Carbon Monoxide Poisoning, Smoke Inhalation, Cyanide Poisoning

Condell EMS System CE

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Objectives

Upon successful completion of this module, the EMS provider will be able to:

1. Identify physical characteristics of CO
2. Identify sources of CO
3. Identify statistics of CO incidents
4. Identify pathophysiology of CO poisoning
5. Identify CO effects on hemoglobin
6. Identify CO effects on major body systems
7. Identify CO exposures and limits (ppm)
8. Discuss importance of being able to monitor CO levels for patients
Objectives cont’d

- 9. Identify signs/symptoms of CO poisoning and smoke inhalation
- 10. Identify the treatment of CO poisoning and smoke inhalation
- 11. Identify possible long term effects of CO poisoning
- 12. Identify the difference between acute and chronic CO poisoning
- 13. Identify complications related to smoke inhalation
- 14. Identify preventive measures to prevent possible exposure to EMS personnel
- 15. Identify physical characteristics of cyanide
Objectives cont’d

16. Identify common sources of cyanide
17. Identify the pathophysiology of cyanide poisoning
18. Identify body tissues most susceptible to cyanide poisoning
19. Identify signs/symptoms of cyanide poisoning
20. Identify the OSHA permissible levels of cyanide
21. Identify the appropriate use of monitors prior to SCBA removal
22. Discuss treatment of cyanide exposure
23. Identify definition of rehab
Objectives cont’d

- 24. Identify the NFPA 1584 Standard related to medical rehabilitation
- 25. Identify the 9 steps of NFPA 1584 rehab
- 26. Identify symptoms of heat stress
- 27. Identify symptoms of cold stress
- 28. Identify preventive measures to reduce the risks of heat/cold stress
- 29. Identify aspects of the importance of proper nutrition
- 30. Identify signs and symptoms of dehydration
- 31. Identify signs and symptoms of over-hydration
Objectives cont’d

- 32. Identify criteria for implementation of the rehab area
- 33. Identify components of the rehab area
- 34. Identify assessment performed in the rehab area
- 35. Identify treatment in the rehab area
- 36. Identify the work to rest ratio
- 37. Identify requirements for returning to work after incident
- 38. Actively participate in case study discussion
- 39. Successfully complete the post-quiz with a score of 80% or better
Carbon Monoxide (CO)

- An odorless, colorless, tasteless gas
- Results from incomplete combustion of carbon-containing fuels
  - Gasoline, wood, coal, natural gas, propane, oil, and methane
- Affects 40 – 50,000 Americans annually who need to seek care
- Kills an additional 6,000 persons annually in the USA
- CO is the #1 cause of poisoning in industrialized countries
Sources of Carbon Monoxide – any combustible item

- Homes
- Cigarette smoke
- House fires
- Automobile exhaust fumes
- Worksites
  - Including fumes from propane-powered equipment like forklifts
- Commercial structures
- Smoke from charcoal-fired cook stoves & ovens
Sources cont’d

- Heat provided to homes
  - Gas-fueled heaters
  - Wood burning stoves

- Indoor stoves

- Camp stoves

- Gas-powered generators

- Recreational environments

- Recreational vehicles

- Boat exhaust fumes
Carbon Monoxide Incidents

- Peak time of day 1800 – 2159
- Overall, 75% of non-fire CO incidents are reported between 0900 and 2259
- Peak months are December and January for non-fire CO incidents
- Almost 9/10 (89%) of non-fire CO incidents took place in the home

Source: Non-Fire Carbon Monoxide Incidents Reported in 2005; NFPA Fact Sheet
What Effect Does Carbon Monoxide Have on Hemoglobin?

- Hemoglobin molecules each contain four oxygen binding sites
- Carbon monoxide binds to hemoglobin
- This binding reduces the ability of blood to carry oxygen to organs
- Hemoglobin occupied by CO is called carboxyhemoglobin
- Body systems most affected are the cardiovascular and central nervous systems
Effects of Carbon Monoxide

- Oxygen cannot be transported because the CO binds more readily to hemoglobin (Hgb) displacing oxygen and forming carboxyhemoglobin
- Premature release of O₂ prior to reaching distal tissue leads to hypoxia at the cellular level
- Inflammatory response is initiated due to poor and inadequate tissue perfusion
- Myocardial depression from CO exposure
  - Dysrhythmias, myocardial ischemia, MI
- Vasodilation – from increased release of nitric oxide; worsening tissue perfusion and leading to syncope
Half-life of Carbon Monoxide

- Half-life – time required for half the quantity of a drug or other substance to be metabolized or eliminated

  - CO half-life on 21% room air $O_2$ – 4 - 6 hours
  - CO half-life on 100% $O_2$ – 80 minutes
  - CO half-life with hyperbaric $O_2$ – 22 minutes
CO Levels

- Fresh air: 0.06 - 0.5 ppm
- Urban air: 1 – 300 ppm
- Smoke filled room: 2 – 16 ppm
- Cooking on gas stove: 100 ppm
- Actively smoking cigarette: 400 – 500 ppm
- Automobile exhaust: 100,000 ppm
Exposure Limits For CO

- OSHA – 50 ppm as an 8-hour-weighted average
- NIOSHA – 35 ppm as an 8-hour-weighted average
  - Set lower than OSHA based on cardiac effects of CO
Expected Carboxyhemoglobin Levels

- Non-smokers – 5%
- Smokers – up to 10%
  - 5 – 6% for a 1 pack per day smoker
  - 7 - 9% for a 2-3 pack per day smoker
  - Up to 20% reported for cigar smokers
- Urban commuter – 5%
CO Poisoning

- Symptoms are often vague, subtle, and non-specific; can easily be confused with other medical conditions;
  - Flu – nausea, headaches
  - Food poisoning - nausea
  - Cardiac and respiratory conditions – shortness of breath, nausea, dizziness, lightheadedness
- CO enters the body via the respiratory system
- Poisoning by small amounts over longer periods of time or larger amounts over shorter time periods
Symptoms of CO Poisoning Related to Levels and Exposure Time

- 50 ppm – no adverse effects with 8 hours of exposure (OSHA limit)
- 200 ppm – mild headache after 2-3 hours
- 400 ppm – serious headache and nausea after 1-2 hours (life-threatening >3 hours)
- 800 ppm – headache, nausea, dizziness after 45 minutes; collapse and unconsciousness after 2 hours; death within 2-3 hours
- 1000 ppm – loss of consciousness after 1 hour
- 1600 ppm – headache, nausea, dizziness after 20 minutes; death within 1 hour
- 3200 ppm – headache, nausea, dizziness after 5-10 minutes; collapse and unconsciousness after 30 minutes; death within 1 hour
- 6400 ppm – headache, dizziness after 1-2 minutes; unconsciousness and danger of death after 10-15 minutes
- 12,800 ppm – immediate physiological effects; unconsciousness and danger of death after 1-3 minutes
Carbon Monoxide Absorption

- Dependent upon:
  - Minute ventilation
    - Amount of air exchanged in the lungs within one minute
  - Duration of exposure
    - The longer the exposure, the more the absorption
  - Concentration of CO in the environment
    - The higher the concentration, the greater the toxicity
  - Concentration of O$_2$ in the environment
    - The lower the O$_2$ concentration to begin with, the faster the symptoms will develop
      - higher altitudes
      - closed spaces
Assessment for CO Exposure

- EMS summoned to monitor the air quality for the presence of carbon monoxide
  - Airborne CO meters are used and documentation made whether there is a patient transport or not
- A more immediate concern is the level of CO in the patient’s blood
  - RAD 57 monitors are a non-invasive tool that allows results in less than 30 seconds
  - Rapid diagnosis leads to rapid and appropriate treatment
Signs and Symptoms CO Poisoning

- Carboxyhemoglobin levels of $<15$ – $20\%$
  - Mild severity
    - Headache
    - Nausea and vomiting
    - Dizziness
    - Blurred vision
Signs and Symptoms CO Poisoning

- Carboxyhemoglobin levels of 21 – 40%
  - Moderate severity
    - Confusion
    - Syncope
    - Chest pain
    - Dyspnea
    - Tachycardia
    - Tachypnea
    - Weakness
Signs and Symptoms CO Poisoning

- Carboxyhemoglobin levels of 41 - 59%
  - Severe
    - Dysrhythmias
    - Hypotension
    - Cardiac ischemia
    - Palpitations
    - Respiratory arrest
    - Pulmonary edema
    - Seizures
    - Coma
    - Cardiac arrest
Signs and Symptoms CO Poisoning

- Carboxyhemoglobin levels of >60%
  - Fatal
    - Death

- Cherry red skin is not listed as a sign
  - An unreliable finding
Increased Risks

- Health and activity levels can increase the risk of signs and symptoms at lower concentrations of CO
  - Infants
  - Women who are pregnant
    - Fetus at greatest risk because fetal hemoglobin has a greater affinity for oxygen and CO compared to adult hemoglobin
  - Elderly
  - Physical conditions that limit the body’s ability to use oxygen
    - Emphysema, asthma
    - Heart disease
  - Physical conditions with decreased $O_2$ carrying capacity
    - Anemia — iron-deficiency & sickle cell
Risks to Firefighters from CO Exposure

- On the job from repeated exposures
  - Structure fires
  - Apparatus fumes
  - Portable equipment fumes
  - Gasoline powered saws
  - Generators

- Premature removal of SCBA equipment increases the risk of exposure
CO Identification

- Sooner the suspicion the sooner the appropriate treatment can be initiated
- Complications to monitor
  - Seizures
  - Cardiac dysrhythmias
  - Cardiac ischemia
CDC Diagnostic Criteria

- **Suspected CO exposure**
  - Potentially exposed person but no credible threat exists

- **Probable CO exposure**
  - Clinically compatible case where credible threat exists

- **Confirmed CO exposure**
  - Clinically compatible case where biological tests have confirmed exposure
Patient Assessment

● Continuously monitor SpO$_2$ and SpCO levels
  - Remember that SpO$_2$ may be falsely normal
  - If you have a CO-oximeter, report the findings to the ED staff
    ● Generally, results >3% indicate suspicion for CO exposure in non-smoker
● Cardiac monitor
● 12 lead EKG obtained and transmitted to ED
Pulse Oximetry

- Device to analyze infrared signals
- Measures the percentage of oxygenated hemoglobin (saturated Hgb)
- Can mistake carboxyhemoglobin for oxyhemoglobin and give a false normal level of oxyhemoglobin
- Never rely just on the pulse oximetry reading; always correlate with clinical assessment
Pulse CO-oximeter Device

- Hand-held device
- Attaches to a finger tip similar to pulse ox device
- Most commonly measured gases in commercial devices include
  - Carbon monoxide (SpCO)
  - Oxygen (SpO₂)
  - Methemoglobin (SpMet)
  - Other combustible gases
- Without the device, need to draw a venous sample of blood to test for CO levels
Pulse CO-oximeter Tool

- Firefighters have an increased exposure risk
  - Active firefighting
  - Inhaled products of combustion in structure fire
  - Inhaled exhaust from vehicles and power tools

- Rehab operations more efficient when firefighter can be screened for release back to duty
  - Pulse rate, oxygen saturation, carboxyhemoglobin level
Treatment CO Poisoning

- Increasing the concentration of inhaled oxygen can help minimize the binding of CO to hemoglobin
- Some CO may be displaced from hemoglobin when the patient increases their inhaled oxygen concentrations
- Treatment begins with high index of suspicion and removal to a safer environment
- Immediately begin 100% O\textsubscript{2} delivery
Treatment CO Poisoning

- Some guidelines indicate to initiate treatment when SpCO levels exceed 10%; some at 12%
  - Treatment levels vary significantly
  - If you do not have a CO-oximeter to use, maintain a heightened level of suspicion and base treatment on symptoms

- Monitor for complications
  - Seizures
  - Cardiac dysrhythmias
  - Cardiac ischemia
CO Poisoning and CPAP

- CPAP could assist in fully oxygenating hemoglobin
- If considered, call Medical Control for permission to use CPAP
Long Term Effects CO Exposure

- Hypoxemia follows CO exposure
- Effects of hypoxemia from CO exposure is dependent on presence of underlying diseases
- Hypoxemia can cause the formation of free radicals – dangerous chemicals
Long Term Cardiovascular Effects

- Myocardial injury from hypoxia and cellular damage
  - Pump failure
  - Cardiac ischemia
  - Later development cardiovascular complications
  - Premature death especially if myocardial damage at the time of initial exposure

- Factors increasing myocardial injury risk
  - Male gender
  - History hypertension
  - GCS <14 when patient first found
Long Term Neurological Effects

- Effects are primarily affective (mood) and cognitive (thought)
  - Increased depression and anxiety regardless if exposure accidental or suicidal attempt
  - Phenomenon called delayed neurological syndrome (1 - 47% of cases)
    - More likely if there was a loss of consciousness
    - Behavioral and neurological deterioration
    - Memory loss, confusion, ataxia, seizures, urinary & fecal incontinence, emotional lability, disorientation, hallucinations, mutism, cortical blindness, psychosis, gait disturbances, Parkinsonism
Increased Risk to Firefighters

- CO and other poisonous gas exposure present to the occupation
  - Often the SCBA is not worn through all phases of fire operations
- Most duty-related firefighter deaths result from cardiovascular disease
  - Increased risks in this population
    - Smoking
    - Obesity
    - Lack of exercise
    - Dietary issues
- Studies have not correlated chronic CO exposure with additional risk factors – just something to consider
Methylene Chloride

- Product used in industry as a paint and adhesive remover.
- Repetitive and prolonged exposure can result in development of CO
  - Slowly metabolized to CO in the liver following exposure
- Contamination risk to rescuer
  - Patient’s clothing, skin, vomitus from off-gassing
- Watch for same signs & symptoms as CO
- Treatment – high flow oxygen therapy
Smoke Inhalation

- Expect inhalation injury when patients are trapped or unconscious in an enclosed space
  - Can also occur in open space if smoke is dense enough
- Enclosed space inhalation hazards
  - Noxious, poisonous gases
  - Heated air
  - Flames
  - Steam
Signs and Symptoms Smoke Inhalation

- Hoarseness
- Dyspnea
- Stridor (high-pitched crowing) on inspiration
- Singed facial and nasal hair
- Black-tinged (carbonaceous) sputum
- Facial burns
Assessment for Smoke Inhalation

- Monitoring pulse oximetry
- Frequently reassessing vital signs
  - Watch for changes in the respiratory system
  - Frequently reassess breath sounds listening for any changes
- Listen for changes in tone of speech
  - Hoarseness will develop
- If CO-oximeter available, evaluate for the presence of CO
Treatment for Smoke Inhalation

- With suspected thermal or chemical airway burns, airway compromise is highly potential
- Intubation needs to be considered and prepared for
- Administer 100% O₂ as soon as possible
  - Treats hypoxia
  - Displaces CO, if present, from hemoglobin
- Establish IV access
Complications of Smoke Inhalation

- Swelling of the highly vascular tissues
  - Airway restrictions
  - Severe dyspnea
  - Respiratory arrest

- In any environment where carbon monoxide is present, cyanide should be suspected
Protecting EMS Personnel From Smoke Inhalation

- Exercising all means of scene safety
- Wearing and using all means of protective equipment available and keeping it in place
- Reporting to medical rehab if feeling ill
- Following the guidelines and advice of personnel in medical rehab
Cyanide Poisoning

- Cyanide can be any of various salts or esters of hydrogen cyanide containing a CN group
  - Contains especially poisonous compounds potassium cyanide and sodium cyanide
- Rapidly fatal without an antidote
Physical Characteristics Cyanide

- Colorless gas with a faint smell of bitter almonds
  - 40% of population cannot smell cyanide
- Can be ingested or inhaled
Sources Cyanide

- Found during combustion of plastics, wool, silk, synthetic rubber, polyurethane, asphalt
- Most accidental exposure is to cyanide gas
- Most intentional exposure (i.e., suicide or homicide attempts) are to cyanide powder
OSHA Permissible Levels of Cyanide

- 10 ppm as an 8-hour time-weighted average
Pathophysiology of Cyanide Effects

- Cyanide is a cellular toxin
- Inhibits an enzyme involved in energy production in the cells (ATP)
- Cells shift from aerobic to anaerobic metabolism
- Energy production dramatically decreased
Susceptible Body Tissues to Cyanide

- Cardiovascular and central nervous system most affected body systems
- Exposure is rapidly fatal unless antidote quickly administered
Signs and Symptoms Cyanide Exposure

Levels measured as the methemoglobin level

- 1-3% - asymptomatic
- 3-15% - slight grayish-blue skin discoloration
- 15-20% - asymptomatic, but cyanotic
- 25-50% - headache, dyspnea, confusion, weakness, chest pain
- 50-70% - altered mental status, delirium
Early Signs of Low Exposure to Cyanide

- Rapid breathing
- Dizziness
- Weakness
- Nausea and vomiting
- Eye irritation
- Pink or red skin color
- Increased heart rate
- Perspiration
Later Signs of Exposure to Moderate-High Concentrations of Cyanide

- Loss of consciousness
- Respiratory arrest
- Cardiac arrest
- Coma
- Seizures
Monitoring for Cyanide Levels

- Not measurable on standard, hand-held, non-invasive devices
- Must be evaluated for in a hospital setting where a lab draw can be performed and results tested in the laboratory
- For these reasons, health care workers must maintain a high level of suspicion and treat on the assumption of its presence
Cyanide Antidote Kit

- Contents
  - Amyl nitrite, sodium nitrite, sodium thiosulfate
- Nitrites can be dangerous when administered in the presence of additional CO poisoning
  - Oxygen can only bind with the heme (iron) molecule in the ferrous state
  - When hemoglobin converts to methemoglobin, the heme molecule changes to the ferric state of iron
  - Nitrites induce formation of methemoglobin (form of hemoglobin that does not bind/carry oxygen)
- Nitrites not to be given when SpCO is >10%
- Nitrites can also cause hypotension
Signs and Symptoms Methemoglobinemia

- 1-3% SpMet – normal, asymptomatic
- 3-15% SpMet – slight grayish-blue skin
- 15 – 20% - asymptomatic but cyanotic
- 25 – 50% - headache, dyspnea, confusion, weakness, chest pain
- 50 -70% - altered mental status, delirium

Methemoglobinemia is also a complication when Benzocaine (to decrease the gag reflex) is used even under normal 2 second spray time frame
Cyanokit

- This kit uses hydroxocobalamin
  - A form of Vitamin B12 (cyanocobalamin)
  - Binds with the cyanide ion
  - Eliminated through the kidneys
- Preferred kit if concomitant CO and cyanide poisoning suspected
  - Significant signs and symptoms with low CO levels
  - Decreased cardiac output, decreased heart rate
  - Hypotension, shock, and falling ETCO$_2$ levels
- Signs & symptoms of CO and cyanide poisoning indistinguishable
Medical Rehabilitation

- Firefighting has the greatest short-surge of physiological demands compared to any other profession
- 50% of all firefighter deaths occur on-scene
  - Most likely contributing factors are
    - pre-existing medical conditions
    - Inadequate fitness level
    - Incident-related exertion
NFPA 1584

- **Standard on the Rehabilitation Process for Members During Emergency Operations and Training Exercises**
  - Recognition to benefit of on-scene recovery of fire personnel
- Updates *Emergency Incident Rehabilitation* manual published by the US Fire Administration in 1992
- Rehab became a requirement January 2009
Definition of Medical Rehab

- An organized process to allow for rest and recuperation of personnel exposed to an environment that exceeds safe levels of physical or mental endurance
- NFPA 1584 Standard intended to minimize firefighter exhaustion and related injuries and illnesses at the scene
9 Key Components of Rehab per NFPA 1584

- Relief from climactic conditions
- Rest and recovery
- Cooling or rewarming
- Re-hydration
- Calorie and electrolyte replacement
- Medical monitoring/assessment
- EMS treatment/transport per local protocol
- Member accountability for personnel tracking
- Release to return to full duty
Symptoms of Heat Stress

- Heat exposure can result in:
  - Heat rashes
  - Heat cramps
  - Heat exhaustion
  - Heat stroke

- Injuries can increase related to:
  - Sweaty palms
  - Fogged glasses
  - Dizziness
Heat Cramps

- Usually affect those that are sweating causing a depletion of body salt and moisture
- Muscle pain or cramps usually in abdomen, arms, and legs
- Treatment
  - Rest
  - Drink fluids
Heat Exhaustion

- Body’s response to excessive loss of water and salt usually through excessive sweating
- Heavy sweating, extreme weakness/fatigue, dizziness, confusion, clammy/moist skin, pale or flushed complexion, muscle cramps, slightly elevated temp, fast & shallow breathing
- Treatment
  - Rest in cool environment
  - Drink extra fluids
  - Cool off with shower or other water source
Heat Stroke

- The most serious of heat stress injuries
- Body unable to control its temperature
- Sweating mechanism fails; body does not cool
- Hot/moist skin when exertional heat stroke, (hot & dry in classic heat stroke); hallucinations; throbbing headache; high body temp; confusion/dizziness; slurred speech, hypotension

- Treatment
  - Cool environment; fan and spray body; ice paks to body
  - IV access
  - $O_2$ therapy
Symptoms of Cold Stress

- Cold exposure can result in:
  - Chilblains
  - Trench foot
  - Frostbite
  - Hypothermia

- When temperatures drop and the wind chill increases, persons become susceptible to cold emergencies.
Chilblains

- From repeated exposure of skin to temperatures from just above freezing to 60°F
- Cold exposure damages capillary beds in skin
- Damage is permanent
- Redness & itching return with each new exposure
- Vulnerable areas
  - Cheeks
  - Ears
  - Fingers & toes
Chilblains

- Redness & itching
- Possible blistering
- Inflammation

Treatment
- Slowly warm skin
- Cover blisters with dry dressing
Trench Foot/Immersion Foot

● Injury to feet from prolonged exposure to wet and cold conditions
● Wet feet lose heat 25 times faster than dry
● Body is constricting blood vessels to prevent heat loss which decreases circulation
● Red skin, numbness, leg cramps, swelling, tingling pain, blisters, bleeding
● Treatment
  – Remove wet shoes and socks
  – Dry feet
  – Avoid walking on feet to minimize tissue damage
Frostbite

- Injury caused by freezing
- Often affects nose, ears, cheeks, chin, fingers, toes
- Numbness. Tingling or stinging, aching, bluish or pale, waxy skin
- Treatment
  - Get into warm environment
  - Warm affected area using body heat (ie: armpit)
  - Do not walk on injured feet
  - Immerse part in warm water
  - Do not rub or massage area – more damage likely
Hypothermia

- Heat lost faster than produced
- Uses up stores of energy
- Early symptoms: shivering, fatigue, loss of coordination, confusion & disorientation
- Late symptoms: no shivering, blue skin, dilated pupils, slowed pulse and breathing, loss of consciousness

Treatment
  - Remove from wet, cold environment
  - Warm from center of body first
Reducing Risk of Heat/Cold Stress

- Passive cooling
  - Sweating
  - Removing PPE
  - Moving to a cool environment
- Active cooling
  - Immersion in water
  - Misting fans
  - Ice vests
- Evaluation for frostbite
Nutritional Maintenance

- Fluids: water, electrolyte solutions
- Food: soup, broth, stew, fruit
- Recommendation to drink 500 ml (16 oz) of fluid prior to training exercise
- In rehab, recommendation to drink 5 – 7 ounces of fluid for every 20-30 minutes of heavy or moderate work
Signs and Symptoms Dehydration

- Increased thirst
- Excessive perspiration
- Tachycardia
Signs and Symptoms Over-hydration

- Tachycardia
- Crackles in lung bases
Implementing Medical Rehab

- Recommended any time scene response or training poses a risk to responders by exceeding a safe level of physical or mental endurance.
- Recommendations, at minimum, to rotate through rehab after completing a work cycle of finishing 2 – 30 minute bottles or 1 – 45 minute bottle.
- Need to provide an area to rehydrate and rest.
Components of Rehab Area

- Shelter including seating
- Fluid and calorie replenishment
- Rehab equipment
- Organized health evaluation
- Opportunity to deliver therapy
- Ability for mental decompression
Assessment Often Performed in Medical Rehab

- VS - Pulse rate, respiratory rate, B/P, temp
- $O_2$ level
- CO level
- Presence of injuries
- Signs or symptoms of illness
- Determination of ability to return to work duty based on pre-set release criteria
- Determination of need for EMS transport to ED based on pre-set transport criteria
NFPA Standard – Specifics to Assess For

- Presence of
  - Chest pain
  - Dizziness
  - Shortness of breath
  - Weakness
  - Nausea
  - Headache

- General complaints such as cramps, aches, pains
- Changes in gait, speech, behavior
- Level of alertness to person, place, time
- Vital signs
  - Determining normal or abnormal ranges
Treatment in Medical Rehab

- If personnel not able to be released back to work (ie: symptoms present), consider that they become a patient
- Provide Routine Medical Care
- Transport to ED or have release signed
- For any person refusing rehab, the immediate supervisor is notified
  - This person should not be allowed to continue to work at the incident site
Work to Rest Ratio

● Rehab after
  - A 2\textsuperscript{nd} 30-minute SCBA used
  - A single unit 45-minute SCBA used
  - Or 40 minutes of intense work without SCBA

● Depending on conditions and environment, time frames may need to be adjusted

● Vital signs taken and recorded at least twice and 10 minutes apart

● Repeat vital signs in 10 minutes if levels abnormal
Requirements to Return to Work

- No consensus established
- To be defined by each department’s medical authority
  - Which parameters to measure and what levels are considered acceptable/normal are determined
  - Typical heart rates are under 120 beats per minute
  - Typical SpO2 are >92%
  - Typical CO-oximeter readings <5% in nonsmokers and <8% in smokers
Equipment in Rehab

- Blood pressure cuffs, stethoscopes
- Thermometers
- Pulse oximetry
- CO-oximeter
- $O_2$ delivery devices
- Cardiac monitor/defibrillator
- IV equipment
- Resuscitation drugs
Case Study Discussion

- Review the following cases.
- What is your assessment?
  - Think out-of-the-box
- What would be your treatment?
- Would you transport this patient?
Case Study #1

- Called for a 42 year-old male in a factory experiencing heat exhaustion
- Pt confused, agitated, sweating
- VS within normal limits

- What are your general impressions/suspicions?
- What is included in your assessment?
- What is your treatment?
Case Study #1

- The patient appears to be experiencing a heat related problem and the environment may support this suspicion but consider other possibilities as well.

- Perform as much evaluation as you have equipment for
  - CO levels
  - Glucose levels
  - Head injuries
Case Study #2

- 72 year-old male patient driving erratically and had struck a parked car
- Pt alert, confused, complaining of a headache, nausea, weakness and dizziness with evidence of vomitus on his shirt
- VS normal range; no signs of trauma

- What are your general impressions/suspicions?
- What is included in your assessment?
- What is your treatment?
Case #2

- Again, many possibilities for this behavior
  - Hypoglycemia
  - Head injury
  - ETOH
  - CO exposure
  - Could be normal for this patient
- Evaluate vital signs and neurological signs
- Evaluate glucose level
- Evaluate Cincinnati stroke scale
- Evaluate for a CO level if you have a CO-oximeter
Case #3

- Call to a local banquet hall for ill persons
- 5 guests complaining of dizziness, weakness, and nausea. All patients were from the same event; no illnesses from other simultaneous banquet

- What are your general impressions/suspicions?
- What is included in your assessment?
- What is your treatment?
Case #3

- The citizens all thought they had suffered from food poisoning
- As word spread, more patients presented to EMS with complaints
- A multiple patient incident plan was put into place
- When rescuers began to become ill, CO was suspected and tested for
- CO levels were found to be elevated
- Evacuation was performed
- Reentry into the scene with SCBA in place
Case #4

- Received call from a 10 year-old child that he could not wake up his mother. On arrival the 34 year-old female was unconscious with signs of seizure activity. 2 other children are in the home.

- What are your general impressions/suspicions?
- What is included in your assessment?
- What is your treatment?
Case #4

- Upon scene arrival, a faint odor of exhaust was noted
- Evaluate the patient for normal reasons of altered level of consciousness including history of seizure disorder and suicide attempt
- After 5 minutes on scene, rescue personnel began complaining of headache
- A car was found running in the garage directly under the bedroom/bathroom
Case #5

- Call received to a local camp ground for 3 unresponsive persons. One patient had no respirations; the other 2 had slowed, shallow respirations. There was evidence of ethanol consumption and minor drug paraphernalia was evident.

- What are your general impressions/suspicions?
- What is included in your assessment?
- What is your treatment?
Case #5

- CO poisoning should be immediately suspected due to the environment
- This could also be drug/ETOH related problems
- 2 patients need immediate initiation of ventilation support
- Depending on resources available, a 3rd victim would need resuscitation if no contraindication noted
- This sight would most likely become a crime scene increasing the number of persons in it
Case #6

- Called for a 78 year-old female not feeling well. You had transported her 2 days ago for a fall from dizziness. Today, complaints are continued dizziness and a severe headache. The patient has extensive respiratory and cardiac histories.

- What are your general impressions/suspicions?
- What is included in your assessment?
- What is your treatment?
Case #6

- From the earlier fall, the patient had healing soft tissue facial injuries
- Room was filled with cigarette smoke
- GCS 15
- SpO₂ was 83%
- SpCO level was 13%
- Husband had just recently turned on the furnace for the first time that season
Bibliography

- NFPA 1584
- Firerehab.com
- www.nfpa.org