



Carbon Monoxide Turns Camping Event Deadly

This case study summarizes a matter in which a group of campers were overcome by carbon monoxide poisoning. It illustrates the importance of taking the initiative to acquire necessary objective evidence to refute presumptions through a scientifically credible toxicological assessment.

A group of campers attending an event at the height of summer stayed in a rented trailer in an open field adjacent to other campers. A rented portable generator provided AC power. Initially set a reasonable distance away from the trailer, the generator was moved directly next to the trailer sometime during the early morning hours. Later that morning, all inside were found dead.



A group of campers were overcome by carbon monoxide.^[a]

Families of the victims filed a high-dollar lawsuit naming multiple defendants. Specifically, the plaintiffs' alleged that the generator rental company failed to provide training and documentation regarding use of the generator. They further alleged that the generator itself was defective and caused or contributed to the fatalities. Finally, they contended that the failure of the trailer rental organization to provide a working carbon monoxide detector constituted fault in the matter. Defendants argued that the rental agreement precluded claims for liability and that they were not accountable for the generator warning labels.

Confronted with emotionally-charged litigation and minimal unbiased evidence, defendants retained Dr. Sawyer to conduct an independent investigation and produce an objective toxicological assessment.

Toxicological Investigation

Dr. Sawyer reviewed police, fire department and medical examiner reports, deposition testimony, witness statements, on-site videos, photographs, expert reports, owner's manuals and every other available scrap of information. He consulted the generally-accepted toxicological methodology and reference sources. Needless to say, this encompassed a broad scope of material.

Based on his preliminary findings, Dr. Sawyer prepared a physiologically-oriented assessment of each victim. The primary focus of his assessment was whether alcohol intoxication on the part of the victims contributed to their death and whether the carbon monoxide alarm (had it been operational) would have aroused the victims from sleep if they were, in fact, intoxicated.

Although Dr. Sawyer relied on the measured postmortem blood levels of COHb (carboxyhemoglobin), several critical questions remained unanswered. Merely summarizing existing records was not sufficient to make a determination. Dr. Sawyer found it was necessary to go further to obtain credible objective evidence involving the circumstances of death. To that end, a comprehensive accident reconstruction was organized with both parties (plaintiffs and defendants) present.

Accident Reconstruction

By using the same trailer and generator and duplicating the original conditions as closely as possible, the reconstruction addressed every possible aspect of the original event. This provided Dr. Sawyer with the opportunity to obtain insights into unanswered questions arising from the tragedy including:

- Was alcohol a contributing factor in placing the generator in such a hazardous location?
- How long would it have taken the generator exhaust to raise CO levels within the trailer enough to trigger the detector?
- How long would it have taken to reach fatal carboxyhemoglobin (COHb) blood levels in the sleeping victims?
- Did the CO level increase so rapidly that it decreased the victims' ability to be aroused?
- Or, did the the victims' high blood alcohol levels preclude their awakening even if the CO detector had been working?

Exposure analysis of the results provided answers to most of the unanswered questions. Some of the revelations were significant.

Inadvertent Enhancement of Toxicity

An important revelation arising from the accident reconstruction was how the carbon monoxide became so concentrated. Exhaust fumes entered primarily through a small storage hatch adjacent to the generator which was not properly closed. The generator exhaust was pointed directly at the panel. This actually pressurized the contamination, forcing it inside through seams and small openings.



The generator exhaust was pointed directly at the trailer. [b]

Although the generator provided overall AC power to the vehicle, the victims mainly relied on the generator to operate a roof-mounted air conditioner to escape the August heat. The reconstruction demonstrated several different air intakes and leakage points throughout the trailer interior. Contaminated air inside the trailer living area was recirculated back into the living area after being cooled. While such closed-air containment is a common feature in many air conditioning systems, it had a disastrous effect in this instance.

A defendant's expert inspecting the system noted that the air conditioner took in carbon monoxide from the infiltrating generator exhaust. It quickly moved the cooled, contaminated air to a ceiling vent at the far end of the trailer. Thus, the air conditioning system concentrated and recirculated the carbon monoxide throughout the interior, enhancing and accelerating the toxic effects.

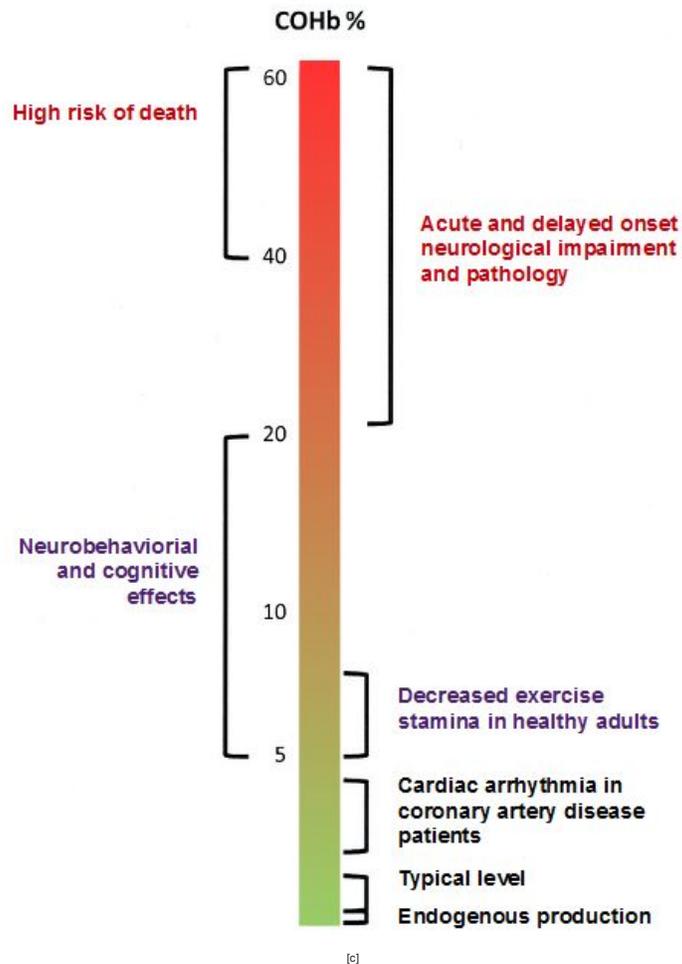
Additionally, the generator was placed between an adjacent parked truck and the trailer (with its "slide-out" extended). This arrangement created a "stagnant air zone" in which the generator recycled some of its own exhaust gases. This recycling further increased CO concentrations in the exhaust.

Toxicology of Carbon Monoxide

In assessing the circumstances surrounding the fatalities, Dr. Sawyer relied strictly on the case facts. Expert testimony must always have its basis in reliable scientific techniques that are generally accepted by the relevant scientific community. Thus, although personal observations and professional experience may play a role in formulating an opinion, they do not constitute an admissible basis for a conclusion. Only by pragmatically assessing the list of contributing factors and weighing them appropriately can the expert communicate findings in a scientifically-sound and objective manner.

In the case of carbon monoxide, Dr. Sawyer's report identified the known physiological characteristics of CO poisoning based on generally-accepted dose-response levels as shown below:

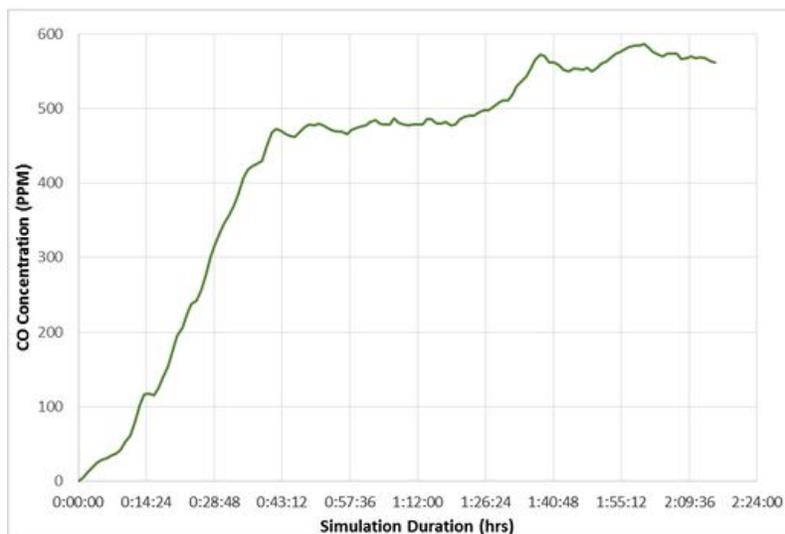
Adverse Health Effects of Carbon Monoxide Based on Blood Carboxyhemoglobin (COHb) Levels



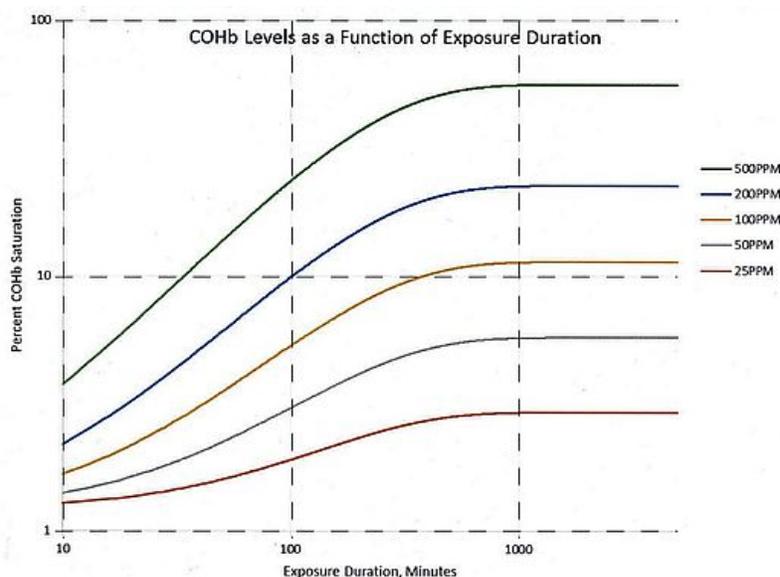
Dr. Sawyer determined the blood alcohol concentration (BAC) of each victim at the time the CO detector would have triggered (had it been operative). Then he determined whether or not alcohol consumption on the part of the victims would have played a role in decreased vigilance and increased waking time had the detector triggered.

By comparing the carbon monoxide measurements in the accident reconstruction simulation to the levels measured postmortem (as a function of exposure duration), Dr. Sawyer was able to back-extrapolate the BAC levels. By comparing these to the generally-accepted, peer-reviewed exposure characteristics in the toxicological literature, it became possible to calculate the time required for the victims to reach fatal carboxyhemoglobin (COHb) blood levels.

Carbon Monoxide Measurement vs. Time (Simulation)



[d]



[e]

Results of Investigation

With only one exception, all of the victims had intoxicating levels of alcohol in their blood at the time the detector would have sounded (if operational). Multiple toxicological studies have assessed the impact of blood alcohol levels on the ability of individuals to awaken and respond to a CO alarm emitting the standard 3100 Hz (Hertz) tone.

Dr. Sawyer worked with an expert audiologist with specialized equipment to monitor the sound levels throughout the RV at the time the generator was running. Using specific decibel measurements, the audiologist found that the overbearing engine noise of the generator would have substantially diminished the decibel level of the CO detector's alarm. Dr. Sawyer further noted that, in the peer-reviewed studies, even low blood alcohol levels significantly diminished the ability to discriminate this particular frequency. Thus, even if the CO detector had been operational, the victims' level of vigilance and ability to waken from sleep would have been substantially or completely impaired.

The sole exception was a victim without intoxicating levels of alcohol who might have reacted to the sound of the alarm (had it been operating). However, the decibel level of the CO detector was nearly the same as that of the interior generator noise and adjacent air conditioner located immediately above the victim. This combined noise would have masked the alarm tone and effectively prevented the victim from hearing it.

Presentation of Findings

Dr. Sawyer presented his findings in a written report and testimony in deposition. He noted that the autopsy reports revealed postmortem COHb concentrations as high as 68%. This represents a "100% lethal" carbon monoxide level. The accident reconstruction validated this concentration as it revealed a rapid CO rise to 300 ppm (at which point the detector alarm sounded in the accident reconstruction) and well beyond that level thereafter.

Dr. Sawyer further noted that the accident reconstruction was scientifically credible as it was conducted using the original vehicle and all of the equipment present at the original accident scene. The generator itself was tested and found to be in proper working order, producing exhaust gases consistent with other units of its type.



Outcome

Attempts by plaintiffs' counsel to discredit Dr. Sawyer's report and testimony were unsuccessful. Plaintiffs and defendants settled the case in a manner that satisfied both parties. It remains uncertain to this day who moved the generator next to the trailer.

Word to the Wise

Known as the "silent killer," carbon monoxide is an odorless, tasteless, and colorless gas. A police officer investigating the event testified that vehicles parked closely to one another also had generators positioned too closely to the trailers. Those inside were most fortunate that no other CO poisoning events occurred. **Situational awareness is the key to safety and survival.**

(Disclaimer: Toxicology case studies are impartial and objective summaries of toxicological matters in which TCAS was retained for the purpose of assessing health-based factors which, in some cases, led to a determination of causation. In the above matter, Dr. Sawyer was retained by defendants)

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A Message from Dr. William R. Sawyer Chief Toxicologist, TCAS, LLC



"Carbon monoxide poisoning usually occurs indoors. There are multiple factors to consider including dose, duration and circumstances of exposure. An objective toxicological assessment is essential in any case involving carbon monoxide."

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