

**CDC, our planners, and our presenters wish to disclose they have no financial interests or other relationships with the manufacturers of commercial products, suppliers of commercial services, or commercial supporters with the exception of Dr. Hampson and he wishes to disclose that he is a past recipient of a speaker and consultant honorarium from Masimo, Inc., manufacturer of carboxyhemoglobin assessment devices.**

000a

**Presentations will not include any discussion of the unlabeled use of a product or a product under investigational use.**

000ba

# CARBON MONOXIDE

**Poisoning Prevention Clinical Education**

001

## **Goal**

---

**Enhance recognition and clinical management of carbon monoxide poisoning by clinicians, healthcare providers and public health officials**

001a

## **Objectives**

---

- **Describe the epidemiology of CO poisoning**
- **Identify the mechanisms of CO toxicity**

## **Objectives**

---

- **Describe the clinical aspects of CO poisoning**
- **Identify the symptoms of CO poisoning**

## **Objectives**

---

- **Explain the treatment of CO poisoning**

# **Continuing Education Credit**

---

**[www2a.cdc.gov/TCEOnline](http://www2a.cdc.gov/TCEOnline)**

**Course number: WD1233**

**CE Expiration Date: 9/20/2010**



[www2a.cdc.gov/phtn/webcast/COPoisonPrev](http://www2a.cdc.gov/phtn/webcast/COPoisonPrev)

006

**E-mail: [coinq@cdc.gov](mailto:coinq@cdc.gov)**

007

## **Males Exposed to CO**

- **During high risk activities such as working in enclosed garages with generators or power tools**
- **Age range is 25-44 years old**

## **At Risk Populations**

---

- **Babies and infants with rapid respiratory rate**
- **Elderly in poor health**

## **At Risk Populations**

---

- **People with chronic heart disease, anemia or respiratory illness**
- **Death rate highest among those over 75-years-old**

# Sources of CO Poisoning

---

- **Motor Vehicles**

## **Sources of CO Poisoning**

---

- **Motor Vehicles**
- **Fire**
- **Boats, power washers and other gas-powered tools**

## **Job Related Poisonings**

---

- **Combustion engines or combustible gases**
- **Propane-fueled forklifts**



## **Job Related Poisonings**

---

- **Plants producing formaldehyde or coke**
- **Steel foundries or pulp mills**

## **CO Poisoning-Hurricane Katrina**

---

- **27 incidents of CO poisoning resulting in 78 non-fatal cases and 10 deaths**
- **Nearly all caused by gasoline-powered generators**

## **CO Poisoning-Hurricane Katrina**

---

- **51 cases in Alabama, Louisiana and Mississippi due to portable generators**
- **Most occurred within first week after hurricane**

## **The Haldane Effect**

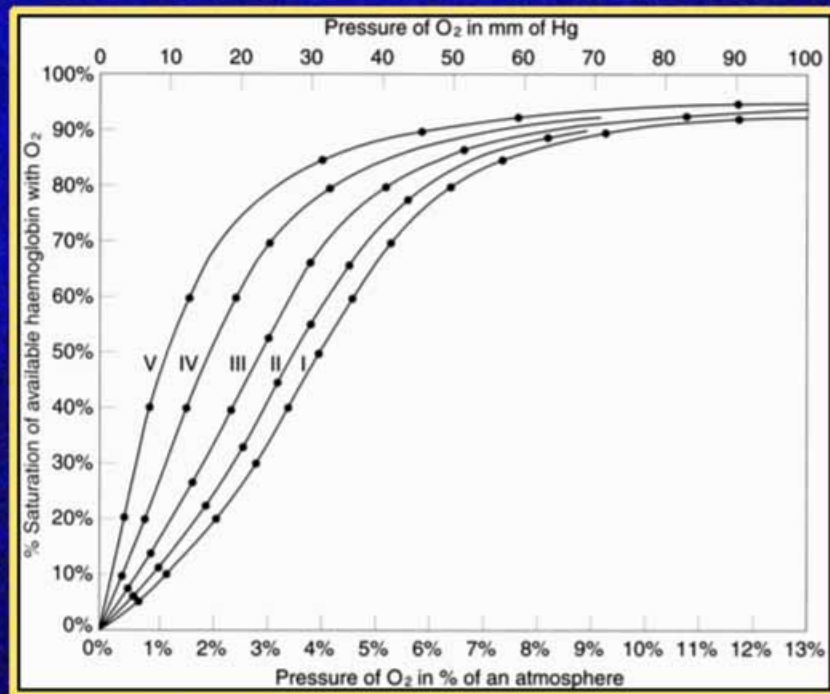
---

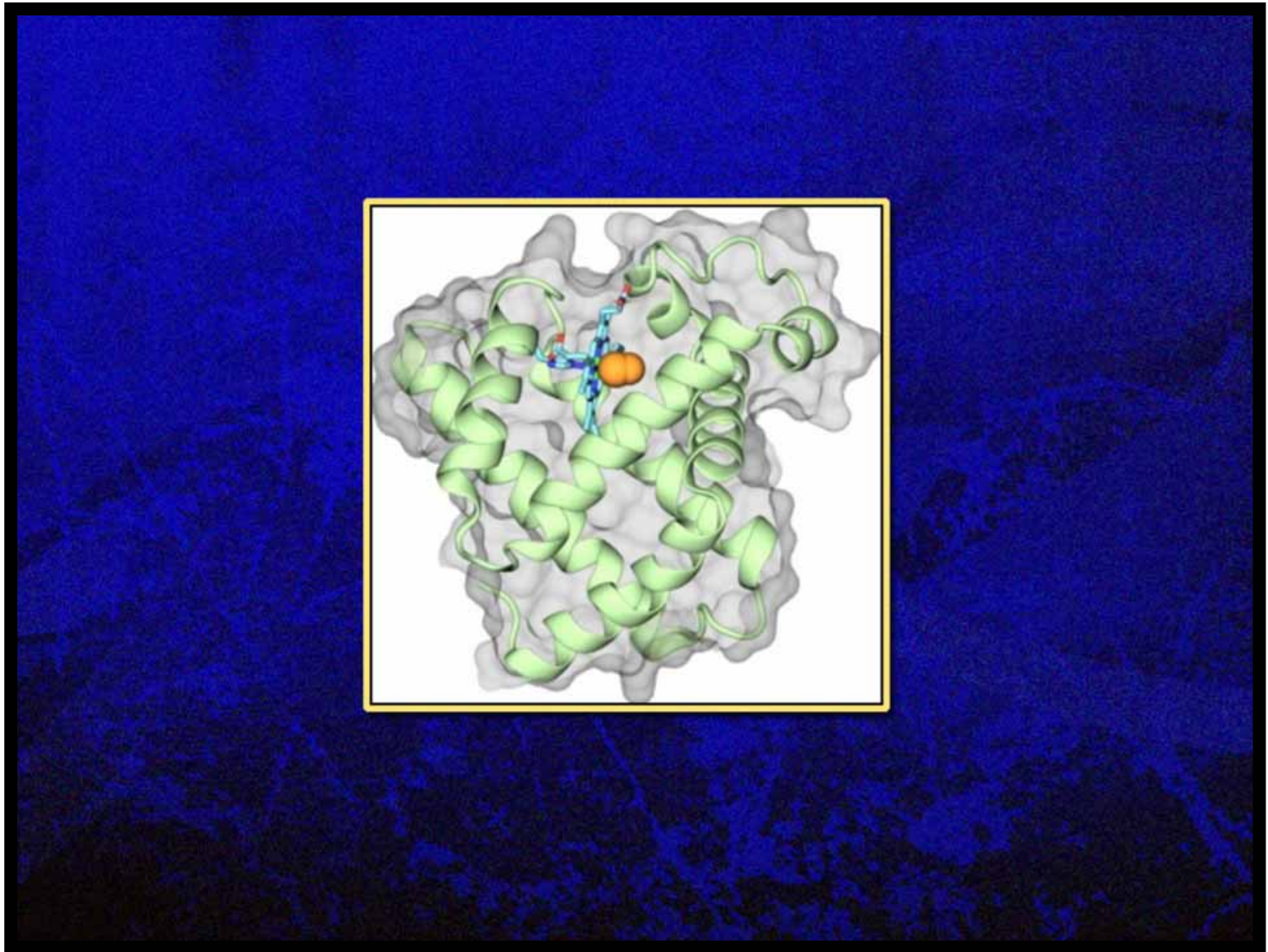
- **CO enters through the lungs where it binds to hemoglobin**
- **Reduces the blood's oxygen carrying capacity**

## **The Haldane Effect**

---

- **Binds to the iron sites in hemoglobin with an affinity 200-250 times that of oxygen**





020

## **Symptoms of CO Poisoning**

---

- **Headache**
- **Dizziness**
- **Fatigue**
- **Nausea/vomiting**
- **Altered mental status**



## **Red Flags**

---

- **No fever**
- **History of Exposure**
- **Multiple patients with similar complaints**

## **Severe CO Poisoning**

---

- **Neurological disorders may include confusion, irritability, ataxia, seizures and loss of consciousness**

## **Severe CO Poisoning**

---

- **Cardiovascular disorders may include hypotension, arrhythmias, myocardial ischemia or infarction**

## **Severe CO Poisoning**

---

- **Respiratory disorders may include pulmonary edema, tachypnea or respiratory arrest**

## **Testing for Other Conditions**

---

- **Smoke inhalation**
- **Trauma**
- **Medical illness**
- **Intoxication**

# Neurological Exam

---

- **Assessment of cognitive function**
- **Mini-mental status exam**

## **Elevated Carboxyhemoglobin (COHb) Level**

---

- **2% for non-smokers**
- **>9% for smokers**

**Strongly supports diagnosis of CO poisoning**

## **Percentage of COHb in Blood**

---

- **0-10% - may be no symptoms**



## **Percentage of COHb in Blood**

---

- **0-10% - may be no symptoms**
- **10-20%- tightening across forehead or headache, dilation of cutaneous vessels & dyspnea**

## **Percentage of COHb in Blood**

---

- **20-30% - throbbing headache, nausea, vomiting, fatigue and irritability**

## **Percentage of COHb in Blood**

---

- **30-40% - syncope upon exertion, severe headache, dizziness, fatigue and weakness**

## **Percentage of COHb in Blood**

---

- **40-50% - confusion, syncope, tachypnea & tachycardia, risk of collapsing, pulse & respiration increasing**

## **Percentage of COHb in Blood**

---

- **50-60% - respiratory failure, collapse, convulsions or seizures, comatose state**

## **Percentage of COHb in Blood**

---

- **60-70% - respiratory failure, severe hypotension, coma, convulsions, may be fatal**

## **Percentage of COHb in Blood**

---

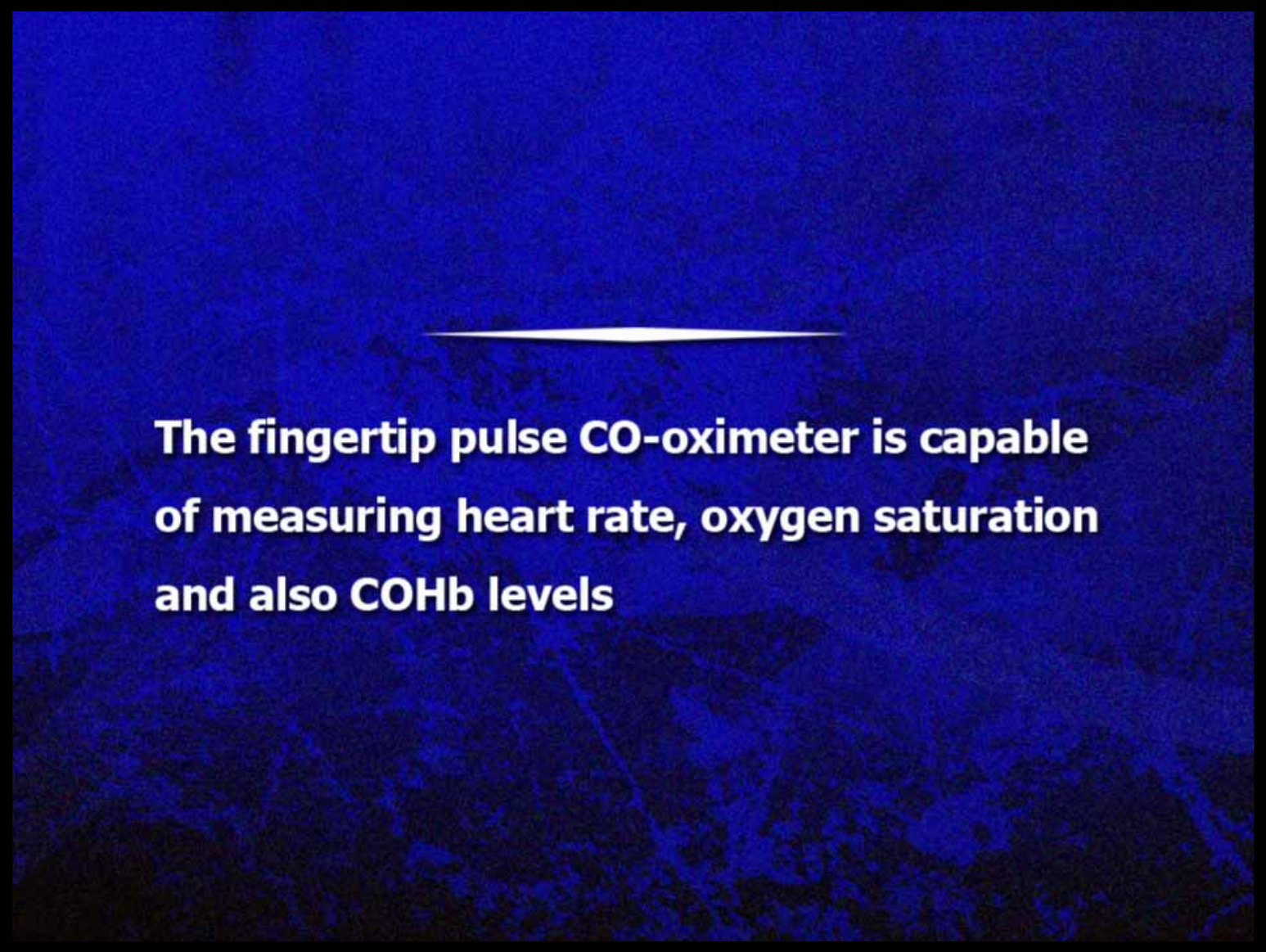
- **>70% - comatose rapidly becoming fatal**

## **Measuring CO in Blood**

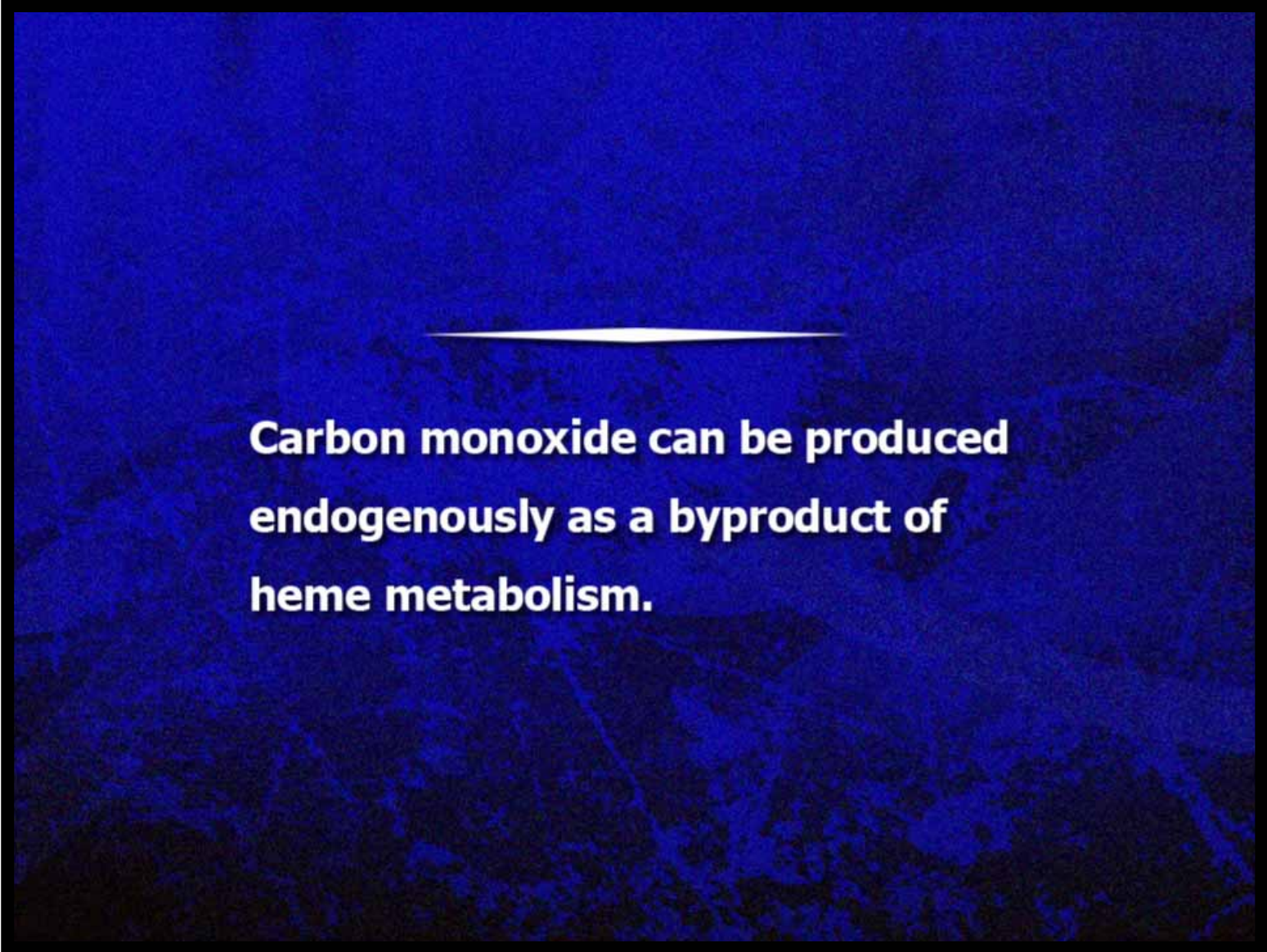
---

**The most common technology available in hospital laboratories for analyzing the blood is the multiple wavelength spectrophotometer, also known as a CO-oximeter**

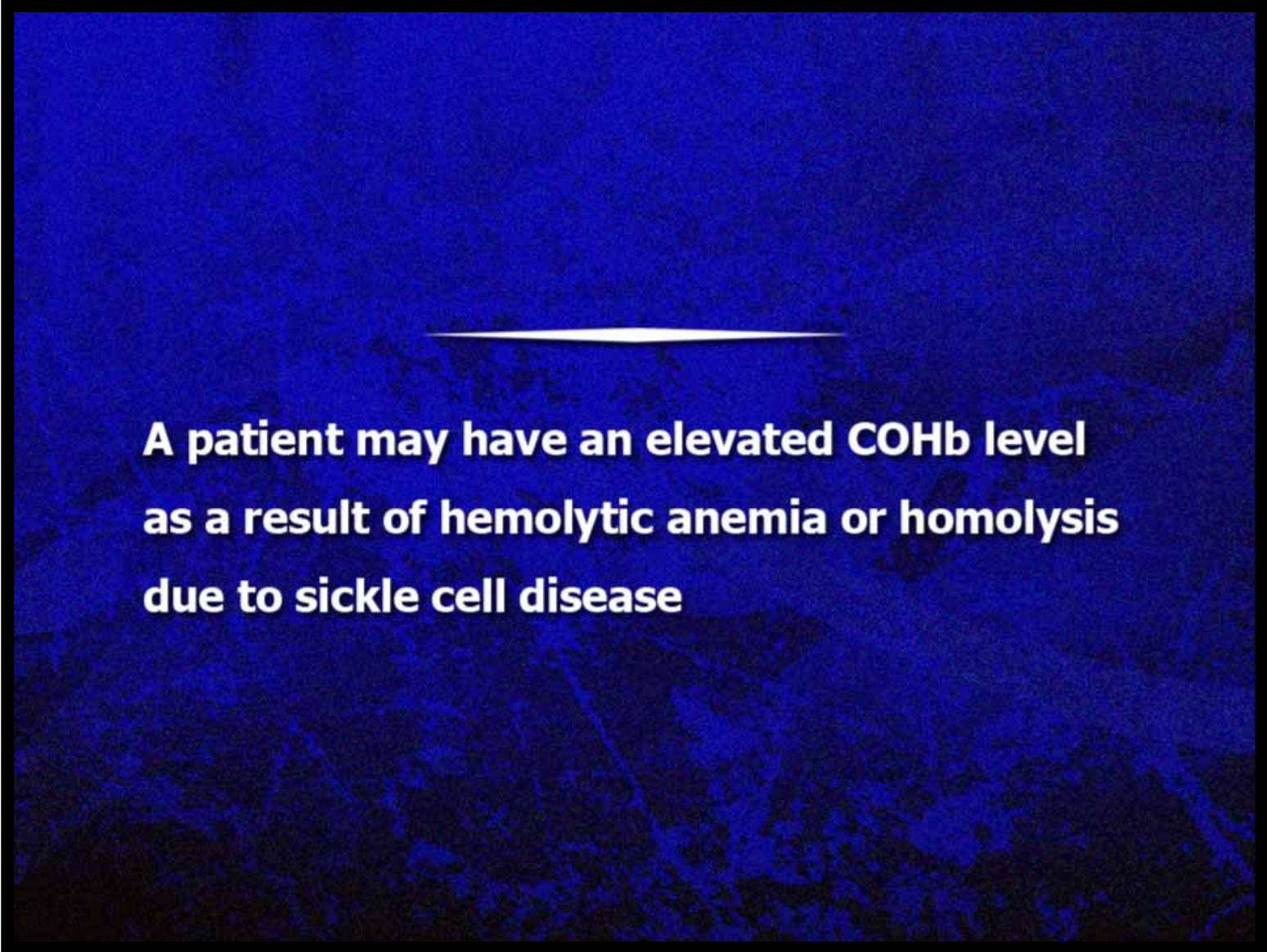




**The fingertip pulse CO-oximeter is capable  
of measuring heart rate, oxygen saturation  
and also COHb levels**



**Carbon monoxide can be produced  
endogenously as a byproduct of  
heme metabolism.**



**A patient may have an elevated COHb level  
as a result of hemolytic anemia or hemolysis  
due to sickle cell disease**

## Measurement of Exhaled CO

---

- **Non-smokers: 0-6 ppm**
- **Smokers: up to 70 ppm**

## **Suspected CO Poisoning**

---

- **Evacuate the area**
- **Ventilate environment**
- **Determine the source**

## **Suspected CO Poisoning**

---

- **Administer 100% oxygen**
- **Continue until patient is symptom-free, about 4 -5 hours**

## **Consider HBO<sub>2</sub> therapy when:**

- **A COHb level of more than 25 – 30%**
- **Evidence of cardiac involvement**
- **Severe acidosis**
- **Transient or prolonged unconsciousness**

## **Consider HBO<sub>2</sub> therapy when:**

- **Neurological impairment**
- **Abnormal neuropsychiatric testing**
- **Age greater or equal to 36**



## **HBO<sub>2</sub> Therapy Results**

---

- **Decreased platelet aggregation & degranulation**
- **Decreased neutrophil chemotaxis**
- **Decreased rise in NO levels**
- **Clearly demonstrated antioxidant properties**

## **HBO<sub>2</sub> Therapy Results**

---

- **Increased dissolved oxygen content in blood**
- **Prevention of lipid peroxidation in the brain**
- **Preservation of ATP levels in tissue exposed to CO**

## **HBO<sub>2</sub> vs. Mask Oxygen Therapy**

---

- **Eliminates CO from body more rapidly**
- **Improves tissue oxygenation**
- **Reduces rate of subsequent cognitive dysfunction**

## Effects of HBO<sub>2</sub> Therapy

- 33% of patients NOT treated with HBO<sub>2</sub> had cognitive sequelae
- 18% of patients treated had sequelae

## **Aftereffects of CO Poisoning**

---

- **43% of patients exhibited affective problems 1 year following poisoning**

## **Aftereffects of CO Poisoning**

---

- **Cardiac injury during poisoning increases risk of mortality over next 10 years**

## **Prevention of CO Poisoning**

---

- **Have all gas, oil or coal burning appliances serviced yearly**

## **Prevention of CO Poisoning**

---

- **Call for service if an odor exists from gas refrigerator cooling unit**



## **Prevention of CO Poisoning**

---

- **Purchase gas equipment with the seal of a national testing agency such as AGA or UL**

## **Prevention of CO Poisoning**

---

- **Allow for appropriate venting of gas appliances in home, cabin or camper**

## **Prevention of CO Poisoning**

---

- **Indoor vent pipes should be angled upward as they go outdoors and don't patch them with tape**

## **Prevention of CO Poisoning**

---

- **Chimneys should be cleaned every year**

## **Prevention of CO Poisoning**

---

- **Have your car's exhaust system checked yearly**



[www2a.cdc.gov/phtn/webcast/COPoisonPrev](http://www2a.cdc.gov/phtn/webcast/COPoisonPrev)

057

# **Continuing Education Credit**

---

**[www2a.cdc.gov/TCEOnline](http://www2a.cdc.gov/TCEOnline)**

**Course number: WD1233**

**CE Expiration Date: 9/20/2010**

**Produced for**

---

**Environmental Hazards  
and Health Effects (EHHE)**

**National Center for Environmental  
Health (NCEH)**



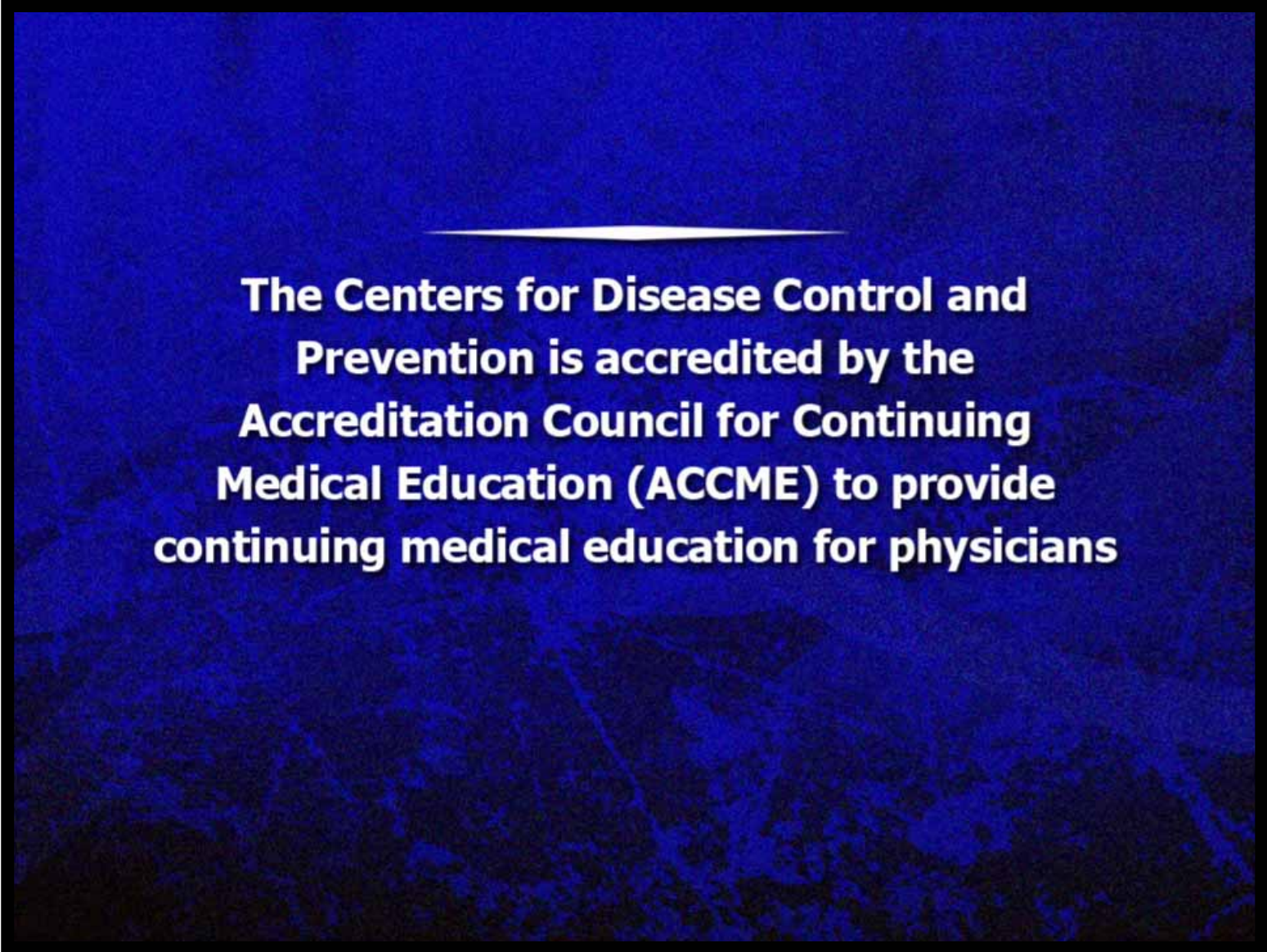
**Produced by**

---

**Centers for Disease Control and Prevention**

**Department of Health and Human Services**

060



**The Centers for Disease Control and  
Prevention is accredited by the  
Accreditation Council for Continuing  
Medical Education (ACCME) to provide  
continuing medical education for physicians**

**The Centers for Disease Control and Prevention designates this educational activity for a maximum of 1.0 category 1 credits toward the AMA Physician's Recognition Award. Each physician should claim only those credits that he/she actually spent in the activity.**

---

**This activity for 1.0 contact hours is provided by the Centers for Disease Control and Prevention, which is accredited as a provider of continuing education in nursing by the American Nurses Credentialing Center's Commission on Accreditations.**

---

**The CDC has been reviewed and approved  
as an Authorized Provider by the  
International Association for Continuing  
Education and Training (IACET), 8405  
Greensboro Drive, Suite 800, McLean, VA  
22102. The CDC has awarded 0.1 of CEU's  
to participants who successfully  
complete this program.**