

Background:

Carbon monoxide (CO) poisoning is a leading cause of unintentional poisoning deaths and claims 500 victims annually in the United States.¹ Recent studies suggest that CO poisoning is responsible for at least 50,000 emergency department admissions annually.² CO poisoning is traditionally diagnosed with hemoximetry from arterial blood draws. However, advances in pulse oximetry have enabled noninvasive monitoring of carboxyhemoglobin (COHb). An important use of this technology has been firefighter rehabilitation. The National Fire Protection Association suggests assessment of firefighters for CO poisoning after all live fire exposures.³ Exposure can result from settings such as operating near fire locations without respiratory equipment. As such, many emergency medical services (EMS) have adopted the Rad-57 pulse oximetry system for monitoring COHb as a part of their standard firefighter rehabilitation. However, studies have indicated varying reliability and accuracy of the Rad-57 device for CO monitoring.⁴ Nonin Medical has recently developed a new oximetry system capable of measuring COHb with a clinical accuracy during hypoxia. *The purpose of this study was to evaluate the reliability of the COHb measurements from the Nonin device versus the Rad-57 device in actual firefighter rehabilitation.*

Patients & Methods :

The study was Institutional Review Board-approved and conducted in compliance with the Declaration of Helsinki. All subjects provided written informed consent. The ongoing study is a prospective observation study completed by HealthEast EMS personnel.



Fire fighters undergoing standard fire rehabilitation were enrolled and had a DCI sensor (no light shield) with a Rad-57 Pulse CO-Oximeter™ utilized in keeping with standard use. On the opposite hand, a Nonin 8330AA CO-Met™ fingertip sensor was applied to the index, middle, or ring finger. Patient demographics were collected along with the noninvasive COHb, peripheral oxygen saturation, and pulse rate values obtained from the oximeters. Observations from the EMS personnel operating the two systems were also collected.



Figure 1: Shows the A) Nonin CO-Met™ Noninvasive Oximetry System and B) the Masimo Rad-57 Pulse CO-Oximeter under test

Results and Discussion:

Preliminary results include 59 measurements on 43 (42 M: 1F, Age: 36 ± 10 years old, one smoker) enrolled firefighter patients. Longer fire events occasionally resulted in multiple rehabilitations and measurements for a single firefighter. To date, the Nonin CO-Met™ System reported readings for COHb on 100% of attempted measurements, whereas the Rad-57 had a blanked display on 25% of attempted measurements. Additionally, EMS operators noted that the Nonin device displayed readings faster than the Rad-57. 60% of blank readings on the Rad-57 occurred at a nighttime fire with an ambient temp of -8 Celsius. The Rad-57 manual notes that ambient light can interfere with its COHb readings. Light shields were not used with the Rad-57 device as the Rad-57 recordings were not taken in direct sunlight or in proximity to strobing light. Per the manufacturer, the Nonin device requires no light shield.

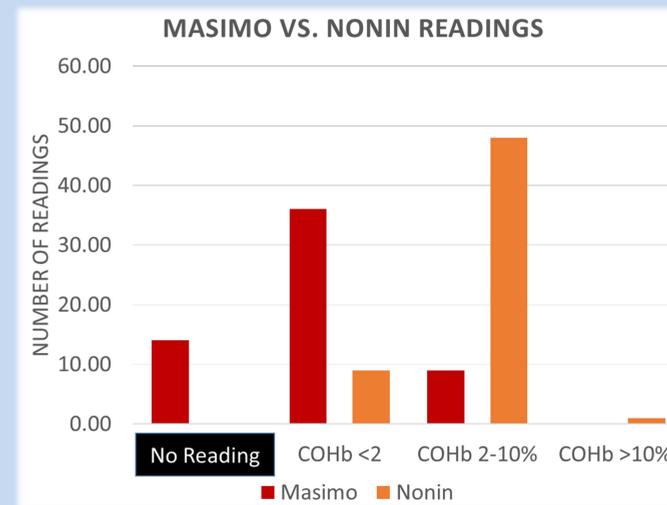


Figure 2: Shows the number of missing readings and readings in different relevant ranges for COHb for each device.

One firefighter on whom the Masimo device struggled to read had replicate readings and was a known smoker. The Nonin device produced a COHb of 8% then 12% while the Masimo device produced a 1% then failed to read. Smokers would be expected to read at least 3% but up to 15%.⁵ However, this result is aligned with reports questioning the Rad-57's false negative rate.⁶

Subject	Nonin COHb	Masimo SpCO
#35 Reading 1	8	1
#35 Reading 2	12	No Reading

Table 1: Known smoker readings comparing the Nonin and Masimo devices.

Overall, the Nonin device produced the majority of its readings between 2-10% while the Masimo device produced readings of 0-1%. This led to an average paired reading bias of 3.05% higher on the Nonin device than the Masimo device. A physiologically relevant level for COHb in urban non-smokers is 2-5%.⁷ For individuals exposed or potentially exposed to CO, such as firefighters, a higher COHb of 2-10% would not be unexpected.

Conclusions & Perspectives:

These initial results suggest the new Nonin CO-Met™ Noninvasive Oximetry System delivers reliability in a fire rehabilitation environment and a reading in keeping with expected outcomes. The ongoing study will continue to expand these results adding subjects. This work highlights the need for future studies that include confirmatory invasive blood gas readings.

Acknowledgement:

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References:

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