



Sierra-Sacramento Valley Emergency Medical Services

Prehospital use of non-invasive point of care testing utilizing Pulse CO-Oximetry Devices

Trial Study – 18 Month Report

December 14, 2011

Introduction:

Carbon monoxide poisoning is the most common type of fatal poisoning in the United States. Unintentional CO exposure accounts for an estimated 20,000 emergency department visits and 500 unintentional deaths in the United States each year.¹ According to the California Air Resources Board, each year about 30 Californians die from accidental carbon monoxide poisoning and over 600 others go to emergency rooms for non-lethal exposures.² Several locations throughout the Sierra–Sacramento Valley EMS Region have seasonal characteristics that result in increased risk of CO exposure and/or poisoning. There have been several fatalities involving CO exposure patients in these areas in the past several years.³

In May 2010, the State of California enacted a law requiring the installation of CO detectors in all homes as of July 1, 2011.⁴ Although the installation of CO detectors in homes is meant to alert residents to the presence of a possible hazardous environment, the use of these devices also presents the potential of increased false alarms and unnecessary EMS treatment and/or transport of worried well patients.

Current NFPA standards establish that “any firefighter exposed to CO or presenting with headache, nausea, shortness of breath, or gastrointestinal symptoms” must be measured for CO poisoning by Pulse CO-Oximetry or other available methods.⁵ In addition, the NAEMT has recently issued recommendations that EMS professionals “non-invasively screen patients for carbon monoxide poisoning that have had a suspected exposure, or present with any of the signs or symptoms of carbon monoxide poisoning.”⁶

Non-invasive point of care Pulse CO-Oximetry devices are becoming increasingly available for prehospital use and have been utilized for the purpose of fire firefighter evaluation and rehab on the Fire Ground for several years without any reported complications. However, these devices are not currently approved by EMSA for general prehospital patient use.

The objective of this trial study was to determine if point of care testing using non-invasive CO-Oximetry can accurately and consistently identify patients with CO exposure/poisoning as well as be utilized as an assessment tool to rule out CO exposure/poisoning when appropriate.

Methods:

Study Design

The trial is a prospective, non randomized study to evaluate the accuracy and effectiveness of point of care CO testing using non-invasive Pulse CO-Oximetry. The trial study was approved by the Sierra–Sacramento Valley EMS Medical Control Committee and subsequently approved by the EMS Authority Director.

Setting

The Sierra–Sacramento Valley EMS Region consists of 10 Northern California Counties (Butte, Colusa, Nevada, Placer, Shasta, Siskiyou, Sutter, Tehama, Yolo and Yuba) with a permanent population of 1,400,000 as well as a significantly higher seasonal population. The Sierra–Sacramento Valley EMS Region is serviced by multiple public and private BLS, LALS and ALS first responder and ambulance prehospital provider agencies.

The following prehospital provider agencies requested and were approved to participate in this trial study:

- North Tahoe Fire Protection District
 - Paramedic first responder and ambulance transport provider
 - Annual EMS call volume: approximately 1000
- City of Roseville Fire Department
 - Paramedic first responder provider
 - Annual EMS call volume: approximately 8000
- St. Elizabeth Community Hospital Ambulance
 - Paramedic ambulance transport provider
 - Annual EMS call volume 8000

Duration

June 1, 2010 through December 1, 2011

Inclusion criteria

All patients with known or suspected CO exposure encountered by one of the trial study approved prehospital provider agencies.

Exclusion criteria

There were no exclusion criteria specific to this trial study.

Training

All paramedic personnel employed by the approved trial study prehospital provider agencies received training on the use of the non-invasive Pulse CO-Oximetry device as well as Sierra-Sacramento Valley EMS Agency policy / treatment protocol related to the use of these CO-Oximeter devices.

Policy / Protocol

A new policy / treatment protocol on the use of CO-Oximeter devices was developed and approved by the Sierra-Sacramento Valley EMS Agency Medical Control Committee. This policy / treatment protocol addresses the following items:

- Signs and symptoms of possible CO exposure
- Indications for and application of CO-Oximetry devices
- CO exposure assessment and triage algorithm based on SpCO measurements
 - Note: transport from the field directly to a facility with hyperbaric capabilities is not allowed without base hospital direction.
- CQI requirements

Data Collection

The following data was collected on all patients:

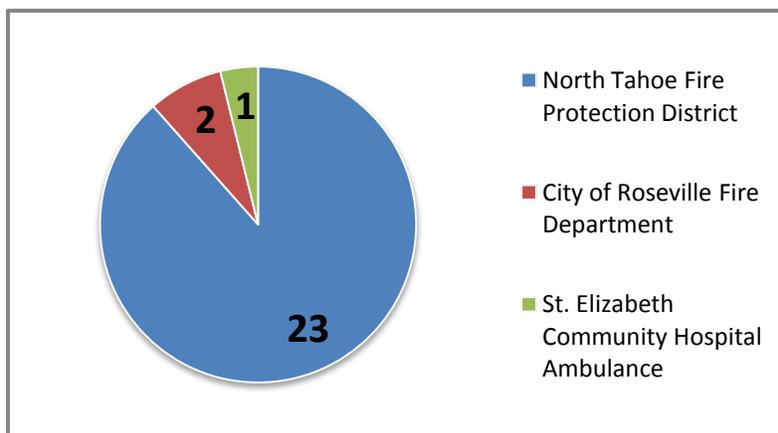
- Date
- EMS provider agency
- Patient name and/or ID (for hospital follow-up)
- Time of 911 call
- Time of first EMS contact
- Suspected CO exposure (yes / no)
- Symptoms of CO exposure
- Time of CO-Oximeter application
- Prehospital CO Level (oximeter readings)
- Transport (yes / no)
- Name of receiving facility
- 100% O2 administered if CO >25% adults, >15% pediatric or pregnant female (yes / no)
- Transport to closest facility (yes / no)
- Suspected source of CO exposure
- Initial CO level in ED
- ED diagnosis
- Transfer to hyperbaric chamber (yes / no)

Patient care reports were submitted to the Sierra-Sacramento Valley EMS Agency for all patients where a CO-Oximeter was utilized. EMS Agency staff subsequently contacted the receiving hospital for all transported patients to obtain hospital specific outcome data. All records regarding this trial have been maintained in a secured electronic data base which can be accessed by the EMS quality managers and medical director involved in the study.

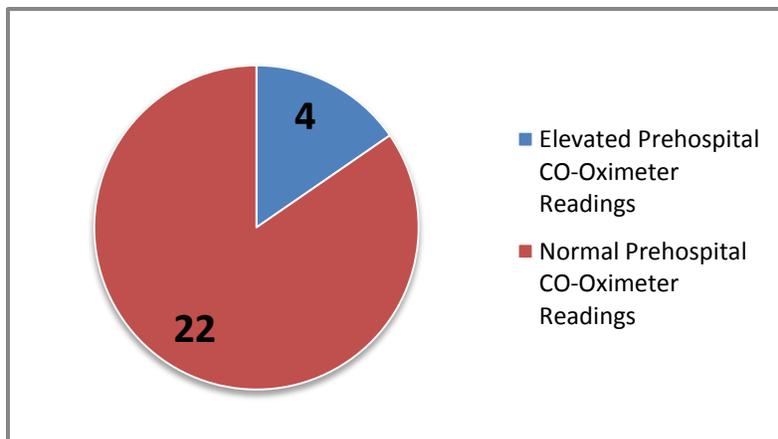
Results:

26 patients were enrolled during the 18 month trial study period which included a medical MCI event at an elementary school in the Lake Tahoe area involving multiple adult and pediatric patients.

Number of trial study enrolled patients by prehospital provider agency



Number of patients with elevated and normal prehospital CO-Oximeter Readings



CO-Oximetry Trial Study Enrolled Patient Detail

Incident Date	EMS Provider	Suspected Source of CO Exposure	Number of Patients	EMS CO Reading(s)	Transport (yes / no)	ED CO Measurement	ED Diagnosis	Transfer to Hyperbaric Chamber
6/12/2010	NTPFD	Propane heater in enclosed area	1 - adult	0%	No	N/A	N/A	N/A
7/5/2010	NTPFD	Boat exhaust leak	1 - pediatric	35% / 20%	Yes	carboxyHgb 15%	CO poisoning	No
12/2/2010	NTPFD	Unk. source	17 – adult & pediatric	0% on all	No	N/A	N/A	N/A
12/2/2010	NTPFD	Unk. source	1 - adult	5%	Yes	carboxyHgb 0%	Chemical inhalation	No
1/13/2011	NTPFD	Vehicle exhaust leak	1 - adult	0%	No	N/A	N/A	N/A
3/21/2011	St. Elizabeth Ambulance	Faulty gas heater	1 - adult	14%	Yes	carboxyHgb 15%	CO poisoning	No
4/7/2011	Roseville FD	Gas generator in enclosed garage	1 - adult	35%	Yes	carboxyHgb 32.1%	CO poisoning	Yes
4/27/11	NTPFD	Burning inside residence	2 - adult	2% - Pt. 1 4% - Pt. 2	No	N/A	N/A	N/A
10/31/2011	Roseville FD	Unk. Source	1 - adult	20% / 16%	Yes	Not taken	Pt. signed out AMA	N/A

Discussion:

This trial study was limited by the small number of participating prehospital providers as the result of the cost of CO-Oximeter devices and the fact that they are not currently approved by the EMS Authority for general prehospital patient use. The prehospital providers who participated in this trial study represent approximately 15% of the total EMS patient volume in the Sierra-Sacramento Valley EMS Region.

As indicated by the limited data that we obtained during this trial study period, the following were identified:

- The use of CO-Oximetry for point of care testing by EMS prehospital personnel did not result in the delay of patient care or extended scene times and there was no detriment to patient care identified.
- All patients that were identified in the prehospital setting as having an elevated CO reading by Pulse CO-Oximetry were subsequently verified as having elevated caboxyHgb levels by hospital laboratory testing. (*note: one patient left AMA prior to testing).
- EMS prehospital providers were able to utilize CO-Oximetry to appropriately rule out CO exposure / poisoning on multiple patients with signs / symptoms / history of possible CO exposure.

Although CO-Oximetry devices are not currently widely utilized by EMS prehospital providers in California, for the reasons indicated above, we have been notified by multiple agencies that they plan to purchase and utilize these devices for both firefighter and general EMS patient use if and when they are approved by the EMS Authority. CO-Oximetry capabilities are also being incorporated into newer cardiac monitoring devices available from several manufacturers.

Finally, in addition to the current California State law requiring CO detectors to be installed in private residences, SB 840 (Introduced by Senator Evans, February 18, 2011) would also require CO monitors to be installed in all California skilled nursing facilities. Again, as explained earlier in this document, this presents the potential of increased false alarms and unnecessary treatment and/or transport of worried well patients without any definitive means of ruling out CO exposure / poisoning in the prehospital setting.

Conclusion / Recommendations:

The EMS Authority is proposing to add point of care testing, which includes CO testing, to the paramedic basic scope of practice in the current draft of revision to the Paramedic Regulations.

We recommend that the EMS Authority incorporate the use of CO point of care testing as a paramedic basic scope of practice item in the final revision to the Paramedic Regulations as is currently proposed.

References:

1. CDC. Unintentional non-fire-related carbon monoxide exposures in the United States, 2001-2003. *MMWR Morb Mortal Wkly Rep.* 2005;54(2):36-39
2. California Environmental Protection Agency Air Resources Board. (2011, October 27). Carbon monoxide: deadly in enclosed rooms. Retrieved December 8, 2011, from <http://www.arb.ca.gov/newsrel/newsrelease.php?id=247>
3. Fimirte P. (2008, December 17). 3 squaw valley workers found dead in car. *SFGate.com*. Retrieved December 8, 2011, from http://articles.sfgate.com/2008-12-17/bay-area/17133582_1_monoxide-poisoning-exhaust-pipe-placer-county.
4. California Carbon Monoxide Poisoning Prevention Act of 2010, SB 183, (2010).
5. NFPA 1584: Standards on the rehabilitation process for members during emergency operations and training exercise. Annex A section A.6.2.6.4(1)
6. Masimo. (2008, January 29). National association of emergency medical technicians (NAEMT) supports prehospital screening for carbon monoxide in the blood. Retrieved December 8, 2011, from <http://ir.masimo.com/phoenix.zhtml?c=117065&p=irol-newsArticle&ID=1101577&highlight=>.