

## 1. Executive Summary

Carbon Monoxide (CO) inhalation is second only to opioid overdose as the leading cause of death via unintentional poisoning in the United States; with an average of 438 fatalities per annum. CO is both colorless and odorless; the early symptoms of exposure are often non-specific and easily mistaken for general fatigue or viral illness, making detection by the victim virtually impossible until they become too impaired for self-rescue or alerting others and may ultimately die.

Altitude has an exacerbating effect on CO uptake into the human bloodstream, and on the bonding of CO with the body's primary oxygen carrier (hemoglobin) to form carboxyhemoglobin (COHb). Therefore existing building standards for acceptable environmental CO levels may not be safe at significant altitudes above sea level. This claim is strongly supported by the fact that for any given concentration of CO exposure, the rate of uptake as well as steady state COHb production is increased under the effects of elevation. Furthermore the degree of impairment observed in both man and rodent is higher under such conditions

A review of existing literature has found gaps in terms of definitive quantitative data with regards to COHb production at altitude. Nevertheless there is a general consensus that altitude and CO exposure have an additive relationship. In addition to this it has become evident that the widely held belief replicated even in the NFPA 720 official standard- that a simple correlation between COHb levels and the presentation of clinical symptoms exists is in fact false.

Early detection of CO in the atmosphere is of paramount importance in preventing severe accidents. The latter inherently requires determining a threshold value at which CO detectors should sound the alarm, since they are perhaps the single most important preventive safety measure. Although it is currently ambiguous what exactly this threshold value should be, it is abundantly clear that guidelines for sea level conditions are not well suited to environments at altitude. Therefore a review of mapping techniques between COHb levels and clinical symptoms, as well as new guidelines for safe levels of CO tailored specifically for residents at altitude are both urgently required.