oxygen (HBO) therapy may be necessary since it saturates the blood with oxygen which is administered at up to three atmospheres of pressure in a special chamber. In either case, the administration of oxygen will generally occur in an ambulance enroute to a hospital or in a hospital. The costs associated with an emergency medical services response and a brief emergency department visit are substantial. If HBO therapy is necessary (and this may necessitate further costly transfer to one of a limited number of health care facilities with HBO treatment capability), the costs can escalate to several thousand or tens of thousands of dollars. Victims who are debilitated by the delayed neurological effects of CO, may require weeks to years of post-exposure therapy. Including the lost work time and productivity associated with undiagnosed CO poisoning mimicking as the flu or food poisoning, the financial toll associated with CO poisoning is astronomical. All of the human and financial costs of CO poisoning can be prevented with a small investment by purchasing a UL approved CO alarm.

I urge you to pass Senate Bill 920. This legislation will save the lives of Pennsylvanians and save money, but most importantly, it will prevent the human devastation that occurs with CO poisoning.

Thank you for the opportunity to share my experience and perspective on CO poisoning and the benefits of CO alarms.

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Biographical Sketch

Dr. Krenzelok is the Director of the Pittsburgh Poison Center and the Drug Information Center at the University of Pittsburgh Medical Center, a Professor of Pharmacy and Pediatrics at the University of Pittsburgh and the Dr. Gordon J Vanscoy Endowed Chair in Pharmacy. He received his Bachelor of Science degree in Pharmacy from the University of Wisconsin in 1971 and his Doctor of Pharmacy degree from the University of Minnesota in 1974. Dr. Krenzelok is active in numerous professional toxicology and medically related societies and associations and is a Past-President of the American Academy of Clinical Toxicology. He is board-certified in clinical toxicology by the American Board of Applied Toxicology and has been awarded the distinction of being a Fellow in the American Academy of Clinical Toxicology. In 2009 Dr. Krenzelok received the American Academy of Clinical Toxicology Career Achievement Award. Dr. Krenzelok is former member of the Board of Directors of the American Association of Poison Control Centers. He is a former Chair of the United States Pharmacopeia Clinical Toxicology and Substance Abuse Committee, a former member of the Food and Drug Administration Nonprescription Drug Advisory Committee, a consultant to the FDA Drug Safety and Risk Management Advisory Committee, on the editorial boards and review panels of numerous medical and toxicology journals and is the author of several hundred scientific publications and book chapters and the editor of three books.