

This document provides guidelines to all Florida County Health Departments (CHDs) about the interpretation and use of case report forms developed for carbon monoxide poisoning reporting. These guidelines will help to identify cases and to report them in a systematic manner so that control measures can be initiated promptly and effectively.

## **I. General Information: Carbon Monoxide <sup>1</sup>**

Carbon monoxide (CO) is an odorless, colorless, poisonous gas that can cause sudden illness and death if present in sufficient concentration in the ambient air. When power outages occur during emergencies such as hurricanes or winter storms, the use of alternative sources of fuel or electricity for heating, cooling, or cooking can cause CO to build up in a home, garage, or camper and poison the people and animals inside. Generators, grills, camp stoves, or other gasoline, propane, natural gas, or charcoal-burning devices should never be used inside a home, basement, garage, or camper - or even outside near an open window or window air conditioner.

## **II. Case classification**

### **A. Carbon Monoxide Poisoning:**

#### **Clinical description**

The clinical presentation of acute carbon monoxide (CO) poisoning varies depending on the duration and magnitude of exposure and between individuals with the same degree of exposure and/or the same venous carboxyhemoglobin (COHb) level. The most common signs and symptoms include headache, nausea, lethargy (or fatigue), weakness, abdominal discomfort/pain, confusion, and dizziness. Other signs and symptoms may include visual disturbances including blurred vision, numbness and tingling, ataxia, irritability, agitation, chest pain, dyspnea (shortness of breath), palpitations, seizures, and loss of consciousness.

#### **Laboratory criteria for diagnosis**

Biologic: elevated carboxyhemoglobin (COHb) concentration found in blood specimen determined by laboratory tests. Elevated levels of carboxyhemoglobin should be interpreted in light of endogenous production, patient smoking status and exposures to second hand smoke.

OR

Environmental: detection of carbon monoxide from environmental monitoring data as provided by first responders (Fire Department, Hazmat, etc.), environmental consultants or other sources if deemed reliable.

#### **Case classification**

##### Confirmed:

1. A clinically compatible case in which laboratory tests or pulse CO-oximetry have confirmed elevated COHb level ( $\geq 9\%$ )

OR

2. A case with signs and symptoms consistent with CO poisoning (in the absence of clinical laboratory data), AND supplementary evidence in the form of environmental monitoring data suggesting exposure from a specific poisoning source.

OR

3. A case with a reported blood specimen (in the absence of clinical and environmental laboratory data) with COHb level that is equal to or greater than a volume fraction of 0.12 (12%).

Probable:

A clinically compatible case with no laboratory and/or environmental monitoring evidence of exposure with the same environmental exposure as that of a confirmed case

OR

A clinically compatible case, with no laboratory and/or environmental monitoring evidence of exposure with smoke inhalation secondary to conflagration (explosive fire).

OR

A case with a reported blood specimen of COHb level that is equal or greater than a volume fraction of 0.09 (9%) and less than a volume fraction of 0.12 (12%), ( $9\% \leq \text{COHb} < 12\%$ ) in the absence of compatible symptoms or environmental monitoring data.

Suspected:

A clinically compatible case that is not laboratory confirmed but has a history of present illness that is consistent with exposure to carbon monoxide.

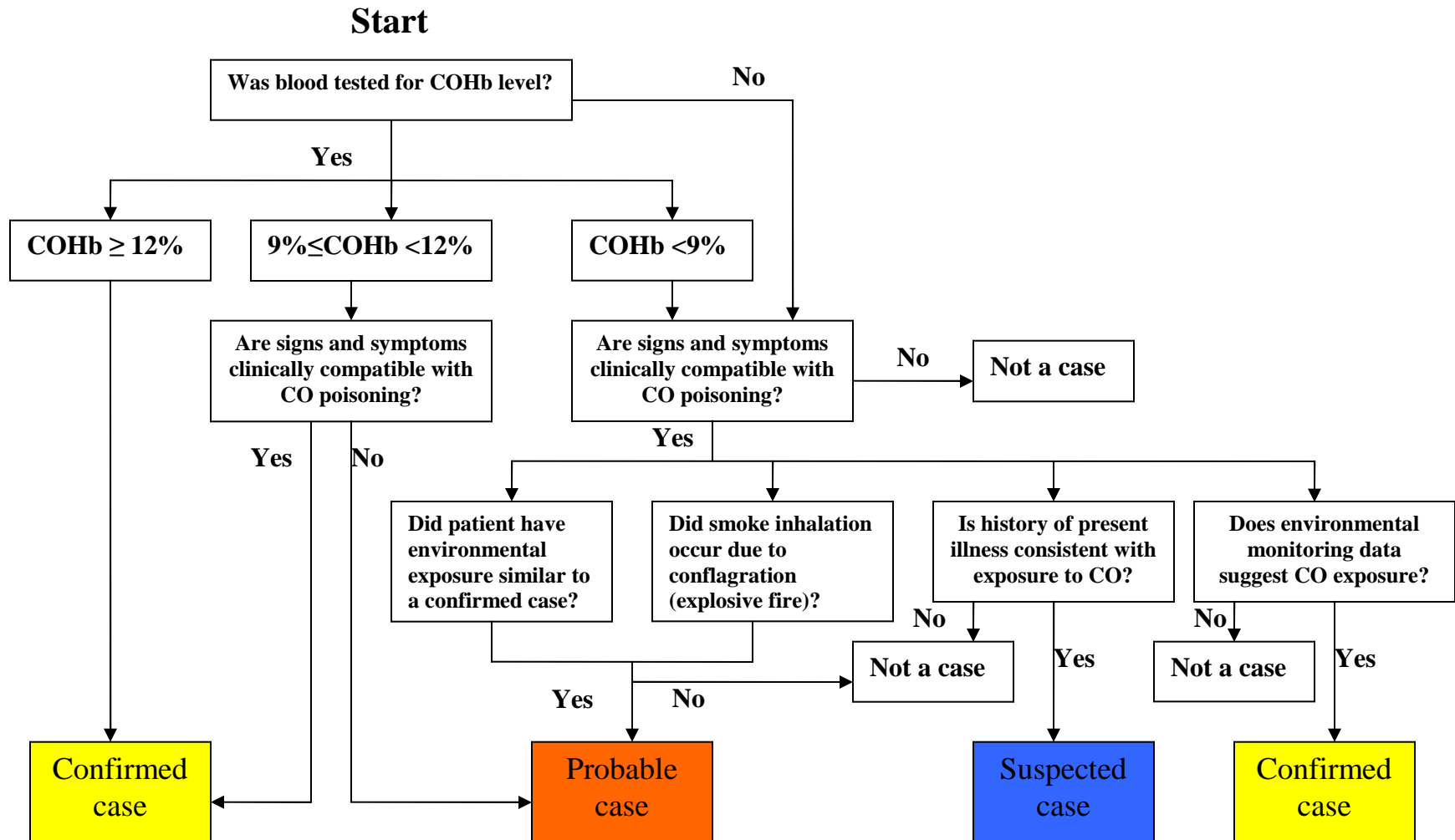
E.g. A CO poisoning death due to extended intentional or unintentional exposure to exhaust from an automobile, generator or fireplace.

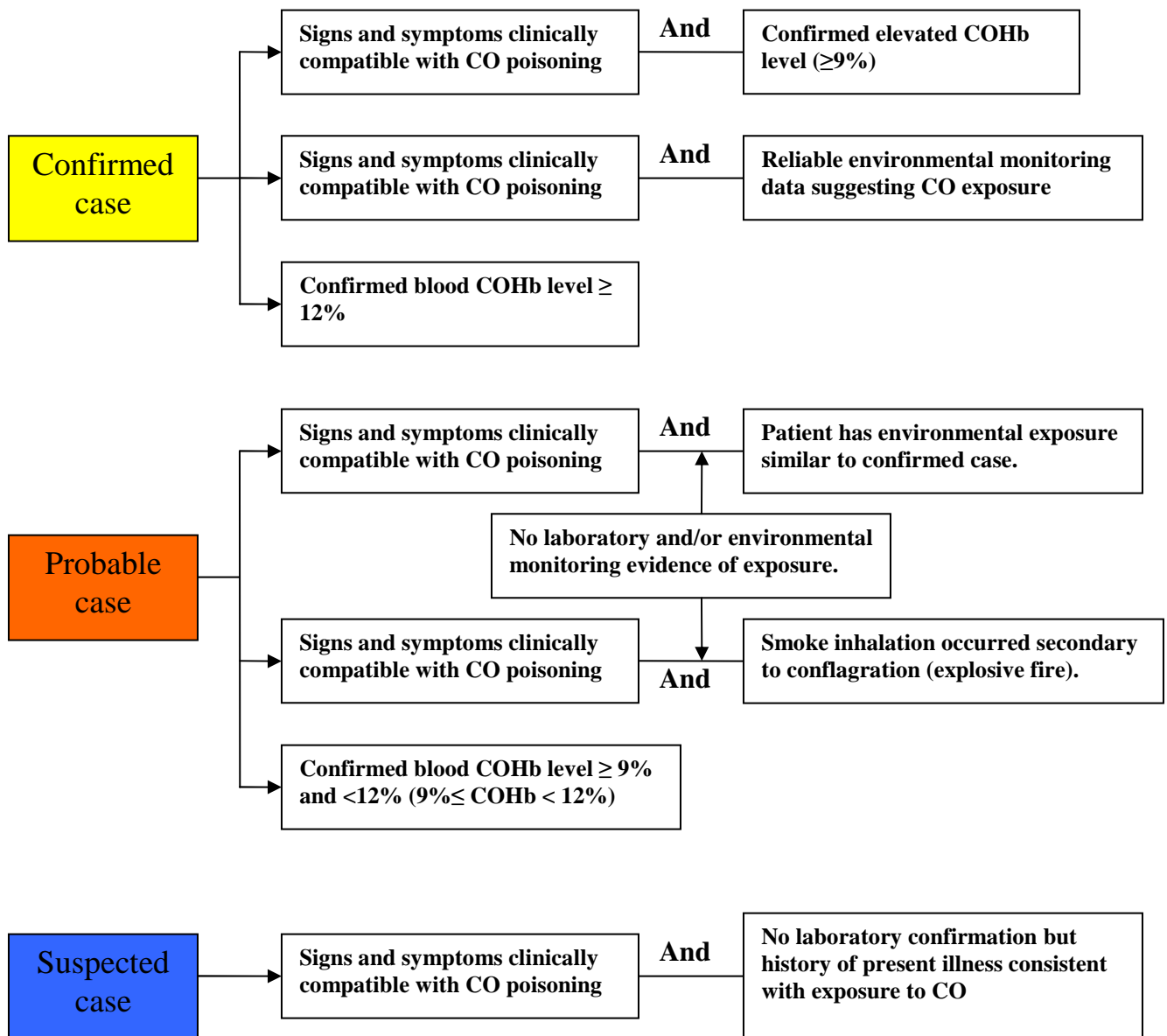
**Comment**

Reliable CO environmental monitoring data

The acceptance of this data is at the discretion of the public health investigator/official. The quality of environmental monitoring data is dependant on the capabilities and limitations of the monitoring equipment and the equipment users. False positive environmental monitoring data is possible (e.g. some CO sensor technologies are known to be cross-sensitive when exposed to other chemicals such as hydrogen sulfide). Please contact the Department of Health, Bureau of Community Environmental Health, Radon and Indoor Air Program Office at (850) 245-4288 or (800) 543-8279 for assistance with the interpretation of CO environmental monitoring data.

**B. Carbon Monoxide (CO) poisoning Flow Charts:**





### C. Background on CO poisoning case definition <sup>2</sup>

The surveillance case definition for acute carbon monoxide poisoning has been formulated to address the general population. There are several sub-populations which may be more or less susceptible to the adverse health effects of carbon monoxide intoxication, due to pre-disposing environmental and physiologic conditions (see below). Separate surveillance case definitions for sub-populations have not been formulated at this time as it is unclear from the published peer-reviewed literature whether these groups suffer more extreme outcomes from poisoning at lower levels of exposure and/or lower levels of carboxyhemoglobin saturation.

The following sub-populations have been identified in the literature as having special concerns with respect to acute carbon monoxide poisoning:

**1. Persons Exposed to Tobacco Smoke:** Active and passive exposure to tobacco smoke elevates carboxyhemoglobin levels as a result of inhalation of combustion by-products. Self reported current smokers showed larger variability in COHb levels along with a relative insensitivity of this group to incremental changes in the environmental burden of CO when compared with the never smoking group. It is also reported that approximately 95.9% of the current smokers had a concentration of COHb less than or equal to 9%.<sup>3</sup>

**2. Children:** It is known that children have higher minute ventilation per unit body weight than adults and those children have been reported to be more susceptible to the acute adverse health effects from exposure to CO. It is acknowledged that while children may accumulate COHb faster than adults, it is unclear whether they experience more severe outcomes at lower levels of COHb saturation.

**3. Fetal Exposure/Pregnancy:** It is known that fetal blood has a higher affinity for CO than adult hemoglobin and this is an important distinction considered by the clinician when treating the pregnant patient.

**4. Persons Living at High Altitude:** It is known that persons living at higher altitudes experience faster loading of COHb as result of a leftward shift of the oxygen-hemoglobin dissociation curve. It is unclear whether persons at higher altitudes experience more severe outcomes at lower levels of COHb saturation.

**5. Persons with Certain Health Conditions:** It is known that sub-populations diagnosed with conditions associated with low oxygen saturation (e.g.; chronic obstructive pulmonary disease) and conditions with decreased oxygen delivery to the tissues (e.g.; ischemic heart disease) experience adverse health effects with increased COHb levels. It is unclear whether these sub-groups experience more severe outcomes at lower levels of COHb saturation.

**6. Persons with Occupational Exposure:** Occupational exposure to CO is not uncommon. The outcomes from acute CO poisoning at work are no different than the consequences of other sources of exposure. It is important to gather information on potential occupational exposures as this information is important for preventing future poisonings.



Merlin Case #: \_\_\_\_\_

# Carbon Monoxide Poisoning Reporting Form

## Exposed Person Demographic Information

Name: \_\_\_\_\_ Date of Birth: \_\_\_\_/\_\_\_\_/\_\_\_\_  
First M.I. Last mm/dd/yyyy

Street address: \_\_\_\_\_

City: \_\_\_\_\_ County: \_\_\_\_\_ Zip: \_\_\_\_\_

Telephone #: Home: \_\_\_\_\_ Work: \_\_\_\_\_ Other: \_\_\_\_\_

Name of Employer OR School: \_\_\_\_\_

Gender:  Male  Female  
Race/Ethnicity:  White  Black  Asian  Native American  
 Hispanic  Other \_\_\_\_\_

## Exposure/Incident Information

Date and time of incident (mm/dd/yyyy): \_\_\_\_/\_\_\_\_/\_\_\_\_ Time: \_\_\_\_:\_\_\_\_

Brief description of incident: \_\_\_\_\_

Total # of people exposed: \_\_\_\_ Relation among exposed: \_\_\_\_\_

Poisoning intent:  Intentional CO Poisoning  Unintentional CO Poisoning

Type of exposure:  Generator  Automobile/RV  Boat  Kerosene/gas space heater  
 Power Tools (include mower)  Fuel Burning Appliances (fixed stove/boiler/furnace)  
 Portable fuel burning grill/stove  Other \_\_\_\_\_

Site of exposure:  Residential  Work  Recreational Area (park/campsite)  
 Lake/River/Ocean  Commercial dwelling  Other \_\_\_\_\_

## Health and Medical Information

Date of illness onset (Required Field) (mm/dd/yyyy): \_\_\_\_/\_\_\_\_/\_\_\_\_

Signs/symptoms (Check all that apply)

- Weakness
- Headache
- Nausea
- Chest pain
- Dizziness
- Drowzines
- Vomiting
- Shortness of breath
- Fatigue
- Confusion
- Stomach pain
- Wheezing
- Numbness
- Palpitation
- Agitation
- Loss of consciousness
- Other \_\_\_\_\_

Date of last follow up (mm/dd/yyyy): \_\_\_\_/\_\_\_\_/\_\_\_\_

Resources Used?  911 Call  ED Only  Treated on Site  Poison Information Call

Was medical care received?  Yes  No  Unknown

If yes, what type? \_\_\_\_\_

Name of physician: \_\_\_\_\_ Telephone #: \_\_\_\_\_

Was injured person hospitalized?  Yes  No  Unknown

If yes, name of medical facility and address: \_\_\_\_\_

Date of admission (mm/dd/yyyy): \_\_\_\_/\_\_\_\_/\_\_\_\_/ Diagnosis (if available): \_\_\_\_\_

Type of treatment: \_\_\_\_\_

Medical outcome:  Survived  Died  Unknown

Date of discharge/death (mm/dd/yyyy): \_\_\_\_/\_\_\_\_/\_\_\_\_

**Risk Factor Information**

Are there any preexisting conditions?  Yes  No  Unknown

If yes, type of preexisting condition:  COPD  Ischemic heart disease  Other \_\_\_\_\_

Pregnancy (if applicable)?  Yes  No  Unknown

Smoking status?  Smoker  Non-smoker  Unknown

If smoker \_\_\_\_\_ (#) cigarettes/ day

**Environmental Measurements**

Were environmental measurements taken?  Yes  No

If yes, CO level: \_\_\_\_\_ (ppm), Name and Model of Measuring Device: \_\_\_\_\_

**Test/Laboratory Information**

Were laboratory tests performed?  Yes  No  Unknown

If yes, name & location of reporting laboratory: \_\_\_\_\_

Date and time of test (mm/dd/yyyy): \_\_\_\_/\_\_\_\_/\_\_\_\_ Time \_\_\_\_\_

Test results:  Elevated COHb level  Normal COHb level  Unknown

Test value: \_\_\_\_\_

<b>Case Classification</b>			
<input type="checkbox"/> Confirmed	<input type="checkbox"/> Probable	<input type="checkbox"/> Suspect	<input type="checkbox"/> Not a case

Investigator's name: \_\_\_\_\_ (Please print) Phone: (\_\_\_\_) \_\_\_\_\_

Please submit form to the Office of Environmental Public Health Medicine, Division of Environmental Health, Department of Health, Bald Cypress Way, Bin A08, Tallahassee, Florida 32399-1712 or FAX 850-922-8472. For questions call 850-245-4299.

### **III. Instructions for completing the case report form-Carbon monoxide**

**A. Demographic Information-** All demographic information needs to be filled out in full.

**B. Exposure/Incident Information-** Complete this series of questions.

**Poisoning intent:**

1. Intentional CO poisoning: Involves suicidal or homicidal use of carbon monoxide.
2. Unintentional CO Poisoning: CO is a colorless, odorless, tasteless, non-irritating gas; many people do not realize they have been exposed until they experience symptoms of CO poisoning. Consider as unintentional if patient is unaware of potential exposure to carbon monoxide.

**Type of exposure:** Following is a list of common sources of CO poisoning.

1. Generator
2. Automobile/ RV
3. Boat
4. Kerosene/gas space heater
5. Power tools (include mower)
6. Fuel burning appliances (fixed stove/boiler/furnace)
7. Portable fuel burning grill/stove
8. Other: fire, charcoal grills, charcoal briquettes for both cooking and heating indoors etc.

**C. Health Effects and Medical Information:** Complete this series of questions

**Date of illness onset:** Month/ day/year that symptoms started, if patient is unsure or you are unable to contact the patient, please enter the first positive laboratory date and indicate that it is a laboratory date and not an onset date.

**Signs and Symptoms (Check all that apply):** Please select appropriate signs and symptoms. \*

**D. Risk Factor Information:** Please ask this series of questions to complete the risk factor information section.

**Are there any preexisting conditions?** It is known that people with pre-existing conditions involving low oxygen saturation (e.g.; chronic obstructive pulmonary disease) and conditions with decreased oxygen delivery to the tissues (e.g.; ischemic heart disease) experience adverse health effects with increased COHb levels.

**Pregnancy (if applicable)?** Fetuses of pregnant women are also at increased risk-especially when mothers are exposed to high CO levels.

**Smoking status?** Smoking tobacco elevates the CO levels in the blood. Smokers have higher levels of COHb as compared to non-smokers.

\*Signs and symptoms can not be entered in to Merlin.



## **E. Environmental Measurements**

**Environmental Monitoring Data:** For the purposes of carbon monoxide case definition, it is suggested that epidemiologists consider environmental monitoring data, associated with the suspect case report, at 80 parts per million (ppm) or higher as a level that is likely to produce symptoms and signs of acute CO poisoning. This environmental monitoring value was calculated based on the Coburn-Forster-Kane equation, a model using CO uptake in humans, using 12% CoHb levels in blood in the equation.

Average levels in homes without gas stoves vary from 0.5 to 5 ppm. Levels near properly adjusted gas stoves are often 5 to 15 ppm and those near poorly adjusted stoves may be 30 ppm or higher.<sup>4</sup> Public health, occupational health and emergency levels of concern vary from 9 ppm<sup>4</sup> (US Environmental Protection Agency's National Ambient Air Quality Standards for concentration over 8 hours average) to 1,200 ppm (National Institute for Occupational Safety and Health's immediately dangerous to life and health concentration) depending on the specific target population (the public or workers) and the duration of exposure (moments to hours).<sup>5</sup>

Reliable sources for environmental monitoring data include hazardous materials teams, fire department responders and environmental consultants using field calibrated CO measurement instruments. Unfortunately, as with many types of environmental monitoring technologies there is a possibility of false positive readings in the presence of other interfering gasses such as hydrogen sulfide. Since the reliability of some residential CO alarms have not been determined and can not be field calibrated, a report of an auditory alert or readout from a residential CO alarm should not be considered as reliable environmental monitoring data for the purposes of this case definition. Should there be a question regarding the interpretation of reported CO environmental measurements associated with a suspect case, please contact your regional or county health department's indoor air quality specialist (if there is one) or the State Radon and Indoor Air Program at (800) 543-8279. Additional information can be found at <http://www.doh.state.fl.us/environment/community/indoor-air/index.html> .

**F. Test/ Laboratory Information:** Please ask this series of questions to complete the Test/Laboratory Information section.

### **Were laboratory tests performed?<sup>1</sup>**

The laboratory tests to confirm CO poisoning involves measuring the patient's COHb level. The most common technology available in hospital laboratories for analyzing blood is the multiple wavelength spectrophotometer, also known as a CO-oximeter. Venous or arterial blood may be used for testing. It is important to know how much time has elapsed since the patient has left the toxic environment, because the elapsed time from exposure to measurement does impact the resulting COHb level measured. If the patient has been breathing normal room air for several hours, COHb testing may be less useful.

**Test results:**

**Elevated COHb level:** For laboratory criteria for case classification, COHb level  $\geq 9\%$  is considered to be elevated.

**Normal COHb level:** For laboratory criteria for case classification, COHb level  $< 9\%$  is considered to be normal.

**Department of Health Contacts:**

Prakash Mulay: [Prakash\_Mulay@doh.state.fl.us] 850-245-4444 ext 4576

**\* YOU MUST ATTACH LAB REPORTS WITH THIS CASE REPORT FORM**

## References

- <sup>1</sup>CDC, Emergency preparedness and Response, Clinical Guidance for Carbon Monoxide (CO) Poisoning After a Disaster, Retrieved from [http://emergency.cdc.gov/disasters/co\\_guidance.asp](http://emergency.cdc.gov/disasters/co_guidance.asp) on February 9, 2009.
- <sup>2</sup>CSTE (2007). Updates to 1998 Case Definition for Acute Carbon Monoxide Poisoning Surveillance. Retrieved from <http://www.cste.org/PS/2007ps/2007psfinal/EH/07-EH-03.pdf> on February 9, 2009.
- <sup>3</sup>National Center for Health Statistics, EP Radford and TA Drizd: Blood carbon monoxide levels on Persons 3-74 Years of Age: United States, 1976-80. Advance Data from Vital and Health Statistics, No. 76. DHHS Pub. No. (PHS) 82-1250. Public Health Service, Hyattsville, Md. March 17, 1982.
- <sup>4</sup>EPA, An Introduction to Indoor Air Quality, Carbon Monoxide (CO), Retrieved from <http://www.epa.gov/iaq/co.html> on February 9, 2009.
- <sup>5</sup>CDC, National institute for Occupational Safety and Health (NIOSH), NIOSH Pocket Guide to Chemical Hazards, Retrieved from <http://www.cdc.gov/niosh/npg/npgd0105.html> on February 9, 2009.