

# **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 at 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
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- 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 O<sub>2</sub> 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<sub>2</sub> – 4 - 6 hours
- CO half-life on 100% O<sub>2</sub> – 80 minutes
- CO half-life with hyperbaric O<sub>2</sub> – 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

# Levels & Exposure Time Cont'd

Source: NFPA Fire Protection Handbook, 20<sup>th</sup> Edition

- 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<sub>2</sub> in the environment
    - The lower the O<sub>2</sub> 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<sub>2</sub> 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<sub>2</sub> and SpCO levels
  - Remember that SpO<sub>2</sub> 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 (SpO<sub>2</sub>)
  - 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<sub>2</sub> 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

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- 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% O<sub>2</sub> 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

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- 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 (ie: 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  $\text{ETCO}_2$  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 packs to body
  - IV access
  - O<sub>2</sub> 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

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- 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

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- Increased thirst
- Excessive perspiration
- Tachycardia

## Signs and Symptoms Over-hydration

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- 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

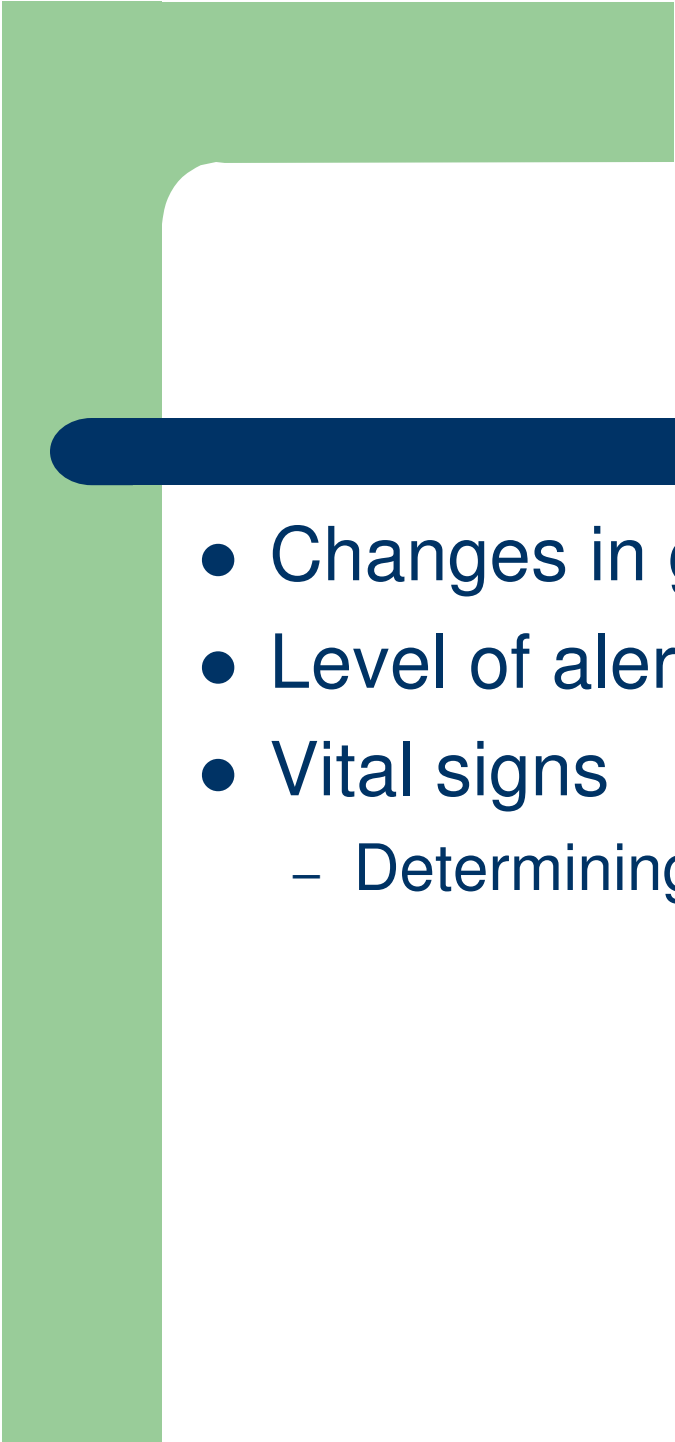



## Assessment Often Performed in Medical Rehab

- VS - Pulse rate, respiratory rate, B/P, temp
- O<sub>2</sub> 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

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- 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<sup>nd</sup> 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<sub>2</sub> 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/suspensions?
- 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/suspicious?
- 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/suspensions?
- 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/suspensions?
- 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/suspensions?
- 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 3<sup>rd</sup> 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

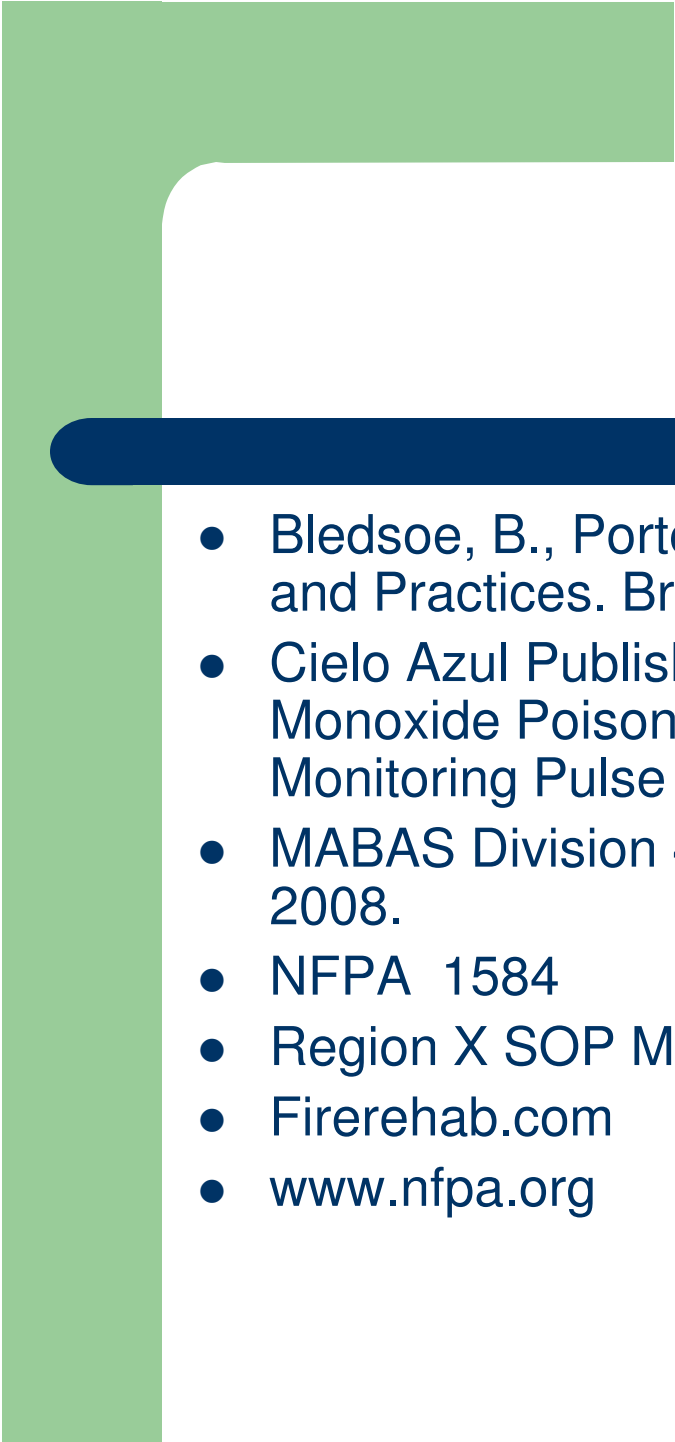

- Called for a 78 year-old female not feeling well. You had transported her 2 days ago for a fall from dizziness. Today, complaints are continued dizziness and a severe headache. The patient has extensive respiratory and cardiac histories.
- What are your general impressions/suspensions?
- What is included 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
- SpO<sub>2</sub> was 83%
- SpCO level was 13%
- Husband had just recently turned on the furnace for the first time that season

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