V. CONFINED SPACE MEDICINE
A. MEDICAL CONSIDERATIONS

INTRODUCTION

- This section will introduce you in more depth to the US&R Medical Team concept and the medical care aspects of the team.

TRAINING COURSE PHILOSOPHY

- Conservative medical approach to patient management - based on proven therapy.

- The medical approach to be presented in this course represents a "conservative" patient-management philosophy.
- Procedures and methodology advocated in this course are those that have been shown through medical practice and in the medical literature to be safe and effective. Other approaches that "make sense" yet have little application experience or research data to back them are avoided if they have a potentially major "down side."

- Determining medical procedures and methods must be a personal, carefully considered decision of each task force Medical Team and their individual physicians and medics.
  - The practitioner's attention to detail is emphasized.
  - The application of basic, well-proven evaluation and intervention technique is very important

DIFFERENCES FROM TYPICAL EM and PRE-HOSPITAL CARE

- Personal performance problems.

- Austere, dangerous, prolonged, limited access, dark, dusty.

- Must be concerned about own safety:
  - Roof collapse, haz mat, etc.
  - "Universal precautions."
  - Adequate help/equip./supplies is not assured (tight space, limited cache equipment, difficulty getting equipment into space, etc.).

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- **Philosophy...**
  - **Conservative medical approach to patient management — based on proven therapy**
  - **Attention to detail is emphasized**
  - **Basic evaluation and intervention techniques are most important**

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MEDICAL CARE PROBLEMS

- Inherent delay in reaching trapped patients.
- So there is progression of trauma/medical problems beyond that normally seen in pre-hospital trauma management.
- Unselected victim population.
  - Nonselective process of victim involvement: Hospital nursery (infants), nursing home (elderly, many with baseline medical problems), psychiatric patients, HIV/TB patients, etc.
  - The probability of the victims having baseline medical problems is significant.
- Unusual medical problems.
  - Crush syndrome.
  - Haz mat injury.
  - Airway dust impaction, etc.
- Unable to "scoop and run."
  - Patients may be trapped with prolonged extrication or egress from the structure, transport delayed, etc.
- Inadequate medical back-up.
  - Medical system chaos secondary to loss of communications, overwhelmed/ compromised EMS and hospitals, loss of medical personnel, workers occupied with personal/family calamity X 3-5 days post-event.

"THE PROBLEM:" Overview of Injury Patterns/Medical Problems

- Earthquake injury patterns (i.e., injury patterns in collapsed-structure victims).
- Wide variation due to multiple factors:
  - Characteristics of the quake.
  - Magnitude, length of shaking, type of force waves, etc.
  - Examples: Loma Prieta 15 sec. vs. Armenia's 45 sec. X

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■ Earthquake injury patterns —

Wide variations due to multiple factors...

- Characteristic of the quake
- Time of day and consequent location of population
- Building and ground characteristics
- Type of response
- Ability to document types of injuries/deaths

two shakes.

- Time of day and consequent location of population.

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"THE PROBLEM:" Overview of Injury Patterns/Medical Problems (continued)

- If a workday, people are more likely to be in large structures (schools, factories, hotel conference rooms) that are susceptible to collapse. Examples:
  - Armenia: daytime so in schools, factories.
  - Loma Prieta: World Series cleared the Cypress.
  - Tangshan: night-time quake w/ preceding tremble, many lumbar spine injuries from sitting up in bed and then roof falling.

- Building and ground characteristics.
  - Building characteristics include its age, size, materials.
  - These determine how much it will sway and when/how it will fail. Example is Armenia with most buildings failing and with a high death-to-injury ratio.
  - Type of soil important because "liquefaction" causes the highest likelihood of structure collapse; this was esp. evident in Mexico City with soil differences.
  - Impacts on amount of "shaking" the building endures and how resistant the buildings are to collapse.
  - Building occupancy: i.e. hospital, nursing home, TB sanitarium, pesticide factory, news building, etc.

- Type of response.
  - A fast response will find patients with more acute medical problems (this population would be found deceased by a slower response team.

- Ability to document types of injuries/deaths.
  - For example, hypothermia is rarely noted as a problem, even in the Armenian earthquake, probably because no temps are taken.

- Each disaster is different with unpredictable effects, so only generalities are helpful (no two events are alike).

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EARTHQUAKE INJURY PATTERNS

- Valid generalizations:
  - "Golden Day": the first 24 to 48 hours after impact.
  - After this period, there is a consistent and dramatic drop-off in the percent of victims found alive.

- Injury-severity classification:
  - Patients consistently fall into categories classified by when they would die if untreated.

DEATH FROM TRAUMA

- Classification by natural history:
  - Immediate or "Golden Hour" trauma patients - not an issue in disasters.
  - These patients will be dead when finally reached or unsalvageable due to lack of resources (proximity to an operating room, blood bank, ICU, etc.).

- Patients who will die in 4 to 24 hours if untreated (shock, airway compromise, etc.) — intervention is crucial to survival.

- Patients who will die later if untreated prior to reaching definitive care facility (from sepsis, multi-organ failure, etc.) - Intervention during rescue is possibly life-saving.

FACTORS IN VICTIMS' DEATH

- Entrapment.

- Severity of injury.

- Injury deteriorating prior to medical intervention.

- We cannot control these variables.
  - Time to rescue and medical treatment
  - This is where our program can make a difference.

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■ Death from trauma —
classification by natural history...

- Immediate or "Golden Hour"
  - Not an issue in disasters

- 4-24 hours
  - Shock
  - Airway compromise, etc.
  - Intervention is crucial to survival

- Late
  - Sepsis
  - Multi-organ failure, etc.
  - Intervention possibly life-saving

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■ Earthquake injury patterns —
valid generalizations...

- "Golden 24-48 hours"
- Injury-severity classification
- Commonly seen injuries
- Group of unusual injuries

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■ Earthquakes —
factors in victim death

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FACTORS IN VICTIMS' DEATH (continued)

- There is a group of common injuries that are frequently seen in collapsed-structure victims. Common medical care problems incurred by collapsed-structure victims:
  - Fractures/lacerations.
  - Multiple trauma.
  - Closed head injury.
  - Hypothermia.
  - Dehydration.

- Many of these are common to everyday EMS and Emergency Department care.

- Group of unusual injuries seen commonly in collapsed-structure victims.
  - Some are unusual entities, others are unusual variations from typical pre-hospital setting.

UNUSUAL MEDICAL CARE PROBLEMS AND VARIATIONS OF COMMON PROBLEMS

- Crush injury and syndrome.
  - This has been noted to be a leading cause of victim deaths in some earthquakes.

- Dust impaction/airway injury.
  - Occurs from the dense cloud of dust generated by the collapsing structure; exacerbated by resuspension of dust during rescue efforts.

- Haz mat injuries.

- Prolonged untreated trauma.
  - Common trauma injuries that have had time to progress and problems that require adaptations because of the circumstances.

- Pain control in the pre-hospital setting.

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UNUSUAL MEDICAL CARE PROBLEMS AND VARIATIONS OF COMMON PROBLEMS (continued)

- Structure type and injury pattern.
  - Certain kinds of collapsed structures allow general predictions of types of injuries.
  - Wood structures: lacerations and punctures.
  - Adobe and brick: dust impaction airway injuries.

OVERVIEW OF CONFINED SPACE MEDICAL CARE

- Traditional phases of patient care:
  - 1) Pre-hospital (EMS).
  - 2) Emergency medicine (ED).
  - 3) Surgery/critical care (OR/ICU).
  - 4) Convalescence (hospital ward).
  - 5) Rehabilitation (outpatient).

- Unfortunately, we cannot expect to follow this course with our patients, due to the circumstances.

- "SCOOP and RUN" ?
  - With victims in a collapsed-structure disaster, this is often not possible.

- Confined space medical response objective.
  - Therefore, we must bring EMS, emergency medicine and critical care to the patient.

- Confined space medical response. Who is it?
  - Members of an integrated team (cave rescue teams, FEMA US&R Task Force Medical Teams).
  - A group allied pre-incident with a rescue team (SMRTeam with mine rescue teams).
  - Local EMS/medical personnel allied on-scene with rescuers (everyday incidents).

- The objective for this type of course is to benefit all of these groups.

- Objective...
  - "To bring EMS, emergency medicine, and critical care to the patient..."
- Who is it?
  - Members of an integrated team
    - cave rescue teams
    - FEMA US&R task force
  - A group allied with a rescue team (SMRTeam)
  - Local EMS/medical personnel allied with rescuers on-scene

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OVERVIEW OF CONFINED SPACE MEDICAL CARE (continued)

- Confined space medical requirements. These are the requirements to provide effective confined space medical care for all types of medical teams:
  - Rapidly deployable.
  - Self-supporting.
  - Relatively sophisticated medical capability.
  - Integrated into the disaster response structure.

- Adequately prepared with:
  - Medical equipment.
  - Protective capability.
  - Survival ability.

- FEMA US&R Medical Team.
  - Same level of sophistication as the search, rescue and other components of the task force.

CONFINED-SPACE MEDICAL CARE OBJECTIVES

- Increased survival/decreased morbidity.
  - By prompt patient stabilization (but we are not talking about setting up an ICU in the rubble!).

- Expedite extrication by providing:
  - Stabilization of vital signs (less pressured extrication).
  - Immobilization of fractures, etc.
  - Pain control.
  - Improved victim cooperation from the above and by patient reassurance.
  - Specialized extrication technique.
  - Anatomic/physiologic advice for moving patient.
  - Prepare patient for hand-off to appropriate accepting EMS personnel.

- Collapsed structure extrication is not the same as vehicular extrication. Extrication difficulties:
  - You can't just pop the top 8 floors of a 10-story building with a Jaws of Life.

- Rapidly deployable
- Self-supporting
- Relatively sophisticated capability
- Integrated into the disaster response structure
- Prepared:
  - Medical equipment
  - Protective capability
  - Survival ability

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- Increase survival/decrease morbidity
- Expedite the extrication
  - Stabilize the patient
  - Immobilize fractures

- So must be knowledgeable in how to move the patient.

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CONFINED SPACE MEDICINE OPERATIONAL APPROACH

- Overview of the approach to medical care in confined spaces.

- Operational approach:
  - #1 Rescuer safety first!
    - confined space: physical, atmospheric, haz mat.
  - #2 "ABCs" - same basic approach as EMS/ED care.
    - patient: "universal precautions."
  - #3 For difficult problems — use a sound approach ("Think").
    - this should be done by combining the strengths of both doctors and medics.

OVERVIEW OF CSM MEDICAL PRACTICE

- Acquire patient data from earliest possible time.
  - Victim-specific information: ask bystanders/family about patient's age, PMH, etc.
  - Ask about possible hazards in the structure (chemicals, etc).

- Monitor Rescue Team's activities for impact on patient:
  - CO production, dust, etc.
  - Remember to also monitor for impact on the rescuers (fatigue, dehydration, dust, etc.).

- Patient evaluation begins as soon as there is voice contact with victim.

- Prepare and pre-position your equipment prior to accessing patient.

- Efficient evaluation/treatment performed to minimize rescue time.

- Coordinate ongoing evaluation/treatment with Rescue Team activities.

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- Acquire patient data ASAP
- Monitor Rescue Team's impact on victim
- Evaluation begins with first voice contact
- Prep equipment beforehand
- Efficient evaluation/treatment
- Coordinate with Rescue Team
- Full evaluation outside structure
- Hand-off issues

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- Rescuer Safety First
- Confined space
  - Physical
  - Atmospheric

- Full evaluation as soon as safely extricated.

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OVERVIEW OF CSM MEDICAL PRACTICE (continued)

- Hand-off issues, including Patient Care Forms.

- CSM - important points:
  - Evaluate/treatment should begin as soon as patient is reached and the space is stabilized.
  - YOU (The Medical Team personnel) are responsible for the patient.
  - Not the Rescue team: they do the extrication in conjunction with the Medical Team.
  - Re-evaluate the patient after any significant extrication move.

DOCUMENTATION

- Objectives:
  - Capture pertinent patient information.
  - These include important history, physical findings, details of entrapment (if any), interventions performed and the patient's course.
  - Transfer the information along with the patient to the next providers and eventually to the definitive-care center.
  - Provide accountability for the Medical Team.
  - Enable patient follow-up for outcome studies.

- Patient-Care Form.
  - Top copy to be retained by Medical Team for their records.
  - Back (sturdy) copy to be attached by string to the patient.

- Explanation of each part:
  - Patient's background medical history.
  - Details of entrapment and injury.
  - Physical examination.
  - Interventions.
  - Patient's course during Medical Team's care.
  - Receiving medical resource.
  - Signatures: care provider and Medical Team Manager.

- Important Points...
  - Evaluation/treatment begins as soon as patient is reached and the space stabilized.
  - Medical Team has primary patient responsibility.
  - Re-evaluate patient after every significant move.

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DOCUMENTATION (continued)

- Patient Care Form — lower section:
  - Lower section hopefully will be completed and returned by eventual receiving facility.

- Matching numbers on top and bottom of form will allow follow-up information to be correlated and allow medical team to receive follow-up input.

- To be completed for all:
  - Victims cared for by the task force.
  - All task force personnel treated for illness/injury or evaluated for haz mat/biologic exposures.
  - All support personnel or other rescuers treated by the Medical Team.

SUMMARY OF THE CONCEPT OF A VERY EQUIPPED AND SOPHISTICATED MEDICAL TEAM

- CSM: Sophisticated medicine in an austere environment.

- It is the philosophy of US&R that if this much time, effort, risk and expense is devoted to responding, locating and extricating deeply entombed victims, it is important to maximize the victims' chances for survival.

- It is not a 'successful' rescue if the victims dies hours, weeks, or months after removal from the rubble.

V. CONFINED SPACE MEDICINE
B. ENVIRONMENT

INTRODUCTION

- It is mandatory that all rescue medical personnel be able to function safely and efficiently in confined spaces.

- This section is designed to prepare the students to function in the confined space by introducing the students to the hazards associated with confined spaces and describing methods that improve functional efficiency in confined spaces.

CONFINED SPACES

- Description: Any space with limited access (ingress/egress) and ventilation.

- Examples of confined spaces which may present difficulties in the medical treatment of injured persons:
  - Mines, caves and tunnels.
  - Collapsed buildings.
  - Collapsed elevated roadways and other man-made structures.
  - Farm silos.
  - Manholes and sewers.
  - Utility tunnels and crawl spaces.

CONFINED SPACES IN BUILDING COLLAPSE

Types of collapse and void spaces that are formed:

- Pancake collapse:
  - Floors fall one on top of another creating void spaces:
    - near appliances or heating/air conditioning units.
    - near supporting structures.
  - Victims can be found in the small void spaces next to whatever object is supporting the ceiling or between the floor joists of the floor above.
  - This collapse can be supported with standard box cribbing and once cribbed is rather stable.

- Types of building collapses
  - Pancake collapse: floors fall one on top of another creating void spaces.
  - Lean-to: floor collapses but is supported by one wall forming a void along the supporting wall.
  - V-collapse: center of the floor or the roof collapses but is supported along the walls, creating a void space along the supporting walls.
  - Cantilever: one end of roof is hanging free because of wall failures.

- Confined spaces — Examples...
  - Mines, caves and tunnels
  - Collapsed buildings
  - Collapsed elevated roadways and other man-made structures
  - Farm silos
  - Manholes and sewers

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B. ENVIRONMENT

CONFINED SPACES IN BUILDING COLLAPSE (continued)

- "Lean-to" floor collapse:
  - Floor collapses but is supported by one wall, forming a void along the supporting wall.
  - This void can be stabilized with raker shoring or box cribbing.
  - Hazards in this type of void include failure of the supporting wall resulting in the total collapse of the void space.

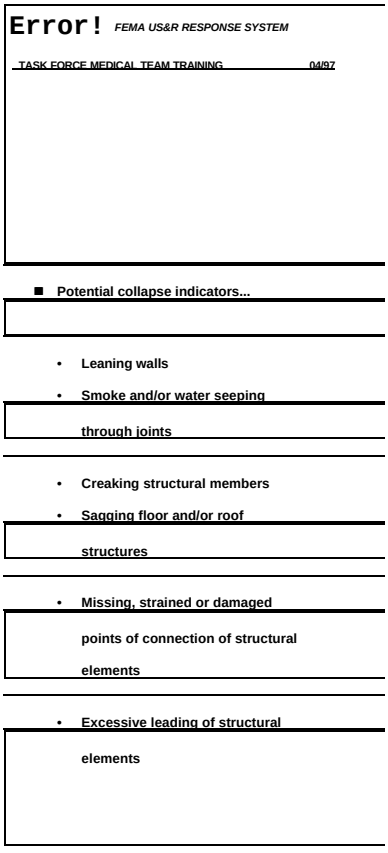
- V collapse:
  - Center of floor collapses but supported along walls creating void space along walls.
  - This collapse is similar to the lean-to collapse and effectively stabilized with raker shoring or box cribbing.
  - Hazards in this collapse include failure of the supporting walls resulting in the collapse of the void space.

- Cantilever collapse:
  - Formed when one end of the floor is hanging free because of one or more wall failures. Other end still attached to walls.
  - Very hazardous (high risk for secondary collapse).
  - May require extensive cribbing and shoring.

- Types of building collapse.
  - Most collapses of structures will include all of these types of void spaces and many undefined patterns.

- Indications for potential secondary collapse:
  - Leaning walls.
  - Seeping smoke and/or water through joints.
  - Creaking structural members.
  - Sagging floors and/or roof structures.
  - Missing, strained or damaged points of connection of structural elements.
  - Excessive loading of structural elements.

- Access to the victim.



- The Rescue Specialist will provide access into the void space and stabilize the space with cribbing and shoring.

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B. ENVIRONMENT

CONFINED SPACE "STABILIZATION"

- Stabilization of the void spaces may become a complex problem due to the various types of voids.

- Access into the voids can be from any angle - example:
  - Lateral - through the supporting wall or through the collapsed floor section.
  - Vertical - either from above the void through the "roof" or from below the void through the "floor."

- Structural safety:
  - Safety is a major consideration due to the problems of accessing the confined space and potentially disrupting the supporting structures that created the void space's "stability".

STABILIZATION METHODS

- Cribbing — usually consists of:
  - 4" x 4" x 18" wood blocks.
  - 2" x 4" x 18" wood blocks.
  - Wooden wedges 18" long tapering from 4" height.

- Cribbing should be ideally made from rough cut oak.

- Cribbing height should never exceed two times the width of the base unless it is also adequately shored.
  - Example - if 18" long cribbing blocks are used the maximum height of the cribbing tower should be 36 inches.

- Cribbing blocks can be of any length if a large crib tower needs to be constructed.

- Shoring:
  - Material used for "bracing" the structure.
  - Shoring has many forms and usually consists of wooden posts, but can also be structural steel, etc.

- Confined-space stabilization

- Complex problem due to many variables

- Complicated by sometimes having to access the space through a supporting structure

- Must be assured prior to committing human resources

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B. ENVIRONMENT

RESCUER SAFETY

- The Medical Specialist must monitor the safety aspects of the rescue and report concerns to the rescue team and/or the Safety Officer.

- Rescuer safety — personal protection must include:
  - Dust mask to protect the rescuers respiratory system.
  - Should include cartridge-style respirator masks with asbestos filtration capability until asbestos and other toxic dusts are ruled out.
  - Hearing protection. There will be a number of rescue tools in operation creating noise levels that may result in hearing loss.
  - Safety glasses. The operation of the power tools can and does create large amounts of fine dust that can result in the rescuers sustaining eye foreign bodies and corneal abrasions.
  - Helmet. For vital head protection.
  - Gloves.
    - Latex gloves can and should be worn under the rescuer type leather gloves.
    - Leather gloves should be worn to protect the rescuers hands from sharp objects or abrasions from the concrete.
    - Leather gloves soak up blood and body fluids and do not act as an acceptable "universal precautions" barrier.
  - Appropriate foot wear - steel toe and shank boots.
    - Also consider shoe covers for protection from blood and body fluids (leather boots will absorb blood and body fluids).
  - Impermeable coveralls when indicated.
    - Tyvec coveralls to protect the rescuer from blood and body fluids.
  - Cap lamp or helmet light

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Atmospheric Monitoring - Terms and Definitions

- **Threshold Limit Value (TLV)**
  - The ceiling limit for exposure before breathing apparatus is required.

- **Immediately Dangerous to Life and Health (IDLH)**
  - The level that represents the maximum concentration from which, in the event of a respirator failure, a rescuer could escape within 30 minutes without experiencing irreversible health effects.

- **Lower Explosive Limit (LEL)**
  - The minimum concentration of gas in air (measured in % by volume) at which an explosion can occur.

- **Upper Explosive Limit (UEL)**
  - The maximum concentration of gas in air (measured in % by volume) at which an explosion can occur. Above this limit an explosion cannot occur without dilution of the gas with air.

- **Carbon Monoxide**
  - Odorless, colorless, and tasteless.
  - Will accumulate in low areas and displace oxygen.
  - Binds with hemoglobin 257 times stronger than oxygen.
  - Also toxic within cells by binding to the cytochrome oxidase system and disrupting energy generation.
  - Explosive in a range from 12.5 percent to 74.2 percent.
  - TLV - 50 ppm or 0.005 percent.
  - Symptoms include headache, nausea, vomiting, increased heart rate, coma.
  - IDLH - 1500 ppm.
    - 0.1 percent (1000 ppm) — death in 2-3 hours.
    - 0.4 percent (4000 ppm) — death in less than 1 hr.
    - Zero tolerance during operations.

- **Natural Gas (Methane)**
  - Colorless and tasteless (if no odor is added).
  - Explosive range is 5 to 15 percent.
  - May displace oxygen and so act as an asphyxiant.

- Terminology
  - Lower Explosive Limit (LEL)
    - The minimum concentration of a gas mixed in air (measured in percent by volume) at which an explosion can occur
  - Upper Explosive Limit (UEL)
    - The maximum concentration of a gas mixed in air (measured in percent by volume) at which an explosion can occur

- Occurs naturally as sewer gas.

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Atmospheric Monitoring - Terms and Definitions (continued)

- **Carbon Dioxide**
  - By-product of respiration.
  - Colorless and odorless.
  - Acid taste in high concentrations.
  - IDLH - 50,000 ppm.
  - Concentration of 10 percent cannot be tolerated for more than a few minutes.
  - Symptoms include increased respiration rate.

- **Oxygen**
  - 21 percent - normally in atmosphere.
  - 19.5 percent - oxygen deficiency.
  - 17 percent - patient or rescuers will "pant."
  - 15 percent - patient and rescuers will complain of dizziness and headache .
  - 9 percent - unconsciousness.
  - 6 percent - death.

ATMOSPHERIC MONITORING

- Common problems in confined spaces include:
  - Decreased O_2 concentration.

- Decreased O_2 level for a variety of reasons including:
  - Poor ventilation.
  - Increased consumption by rescuers working strenuously in small areas.
  - Displacement by heavier gases (carbon monoxide, CO_2, methane, etc.).

- Increased carbon dioxide level.
  - Generated by victim and rescuers.

- Carbon monoxide (CO).
  - From rescue vehicles, generators or by mechanical equipment in the area.

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- Common problems in confined spaces:
  - Decreased oxygen levels
  - Increased carbon dioxide
  - Carbon monoxide
  - Natural gas (methane)
  - Other hazardous materials

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ATMOSPHERIC MONITORING (continued)

- Methane or natural gas.
  - Natural gas from the rupture of gas lines within the building or general area or from sewer gas.
- Other hazardous materials.
  - Other hazardous materials that are present in the building and released during the collapse.
- Atmospheric monitoring for O_2, CO, and natural gas:
  - Must occur as all new void areas are penetrated and prior to canine or human rescuers being permitted to enter and search.
  - Rescuers ideally should be trained in self-contained breathing apparatus (SCBA) in the event of toxic atmospheres.
  - SCBA may be standard fire service apparatus, supplied air systems or long duration closed circuit breathing apparatus (Dreager or Biopak).
- Other hazardous materials.
  - There is a high likelihood of hazardous chemicals in all collapsed structures:
    - apartment building — common household solvents and cleaners.
    - schools — chemistry labs, wood shops, etc.
    - retail stores — chemicals.
- In the aftermath of the collapse it may be unclear as to what the buildings function had been.
- Voids should be evaluated by the Haz Mat Specialists with the appropriate monitors prior to entry.

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■ Other hazardous materials

- High likelihood of chemical spills
- Void should be evaluated by Hazardous Materials Specialists prior to entry

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■ Atmospheric monitoring . . .

- MUST occur as any new void space is penetrated before human or canine rescuers are permitted to enter
- Rescuer training in SCBA is recommended

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CONFINED SPACE ODORS

- All unusual odors and/or liquids should be evaluated by the Haz Mat Specialists.
- The Rescue Team should assure ventilation of the space.
- Atmospheric monitoring should continue at all times, especially if several rescuers are working in the area.
- Falling oxygen levels indicate the need to increase ventilation.
- Additionally, falling oxygen levels in a confined space may indicate:
  - Increased CO_2 as a byproduct of the rescuers respiration, or
  - O_2 displacement by some other heavier-than-air gas.
- Dead bodies produce a very foul odor.
- Use of charcoal impregnated masks or Noxema under your nose will help with the unpleasant body odors in the confined space.

OTHER HAZARDS IN COLLAPSED STRUCTURES

- Electrical services.
- Propane and fuel oil.
- Sewers.
- Communications equipment.

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- Confined space odors
  - Treat ALL unknown odors as a hazardous material
  - Ventilate the space if possible
  - Decomposing bodies produce a very foul odor
  - Dead body odors can be very demoralizing
  - Use of charcoal impregnated masks or noxems under your nose help with confined space

Error!

V. CONFINED SPACE MEDICINE
B. ENVIRONMENT

UNIVERSAL PRECAUTIONS

- Blood and other body fluids are definitely a health hazard and must be dealt with very carefully.

- OSHA 29CFR 1910.1030 requires:
  - All responders to be in-serviced in universal precautions.
  - Recapping of needles or sharps is prohibited.
  - Gloves are mandatory.
  - Rescuers should be immunized for hepatitis B.
  - Records are to be maintained for immunizations and training.
  - Eye protection is necessary if the potential exists for aerosol contamination.

- Mitigation of the health hazard in the confined space may include:
  - Soaking up the body fluid.
  - Covering the body with occlusive material/plastic.
  - Bridge over body fluid with plastic sheeting or placing 2x2 cribbing and plywood etc. over the area.
  - Protective clothing such as Tyvec coveralls when moving or being near bodies.
  - Remove the body or body parts into body bags if they are in your way.

- Remember - bodies may fall apart.

CONFINED SPACE LIFELINES

- Lifelines can and probable should be attached to the person entering the confined space.

- Lifelines are mandatory at any time the rescuer is in a tight confined space or out of sight of the rescue team.

- Lifelines should be attached to both ankles in the event that the rescuer needs to be retrieved.

- Extra lifelines can be used to pull equipment to the void space.

■ Universal Precautions —

OSHA 29CFR 1910, 1030 requires:

- Training in universal precautions
- Recapping needles is prohibited
- Gloves are mandatory
- Rescuers should be immunized for Hepatitis B
- Eye protection is necessary

■ Universal Precautions

- Soak up body fluids
- Cover bodies with occlusive material
- Bridge over areas contaminated with body fluids
- Tyvec or other protective coveralls when moving bodies (include boot covers)

V. CONFINED SPACE MEDICINE
B. ENVIRONMENT

MOBILITY IN THE CONFINED SPACE

- Crawl on your elbows and push with your toes.
- Usually if your head and chest fit, the rest of your body will fit.
- In tight spaces equipment will need to be pulled behind you by a rope or cord.
- Spaces in which you must remove your helmet to fit are not large enough to safely enter.
- It may be necessary to back out, roll over and re-enter to perform a given function (for example):
  - To start the IV with your right hand may not be possible lying supine due to the tight space .

ROUTES OF EGRESS

- Begin evaluation of egress routes ASAP.
- Determine if the route is large enough to accommodate the patient and the immobilization device.
- A tape measure is a necessary tool for this task.
- If the route needs to be enlarged, assure that rescue personnel provide additional shoring or stabilization.
- For patient and rescuer protection cover and pad all sharp objects such as cut off rebar.
- **Coordinate closely with the Rescue Team.**

FEMA US&R RESPONSE SYSTEM

FEMA US&R RESPONSE SYSTEM
TASK FORCE MEDICAL TEAM TRAINING 04/97

■ Routes of egress
TASK FORCE MEDICAL TEAM TRAINING 04/97

■ Routes of egress
• Begin evaluating early
• Large enough for patient AND immobilization d
• Use a tape measure
• Assure stability of egress route
• Cover sharp/rough areas

TASK FORCE MEDICAL TEAM TRAINING 04/97

V. CONFINED SPACE MEDICINE
C. MEDICAL OPERATIONS

INTRODUCTION

- The preceding sections have covered many of the specifics of collapsed-structure response and confined-space medical care.
- In order for this knowledge and skill to be effectively applied within the difficult environs of a collapsed structure, a systematic patient-care format must be used.

COLLAPSED-STRUCTURE DISASTER

- Medical response obstacles.
  - In order to be effective, we must be able to provide medical care from the time the victim is reached.

- Objective - quality medical care.
  - This medical care must be at a rather sophisticated level to minimize morbidity and mortality in trapped victims.

- To do this is difficult because of the confined space medicine impediments/problems caused by:
  - Dark, dusty, hot, etc.
  - Safety concerns beyond the ordinary.
  - Tight space and restrictive protective gear make movement difficult.
  - Sharp/hard objects and other hazards.
  - Access to patient's body may be poor.
  - Not enough space for an assistant.

- Compensatory mechanisms:
  - Learn safe operation in confined spaces.
  - Hone efficiency (no "down time").
  - Foresight ("anticipate") for next intervention and its requirements, so necessary meds/equipment are prepped and ready.
  - Communicate profusely with colleagues so all meds/equipment/preparatory procedures are done before being needed.

- Medical response — obstacles...
  - Loss of basic services
  - Medical system chaos
  - Non-selective victim process
  - Inherent delay in treatment
  - Unusual medical problems
  - "Race against time"
  - High risks for rescue personnel

V. CONFINED SPACE MEDICINE
C. MEDICAL OPERATIONS

COLLAPSED-STRUCTURE DISASTER (continued)

- Communicate with rescue personnel to closely coordinate extrication:
  - Acquire "tricks."
  - Practice!
    - Develop comfort level in confined space.
    - Develop efficient personal methodology.
    - Learn the subtle but important limitations of personnel/equipment/situations.

MEDICAL TEAM ORGANIZATION FOR CONFINED SPACE OPERATIONS

- Providing efficient medical care in this environment requires a highly organized unit with clearly assigned roles. The following is one organizational method for this type of care.

- Functions to be assigned. Five functions (several functions may be covered by one person):
  - Provider.
  - Anticipator.
  - Medical Control Physician.
  - Recorder/Safety Officer.
  - Equipment/Supply Officer.

- Provider(s): The "point person" having "hands-on" contact with victim:
  - Performs evaluation/treatment.
  - Thinks and acts "out loud."

- The provider at the patient's side may vary depending on multiple parameters:
  - Physical characteristics - size of the space/personnel, strength needed to move patient, etc.
  - Technical needs - physician procedures/assessment vs. medics immobilization and extrication skills.
  - Personal - fatigue, heat sensitivity, etc.

V. CONFINED SPACE MEDICINE
C. MEDICAL OPERATIONS

MEDICAL TEAM ORGANIZATION FOR CONFINED SPACE OPERATIONS (continued)

- Anticipator:
  - Person listening to the evaluation/treatment.
  - Communicates anticipated needs of the Providers.
  - Prevents "dead time" with the providers awaiting equipment/supplies.
  - Asks "what's needed" frequently.
  - Assures equip/supplies are delivered and prepped.

- Medical Control MD:
  - Physician providing orders if the providers are Medical Team Specialists.
  - May also be the Anticipator.

- Recorder/Safety Officer:
  - It is vitally important that a member be assigned this function.
  - Records "timed" assessments, interventions, repeat vital signs and patient re-assessments.
  - Assures atmosphere monitoring reading if indicated; assures recheck of "roof" and other safety precautions.
  - Monitors providers' length of time are "in the hole" and so need for rotation, etc.
  - Tracks amount of O_2 in tanks, etc.
  - Assures # of providers in and out of space are equal; records type and number of feet of rope into space, etc.

- Equipment/Supply Officer:
  - Person obtaining needed equip/supplies.
  - Prepares (pre-assembles) them for immediate use by the providers.
  - Monitors expenditures of cache supplies.

- Designation of functions — selection of personnel for each function must be:
  - A flexible and dynamic process with the many variables involved.

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- Recorder/Safety Officer
  - Records "timed" —
    - assessments
    - interventions
    - re-assessments
  - Assures atmospheric monitoring, "roof" checks, etc. are performed
  - Monitors providers "time in the hole," need for rotation
  - Tracks amount of O_2 in tanks
  - Assures # of providers in and out are equal, etc.

FEMA US&R RESPONSE SYSTEM

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- Equipment/Supply Officer

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  - Obtains required equipment/supplies
  - Prepares (pre-assembles) for immediate use

- Anticipator
  - Monitoring expenditures of cache supplies
  - Person listening to the evaluation/Rx
  - Communicates expected needs of Provider

- Based on situation needs, NOT Medical Team position.

V. CONFINED SPACE MEDICINE
C. MEDICAL OPERATIONS

MEDICAL TEAM FUNCTIONAL STRUCTURE

- Medical team personnel:
  - Managers — emergency physicians.
  - Specialists — paramedics.
- Team Structure patterned after the EMS "Medical Control MD/Paramedic model.
- Mutual respect between the disciplines is emphasized.
- Medical Team personnel must use management processes that allow optimal application of all members' expertise.
- Compliment the strengths of each discipline:
  - Managers (doctors) — medical knowledge.
  - Specialists (medics) — immobilization/extrication knowledge and pre-hospital "savvy".

APPROACH TO MEDICAL CARE IN CONFINED SPACES

- Overview of tasks in CSM:
  - A more detailed listing than in the earlier sections and incorporates many "minor" points to be made in the skill stations.
- Acquire patient data from earliest possible time.
- More victim-specific than the general medical intelligence gathered earlier at briefings.
- Victim data:
  - From bystanders/family about patient's age, PMH, allergies, etc.
  - From rescuers about possible hazards in the structure and the victims position, injuries, etc.
  - From the function of structure (pre-school vs. nursing home, etc.)
  - From the victim as soon as voice contact is established with patient: obtain brief Hx and complaints.

■ Acquire patient data ASAP...

- From bystander family/friends
  - age
  - PMH
  - allergies, etc.
- From rescuers
  - possible hazards in the structure
- From the victim

V. CONFINED SPACE MEDICINE
C. MEDICAL OPERATIONS

APPROACH TO MEDICAL CARE IN CONFINED SPACES (continued)

- The objective of data collection is to be prepared as possible to care for patient's injuries when reached in the rubble.

- Monitor Rescue Team's activities for impact on patient.

- Impact from:
  - Dust production.
  - Carbon monoxide generation.
  - Movement of compressing rubble.
  - Impact on the rescuers (fatigue, dehydration, dust, etc.); may affect their safety judgement.

- Patient evaluation begins with first voice contact.

- Objective of voice contact:
  - Determine injuries/illnesses of victim to anticipate medical/extrication needs prior to accessing patient.
  - Determine any patient problems that will require alteration in rescue teams approach to accessing the patient.

- Prep equipment beforehand. Preparation:
  - Have all equipment/supplies prepared and pre-positioned prior to patient being accessed!
  - patient protection equipment (mask, goggles or shield, ear plugs, wet gauze to clean mouth, C-collar, helmet) should be packaged with backboard, SKED or other mobilization device.
  - Important to do this to avoid any "down time."

EFFICIENT EVALUATION/TREATMENT

- Evaluation/treatment:
  - Evaluate/begin treatment as soon as patient is reached and the space is stabilized.
  - Safety first!
    - confined space considerations.

- Voice contact with victim —

  Objectives:

  - Determine illness/injury
  - Anticipate medical/ extrication needs prior to accessing patient
  - Determine patient problems
  - May require alterations in Rescue Team's approach in accessing patient

- universal precautions considerations.

V. CONFINED SPACE MEDICINE
C. MEDICAL OPERATIONS

EFFICIENT EVALUATION/TREATMENT (continued)

- General patient approach:
  - Protect patient from further harm (dust mask, face shield, ear plugs, further shoring of the roof, etc.).
  - Remove all jewelry, constrictive/ wet clothing, etc.
  - Access: work with what you can reach, advance as the patient is uncovered, communicate with the patient.

- Standard BTLS/PHTLS care:
  - Airway.
  - Breathing.
  - Circulation.
  - Disability.
  - Exposure: use tactile evaluation.
  - Secondary survey: includes constant re-evaluation and close monitoring.

- Adapt definitive care: "long distance O_2," specialized immobilization, etc.

- Communicate:
  - With the patient.
  - With Medical Team members.
  - With Rescue Team members.

- Re-evaluate patient after every significant move.

- Full evaluation as indicated once outside collapsed structure.

EVALUATION/TREATMENT AND SCOPE OF PRACTICE

- In providing treatment, specialists must not exceed the everyday qualifications/scope of practice within their home jurisdiction.

- Coordinate ongoing evaluation/treatment with Rescue Team activities.

V. CONFINED SPACE MEDICINE
C. MEDICAL OPERATIONS

EVALUATION/TREATMENT AND SCOPE OF PRACTICE (continued)

- Coordinating with Rescue Team operations:
  - Communicate.
  - Plan extrication/evacuation together.
  - Medical Team is responsible for patient (not Rescue Team: they do the extrication in conjunction with Medical Team).

- Re-evaluation after any significant extrication move.
  - This is a continuous process of patient evaluation/re-evaluation, searching for subtle changes/clues and providing treatment and treatment modification based on these.

- Full evaluation:
  - More complete evaluation as soon as safely extricated to the safe zone: "Medical Treatment Area".
  - Degree of further evaluation/care based on injuries, access to definitive care, sophistication of transport services, etc.

- Degree of intervention dependent on:
  - Type of entrapment.
  - Degree of treatable injury ("triage").
  - Number of patients/amount of resources ("triage").
  - Safety of the structure.
  - Presence of hazardous materials.
  - Time to reach definitive care beyond the collapse site.
  - Degree of sophistication of definitive care center.

- Triage - "to sort." Process applies to many situations:
  - Patients.
  - Patient intervention.
  - Transportation method.
  - Building search.
  - Rescue opportunities selection.
  - Other response activities.
  - Dynamic, complex processes based on current needs and availability of resources.

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■ Degree of intervention dependent on...

• Type of entrapment

• Degree of treatable injury

• # of patients, amount of resources

FEMA US&R RESPONSE SYSTEM • Safety of structure

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• Presence of haz mat

• Time to reaching definitive care

• Degree of sophistication of definitive care

■ Triage - "To sort" —

• Applies to patients
  - patient interventions
  - transportation method
  - building search
  - rescue opportunities
  - other response activities

• Dynamic, complex processes based on current needs and availability of resources

• Medical Team may be involved in all of these situations

TASK FORCE MEDICAL TEAM TRAINING 04/97

V. CONFINED SPACE MEDICINE
C. MEDICAL OPERATIONS

EVALUATION/TREATMENT AND SCOPE OF PRACTICE
(continued)

- Medical Team may be involved in all of these triage processes.

HAND-OFF ISSUES

- Documentation:
  - Patient Care Form
  - Patient Referral Form

- Retention of Medical Team personnel and important "fixed medical assets" at the site.
  - Applies to equipment/supplies/ personnel.

- Important to maintain the "functional integrity" of the Medical Team for:
  - Task force personnel.
  - Future victims.

- Some flexibility is allowed in this based on the judgement of the Medical Team Manager and Task Force Leader

- This policy is backed up by the FEMA process.

- FEMA POLICY
  - *"It is recognized that the task force Medical Team, being medically sophisticated, may be 'handing off' a potentially unstable patient to a less sophisticated, interim level of medical provider for transport to definitive care. This is considered to be standard practice under the circumstances of disaster operations*." (Task Force Medical Procedures, page 1.)

V. CONFINED SPACE MEDICINE
C. MEDICAL OPERATIONS

HAND-OFF ISSUES (continued)

- Determining the best resource for transfer of your patient. Decision based on:
  - Prior medical intelligence gathering by the Medical Team and the IST.
  - Patient's injuries/medical needs and what resource best meets them.
  - What's currently available and uncompromised.
  - Ability to communicate with the resource.
  - Decision must be made within the context of the Incident Management System operating in the disaster area.

- Stabilization issues:
  - Degree of your stabilization/treatment may depend on length of transport, level of care, etc.
  - Ground vs. air; fixed wing vs. rotary wing (altitude, accel/decel forces, hypoxia, pneumothorax, air splints, nasogastric tube/suction, etc.) .