UNIT TERMINAL OBJECTIVE

8-3 At the completion of this unit, the paramedic student will be able to integrate the principles of rescue awareness and operations to safely rescue a patient from water, hazardous atmospheres, trenches, highways, and hazardous terrain.

COGNITIVE OBJECTIVES

At the completion of this unit, the paramedic student will be able to:

8-3.1 Define the term rescue. (C-1)
8-3.2 Explain the medical and mechanical aspects of rescue situations. (C-1)
8-3.3 Explain the role of the paramedic in delivering care at the site of the injury, continuing through the rescue process and to definitive care. (C-1)
8-3.4 Describe the phases of a rescue operation. (C-1)
8-3.5 List and describe the types of personal protective equipment needed to safely operate in the rescue environment to include: (C-1)
- a. Head protection
- b. Eye protection
- c. Hand protection
- d. Personal flotation devices
- e. Thermal protection/ layering systems
- f. High visibility clothing
- g. Specialized footwear

8-3.6 Explain the differences in risk between moving water and flat water rescue. (C-1)
8-3.7 Explain the effects of immersion hypothermia on the ability to survive sudden immersion and self rescue. (C-1)
8-3.8 Explain the phenomenon of the cold protective response in cold water drowning situations. (C-1)
8-3.9 Identify the risks associated with low head dams and the rescue complexities they pose. (C-1)
8-3.10 Given a picture of moving water, identify and explain the following features and hazards associated with: (C-2)
- a. Hydraulics
- b. Strainers
- c. Dams/ hydro-electric sites

8-3.11 Explain why water entry or go techniques are methods of last resort. (C-1)
8-3.12 Explain the rescue techniques associated with reach-throw-row-go. (C-1)
8-3.13 Given a list of rescue scenarios, identify the victim survivability profile and which are rescue versus body recovery situations. (C-1)
8-3.14 Explain the self rescue position if unexpectedly immersed in moving water. (C-1)
8-3.15 Given a series of pictures identify which would be considered "confined spaces" and potentially oxygen deficient. (C-3)
8-3.16 Identify the hazards associated with confined spaces and risks posed to potential rescuers to include: (C-1)
- a. Oxygen deficiency
- b. Chemical/ toxic exposure/ explosion
- c. Engulfment
- d. Machinery entrapment
- e. Electricity

8-3.17 Identify components necessary to ensure site safety prior to confined space rescue attempts. (C-1)
8-3.18 Identify the poisonous gases commonly found in confined spaces to include: (C-1)

a. Hydrogen sulfide (H_2S)
b. Carbon dioxide ($C0_2$)
c. Carbon monoxide (CO)
d. Low/ high oxygen concentrations ($Fi0_2$)
e. Methane (CH_4)
f. Ammonia (NH_3)
g. Nitrogen dioxide (NO_2)

8-3.19 Explain the hazard of cave-in during trench rescue operations. (C-1)
8-3.20 Describe the effects of traffic flow on the highway rescue incident including limited access superhighways and regular access highways. (C-1)
8-3.21 List and describe the following techniques to reduce scene risk at highway incidents: (C-1)
a. Apparatus placement
b. Headlights and emergency vehicle lighting
c. Cones, flares
d. Reflective and high visibility clothing
8-3.22 List and describe the hazards associated with the following auto/ truck components: (C-1)
a. Energy absorbing bumpers
b. Air bag/ supplemental restraint systems
c. Catalytic converters and conventional fuel systems
d. Stored energy
e. Alternate fuel systems
8-3.23 Given a diagram of a passenger auto, identify the following structures: (C-1)
a. A, B, C, D posts
b. Fire wall
c. Unibody versus frame designs
8-3.24 Describe methods for emergency stabilization using rope, cribbing, jacks, spare tire, and come-a-longs for vehicles found on their: (C-1)
a. Wheels
b. Side
c. Roof
d. Inclines
8-3.25 Describe the electrical hazards commonly found at highway incidents (above and below ground). (C-1)
8-3.26 Explain the difference between tempered and safety glass, identify its locations on a vehicle and how to break it safely. (C-3)
8-3.27 Explain typical door anatomy and methods to access through stuck doors. (C-1)
8-3.28 Explain SRS or "air bag" systems and methods to neutralize them. (C-1)
8-3.29 Define the following terms: (C-1)
a. Low angle
b. High angle
c. Belay
d. Rappel
e. Scrambling
f. Hasty rope slide
8-3.30 Describe the procedure for stokes litter packaging for low angle evacuations. (C-1)
8-3.31 Explain the procedures for low angle litter evacuation to include: (C-1)
a. Anchoring
b. Litter/ rope attachment
c. Lowering and raising procedures

8-3.32 Explain techniques to be used in non-technical litter carries over rough terrain. (C-1)
8-3.33 Explain non-technical high angle rescue procedures using aerial apparatus. (C-1)
8-3.34 Develop specific skill in emergency stabilization of vehicles and access procedures and an awareness of specific extrication strategies. (C-1)
8-3.35 Explain assessment procedures and modifications necessary when caring for entrapped patients. (C-1)
8-3.36 List the equipment necessary for an "off road" medical pack. (C-1)
8-3.37 Explain specific methods of improvisation for assessment, spinal immobilization and extremity splinting. (C-1)
8-3.38 Explain the indications, contraindications and methods of pain control for entrapped patients. (C-1)
8-3.39 Explain the need for and techniques of thermal control for entrapped patients. (C-1)
8-3.40 Explain the pathophysiology of "crush trauma" syndrome. (C-1)
8-3.41 Develop an understanding of the medical issues involved in providing care for a patient in a rescue environment. (C-1)
8-3.42 Develop proficiency in patient packaging and evacuation techniques that pertain to hazardous or rescue environments. (C-1)
8-3.43 Explain the different types of "stokes" or basket stretchers and the advantages and disadvantages associated with each. (C-1)

AFFECTIVE OBJECTIVES
None identified for this unit.

PSYCHOMOTOR OBJECTIVES
At the completion of this lesson, the paramedic student should be able to:

8-3.44 Using cribbing, ropes, lifting devices, spare tires, chains, and hand winches, demonstrate the following stabilization procedures: (P-1)
- a. Stabilization on all four wheels
- b. Stabilization on its side
- c. Stabilization on its roof
- d. Stabilization on an incline/ embankments

8-3.45 Using basic hand tools demonstrate the following: (P-1)
- a. Access through a stuck door
- b. Access through safety and tempered glass
- c. Access through the trunk
- d. Access through the floor
- e. Roof removal
- f. Dash displacement/ roll-up
- g. Steering wheel/ column displacement
- h. Access through the roof

8-3.46 Demonstrate methods of "stokes" packaging for patients being: (P-1)
- a. Vertically lifted (high angle)
- b. Horizontally lifted (low angle)
- c. Carried over rough terrain

8-3.47 Demonstrate methods of packaging for patients being vertically lifted without stokes litter stretcher packaging. (P-1)
8-3.48 Demonstrate the following litter carrying techniques: (P-1)
- a. Stretcher lift straps
- b. "Leap frogging"

c. Passing litters over and around obstructions

8-3.49 Demonstrate litter securing techniques for patients being evacuated by aerial apparatus. (P-1)
8-3.50 Demonstrate in-water spinal immobilization techniques. (P-1)
8-3.51 Demonstrate donning and properly adjusting a PFD. (P-1)
8-3.52 Demonstrate use of a throw bag. (P-1)

DECLARATIVE

I. Role of the paramedic in rescue operations
   A. Definition of rescue according to Webster - the act of delivery from danger or imprisonment
      1. Humans who are traumatized or stranded need rescue
      2. No patient - no rescue
      3. Rescue is a patient driven event
   B. Rescue involves both medical and mechanical skills with the correct amount of each applied at the appropriate time
      1. Patients must be accessed and assessed for treatment needs
      2. Patient treatment must begin at the site
      3. Patient must be released from entrapment or imprisonment
      4. Medical care must continue throughout the incident
      5. There is no army in the world that does not train and deploy medical people into combat
      6. Medical and mechanical skills must be carefully balanced to ensure that patients obtain effective treatment and timely extraction
      7. Must have a well coordinated effort between medical care and specialized rescue effort
      8. Rescue effort must be driven by the patient's medical and physical needs
   C. Role of the paramedic in rescue operations
      1. Have proper training and PPE to allow access and the provision of treatment at the site and continuing throughout the incident
      2. As first responders to many incidents
         a. Understand hazards associated with various environments
         b. Know when it is safe/ unsafe to gain access or attempt rescue
         c. Have skills to effect a rescue when safe and necessary
         d. Understand the rescue process and when certain techniques are indicated or contraindicated
      3. Be skilled in specialized patient packaging techniques to allow safe extraction and medical care
   D. Phases of a rescue operation
      1. Arrival and size-up
         a. Responders must understand the environment and risks
         b. Establish command and conduct a scene assessment
         c. Determine the number of patients and triage as necessary
         d. Determine if situation is a search, rescue or body recovery
         e. Risk versus benefit analysis
         f. Request additional resources
         g. ICS used as a command/ control mechanism
         h. Make a realistic "time" estimate in accessing and evacuating
      2. Hazard control
         a. Control as many of the hazards as possible
         b. Manage, reduce and minimize the risks from the uncontrollable hazards
         c. Make the scene as safe as possible
         d. Ensure all personnel are in PPE appropriate for the situation
      3. Gain access to the patient
         a. Determine the best method to gain access to the patient
         b. Deploy personnel to the patient
         c. Stabilize the physical location of the patient

4. Medical treatment
    a. Medical treatment provided appropriate to the situation
5. Disentanglement
    a. Release from physical entrapment
    b. Methods must be driven by patient's needs
    c. Risk versus benefit assessment
    d. Could involve use of specialized equipment and techniques
6. Patient packaging
    a. Patient packaged to ensure their medical needs are addressed
    b. Physically secure to prevent additional injury
7. Transportation
    a. Often as simple as carrying the patient to an ambulance
    b. Could involve air evacuation
    c. Could involve specialized operations

II. Rescuer personal protective equipment (PPE)
A. Rescuer protection
1. The same PPE is not appropriate in all situations
    a. PPE must be appropriate for/ to the situation encountered
    b. PPE may not prevent exposure to infectious disease but it does minimize risk
    c. Most PPE is not specifically designed for EMS workers
2. EMS PPE historically has been adapted from other fields
    a. EMS does not have a national uniform trauma reporting system to identify potential work related exposures
    b. Risk management and PPE design needs to be driven by data

B. Head/ eye/ hearing/ hand/ foot protection
1. Adequate head protection depends on the environment
    a. Compact firefighter's helmet meeting NFPA standards adequate for most vehicle/ structural applications
    b. Climbing helmet used for many confined space and technical rescue applications
    c. Padded rafting/ kayaking helmet for water rescue
    d. Must meet safety standards for the appropriate application
2. Eye protection
    a. Face shield on most fire helmets is inadequate
    b. ANSI approved safety glasses/ goggles with side shields is best
3. Hearing protection
    a. For high noise areas
    b. Ear plugs or ear muffs
4. Hand protection
    a. Gloves to protect the hands
    b. Must allow for adequate dexterity
    c. Protection from cuts/ puncture
5. Foot protection
    a. Ankle support to limit range of motion
    b. Tread to provide traction and prevent slips
    c. Insulated in some environments
    d. Steel toe/ shank required to meet some safety requirements

C. Flame/ flash protection

1. Nomex/ PBI/ flame retardant cotton designed to provide limited flash protection
    a. Turnout clothing
    b. Jump-suits/ flyers coveralls
2. Does not provide complete protection from puncture or cuts
3. Thermal protection from turnout clothing increases heat stress
4. Should be used when danger from fire exists

D. Personal flotation devices (PFD)
1. Meet Coast Guard standards for flotation
2. Must be used when operating on or around the water
3. Type III preferred for most rescue work
    a. Should have whistle and strobe light attached
    b. Knife for cutting should be attached

E. Visibility
1. Reflective trim should be on all outer-wear
2. Orange clothing or safety vests should be used when in highway operations

F. Extended, remote or wilderness protection
1. Additional/ different PPE must be considered for bad weather conditions not normally encountered (cold, rain, snow, wind)
2. Personal drinking water
3. Personal snacks for a few hours
4. Possible shelter needs

III. Surface water rescue

A. Moving water and common hazards
1. Hydraulics of moving water change with many variables
    a. Water depth
    b. Velocity
    c. Obstructions to flow
2. Force of moving water is very deceptive
3. Rescue using "go" techniques requires special skills
4. Rescuer perception
    a. People are drawn to moving water for recreation
    b. Many underestimate the power of the water
    c. Unaware rescuers also underestimate the power of the water
    d. Fail to understand the hazards involved
5. "Drowning machines"- recirculating currents
    a. Water moving over a uniform obstruction to flow
    b. Most commonly found on "low head" dams
    c. Commonly found on many rivers
    d. Innocuous in appearance
    e. Victims caught in the recirculating flow of the current
    f. Escape very difficult
    g. Same hydraulic can be created by many other obstructions
    h. Hazardous rescue
6. Strainers
    a. Water moving through obstructions in flood or river
        (1) Trees
        (2) Grating/ wire mesh

b. Current may move victim into strainer
c. Force of water against victim makes escape difficult
d. Hazardous rescue

7. Foot/ extremity pin
   a. Unsafe to walk in fast moving water over knee depth
   b. If extremity becomes trapped force of water forces victim under the surface
   c. Extremity must be extricated the same way it went in
   d. Hazardous rescue
8. Dams, hydroelectric intakes
   a. Height of dam no indication of the degree of hazard
   b. Intakes can act as strainers
   c. Most dams create recirculating currents
   d. Hazardous rescue

B. Flat water (slow moving or still water)
   1. Most people who drown never planned on being in the water
      a. PFDs routinely worn and fastened properly when on or around the water save lives
      b. Having the PFD available but unworn is not enough
   2. Alcohol consumption is a contributory factor to many flat water boating incidents
      a. Alcohol alters mental ability and reason
   3. Water temperature and hypothermia can quickly incapacitate and lead to drowning
      a. Routine use of PFDs decreases the likelihood of drowning

C. Water temperature
   1. Immersion in cold water can rapidly lead to hypothermia
      a. Any water temperature less than 98 degrees will cause hypothermia
      b. Cannot maintain body heat in water less than 92 degrees
      c. Colder water causes a faster rate of heat loss
      d. Water causes heat loss 25 times faster than air
      e. A 15-20 minute immersion in 35 degree water is likely to kill
   2. Hypothermic patients rapidly lose the ability for self rescue
      a. Sudden immersion in cold water may trigger laryngospasm
      b. Hypothermic victims are unable to follow directions
      c. Hypothermia makes it difficult for a victim to grab anything
      d. Hypothermia increases the likelihood of drowning
      e. Victims become incapacitated and unable to help themselves
   3. Water temperature varies widely with seasons and run off
      a. Even on warm days water temperature can be very low
   4. PFDs lessen heat loss and energy required for flotation
      a. If sudden immersion occurs assume HELP position
      b. If multiple people are in the water huddle to decrease heat loss

D. Cold protective response
   1. Increases the chances of a cold water drowning victim's survival
      a. Documented saves from cold immersion of up to 45 minutes
      b. Colder water seems to increase chances of survival
      c. How long is the head above water during the cooling process
   2. Protective physiologic response
      a. Face immersion causes parasympathetic stimulation
      b. Heart rate decreases/ bradycardia

c. Peripheral vasoconstriction and blood shunted to the core
d. Blood pressure drop

3. Survivability profile affected by
   a. Age
   b. Posture
   c. Lung volume
   d. Water temperature
4. You are never cold and dead - only warm and dead
   a. Hypothermic patients should be presumed salvageable
   b. A patient must be re-warmed before an accurate assessment can be made
5. Rescue versus body recovery
   a. Length of time submerged
   b. Any known or suspected trauma
   c. Age and physical condition
   d. Water temperature and environmental conditions
   e. Time until rescue or removal

E. Scenario options for water rescue training
1. Rescue safety - equipment
   a. Properly fitting personal flotation device (USGA approved)
   b. Helmet - for head protection
   c. Knife - for entanglement protection
   d. Whistle - for location if in trouble
   e. Thermal protection
2. Rescuer safety - training
   a. Confined water situations - pool, stock tank
   b. Flat water situations - lakes, ponds, marsh
   c. Moving water - rivers, streams, creeks
   d. Fast water - spring runoffs, mountain streams
   e. Floods and debris flows
   f. Heavy surf - ocean, Great Lakes
   g. Man made barriers - dams, piers, weirs
3. Victim safety - equipment
   a. Flotation for victim
   b. Immobilization equipment
   c. Extrication equipment
   d. Thermal protection equipment
   e. Resuscitation equipment
   f. Transportation equipment
4. Victim safety - training
   a. Victim recognition skills
   b. In-water patient management skills
   c. Airway management skills
   d. In-water immobilization skills
   e. Extrication from water skills
   f. In-water thermal loss skills
   g. Resuscitation skills - in-water, land and boat
5. Factors determining - rescue or recovery
   a. Number of victims

b. Number of trained and equipped rescuers
c. Environmental conditions present and expected
d. Age of victims
e. Length of submersion of victims
f. Known trauma to victims
g. Temperature and speed of water

6. Location of submerged victims - witness interviews
   a. Separate witnesses and have them return to where they were during the incident
   b. Have each witness locate an object across water to form a line
   c. Use the point of convergence of lines to locate last seen point
   d. Use last seen point as “datum” point to begin search
   e. Search in area where last seen point is center and radius out is equal to depth of water
7. In-water spinal immobilization
   a. Head-splint technique (rescuer PFD inhibits other techniques)
   b. Approach victim from the side
   c. Move victim’s arms over their head
   d. Hold victim’s head in place by using victim’s arms as a “splint”
   e. If victim is face-down, perform steps 1-4, then rotate victim toward rescuer to face-up position
   f. Assure open airway
   g. Maintain position until C-collar is applied
8. C-collar application
   a. Second rescuer determine collar size
   b. Second rescuer holds open collar under victim’s neck
   c. Primary rescuer maintains immobilization and patent airway
   d. Second rescuer brings collar up to back of victim’s neck, primary rescuer allows second rescuer to bring collar around victim’s neck and throat while second rescuer maintains airway
   e. Second rescuer secures fastener on collar while primary rescuer maintains airway
   f. Second rescuer secures victim’s hands at waist of victim
9. Back boarding and extrication of victim
   a. Submerge board under victim at their waist
   b. Never lift the victim to the board, allow the board to float up to the victim (if board does not float, lift it gently to the victim)
   c. Secure victim with straps, cravats or other devices
   d. Move victim to extrication point at shore or boat
   e. Always extricate victim head first, so that body weight will not compress possible spinal trauma
   f. Avoid extrication of victim through surf - board could capsize
   g. Maintain airway management during extrication
10. Overview of rescue techniques
    a. Never underestimate the power of moving water
       (1) Moving water is very deceptive
       (2) Do not enter without highly specialized training
    b. The water rescue model is reach-throw-row-go
    c. As a first responder, a shore based rescue attempt (either by talking the victim into self-rescue, reaching or throwing) are the methods of choice

(1) Either boat based or go techniques require specialized training
d. Even with shore based rescue techniques a PFD must be worn
(1) Reach with a pole or long rescue device
(2) Throw a floatation device
(3) Become proficient with a water throw bag
e. Self rescue if fallen into flat or moving water
(1) Cover mouth/ nose during entry
(2) Protect your head and keep face out of the water
(3) If flat water assume the HELP position
(4) In moving water do not attempt to stand up
(5) Float on back with feet downstream and head pointed towards the nearest shore at 45 degree angle

IV. Hazardous atmospheres
A. Oxygen deficient environments/ confined spaces (CFR 1910.146)
1. Defined as a space with limited access/ egress not designed for human occupancy or habitation
2. Has a limited or restricted means for entry or exit and is not designed for continuous employee occupancy
a. Tanks
b. Vessels
c. Silos
d. Storage bins
e. Vaults
f. Pits
3. NIOSH estimates that 60% of the fatalities associated with confined spaces are people attempting a rescue of someone
4. Examples of confined spaces
a. Grain bins and silos
b. Wells and cisterns
c. Storage tanks
d. Manholes, pumping stations
e. Drainage culverts
f. Underground vaults
B. Hazards associated with confined spaces
1. Oxygen deficient atmospheres
a. Oxygen deficient atmospheres are not a visible problem
b. Rescuers often presume an atmosphere is safe
c. Be aware that increased oxygen content can give atmospheric monitoring meters a false reading
2. Chemical/ toxic exposure/ explosion
a. Toxicity of chemicals and the displacement of oxygen
b. Explosion is a hazard in some environments
3. Engulfement
a. Grain, coal or substances that can bury a person
b. Dusts can also create an explosion hazard
4. Machinery entrapment
a. Spaces often have auger/ screws which can entrap

5. Electricity
    a. Motors and materials management equipment have power
    b. Risk of stored energy
    c. Physiology of oxygen deficiency
6. Structural concerns
    a. I beams inside space
    b. Not all spaces are cylindrical - L, T and X shaped spaces compound extrication pathway

C. Emergencies in confined spaces
1. OSHA requires a permit process before workers may enter a confined space
    a. Area must be made safe or workers must don PPE
    b. Retrieval devices must be in place
    c. Environmental monitoring of the site before entry
2. Non-permitted sites are likely locations for emergencies
    a. No atmospheric monitoring is done
    b. Entrants are likely to encounter oxygen deficienct atmosphere
3. Types of emergencies
    a. Falls
    b. Medical emergencies
    c. Oxygen deficiency/ asphyxia
    d. Explosion
    e. Entrapment
4. Types of gases found in confined spaces
    a. Hydrogen sulfide (H_2S)
    b. Carbon dioxide (CO_2)
    c. Carbon monoxide (CO)
    d. Low/ high oxygen concentrations
    e. Methane (CH_4)
    f. Ammonia (NH_3)
    g. Nitrogen dioxide (NO_2)

D. Safe entry for rescue requires specialized training
1. Safe entry cannot be made without the following
    a. Atmospheric monitoring to determine
        (1) Oxygen concentration
        (2) Hydrogen sulfide level
        (3) Explosive limits
        (4) Flammable atmosphere
        (5) Toxic air contaminants
    b. Lock out/ tag outfox all power
    c. Blank out of all flow into the site
    d. Dissipation of stored energy
    e. Area is ventilated
2. No rescuers are allowed to make entry until a rescue team has made the area safe
3. Access to confined spaces is often limited making access and extraction difficult
    a. SCBA use is usually dangerous
        (1) Limited air supply
        (2) Removal of SCBA to make some entries
    b. Supplied air breathing apparatus is preferred

c. Rescuer lowering and retrieval system is in place
d. Limited space makes extraction difficult

4. Arriving EMS personnel should
a. Establish a safe perimeter
b. Not allow any additional entry to the space
c. Assist in attempting remote retrieval
d. Determine from permit/ entry supervisor what type of work is being done
e. Determine from entry supervisor how many workers are inside

E. Rescue from trenches/ cave ins
1. Most trench collapses occur in trenches less than 12' deep and 6' wide
a. Weight of soils - 1 cubic foot = 100 pounds
b. 2 feet of soil on the chest or back = 700-1000 pounds
c. Being buried rapidly leads to asphyxia
2. Reasons for cave in/ collapse
a. Federal law requires either shoring or trench box for excavations deeper than 5'
b. Contractors forsake safety due to increased costs
c. Lip of one or both sides of trench caves in
d. Wall shears way and falls in
e. Spoil pile too close to edge causing collapse
3. Factors contributing to collapse
a. Previously disturbed soil
b. Intersecting trenches
c. Ground vibrations
d. Dirt (spoil) pile too close to edge of trench
e. Water seepage
4. Initial response
a. If collapse has occurred causing burial, secondary collapse is likely to occur
b. Secure the scene, establish command, and secure a perimeter
c. Call for a team specializing in trench rescue
d. Do not allow entry into the trench or cave in area
e. Safe access only when proper shoring is in place

V. Highway operations
A. Hazards in highway operations
1. Traffic flow is the largest hazard associated with EMS highway operations
a. Response to limited access highways
b. Response to unlimited access highways
c. Risk of apparatus and rescuers being struck
d. Back-up impedes flow to and from scene
e. EMS must work closely with law enforcement
2. Traffic hazard reduction techniques
a. Staging of unnecessary apparatus off highway
(1) Essential on limited access highways
(2) Use staging area away from scene
b. Place apparatus in position to protect scene
(1) Attempt minimal reduction to traffic flow
(2) Have a safe ambulance loading area
c. Use only essential warning lights

(1) Too many lights distract/ confuse/ blind drivers
(2) Turn off headlights
(3) Consider use of amber scene lighting

d. Use traffic cones/ flares to redirect traffic
(1) Create a safe zone
(2) Move traffic away from workers
(3) Caution on use of flares and their proximity to scene
(a) Allow flares to burn out
(b) Do not extinguish once ignited

e. All rescuers should be in high visibility clothing
(1) Orange highway vests
(2) High visibility clothing
(3) Reflective trim

3. Other scene hazards
a. Fuel/ fire hazards
(1) Fuel spilled on the highway increases fire risk
(2) Catalytic converters can ignite spilled fuel

b. Alternate fuel systems
(1) Natural gas in high pressure cylinders
(2) Electrical power and storage cells

c. Sharp metal and glass
(1) Cut and puncture hazard to patients and rescuers

d. Electrical power
(1) Downed power lines and contact with underground electrical feeds

e. Energy absorbing bumpers
(1) When exposed to fire can explode
(2) When "loaded" can spring out causing rescuer trauma

f. Air bags/ supplemental restraint systems(SRS)
(1) Can deploy during rescue operations
(2) Must be deactivated prior to mechanical extrication

g. Vehicles carrying hazardous cargoes
(1) Most hazardous substances travel by road
(2) Be suspicious with crashes involving commercial vehicles
(3) Look for UN numbers and placarding

h. Vehicles in unstable positions
(1) On side
(2) On roof
(3) On incline or unstable area/ terrain
(4) Weather conditions
(5) On-site spills/ leaks

B. Auto anatomy
1. Roof and roof support posts
a. "A "post
b. "B" post
c. "C" post
d. "D" post
e. Cutting the supports interrupts the unibody construction

2. Fire wall

a. Separates engine and occupant compartment
b. Frequently collapses onto occupants legs during high speed head on collisions

3. Engine compartment and power train
   a. Battery usually in the engine compartment
4. Under-carriage and unibody versus frame construction
   a. Roof posts, floor, firewall, trunk support integral to unibody
   b. Most cars are of unibody construction
   c. Light trucks are usually of frame construction
5. Safety versus tempered glass
   a. Safety glass usually in windshield
      (1) Glass-plastic laminate-glass
      (2) Designed to stay intact when shattered/ broken
      (3) Fractures into long shards
   b. Tempered glass
      (1) Glass with high tensile strength
      (2) Does NOT stay intact when shattered/ broken
      (3) Fractures into small pieces when broken
6. Doors
   a. Reinforcing bar in most car doors
   b. Bar designed to protect occupant in side impact collisions
   c. Case hardened steel "Nader" pin designed to prevent car door from opening during collisions
   d. If Nader pin/ latch engaged difficult to pry door open
   e. Latch must be disengaged first
7. Deactivation of the SRS
   a. Power removal
   b. Power dissipation

C. Rescue strategies
1. Initial size-up, hazard control
   a. Establish command
   b. Scene size-up
   c. Call appropriate back-up
   d. Control the hazards
   e. Locate and triage patients
2. Assess degree of entrapment and fastest means of extraction
   a. Try all of the doors
   b. Considerations for door removal
   c. Considerations for roof removal
   d. Considerations for dash roll-up maneuver
   e. Considerations for door removal and making a new door
3. Inner circle/ outer circle rescue concept

VI. Hazardous terrain
A. Types of hazardous terrain
1. Steep slope or "low angle" terrain
   a. Slope capable of being walked on without using hands
   b. Footing may be difficult
   c. Difficult to carry a litter even with multiple people

d. Rope used to counteract gravity during litter carry
e. Consequence of error likely to be a fall and tumble

2. Vertical or "high angle" terrain
   a. Cliff, building side or terrain so steep hands must be used for balance when scaling it
   b. Total dependence on rope or aerial apparatus for litter movement
   c. Consequence of error likely to be fatal
3. Flat terrain with obstructions
   a. Rocks, scree, creeks etc.

B. Patient access in hazardous terrain
1. Specialized training and equipment required for the high angle environment
   a. Rappelling and retrieval of personnel (ascending or raising) once rappelled in
   b. Belaying
   c. High angle litter evacuation
   d. Use of ladders
   e. Serious consequence of errors
   f. High degree of training required for access and evacuation
2. Low angle environment
   a. Access often gained by walking or scrambling
   b. Rope sometimes used as a hand line to assist with balance
   c. Less severe consequence of error
   d. High degree of training required for low angle rope evacuation of litter
   e. Hasty rope slide to assist with balance and footing on rough terrain

C. Patient packaging
1. Basket stretcher is the standard for rough terrain evacuation
   a. Rigid frame for patient protection
   b. Easy to carry with adequate personnel
   c. Standard EMS patient handling device
   d. Alternative spinal immobilizers can be used in them (KED, OSS)
   e. Can be used as a spinal immobilizer by itself as a last resort
2. Wire mesh stokes baskets
   a. Generally strongest of baskets
   b. Better air/ water flow through the basket
   c. Inexpensive
   d. With flotation, better for water rescue
   e. Older “military style” will not accept backboard
3. Plastic basket stretchers
   a. Generally weaker than steel baskets
   b. Provide better patient protection
   c. Plastic bottom with steel frame is best
4. Most basket stretchers are not equipped with adequate restraints
   a. All require additional strapping or lacing for rough terrain evacuation/ extraction
   b. Plastic litter shield for patient protection
   c. High angle restraint
      (1) Harness applied to patient
      (2) Leg stirrups applied
      (3) Lifters applied to prevent movement
      (4) Tail of 1 litter line to patient’s harness

(5) Helmet or litter shield on patient
(6) Fluids (IV or PO)
(7) Accessibility for BP, suction, distal perfusion assessment
(8) Padding is crucial
(9) Patient heating/ cooling system
(10) Airway clearing system via gravity “tip line”

d. Low angle restraint
(1) Same restraint as for high angle

e. Flat rough terrain
(1) Lacing or securing to prevent movement

D. Patient movement
1. Non-technical/ non-rope evacuation is usually faster
2. Flat rough terrain
a. Litter carrying procedures
b. Leapfrogging
c. Adequate numbers of bearers
d. Load lifting straps to assist with carry
3. Low angle/ high angle evacuation
a. Secure anchors
b. Rope lowering systems
c. Rope hauling systems
d. Specialized knowledge and skill required for use
4. Use of aerial apparatus
a. Tower-ladder or bucket trucks
(1) Litter belay during movement to bucket
(2) Attachment of litter to bucket
b. Aerial ladders
(1) Upper sections not wide enough to slot litter
(2) Litter must be belayed if being slid down ladder
c. Ladder or aerial apparatus should not be used as a crane to move a litter

E. Use of helicopters in hazardous terrain rescue
1. Difference in mission, crew and capabilities of medical versus rescue and military helicopters
2. Need for constant reassessment of risk of rescue technique involving a helicopter
3. Need for non-aircrew-member rescue training, specific to helicopter rescue techniques
a. Know general safety around helicopters
b. Be familiar with these uses of helicopters for rescue - the advantages, disadvantages, hazards and local restrictions for each of these
(1) Boarding, deboarding, riding
(2) One-skids, hovers, toe-ins
(3) Short hauls or sling loads (personnel and equipment)
(4) Cable hoists

VII. Vehicle rescue
A. Practice initial stabilization of vehicles using cribbing, lifting devices, spare tires, 2 ton come-a-long on (be certain all fluids are drained)
1. Wheels
2. Roof

3. Side
4. Embankments

B. Gain access using hand tools through
1. Non-deformed door
2. Deformed door
3. Safety and tempered glass
4. Trunk
5. Floor

C. Package and extricate simulated patients
1. Rapid extraction of patients using long spine boards
2. Vertical extrication of patients from vehicles using spineboards

D. Observe the following procedures being accomplished using heavy hydraulic equipment
1. Door removal
2. Roof removal
3. Making of a "third door"
4. Dashboard/ firewall "roll-up"

VIII. Assessment procedures

A. Environmental issues affecting assessment
1. Weather/ temperature extremes
   a. Difficulty in completely exposing patients for full assessment and treatment
   b. Physical examination compromised
   c. Patients susceptible to hypo/ hyperthermia
   d. Rescuer mobility restricted due to clothing/ PPE
2. Access to patient may be limited
   a. Parts may not be accessible for examination
   b. Cramped space
   c. Limited lighting
3. Typical street equipment may not be transportable to patient
   a. Boxes and street "packaging" of equipment
   b. Downsizing of initial assessment/ management equipment
4. Patient may be entrapped for an extended period of time
5. Rescuer PPE essential but cumbersome
   a. PPE must be used
   b. Some must be removed to perform skills
   c. Reapply as soon as possible

B. Specific assessment/ management considerations
1. Equipment considerations
   a. Must be downsized and capable of being brought to patient
   b. Capable of being carried hands free
   c. Have lighting to facilitate assessment/ treatment in dark
   d. Have the following
      (1) Airway control
         (a) OPA/ NPA
         (b) Manual suction
         (c) Intubation
      (2) Breathing
         (a) Thoracic decompression

(b) Small oxygen tank/ regulator
(c) Masks/ cannulas
(d) Pocket mask/ BVM

(3) Circulation
(a) Bandages/ dressings
(b) Triangular bandages
(c) Occlusive dressings
(d) IV administration
(e) BP cuff and stethoscope

(4) Disability
(a) Extrication collars

(5) Expose
(a) Scissors

(6) Miscellaneous
(a) Headlamp/ flashlight
(b) Space blanket
(c) SAM splint
(d) PPE (leather gloves/ latex gloves/ eye shields)

2. Exposure of patients
a. Cover patient and assure thermal protection
b. During extrication place hard protection (spine board)
c. Prevent glass shards from contacting patient
3. ALS skills only if really necessary (good BLS skills are mandatory)
a. More wires and tubing complicate the extraction process
b. Definitive airway control and volume may be essential
c. Continuous oxygenation
4. Patient monitoring
a. In high noise areas take BP by palpation
b. Pulse oximetry compact and helpful
c. ECG cumbersome during extrication
d. Continue talking to patient
e. Explain what is being done and answer questions
5. Improvisation
a. Upper extremity fractures tied to torso
b. Lower extremity fractures tied to uninjured leg
c. SAM splints very useful

C. Pain control
1. Non-pharmacological management
a. Splinting
b. Distraction - talking to the patient and asking questions
c. Scratching or creating sensory stimuli when doing painful procedure
2. Pharmacologic agents
a. Pain control with isolated extremity trauma
b. Pain control with multiple trauma

D. Crush and compartment syndromes secondary to entrapment
1. Compartment syndromes can be caused by crushing mechanisms
a. Increased pressure in the muscle compartment enclosed by fascia
b. Pressure increase causes ischemic muscle damage

c. Tissue necrosis and nerve injury can occur

2. Crush syndrome
   a. Compressive forces crush and cause prolonged hypoxia
   b. Prolonged compression 4-6 hours or longer
   c. May appear stable with compressive forces in place
   d. Compressive force removed - part is reperfused
   e. Vascular volume lost into the tissue
   f. Myoglobin, lactic acid and other toxins released into circulation
   g. Rapid decompensation may occur

E. Patient packaging
   1. Stokes basket orientation and practice with
      a. Types of basket stretchers and their uses
      b. Patient comfort and packaging
      c. Patient immobilization and restraint
   2. Other patient devices for rough terrain and practice with
      a. SKED
      b. Half-spine devices
   3. High angle-non-technical evacuation using aerial apparatus
   4. Low angle-non-technical evacuation using manpower
   5. Handing a litter over terrain
   6. Litter carry over rough terrain and practice the following
      a. Litter carry sequence with six people
      b. Use of litter lifting or load slings
      c. Passing litter over uneven terrain
   7. It is required that the EMS response team fully understands the capability of the rescue response team thereby circumventing any “turf” issues