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Preparing for the EMS Certification Exam

Over the past few years many excellent medical directors have failed to pass the subspecialty exam on their first try. Performance on the exam is multifactorial, but we believe there are a few strategies worth discussing before you begin your preparations.

The first critical step is understanding that this is an examination of the practice of EMS Medicine, not your practice of EMS Medicine. Each system has unique demands and the work of EMS medical directors is highly heterogeneous...But the exam is not. The items on the exam correspond to the Core Content of EMS Medicine. The content areas are organized into Clinical Aspects of EMS Medicine, Medical Oversight of EMS, Quality Management and Research, and Special Operations with relative weighting of 40%, 30%, 10% and 20%, respectively. In other words, decades of front-line performance on the job is unlikely to prepare you for the exam without additional focused effort.

Each individual who qualifies to sit for the exam will have a long history of objective success in test taking, notwithstanding the fact that many would consider themselves “good” or “bad” test-takers. Therefore, each individual should consider those techniques they have used that got them to this point, and to avoid major changes to study and test-taking paradigms. If past success was associated with highlighting text and forming study groups, for example, then that is likely a pathway to ongoing success. Contrariwise, if the candidate has always studied alone late at night, then changing to study groups may not be the best strategy. Test-taking techniques themselves can still be improved. There are good online resources for this but practicing on how to read questions, and what the “distractors” are, can be valuable.

Finally, in our experience, some EMS physicians have diligently prepared for the exam, but squandered their time studying material which was unlikely to be on the exam. We recommend focusing on a textbook specific to the core content of EMS medicine, and one or more of the available review sources (review books, review courses, simulated exam items). We recommend against spending time focusing on primary material (research studies) or guidelines (other than the AHA’s), as the testable areas of these resources are likely adequately covered in the available text books and review materials.

The increase in the number of board-certified EMS physicians is key to the growth of the EMS subspecialty. As EMS physicians prepare for the exam, they are doing so not only for themselves, but also for the providers and patients that rely on them.

Many have reached out regarding a printed version of this work. We recommend searching the internet for one of the many services that can print PDF files e.g. to spiral notebooks that can be delivered to your home for a reasonable cost. If you find errata or other imperfections, please email them to ryan.coughlin@yale.edu.

We wish you the best of luck in your exam preparation,

Dr. Ryan F. Coughlin
Editor-in-Chief, NAEMSP Board Certification Exam Review Guide

Dr. Brian Clemency
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Course Director, NAEMSP/ACEP Content Review Course
Emergency Medical Services

Clinical Practice and Systems Oversight

Volume 1: Clinical Aspects of EMS
1: History of EMS, Textbook Page 1

Before 1966 - Historical perspectives

- Documented prehospital medicine dating back to 1500 BC
- Military surgeons delivering care on the battlefields in the Napoleonic era
- Medical experiences of Civil War stimulated the beginning of civilian urban ambulance services
- Successful CPR (1960), use of rescue breathing and defibrillation, high resuscitation rate in e.g. Ireland

1966 - The National Academy of Sciences National Research Council (NAS-NRC) Report

- >47,000 deaths in 1965 in motor vehicle accidents, many preventable
- Highway Safety Act of 1966 funded EMS standards, improve ambulance services, and demonstrations
  - Prompted DOT (Department of Transportation) to contribute more than $142 million to regional EMS systems between 1968 and 1979 ($10 million on research alone)
- First to recommend categorization of emergency facilities
- EMS and EDs in the United States = “woefully inadequate” [Figure 1.1]

![Image of Inadequacies of Prehospital Care in 1966](image)

### Figure 1.1

1970 - LACFD paramedic program

- Legal changes to allow paramedics to use procedural skills

1973 - The Emergency Medical Services Systems Act

- Money ran out in 1980s, but this helped create the infrastructure for EMS funding
- Universal 911 also advocated in 1973
Emphasized a regional systems approach, a trauma orientation, and a requirement that each funded system address the 15 “essential EMS components.” [Figure 1.2] Provided $300 million

![Figure 1.2 The Fifteen Essential EMS Components. Washington, DC: Department of Health, Education, and Welfare, Division of EMS, 1973.](image)

- **Pros of EMS systems act:**
  - Started money flow for EMS nationally
  - Created DHEW (Department of Health, Education, and Welfare) KKK-A 1822 - standards for ambulance design and equipment (one of 15 components)

- **Cons of EMS systems act:**
  - *Lacked medical direction & oversight* as important factors
  - Not developed for patient or consumer
  - Lacked infrastructure for engineering of system
  - Elements of a successful system could not be assembled into useful framework
  - Some feel it was oversimplified

1978 - The DOT & DHEW signed Memorandum of Understanding (MOU) on EMS system development responsibilities, which quickly failed

1980 - Formation of NASEMSD (National Association of State EMS Directors)

**1981 - The Omnibus Budget Reconciliation Act**
- Reagan signed legislation that converted 25 Department of Health and Human Services (DHHS) funding programs into seven consolidated block grants
- EMS was included in the Preventive Health Block Grant
  - Effectively, individual states were left to determine how much money from the block grants would be distributed locally
- Generally, quite political, with little direct input from the public or the medical community
- By 1982, all federal EMS system financial support would end, and regional EMS programs would be the responsibility of the regional agencies.
1984 - EMS for Children (EMSC) program authorized and funded by US Congress
   ● Also, in 1984 National Highway Traffic Safety Administration (NHTSA) created the American Society for Testing and Materials which created 30 EMS standards, all non-mandated
   ● NHTSA took over roles/responsibilities of DHEW

1985 - NAEMSP started
   ● COBRA/EMTALA (Consolidated Omnibus Budget Reconciliation Act & Emergency Medical Treatment and Labor Act) also passed this year

1991 - AHA (American Heart Association) introduced chain of survival and ‘early’ approach to cardiac arrest

1996 - NHTSA creates the EMS Agenda for the Future
   ● Better roadmap on how to build effective EMS system

   ![Box 1.3 EMS Agenda for the Future Attributes of the EMS system](image)

   ● Also, national EMS Education for the Future
     ○ Core content
     ○ Scope of practice blueprint
     ○ Education standards
     ○ Education program accreditation
     ○ Certification

2002 - Medicare reimbursement for air ambulances change in 2002, resulting in an increase in programs, along with problems in regulation of these services due to the 1978 Airline Deregulation Act
   ● Advocates for EMS founded in 2002

2003 - Institute of Medicine (IOM) released ‘Emergency Medical Services at the Crossroads’ which recommended coordinated emergency and trauma care systems across the country and most importantly said that EMS should be an ABEM recognized subspecialty (published in 2006 report ‘The Future of Emergency Care’)

Jump to Contents
2005 - National EMS Information System (NEMSIS) MOU signed by all 50 states and 2 Territories (only 4% of post-9/11 funding went to EMS)

2006 - Initiation of the new Federal Interagency Committee on EMS (FICEMS) which would ID state and local EMS needs, recommend new EMS programs, and coordinate Federal program interface with EMS systems

2009 - NHTSA published the National EMS Education Standards (four levels of providers: emergency medical responder, emergency medical technician, advanced emergency medical technician, and paramedic)

2010 - EMS approved by ABEM as subspecialty

2012 - Reimbursement for community paramedic services in some states

2013 - Development of a National EMS Culture of Safety Strategy
Section I: Airway

2: EMS Airway Management, Textbook Page 21

- Emphasis that “airway management” means more than ETI -- a system of care involving basic & advanced airway interventions at all provider levels that requires close medical oversight.

- Continuous waveform capnography is critical for EMS airway monitoring.

- Controversies: Prehospital endotracheal intubation (ETI):
  - No proof it improves survival
  - Adverse events are common
  - Adverse effect of ETI is more “time off chest” in CPR
  - Alternative airways in CPR may be better than ETI
  - EDs don’t change alternative airways for ETTs until patient stable
  - Jury still out on pediatric ETI. May be harmful

- Most successful prehospital airway management programs include:
  - Training
  - Skills verification
  - Equipment selection
  - Decision support
  - Continuing education
  - Total Quality Management -- iterative process of training, continuing education, data collection, assessment, and re-education

- RSI should only be used by agencies with “the highest standards of clinical airway management practice.”

- Suggest limiting prehospital ETI attempts to 3.

- Support use of alternative airways e.g. NIPPV (non-invasive positive pressure ventilation).

- All airway management cases should be reviewed if possible and directed feedback given to providers.
3: Airway Procedures, 30

- Basic airway interventions can be performed by all prehospital providers e.g. positioning

- Best to base oxygen protocols on clinical findings, not pulse ox reading.

- Always preferable to have NPA/OPA and 2 providers for effective BVM (bag-valve mask).

- Prehospital laryngoscopy is difficult. Video-assisted, nasotracheal, digital, lighted stylet, retrograde intubation, and bougie may all confer advantages.

- Supraglottic airways (SGAs) are increasingly popular, but limited prehospital data.

- Many medical directors question role of prehospital cricothyrotomy given rarity and difficulty of procedure.

- Effective TTJV (transtracheal jet ventilation) requires flow of 50 L/min, only available with “wall” oxygen.
  - 16G IV with 50 LPM+20 BPM=TV 950 cc.

- Must continuously verify ETT positioning given risk of dislodgement.
  - Capnometry capable of providing continuous tube placement confirmation.

- ACLS guidelines recommend commercial tube holders, but these have not been verified in a prehospital environment and aren’t designed for SGA’s (which also need to be secured).

- “Drug-facilitated” intubation includes both RSI (rapid sequence intubation) and sedation-only.
  - NAEMSP has published national consensus standards.
  - Most common agents are etomidate and succinylcholine.
  - Agencies that perform RSI should also offer longer-acting paralytics.
  - Specialized pediatric teams may have additional protocols.

- Prehospital NIPPV has been shown to decrease intubation rates, shorten hospital length of stay, and improve survival.
• Approaches for the rescuer position for ETI include prone, left lateral decubitus, kneeling, sitting, or straddling the patient in a face-to-face fashion (“Tomahawk” intubation).

• Limited evidence suggests left lateral decubitus may be more successful than other positions

• In terms of lighting: Increase ambient lighting of the surrounding environment as much as possible. If adequate lighting is impossible, may consider blind digital intubation, lighted stylet, or SGA (supraglottic airway).

• Small, portable versions of many devices such as VL (video laryngoscopy), ETCO2, suction, and BVM exist for use by specialized wilderness/tactical/etc. teams.

• Feasibility studies have been performed examining the ability to broadcast ETI attempts from the ambulance to a remote observer, utilizing modified VL technology, or even regular smartphone technology.

• Advanced airway management is impossible and should not occur in care under fire/direct threat

• In the tactical field care/indirect threat care phase, basic airway maneuvers can be attempted, NPA/OPA placed, or placement in the recovery position if unconscious (or sitting upright if conscious and bleeding). Cricothyrotomy can be performed in this phase as well.

• In the evacuation phase, acceptable airway management more closely mirrors normal prehospital environments including multiple ETI options, SGA, cric, etc.

• Airway management techniques can affect exposure of tactical providers to an active threat.

• Operational constraints or type of injury may increase consideration of early surgical airway.
Section II: Breathing

5: Respiratory Distress, 51

- 13% of adult EMS calls

- Ontario Prehospital EMS Advanced Life Support (OPALS) Study demonstrated significant survival benefit with interventions such as nebulized beta agonists, SL nitro, intubation, IV meds and fluids

- Paramedics have a moderate (not perfect) degree of accuracy in etiology diagnosis
  - Agree with EM physician diagnosis 81% of time

- Important to know upfront to what extent a patient wants resuscitation efforts

- Breath sounds: Cornerstone of diagnostic evaluation, can be fooled

- General treatments for respiratory distress:
  - IV, O2, monitoring
  - SpO2 goal 92-96% (general resp distress), 88-92% (pts with known COPD)
  - Short Acting Beta-agonists (SABA): Little harm with initial trial. Can be harmful in cardiac etiologies d/t chronotropic, inotropic, vasoactive effects), but no mortality difference between pts who did or did not receive SABAs. SABAs may temporarily worsen hypoxemia by increasing ventilation/perfusion mismatch.
  - NIPPV - can use in all undifferentiated acute resp failure - decreased mortality/reduced ICU stay/reduced intubation rates. Contraindicated in pts requiring immediate ETI, unable to protect airway, altered mentation, cannot tolerate pressure mask.

Specific Disease Processes:

- Asthma: SABA, ipratropium, epi, steroids
  - Benefits of prehospital corticosteroids have not been proven through randomized controlled trials- - But also some non-randomized observational studies show decreased admission rates and enhanced effectiveness of SABA with early corticosteroid use.
  - NIPPV shows benefits
  - If ETI is necessary, use Ketamine, ventilation should be kept at low volume, I/E ratio, permissive hypercapnia. Monitor for signs of barotrauma.

- COPD: beta-agonists, NIPPV
  - Increasing ETCO2 levels indicate a deteriorating condition
  - SABA, anticholinergics, NIPPV, ETT w/ decreased respiratory rates, low TV, monitor for barotrauma
- Acute Decompensated HF/Cardiogenic Pulm Edema: nitroglycerin, NIPPV
  - No widely accepted guidelines for prehospital setting
  - Volume overload + adequate/high BP -> Nitrates
  - Nitro SL/IV OK but *transdermal not recommended* (slow absorption, decreased skin perfusion)
  - Nitro low rates of serious adverse effects 0.3-3.6%
  - Furosemide: IV peak response 30 min, more delayed in pts with decreased cardiac output.
  - Diuretics are rarely indicated in prehospital settings -> *Use is discouraged*.
  - Many EMS systems have eliminated furosemide use in favor of nitro alone
  - Morphine also debunked, increased death and adverse outcomes
  - NIPPV useful, should be used in conjunction with nitro
  - Focused US is promising to DDx COPD vs CHF in the prehospital setting.

- Infectious: O2, NIPPV, IVF, bronchodilators if needed, personal protective equipment
  - Respiratory precaution for resp distress patient presumed to have infectious etiology

- Pulmonary embolism (PE)
  - High flow O2, vascular access, cardiac monitoring
  - Fluid bolus for suspected massive PE and perfusion failure
  - Use of pre-hospital tPA for refractory PEA *failed to show improved outcomes in RCTs*

- Pneumothorax (PTX)
  - Simple PTX: monitor for tension etiology
  - Tension PTX: Immediate needle chest decompression
6: Oxygenation and Ventilation, 61

- **Oxygenation:** Typically assessed via pulse oximetry, which is unreliable in low tissue perfusion states and falsely reassuring in cases of carbon monoxide poisoning.

- **Ventilation:** EtCO2, as measured by a continuous waveform capnometer, is used as an indirect measure. It also gives information on the frequency and flow rate (i.e., rate & depth) of inhalation and exhalation. It will provide a more immediate representation of changes in respiratory function than SpO2. [Figure 6.2]
  - **Minute ventilation:** TV x RR → normal 6 - 7 L/min

\[ \text{ETCO2 level typically about 5 mmHg lower than actual pCO2 level in the blood d/t alveolar dead space} \]

- **Supplemental oxygen** should be considered for all patients with respiratory distress, clinical markers of respiratory compromise (e.g., altered mental status), or measured inadequate oxygenation (SpO2 <94%) or ventilation (ETCO2 <35 or >45). [Table 6.2]

\[
\begin{array}{|c|c|c|}
\hline
\text{Device name} & \text{O2 flow rate (L/min)} & \text{FiO2 (approximate %)} \\
\hline
\text{Nasal cannula} & 1-6 & 24-44 \\
\text{Simple face mask} & 5-12 & 35-55 \\
\text{Partial rebreather mask} & 8-15 & 35-60 \\
\text{Non-rebreather mask} & 8-15 & 60-95 \\
\text{Venturi mask} & 4-15 & 24-50 \\
\text{Tracheostomy mask} & 10-15 & 35-60 \\
\hline
\end{array}
\]

- **Capnography** is superior to pulse oximetry as monitor of respiratory function
  - "Shark fin" pattern = obstructive airway disease, often seen in COPD or asthma

- **NIPPV** is useful in patients when supplemental O2 does not provide adequate oxygenation of blood - pulmonary edema, COPD, asthma, and pulmonary hypertension.
- **Ventilator modes:**
  - **Assist Control (AC):** Vent delivers set tidal volume with each breath. Patients can trigger breaths if breathing faster than set rate.
  - **Synchronized Intermittent Mandatory Ventilation (SIMV):** Identical to AC except patient-triggered breaths are effort-dependent (patient's effort to determine the volume of the breath). If no respiratory effort: SIMV=AC.
  - **Pressure Support (PS):** Delivers set inspiratory pressure above baseline PEEP with each patient-triggered breath. Patient's respiratory drive determines the rate and the patient's lung compliance and airway resistance determine the tidal volume developed.

- Lung-protective ventilation (tidal volume ~6 mL/kg using **ideal body weight**) should be used when possible. Common in ARDS (Acute Respiratory Distress Syndrome).

- Changes in peak inspiratory pressure (PIP) are a common cause of vent alarms.
  - Low PIP is usually a leak in the ventilator circuit.
  - High PIP can be caused by increased airway resistance (blocked tube, secretions) or decreased lung compliance (pulmonary edema, pneumothorax, pleural effusion, hyperinflation).
  - Inspiratory hold tests can be used to tell these apart (disallows exhalation, eliminating airway resistance from measurement). If the plateau pressure rises along with PEEP, decreased lung compliance is likely the cause.

- Must maintain a high index of suspicion for pneumothorax, and any sign of tension physiology must be addressed immediately with needle decompression.

**Pneumothorax:**
- **Average rotor transport** will not result in significant clinical effect on pneumothorax (usually 1,000-3,000 ft).
- **Instrument flight conditions** sometimes lead to **altitudes of 6,000 feet, which will increase pneumothorax size by about 25%**. Patients should not be flown fixed-wing (especially without cabin pressurization) without tube thoracostomy.
  - Boyle's law \((P1V1 = P2V2)\): Air in the pleural space will expand with decreasing atmospheric pressure associated with increasing altitude.
Section III: Circulation

7: Hypotension and Shock, 71

- Clinical signs and symptoms: tachycardia, poor skin perfusion, EtCO2 and AMS.

- Error rate of 20% for VS obtained prehospitaly.

- Blood Pressure = Cardiac Output × Peripheral Vascular Resistance

- Cardiac Output = Heart Rate × Stroke Volume

- Shock Index: Pulse Rate / Systolic Pressure → Normal = 0.5 - 0.8, Shock > 1

- Most EMS providers use the “pump-fluid-pipes” model.
  - Pump - cardiogenic shock
  - Fluid - hypovolemic/hemorrhagic shock
  - Pipes - distributive shock

- EMS can be lulled into a false sense of security with “normal” VS and miss early signs of shock.

- Any episode of prehospital hypotension may be evidence of significant shock or critical illness

- Shock treatment: isotonic crystalloid IVF (or IO), hemostatic agents or tourniquets, pressors

- Lack of definitive studies on out-of-hospital shock treatment → controversies (i.e. pneumatic anti-shock)

- Studies showed no difference in survival to hospital discharge with prehospital IVF in traumatic hemorrhage...done in systems with short transport times.
  - Goal: Give only enough IV/IO fluids to restore peripheral pulse, or SBP 80-90 (optimum target not defined).

- Pediatric shock is more commonly present with a low cardiac output and a relatively high systemic vascular resistance (SVR). Usually requires more aggressive fluid resuscitation with volumes of 60 cc/kg or more.

- Narrow pulse pressure < 30 mmHg or 25% of SBP may be early hypovolemic or obstructive shock.

- Wide pulse pressure may be distributive shock.

- Prehospital hypotension = 30% higher mortality rate.
Protocol development for treatment of shock should address:

- Perform the initial assessment
- Perform definitive or lifesaving interventions appropriate for these patients
- Access to definitive care without unnecessary prehospital delay ("load and go")
- Resources to be used in the field
- Skills of the various levels of prehospital care providers in the field
Flow is based on Poiseuille's Law: it is directly proportional to the radius to the fourth power, and inversely proportional to the length. Large gauge, short catheters are best when possible.

IO sites:
- Humeral head – Adducted with palm pronated. Palpate greater tuberosity.
- Proximal tibia – Two finger breadths below and just medial to tibial tuberosity.
- Distal tibia – Abduct and externally rotate the hip. Site is the flat portion of bone just proximal to the medial malleolus.

Dialysis fistula is a last resort, but this site is acceptable when the patient is in extremis.

Pain and anxiety in the pediatric patient are difficult. Can attempt creams or small doses of lidocaine for pain control.

No demonstrable benefit from IV placement or IVF in trauma.
9: Chest pain and acute coronary syndrome, 90

- Epidemiology:
  - An MI every 26 seconds
  - 10x mortality of MVAs
  - Pts arriving to ED via EMS with chest pain -> higher pretest probability of MI than general ED pop

- EMD not as accurate at predicting ACS versus stroke (PPV 6% versus 42%)
  - EMD should instruct patient to take ASA for non-traumatic chest pain, reduces mortality

- EKG interpretation—*computerized interpretation misses up to 20% true STEMIs*. Therefore, education also important

- Meds for ACS:
  - ASA (only med with mortality benefit)
  - O2 only if SaO2 < 94%, dyspnea, heart failure or shock. Otherwise may theoretically increase damage secondary to free radical production
  - NTG (decreases MvO2 and increases collateral flow to ischemic areas)
  - Morphine (reduced from class I to Ila for NSTEMI; remains I in STEMI)
  - Fentanyl instead of morphine shown to be equivalent prehospitaly
  - Beta blockers (limited/no EMS use – reducing arrhythmic events is equally offset by an increase in development of cardiogenic shock, and survival is similar regardless of early administration)

- Prehospital Fibrinolysis: feasible safe effective, not necessary if PCI readily available
  - PCI reduces mortality

- Systems of care
  - Designated centers for destination
  - prehospital notification (possible earlier activation)
  - Air medical transport for PCI
  - Expanding role of BLS
  - Shortening door to balloon time by 30 minutes reduces in hospital mortality from STEMI by 1%
10: Cardiac dysrhythmias, 100

- Treat unstable
  - Hypotension
  - Chest pain
  - Altered LOC

- Classify EKG findings
  - Rate
  - Regularity
  - Wide vs narrow

- Focus actions to evaluate stable but symptomatic and borderline patients

- Stable wide complex tachyarrhythmias (WCTs)
  - Differentiating SVT vs VT if no P-QRS relationship:
    - A patient with new-onset WCT and a history of previous myocardial infarction or VT will very likely have VT
    - VT will often not slow during vagal maneuvers. Therefore, slowing of a WCT during these efforts suggests SVT. However, the absence of change does not diagnose VT.
    - Most VT does not respond to adenosine, whereas SVT usually slows or terminates. Conversely, lidocaine has little effect on most SVT and will terminate 75–85% of VT.
    - VT is usually regular and rarely seen at a rate of greater than 220/minute. Any chaotic WCT should be considered atrial fibrillation with abnormal conduction. When a chaotic WCT at a rate of greater than 220/minute occurs, atrial fibrillation from Wolff–Parkinson–White syndrome is present. This rhythm is prone to deterioration.

- Amiodarone (5 mg/kg IV over 5 minutes)

- Lidocaine (1.0–1.5 mg/kg IV up to 3 mg/kg)

- Adenosine and verapamil can be used to terminate narrow complex tachycardias along with diltiazem

Controversies

- Rhythm strips vs monitors: Strips are best whenever possible
- Synchronization and sedation during electrical cardioversion
- Prophylactic lidocaine for PVCs—no benefit
- Pediatric dysrhythmias—Peds can have higher HR - up to 225 in response to physiologic stress.
  - 2 J/kg = unstable dosing
  - Consider volume challenge
● Torsades: tends to be HR dependent and greatest chance of occurring when HR drops below 80-100.
  ○ Cardiovert when unstable and transcutaneous pacing or isoproterenol titrated to keep the HR >120
  ○ Magnesium sulfate 2g IV push for those who fail cardioversion

● Renal failure rhythm disturbances: most commonly hyperkalemia — early calcium (gluconate preferred over chloride since it doesn’t fry the veins as much, however need 3 times as much gluconate)
  ○ *Lidocaine can cause asystole in the presence of hyperkalemia*

Protocols:
● Both the bradycardia and tachycardia protocols should distinguish between “stable/no symptoms” and “symptomatic/unstable or borderline.” Observe, transport and start an IV in the former, and slap the pads on the latter since they likely need the Edison Medicine (electricity).

● If the medic can get sedation on board prior to electrical synchronized cardioversion or transcutaneous pacing, fantastic. But do not delay treatment in order to provide sedation in unstable patients who are peri-arrest.
11: Cardiac procedures and managing technology, 108

Intraaortic Balloon Pump (IABP)

- IABP role is to stabilize the patient until definitive care can be achieved
  - Decreased cardiac afterload, augment diastolic perfusion pressure, increase coronary perfusion pressure

- Procedure:
  - Inserted into the femoral artery and advanced into the thoracic aorta
  - Balloon placed 1-2 cm distal to the beginning of the subclavian artery and MUST BE above the branches of the renal arteries
  - Tip of the catheter - visible between the 2nd and 3rd ICS

- Indications:
  - Acute MI, cardiogenic shock, ventricular aneurysm, left ventricular failure, valve or papillary muscle rupture

- Contraindications:
  - Absolute: Aortic dissection, abdominal aortic aneurysm, aortic valve incompetence
  - Relative: bleeding disorders and atherosclerosis

- Timing of pump - CRITICAL TO FUNCTION OF THE PUMP
  - Diastole: Balloon is INFLATED - Coronary and carotid arteries are perfused
  - Systole: Balloon is DEFLATED just prior to systole

- Triggers for pump timing:
  - ECG and arterial pressures

- Special circumstances:
  - Cardiac arrest will initiate "trigger arrest" alarm - will lead to thrombosis if left like this
  - CPR - switch to "arterial trigger" mode
  - If this does not work - switch to "internal trigger" within the IABP to avoid thrombus formation (last resort)
  - If ROSC is achieved this mode will need to be discontinued
  - With IABP failure: manual pumping of the balloon should occur with a Luer-Lok syringe

Ventricular Assist Devices (VAD)

- Cannulae in apex of left ventricle with blood flow TO pump and in ascending aorta with blood flow FROM pump

- LVAD (Left VAD) Complications:
  - Device problems
    - Battery or cable connection problems
    - Device failure
    - Neurological events like TIAs and CVAs
    - Bleeding (GI, epistaxis, hematomas, etc.)
    - Cardiac dysrhythmias
    - Equipment Infection
• Prehospital Encounters for LVADs
  ○ Patients will not have palpable pulse and difficult to measure blood pressure
  ○ If possible, EMS should get a list of nearby patients with LVAD
  ○ Do NOT cut clothes with shears since you could cut the wires
  ○ EKG
  ○ Hemodynamic compromise: provide IV fluids
  ○ Only treat arrhythmias if symptomatic
  ○ CPR should only be performed in 2nd generation or later LVADs, and only as a last resort
    ■ *This point is controversial (therefore, unlikely to be on exam)*
  ○ Transport to an LVAD facility only. With all batteries, controllers, etc.
  ○ Patient/family should have a card with the number for the LVAD team where they had the device placed. Call them ASAP, they are an invaluable resource.
Implanted Cardiac Pacemaker

- Five letter codes, first three letters most commonly used:
  - First letter: Chamber paced
  - Second letter: Chamber sensed
  - Third Letter: Response after sensing
- AOO Atrial pace; no sense, no inhibitions
- AAI Atrial paced; atrial sense, inhibited by atrial beat
- VOO Ventricular pace; no sense, no inhibitions
- VVI Ventricular paced; ventricular sense, inhibited by ventricular beat
- DOO Dual chamber pace; no sense, no inhibitions
- DVI Dual chamber paced; ventricular sense, inhibited by ventricular beat
- DDD Dual chamber pace; dual chamber sense, inhibited by either chamber

- If pacemaker requires suspension of firing, place magnet over pacemaker
  - This places pacer in an asynchronous fixed rate

**Implantable cardioverter-defibrillators**

- Three most common scenarios prehospital:
  - 1. Device failure and not firing with ventricular arrhythmia
  - 2. Appropriate firing with ventricular arrhythmia
  - 3. Inappropriate firing with NO ventricular arrhythmia
    - In this scenario, a magnet could be used to stop the firing
12: Cardiac arrest systems of care, 120

- Much of the sudden cardiac arrest (SCA) survival benefit is due to community-based systems such as rapid recognition, bystander CPR (including dispatcher-assisted), and AED deployment and use.

- Epidemiology: Incidence of SCA is estimated between 166k and 450k/yr.
  - Survival to hospital discharge for OHCA is estimated between 5-10%.
  - VF is the initial rhythm in approx. 24-60% of cases (i.e. shockable).

- Elements of Community Cardiac Arrest Care System (Chain of survival):
  - Early recognition and calling for help
  - 9-1-1 dispatching and PAI/DLS
  - Bystander CPR
  - PAD public access defibrillation
  - First responder BLS care including defibrillation
  - ALS care
  - Post-arrest care (including hospital interventions).

<table>
<thead>
<tr>
<th>Variable</th>
<th>Adjusted Odds Ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &lt;75 yr</td>
<td>1.6 (1.2–2.3)</td>
</tr>
<tr>
<td>First link: early access by bystander</td>
<td>4.4 (3.1–6.4)</td>
</tr>
<tr>
<td>Second link: early CPR by bystander</td>
<td>3.7 (2.5–5.4)</td>
</tr>
<tr>
<td>Third link: defibrillation in ≤8 min</td>
<td>3.4 (1.4–8.4)</td>
</tr>
<tr>
<td>Fourth link: advanced life support</td>
<td>1.1 (0.8–1.5)</td>
</tr>
</tbody>
</table>

Figure 12.1 Contributors to cardiac arrest survival. While the first links of cardiac arrest care (early 9-1-1, early bystander CPR, and early defibrillation) contribute to cardiac arrest survival, ALS care does not. Source: Stiell IG, Wells GA, Field B, et al. Advanced cardiac life support in out-of-hospital cardiac arrest. N Engl J Med. 2004; 351:647–56. © 2004 Massachusetts Medical Society. All rights reserved.

- Bystander recognition of SCA has been variable due to agonal breathing etc.

- Role of EMD in recognizing SCA from calls that arrive with other chief complaints. Dispatch algorithms have been updated recently to improve dispatcher recognition of agonal breathing as an indicator of OHCA.

- Emphasis on compressions > ventilations

- Public Access Defibrillation: 70-80% of VF can be successfully converted to perfusing rhythm if shocked within 3 min of VF onset, but survival decreases 7-10% per minute for each minute of delay.
  - AEDs provide faster access to defibrillation. Need to be well placed in the community with members knowing they are present and how to put them on.
  - AEDs are very safe, but still some hesitancy of lay public with use.
  - Newer studies (such as ROC) show survival doubles with AED +CPR compared to CPR alone.
BLS Care of first responders: 1st goal: early defibrillation access - OPALS study found that by increasing BLS response rate of <8 minutes improved survival to hospital discharge in SCA patients from 3.9 to 5.2%. 2nd goal: performing/continuing high quality chest compressions/CPR.

ALS Care: Despite traditional "cornerstone of cardiac arrest care" ALS now recognized as secondary in importance to overall survival when compared to BLS and bystander response.

Figure 12.3 Relation of collapse to CPR and defibrillation to survival: simplified model. Graphical representation of simplified (includes collapse to CPR and collapse to defibrillation only) predictive model of survival after witnessed, out-of-hospital cardiac arrest due to VF. Each curve represents change in probability of survival as delay (minutes) to defibrillation increases for a given collapse-to-CPR interval (minutes). Source: Valenzuela TD. Circulation. 1997; 96:3308–13. Reproduced with permission of Lippincott, Williams and Wilkins.
13: Cardiac arrest: clinical management, 134

- **Chest compressions**: Emphasis on early start of continuous, high-quality chest compressions with minimal interruptions. Coronary perfusion pressure >20 mmHg important for ROSC

- **Defibrillation**: A critical and time-sensitive intervention. Precede defib with chest compression and continue chest compressions following in order to better perfuse myocardium
  - Biphasic defibrillators → electrical current flows in one direction then the opposite → increased rates of ROSC compared to monophasic

- **Airway management**: Emphasize compressions. More attempts halt CPR. Blind insertion supraglottic devices may be of use and recent literature shows this to be an excellent option

- **Ventilation**: Minimize ventilations to 8-10 bpm in order to prevent preload reduction due to increased intrathoracic pressure.
  - **Impedance threshold device**: haven’t been shown much benefit. Contains one-way valve that permits exhalation during downstroke of chest compression, but prevents passive inhalation during upstroke → increased negative intrathoracic pressure, increased cardiac preload, and CPP

- **Medications**: No drug has demonstrated improved long-term outcomes in cardiac arrest

- **High performance CPR**: use pit crew approach
  - Assure continuous chest compressions with proper depth, rate, and recoil. Minimize pauses
  - Changing compressors (quickly) every 100–200 compressions
  - Integrating defibrillation and precharge so ready to shock

- **DNR and Termination of Resuscitation efforts**: Protocols are useful for addressing these situations. Direct medical oversight is useful as well. Two primary situations of non-initiation: patient has DNR status; or has clear signs of irreversible death

- **Verbeek/ Morrison rule**: Indicates termination of resuscitation in patients with an unwitnessed arrest after three periods of CPR, three AED analyses without shock recommendation, and no ROSC

- **Post Arrest Care**: Goals of post arrest care:
  - 1. Maintain hemodynamic stability;
  - 2. Preserve the brain;
  - 3. Correct metabolic derangements;
  - 4. Consider cooling

- **Therapeutic hypothermia**: AHA Class I recommendation for comatose survivors of out of hospital VT/ VF cardiac arrest, Class IIB for other rhythms - but no evidence that starting cooling in the field is beneficial
Section IV: Medical Problems

14: The Challenge of the Undifferentiated Patient, 147

- EMS have to compile a massive amount of information in a relatively short amount of time

- For truly undifferentiated patient, review the history, diagnosis and testing used prior to transfer to ED staff

- Use witnesses or next of kin, and scan the environment for more information

- Modes of clinical decision making:
  - Pattern recognition, or skill based (clinical gestalt)
  - Rule based (e.g. ACLS algorithms)
  - Hypothetical deductive or knowledge based (highest level of deduction - makes a hypothesis then uses existing & new knowledge to find answer)

- Classification of clinical errors:
  - Skill-based errors (failure of execution of intended action, tubing the esophagus)
  - Rule-based errors (wrong rule chosen or misapplication of rule)
  - Knowledge based errors (lack or misinterpretation of knowledge)

  OR, using an alternative approach:

  - Procedural errors (IV starts, intubations, etc.)
  - Cognitive errors (wrong diagnosis, wrong management, etc.)
  - Affective errors (emotional state of the medic influences decision making)
15: Altered Mental Status, 152

- When history is not possible from patients:
  - Clues from surroundings are useful: bystanders, family, med-alert bracelets, medications, other sick residents, or pets.
  - Questions about the loss of consciousness or seizure-like activity.
  - Search bathrooms, medicine cabinets, nightstands.
  - Consider “huffing” / inhalant abuse.

**Box 15.1 Mnemonic for causes of altered mental status**

| A = Alcohol | E = Epilepsy, Electrolytes, Encephalopathy |
| I = Insulin (hypoglycemia) | O = Oxygen (hypoxia), Overdose |
| U = Uremia | T = Trauma, Temperature |
| I = Infection | P = Poisons |
| P = Psychiatric | S = Shock, Sepsis, Stroke, Space-occupying lesion |

- **Physical exam findings:** AVPU classification for level of responsiveness.
  - A = the patient is Alert
  - V = the patient responds only to loud Verbal stimuli
  - P = the patient responds only to Painful stimuli
  - U = the patient is Unconscious

**Medications and Antidotes:**

- **Dextrose** - Only 25% of patients with AMS are hypoglycemic.
  - Can cause skin necrosis after inadvertent extravasation or subcutaneous infiltration, hyperosmolality, hyperkalemia, and potentially a **worsened neurological outcome in patients with focal or global cerebral or myocardial ischemia.**

- **Naloxone** - may need higher doses with synthetic opioids. Frequent titration with small doses is recommended to prevent instant withdrawal and an O2 canister swung at your head.

- Don’t use flumazenil → may precipitate seizures in patients with unknown chronic benzo use or EtOH abuse. Just use supportive care in these folks.
Possible criteria for non-transport of treated hypoglycemic diabetics:

- History of IDDM (insulin dependent diabetes mellitus) and not taking long acting oral hypoglycemics
- Post treatment BGL 80-100 mg/ dL
- Return of normal mental status and tolerating PO intake in front of EMS
- Responsible adult is present to observe patient
- Absence of complicating factors
- Direct medical oversight may be useful in these cases

Possible criteria for non-transport of treated opiate overdose:

- Isolated IV heroin use and/or patient has no OD’d on any oral or long-acting opiates
- Pt was not in cardiac arrest and naloxone was only used to treat AMS/respiratory depression
- ≤ 2mg naloxone was used to get the patient back to normal mental status
- Pt consents to an additional dose of naloxone and/or has naloxone available to be readministered if needed (e.g. a nasal naloxone kit)
- A responsible adult is present to assist the patient if needed
16: Syncope, 158

- **Syncope**: loss of consciousness and postural tone caused by diminished cerebral blood flow which self corrects to a normal state of consciousness
  - Must include both cerebral hemispheres simultaneously or reticular activating system in brainstem

- **Causes**
  - Reflex mediated is the most common cause and best prognosis (35%)
    - Body has an inappropriate autonomic response (hypotension with or without bradycardia) to a change in posture
    - Examples: vasovagal, orthostatic
  - Cardiac (20%)
    - Transient lack of adequate cardiac output leading to inadequate cerebral perfusion
    - Most commonly is transient V tach
    - Examples: V Fib/tach, SVT, sick sinus, afib with RVR, AS, PE, long QT
  - Neurogenic (10%)
    - Rare
    - TIA, SAH, migraine, psychogenic
  - Idiopathic (35%)

- **Assessment**:
  - True syncope resolves on own, not with dextrose or after seizure
  - History is pivotal, but may need to get supporting details from bystanders
  - Complete physical exam is important although may be normal
  - Check glucose and EKG

- **Differential diagnosis**: seizure, pseudosyncope, narcolepsy, cataplexy
17: Seizures, 163

- **Seizure**: Excitation of susceptible groups of cerebral neurons by glutamate and then failure of inhibition by GABA system leads to prolongation of seizures
  - Seizures originate from cerebral cortex or thalamus
  - Important to determine if symptomatic seizure (secondary to another condition) or unprovoked

- **Status epilepticus**: 5 min of seizing or multiple episodes without recovering to full consciousness between seizures

- **Causes**:
  - Electrolyte abnormalities
  - Medication and medication withdrawal
  - Toxins
  - Infections (CNS and systemic)
  - Hypoxia
  - Trauma
  - Sleep deprivation
  - Pregnancy

- **Febrile seizure**:
  - Usually 6 mo-5 yrs due to maturing brain
  - No other cause found for seizure
  - **Simple Febrile Seizures**: last less than 15 min, are generalized tonic-clonic, and occur only once in 24 hours
  - **Complex Febrile Seizures**: the other ones!

- **Treatment**:
  - Protect patient
  - Oxygen
  - Check fingerstick
  - Benzodiazepines
    - **Lorazepam** (Ativan): 0.1-0.15 mg/kg IV over 1-2 minutes, max of 8 mg
    - **Midazolam** (Versed): 0.2 mg/kg IM or IV, max of 10 mg
    - **Diazepam** (Valium): 0.2 mg/kg IV at 5 mg/minute, max of 10 mg in pediatrics and 20 mg in adults
      - Can be given rectally at 0.5 mg/kg in pediatrics
    - RAMPART study shows IM midazolam as effective as IV lorazepam
  - Spinal immobilization probably unnecessary unless significant trauma
18: Stroke, 171

- Epidemiology:
  - Stroke is a leading cause of death in the US and leading cause of adult disability
  - Fall was stated as the primary problem in 21% dispatches in one review
    - Dispatchers correctly identify stroke 31-52% of time, and caller use of the word stroke was highly predictive
  - Strokes are ischemic (80%) or hemorrhagic

- Definitions:
  - **Ischemic penumbra**: area surrounding central ischemia which has decreased blood supply, but can be salvaged depending on severity and duration of ischemia
  - **TIA**: neurological deficit lasting from a few minutes to 24 hours
    - Patients with TIA have a 10-20% risk of stroke in next 90 days, half in next 24-48h

- Management:
  - Last known well time is an imperative part of the history
  - Treat reversible conditions such as hypoglycemia
  - Identify stroke mimics
    - Complex migraine
    - Conversion disorders
    - Encephalopathy
    - Hypoglycemia
    - Labyrinthitis
    - Meniere disease
    - Todd Paralysis
    - Ramsay-Hunt syndrome
  - Blood pressure control may be feasible in the prehospital setting, but best done in ED
  - TPA

- Prehospital Stroke Scales:
  - Cincinnati and LAPSS are validated prehospital stroke scales that increase sensitivity
  - Melbourne Ambulance Stroke Screen (MASS) is hybrid of both
  - Goal is to use pre-hospital notification to decrease door to CT and time to tPA
  - There are many stroke scales for large vessel occlusion screening, none is perfect
### Table 18.1 The Cincinnati Prehospital Stroke Scale

<table>
<thead>
<tr>
<th>Evaluate the following</th>
<th>Result</th>
</tr>
</thead>
</table>
| Facial droop (ask the patient to smile showing teeth) | Normal: No asymmetry  
Abnormal: One side of the face droops |
| Arm drift (with eyes closed, have the patient hold arms in front of body, palms up, for 10 seconds) | Normal: Able to hold arms out at 90º; both arms stay up or fall together  
Abnormal: One arm drifts downward |
| Abnormal speech (ask the patient to say a simple sentence, for example, “It is sunny today.”) | Normal: No slurring  
Abnormal: Slurs words or uses words that make no sense |


### Table 18.2 Los Angeles Prehospital Stroke Scale

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over age 45</td>
<td>Yes</td>
</tr>
<tr>
<td>No history of seizures</td>
<td>Yes</td>
</tr>
<tr>
<td>Symptoms less than 24 hours</td>
<td>Yes</td>
</tr>
<tr>
<td>Patient’s baseline function is not bedridden or confined to a wheelchair</td>
<td>Yes</td>
</tr>
<tr>
<td>Blood glucose between 60 and 400</td>
<td>Yes</td>
</tr>
</tbody>
</table>

#### Examination for asymmetry

| Facial droop | Normal | Right | Left |
| Grip strength | Normal | Weak/none |
| Arm strength (by downward drift) | Normal | Drifts down | Falls rapidly |
| Examination finding unilateral? | Yes | No |

**Box 18.2** Inclusion and exclusion criteria for intravenous tPA

**Inclusion criteria**
- Ischemic stroke onset within 4.5 h of drug administration
- Measurable deficit on NIH Stroke Scale examination
- Head CT does not show hemorrhage or nonstroke cause of deficit. Patient’s age is >18 years

**Exclusion criteria**
- Minor or rapidly improving symptoms
- Seizure at onset of stroke
- Major surgery within 14 days
- Prior stroke or serious head trauma with past 3 months
- Known history of intracranial hemorrhage
- Sustained blood pressure >185/110 mmHg
- Aggressive treatment necessary to lower blood pressure
- Symptoms suggestive of subarachnoid hemorrhage
- Gastrointestinal or genitourinary hemorrhage in last 21 days
- Arterial puncture at a noncompressible site within 7 days
- Heparin administration within 48 h with elevated aPTT
- Prothrombin time >15 s
- Platelet count <100,000 µL
- Serum glucose <50 mg/dL or >400 mg/dL

**Relative contraindications**
- Large stroke with NIH Stroke Scale score >22
- CT shows evidence of large MCA territory infarction (sulcal effacement or blurring of gray-white junction in greater than one third of MCA territory)

**Relative contraindications for the 3- to 4.5-h treatment window**
- History of prior stroke and diabetes mellitus
- NIH Stroke Scale >25
- Oral anticoagulant use regardless of INR
- Age >80 years

Abdominal pain, 181

- Abdominal pain patients represent approximately 5% of EMS calls. Undertriage by EMs providers is common (11 to 22% sensitivity)

- Pain is caused by inflammatory, ischemic, or infectious etiologies, and differential diagnoses are commonly developed by quadrant location of the symptoms
  - Consider special populations when making differential: elderly, pediatric, women of childbearing age, immunocompromised, obese or bariatric surgery patients
  - Remember conditions of lungs, pleural cavities, and heart can be perceived as abdominal pain

- There are 3 pain mechanisms:
  - Viscera: from a hollow or solid organ, causing poorly localized pain, usually associated with other autonomic symptoms (i.e. nausea, vomiting, anorexia)
  - Somatic: from the peritoneal lining causing more severe and localized pain
  - Referred: pain at a site not directly involved in the process i.e. right scapular pain due to gallbladder pathology

- Adequate history includes SAMPLE and OPQRST description of pain
  - SAMPLE: Signs and Symptoms, Allergies, Meds, Previous medical history, Last meal, and Events leading up to the EMS call
  - OPQRST: Onset, Palliation/Provocation, Quality, Radiation, Severity, and Time

- Physical exam includes vital signs, which are commonly normal, and palpation of the abdomen in all 4 quadrants and eliciting peritoneal discomfort (e.g. tapping on the heel)

- Treatment
  - In all cases, stabilize ABC’s, assure hemodynamic stability and relieve pain
  - IV fluid therapy to maintain an SBP over 90
  - Small doses of IV opioid analgesics
  - 12-lead EKG and cardiac monitoring
  - O2 therapy as appropriate
20: Diabetic emergencies, 188

- Epidemiology:
  - 8.3% of total US population with DM
  - Not all recognized (90-95% Type II)
  - EMS is usually called for hypoglycemic emergencies

- Hypoglycemia:
  - Glucose < 70
  - Treatments:
    - Oral glucose
    - IV dextrose
      - 50 ml of D50 on average raises blood glucose 166 mg/dL, but varies widely
      - D10 has the same median time to euglycemia, requires 15g less glucose, so there are fewer hyperglycemic events, and is less sclerosing
    - IM/IN/SC glucagon is an option, but less beneficial in alcoholic or malnourished patients

- Safe refusals after correction of hypoglycemia by paramedics include:
  - Returning to baseline mental status
  - Tolerating PO intake
  - Having a responsible adult present with the patient
  - Not having any condition that predisposes to a repeat episode
  - Written instructions to follow-up with their physician
  - No long acting agents (either insulin or oral)

- Hyperglycemia:
  - Glucose > 200 mg/dL
  - Includes DKA and hyperglycemic hyperosmolar state (HHS)
    - HHS mortality 10-50%

- Pediatric hyperglycemia/DKA:
  - Predisposed to life-threatening cerebral edema with rapid volume repletion
  - Initial resuscitation should only be intended to reverse appearance of shock or hypotension
  - Insulin at the hospital plays an important role
21: Allergic reactions, 194

- **Management:**
  - Determine mechanism of sting or origin of allergy
  - ABC’s, IV, oxygen, monitor
  - Albuterol nebulizer as needed
    - Epi nebulized by placing 0.5 mL of 1:1000 solution in 2.5 mL NS
  - Epi auto injector if available
    - Caution in Epi >age 50
    - Epi IM > SQ 0.3ml of 1:1,000 IM (higher concentration IM 1:1,000 than IV 1:10,000)
  - Epi IV
    - Epi IV 1 ml of 1:10,000 if hemodynamically unstable (mix w 10 mL NS and slow push over 5-10 min)
  - Wound Care
  - Antihistamines and steroids
  - If the patient takes beta blocker, give glucagon 1 mg increments to overcome beta blockade

**Box 21.1 Types of hypersensitivity reactions and anaphylaxis production**
- Type I immediate (IgE or IgG) – most common
- Type II Cytotoxic complement cascade (IgG or IgM) – Yes
- Type III Immune complex (IgG or IgM) – Yes
- Type IV Delayed T-cell – No anaphylaxis

**Box 21.2 Definition of anaphylaxis**
Acute onset cutaneous and/or mucosal involvement after antigen exposure, plus any of the following:
- Respiratory compromise
- Bronchospasm
- Stridor
- Hypoxia
- Cardiovascular compromise
- Hypotension
- Collapse
- Persistent gastrointestinal symptoms
- Vomiting
- Cramping abdominal pain
22: Renal failure and dialysis, 199

- Pathophysiology:
  - Kidneys receive about 20% of cardiac output

- Acute Kidney Injury (AKI):
  - Rapid loss of the kidneys’ excretory function with accumulation of urea and creatinine or decreased urine output
    - Increase in serum creatinine by ≥0.3mg/dL within 48 hours
    - Increase in serum creatinine ≥1.5 times baseline of previous 7 days
    - Urine output <0.5mL/kg/h for 6 hours
  - Causes are classified as pre-renal, post-renal, and intrinsic

- Chronic Kidney Disease (CKD):
  - Presence of kidney damage or renal dysfunction with GFR < 60 for > 3 months
  - Mainly caused by intrinsic disease most likely secondary to diabetes or hypertension
  - African Americans have a 3.4 times higher incidence of ESRD than Caucasians

- Complications of renal failure include:
  - Fluid overload
  - Electrolyte abnormalities
  - Uremic or infectious pericarditis which may progress to tamponade
  - Cardiovascular disease & Stroke
    - Left ventricular hypertrophy is a common EKG finding that may obscure ischemic changes in CKD patients
  - Anemia with hemoglobin < 10
  - Infection of indwelling catheter

- Post Dialysis complications include:
  - Hypotension
  - Air embolism
  - Bleeding
  - Infection-especially with peritoneal dialysis
  - Disequilibrium syndrome

- Destination selection
  - Consider choosing hospitals with dialysis capabilities for ESRD patients

- Include dialysis units in your Disaster and Mass Casualty Preparedness
23: Infectious and communicable diseases, 208

- Paramedics are typically the first health care personnel to encounter communicable diseases
- General approach:
  - Risk assessment by call taker
  - On scene personnel
    - “Do you have nausea, vomiting, diarrhea, cough, runny nose, etc.?”
    - “Do you have fever or chills?”
    - “Have you recently returned from or been in contact with someone who has been in an area with a currently active outbreak?”
    - Choose appropriate PPE and transport to appropriate facility
- Definitions:
  - **Infectious disease**: invasion of host by disease producing organism
  - **Communicable disease**: disease that can be transmitted from one person to another
    - Example: Malaria is infectious, but NOT communicable
- Modes of transmission:
  - Contact:
    - **Direct**: Contact occurs between an infected individual and the host
      - Examples: biting, kissing, sexual contact (herpes)
    - **Indirect**: Passive transfer through contaminated intermediate object
      - Example: Unwashed bedclothes (staph infection)
  - Droplet:
    - Large droplets generated from respiratory tract from coughing or sneezing, or invasive airway procedures (intubation, suctioning)
      - Examples: SARS, RSV, flu, rhinovirus
  - Airborne
    - Infectious agents are contained in very small droplets which can remain suspended for prolonged periods of time which can be inhaled by susceptible host some distance from source
      - Examples: varicella, tuberculosis, measles
    - Dispersed by air currents
  - Vector
    - Illness is caused by parasites, viruses, or bacteria that are transmitted by arthropods to humans
      - Examples: West Nile Virus, Malaria
  - Common Vehicle
    - Spread of infectious agents by a single contaminated source to multiple hosts which can lead to large outbreaks
      - Examples: Salmonella or E. coli outbreaks from food or water
• Influenza
  ○ Types: A, B, C
    ■ A is more severe and causes pandemics
    ■ B is milder and affects pediatrics more
    ■ C rarely affects humans and has NOT caused pandemics
  ○ Symptoms: Fever, sore throat, cough, myalgia, headache, chills
  ○ Transmission: droplet
  ○ Incubation: 1 day prior to symptoms to 5 days after symptoms begin
  ○ Prevention: vaccine is primary way to prevent disease, hand-washing, shielding coughs and sneezes, antivirals as prophylaxis
  ○ Treatment: Antivirals can be used as treatment for the immunocompromised

• Avian influenza
  ○ Carried by wild birds, but may kill domesticated birds
  ○ Type of Influenza A
  ○ H1N1 and H5N1 are deadly strains found in humans

• Tuberculosis
  ○ Mycobacterium tuberculosis
  ○ Symptoms: cough, hemoptysis, weight loss, decreased appetite, chills, night sweats, fever and fatigue
  ○ Transmission: airborne
  ○ Incubation: 2-10 weeks
    ■ Those exposed should get a test on first evaluation and a second test 8-12 weeks later
  ○ Prevention: N95 mask
  ○ Treatment for active TB: Four drug regimen: Rifampin, isoniazid, pyrazinamide, ethambutol (RIPE)
    ■ Eliminate in 2-4 weeks with medical therapy
  ○ Treatment for latent TB: Isoniazid for 6-9 months
  ○ Notify public health

• SARS, MERS, and Related Coronaviruses
  ○ Coronaviruses
  ○ Symptoms: fever, headache, malaise, myalgia, diarrhea, vomiting, cough
  ○ Transmission: droplet
  ○ During an outbreak, EMS services could elect to limit or avoid procedures that increase risk to EMS personnel including intubation, nebulization, deep suction, and non-invasive ventilatory support
Bioterrorism Agents:

- **Anthrax:***
  - *Bacillus anthracis*
  - Presentations: cutaneous, gastrointestinal, inhalational. Category A
    - Cutaneous: small, painless, pruritic papule, then painless eschar with edema out of proportion to size of lesion
      - Low mortality with antibiotics
    - GI: nonspecific symptoms, may progress to widespread GI hemorrhage
      - Mortality of 25-60%
    - Inhalational: flu-like symptoms initially, 2-3 days later fulminant disease
      - Mortality of 97% without antibiotics, 75% with antibiotics
  - Transmission: Injected, ingested or inhaled from environment
  - Prevention: Vaccine is available
  - If exposed to inhalational, post-exposure prophylaxis is recommended
    - Doxycycline and ciprofloxacin are antibiotics of choice for 60 days

- **Botulism:**
  - *Clostridium botulinum*
    - Neurotoxin prevents release of acetylcholine; Category A
    - Symptoms: neurotoxin causes flaccid paralysis
    - Four types of exposure: foodborne, wound, intestinal, inhalational
    - Treatment: Trivalent and Heptavalent Botulinum Antitoxin and supportive care
○ No reported cases of person to person transmission
○ Bag any suspected clothing or items with botulism suspected

● Plague:
  ○ *Yersinia pestis*; Category A
  ○ Symptoms: fever, chills, sore throat, malaise, headache, suppurative lymph nodes.
  ○ Transmission: Contact and vector-borne
  ○ Precautions: Airborne precautions
  ○ Treatment: Doxycycline and ciprofloxacin
  ○ Prophylaxis: Ciprofloxacin or Doxycycline for 7 days
  ○ Fatality of 50-90% without antibiotics, treated is 15%

● Smallpox
  ○ *Variola major* and *Variola minor*; Category A
  ○ *V. major* is the more severe type with a 30% mortality rate
    ■ Flat and hemorrhagic smallpox have a very high mortality >90%
  ○ Symptoms: fever, headache, nausea, vomiting, muscle pain, malaise
  ○ Transmission: Airborne
    ■ Strict respiratory and contact precautions
  ○ Prevention: Vaccine
    ■ Modified smallpox can occur in previously vaccinated persons
    ■ Suspected patient: N95 masks
  ○ Contaminated clothing, bed, items: Autoclaved or washed with bleach

● Tularemia
  ○ *Francisella tularensis*; Category A
  ○ Forms: ulceroglandular, glandular, oculoglandular, septic, oropharyngeal, pneumonic
    ■ Ulceroglandular is the most common form
  ○ Symptoms: flu-like sx, fever, cough, sore throat, chills, headache, body aches
  ○ Transmission: through skin, mucous membranes, lungs and GI tract
  ○ Vehicles and equipment must be decontaminated afterwards

● Viral hemorrhagic fevers
  ○ *Arenaviruses, Bunyaviruses, Flaviruses*, and *Filoviruses*
    ■ Examples: Ebola, Marburg, Hantavirus, Lassa, Machupo; Category A
  ○ Symptoms: fever, headache, muscle aches, fatigue
  ○ Initial transmission is via vector and varies with each virus
  ○ Person to person is typically by direct contact with blood fluids
  ○ Monitoring of exposed persons: 3-21 days with twice daily temperatures
  ○ Treatment: supportive care

● Chickenpox
○ Varicella zoster
  ○ Symptoms: fever, headache, rash starting on the chest, back, and face then spreading to the extremities (“dew drops on a rose petal”)
  ○ Incubation: 10 days
  ○ Prevention: vaccine is 90-100% effective
  ○ Non-immune adults must avoid patient contact from 10-21 days after exposure
    ■ Should be immunized within 3-5 days of exposure
  ○ If non-immune and pregnant or immunocompromised, VZIG should be offered up to 96 hours after exposure

● Meningitis
  ○ Neisseria meningitidis
  ○ Patients are infectious from 1 week prior to symptom onset to 24 hours after treatment was started
  ○ Post exposure prophylaxis should only be administered when there was close, unprotected contact
    ■ Simple proximity to patient must be <3 feet for >8 hours to warrant PEP
  ○ Prophylaxis: ceftriaxone 250 mg IM x 1, ciprofloxacin 500 mg PO x 1, or rifampin 600 mg bid for 2 days
    ■ Exposed workers may return to work 24 hours after PEP was started
24: Choking, 222

- Time sensitive nature and can quickly progress to cardiac arrest
- Bystanders are optimal first responders, and knowing maneuvers (Heimlich) to help dislodge FB is important
- Epidemiology:
  - Most occur in hypopharynx
  - Food most common object, but other non-edible objects are frequent in children
  - Toddlers 1-4 years old are highest risk--usually non-food items, then 4-9 year olds--usually gum and candy, then adults over 60 due to concurrent medical conditions
- Maneuvers
  - For awake persons, the Heimlich is 86.5% effective at removing an obstruction
  - ACLS is recommending chest thrusts
    - Preferred in unconscious, pregnant, obese, and infants < 1 year old
    - Have higher morbidity than abdominal thrusts
    - Blind finger sweeps no longer recommended
  - EMS may attempt the Heimlich, direct visualization, and removal with Magill forceps
  - Intubation may be attempted to push the foreign body into the mainstem bronchus
  - Cricothyroidotomy is a last resort
  - ENT may be required after initial stabilization
  - All choking patients should be transported to the hospital
25: Submersion injuries and drowning, 228

● Epidemiology
  ○ 4,000-7,000 non-fatal cases/year and over half require hospitalization
  ○ 3,000-6,000 fatal cases/year
  ○ Drowning of children generally result from lapses in adult supervision
  ○ The risk of drowning or near-drowning is 3–4 times higher in unfenced pools
  ○ Up to 80% of deaths are preventable
  ○ 10% survivors have severe lasting effects secondary to cerebral hypoxia

● Definitions:
  ○ Drowning: suffocation and death as a result of submersion in liquid
    ■ Classically begins with a period of struggle and panic and ends in suffocation
  ○ Near drowning: immediate survival after submersion event which ranges from asymptomatic patients to ROSC patients
  ○ Secondary drowning: death from ARDS following drowning

● Management:
  ○ Dispatch life support instructions with CPR with AED (if available) are crucial
    ■ 42% kids who drowned at home had no CPR until EMS arrival
  ○ Scene/crowd control assists with good CPR and prevention of secondary victims
  ○ Treat as all other cardiac arrests, but anticipate nearly all will vomit
  ○ Consider transport to specialty centers as indicated
  ○ Consider active rewarming if severe hypothermia
  ○ Management of near drowning—focuses on ABC’s, supplemental oxygen, consider medical conditions that may have caused the drowning
  ○ Trauma is often concurrent, but benefits of c-spine immobilization should be weighed against difficulty of rescue efforts and rescuer safety
  ○ Should not be allowed to AMA
Section V: Trauma Problems

26: Trauma Systems of Care, 235

- Trauma System Organization
  - Usually statewide trauma systems of care with most states using American College of Surgeons Committee on Trauma (ACS-COT) standards
    - Undertriage rate of <5% is considered a highly functioning trauma system of care
  - **Designation**—authorization from a state agency for an institution to represent itself to the public as a trauma center
  - **Verification**—inspection by a non-biased team of experts (usually from outside the community) who have confirmed that all the necessary services and processes are in place to meet the ACS-COT standards

- Trauma Care Facilities
  - **Level 3**—provide basic trauma care with onsite EM physician and general surgeon immediately available and on-call panel including: *ortho, plastics, radiology, anesthesia*
  - **Level 2**—provide care for more complex cases with trauma surgeon available within 15 minutes and on-call panel including: *neurosurgery, hand, OBGYN, OMFS, ophthalmology, thoracic surgery, and critical care medicine*
  - **Level 1**—highest level trauma center and regional referral center. Minor additions to call panel including *in-house OR staff, cardiothoracic surgery with CABG capabilities, reimplantation services, and surgical critical care services*. Additionally, must have surgical residents, teach ATLS, and conduct injury research.

- Trauma Registries
  - **Trauma Quality Improvement Project (TQIP)**
    - Conducts risk-adjusted analysis of outcomes at trauma centers on a voluntary basis
  - **National Trauma Data Bank (NTDB)**

- Central EMS trauma concepts:
  - Consistent assessment algorithm that can be applied to any trauma patient
  - Time is of the essence so have appropriate destination policies
  - Limit additional mortality
  - Universal precautions and scene safety

- Special Considerations:
  - **Scene assessment**
    - Photography, event data recorders in MVCs, telemedicine evals
  - **Airway management**
    - Ideally related to distance to trauma center, adequacy of BVM oxygenation, and ability of paramedics to perform prehospital RSI
○ Perfusion
  ■ Hypotensive or hypoperfusing patients should receive IV/IO access and fluids
  ■ Permissive hypotension: 80-90 mmHg systolic is the goal of therapy
○ Pregnancy
  ■ Mostly commonly due to MVCs which predispose to abruptio placentae
  ■ Fetal viability at 24-26 weeks gestation may determine destination (neonatal)
  ■ Perimortem c-section: maternal cardiac arrest < 5 minutes and fetal distress
○ Pediatrics
  ■ Fluid resuscitation usually underestimated, 20 ml/kg boluses

● Field Triage Decision Scheme
  ○ Revised 2006 and 2011 approved by ACS, CDC, NHTSA
  ○ Isolated traumatic mechanism criteria have very low sensitivity and PPV->overtriage

● Public Health Campaigns
  ○ Drunk driving
  ○ Helmets
  ○ Seatbelt use
  ○ Firearm storage
27: Blunt trauma considerations, 240

- Critically ill patients
  - On scene time ideally < 10 mins
  - Controlling life-threatening hemorrhage and airway management are only interventions on scene
  - Secondary survey can be deferred to trauma center

- Air transport controversial - may not confer any benefit likely due to poor field triage of patients

- Patient outcomes significantly better at trauma centers, 25% reduction in mortality

- Special Populations
  - Pregnancy
    - Trauma is leading cause of maternal mortality
    - “What’s best for mom, is best for baby”
    - Predictors for fetal loss include: higher ISS, lower GCS, abbreviated injury scale (AIS) >3, vaginal bleeding, and shock with significant base excess
    - Patients over 20 weeks gestation should be placed in left lateral decubitus
    - Destinations capable of OB/NICU care should be considered if fetus is potentially viable
  - Geriatrics
    - More likely to have intra-abdominal injury with concurrent head, leg, or chest trauma regardless of MVC speed
    - CDC field triage guidelines use age >55 for increased risk of death due to trauma

- Revised Trauma Score (RTS) is one of the more common scoring systems in addition to ISS and incorporates GCS, respiratory rate, and systolic blood pressure (0-4 in each category)
  - Better for research than field patient care
28: Motor vehicle crashes, 248

- 5th leading cause of death

- Extremes of age are more likely to be seriously injured

- Three-point seat belts decrease fatalities by 45% and risk of moderate to critical injury by 50% (60-65% in light trucks)

- 4 possible collisions during a motor vehicle accident:
  - Collision of car with object
  - Collision of passenger with interior
  - Collision of internal organs to bony structures
  - Loose items/people in car hitting other passengers

- Frontal crashes
  - 56% of fatal crashes
  - Most commonly affect: lower extremities, pelvis, thorax, head, abdomen
  - Since airbags: head, face, aortic, and cardiac injuries less common
  - Rib fractures still common especially in elderly

- Side-impact Crashes
  - 23% of fatal crashes
  - More dangerous than frontal crashes
  - Involve a “bullet vehicle” that hits the “struck vehicle”
  - Most commonly affect: head, thorax, pelvis, abdomen
  - More likely to be injured if you are the “near-side” passenger

- Rear Crashes
  - 22% of crashes
  - Least worrisome of planar crashes
  - Large crumple zone
  - Occupants also protected by seats

- Rollover Crashes
  - 30% of all fatalities in single vehicle type crashes
  - Arrested/ partial rollovers are associated with greater risk of injury
  - Ejection is much more likely and associated with severe injury
  - Most commonly injured include: thorax, abdomen, head, spine, extremities

Unique Problems: Batteries

EV/ hybrid vehicles have high voltage cables, identified by orange insulation
29: Penetrating trauma, 254

- Trauma: leading cause of death for North Americans 1 – 34 YO;
  - Surpassed only by cancer and cardiovascular disease > 35 YO.

- Deaths have trimodal distribution:
  - 50% occur within few minutes
  - 30% die in first few hours (EMS can make a difference)
  - 20% occur days-weeks later (multi-organ failure)

- Kinetic Energy = \( \frac{1}{2} \text{mass} \times \text{velocity}^2 \)

- Conservation of Energy: energy cannot be created or destroyed, only transferred from one form to another

- Ballistics = trajectory AND how projectile acts when it hits its target
  - Low energy: knives, hand-launched missiles
  - Medium energy: handguns, smaller bullets, lower velocity projectiles (200–400 m/s)
  - High energy: military or hunting rifles, larger bullets, higher velocity projectiles (600–1000 m/s)

- High velocity projectile injury (>750 m/s) = three injury patterns: direct, pressure wave, cavitation
  - Pressure wave: moves faster than the bullet (faster/blunter projectile = greater effect)
  - Cavitation: high-energy missiles -> shockwave and cavity in body tissues (can be 40x diam of bullet)

- Bullets may tumble or wobble (yaw), often decreasing the velocity and accuracy
  - If it tumbles or yaws after hitting tissue, the bullet’s surface area with respect to tissue is increased, thereby increasing the amount and rate of energy transfer and thus the extent of injury

- Conditions requiring rapid stabilization:
  - Open PTX (sucking chest wound -> occlusive dressing sealed on 3 sides)
  - Tension PTX (needle decompression)
  - Hemorrhage -> tourniquet
  - Hypotension in trauma -> ONLY give fluids if SBP < 70 or absent radial pulse (1 liter, then blood)
  - Airway obstruction: if no contraindication -> jaw thrust, otherwise OPA/NPA, intubation, cric

- Up to one-third of all traumatic deaths occur before arrival at hospital

- Prehospital traumatic cardiopulmonary arrest is associated with very poor survival (0 – 5%)

- Isolated penetrating trauma (stab wound) to the thorax is the most salvageable
  - ED thoracotomy within 15 min - may have up to a 25% survival rate

- Penetrating abdominal trauma: high mortality
- Relative lack of skeletal protection and highly vascular structures, solid organ injury
  - Hemorrhagic shock, hollow organ injury -> peritonitis

- Penetrating neck trauma: zone 1 = high mortality, use occlusive dressing to avoid air embolism
  - IV on opposite extremity to neck injury
  - Common carotid injuries in 10% of penetrating neck trauma
  - Assess for neurologic deficit

- Penetrating extremity trauma: vascular injuries, bony injuries, amputations

- “Scoop and Run” vs. “Stay and Play”: **Reduced mortality when scene times shorter**

- Spinal motion restriction has little role in isolated penetrating trauma

- Permissive hypotensive resuscitation: only trauma patients without radial pulses or with SBP<70mmHg should receive fluid resuscitation in the field.
  - Whole blood or RBC transfusion preferred.
  - Significant reduction in mortality with permissive hypotension in trauma on systematic review

- TXA: May have benefit in specific populations. Variable results in research trials. NAEMSP, ACEP, and ACS-COT suggest that “there is insufficient evidence to support or refute the prehospital administration of TXA”

- Golden Hour for Trauma: best survival for pts requiring surgery when the surgery begins within one hour

- Platinum 10 minutes: goal is to begin transport of the patient within 10 minutes of arrival on scene (barring e.g. extrication)

- ACS Prehospital trauma triage criteria using physiologic parameters, anatomic injury, mechanism, age, and comorbid conditions

- Trauma systems are designated to provide a coordinated response across a continuum of injury prevention strategies, emergency access (911), prehospital EMS, trauma triage, dedicated trauma centers, specialized trauma teams, rehabilitation
- Medicolegal:
  - Documentation/PCR legal records
  - Forensic evidence preservation -> may need to notify police of all GSWs
  - Mandated reporters if children in imminent risk
- Termination of resuscitation in penetrating trauma
  - Futility: For penetrating trauma, if the injuries are incompatible with life (decapitation, hemicorporectomy, rigor mortis, dependent lividity), or the patient is apneic, pulseless, and without organized electrocardiographic activity upon arrival of EMS, resuscitation may be withheld.
  - Resuscitative measures can be terminated if CPR is provided up to 15 minutes
30: Traumatic brain injury, 264

- TBI accounts for ⅓ of traumatic deaths in US
  - Falls (35%), motor vehicle collisions (17%), direct blows to the head (16%)
  - Men > Women. Children are ⅓ of cases
  - Kids/elderly more likely to present to ED and also to die from injury

- Primary injury: Direct impact, acceleration/deceleration injury, or penetrating wound
  - Bleeding, contusion, and ultimately cell death

- Secondary insult: even single episode of hypotension or hypoxemia, 2x fold increase mortality
  - Both hypotension and hypoxemia -> 6x fold increase mortality

- CPP = MAP - ICP → very difficult to measure pre-hospital

- Secondary assessment: pupils, GCS, EtOH can complicate
  - Mild TBI (GCS 14-15), moderate (GCS 9-13), severe (GCS 8 or less)
  - Field differentiation of TBI impossible, important to **reassess** GCS, eval for herniation
    - Decrease of more than 2 points -> increased ICP and increase in hospital mortality
  - If clinical sx herniation → mild hyperventilation to ETCO2 30-35 mmHg
  - Hyperventilation → cerebral vasoconstriction → reduction blood flow → lower ICP → secondary brain injury
31: Electrical injuries, 271

- Electrical injuries have trimodal age distribution:
  - Toddlers - household sockets and cords
  - Adolescents - risky behavior around electrical power lines
  - Adults - occupational exposure
- Most frequently, electrical injury is minor

Background
- Electricity = flow of electrons from higher to lower concentration
- Six factors determine outcome of human contact with electrical current:
  1. Voltage
     - High Voltage = greater than 1,000 volts
  2. Type of current
     - Direct Current (DC) = electrons flow constantly in *one direction* across a voltage potential (battery)
     - Alternating Current (AC) = direction of electron flow *alternates rapidly* in a cyclic fashion
       - The US standard household current flows at 60Hz and 110V
       - Ventricular fibrillation (VF) occurs at 50 - 100 mA
  3. Amount of current
     - Ohm's law: current (I) = voltage (V) / resistance (R)
     - AC exposure is 3x more dangerous than same voltage of DC current
     - “Let-go current” (6 - 9 mA) = the level above which muscular tetany prevents release of the current source, flexor tetany of fingers/forearms overpower extensors, leading to extended contact with the power source
  4. Resistance
     - Low resistance tissues = nerve, blood vessels
     - High resistance = skin, bone, fat
  5. Pathway of current
     - Determines the tissues at risk, the type of injury, and the degree of conversion of electrical injury to heat
  6. Duration of contact

- Scene Safety / Prehospital Considerations
  - Personnel should stay 10-30 feet away from source until utility company confirms off
  - Protective equipment: rubber gloves and boots DO NOT prevent injury, unless specifically designed for voltage present

- Management
  - Most common cause of death electrical injury = arrhythmias and cardiac arrest
Most common ECG abnormality = sinus tach, Non-specific ST-T Wave changes (transient)

Baseline ECG in all patients and early cardiac monitoring if abnormal or history of high voltage injury is important as arrhythmias will typically present within the first few hours

- Prompt initiation of cardiopulmonary resuscitation (CPR) in those with cardiac arrest
- Consider early intubation in those with respiratory arrest
- Treatment also includes trauma and burn evaluation as well as aggressive fluid resuscitation
  - Electrical energy -> thermal energy conversion, leading to massive internal/external burns
  - Blunt trauma, fractures, cervical spinal injuries can occur from massive muscular contraction leading to the body being “thrown”

- **Lightning**: unidirectional cloud-to-ground current resulting from static charges that develop when cold high-pressure front moves over a warm, moist low-pressure area
  - Actual energy delivered is less than typical high-voltage injury due to short duration
  - 70% lightning strikes *nonfatal*, 30% strikes involve more than 1 patient
  - 5 Basic Mechanisms of Injury:
    1. **Direct Strike**: hits person out in open, usually fatal
    2. **Splash Injury**: lightning strikes object or person and ‘splashes’ to nearby victim
    3. **Contact Injury**: victim in physical contact with person directly struck
    4. **Step voltage/ground current injury**: lightning hits ground, spreads radial to human body as it offers less resistance than ground, travels one leg to the other
    5. **Blunt trauma**: victim thrown by concussive forces of shockwave due to opisthotonic muscle contractions, causing fractures and blunt trauma
  - Most common cause of death is immediate cardiopulmonary arrest
  - Most lightning strike victims can have great prognosis despite cardiopulmonary arrest with prompt initiation of bystander and EMS CPR
  - *Initial care to apparently dead victims first, change in typical MCI triage*
    - Dilated or nonreactive pupils are not indicative of brain death in lightning strike victims
  - Severe burns uncommon due to brevity of exposure
    - Less important for burn care/aggressive IVF compared to high-voltage electrical injury
    - Victims struck during rain can experience *flashover effect* which decreases the current transiting through body, leading to decreased risk of severe internal injury
    - Lichtenberg/feathering burns are pathognomonic for lightning injury, not true burn (extravasation of RBCs into superficial skin layers along current lines of flashover)
    - Keraunoparalysis (“lightning paraplegia”): immediate effect of lightning injury that presents with paralysis of limbs with pallor, cool temp, absent pulses (result of severe arterial vasospasm from catecholamine release, resolves in few hours)
    - Other injuries: neuro effects (LOC, confusion), TM injury, ARF
Table 31.1 Comparison between lightning, high-voltage, and low-voltage electrical injuries

<table>
<thead>
<tr>
<th></th>
<th>Lightning</th>
<th>High Voltage</th>
<th>Low Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Voltage, V</td>
<td>&gt;30,000,000</td>
<td>&gt;1,000</td>
<td>&lt;600 (&lt;240)</td>
</tr>
<tr>
<td>Current, A</td>
<td>200,000</td>
<td>1,000</td>
<td>240</td>
</tr>
<tr>
<td>Duration</td>
<td>Instantaneous</td>
<td>Brief</td>
<td>Prolonged</td>
</tr>
<tr>
<td>Type of current</td>
<td>Similar to DC</td>
<td>DC or AC</td>
<td>Mostly AC</td>
</tr>
<tr>
<td>Cardiac arrest (cause)</td>
<td>Asystole</td>
<td>Ventricular fibrillation</td>
<td>Ventricular fibrillation</td>
</tr>
<tr>
<td>Respiratory arrest (cause)</td>
<td>Direct CNS injury</td>
<td>Indirect trauma or tetanic contractions of respiratory muscles</td>
<td>Tetanic contractions of respiratory muscles</td>
</tr>
<tr>
<td>Muscle contraction</td>
<td>Single</td>
<td>DC: single</td>
<td>Tetanic</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AC: tetanic</td>
<td></td>
</tr>
<tr>
<td>Burns</td>
<td>Rare, superficial</td>
<td>Common, deep</td>
<td>Usually superficial</td>
</tr>
<tr>
<td>Rhabdomyolysis</td>
<td>Uncommon</td>
<td>Very common</td>
<td>Common</td>
</tr>
<tr>
<td>Blunt injury (cause)</td>
<td>Blast effect, shock wave</td>
<td>Muscle contraction, fall</td>
<td>Fall (uncommon)</td>
</tr>
<tr>
<td>Mortality (acute)</td>
<td>Very high</td>
<td>Moderate</td>
<td>Low</td>
</tr>
</tbody>
</table>

DC, direct current; AC, alternating current; CNS, central nervous system.
Source: Reproduced with permission from ref. [13]. Wolters Kluwer Health, Inc.
32: Blast injury, 278

- Explosive injury is caused by the blast wave generated by the transformation of a high explosive from solid to gas almost instantaneously.

- Unexploded ordnance (UXO): grenades/ ammunition

- IED: improvised explosive device -> most common, seen in most purposeful combat injuries

- Spall: tissue disruption occurs via blast wave and small particles of tissue and liquids are thrown into the air space; occurs in gas/tissue interfaces e.g. sinus, lung, middle ear, bowel-- this is primary injury.

<table>
<thead>
<tr>
<th>Table 32.1 Categories of explosive injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
</tr>
</tbody>
</table>
| Primary    | A form of barotrauma, unique to explosions, which causes damage to air-filled organs | • Blast lung  
• Tympanic membrane rupture and middle ear damage  
• Abdominal hemorrhage and perforation  
• Globe (eye) rupture  
• Concussion |
| Secondary  | Trauma caused by the acceleration of shrapnel and other debris by the blast | • Penetrating ballistic (fragmentation)  
• Blunt injuries (rapid deceleration)  
• Eye penetration |
| Tertiary   | Casualty becomes a missile and is propelled through the air, with typical patterns of blunt trauma | • Fracture and traumatic amputation  
• Blunt chest and abdominal trauma  
• Impalement  
• Closed and open brain injury |
| Quaternary | All other explosion-related injuries, illnesses, or diseases which are not due to primary, secondary, or tertiary mechanisms | • Burns (flash, partial, and full thickness)  
• Crush injuries  
• Exacerbation of underlying conditions (asthma, angina, etc.)  
• Inhalation injury |
| Quinary    | The intentional addition of agents that may result in injury | • Radiation  
• Chemical  
• Biological (including suicide bombers with hepatitis or HIV) |

- Category 1 injuries: penetrating injuries or non-intact skin exposures -> treat for HBV and tetanus

- Patients with primary blast lung are at risk for arterial gas embolism, consider if decompensating after intubation

- In a mass casualty incident with blast and burn injuries, CPR should be withheld unless the injuries are the result of an electrical incident, consider immediate reversible causes such as airway obstruction and tension Ptx.

- Medical threat assessment (MTA): consider potential medical threats that may confront the responding during EMS operations and develop a plan to mitigate and respond to the threats

- Secondary Devices - up to 50% of terrorist attacks have a secondary device
  - Sweeper/spotter - designee for searching area for out of place people or things that could be a secondary device.
33: Thermal and chemical burns, 285

- Demographics:
  - Deaths from fires and burns are third leading cause of fatal home injury
  - Chemical burns account for 3% of all burns and 7% burn admissions annually
  - Approximately 3,400 deaths annually, most from smoke inhalation
  - Risk factors: extremes of age, poverty, African or Native American descent, and rural area dwellers

- Skin is largest organ and serves as a barrier to the environment

- Skin is made up of epidermis, dermis, and subcutaneous tissue

- Assessing burns
  - Severity
    - Consider age of patient, location of burn, pre-existing conditions, presence of trauma
  - Depth

<table>
<thead>
<tr>
<th>Classification</th>
<th>Cause</th>
<th>Appearance</th>
<th>Sensation</th>
<th>Healing time</th>
<th>Scarring</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial burn</td>
<td>Ultraviolet light, very short flash</td>
<td>Dry and red; blanches with pressure</td>
<td>Painful</td>
<td>3–6 days</td>
<td>None</td>
</tr>
<tr>
<td>Deep partial-thickness</td>
<td>Scald (spill or splash), short flash</td>
<td>Blister; moist, red and weeping; blanches with pressure</td>
<td>Painful to air and temperature</td>
<td>7–20 days</td>
<td>Unusual; potential pigmentary changes</td>
</tr>
<tr>
<td>Deep partial-thickness</td>
<td>Scald (spill), flame, oil, grease</td>
<td>Blister (easily unroofed); wet or waxy dry; variable color</td>
<td>Perceptive of pressure only</td>
<td>More than 21 days</td>
<td>Severe (hypertrophic) risk of contracture</td>
</tr>
<tr>
<td>Full-thickness burn</td>
<td>Scald (immersion), flame, steam, oil, grease, chemical, high-voltage electricity</td>
<td>Deep pressure only; gray to charred and black; dry and inelastic; does not blanch with pressure</td>
<td>Deep pressure only</td>
<td>Never (if the burn affects more than 2% of the total surface area of the body)</td>
<td>Very severe risk of contracture</td>
</tr>
</tbody>
</table>

Table 33.1 Classification of burns based on depth

Source: Data from US Army Institute of Surgical Research.

- Size
  - Rule of 9's for Adults (exclude 1st degree): 9% for each arm, 18% for each leg, 9% for head, 18% for front torso, 18% for back torso.
  - Rule of 9's for Children (exclude 1st degree): 9% for each arm, 14% for each leg, 18% for head, 18% for front torso, 18% for back torso.
    - For fluid resuscitation, aggressive hydration is important
Critically ill burn patients are best cared for at a dedicated burn center, particularly patients with any of the following:

- > 10% TBSA partial thickness burns
- Any size full-thickness burn
- Burns to hands, genitals, face, eyes, ears, or joints
- Circumferential burns
- Inhalation injury
- Serious chemical injury
- Serious electrical injuries, including lightning
- Burn with trauma, chronic underlying conditions
- Pediatric burns requiring specialized care of pediatric patients
- Burns requiring special social, emotional or long-term rehabilitation

Outpatient management: < 10% TBSA in adult, < 5% TBSA in young or old, < 2% full thickness burn
• Inhalational Injuries
  ○ Increased pulmonary compliance and fluid requirements
  ○ Doubles mortality
  ○ Edema formation in posterior pharynx is associated with deep burns to upper chest, lower face, and neck
  ○ Stridor and tachypnea are late signs
  ○ Early grading by fiberoptic bronchoscopy is often inaccurate

• Chemical Burns
  ○ A caustic or corrosive agent is a chemical capable of causing tissue and mucous membrane injury upon contact
    • pH < 3 or > 11
  ○ Majority of burns are result of accidental exposure at work
  ○ Most common complications: cellulitis, pneumonia, and respiratory failure
  ○ Common agents: hydrochloric acid, potassium hydroxide, sulfuric and, phosphoric acid

• Prehospital Considerations
  ○ Trauma occurs in 5 - 15% of burn patients and takes precedence over burn care. Transport to trauma center if appropriate
  ○ If intubated, use umbilical ribbon to secure, do not tape to patient as skin (and tape) will fall off
  ○ Resuscitate with Parkland formula (lactated ringers at 4 mL/kg/% TBSA burn for adults and 3 mL/kg/% TBSA burn for kids over 24 hours) vs modified Brooke (lactated ringers at 2 mL/kg/% TBSA burn for adults and 3 mL/kg/% TBSA burn of kids over 24 hours)
• Special Considerations
  ○ Compartment syndrome
    ■ May need escharotomy and/or fasciotomy (consider scope of practice)
    ■ Escharotomies are performed on the medial and lateral portions of the affected extremities and on the midaxillary lines of the trunk connected by an inverted V along the costal margins
  ○ Pain Management
    ■ Failure to appropriately manage pain associated with increased chronic pain and PTSD
  ○ Hydrofluoric Acid Burns
    ■ HF over 20% concentration exposure results in risk for severe burns and toxicity
    ■ Tx: Calcium
  ○ Prolonged transport interval
    ■ Antibiotics e.g. Levaquin PO is given in the military if abdomen is unaffected
    ■ Control hypothermia
    ■ advanced methods of pain management, including ketamine, transmucosal analgesia, peripheral nerve blocks.
• Prevention:
  ○ Prevention programs and safety legislation have decreased the incidence and severity of burn injury
    ■ Flame burn prevention: test smoke detectors, create escape plan, safety devices around stoves and fireplaces, keep matches and lighters away from children
    ■ Scald prevention: Use stove splash guards, lower hot water tank to <54 degrees C
34: Crush injury, 294

- Crush syndrome leading to acute renal failure is the 2nd most common cause of morbidity in disasters situations after direct trauma
- Crush injury is defined as an anatomical injury associated with direct trauma due to compressive force
- Extended entrapment may cause crush syndrome, traumatic rhabdomyolysis, or compartment syndrome
- Crush syndrome - systemic manifestation of skeletal muscle injury from extended compression
- Compartment syndrome - increase in pressure within a fascial compartment that compromises venous outflow, and then arteriolar inflow, with capillary leakage and edema that leads to progressive muscle damage and rhabdomyolysis

- Pathophysiology of Crush Injury
  - Ischemia/reperfusion injury (mediated by reactive oxygen species and activated neutrophils) and the intense local and systemic inflammatory response
  - Risk factors- mass of injured muscle and ischemia time
    - Takes 4 hours for skeletal muscle at room temperature but can be shorter if direct trauma is the cause of ischemia rather than vascular occlusion alone
  - The injury results in leakage of myoglobin, urate, potassium and phosphate from the sarcolemma membrane and an influx of water, calcium, and sodium into muscles
  - Systemic manifestations: hypovolemia/hypotension due to fluid shifting into muscles, hyperkalemia and metabolic acidosis, acute renal failure from urate and myoglobin

- Management of Crush Injuries
  - Depends on the circumstances of the injury but should begin as all trauma with primary survey and treatment of immediate life threats
  - Consider antibiotics for open injuries/fractures, especially with anticipated prolonged time to definitive care
  - For compartment syndrome, it is likely better to elevate the extremity and fluid resuscitate rather than perform field fasciotomy

- Management of Crush Injuries with Crush Syndrome
  - Should be clinically suspected based on time of entrapment and mass of skeletal muscle involved
  - Treatment focus: hypotension and cardiovascular collapse upon extrication and late renal failure
  - Traumatic rhabdomyolysis has been reported to occur in less than 1 hour
  - Acute renal failure following rhabdomyolysis has been reported in up to 33% cases and has been reported to account for up to 50% of the fatalities
  - The mainstay of treatment should be fluid resuscitation via intermittent fluid bolus, but consider surrounding environment as there will likely be technical operations that are ongoing
    - IV/IO access should be obtained on largely uninjured extremity
    - Consider central venous access as well as hypodermoclysis if EMS physician or
advanced EMS provider is available and this is in the scope of practice

- When vascular access is impossible you could consider applying a tourniquet close to the time of extrication. This may prevent sudden fluid and electrolyte shifts, but literature is lacking for this purpose

  ○ Therapeutic options of hyperkalemia treatment will be based on scope of practice and the availability of resources

  - Consider empiric treatment of metabolic acidosis with sodium bicarbonate intermittent bolus vs drip (1 amp in a bag of 0.45% NS or 3 amps in D5W)
  
  - If EKG changes, calcium would be warranted; however, calcium will be taken up by the injured skeletal muscles and can aggravate the calcium dependent apoptosis of muscle cells

  - Consider albuterol as a treatment for hyperkalemia, but keep in mind the safety of oxygen vs compressed air with ongoing technical rescue operations and with oxygen as a possible limited resource in a disaster setting

  - Consider mannitol as a nephroprotective option as it can reduce compartment pressures and reduces interstitial volume. It acts as an osmotic agent as well as a free radical scavenger.

  ○ Transport should be to a designated trauma center even in the absence of multisystem trauma
35: Hemorrhage control, 299

- Arterial hemorrhage will require pressure higher than SBP for 20 min to control.
  - In contrast, venous and capillary bleeding may be amenable to hemostatic dressings.

- Some metrics have shown promise such as pulse pressure (SBP - DBP) and shock index (HR/SBP). Serum lactate and dynamic pulse oximetry still in development.

- Control hemorrhage with direct pressure, pressure dressing, splinting, and tourniquet application. Elevation and pressure points alone may not be adequate.

- Rapid wound closure would be helpful but has limited utility in the field.

- Advanced hemostatic agents (for dressings) all have drawbacks.
  - Zeolite (QuikClot) - rapid absorption of water, concentrating platelets and factors at site.
    - Cheap but produces a hyperthermic reaction.
  - Kaolin (Combat gauze) - impregnated gauze that theoretically activates clotting factors.
    - Less hyperthermic.
  - Chitosan (Celox) - mucoadhesive properties that directly seal the leak.
    - Cheap but unproven.

- Permissive hypotension (target MAP in the 60's) seems safe

- Terrible triad of trauma - acidosis, hypothermia, coagulopathy.

- Special considerations
  - Transfusion - complex. Limited to special prehospital teams and air medical providers.
  - Recombinant factors - used primarily for hemophiliacs at this time although may have application in trauma in future. Factor VIIA has not been shown to reduce mortality of critical complications.
  - TXA - showed benefit when given in first 3 hrs. May have a role in EMS in future.
36: Orthopedic injuries, 307

- Include mechanism of injury as part of history and report

- Control hemorrhage direct pressure, covering exposed bones with saline moistened gauze, and manage pain (opiates and immobilization)

- Decision for field reductions should be based on neurovascular compromise, extrication time, transport time, and provider training

- A neurovascular exam including nerve function and vascular patency should be conducted on all extremity injuries, especially prior to and after any manipulation or splinting

- **Clavicle**
  - Sling and swathe
  - Check for neurovascular status of subclavian vessels, brachial plexus, and for pneumothorax.
  - AC and SC joints should be checked

- **Scapula**
  - Up to 75% will have additional injuries due to significant mechanism.
  - Careful exam for rib fractures, pneumothorax, and upper arm injuries is warranted.
  - Sling and swathe

- **Shoulder**
  - Shoulder is the most common major joint dislocation. Usually anterior.
  - Axillary nerve (deltoid, lateral shoulder sensation) injury.
  - Rarely has vascular injury, but if so, it will be the axillary artery.
  - 15-35% have associated second fractures.
  - No indication for prehospital reduction in most cases.
  - Sling and swathe
  - Consider short board if concern for humeral head fracture.

- **Humerus**
  - Injuries divided into proximal, midshaft, and distal.
  - Axillary nerve and artery injuries in up to 50% displaced humeral fractures.
  - Humeral shaft fractures can be associated with radial nerve (wrist and finger extension, first dorsal web space sensation) or brachial artery/vein injuries.
  - Short board splint with sling and swathe
• **Elbow**  
  ○ Elbow is composed of humerus, ulna, radius.  
  ○ Brachial vessels run in close proximity.  
  ○ Supracondylar fractures among most common fractures in pediatrics.  
  ○ 90% of dislocations are posterolateral from FOOSH.  
  ○ Most commonly associated with brachial artery and ulnar nerve (index finger abduction, pinky finger) injuries.  
  ○ Short board splint  

• **Forearm**  
  ○ Neurovascular compromise less common than injuries to elbow/humerus.  
  ○ Short board with sling.  

• **Wrist**  
  ○ Most common fractures: distal radius and ulna followed by carpal bones (scaphoid and triquetrum).  
  ○ Short board or pillow in position of function in sling.  

• **Hand/fingers**  
  ○ Assess function of median nerve (thumb and index opposition, index finger sensation), ulnar, and radial nerves.  
  ○ Assess capillary refill and flexor and extensor function in each finger.  
  ○ High pressure injection injury always requires transport to the ED e.g. paint injector gun.  
  ○ Malleable finger splint, buddy tape, tongue depressors.  

• **Pelvis**  
  ○ Associated with high mortality (10-15%)  
  ○ Mechanism should be considered: high speed MVC, ped vs auto, significant falls  
  ○ Anterior-posterior compressive forces associated with most hemodynamic instability  
  ○ Suspect if: perineal/flank hematoma, blood at meatus or vaginal, obvious bony instability  
  ○ Consider use of pelvic binder  

• **Hip**  
  ○ 80% hip fractures occur in people aged 75 and over and 75% of those are female.  
  ○ 90% due to elderly falls.  
  ○ Pain, shortening, and external rotation of limb can be seen.  
  ○ Dislocations are generally caused by high energy mechanism and should receive prompt transport as neurovascular complications common if not reduced within 6 hours.  

• **Femur**
• Large volume hemorrhage can occur with potential distal limb ischemia/hypovolemia, but compartment syndrome is rare.
• Limb appears shortened.
• Traction splint

• Knee
  • Knee dislocations rare, but can cause popliteal artery injury.
    ■ 50% of knee dislocations spontaneously reduce prior to ED presentation.
  • Medial tibial plateau fracture to peroneal nerve (ankle eversion/dorsiflexion, dorsal foot surface and 1st dorsal web space sensation) and/or popliteal artery and compartment syndrome.
  • Short board A splint, but do not splint fully extended.

• Lower leg
  • Tibia is most commonly fractured of all long bones;
    ■ 80% time there is an additional fibula fracture.
  • Compartment syndrome occurs in 8% of tibial shaft fracture.
  • Longboard splint.

• Ankle/foot
  • Consider Ottawa rules for triage purposes only, but this has not been validated in prehospital setting.
  • Pillow splint.

• Spine Injuries
  • Incidence of cervical spine injuries in trauma is 4%. Higher if trauma above the clavicles (5-10%).
  • Overall incidence of spinal cord injury <2% in blunt trauma.
  • Neurogenic shock: autonomic dysfunction i.e. presents with hypotension and bradycardia.
  • Altered patients have a higher potential for occult spinal injuries
  • Central Cord (most common): bilateral upper extremity weakness most severe in distal upper extremities. Common in elderly.
  • Immobilization: Controversial. Spinal motion restriction and selective immobilization are options.

• Splinting
  • Mainstay of prehospital care.
  • Reduces pain, chance of further injury, reduction of hemorrhage, and maintenance of alignment
  • Prefabricated splints, pillows, cardboard, sheets, sticks can be used as needed for splinting
  • Traction splints are considered standard of care for femoral shaft fractures.
  • Complications of traction: peroneal nerve palsies, compartment syndrome, urethral injury, pressure ulcer, distal ischemia
• Reductions
  ○ System specific, but generally deferred if transport time is minimal
  ○ Indications for gentle reduction: severe angulation and distal neurovascular compromise

• Amputations
  ○ Control bleeding with direct pressure or tourniquet
  ○ Stump can be cleaned of debris with sterile saline and then covered with moistened gauze
  ○ Do not manually debride in prehospital setting
  ○ Efforts should be made to locate the amputated part which should be wrapped in sterile gauze and placed in a bag. That bag should be placed on ice, but should not be frozen.
Eye injuries are significant in 50% of facial trauma cases.

Most common in male patients and those under 30.

Trauma is the second most common cause of monocular blindness, trailing only cataracts

Beware distraction of eye injuries; facial injuries can include airway compromise

Chemical exposure of the eye requires immediate, copious irrigation with tap water or NS

Do a visual acuity, even counting fingers or presence or movement of light is helpful
  ○ Pocket Snellen chart with pinhole occluder if patient usually wears glasses.

Check eyelids and associated anatomy for injury
  ○ EOM especially superior gaze for orbital blowout
  ○ Cornea for hyphema - elevate head 30-45 degrees, cover eye with protective shield
  ○ Periorbital sensation for infraorbital nerve injury.

If open globe injury suspected,
  ○ Protect eye with hard shield
  ○ Elevate head of bed 30 to 45 degrees
  ○ Provide pain control and anti-emetic meds
  ○ Check for penetrating/retained foreign bodies; do not remove.

Retinal injuries
  ○ Less common
  ○ Flashes or floaters are common symptoms
  ○ Transport for dilated ophthalmological evaluation
38: Bites, stings, and envenomations, 321

- Recall the types of allergic reactions:

  - Anaphylaxis can rapidly progress to life threatening event
    - Causative agents broad: medications, foods, additives, latex, contrast dye, Hymenoptera, arthropod bites, marine envenomations, insect bites, mold

  - Assessment and Treatment Approach:
    - Importance of scene safety (rescue/rx not possible if providers afflicted)
    - Determine origin of allergy
    - Exam: voice, airway edema, facial edema, lungs/wheeze, rash, hypotension
    - Prehospital treatment: IV, O2, monitor, neb prn, Epi auto injector if available, wound care/removal of stinger, antihistamines, Epi IV
      - Note: caution in Epi >age 50
      - Epi IM > SQ –if hemodynamically stable 0.3ml of 1:1000
      - Epi IV 1 ml of 1:10,000 if hemodynamically unstable

  - Hymenoptera: greater chance of systemic reaction than other insects, particularly if multiple stings

  - Consider allergic reaction as etiology of SOB calls

Animal Bites

- Account for 1% of ED visits but are seldom encountered in EMS. Arthropods make up majority.
  - Scene safety concerns are paramount, co-dispatch law enforcement and/or animal control and do not transport
● The EMS Medical Director should be aware of dangerous animal species in the area.

● All bites other than marine envenomations should be copiously irrigated after hemostasis is achieved.

● Splint extremities if they are involved.

● Most mammalian bites are caused by dogs and cats and involve the upper extremities with high rates of infection and corresponding need for antibiotics.

● Reptile bites are mainly from Crotalid snakes (hemotoxic symptoms) and Elapid snakes (water environments, neurotoxic symptoms).
  ○ Compression immobilization not indicated in Crotalid snake bites prehospital, keep extremity in neutral position.
  ○ Analgesia with fentanyl only to avoid morphine histamine release which could cloud clinical picture.

● Gila monster bites infrequent, but may still be attached to patient
  ○ Pry jaws apart
  ○ Place flame under belly
  ○ Submerge in cold water

● For marine envenomations remove any remaining tentacles or nematocysts with gloved hands/instruments after stabilizing with a vinegar solution and use local heat application to degrade toxins and provide pain relief.

● Black widow spider bites should be treated with analgesics and benzodiazepines as needed for pain and muscle spasm. Releases ACh and can act like rigid abdomen.

● Bark scorpion venom opens sodium channels. Use benzodiazepines and opioids for neurotoxic symptoms.

● Rabies PEP recommended universally for bites from skunks, foxes, raccoons and bats (directly witnessed or suspected).
  ○ Dogs, cats or ferrets who cause bites should be observed for 10 days in quarantine before deciding on RPEP if the animal is asymptomatic. Use the poison center as a resource when dealing with non-indigenous animals/insects.
39: Field trauma triage, 327

- Unintentional injury is leading cause of death in patients ages 1-44 years old
- 30 million injuries annually lead to ED visits, and 18% of those are transported by EMS
- Severely injured adults who received care at Level 1 have 25% reduction in mortality vs non-trauma center
- Trauma system (ACS-COT) began publishing hospital and destination guidelines in 1976
- Target for undertriage within trauma systems range from 0-5% of patients requiring Level 2 or higher care
- Field Triage Decision Scheme Recommendations (taken from MMWR from CDC):
  - Step 1: Physiologic Criteria
    - Measure vitals and GCS (GCS <13, SBP<90, RR<10 or >29)
      - Abnormal vitals are specific, not sensitive for ISS>15 with PPV approx. 40%
      - Adults meeting these criteria had reduced mortality if treated at level 1 center
  - Step 2: Anatomic Criteria
    - Combining physiologic and anatomic criteria has sensitivity of 0.8 and PPV 26%
      - Includes: penetrating injuries to head, neck, torso, and proximal to knees and elbows, chest wall instability or deformity, two or more proximal long bone fractures, crushed/degloved/mangled/pulseless extremity, amputation proximal to wrist or ankle, pelvic fractures, open or depressed skull fractures, paralysis
  - Step 3: Mechanism of Injury Criteria
    - Uses mechanism of injury to determine if there may be severe, but occult injury to helps reduce undertriage
      - Includes: falls >20 ft for adults and >10 feet or 2-3 times height of child, high risk auto crashes (intrusion >12” on occupant side or >18” on any side, ejection, death in same vehicle, vehicle telemetry data consistent with high risk injury), auto vs ped/bike >20 mph or run over or thrown, motorcycle crash >20 mph
  - Step 4: Special Considerations
    - Designed for patients with underlying conditions that place them at higher risk for injury to reduce undertriage
      - Includes: Age >55, SBP <110 if over 65, children should preferentially go to peds trauma centers, anticoagulants and bleeding disorders, burns (either to burn centers or trauma centers if concomitant trauma), pregnancy > 20 weeks, EMS provider judgment
40: Trauma-stabilizing procedures, 335

- Hands-on and didactic training with skill verification should occur prior to implementation of any procedure

- Needle Thoracostomy
  - Purpose: Relieve tension pneumothorax
  - Considerations: any patient with blunt chest trauma and precipitous decline, obvious subcutaneous emphysema, tracheal deviation, decreased breath sounds
  - Technique: Sterile prep and insertion at the 2nd intercostal space in the midclavicular line with an alternate site being the 4th or 5th intercostals space at the midaxillary line. Over rib.
  - Complications: Subclavian vessels if too high, abdominal viscera or internal mammary artery

- Tube Thoracostomy
  - Limited in the field generally to air medical services and military situations
  - Indication: Rapidly evacuate large amount of blood from pleural space or to decompress a large pneumothorax if a long transport time is expected
  - Advantages: Lower likelihood of tube kinking, clotting, or dislodging compared to needle
  - Technique: Sterile prep, 4/5th intercostal space at the midaxillary line; drainage apparatus vs Heimlich value
  - Complications: Empyema (given unsterile prehospital environment); injury to heart, abdominal organs, great vessels, lung parenchyma

- Pericardiocentesis
  - Procedure of choice for cardiac tamponade, but not fully investigated in prehospital setting
  - Cardiac tamponade presents in up to 90% of penetrating injuries to heart
  - Indication: Beck's triad (muffled heart sounds, JVD, and hypotension), Kussmaul signs (pulsus paradoxus, drop of >10 mmHg during inspiration and paradoxical increase in JVD), resuscitation of PEA when other causes have been ruled out and patient remains pulseless
  - Technique: Sterile prep to subxiphoid region. Use 18G spinal needle and enter directly below/adjacent to xiphoid process at 45-degree angle and aiming towards the left shoulder until blood return is achieved. Initially 50cc blood should be removed, then 25 cc increments with reassessment between until hemodynamic improvement.
  - Technique with EKG or US: Same technique as above, but use an alligator clip jumper cable from EKG lead V1 (if 12 lead) or II (if 3 lead) to proximal metal portion of spinal needle. Look for ST elevation on monitor. If ultrasound, identify point of maximal effusion to guide site selection, but you should try to use the most superficial site possible. Angle and depth should be guided by US.
  - Complications: Use of this technique may prolong time to thoracotomy. Additionally, you may injure the pericardium or lacerate a coronary vessel.

- Spinal Motion Restriction (SMR)
  - To protect the spinal cord for further injury; difficult procedure to study given medical-legal climate
 Recent studies show lack of evidence of effectiveness of c collars and long spine boards in maintaining spinal alignment as well as documented adverse events with routine immobilization.

 Joint NAEMSP-ACOT position paper (To provide guidance in controversy)

 Penetrating trauma

 - Studies indicate that spinal cord injuries from bullet wounds are complete at the time of injury or stable and thus do not require immobilization.
 - C-collars prevent full visualization of any neck wounds.
 - Therefore, patients with penetrating trauma and no signs of spinal injury should not be immobilized on a long spine board.

 Blunt trauma

 - Patients with altered mental status, neurologic deficit, intoxication, or suspected extremity fracture were more likely to have spinal injuries.
 - Extremes of age, language barriers, and midline or paraspinal pain, in addition to the above-mentioned criteria, should be considered for full immobilization.
 - The position paper includes the concept that spinal immobilization does not require use of the long spine board.

 - Long spine board should only be used when necessary for patient movement, and should be moved off board for transport.

 Indications for SMR

 - Acute altered mental status
 - Midline neck/back pain or tenderness
 - Focal neurologic signs/symptoms
 - Anatomical deformity of spine
 - Distracting circumstances or injury or any injury that impairs the patient's ability to contribute to a reliable examination.

 C-collar

 - Immobilization starts with manual stabilization of the head and placement of an appropriately sized rigid cervical collar
 - The patient should not be able to flex or extend the neck, but should be able to open the mouth.
 - Complications: respiratory compromise, vascular occlusion, and patient comfort if not properly fitting

 Backboard

 - Indications: Position paper states this may be appropriate in blunt trauma with altered mental status, spinal pain or tenderness, a neurologic complaint, anatomical deformity of the spine, a high-energy mechanism, intoxication, inability to communicate with the patient, or a distracting injury. Many medical directors no longer use backboards
 - Long spine board: application is with log roll. Patient is secured from chest down.
 - Scoop stretcher: Stretcher is opened and hinged portion is placed above the patient’s
head and bottom is left open. Stretcher then closed under patient (watch for pinching). Patient is secured from chest down.

- **Vacuum Mattress:** Place mattress on ground with valve facing up near the patient's feet. Patient is placed onto mattress while maintaining spinal stabilization. Mattress is pumped up several times, and then molded to patient with special attention around the head, and straps are placed. Air is vacuumed from the mattress.

- **Extrication device:** After application of c-collar and placement of device behind the patient, straps are secured in this order: Middle torso, bottom torso, legs, top torso, head. Patient is then extricated and placed on longboard.

- **Complications:** Discomfort, increased utilization of radiology, decubitus ulcers, risk of respiratory compromise. Pregnant patients >20 weeks may experience compression of great vessels, and the board should be wedged toward a left lateral slant during immobilization.

- **Padding:** consider padding to reduce discomfort and tissue damage. Time of spinal immobilization should be limited, especially in high risk patients.

- **Children:** Use undamaged car seats if the child is already immobilized in one and does not require further assessment or care. Consider short boards with padding, KED, or another modality.

  ○ **Selective Spinal Immobilization**
    - Reasonable to employ protocols that limit spinal motion immobilization to patients who may benefit.
    - Most protocols use NEXUS or Canadian C-Spine rules
    - Both rules have been studied in prehospital setting and found to function effectively
Section VI: Obstetrics and Gynecological Problems

41: Physiology of pregnancy: EMS implications, 345

- Physiologic changes:
  - Increased blood volume, HR, RR, CO, minute ventilation, O2 consumption, GFR
  - Decreased FRC, venous return, pCO2, Hct
  - BP can be decreased or normal

- Higher risk of difficult airway: increased edema, increased risk of regurgitation/aspiration, increased bleeding due to capillary engorgement, decreased FRC, increased O2 consumption.
  - Anticipate more liberal use of airway adjuncts (NPA, OPA, etc.).
  - Anticipate rapid desaturation. Keep as upright as possible to avoid pressure on diaphragm and increase FRC and use supplemental O2 or BIPAP liberally.
  - Keep a smaller than expected ETT readily available

- Increased blood volume and lower Hct may lead to initial compensation for major blood loss, but followed by rapid decompensation.
  - Treat aggressively with IV fluid resuscitation.
  - *Permissive hypotension probably shouldn’t be applied to pregnant patients.*
  - Place in left lateral decubitus position

- EKG changes are common, including left axis deviation, ST wave flattening, TWI and nonspecific ST changes. Common arrhythmias are SVT, AFib/flutter, and rarely VT.
  - Avoid pharmacologic therapy if possible.
  - Adenosine is probably safe.
  - Use lidocaine as first-line agent for VT, followed by procainamide. Avoid amiodarone.
  - Electrical cardioversion is considered safe for unstable patients.
  - Can present with CHF symptoms due to idiopathic cardiomyopathy

- Standard prehospital treatments for asthma exacerbations are considered safe in pregnancy

- Carbon Monoxide: Due to the higher affinity of fetal Hgb for CO than maternal Hgb, fetus has a higher risk for adverse events even if mother appears well. EMS providers should immediately start 100% O2 for patients with CO toxicity and consider transport to a specialty center that can provide hyperbaric oxygen for the following indications:
  - CO level >20%
  - Depressed mental status or LOC
  - Seizures
  - Severe metabolic acidosis
  - Fetal distress
  - Cardiotoxicity (EKG changes, chest pain)
● Pregnant women are at higher risk for UTI

● Pregnant women are 4-5 times more likely to have DVT/PE and are at risk for stroke due to hypercoagulability.

● Newborns of mothers with gestational diabetes mellitus are at high risk of severe hypoglycemia in the minutes after delivery. EMS providers should anticipate this and have a neonatal dextrose protocol.

● Appendicitis is the most common non-obstetric surgical diagnosis in pregnancy
  ○ Higher rate of missed early diagnosis and perforation due to altered anatomy

● Acute cholecystitis is the second most common non-obstetric surgical condition during pregnancy
42: Emergencies of pregnancy, 350

- Pertinent historical information
  - Estimated weeks of gestation
  - Number of previous pregnancies (Gravity)
  - Number and type of deliveries (Parity)
  - Complications of previous pregnancies (GDM, preeclampsia, preterm labor)
  - Contraction intervals, membrane rupture, and bleeding

- Pregnancy can be divided into 3 13-week trimesters

- Miscarriage is the most common disorder of early pregnancy. Primary EMS management is supportive.

- Any woman of reproductive age with abdominal pain or vaginal bleeding has ruptured ectopic pregnancy until proven otherwise
  - Note: the passage of tissue does not distinguish miscarriage from ruptured ectopic
  - If in shock, obtain large-bore IV access and resuscitate appropriately with IV fluids
  - Transport any passed tissue to receiving facility when possible

- Placental abruption should be considered in women who present with vaginal bleeding +/- abdominal pain, a history of trauma, or appear to be in preterm labor
  - Determine presence of risk factors: cocaine/drug use, hypertension, preeclampsia, etc.
  - Large-bore IV access and transport to OB-capable facility (trauma center if traumatic injury)
  - Abruption may be concealed (no obvious vaginal bleeding)
  - Treat shock aggressively with IV fluid resuscitation even if minimal bleeding. Vasopressors should be last resort 2/2 risk of fetal hypoxia.
  - Maternal risk (depends on severity of abruption) includes massive bleeding, DIC, coagulopathy and death
  - Fetal risk depends on severity of abruption and age at which it occurs

- Classic presentation of placenta previa is painless bleeding in late second or early third trimester, though bleeding can be painful
  - If suspected, obtain large-bore IV access and transport to OB-capable facility
  - Treat shock with IV fluids as appropriate
  - Digital vaginal exam can provoke catastrophic hemorrhage and thus should be avoided

- Gestational Hypertension is typically recognized with a new BP reading of 140/90 mmHg or higher.
  - Present in 6-8% pregnancies
  - Resolves post-partum

- Pre-eclampsia is gestational hypertension plus proteinuria after 20 weeks gestation
  - Also associated with edema, vision changes, headache, epigastric pain
○ Severe pre-eclampsia can exhibit hypertensive emergency, acute renal failure, cerebral and visual changes, pulmonary edema and/or cyanosis
○ Prophylactic use of magnesium in patients with preeclampsia may reduce risk of eclampsia and maternal death. Magnesium is critical for seizure control NOT BP control
○ Prehospital treatment should focus on supportive care and transport to OB-capable facility
○ Severe range blood pressures (above 160 systolic, or 110 diastolic) can be treated with IV labetalol/hydralazine or PO nifedipine

● Eclampsia: seizures and signs of preeclampsia
  ○ May occur in the absence of pre-eclampsia: in 10-15% cases, hypertension may be absent or modest and/or proteinuria may not be detected
  ○ Can occur up to several weeks postpartum
  ○ Eclampsia should be treated with IV magnesium in a loading dose of 4-6 g over 15-20 minutes followed by continuous infusion of 2 g/hr. Magnesium is seizure control not blood pressure control and is more effective than phenytoin or diazepam in preventing initial AND recurrent seizures and lowering maternal mortality.
  ○ Magnesium toxicity presents with decreased deep tendon reflexes, decreased respirations, muscular paralysis, respiratory arrest, and maternal cardiac arrest
    ■ Decreased deep tendon reflexes will present prior to cardiac toxicity

● Hypertensive emergencies in pregnancy are the second leading cause of maternal death in the US
43: Normal childbirth, 357

- Pertinent historical information (see previous chapter)

- Exam: If signs of active labor (regular contractions, urge to defecate or push, rupture of membranes, etc.), visual exam of the perineum is necessary.
  - Make sure protocol is clear to protect both the EMS provider and EMS physician

- Gestational age can be estimated either by last menstrual period or by fundal height. At around 12 weeks the uterine fundus can start to be felt above the pubic symphysis, at around 20 weeks it reaches the umbilicus, and around full term it reaches the xiphoid process.

- Ultrasound can be used to assess fetal viability by looking at heart rate. Ultrasound can also show evidence of early pregnancy including gestational sac, yolk sac, and fetal pole. Free fluid, adnexal mass, or evidence of a gestational sac, yolk sac, fetal pole or fetal heart rate outside of the uterus may indicate ectopic pregnancy,

- Management:
  - Supplemental O2 and large-bore IV access should be started
  - Direct medical oversight should always be notified of any impending delivery
  - Ensure adequate personnel to assist when able
  - Maintain gentle, constant pressure on the posterior and anterior aspect of fetal head during delivery
  - After delivery of the head, assess for nuchal cord.
  - Umbilical cord should be double-clamped and cut after it stops pulsating
  - Baby can be placed on the mother's chest for warming/drying and to encourage nursing.

- Basic care of a newborn includes gentle stimulation of feet or back, drying, and warming. If warming and stimulation do not lead to adequate respirations, resuscitation via PALS or NRP algorithms should be begun. Most neonates do not require suctioning.
  - Do not delay transport for delivery of the placenta
  - If neonate is stable, place on mother’s chest
  - Neonatal IV access not necessary unless resuscitation is necessary
  - Expected blood loss in normal delivery is about 500cc
  - APGAR scale can be used to evaluate newborn’s condition
● Protocols should reflect the fact that “minor” trauma can cause placental abruption

● Basic trauma care includes airway & hemorrhage control, supplemental oxygen, immobilization, and rapid transport to appropriate facility (ideally one with both trauma & OB capabilities)
  ○ All supine trauma patients in second or third trimester should be tilted 15 degrees to the left

● Pregnant patients over 20 weeks gestation with cardiac arrest should be immediately transported, as success of perimortem C-section in the ED correlates directly with duration of arrest.
  ○ Medication doses and defibrillation energy are the same as in non-pregnant patients in cardiac arrest
44: Childbirth emergencies, 361

- Request for additional resources should be made as soon as crews encounter a multiple gestation birth, an abnormal presentation, or any other childbirth emergency

- **Umbilical cord prolapse**: priority is manual elevation of the presenting part off of the cord, positioning mother in knee-to-chest or steep Trendelenburg to ease pressure on the cord, and rapid transport to appropriate facility
  - High association with footling breech position
  - Exposed cord can be covered with moist sterile towel

- **Nuchal cord**: attempt should be made to lift the cord over the infant’s head - If the cord is too tightly wrapped, the nares and mouth should be suctioned while the cord is double-clamped in preparation to cut the cord
  - Delivery should proceed as quickly as possible after the cord is cut

- **Breech delivery**: once recognized, proceed with rapid transport to OB facility
  - Three types: complete, incomplete (footling), frank
  - Presenting part should be wrapped in towel and supported, but not elevated (unless cord prolapse)
  - Avoid traction
  - If head entrapment occurs, the provider may place fingers gently on the maxilla to flex the neck and facilitate delivery of the head

- **Shoulder dystocia**: should be suspected with the “turtle sign” (movement of fetal head backwards into introitus), or when delivery does not complete with gentle downward movement of fetal head
  - Primary focus of prehospital effort should be positioning and gentle suprapubic pressure to attempt reduction of anterior shoulder impaction
  - Can be accompanied by the McRoberts maneuver (hyperflexion of maternal hips) with suprapubic pressure (not fundal)
  - If these fail, attempt Gaskin maneuver (rolling patient to all fours)
  - Corkscrew maneuver can be attempted with direct medical oversight (apply two fingers to front part of top shoulder and rotate neonate toward the back)
  - EMS physicians may attempt other maneuvers (Woods, Rubin, Zavanelli), but instructing crews to perform any of these via online consult is extremely difficult
  - Episiotomy is generally not useful

- **Postpartum hemorrhage**:  
  - Treatment starts with with fundal massage for uterine atony (primary cause)
  - Large-bore IV access should be obtained and treatment for shock as needed
  - Maneuvers to facilitate delivery of the placenta (traction on the cord) should not be undertaken by prehospital providers
  - Second most common cause of postpartum hemorrhage is laceration of the genital tract
- Bleeding from perineal lacerations should be controlled using standard techniques
  - Online direction for manual reduction of inverted uterus may be attempted in special circumstances (prolonged transport times, remote scenes, etc.)
  - Specialty treatment teams (eg: CCT) may have other pharmacologic agents to assist
  - TXA may be useful as an adjunct
45: Perimortem cesarean section, 365

- Should be performed within 4 minutes of maternal arrest, with delivery by 5 minutes
  - Only applicable for cases beyond 20-24 weeks gestation (fundus at or above umbilicus)

- PMCS is beneficial to maternal resuscitation, not only to rescue the fetus

- Few cases of field PMCS reported
  - Only applicable for cases beyond 20-24 weeks gestation (fundus at or above umbilicus)

- Time should not be spent looking for fetal viability
  - Consider PMCS for any pregnancy beyond 20 weeks, or for any obviously gravid uterus deemed to large enough to cause aortocaval compression

- PMCS should still be considered beyond "4 minute" rule as neurologically intact infant survival is documented well beyond this cutoff

- Training courses exist (ALSO, MOET, ALARM) which include PMCS
  - EMS physicians should be trained adequately to perform this procedure in the field if appropriate.

- Procedure:
  - Generous midline incision from pubis to umbilicus (following linea nigra) - extend to xiphoid pm
  - Displace bladder caudally
    - Stab incision of bladder if distended and obstructing access
  - Short vertical incision of lower uterine segment, just cephalad to bladder
  - Extend incision cephalad using scissors, incising through placenta if necessary
  - If vertex, insert hands into uterine cavity and elevate head and shoulders out of incision
  - Resuscitate neonate as indicated
  - Palpate uterus for potential multiple gestation
  - Remove placenta if time/resources allow
  - Consider packing or suturing uterus if appropriate
    - Can also apply direct aortic pressure

- No physician in the US has been held liable for performing PMCS, even when against wishes of family
  - Have been held liable for NOT performing PMC

- Consider mental health care for clinicians involved
Section VII: Toxicological Problems

46: Principles of toxicology, 373

- Toxicologic protocols should remain general -- impossible to prepare for each agent individually. Always include poison control center contact information.
  - Many toxins do not have specific antidotes or treatment, so supportive treatment is most important, including ensuring airway patency and ventilation (with ETI if necessary), IV access and IV fluids, continuous cardiac monitoring including pulse ox, and fingerstick glucose measurement.

- Gather as much information about the exposure as possible, including a list of all medications in the home, or collateral info from friends/family.

- Directed examination can reveal significant findings suggesting specific toxin/toxidrome.

- Treat any poisoned patient with a prolonged QRS interval with 1-2 mEq/kg of sodium bicarb.

- Treat any poisoned patient with prolonged QTc (especially if >500 ms) with IV magnesium +/- calcium.

- Treat any poisoned patient with seizures requiring treatment with IV/IM benzodiazepines.

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<thead>
<tr>
<th>Table 46.1 Odors that suggest a toxicological exposure</th>
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<tr>
<td>Odor</td>
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<td>Bitter almonds</td>
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<td>Fruity</td>
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<td>Garlic</td>
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<td>Gasoline</td>
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<tr>
<td>Mothballs</td>
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<td>Pears</td>
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<tr>
<td>Minty</td>
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<tr>
<td>Rotten eggs</td>
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<td>Freshly mowed hay</td>
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<th>Table 46.3 Examples of potential toxins associated with miosis or mydriasis</th>
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<tr>
<td>Miosis</td>
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<tr>
<td>Antipsychotic agents</td>
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<tr>
<td>Carbamates</td>
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<tr>
<td>Clonidine</td>
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<tr>
<td>Opiates</td>
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<tr>
<td>Organophosphates</td>
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<td>Sedative-hypnotics</td>
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- Hydrofluoric acid is a unique agent that does not behave like typical acids, found in wheel cleaner and glass etching agents. It permeates tissues and binds calcium and magnesium, leaching them out of cells. This causes severe pain and electrolyte derangements -- hyperkalemia, hypocalcemia, hypomagnesemia. Treatment is aggressive IV fluid electrolyte repletion and cardiac monitoring.
Decontamination:
  
  o Surface decontamination should occur before transport. Wear appropriate PPE for contaminating agent. Gas or vapor exposure requires removal from the site only (ocular decontamination may still be needed). Remove and seal contaminated clothing in plastic bags to prevent off-gassing. Brush all solids from skin and clothing, irrigate exposed areas 10-15 minutes with water or saline, scrub with a soft brush. Irrigate any wounds for additional 5-10 minutes.
  
  o Tap water is acceptable alternative to saline, though LR is preferable. Irrigate away from medial canthus. As endpoint of ocular decontamination is normalization of pH and this is not typically able to be checked in the field, irrigation should be continued during transport. If a question asks for minutes, at least 15-30 minutes.
  
  o Gastric lavage, forced emesis, or activated charcoal are all probably inappropriate for prehospital care. Focus on supportive care and rapid transport to appropriate facilities.

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<th>Table 46.4 Toxidromes</th>
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<td><strong>Toxidrome</strong></td>
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<tr>
<td>Opioid</td>
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<td>Anticholinergic</td>
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<td>Sedative hypnotic</td>
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<tr>
<td>Sympathomimetic</td>
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<tr>
<td>Cholinergic</td>
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<td>Serotonin toxicity</td>
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<th>Table 46.5 Antidotes</th>
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<tr>
<td><strong>Agent or clinical finding</strong></td>
</tr>
<tr>
<td>Acetaminophen</td>
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<td>Benzodiazepines</td>
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<tr>
<td>Beta-blockers</td>
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<tr>
<td>Cardiac glycosides</td>
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<tr>
<td>Crotalid envenomation</td>
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<tr>
<td>Cyanide</td>
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<tr>
<td>Ethylene glycol</td>
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<td>Iron</td>
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<td>Isoniazid</td>
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<td>Methanol</td>
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<td>Methemoglobinemia</td>
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<td>Opioids</td>
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<td>Organophosphates</td>
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<td>Sulfonyleureas</td>
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*Antidotes that may be available to EMS personnel.
• Endpoint of naloxone treatment is restoration of respiratory function, ability to protect airway, and improved level of consciousness. Over-treatment with naloxone can precipitate severe withdrawal, violence, emesis.
  ○ Onset of action for IN naloxone is longer than IV (8-12 vs 6-8 minutes), and optimal IN dosing is unclear.
47: Treatment and evaluation of specific toxins, 383

- Agents that can cause rapid loss of consciousness: CO, hypoxic environment, nerve agents, H2S.

- Victims exposed to gas or vapor only (without skin or eye irritation and no visible toxins in person) may be evacuated immediately. Eye irritation indicates need for irrigation during transport.

- Priorities include recognizing potential chemical sources, adopting appropriate PPE, removing victims from exposure, and decontamination if necessary, followed by supportive care.

- **Organophosphates:** pesticides and nerve agents; cause DUMBELLS physiology
  - PPE: *Level A required for nerve agents*; all are highly volatile (except VX).
  - For carbamate pesticides, unless the patient is drenched in pesticides, standard universal precautions are sufficient.
  - Vomitus may be capable of causing secondary contamination.
  - Decontamination involves removing all clothes and jewelry, and irrigation with water +/- soap.
  - Pesticides may require significant scrubbing.
  - Miosis is an uncommon sign with organophosphate toxicity with non-vapor exposure (such as ingestion of carbamate pesticide).
  - Treatment begins with airway management and ventilatory support, including suction.
  - Avoid succinylcholine if intubating.
  - Begin with atropine (2 mg adult, 0.05 mg/kg peds), repeated every 1-5 minutes titrated to effect (reduced secretions/bronchoconstriction and improved bradycardia).
  - If symptoms do not immediately resolve with single dose atropine, pralidoxime should be given (1-2g adult, 25-50 mg/kg peds) over 15-30 minutes. (Not necessary for carbamate pesticides.)
  - Benzodiazepines for seizures, knowing these may worsen respiratory depression.
  - MARK 1 auto injector contains 2 mg atropine + 600 mg pralidoxime in two injections.
  - ATNAA/DuoDote administers 2.1mg atropine + 600 mg pralidoxime simultaneously

- **Gases:** chlorine, phosgene, anhydrous ammonia, hydrofluoric acid, hydrocarbons
  - Chlorine, ammonia, HF all have high water solubility, which leads to pungent odors and rapid onset of symptoms in the eyes and *upper* airway mucosa.
  - Phosgene has lower water solubility, so not as strong of a warning odor (newly mown hay), and is more likely to penetrate to *lower* airways and cause alveolar damage with noncardiogenic pulmonary edema, in a more delayed fashion requiring prolonged observation.
  - Remove clothing and irrigate eyes. Supportive care includes supplemental O2, suctioning, beta-agonist/anticholinergic nebs, IV fluids for shock. Consider IV steroid if gas exposure triggers underlying asthma/COPD symptoms. Respiratory distress or stridor indicates need for intubation.
  - Phosgene exposures require prolonged observation period for *delayed* symptoms.
  - No specific antidotes. Consider nebulized sodium bicarb in chlorine exposure. Consider IV calcium gluconate for prophylaxis with significant inhalation exposure to HF.
  - Hydrocarbons are themselves minimally toxic but can *displace oxygen*. Exposed patients should be
removed from environment (maintaining safety of rescuers in hypoxic environment), and administered 100% O2.

- Hydrocarbon abuse (huffing) may lead to sudden cardiac death when an epinephrine surge triggers fatal ventricular arrhythmia. Epi should be avoided in this population.
- Huffing methanol-containing products can lead to methanol toxicity (blindness, metabolic acidosis).
- Huffing metallic spray paints or glue can lead to toluene toxicity (acidosis and severe hypokalemia, even to the point of paralysis).
- Huffing solvents containing methylene chloride can lead to carbon monoxide toxicity.

**Carbon monoxide:** Binds Hgb much more avidly than O2.
- Non-specific symptoms such as headache, nausea, dizziness progressing to altered mental status, syncope, seizures, coma. Hypotension, ischemia, infarct, arrhythmia are possible. Rhabdo, renal failure, pulmonary edema can also occur.
- Chronic low-level exposures can cause headaches, lightheadedness, ataxia, cognitive/mood changes.
- Firefighting units typically carry CO detection equipment. Gold standard is CO-oximeter measurement of venous carboxyhemoglobin levels. Prehospital non-invasive CO-oximetry unit is available, though its role remains undefined.
- Initiate treatment based on clinical symptoms and history, in conjunction with measured environmental CO levels. Remove patient from environment and give high-flow 100% O2.
- Utility of hyperbaric oxygen treatment for CO poisoning remains controversial. ACEP has published clinical policy paper stating HBO cannot be mandated, based on available evidence. Reasonable to consider HBO for CO-poisoned patients with loss of consciousness, focal neurologic signs, or for pregnant patients with fetal distress. Some also recommend it for cardiovascular signs. *Adult patients with cardiac arrest from CO poisoning have nearly universally fatal outcomes; only pediatric arrest or witnessed arrest should be considered for HBO.* If decided upon, HBO should be begun as soon as possible, ideally within 6 hours of exposure, no later than 24 hours later.
- CO levels should guide therapy but should not be sole determinant and toxicity is based both on level and duration of exposure. Maternal levels do not correlate with fetal exposure. Some have proposed absolute CO-Hgb levels of >25% (>15% in pregnant patients) for HBO treatment.

**Cyanide:** Usually generated during burning of natural & synthetic substances.
- Uncouples oxidative phosphorylation, leading to dyspnea, headache, nausea, anxiety, and altered mental status with progression to syncope, apnea, and death.
- Should be considered with history suggesting exposure combined with lactic acidosis + hemodynamic or respiratory compromise that does not respond to O2. Bitter almond odor and cherry-red skin or venous blood are not reliable signs.
- No decontamination required other than removing from exposed environment.
- Antidotes include sodium nitrite, sodium thiosulfate, and hydroxocobalamin.
- Sodium nitrite (300 mg adult over 2-3 minutes) produces methemoglobin which displaces CO from mitochondria. Can lead to hypotension and toxic methemoglobinemia. It decreases patient’s O2 carrying capacity, which may be problematic in victims of significant smoke inhalation.
○ Sodium thiosulfate (12.5 g adult, 0.42 g/kg peds) converts cyanide to thiocyanate, which is excreted by kidneys. It is probably the ideal prehospital agent for cyanide toxicity, especially to be given empirically with low suspicion of significant CN poisoning.

○ Hydroxocobalamin (5g adult, 70 mg/kg peds over 15 minutes) scavenges cyanide itself, forming cyanocobalamin which is excreted by kidneys. It does have some side effects including urine/serum discoloration, pustular skin reactions, hypertension. Incompatible in same IV line as sodium thiosulfate.

○ Ingestion of potassium cyanide salts as a suicide attempt can lead to the victim off-gassing CN gas with potential for secondary exposure of providers. It will typically cause nausea, vomiting, and hemorrhagic gastritis in victims.

● Hydrogen sulfide: Similar to CN, has a stronger odor but victims can become "odor fatigued."
  ○ Most tragic situations occur when the initial victim enters a toxic environment and is overwhelmed and loses consciousness, followed by multiple rescuers who do the same.
  ○ Most common agent utilized in “chemical suicides.”
  ○ Treatment is supportive: removal from environment + 100% O2.

● Viscants: sulfur mustard, lewisite, nitrogen mustards (now used as chemo agents)
  ○ PPE: Level A required for hot zone operations.
  ○ Decontamination: Most are internalized within 15 minutes on tissue but can persist on objects so all clothing/jewelry/etc. must be removed.
  ○ Symptoms include desquamation, painful blisters, corneal damage. Vapor inhalation leads to necrosis of upper airways, pulmonary edema.
  ○ Sulfur mustard: Penetrates most materials and has no warning properties. Delayed onset of symptoms. Also causes bone marrow suppression.
  ○ Lewisite: Contains arsenic. Similar to sulfur mustard but much faster symptom onset.

● White phosphorus: Common ingredient in meth labs. When ingested or inhaled, causes vomiting & diarrhea. Breath, emesis, and other excreta has characteristic garlic odor.
  ○ Surface decontamination should occur before transport.
Section VIII: Environmental Problems

48: Cold exposure illness and injury, 393

- **Hypothermia:** Core temp < 95 F (35°C).
  - Stress exceeding body’s ability to produce sufficient heat to maintain body temperature.

- EMS providers are more likely to encounter “urban hypothermia,” a chronic condition resulting from cold exposure with a combination of comorbid factors including medical conditions, medications, change in temperature perception, substance abuse, inadequate nutrition, inadequate social circumstances.

- Heat loss
  - Radiation aka Infrared emission (40% of all heat loss)
  - Evaporation due to sweating
  - Conduction (direct transfer of heat from object to object)
  - Convection (heat loss is a function of the square of wind velocity up to 40 mph; i.e. wind chill).
Beyond removing patient from cold stress, prehospital treatment modalities include forced warm air, full-body blanket, electric heater with rigid torso cover, and charcoal vest forced hot air heaters.

- Avoid warm/hot water immersion (shown to increase mortality).

- Acute environmental (primary) hypothermia patients may not need evacuation if changes can be made to the patient's clothing or route such that recurrent cold stress is minimized. Patients with severe hypothermia should be evacuated in a manner that minimizes bumping and jolting.

- "No one is dead until warm and dead" is not always practical. Rescuer safety comes first. Conditions incompatible with life include core temp <50F (10C), cold water submersion >1 hr, obvious fatal injuries, and frozen patients (ice in the airway or chest wall too rigid to perform CPR).

- Optimal resuscitation techniques for hypothermic arrest have not been determined. Some experts recommend rewarming in place, while others recommend transporting with ongoing CPR if definitive
rewarming care is available within 3 hours.

- **Trenchfoot** subacute exposure to cold (but *non freezing temperatures*), especially when complicated by water exposure, excessively tight footwear, and immobility. Foot becomes macerated with vasomotor instability and anesthesia. Prolonged vasoconstriction leads to tissue injury.
  - Pretreatment: Prehyperemic. Blanching, local edema, anesthesia.
  - Treatment: Hyperemic, swollen, painful. Blisters and gangrene can occur in severe cases.
  - Posthyperemic: Ongoing vasomotor instability, cold sensitivity, limb coolness; exertional blistering, edema, paresthesias. Can last for years.
  - Treatment consists of removing wet clothes, keeping feet dry and elevated. Best prevented by frequent changes with clean, dry socks. Avoiding immobility and prolonged exposure to cold/wet conditions, and keeping feet dry for 8 out of every 24 hours are also important.

- For **frostbite**, prehospital grading system of “degrees” is commonly used:
  - First-degree: numbness, erythema, white/yellow plaques, edema *without tissue loss*.
  - Second-degree: Blisters surrounded by erythema and edema.
  - Third-degree: More extensive blood-containing blisters.
  - Fourth-degree: Includes subcuticular tissues. Difficult to distinguish from third-degree prehospital.
  - Two key principles of frostbite treatment: Avoid thawing and refreezing the frozen part. Avoid burns.
    - Rewarm core temp to >93F (>34C), the completely immerse frozen part in hot water bath (99-108F or 37-42C). Rapid rewarming is probably superior. Pain control is required.
    - In wilderness, only thaw extremity if:
      - 1) The patient will not need to use the part for evacuation
      - 2) The patients themselves can be kept warm until healing is complete.
      - 3) Thawing can be completed in a controlled, uninterrupted manner

- Three phases of cold water immersion:
  - Cold shock response: Hyperventilation & gasp response, can lead to unconsciousness from hyperventilation or panic and water aspiration. High risk of drowning if no floatation device is used.
  - Patient has ~10 min of useful activity, after which drowning will occur without a floatation device.
  - After one hour may lose consciousness
  - If able to breathe, unconsciousness from hypothermia may not be lethal until 2 hours

- Sudden death can occur up to 24 hours after cold water rescue. Rescuers should keep patients horizontal, minimize physical activity, and carefully monitor for cardiopulmonary collapse.
49: Heat-related illness, 403

- Heat-related homeostatic mechanisms:
  - Cutaneous vasodilation, sweating, decreased voluntary movement, anorexia, decreased heat production, and increased respiration.
  - Minute ventilation, HR, and cardiac output increase; perfusion to the viscera decreases.

- Hot, humid environments confer the greatest risk of heat illness.

- High risk populations include the elderly (reduced reserve, decreased ability to thermoregulate, less mobile, more likely to be volume depleted, more likely to be on meds that impair thermoregulation), the obese, and those physically active in hot/humid environments (athletes, military, outdoor workers).

- Heat edema of the extremities is the mildest form.
  - Move to cooler environment, elevate, compression stockings.

- Heat syncope is the result of venous pooling and peripheral vasodilation.
  - Move to cooler environment, administer IV fluids.

- Heat tetany can arise from respiratory alkalosis from hyperventilation due to heat stress.
  - Move to cooler environment. Breathing into paper bag is not recommended.

- Heat cramps are caused by heavy sweating plus repletion with hypotonic fluids causing hyponatremia.
  - Treat by rehydration with oral electrolyte solution or IV fluids. Salt tablets are not recommended.

- Heat exhaustion includes those experiencing systemic symptoms such as dizziness, fatigue, headache, nausea, visual changes, weakness, anxiety, confusion, fever, hypotension, skin flushing, tachycardia. Core temperature is < 40°C. Patients present with near-normal mental status.
  - Treatment is removal of patient from heat stress, cooling, and rehydration (preferably orally).

- Heat stroke: Hyperthermia + CNS dysfunction. Other concerning signs are anhidrosis, cardiac dysrhythmias, pulmonary edema, tachycardia, tachypnea, shock. Core temp often 40-44°C. Classic heat stroke occurs in elderly/debilitated patients that cannot respond to external heat stress over the course of several days. Exertional heat stroke occurs in healthy adults who are active in hot/humid environments.
  - Treatment is the same as heat exhaustion, except that IV fluids are preferred. Treat seizures with benzodiazepines.

- Decreased mortality and improved outcomes with rapid cooling to 38.3°C

- Cooling methods include immersion (neck down or forearm only), evaporation and convection (misting and fans; eg. misting and ambulance AC), and ice packs.
  - Delayed transport for initiated cooling in settings of exertional heat stroke are reasonable, if measuring core temperatures then until 39°C and if not then 10-20 minutes.
50: High-altitude illnesses, 410

- Physiologic changes occur as high altitude is reached (1500m).
  - At 3500m, each breath contains about 60% as much oxygen as sea level, due to decreased barometric pressure -- the concentration of oxygen remains 21%.
  - At 5000m, each breath contains about 50% as much oxygen as sea level.

- Physiologic changes include EPO secretion, increased RR and TV (causing a metabolic acidosis which the kidneys respond to by secreting bicarb, allowing further increases in minute ventilation while maintaining appropriate pH), dehydration, peripheral edema, and periodic breathing.
  - Sympathetic increases in HR & BP are temporary.

- **Acute Mountain Sickness** is the most common altitude illness, and can occur as low as 2500-2700m.
  - AMS may be related to mild increases in ICP and mild cerebral edema.
  - Symptoms resemble those of a hangover. No neurologic deficits or altered mental status occurs.
  - Mild AMS can be treated by halting ascent for acclimatization (3-4 days). Acetazolamide 250 mg PO BID may accelerate acclimatization. NSAID or ondansetron can be used for symptom control.
  - Moderate-severe AMS is treated by descent of at least 500-1000m. Lightweight portable hyperbaric chambers or supplemental O2 are also effective.

- **High Altitude Cerebral Edema** can progress from AMS in as little as 12 hours (usually 1-3 days).
  - Ataxic gait, severe lassitude, altered level of consciousness; also, headache, vomiting.
  - Descent of 500-1000 meters must begin immediately.
  - Treat with dexamethasone 8mg by any route followed by 4 mg every 4-6 hours.
  - Provide supplemental oxygen with goal SpO2 of >90%.
  - Furosemide, hypertonic saline, and mannitol are all reasonable adjunct treatments.

- **High Altitude Pulmonary Edema** is the most common cause of death from altitude illness.
  - Symptoms begin with decreased activity tolerance and progress to fatigue, weakness, exertional dyspnea, dry cough, cyanosis, AMS.
  - Treatment must begin with rapid descent of 500-1000m, along with supplemental high-flow O2.
  - After successful acclimatization at lower altitude (2-3 days), the climber may re-ascend
  - EPAP/CPAP, furosemide, PDE-5 inhibitors, CCB may be considered as adjunctive treatments.
51: Effects of flight, 416

- Effects of decreased temperature and decreased barometric pressure must be taken into account when transporting patients by air.

- Pneumothorax may not require chest tube prior to air transport, especially by helicopter. 1.5% ptx change per 500ft. Supplemental O2 can combat this.

- Endotracheal tube cuff pressures must be monitored on ascent and descent. Consider filling the balloon with saline rather than air prior to air transport.

- Hypoxemia is a major concern. Use pulse oximetry and supplemental oxygen liberally.

- Vibration and noise contribute to crew fatigue and equipment malfunction, especially in helicopters.

- Motion sickness can affect patients and crew. Zofran ODT is probably the ideal treatment for crew.

- “Flicker vertigo” can occur due to helicopter rotor motion; may be attenuated by using helmets with visors to limit view of rotor motion.

- Night vision goggles with counterweight weighs about 3.7kg, which can lead to significant neck pain for crews.

- Flight-specific PPE (helmet, flame-retardant uniforms, etc.) can lead to dehydration and heat injuries.
52: Diving injury, 421

- Every 33 feet of depth (34 feet in freshwater) increases pressure by 1 atmosphere (760 mmHg)

- **Boyle’s law** is responsible for barotraumatic injuries:
  - Volume & pressure of gas are inversely related: \( P_1V_1 = P_2V_2 \)
  - Air inspired at depth will greatly increase in volume upon ascent
  - Greatest relative change in volume is near the surface

- **Dalton’s law** is responsible for oxygen toxicity and nitrogen narcosis:
  - The total pressure exerted by a mixture of gases = sum of partial pressures of gases in the mix
  - \( P(\text{total}) = P(\text{O}_2) + P(\text{N}_2) + P(\text{CO}_2) \)
  - Partial pressures of gases increase proportionally with depth

- **Henry’s law** is responsible for decompression sickness:
  - Concentration of gas dissolved in a liquid is directly proportional to partial pressure of gas above the liquid
  - \( P = kC \)

- Barotrauma (specifically middle ear barotrauma) is the most common medical problem associated with diving; can affect any air-filled organ. The primary dive concern of barotrauma is the resultant panic causing rapid ascent or drowning.

- Injury of descent is barotraumatic and can affect several organ systems:
  - **Middle ear:** “ear squeeze,” inability to clear ears can result in TM rupture and cold caloric response. Avoid diving with a cold, use decongestants.
  - **Inner ear:** Forceful Valsalva against closed eustachian tube can result in trauma to vestibular and cochlear structures. Symptoms are vertigo, “roaring” tinnitus, and hearing loss. Treatment includes rest, HOB elevation, symptom control, and ENT referral. Must be distinguished from inner ear DCS
  - **External ear:** tight-fitting hood causes relative negative pressure gradient in external canal, pulling TM outward with discomfort.
  - **Sinus:** Most commonly frontal sinus. Facial pain, facial numbness, epistaxis, maxillary pain. Use decongestants or topical nasal vasoconstrictors. Steroid burst may hasten recovery.
  - **Mask squeeze:** Failure to equalize pressures can result in facial petechiae/ecchymosis, conjunctival hemorrhage
  - **Suit barotrauma:** Folds in wet or dry suit become compressed and cause ecchymosis.
  - **Dental:** Air trapped below decayed teeth or other hardware becomes painful during dive.
● Injury at depth includes nitrogen narcosis, oxygen toxicity, and immersion pulmonary edema.
  ○ **Nitrogen narcosis:** Typically occurs at depths greater than 100-120 feet. Increased nitrogen tissue concentrations result in euphoria, impaired decision-making and judgment, loss of fine motor skills. It improves rapidly with ascent. Recreational divers should not dive deeper than 120 feet with compressed air. Commercial divers use mixes with other inert gasses to decrease risk of nitrogen narcosis.
  ○ **Oxygen toxicity:** Exposure to increased partial pressures of O2 results in tissue damage, most notably to brain, lung, and eye. Treatment is immediate ascent.
    ▪ CNS toxicity: Occurs at high partial pressures of O2. Symptoms experienced on continuum, abbreviated VENTID-C (visual changes, ear ringing, nausea, tingling/twitching in the face, irritability/anxiety/agitation, dyspnea/dizziness/discordination, convulsions). Convulsions/seizure may be the first sign.
    ▪ Pulmonary toxicity: Occurs with prolonged duration of O2 exposure at partial pressures as low as 0.6 ATA. Pulmonary irritation from prolonged exposure to O2.
  ○ **Immersion pulmonary edema:** rapid onset of dyspnea at depth with cough/hemoptysis upon ascent. Not the same as decompression sickness. Treatment is oxygen and diuretics.

● Injury of ascent is also due to barotrauma. Most severe forms involve pulmonary barotrauma.
  ○ **Reverse sinus/ear barotrauma:** Can result in blood in ear or nose, TM rupture, pneumocephalus.
  ○ **Alternobaric vertigo:** Middle ear pressures become unequal, resulting in vertigo. Redescent of a few feet should resolve symptoms, followed by careful reascent.
  ○ **GI barotrauma (aerogastralgia):** Expansion of bowel gas causes GI discomfort. Eruption or flatulence usually resolve symptoms.
  ○ **Pulmonary barotrauma:** Most commonly caused by uncontrolled rapid ascent without exhaling. Can result in alveolar hemorrhage, pneumothorax/mediastinum, subcutaneous emphysema.
  ○ **Arterial gas embolism:** Most feared complication of pulmonary barotrauma. Second-most common cause of mortality among divers behind drowning. Symptoms occur during ascent or within 10 minutes of reaching the surface, and depend on amount and distribution of air embolism. Most severe presentation is immediate PEA arrest on surfacing. Virtually any neurologic sign is possible, with most common being confusion, stupor, loss of consciousness. Other symptoms can include chest pain, hemoptysis, dyspnea, blindness, nausea/vomiting. ANY SUDDEN NEURO SYMPTOMS WITHIN 10 MINUTES OF SURFACING ARE AGE UNTIL PROVEN OTHERWISE.
  ○ **Decompression sickness:** Inflammatory and obstructive effects of inert gas bubbles in the vascular system and tissues. Risk is increased by length and depth of dive; can occur despite adherence to dive tables. Increased risk with age, obesity, dehydration, activity before diving, flying after diving. Typically classified according to organ system involved:
    ▪ *MSK* ("the bends"): Most common. Boring, deep pain in major joints
    ▪ Cutaneous: Rash, pruritus, forniculation, cutis marmorata (marbling of the skin)

    ▪ Pulmonary ("the chokes"): Dry cough, dyspnea, cyanosis
      ● Results from massive pulmonary gas embolism. Rare but serious.
    ▪ Neurological: Random/diffuse CNS involvement, usually thoracic/lumbar spinal cord
• May be indistinguishable from arterial gas embolism
  ■ Vestibular ("the stagggers"): Vertigo, nystagmus, nausea/vomiting
  ■ Vasomotor: "Decompression shock" unresponsive to IV fluids
  ■ Dysbaric osteonecrosis: Long-term avascular/aseptic necrosis of bone
  ■ Dysbaric retinopathy: Uncommon direct effect to retinas

• **Shallow water blackout**: During breath-hold dive, exercise-induced hypoxemia may cause LOC before CO2 accumulation prompts urge to breath. Most common among sport freedivers and similar.

• Patients suspected to have arterial gas embolism or decompression sickness should be transported as rapidly as possible to a hyperbaric-capable facility. Other treatments are supportive (NRB O2, IVF).

• Divers Alert Network is a 24/7 hotline for dive-related injury & referral and evacuation assistance.

• Physicians should understand targeted questions for diving casualties, including dive profile, to assess risk for different pathologies

• Frequent neurologic exams are important for patients with concern for AGE or Decompression Sickness

• Transportation considerations- avoid unpressurized air evacuation, or stay below 150 m. Consider in-flight O2.

• Physicians should know location and availability of nearest recompression chambers.
Section IX: Special Populations

53: The special needs of children, 433

- NAEMSP model pediatric protocols developed so systems would not have to start from scratch.

- Pediatric Assessment Triangle involves assessment of appearance, work of breathing, and circulation to develop general impression of illness severity in first 30-60 seconds of encounter.
  - Work of Breathing: airway sounds, abnormal positioning (tripoding), retractions/flaring
  - Circulation: Pallor, Mottling (vasoconstriction), Cyanosis

- Providers should be given a reference with normal ranges for vital signs through age ranges.

- Length-based tape devices (most commonly Broselow Pediatric Emergency Tape) are useful for calculating drug dosages and equipment sizing based on lean body weight. Apps e.g. PediSTAT can help too

- AVPU (Alert, responsive to Voice, responsive to Pain, Unresponsive) is easier to remember and more useful than GCS for determining disability in children.

- Clinical signs should trump vital sign values (i.e., A child with signs of poor perfusion should be treated as such regardless of the blood pressure measurement; blood pressure measurement is often wrong due to improper cuff size and patient cooperation and hypotension is often a late finding of shock in children.)

- NAEMSP policy statements include a list of pediatric equipment for ALS and BLS ambulances.

- Must take into account developmental stage of patient; providers should have a general idea of behaviors/capabilities of “average” child at different ages.

- Most important aspect of evaluating child with special health needs is obtaining developmental level and baseline activity/behavior from parent or caregiver.
  - Determine what is different from normal.
  - Ask the caregiver the best way to approach the child, and include caregiver as much as possible
  - May have special emergency information or a “go bag” with special equipment for transportation.
  - These children often obtain care at specialized children’s hospitals, which may require transport outside of usual protocols.

- Children under age 18 cannot provide informed consent unless they are an emancipated minor.
  - Emancipated minor laws differ from state to state. In most states this includes minors who are married, have a child, are pregnant, are active military, or are not living at home and self-supporting.
○ Emancipated minors can consent to and refuse EMS treatment.

- Mature minors are those who have been declared adults by the court. This varies state by state but is usually older than 14 years. A mature minor can refuse treatment and transport as long as they are not on a psychiatric hold and are deemed to have decision-making capacity.

- The emergency exception rule/implied consent rule requires four specific conditions.
  ○ The child’s legal guardian is unavailable or unable to provide consent
  ○ The child is suffering from emergency condition placing health or life in danger
  ○ Treatment or transport cannot be delayed until consent can be obtained
  ○ EMS administers only treatment for the emergency condition

- In implied consent cases, thorough documentation is paramount. This should include attempts to contact guardian, nature of emergency, and treatment provided. Online medical control should be contacted.

- For guardians to refuse for their child, they must have decision-making capacity.
  ○ EMS providers should contact on-line medical control in these cases.
  ○ If it is determined that emergency treatment and transport are required, or the parent does have not capacity, then law enforcement may be required to take temporary protective custody of the child.
  ○ State laws differ in the application, but when temporary protective custody is taken, this allows EMS to transport the child to a hospital for a medical evaluation but NOT necessarily to treat a non-life-threatening illness or injury.
54: Pediatric medical priorities, 439

- Cardiopulmonary arrest in pediatric patients is primarily respiratory in origin.

- Mainstay of respiratory management is to ensure open airway and provide supplemental O2.
  - Signs of distress include tripod positioning, nasal flaring, head bobbing, and retractions.
  - Children in respiratory distress require supplemental high-flow O2 by mask at 12-15 L/min.
    - “Blow-by O2” may be useful in agitated/anxious children. BVM or CPAP if needed.

- The airway should be managed in the least invasive way possible. Transport upright whenever possible.

- Wheezing should be treated with albuterol regardless of suspected etiology. Also consider ipratropium, steroids, IV Mg, nebulized or IM epinephrine.
  - Keep on differential dx: bronchiolitis, aspirated foreign body and pneumonia.

- If respiratory distress with stridor, give nebulized epinephrine, can be repeated for ongoing distress.
  - Children receiving nebulized epi should be transported.

- In cases of bronchiolitis, albuterol may be ineffective. Frequent suctioning is key to maintain airway patency.

- Proficiency in pediatric BVM is mandatory for all prehospital providers. The breadth of available evidence suggests poorer outcomes with attempted prehospital pediatric ETI.

- Children with known cardiac lesions should only be given supplemental O2 needed to maintain their baseline O2 saturation, which is often lower than normal.

- ALTE: Most will be completely recovered by EMS arrival but should still be transported.
  - Blood glucose measurement
  - Scene size-up for any evidence of NAT
  - Causes include NAT, meningitis, metabolic disease, drug ingestion
  - Note: The term ALTE has been replaced by the American Academy of Pediatrics with BRUE – Brief Resolved Unexplained Event

- Seizures:
  - Blood glucose in all actively seizing patients, treat <45 mg/dL in neonates, <60 in infants and older.
  - Prehospital providers should focus on appropriate management and transport of pediatric seizures, not trying to diagnose the cause of the seizure. Many pediatric conditions can mimic seizures.
- **Shock**: Tachycardia is the key vital sign indicating compensated shock. Hypotension indicating decompensated shock is a late finding, and cardiopulmonary failure may occur within minutes.
  - Other signs of shock include skin signs of poor perfusion and altered mental status.

- **Tachycardia without fever, anxiety, or hypoxemia** requires immediate intervention.
  - Treatment begins with IV fluid bolus 20 mL/kg over 5-20 minutes, which may be best given using the push-pull syringe technique, can and should be repeated as needed. If cardiogenic shock suspected, give smaller boluses of 5-10 mL/kg. If suspected DKA, give 10-20 mL/kg bolus over an hour. Stop IV fluid resuscitation if pulmonary edema occurs.
  - IV access can be difficult. For an ill child, avoid prolonged scene time searching for access, consider limiting number of IV attempts prior to IO.

- **Cardiac Arrest**
  - Most pediatric cardiac arrest is the end result of respiratory distress or shock and treatment should focus on adequate oxygen and ventilation
  - Sudden cardiac arrest, mostly occurring during exercise, should be treated as in adults, with high quality CPR and early defibrillation. It is commonly caused by genetic mutations, anatomic anomalies and myocarditis.
  - Most pediatric OHCA occurs in infants and are unwitnessed. Favorable neurologic outcomes more common in adolescents and in those with witnessed arrests.
  - Initial rhythm in pediatric OHCA most commonly asystole 70-80%, followed by PEA and VF/V except in adolescents (VT/VF) or traumatic arrest (PEA).
  - Dose attenuator for AED recommended for children up to 25kg (approx. 8 years old). In infants < 1 year old, dose attenuator for AED may be used, but manual defibrillation is preferred. A regular AED should be used if nothing else is available.

- **Therapeutic hypothermia** has not been shown to be beneficial in pediatric arrest.

- **No model offline protocol for pediatric arrest field TOR exists. No reliable predictors of outcome have been identified to guide TOR protocol development.**
55: Pediatric trauma priorities, 450

- Traumatic injury is most common chief complaint among pediatric EMS calls, and the #1 cause of death and disability in children and adolescents.

- Due to smaller body size, multisystem trauma is more common in children. Internal injury cannot be ruled out by absence of external signs of trauma. Larger surface-area-to-mass ratio leaves children more vulnerable to hypothermia following trauma. Cover infant heads and warm ambulance during transport.

- Disproportionately large head means head trauma is more common and most serious cause of serious trauma.

- Must keep in mind pediatric airway anatomy considerations, which persist until about 8-9 years old. Larynx is more cephalad and anterior, cricoid pressure is often required to bring into view. The epiglottis is floppier.

- Injury risk of cervical spine given large head and relatively weak neck. Fulcrum is higher at C1-2 and injury can result in diaphragmatic impairment.

- Ability to increase cardiac output is almost entirely dependent on ability to increase heart rate. In young children, relatively small volumes of blood loss can result in hemorrhagic shock.

- Musculoskeletal system is more elastic and less likely to yield fractures. When they do occur, they are often in the epiphyseal-metaphyseal region because the ligaments are stronger than the growth plates.

- Significant internal chest & abdominal trauma can occur from blunt chest trauma without rib fracture. The mediastinum is highly mobile and a tension pneumothorax can move it significantly without kinking of the great vessels. The ribs are also more horizontally oriented, leaving the liver and spleen more susceptible to injury.

- Waddell’s triad: multisystem injury pattern seen in pediatric pedestrian struck mechanism.
  - Lower extremity (femur) fracture + blunt chest abdominal trauma + blunt head trauma

- Handlebar injuries from bicycle falls can cause occult intra-abdominal trauma (duodenal hematoma).

- Lap belt sign can indicate significant intra-abdominal injury (hollow viscus), and T/L-spine compression fractures. These injuries may have delayed presentation.

- Pediatric patients are often under-treated in terms of pain. Best evidence supports weight-based dosing of morphine (0.1 mg/kg IV) or fentanyl (0.1 ug/kg IV).

- Pediatric trauma resuscitation pitfalls include:
Failure to recognize early compensated shock (unexplained tachycardia or altered mental status)
Failure to suspect abdominal injury in polytrauma, even if no obvious external injury
Swallowed air with gastric distension can mimic visceral injury, impair ventilation (consider NG/OG tube)

- CDC Field Triage criteria updated to add modification to Step 1 criteria such that any patient requiring ventilatory support, regardless of respiratory rate, should be immediately transported to trauma center.
56: Technology-dependent children, 454

- Increasing proportion of children in America – 15% of all kids have special needs in 2013. Account for 81.7% of hospital days of all children at 23 hospitals in 2009.

- Some of the most common medical devices are gastrostomy/jejunostomy tubes, central venous catheters, medication nebulizers, VP shunts, and tracheostomies.

- Standard BLS care is adequate to care for most technology-dependent children during transport but consider use of pediatric-specific transport teams when appropriate.

- Children’s caretakers and parents are a vital resource, but still may provide incomplete information. Best practice is for EMS agencies to engage with local hospitals to facilitate preparation and information exchange for these patients. AAP and ACEP endorse use of standardized emergency information form.

- DOPE mnemonic: Dislodgement, Obstruction, Pneumothorax (airway) vs Peritonitis/Perforation/Pseudocyst (for G/J tubes or VP shunts), Equipment Malfunction
  - Rely on home equipment when possible. Bring all necessary equipment along when transporting.

- Tracheostomy:
  - Maintains the airway in a ventilator-dependent patient and preserves stoma integrity
  - Most common problems are dislodgement or obstruction. If connected to ventilator, pneumothorax or ventilator equipment failure are also possible.
  - Equipment includes suction & catheters, replacement trach & cannula (parents will often have these), and trach tape or other securing equipment.
  - If in distress, first attempt to BVM via trach or via mouth with trach stoma covered. Use drops of saline to attempt to break up secretions within the trach.
  - If trach needs to be removed, first slightly hyperextend head & neck, release trach ties, and deflate balloon. If replacing the same trach, cleanse it and ensure balloon is still functional. Using the obturator or soaking trach in cold water can ease re-insertion.
  - If replacement trach unavailable, use trimmed ETT. Use lubricant, obturator, and apply traction above & below stoma. If unable to pass, try a smaller trach or ET tube.

- Home O2: Transfer to ambulance O2 supply for transport, but make note of flow/FiO2/etc.

- Ventilators: Transfer to ambulance power for transport, but be sure to bring batteries. Leave on home settings if at all possible. If significant distress, hypoxemia, or high-pressure alarms, consider switching to BVM for transport. Consider DOPE mnemonic for high pressures and hypoxemia.

- G-tubes: Families often have replacement G-tubes, or same tube can be reused after cleansing and rinsing.
  - If mature stoma is open and without injury and G-tube balloon is still functional, attempt to insert. If the G-tube is in place but obstructed, attempt to flush with 5-10 mL of carbonated beverage.
○ Foley catheter can be used if replacement G-tube is unavailable. If high resistance, make attempt with red rubber catheter. If red rubber catheter is passed, then re-attempt with Foley or G-tube. If still unable, use red rubber catheter or smaller Foley. Inflate balloon and check placement with aspiration of gastric contents and auscultation of air insufflation.

- Vagus Nerve Stimulator: Can often be palpated near the patient’s clavicle. A magnet can be placed over the device to treat/prevent breakthrough seizure, but otherwise seizure care should proceed as usual.

- Cochlear implants: In general, should be left in place during prehospital care. Increased risk for meningitis, mastoiditis, and intracranial abscess.

- Ventriculoperitoneal shunts: Drains excess CSF from ventricle to peritoneum (can also drain into atria or pleura). May present with infection, malfunction (obstruction or broken tubing). Both can be associated with headache, fever, nausea/vomiting, altered mental status, and focal neuro signs. No real need for prehospital access to tubing.

- Central venous catheters: If currently in use, can be used by prehospital providers for emergency treatment if expeditious IV or IO access if not possible. Prone to bacteremia and sepsis.

- EMS should be proactive in identifying technologically dependent children in their local area and anticipating their needs should an emergency arise.
57: Approach to the geriatric patient, 460

- Normal Physiologic Changes of aging:
  -Diminished physiological capacity: decreased functional reserve in most organ systems, prolonged recovery periods

- Common changes in normal aging include:
  -Skin is prone to skin tears, pressure ulcers
  -Difficulty with temp regulation
  -Bone loss: increase risk of fractures, reduced spine flexibility
  -Reduced cardiac and pulmonary reserve
  -Decreased renal function & drug clearance
  -Decline in hormone levels
  -Decreased vision (cataracts) and hearing
  -Decreased muscle mass and strength

- Patient Assessment:
  -No change in initial steps (ABCs), still focus on finding and fixing life threats first
  -Medication history (dosing changes, compliance, OTCs), assessment of the patient's living environment and social history particularly important
  -Communication:
    -Do not assume patient is unable to communicate: always speak to the patient first and establish their level of understanding and participation. Strong, clear voice but avoid shouting
    -Ensure that patient has communication aids (hearing/vision)
    -Determine the baseline cognitive & physical functioning of the patient
    -Family can provide critical collateral information/context
    -Identify advanced directives and goals of care, health care proxy or durable power of attorney

- Geriatric medical conditions:
  -Cognitive impairment is very common. The Six-Item Screener is a validated instrument which can be used prehospitaly with good sensitivity & specificity for cognitive impairment:
○ **Depression** is very common & risk factor for increased use of services, death & disability.
○ The Patient Health Questionnaire – 2 (PHQ-2) is effective in identifying potentially depressed patients and can be used prehospitaly:

![Box 57.2 Six-Item Screener for cognitive impairment](image)

> Ask the patient to repeat three words after you: apple, table, and penny. If not repeated correctly, the test cannot continue.
> 1. What year is this?
> 2. What month is this?
> 3. What is the day of the week?
> 4. What were the three objects I asked you to remember?
> 5. apple
> 6. table
> 7. penny
> One point for each question answered correctly. Three or more errors indicate possible dementia.

Source: Callahan CM. Medical Care 2002;40:771–81. Reproduced with permission from Lippincott Williams & Wilkins, Inc.

![Box 57.3 The PHQ-2](image)

> Ask the patient:
> 1. During the past 2 weeks have you often been bothered by little interest or pleasure in doing things?
>   A. Not at all (0 points)
>   B. Several days (1 point)
>   C. More than half the days (2 points)
>   D. Nearly every day (3 points)
> 2. During the past 2 weeks have you often been bothered by feeling down, depressed, or hopeless?
>   A. Not at all (0 points)
>   B. Several days (1 point)
>   C. More than half the days (2 points)
>   D. Nearly every day (3 points)
> Scoring: Add the points from the two questions. A score greater than 2 indicates concern for major depressive disorder.

Source: Kroenke K. Medical Care 2003;41:1284–92. Reproduced with permission from Lippincott Williams & Wilkins, Inc.

● **Falls** are a leading & preventable cause of morbidity, mortality, and loss of quality of life

● **Medications and Drug Toxicity:** High risk of “polypharmacy” in this population. Obtain as complete a list as possible. Bring pill bottles (empty or full) and look for pill-taking strategies (pill boxes, calendars)

● **Altered Mental Status:** Delirium is common, especially among those with multiple underlying comorbidities, and can be precipitated by infection, medication effect/toxicity/overdose, trauma, etc. Extremely important to determine baseline mental status and neurologic function
• **Cardiac Arrest**: Half of prehospital OHCA patients are elderly. Overall poor survival from OHCA (< 10%). Consider Morrison’s field TOR criteria (unwitnessed by EMS, no AED shock [non shockable rhythm], no ROSC in the field), PPV 99.5% for BLS, PPV 100% for ALS

• **Trauma**: Older adults are less likely to receive trauma center care than younger adults with similar injury severity. Original CDC Field Trauma Triage Guidelines were not age-specific. The most recent revision includes a “Special Consideration” that patients > 55 should be considered for transport to a trauma center (not required). Elderly trauma patients are vulnerable to undertriage. Minor appearing injuries and reasonable vital signs often mask major trauma.

• **Social Emergencies**: Gaps in social support, caregiver crisis, or evolving family conflicts can be major underlying precipitants for acute decompensation in health status, hence the request for EMS

• **Medication & Alcohol Abuse**: Older adults misusing alcohol or drugs are often socially isolated; therefore, EMS providers may be the first to identify the problem upon interacting with the patient in their home

• **Elder abuse and maltreatment**: Elder mistreatment includes financial, psychological, physical & sexual abuse. Risk factors include social isolation, dementia and shared living with the abuser.
  o Characteristics of abuser: mental illness, alcohol abuse, dependency on the older adult
  o EMS providers may be mandated reporters of suspected elder abuse - varies by state. Regardless, an established protocol for reporting suspected abuse should be in place.

• **Caregiver distress**: EMS providers should make note of the state of the family/caregivers. Caregiver distress and burnout is a common reason or complicating factor in requesting emergency care

• **Special considerations** include specialized equipment (padded backboards, temperature control mechanisms, etc.), integration of the EMS and ED EMR systems, and increased vigilance regarding the medical and social situation of an elderly patient when considering refusal of transport

• **Nursing homes & assisted living facilities**: EMS agencies should coordinate with local long-term care facilities to improve access to patient records and necessary documentation when called to transport patients to the hospital. EMS should insist that nursing home records accompany the patient

• **Public Health**: The role of community paramedicine/mobile integrated healthcare programs in public health care of the elderly is an area of interest, but logistical/administrative, funding and care integration problems persist.
Section X: Special Considerations

58 Behavioral health emergencies, 469

- "A psychiatric or behavioral health emergency can be defined as an acute change in conduct that results in a behavior that is intolerable for the patient, family, or society."

- Overall little training for prehospital personnel.

- Do not try to make accurate diagnosis in the field. Protocols directed at treatment of symptom patterns. Scene safety first

- Rule out organic causes

- De-escalation attempted first, offer confidence and reassurance to the patient. EMS physicians being present can at times get patients to comply as they are viewed as an authority figure. Consider physical or chemical restraint when patient is uncooperative with assessment and alternative methods fail; in conjunction with law enforcement.

- For a patient to refuse transport they must have decision-making capacity, have organic etiology ruled out by reasonable field evaluation, no suicidal/homicidal/violent behavior, have a known psych history consistent with symptoms, and have some family/social/mental health support available. Many adult patients with new psychiatric symptoms will have organic etiology; transport should be encouraged (contact med control).

- NAEMSP and ACEP joint policy: important elements necessary for successful alternative transport destination include EMS medical director oversight, medical director-led program development/implementation/QI, and appropriate education.
  - Programs may result in 25% of patients being directly transported to psych ED’s with high sensitivity in detecting need for medical evaluation.

Suicidal Patient

- Passive suicidal ideation refers to thoughts without a plan.
- Active suicidal ideation refers to thoughts with a plan.
- Suicide gesture is an act of self-harm without expectation of death.
- Suicide attempt is an act with an expectation of death.
- Field activities include:
  - ensuring scene safety
  - empathic communication with the patient
  - directly asking about thoughts of self-harm (especially if patient reports or exhibits depression)
  - administration of benzodiazepines or neuroleptics when appropriate
  - proper restraint of the patient for safety (i.e., reducing risk of them jumping out of the ambulance)
  - knowledge of state/local statutes regarding involuntary transport.
• Acutely agitated patients must be approached with caution (scene safety) and high clinical suspicion (for organic etiology). Patient should be closely monitored for level of agitation and potential for violence. There should be good documentation to the patient’s level of agitation.
  o Organic etiologies to address include hypoxemia, hypoglycemia, and intoxication, head trauma, renal failure
  o Tactics:
    ■ Do not leave patient unattended
    ■ Do not let patient block exit
    ■ Remove objects from surrounding
    ■ Avid eye contact
    ■ Consider team approach with one responder acting as “negotiator” with adequate attempts to verbally de-escalate the patient. The negotiator should be calm and supportive and allow the patient to vent. A tacit “show of force” of the response team behind the negotiator can sometimes be enough to convince the patient to cooperate.

• Geriatric patients can pose challenges in balancing a patient’s autonomy with possible self-neglect and unkempt surroundings

Violent/Agitated Patient

• NAEMSP has position paper regarding patient restraint, which may be undertaken to prevent the patient, the public, or prehospital providers from harm.
  o The three methods are verbal de-escalation, physical restraint, and chemical restraint.
  o The least restrictive method which is safe should be employed.
  o Key principles from the position paper include personnel safety, patient dignity, methods of restraint, indications for restraint, documentation requirements, and medical oversight & quality improvement.

• The legal justification for physical/chemical restraint and transport against patient’s will is based on the professional judgment by the EMS physician in charge that the patient lacks capacity to refuse treatment & transport.
  o Medical oversight must be involved with these decisions. There is usually much less medicolegal exposure in transporting a patient deemed to be a threat to self or others than leaving that patient unevaluated.

• Project BETA Workgroup advocates for verbal de-escalation and identified 10 techniques including: respecting personal space, not provoking the patient, establishing verbal contact, being concise & simple, identifying wants & needs, using active listening, setting limits, offering choices, and maintaining optimism.

• Ideally 5 people on the “restraint team” -- one for each limb + one for the head & neck.

• The patient should be warned he will be restrained for his own safety and given one last chance to
cooperate. Two team members approach from front and behind. If the patient lunges to one side, the team members left behind can grab both arms, forcing the patient face-down to the floor by pushing forward across the team members’ legs. The patient should be restrained face-up in the stretcher with one arm by the head and the other to the side.

- Restrained patients require constant monitoring, and restraints should not be removed during transport. Chemical restraints should be considered if the patient continues to struggle. Patients should never be transported in a “hog-tied” or prone position. Typically, a good idea to have law enforcement officers present for restraint, transport, and searching of patient belongings, but they should not be able to dictate the evaluation and treatment of the patient.

- Chemical sedation employs the use of rapid tranquilization, usually in concert with physical restraint, in some situations in lieu of or prior to physical restraint.

- Ideal agent: Available IN/IM/IV, rapid onset, short half-life, limited respiratory depression, low side effects
  ○ Haloperidol most commonly-used neuroleptic at time of textbook publication. 5-10 mg IM/IV, onset 20 minutes IM, 5-10 minutes IV. Extrapyramidal symptoms (<10%) reverse with diphenhydramine.
  ○ Second-generation antipsychotics such as olanzapine may have decreased extrapyramidal symptoms but increased respiratory depression in intoxicated patients
  ○ Benzodiazepines are also commonly used, especially 0.05-1 mg/kg lorazepam or 0.05-0.1 mg/kg IV or 0.1-0.2 mg/kg IM midazolam. Drug of choice for patients with for ethanol or benzodiazepine withdrawal.

Pitfalls

- Big pitfall in all behavioral emergencies is failure to perform medical evaluation including physical exam, vitals, blood glucose.
- Scene safety is of utmost importance, EMS should not attempt to fight patient. Law enforcement officers should be called to secure the scene. EMS should also have proper PPE.
- Policies should be in place regarding on-the-job injuries sustained from violent patients.
- Lack of inter-agency coordination can often make risky situations worse.
59: Bariatric patient challenges, 480

- BMI = Weight in Kg/ Height in M; Overweight = BMI 25 – 29.9; Obese = BMI > 30

- Obesity associated with HTN, HLD, DMII, OSA, Cancers, CAD, CVA, Traumatic Injury

- Airway:
  - BMI > 26 independent risk factor of difficulty maintaining oxygenation with mask ventilation
  - Two-person bagging whenever possible.
  - Positioning is critical for management of airway and breathing. Place in fowler’s or semi-fowler’s position if assisting ventilation or breathing spontaneously. Consider ramp positioning for intubation auditory canal in line with sternal notch
  - Surgical airway challenging, landmarks often obscured. Cuffed ET tube is recommended over cuffed tracheostomy tube due to added length.

- Breathing:
  - High intra abdominal pressure decreases effect of diaphragmatic effort and decreases venous return. Weight on chest mimics restrictive lung disease.
  - Decreased lung volumes: decrease functional reserve capacity, expiratory reserve, and decreased lung and chest wall compliance.
  - Desaturate more quickly (smaller oxygen reserve but increased metabolic activity and oxygen demand).
  - Should sit patient in Fowler’s or ramped/semi-Fowler’s to displace soft tissue whenever feasible
  - Increase PEEP with NIPPV (start around 10 cmH20) but balance with predicted drop in preload
  - TV: still use lung protective 6-8 ml/kg, but based on ideal body weight (height)
  - 9.9%–35.4%
  - 9.9 - 35.4% of chest wall on that wouldn’t get decompression with standard needles in the Netherlands, 50% in the US with average size 4.5 cm and needle length 4.4cm.
    ▪ Some recommend increasing needle size to 6-6.5 cm after these results.

- Circulation
  - Increased circulatory volume, hyperkinetic system limits physiologic response to acute insult
  - Noninvasive BP measurement impaired due to extremity adipose
  - CPR: often less effective, mechanical devices may not fit. No current literature demonstrating negative effect of BMI on outcome from OHCA.
  - Venous access may be difficult, landmarks obscured, longer IV or IO needles may be needed
  - Drug dosing a challenge > lipophilic medications should be dosed according to TBW, while hydrophilic medications should be dosed according to IBW.
  - Medications in general more likely to have erratic absorption, longer onset, and prolonged duration.
Bariatric Surgery: reserved from BMI > 40 or > 35 with comorbidities
  ○ Short term complications: infection, delayed wound healing, PE, DVT, anastomotic or staple leak, postoperative hemorrhage
  ○ Long-term complications: SBO, gastric or small bowel ulcers, nausea/vomiting, band erosion or slippage, stricture, gastro-enteric fistula, internal hernia, dumping syndrome

Patient Packaging & Movement:
  ○ Most EMS stretchers are 23 inches wide/ support 550-700 lbs.
  ○ Bariatric stretchers are 29 inches wide, weight of 850-1600.
  ○ May need attachable wings. Stretcher should be kept at lowest position to minimize risk of tipping.
  ○ Immobilization devices (c-collars etc.) may not fit properly, be familiar with towels and alternatives
  ○ No fewer than four, and ideally six, personnel are used to move a loaded bariatric stretcher.
  ○ Hydraulic systems are usually used to put stretcher in ambulance.
  ○ Protocols for caring for the bariatric patient should be in place.
60: Intimate partner violence, 485

- Intimate partner violence (IPV) is a leading cause of injury to American women between the ages of 15 and 44 and is estimated to be responsible for 20–25% of emergency department (ED) visits by women.

- Risk factors include women of color, immigrants, disability, pregnancy, and those separated or divorced.

Cycle of Violence and Types of Abuse

- 3 phases of the cycle of violence: tension building, violence, and honeymoon phases
  - Now believed to be oversimplified and many survivors do not report these phases.

- Johnson Typology: Encapsulates all 4 types of IPV
  - Situational couple violence - episodic and context specific, emerging from emotional reactivity in everyday interactions
    - Less severe in nature, less likely to result in serious forms of physical injury, and less likely to escalate over time.
  - Coercive controlling violence- the use of physical violence by one partner to establish and maintain power and control over the other partner
    - Believed to involve more severe and potentially injury inducing forms of violence and to escalate in severity over time.
  - Violent resistance - one partner’s use of violence is motivated by a desire to enact power and control while the other partner is using violence primarily in self-defense, resistance, or retaliation.
  - Separation-instigated violence - relationships that were nonviolent until the point of separation. Separation-instigated violence is commonly perpetrated by the partner who is left.

- Evaluation of non-physical abuse or coercion can be assisted with the Duluth Power and Control Wheel, this is a resource that highlights nonphysical strategies that abusers may use to exert power over their victims.

- Many types of abuse: physical, verbal, emotional/psychological, sexual, spiritual, financial/material.

- IPV can have a range of health effects not just related to physical injuries of abuse.

EMS Considerations

- If EMS is activated for IPV, law enforcement should secure the scene before EMS entry.

- On-scene safety considerations include:
  - Avoid confronting the suspected abuser.
- Do not place yourself physically between a couple who are arguing
- Ensure that an escape route such as a door is available
- Do not let the suspected abuser get between you and your escape route

- **4 Rs** - Consensus guidelines to define an approach to the assessment and treatment of victims of IPV for EMS personnel
  - **Recognize** the indicators of IPV
    - Emotional, physical and situational risk factors to consider
  - **Respond**
    - Try to get a private area for question, try to separate from partner and children
    - ask about abuse and respond empathically to support the patient. This includes assuring confidentiality of anything they choose to disclose, being forthright about status as a mandatory reporter(if that's applicable), encouraging patients to talk, and using active listening skills (e.g., not forcing the conversation, allowing for silence and for strong emotions)
    - Should the EMS clinician suspect abuse based on physical or behavioral observations, use the observation in the question
  - **Refer**
    - Referrals should be made in a way that empowers the patient to make their own decisions. The person in the situation is the best judge of what is safe to do right now
  - **Record**
    - When creating a record of the interaction, it is important to create as clear a picture of the environment and the patient as possible
    - Preserve evidence
    - Documentation should be objective, without accusations or value statements, accurate, specific, legible, and complete.

- **Assessing Risk**
  - Relationship termination was found to be a significant predictor of domestic homicide
  - abuser’s access to a firearm, the abuser’s use of illicit drugs, the abuser’s use of controlling behaviors, previous threats with a weapon, and prior threats to kill the victim have all been found to significantly elevate the likelihood of fatal violence
  - Danger Assessment, a 20-item empirically validated measure [44]. This measure assesses four levels of danger (variable danger, increased danger, severe danger, and extreme danger)

- Safety planning - a process that is informed by risk assessment in which victims of IPV create plans to promote their safety

- **Trauma-informed practices**
○ The SAMHSA Model emphasizes four key aspects: (1) realization, (2) recognition, (3) response, and (4) resisting retraumatization.

○ Principles of trauma-informed work, including but not limited to safety, trustworthiness, transparency, collaboration, empowerment, and intersectionality

● Know if you as an EMS provider are considered a mandatory reporter in your state or region, this may be different than physician requirements.
61: Sexual assault, 493

Scope of the Problem

- Sexual violence is defined as any form of sexual activity with another person without her or his consent
- In the US, nearly 1 in 5 women and 1 in 71 men have been raped in their lifetime
- Drug-facilitated sexual assault (DFSA) is the term used to describe cases of sexual assault in which the victim is unable to consent or resist because she has been rendered incapacitated or unconscious due to the effects of alcohol and/or drugs
- Consent: an active (and ongoing) choice and constitutes a voluntary agreement between two persons of legal age to engage in sexual activity.
  - A person may withdraw consent at any point

EMS Considerations

- Maintain a professional, non-judgmental, calming demeanor
- It is important than EMS proceed on the presumption that an assault has occurred
- In cases in which DFSA is suspected, it is important that EMS document the patient's level of consciousness, affect, and any symptoms or signs of drug effects
- Genital and/or anal injuries can be difficult to visualize and therefore assessment of these areas should be left to a trained sexual assault examiner (unless life threatening hemorrhage exists)
- Evidence can be physical or verbal
- Chain of custody: If you collect evidence from scene or patient, avoid contamination
- Be familiar with your local mandatory reporting requirements
- Transport destination: Consider a center that includes sexual assault nurse examiners (SANE) and/or sexual assault response teams (SART), specially trained in evidence collection and medicolegal needs of a sexual assault patient
62: Child maltreatment, 498

Scope of the problem

- The majority of child abuse cases suffered from neglect (78.5%), followed by physical abuse (17.6%), sexual abuse (9.1%), and emotional or psychological abuse (9%)

Clinical Manifestations and "Red Flags"

- The most common manifestations of child abuse are cutaneous (bruising, burns, bite marks, etc.), though absence of external signs does not exclude abuse
- 10% of pediatric burns are secondary abuse
- Any mismatch with respect to history, a changing history, mechanism, appearance, and developmental level of the child should be documented

EMS Considerations

- Any child with suspicious injury should be transported
- EMS can provide valuable information about the scene and circumstances of the call
- It is preferable to talk with the child alone, but don't probe into details especially if reluctant
- All states require mandatory reporting of suspicions of child abuse - EMS providers are mandatory reporters, often sharing responsibility with hospital
63: Human Trafficking, 502

- Human trafficking is a major human rights and global health problem
  - 24.9 million forced labor victims and 15.4 million sexual exploitation victims globally.
  - $150 billion / year global industry.
  - U.S. citizens are not immune to human trafficking: a 2017 report from the National Human Trafficking Resource Center reporting more than 5400 cases of human trafficking reported 34.7% of sex trafficking victims as U.S. citizens

- Human trafficking is defined as a form of modern-day slavery.
  - “...the recruitment, harboring, transportation, provision, or obtaining of a person for labor or services, through the use of force, fraud, or coercion for the purpose of subjection to involuntary servitude, peonage, debt bondage, or slavery OR sex trafficking in which a commercial sex act is induced by force, fraud, or coercion, or in which the person induced to perform such act has not attained 18 years of age”

- Action-Means-Purpose (A-M-P) model
  - For Adults one element from each category must be present to meet the definition
    - Actions: induces, recruits, harbors, transports, provides, or obtains the victim.
    - Means: include force, fraud, or coercion
    - Purpose: either commercial sex (sex trafficking) or labor/services (labor trafficking).
  - A minor cannot consent to being bought or sold.
    - For minors under 18 years of age, any commercial sexual activity constitutes human trafficking, regardless of whether any of the means (force, fraud, or coercion) is present.
### Table 63.3 Environmental (scene) indicators of possible human trafficking

<table>
<thead>
<tr>
<th>Living or working setting</th>
<th>Environmental and physical</th>
<th>Behavioral</th>
</tr>
</thead>
</table>
| Any minor child (<18 yr of age) involved in sex work | High security measures, such as:  
* Opaque windows  
* Boarded up windows  
* Rented wire  
* Security cameras  
* Locks on outside of bedroom doors | Mentions new online or virtual behaviors or new groups of online friends |
| Patient or others not free to come and go at all | Large number of occupants in a living space | Avoids answering questions or lets others speak for him or her |
| Patient relates working excessively long hours or unusual hours | Insufficient safety equipment for the job (if work setting) | Appears frightened, resistant, or belligerent to law enforcement |
| Patient relates working without pay or only for tips | Large amounts of cash or sex paraphernalia present on-scene | Lies about age or identity |
| Patient relates lack of breaks or other restrictions | Abusive verbal or physical behavior by supervisors | Looks to others before answering questions |
| Patient lives and works on-site | Third-party (male or female) on-scene who insists on being present and/or translating | Does not ask for help or resists offers to get out of the situation (does not self-identify as a victim) |
| Patient lacks control over identification documents (ID, driver’s license, or passport) | Older male present-on-scene who is not patient’s legal guardian | Seems coached, especially in talking with law enforcement |
| Patient has few or no personal possessions | Mentions prostitution-related terms, such as “Daddy”, “the Life”, or “the Game” | Preoccupation with “getting money” |

**Table 63.6** Indicators associated with child sex trafficking

<table>
<thead>
<tr>
<th>Environmental and Physical</th>
<th>Behavioral</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child has unaddressed medical issues, or presents to EMS, ED, or clinic alone, or with an unrelated female</td>
<td>Mentions new online or virtual behaviors or new groups of online friends</td>
</tr>
<tr>
<td>No identification</td>
<td>Avoids answering questions or lets others speak for him or her</td>
</tr>
<tr>
<td>Sex paraphernalia</td>
<td>Appears frightened, resistant, or belligerent to law enforcement</td>
</tr>
<tr>
<td>Evidence of travel (living out of a car or in a motel, etc.)</td>
<td>Lies about age or identity</td>
</tr>
<tr>
<td>Travel to/from other locations, lack of knowledge of current location or travel plans</td>
<td>Looks to others before answering questions</td>
</tr>
<tr>
<td>Brands or tattoos, especially if reluctant to explain, or if tattoo matches other children’s tattoos</td>
<td>Does not ask for help or resists offers to get out of the situation (does not self-identify as a victim)</td>
</tr>
<tr>
<td>Large amounts of cash or prepaid credit cards</td>
<td>Seems coached, especially in talking with law enforcement</td>
</tr>
<tr>
<td>Hotel keys, hotel receipts or other hotel items</td>
<td>Uses prostitution-related terms, such as “Daddy”, “the Life”, or “the Game”</td>
</tr>
<tr>
<td>Multiple cell phones or electronic devices</td>
<td>Preoccupation with “getting money”</td>
</tr>
<tr>
<td>Items or appearance that do not fit current situation (e.g., homeless child with money, electronics, new shoes or clothes or with hair/tails done)</td>
<td>Knowledge or behavior outside typical range for age</td>
</tr>
<tr>
<td>Child has been recovered at hotel, truck stop, or strip club</td>
<td>Mentions online classified ads or escort services</td>
</tr>
<tr>
<td>Presence of overly controll or abusive “boyfriend” or older female</td>
<td>Mentions traveling job opportunities (e.g., modeling, singing, dancing, or magazine sales crew)</td>
</tr>
<tr>
<td>Multiple children with unrelated adult (male or female)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>EMS Clinician Barriers</th>
<th>Patient Barriers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lack of knowledge, skills or training</td>
<td>Lack of awareness of victimization (cultural factors, children and teens)</td>
</tr>
<tr>
<td>High EMS call volume, with insufficient time or mental capacity for establishing rapport</td>
<td>Lack of understanding of victim and legal rights</td>
</tr>
<tr>
<td>Incorrect assumptions about the familial relationships between the trafficker and the victim</td>
<td>Lack of identification documents or other records</td>
</tr>
<tr>
<td>Preconceived notions and stereotypes about the behavior of a trafficking victim</td>
<td>Fear of deportation, jail, foster home placement, or retribution against family members</td>
</tr>
<tr>
<td>Considering the patient as “just a prostitute” (implicit bias)</td>
<td>Distrust of health care professionals or law enforcement</td>
</tr>
<tr>
<td>Discomfort in asking sensitive questions</td>
<td>Shame, stigma, and helplessness</td>
</tr>
<tr>
<td>Privacy or HIPAA concerns</td>
<td>Trauma bonding with the trafficker or other victims</td>
</tr>
<tr>
<td>Limited education or literacy</td>
<td></td>
</tr>
</tbody>
</table>

64: Ethical challenges, 519

Refusal of treatment and transport

- **Autonomy**: individuals are assumed to have the right to self-determination, even if their decision will result in harm to themselves (or even death).

- Patient must have the freedom to act without undue influence from other parties, including family and friends and must demonstrate medical decision-making capacity:
  - Patient must have sufficient information about his/her medical condition
  - Patient must understand the risks and benefits of available options, including option not to act
  - Patient must have ability to use above info to make decision in keeping with his/her personal values
  - Patient must be able to communicate his/her choice

- Discussing with online medical direction helps to increase likelihood of patients agreeing to come to the hospital

- **Beneficence**: Providers should act to ensure the patient's safety and best interest, including if they believe patient lacks capacity or are a danger to themselves or others.

Triage Decisions

- Emergency Systems are designed to encourage best-use of scarce resources.

- EMS providers traveling en route to one patient should not make triage decisions ad hoc to stop for another patient. Instead, they should report in to dispatch what they are observing, and await instruction

- EMS personnel should not dissuade patients from seeking transportation for medical care. Exceptions would include specific protocols for alternate care/mobile integrated health, or under direct medical oversight. An EMS physician on scene may be able to “discharge” a patient from the scene.

Confidentiality

- All healthcare providers (including EMS) are subject to HIPAA and must maintain confidentiality. Exceptions to law include:
  - Criminal investigations
  - Suicidal or homicidal patients
  - Suspected elder or child abuse
  - Public health threat

Truth telling and Error Disclosure
• Disclosing mistakes to patients is important even if no harm was done
• Apology should accompany disclosure of errors

Personal Risk
• Risk cannot be completely eliminated
• Although EMS providers should act with the principle of beneficence, if patients or a scene present a direct risk to the team, EMS has an ethical obligation to not place themselves (or others) in danger

Treatment of Minors
• Minors (under age 18) are generally legally incapable of providing consent
• Emancipated minors include the following:
  ○ Married
  ○ Legally separated from parents
  ○ Pregnant or have dependent(s)
  ○ Armed Forces

• In certain US states, EMS may treat non-emancipated minors (over age 14) for certain conditions with their consent alone. These conditions include:
  ○ Mental illness
  ○ Substance abuse
  ○ Pregnancy or sexually transmitted diseases
  ○ Life-threatening circumstances

• Mature minor (usually over age 14) may be able to offer limited consent for his/her own care - though still preferable to involve parent/guardian(s)

• Minor care “emergency exception” (any age) - EMS can treat and transport minors with life threatening injuries/illness to prevent morbidity and mortality if parents/guardians are not present

• If an EMS provider believes a minor is in significant and immediate risk by parent’s medical decisions (to not treat), they can treat and transport under temporary protective custody
65: Death, dying, and end-of-life issues, 525

- The basic ethical principles on which modern medicine is founded include respect for patient autonomy, beneficence, non-maleficence, and justice. These should be applied to end-of-life considerations.

- Both ACEP and NAEMSP have position papers stating the recommendation for all EMS systems to have a policy that addresses response to end of life issues, documentation, and death in the field.

- Advance directive: written document, completed by the patient when he/she has decision-making capacity, expressing future wishes and/or appointing a surrogate decision maker.

- Grief support for family members is important for EMS to be able to offer. While family members often find EMS providers to be compassionate and professional, their most common complaint is having questions left unanswered by EMS.

- EMS providers often report feeling unprepared and stressed when delivering death notifications. Education and structured communication models have been shown to increase comfort level, confidence, and competence in delivering death notifications.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>Who completes</td>
<td>Patient</td>
<td>Health professional*</td>
<td>Health professional*</td>
</tr>
<tr>
<td>Who needs one</td>
<td>All adults</td>
<td>Person with advanced illness</td>
<td>Person with advanced illness</td>
</tr>
<tr>
<td>When they apply</td>
<td>Future time</td>
<td>Current time</td>
<td>Pulseless and apneic person</td>
</tr>
<tr>
<td>Guide EMS</td>
<td>Usually not</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Guide hospital</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

*After discussion with patient and/or surrogate decision maker and based on the patient’s goals and values

Figure 65.3 Comparison of advance directives, POLST, and DNAR orders.
66: Family and bystanders, 541

- Family communication is essential in EMS while still respecting patient privacy concerns.
- Understanding family dynamics help help to partner with the patient to facilitate the best care possible
- Even with family present, a patient retains rights of autonomy and privacy. A family member, just because of his or her relationship with the patient, is not automatically entitled to medical information regarding an ill or injured spouse and may not understand the legal ramifications involved.
- Cultural competency is important as well in understanding and navigating family dynamics. The family may not want the patient’s condition revealed to the patient him- or herself, such as in the case of late stage cancer, as seen in some Asian, Jewish, Italian, Navajo, Pakistani, and Hispanic communities [10] where cancer is seen as a curse and a social stigma
- Bystanders can be harmful or helpful depending on the situation.
- Lay bystanders can also be beneficial in providing CPR or recounting the history.
- The most challenging type of bystander to manage is often on scene physicians who are unfamiliar with EMS protocols and procedures. It is important to have a procedure in place to help manage physicians in the field.

Physician bystander, example protocol:

This EMS service would like to thank you for your effort and assistance. Please be advised that the EMS Professionals are operating under strict protocols and guidelines established by their medical director and the State of North Carolina. As a licensed physician, you may assume medical care of the patient, in order to do so, you will need to:

1. Receive approval to assume the patient’s medical care from the EMS agencies online medical control physician.
2. Show proper identification including current North Carolina Medical Board Registrations/Licenses.
3. Accompany the patient to the hospital.
4. Carry out any interventions that do not conform to the EMS agencies protocols. EMS personnel cannot perform any interventions or administer medications that are not included in their protocols.
5. Sign all orders on the EMS Patient Care Report.
6. Assume all medico-legal responsibility for all patient care activities until the patient’s care is transferred to another physician at the destination hospital.
7. Complete the “Assumption of Medical Care” section of this form below

Assumption of medical care

__________________________________________, MD; License 

(Please print your name here)
67: Analgesia, 533

- Prehospital pain protocols should mandate pain assessment, tools for pain measurement, indications and contraindications for pain management, pharmacologic and nonpharmacologic measures, patient documentation and monitoring before and after analgesia, and transfer of information to destination facility.

- Options for analgesia: Opioids (fentanyl, morphine, agonist-antagonists), nitrous oxide, ketamine, NSAIDs.

- Fentanyl is being used in more often in EMS systems because of its lack of histamine-releasing properties, short onset and offset, and lack of effect on cardiac contractility.

- Common pitfalls in prehospital pain management (and their solutions) include the following:
  - Waiting until arrival at hospital to give medication.
  - There is no standardized dosage of meds- consider use of weight-based protocols
  - Pain cannot reliably be gauged by facial expression/vitals. Ask patient, use interpreter if needed.
  - Cumbersome protocols (requiring base hospital contact for all pain management) may delay/deter delivery of medications. Instead protocols should permit initial, safe delivery of analgesia
  - Using inappropriate techniques for painful procedures, such as “walking through” or describing each step, may magnify the pain experienced by the patient. Instead, distract patient if need to perform procedure.
68: Point-of-care testing in EMS, 559

Introduction of POC testing into EMS has 3 sub-issues:

- Is the test valid & reliable? Does the reliability translate to rugged prehospital conditions?
  - No point in doing test when pretest probability extremely low or high
  - Validity = how well POC performs compared to lab version
- Will it make a difference to patients?
  - Will it change clinical action? Does the system allow for it? (system responsiveness)
  - CQI must be in place; performance measures must be defined a priori and be measurable.
  - Effect on scene times?
- Is it within scope & education of EMS professionals?
  - Require extra upfront and ongoing training

Regulations & Considerations

- Medical devices are in US are regulated by FDA. Clinical Laboratory Improvement Amendments (CLIA) sets standards for quality assurance & categorizes of POC tests based on how complex it is for the analyst to run it. CLIA categories include:
  - CLIA-waived – e.g. POC lactate using Lactate Pro device, home pregnancy tests, POC glucose, Urinalysis and fecal occult blood. Can be used without regulatory concerns.
  - CLIA – moderate complexity – majority (70%) of POC tests. Must be overseen by lab director (physician w/ lab training) or Technical & clinical consultant

- EMS personnel must have at least high school degree & documentation of satisfactory training
  - CLIA-high complexity – will not be used by EMS (regulatory barriers too high)
  - Not regulated by FDA-CLIA: non-invasive, breath tests, drugs of abuse, workplace monitoring (e.g. blood pressure) which can be used by laypersons

- Specific Examples
  - POC INR: expensive machine and individual tests, moderate CLIA complexity.
  - Troponin: very expensive, moderate CLIA complexity, chest pain triage (“studies have shown increased detection and improved access to definitive care particularly for patients with non-diagnostic ECGs)
  - Lactate: More affordable. Elevated lactate predictive of need for critical care
    - Trauma: detect occult hypoperfusion, trauma triage
    - Sepsis: sepsis screening protocols (coupled with prehospital notification, decreased mortality)
  - Capnography: viewed by many as standard of care. Can help with titration of ventilation, ET tube placement, ROSC-detection, and more.
  - Non-infrared cranial scanner: uses near infrared transcranial spectroscopy to detect ICH in adults & kids. Sensitivity 88.9% in EMS setting. May help with triage decisions.
Overview and Uses

- Can improve triage decisions
- Can help to avoid unnecessary procedures
- Expedites treatment to correct facility

Specific Examples

- **Trauma:** FAST exam to detect cardiac tamponade & intraperitoneal bleeding

- **Pulmonary:**
  - Evaluation for pneumothorax (absence of lung sliding)
  - Detect pulmonary edema to help distinguish between COPD vs. CHF (B-lines)

- **Cardiac:**
  - Evaluation for pericardial effusion/tamponade
  - Evaluation for cardiac activity in cardiac arrest

- **Abdominal & Obstetric:**
  - Evaluation for AAA or abdominal free fluid in patient with shock/hypotension
  - Evaluation for fetal HR when ambient noise high (i.e. air medical transport)

Protocol examples

- **PAUSE:** Prehospital Assessment with Ultrasound for Emergencies (heart/thorax)
- **CAVEAT** (*designed for military*): chest for pneumothorax, hemothorax, and pericardial tamponade, abdomen for FAST, IVC for volume assessment, targeted extremity for fracture.
Emergency Medical Services

Clinical Practice and Systems Oversight

Volume 2: Medical Oversight of EMS
Section I: Principles of Oversight and Design

70: Medical oversight of EMS systems, Textbook Page 3

- Importance of EMS systems oversight:
  - Ensures the quality and safety of EMS care.
  - Monitors and evaluates EMS systems to identify areas for improvement.
  - Ensures that EMS providers are following evidence-based practices.

- Role of EMS medical directors:
  - Responsible for ensuring that EMS providers are competent.
  - Provides guidance to EMS agencies on how to improve the quality and safety of their services.

- Types of EMS systems oversight:
  - External: conducted by entities outside of the EMS system, such as state and local governments or professional organizations.
  - Internal: conducted by entities within the EMS system, such as EMS agencies or EMS medical directors.

- Key components of an effective EMS medical directorship:
  - Clear understanding of the EMS system.
  - Ability to provide guidance and support.
  - Authority to make decisions.

---

**Box 78.1 Qualification of an EMS medical director**

Preferred qualifications of an EMS medical director:
- Board certification in EMS medicine
- All of the criteria of the minimum qualifications list below

Generally accepted minimum qualifications of an EMS medical director:
- State licensure to practice medicine or osteopathy
- Board certification or preparedness in an appropriate specialty (emergency medicine desirable)
- Familiarity with state/local/regional EMS activities
- Training and/or experience in the clinical practice of EMS, EMS medical direction, and EMS research (EMS fellowship and EMS subspecialty certification desirable)
- Knowledge of all components of the EMS system and any relevant laws, regulations, policies, and plans including:
  - Emergency medical dispatch
  - Operations
  - Education and continuing medical education
  - Quality assurance and quality improvement
  - Mass casualty incident/disaster response
  - Labor relations, management, and fiscal oversight
  - Public health, wellness, and prevention
  - Concepts of EMS specific occupational injury/illness and fitness for duty
  - Involvement in local/regional/state/national EMS organizations

Box 70.2  Authority, support, and resources required by an EMS medical director

**Authority to**
Grant, suspend, or revoke the authority of EMS clinicians (with due process) to practice under the medical director’s oversight
Approve any new medical equipment for the agency/system prior to purchase
Implement or manage clinical protocols in accordance within all applicable laws and regulations (including emergency medical dispatch and any clinical first response activities)
Conduct quality assurance and quality improvement (including emergency medical dispatch)
Establish continuing medical education requirements to address local and quality improvement issues
Oversee all patient care via access to all available data and records, including downstream information from hospital systems
Respond to the field for direct medical oversight and patient care as appropriate

**Supported by administration to**
Interface with local leaders
Suggest new or different equipment when appropriate
Provide input on operational and budget issues that affect patient care
Designate base stations, trauma, and specialty centers
Serve as the medical liaison with the community, state, and national organizations

**Resources**
An equipped response vehicle (when appropriate)
Unrestricted access to local databases and information platforms
Communications equipment (radios, tablets, navigation systems, etc.)
Medical supplies and equipment
Personal protective equipment
Office space and administrative support as appropriate
Compensation sufficient to fulfill the role
Liability coverage for administrative acts and malpractice

**Position within the organization**
An appropriate title (medical director or preferably chief medical officer)
A rank, or position within the organization, that is equivalent to the position responsible for operational oversight and decision making (service director, fire chief, etc.).

Box 70.3  State and federal laws that may affect an EMS medical director
- State EMS laws enforced by the state office of EMS
- State and federal laws on controlled substances enforced by the U.S. Drug Enforcement Administration and states
- Laws on Medicare reimbursement, fraud, abuse enforced by the Centers for Medicare and Medicaid Services (CMS) and the U.S. Department of Justice
- Clinical Laboratory Improvement Amendment—requires either a certificate or waiver to use glucometers and perform other diagnostic tests enforced by CMS and states
- Civil rights laws and laws related to the Health Insurance Portability and Accountability Act and the Health Information Technology for Economic and Clinical Health Act addressing health information—enforced by the U.S. Department of Health and Human Services
- Food, Drug, and Cosmetic Act—regulating medications and medical devices—enforced by the U.S. Food and Drug Administration
- Occupational and Safety Act—enforced by the Occupational Safety and Health Administration and states
- Various civil rights and antidiscrimination laws enforced by the U.S. Equal Employment Opportunity Commission
- Airline Denegation Act—prevents states (and locals) from regulating the rates, routes, or services of air medical services—enforced by the U.S. Department of Transportation
71: Principles of EMS system design, 16

- EMS system design should optimize clinical and service quality with resource use efficiency.
- EMS systems are beginning to offer non-emergency care at the scene as a distinct service line
  - Match community demands- most medically related 9-1-1 calls are not emergencies
- New Payment Models
  - Payment for on-scene care without transport or to transport to alternate destination (ET3)
  - Post-acute care offerings from EMS
    - Post-discharge monitoring, follow up visits
- Key areas of system design: clinical quality, service quality, economic efficiency, accountability, improvement and resilience.

National standards for ambulance design in the United States are described in the *Federal Specification for the Star-of-Life Ambulance* (KKK-A-1822) and NFPA 1917 *Standard for Automotive Ambulances*

Ground ambulance vehicle types: pros and cons

<table>
<thead>
<tr>
<th>Vehicle type</th>
<th>Pro</th>
<th>Con</th>
</tr>
</thead>
</table>
| **Type I:** box on truck chassis. Cab remains, cargo module replaced with patient compartment | Longer service life  
Pt compartment lasts longer than cab- can replace/reuse | Difficult to navigate through congested areas  
Less fuel efficient |
| **Type II:** van chassis without box | Agile (smallest of the 3 types)  
Good fuel economy | Shorter service life  
No option to remount new cab module like type I or III |
| **Type III:** box on van chassis | More agile than type I  
Longer service life | Less(ish) fuel efficient |

- Delivery settings affect ideal system design:
  - Single vs multiple ambulance service providers - multiple more expensive due to redundancy of services, e.g. dispatch, but competition within market can drive quality
    - Can get around this with *allocation of ambulance service market rights*
  - Separation of emergency vs non-emergency ambulance service
    - Government (fire dept) takes emergency, private companies take non-emergent.
      - Consider- if non-emergent is profit generating, and emergent is a net loss- might benefit community to retain non-emergency market rights to cover cost of emergency services
- All ALS vs BLS +
  - Benefits of all ALS: never have to worry about undertriage
  - Downside: Frequency of, and experience with, high-stakes procedures are diluted.
  - Due to expanded scope of AEMT, justification for ALS at all is somewhat under fire
• Tiered systems:
  ○ First response unit (non-transport) + ambulance
    ■ Ambulance may be busy or First response unit is closer
  ○ **Dual or simultaneous response system:** send both ambulance and first response unit at same time
    ■ Pros: (covers worst case scenario) closest available unit arrives on scene ASAP
    ■ Cons: (Most 9-1-1 calls are not "real" emergencies)
      ● Medical first-response units end up on low acuity calls - may not add significant value prior to ambulance arrival
      ● Increased operating costs of first-response agency- needing to cover all ALL calls
      ● Decrease availability for medical first response unit's primary (fire or law enforcement) mission
    ■ Consider appropriate triage process performed by trained dispatch center as option to use first-response units in a more discriminating manner

• Hospital destination policies:
  ○ “Testable” see regionalization chapter.
  ○ Patient should go to the closest hospital equipped to provide the care needed, while honoring patient requests for specific facilities when reasonable and able.

• Rural Systems
  ○ Variable funding
    ■ Taxes vs subscription model vs volunteer
    ■ Small population = low tax base = difficult to afford expensive technology
  ○ Creative response configurations
    ■ Respond from work or home - meet ambulance at scene
    ● Can reduce response time
  ○ Tiered response
    ■ BLS first → ALS intercept (in non-transport vehicle)
  ○ Challenge of overlapping calls
    ■ If there is only 1 unit - they have a long transport to nearest hospital, and another call comes in- there will be challenges
    ● Increased responsibility of medical first responders to manage 2nd call
  ○ EMS education can be more difficult in rural areas (especially for volunteer run agencies)
    ■ Consider evolving and improving online/ distance learning modalities as an important new development
  ○ **Rural paramedic paradox** - heightened need for ALS care in areas least resourced for it (far away from receiving, few providers) due to low call volume, low funding
  ○ Rural Paradox in delivery of mobile integrated health care services- increased need due to gaps in healthcare service availability, but lack of funding constrains the rural system in implementation.

• Important to understand response volume by time of day and day of week, geographical location of responses, use algorithm to locate resources.
Two models of EMS:
- Anglo-American: Non-physicians to staff EMS units, "scoop and run:"
- Franco-German: physician-staffed and more emphasis on on-scene stabilization "stay and play"
- Netherlands as a hybrid example
  - No physicians in the field, but paramedics are critical care nurses with extra paramedicine training. Can both "stay and play" and "treat and street"

Provider organization
- **Fire Dept**: good structure in place for response, cross training burden is low. Less fires with time make it a logical justification to keep funding flowing to the FD. Can integrate medical care into rescue operations
- **Law enforcement**: rare. Police, like fire, have the infrastructure for response, but police agencies have a rising demand for base duties.
- **Third Service** (municipal EMS): most common in large urban/suburban settings. Focused only on patient care (vs fire or police). Financially less efficient than fire/police-based service. Can lead to culture clashes as first response usually provided by different agency (Fire).
- **Private** (includes hospital-based and nonprofit): Single focus, competition over contracts may improve quality; business profit goals, however, may clash with patient care goals.

Deployment
- **Static deployment** - Response units are positioned 24/7 in station locations chosen strategically based on historical patterns of call locations and call timing. This is most commonly used by fire and municipal EMS services. Comfortable staff and garaged vehicles
- **Dynamic deployment** - uses geographical and temporal historical or real-time data to determine how many units are needed to be available for that hour. Different tables may be generated for different months of the year or for special events. Fewer hours of service from response units (called unit hours) are needed to provide the same level of response time performance compared to a static deployment strategy. Cost efficient but leads to burnout.
- **Hybrid deployment** uses combination e.g. some fixed stations along with some posts at key intersections. Crews can be rotated to station posts for a break.

Emergency medical services provider organizations should be held accountable for meeting fair and meaningful performance standards.
- Historically, standards have focused on response times (limited evidence for this!)
72: Emergency care regionalization, 32

Definitions:

- **Regionalization**: Coordinated system of care across a geographical area that combines all necessary components to optimize patient outcomes. Goal to facilitate provision of quality care and ensure overall economy of the system- may improve patient outcomes in STEMI, trauma, stroke

- **Categorization**: Classification of facility capabilities against accepted standards.

- **Designation**: The formal selection of a facility for specialty patient referral by an organization that is legally authorized to do so.
  - This process ensures that categorization is accurate and that facilities meet minimum standards for the level of specialty care they claim to provide.
  - The designation process must be overseen by an appropriately empowered lead agency.
    - Authorization for oversight is typically granted to a lead agency through enactment of state or municipal laws and regulations.

- **Time-critical diagnosis (TCD) system**: Based upon the concept that a coordinated, integrated emergency medical care system can be used to treat conditions whose outcomes *truly* depend on the timeliness of intervention and transport.
  - Seeks to *avoid the creation of three separate systems* (stroke, trauma, and STEMI) within a state or region, since the individual components of the system (EMS, local and regional hospitals, and various bureaucratic and oversight entities) play essential roles for all of these clinical cases.
  - It is more appropriate and cost-effective to coordinate all the critical cases within the emergency medical care system under a common banner of time-critical diagnosis.
  - This allows resource sharing and coordination and decreases duplication.

- **Bypass**: the emergency medical care system structure for transporting agencies that have identified patients falling into certain clinical categories to be transported to the appropriate facility for the condition, even if it is not the closest.

- **Diversion**: an act taken by a hospital/facility that informs field providers that transport to that facility should not occur. Can occur if internal disaster (power outage, fire, active danger) or when the patient traffic in an emergency department is of such a magnitude that additional EMS traffic could endanger current/incoming patients. *Routine diversion leads to worse patient outcomes and prolongs prehospital portion of care.*
Federal support and legal precedence (US)

- Antitrust and Designation - issues and legal precedent
  - Designation creates de facto monopolies, as it restricts the number of facilities allowed to participate within a given system by requiring that certain standards of care be met prior to participation
    - Unauthorized designations expose agencies to risk of liability for violation of the Sherman Antitrust Act
  - Explicit statutory authority affords the greatest protection to a designating agency against antitrust liability.
  - *Huron Valley Hospital Inc. v. City of Pontiac*, the court held that, “[State] regulatory actions within the ambit of valid legislation . . . are exempted from the antitrust laws under the ‘state action’ defense”
  - Governmental agencies with “implied” powers may be considered to be outside the scope of the antitrust laws

- Public Law (PL) 101-590 Trauma Care Systems Planning and Development Act --supports regionalization
  - Total of $5 Million in 1992, well below earlier projections
  - Primary goals
    - 1) remove barriers to regionalization
    - 2) provide incentives/grants to support systems
  - Trauma centers with specialized physicians and equipment immediately available on a 24-hour basis. Also required methods of prehospital identification of severe trauma victims.
  - This law addressed the issue of authority, diminishing the threat of legal challenges of designation, but financial burden of innumerous uninsured patients and inadequate reimbursement rates still presented a great barrier to regionalization

- HR 727- Trauma Care Systems Planning & Development (TCSP&D) Act Amendments passed in 2001 and in 2007, gave additional funding. Regionalization slipped from fiscal federal support back to state and local level

Regionalization considerations

- An agency must be identified with legal authority to oversee the political and administrative processes

- Oversight committee must allow stakeholders input for design and refinement of system processes

- Without federal dollars and legal authority, plans for regionalization through facility designation usually fail.

- Organizational silos need to be acknowledged and resolved. Leadership focused on improving patient outcomes through decreasing the time from symptom onset to definitive care is the key to bridging the gaps between provider groups.
EMS medical directors should ensure that their personnel appropriately identify stroke and STEMI candidates. Important to monitor system for overtriage decisions and minimize whenever possible, i.e. through initial and continued education based upon quality improvement benchmarks.

Simultaneous processing (figure 72.2)

- Usually in emergency care, evaluation and management occur in a **sequential process** (first A, then B, then C).
  - In early days this is how trauma, and other Time critical presentations were approached.
  - This can lead to inherent delays in care when compared to an approach of simultaneous processing.
- Simultaneous processing is a key consideration in the design of any regionalized system.
  - concurrent activation of multiple resources
  - Ex: paramedics giving a “trauma alert” - concept of “field activations”
Telemedicine and emerging telecommunications, 43

- Telemedicine/telehealth definition: the use of medical information exchanged from one site to another via electronic communications to improve a patient's clinical health status - includes teleconsultation, tele-education/tele-mentoring, telemonitoring, and telesurgery.

- Transmission of information can occur in real time (synchronous) or be interacted with at a later time (asynchronous or store-and-forward).

- Tele-Cardiology
  - Sending EKGs, cath lab activations
  - Prehospital thrombolytics for rural STEMI

- Tele-stroke
  - Tele-neurologist
  - Improved time to treatment
  - No morbidity improvement
  - Mobile stroke units with CT not cost effective

- Refusals
  - Improving on radio or phone discussions
  - Video options improved situational guidance in DMO

- Community Paramedicine and Tele-monitoring
  - Monitoring vitals
  - Discussion with on scene paramedics for hospital at home

- Telementoring/telesurgery
  - Airways, US
  - Transmitting video to assist with procedures
  - Initiated by tele surgery in the military
  - Applicable to tactical EMS now with telecommunication to trauma centers giving a better idea of injuries and guide interventions pre-hospital.

- Disaster Applications
  - Tele monitoring, electronic tagging and charting rather than redundant paper charting.
  - Transmit live data to incident command laptop with vitals and triaging.
  - Telemedicine for more available physicians to oversee disaster care.
74: Interfacility transportation, 50

Level of Care: Sending physician responsible for choosing type/level of transport

Must take into account total transport time AND “Out of hospital time” (1 hr ground transport vs 40 min delay and 20 min air transport time- the latter has less out of hospital time)

- Interfacility transport is increasingly relevant as care becomes more regionalized.
- Types of transport: nonmedical (e.g. POV, cab), BLS, ALS, Critical Care, Specialty care (e.g. neonatal, ECMO)
- Hazards of Transfer: lights and sirens for ground; assoc w weather and air traffic for air.
  - Volatile gatherings
    - Be aware- damage to vehicle and delay of care- consider air transport in these situations
  - Disasters
    - Natural vs infectious disease disasters - unique hazards of individual disasters should be considered - coordinate with local and regional experts
- Helps to have multiple medical directors due to complexity of specialty care needs, direct medical oversight/control less common. Primary medical oversight is the responsibility of the sending facility.
- Legal issues: EMTALA, which provider is responsible for patient during transport (sending physician), ride-along risks, deaths en route.
- EMTALA: Sending physician must perform medical screening exam (to determine if the patient is stable or in active labor). If the patient is unstable or in active labor then the hospital is obligated to provide care (regardless of the patient's ability to pay) until stability has been achieved or active labor has resolved.
  - Exceptions i.e. can legally transfer an unstable patient or a patient in active labor if:
    - Patient requests transfer, after being fully informed about the risks and benefits
    - Sending hospital is unable to provide a service that the patient urgently needs; the hospital has found a hospital that can provide the needed care and explicitly agrees to accept the patient; and the patient consents to the transfer after being informed of the risks and benefits of the transfer.
    - A woman in active labor = unstable and can be transferred only “when the expected benefits outweigh the risks of transfer”
  - Accepting physician does not have to be MD, but may be e.g. charge nurse for burn unit ICU.
- Trauma - systems should have considerable overtriage, but in more rural locations, patients may go to lower level hospital
  - Spinal injury: transfer for cord injury; rarely time-sensitive but may help other injuries if polytrauma
• Cardiac - goal to minimize door to balloon time, also for LVAD, ECMO, etc.

• Neurologic - stroke center vs. comprehensive stroke center
  ○ Stroke patient’s outside tPA window may still benefit from transfer to stroke center (although not as time critical).

• Pediatric or neonatal patients - account for a disproportionate number of transfers

• Burns - immediate life threats include volume depletion, infection, airway and polytrauma, CO and CN; other complications develop slowly

• Obstetrics - almost always for fetus
  ○ “The most reliable indication that delivery will occur soon is cervical dilation of >4cm”
  ○ Fetal distress warrants C-section prior to transport
75: Air medical services, 58

Different models of Air medical:
- European/Japan-led by specialist physicians, on-scene care + ground transport
- United States-(reimbursment is tied to transport) the predominant model is a nurse/paramedic team with an associated advanced scope of practice for both scene response and interhospital transport.

History:
- 1915: Military early air evacuation of sick.
- 1972: first hospital-based helicopter program
- 1992: 220 air medical services (AMS) in US
- 2007: 312 AMS with >800 choppers and 282 fixed wing
- 2012: 302 AMS with 946 choppers and 314 fixed wing
- 2002 CMS national ambulance fee schedule increased helicopter reimbursement while ground specialty care transport is reimbursed at much lower rates.

- Accounts for 2% of all ambulance transports in US.

- HEMS distribution of services: Interfacility 54%; Scene runs 33%, Other mission 13% e.g. transplant.

- 4-10x more expensive than ground.
  - 84% of costs of AMS go to fixed/equipment (opposite of ground EMS breakdown).
  - Must transport patient in order to bill for services

- 20% of the population estimated to need HEMS to achieve timely access to “get where they need to be”

- Factors that have affected AMS growth:
  - Closure of EDs
  - Reduction in Level I and II Trauma Centers
  - Reduction in Specialist Availability, esp. rural, esp. NSG
  - Continued concentration of specialists in urban areas
  - Closure of rural hospitals
  - Overcrowding and diversion
  - Expensive in comparison with ground ambulance

- Integration of AMS within EMS systems has been problematic.
  - Currently, HEMS is “more tied to market forces than healthcare planning”
  - Centers for Medicare and Medicaid Services (CMS) as a result of the 1997 Balanced Budget Act significantly increased reimbursement for helicopter transport
  - 2007 consensus document between NAEMSP, NASEMSO, and AAMS suggests course of action
● Outcomes: fairly convincing data that flying a patient to a far-enough-away trauma center is beneficial.

● At this time the literature support for primary air transport of non-injured patients is limited to logistical considerations.
  ○ Usually n is too small to show benefit.

● Possible HEMS benefits to EMS system:
  ○ Extension of Advanced Level of Care through region,
  ○ Provision of ALS “Backup” for parts of an Ems system with limited coverage
  ○ Minimization of transport times
  ○ Direct Transport to specialized centers,
  ○ Transport flexibility in overloaded hospitals
  ○ Ability to perform unusual and ad hoc activities. Providers can provide critical care

● IOM recommends that states assume regulatory oversight of all aspects of AMS.

● FAA oversight—FAR 91 and 135—commuter and on-demand aircraft. Govern things like pilot rest, training, rules to follow in different airspace, etc.
  ○ Final say defaults to certificate holder (i.e. safety over medical mission).
  ○ State licenses AMS as ambulances, but states have no jurisdiction. FAA regulates aviation aspects

● Airline Deregulation Act of 1978: Federal Preemption to state regulation of interstate commerce—limits state regulatory efforts requiring aircraft specific equipment, hospital destinations, certificate of need and CAMTS accreditation requirements.

● Increase in accidents and opaque service quality → CAMTS formed to devise voluntary standards. Now 21 participating orgs and 154 air and ground services.

● Aircraft issues:
  ○ Helicopters: shorter distances but more mobility.
  ○ Fixed wing: longer distances but must land at airstrip—limited use. if truly emergent they can fly in more inclement weather and from more rural locales.
  ○ Space: limited-most aircraft up to two patients and two caregivers. Weight of providers, patients and equipment taken into consideration
  ○ Hearing: loud—need headsets. Communication in advance critical
  ○ Lighting: esp. at night. NVGs in wide use.

● Electronic medical equipment—untoward effects on navigation systems. Must be certified equipment for use in air. Must test in advance.

● Operational challenges: Visibility, freezing precipitation, ambient temperature, landing zones, HazMat.
Special capabilities:
  - Difficult Access Areas, Aerial Rescue, Aerial Reconnaissance (incident scene), Search, Aerial lighting, MCI, Mass gatherings, Go Teams, Hi-Rise Aerial Teams.
Section II: Human Resources

76: EMS personnel, 77

- Emergency Medical Services Systems Act of 1973: first formal national initiative supporting EMS in the US.

  - Regulation is only defensible as it is *in the interest in public protection*

- The competency standard should not change by state, demographics, geography, rurality, agency type, or renumeration status of the individual being assessed. *Same for volunteer or paid.*

- 2019 National EMS Scope of Practice Model
  - Goal to serve as legal and ethical obligations of the states to ensure delivery of EMS care is supplied by qualified individuals
  - Standardization of minimum education and practice, still able to adjust state by state for needs of the community.

- Scope of practice
  - Legal description of the distinction between licensed HCP and lay public and definition of domains of practice between levels.
  - Authority vested by the state
  - Establishes which procedures and activities clinicians can do in the given state, defines tasks and roles that licensed personnel are legally authorized to perform.
  - Differs from standard of care as it focuses on clinician rather than care in a certain situation
  - Currently does not address the IFT specialized domain or the mobile integrated healthcare realm
  - One must be educated, certified, licensed, and credentialed to perform a skill or role

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Scope of practice</th>
<th>Standard of care</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deals with the question “Are you/were you allowed to do it?”</td>
<td>Acts of commission by an unlicensed individual is a criminal offense</td>
<td>Deals with the question “Did you do the right thing, and did you do it properly?”</td>
</tr>
<tr>
<td>Act of commission by an unlicensed individual</td>
<td>Acts of commission or omission may lead to civil liability</td>
<td></td>
</tr>
<tr>
<td>May vary from level to level; does not vary based on circumstances</td>
<td>Situational; depends on many variables</td>
<td></td>
</tr>
<tr>
<td>Established by statute, rules, regulations, precedent, and/or licensure board interpretations</td>
<td>Determined by scope of practice, literature, expert witnesses, and juries</td>
<td></td>
</tr>
<tr>
<td>It's difficult to regulate knowledge through scope of practice.</td>
<td>Used to evaluate the totality of circumstances. What would a reasonable EMS person do in the same or similar circumstances?</td>
<td></td>
</tr>
</tbody>
</table>


- Regulation
  - state's right to protect the public
  - REPLICA - Recognition of EMS Personnel Licensure Interstate CompAct
    - allows for deployment across state boundaries. 20 states enrolled as of 2020
Licensure - process by which a gov agency grants time limited legal authority to an individual to engage in a given activity or occupation after verifying they have met predetermined standardized criteria through certification

- Makes it illegal to engage in activity without a license
- Makes it illegal to present as a qualified person to the public if unlicensed (title protection)
- Greatest for of public protection and most restrictive form of professional credentialing
- State by statute defines scope of practice
- AKA "practice acts"
77: Protection of EMS personnel from occupationally acquired infections, 86

CDC Guidelines
- Universal Precautions (1985)
  - Applies to all moist body substances except for sweat, including mucous membranes and nonintact skin
  - Body Substance Isolation (1987)
- Standard precautions (1986)
  - Include hand hygiene
  - Updated to include respiratory hygiene (cough etiquette) (2007)
- Isolation precautions
  - Airborne, droplet, and contact.
- OSHA Regulations
- 1991- workplace protections for blood borne exposure
  - PPE, engineering controls, training, and immunization against hepatitis B
- The Needlestick Safety and Prevention Act (PL 106–430, passed by the U.S. Congress in 2000)
  - Compelled OSHA to revise this Bloodborne Pathogens Standard
  - 2001 revision. Needlestick and Other Sharps Injuries: Final Rule,
    - Needleless systems and other innovations to decrease the risk of injury while performing medical procedures,
    - Documentation of employee involvement in determination of the risk of exposure
    - Maintenance of a sharps injury log detailing each incident, the type and brand of device involved.
- Ryan White Act (1990) - need ICO infectious control officer. Exposures often go unreported (40-80%)
  - Two situations mandating reporting by health care facilities
    - Emergency Response Employee (ERE) believes an exposure has occurred
    - When the health care facility identifies one of the listed infections in a patient that was potentially infectious when they were cared for by an ERE.
  - health care facility is obligated to make one of the following determinations with respect to the ERE involved:
    1. The ERE has been exposed to a listed pathogen based on
      - (a) The mode of transmission and the ERE’s contact with the patient AND
      - (b) The identity of the infectious agent has been confirmed through laboratory or clinical data.
    2. The ERE has not been exposed to a listed pathogen based on
      - (a) The mode of transmission and the absence of a credible ERE exposure to infectious material OR
      - (b) There is sufficient information to conclude that the source patient did not have a listed infection.
    3. The medical facility does not know whether a putative source patient had a listed infection at the time of a suspected exposure.
      - (a) If the source patient was transported and/or treated by the medical facility for an unrelated medical condition, the patient may not have been tested for potential, occult infection.
      - (b) This determination should be revised appropriately if the medical facility acquires additional information relevant to the exposure.
    4. The facts of the potential exposure incident are insufficient for the medical facility to determine the plausibility of significant exposure.
NFPA standards

- **NFPA 1582 (Standard on Comprehensive Occupational Medical Program for Fire Departments)**
  - Medical evaluation of candidates for firefighter positions and fitness for duty determinations for members of fire departments.
  - Requirements for screening and surveillance for occupationally acquired infectious diseases and requires immunization of members according to current CDC recommendations

- **NFPA 1581 (Standard on Fire Department Infection Control Program)**
  - Outlines the duties of a departmental infection control officer as defined in Ryan White legislation

- HBV Vaccine now essential for providers: 3 doses then check titers.
  - If non-responder to vaccine, needs boosters then check the titers again.
  - If still non-responder, must be aware of status, as may need HBIG if exposed.
  - Need waiver if refused before first patient contact.
  - Remember universal precautions or Body Fluid Isolation "BSI"/hand hygiene/respiratory hygiene paramount for all patient encounters.

- Anthrax:
  - Cutaneous: contact with spores
  - Respiratory Tract (inhalation of spores)
  - Gastrointestinal Tract (ingestion of spores – rare)

- Botulism:
  - GIT: ingestion of toxin-containing food
  - RT: inhalation of toxin-containing aerosol

- Ebola hemorrhagic fever:
  - As a rule, infection develops after exposure of mucous membranes or RT, or through broken skin or percutaneous injury

- Plague:
  - RT: Inhalation of respiratory droplets

- Smallpox:
  - RT: inhalation of droplet or, rarely, aerosols and skin lesions (contact with virus)

- Tularemia
  - RT: inhalation of aerosolized bacteria
  - GIT: ingestion of food or drink contaminated with aerosolized bacteria

**Box 77.1  Body fluid infectivity**

Other potentially infectious material (OPIM)
- Cerebrospinal fluid
- Synovial fluid
- Pleural fluid
- Pericardial fluid
- Amniotic fluid

Material not considered infectious unless visibly bloody
- Feces
- Nasal secretions
- Saliva
- Sputum
- Sweat
- Tears
- Urine
- Vomitus
• HCV:
  ○ Not as infectious as HBV and many patients are asymptomatic—unaware of infected status but may lead to worse disease as well as more chronic states.
  ○ No reliable PEP available. Some respond to interferon.

• HIV:
  ○ Only 5% of HCP exposures are to HIV+ blood.
  ○ Low transmission rate.
    ■ Percutaneous: 0.3% rate of transmission.
    ■ Splatter: 0.09%.
  ○ Rapid testing to assess status of HIV and HCV (and HBV) in exposed and in source patient
  ○ Antiretroviral PEP given to all exposed to HIV+. If source will not consent to testing, give PEP.
  ○ If PEP is indicated, the same first-line or alternative regimens are used, regardless of any specific characteristics of the exposure incident.

• Tuberculosis:
  ○ Droplet transmission, additional resp precautions needed (M95).
  ○ EMS personnel should maintain suspicion in patients with respiratory symptoms and high-risk factors.
  ○ Reportable illness, therefore EMS should be notified by hospital if TB patient later identified and recognized to have arrived via EMS.
  ○ CDC Recommends for HCP yearly TB screening via PPD.

• Varicella
  ○ Recommendation is for vaccination to prevent or diminish illness.
  ○ If non-immune person is exposed, then vaccine can be given within 5 days of exposure.
  ○ If the nonimmune person is pregnant or immunocompromised, then VZIG should be given to prevent disseminated VZV.

• Bacterial Meningitis: universal and droplet precautions when transported suspected patients.
  ○ High case fatality for N. meningitidis (10%).
  ○ PEP should be administered when close unprotected contact occurs
  ○ Close contact is only when the HCP was <3 feet from patient for >8 hours.
  ○ PEP should be given once a case is confirmed via CSF.
    ○ HCP cannot work until 24 hours after PEP given.
<table>
<thead>
<tr>
<th>Clinical syndrome or condition†</th>
<th>Potential pathogens‡</th>
<th>Empiric precautions (always includes standard precautions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diarrhea</td>
<td>Enteric pathogens§</td>
<td>Contact precautions (pediatrics and adults)</td>
</tr>
<tr>
<td>Acute diarrhea with a likely infectious cause in an incontinent or diapered patient</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Meningitis</td>
<td><em>Neisseria meningitidis</em></td>
<td>Droplet precautions for first 24 h of antimicrobial therapy; mask and face protection for intubation</td>
</tr>
<tr>
<td></td>
<td>Enteroviruses</td>
<td>Contact precautions for infants and children</td>
</tr>
<tr>
<td></td>
<td><em>M. tuberculosis</em></td>
<td>Airborne precautions if pulmonary infiltrate</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Airborne precautions plus contact precautions if potentially infectious draining body fluid present</td>
</tr>
<tr>
<td>Rash or exanthems, generalized, etiology unknown</td>
<td><em>Neisseria meningitidis</em></td>
<td>Droplet precautions for first 24 h of antimicrobial therapy</td>
</tr>
<tr>
<td>Petechial/eccymotic with fever (general)</td>
<td></td>
<td>Droplet precautions plus contact precautions, with face/eye protection, emphasizing safety sharps and barrier precautions when blood exposure likely. Use N95 or higher respiratory protection when aerosol-generating procedure performed.</td>
</tr>
<tr>
<td>-if positive history of travel to an area with an ongoing outbreak of viral hemorrhagic fever in the 10 days before onset of fever</td>
<td><em>Ebola, Lassa, Marburg viruses</em></td>
<td>Airborne plus contact precautions</td>
</tr>
<tr>
<td>Vascular</td>
<td>Varicella zoster, herpes simplex, variola (smallpox), vaccinia viruses</td>
<td>Contact precautions only if herpetic simplex, localized zoster in an immunocompetent host or vaccinia viruses mostly likely</td>
</tr>
<tr>
<td></td>
<td>Vaccinia virus</td>
<td>Airborne precautions</td>
</tr>
<tr>
<td>Maculopapular with cough, coryza and fever</td>
<td><em>Rubeola (measles) virus</em></td>
<td></td>
</tr>
<tr>
<td>Respiratory infections</td>
<td>*M. tuberculosis, respiratory viruses, Streptococcus pneumoniae, <em>Staphylococcus aureus</em> (MSSA or MRSA)</td>
<td>Airborne precautions plus contact precautions</td>
</tr>
<tr>
<td>Cough/fever/lower lobe pulmonary infiltrate in an HIV-negative patient or a patient at low risk for HIV infection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cough/fever/pulmonary infiltrate in any lung location in an HIV-infected patient or a patient at high risk for HIV infection</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cough/fever/pulmonary infiltrate in any lung location in a patient with a history of recent travel (10–21 days) to countries with active outbreaks of SARS, avian influenza</td>
<td><em>M. tuberculosis, severe acute respiratory syndrome virus (SARS-CoV), avian influenza</em></td>
<td>Airborne plus contact precautions plus eye protection. If SARS and tuberculosis unlikely, use droplet precautions instead of airborne precautions</td>
</tr>
<tr>
<td>Respiratory infections, particularly broncholiths and pneumonia, in infants and young children</td>
<td>Respiratory syncytial virus, parainfluenza virus, adenovirus, influenza virus, human metapneumovirus</td>
<td>Contact plus droplet precautions; droplet precautions may be discontinued when adenovirus and influenza have been ruled out</td>
</tr>
<tr>
<td>Skin or wound infection</td>
<td><em>S. aureus</em> (MSSA or MRSA), group A streptococcus</td>
<td>Add droplet precautions for the first 24 h of appropriate antimicrobial therapy if invasive group A streptococcal disease is suspected</td>
</tr>
</tbody>
</table>

† Infection control professionals should modify or adapt this table according to local conditions. To ensure that appropriate empiric precautions are implemented always, hospitals must have systems in place to evaluate patients routinely according to these criteria as part of their preadmission and admission care.

‡ Patients with the syndromes or conditions listed below may present with atypical signs or symptoms (e.g., neonates and adults with pertussis may not have paroxysmal or severe cough). The clinician’s index of suspicion should be guided by the prevalence of specific conditions in the community, as well as clinical judgment.

§ The organisms listed under the columns Potential pathogens are not intended to represent the complete, or even most likely, diagnoses, but rather possible etiologic agents that require additional precautions beyond standard precautions until they can be ruled out.

§ These pathogens include enteroheamorrhagic *Escherichia coli O157:H7*, *Shigella* spp, *hepatitis A virus*, noroviruses, rotavirus, *C. difficile*.

78: Medical surveillance of emergency response personnel, 96

- Greater and more varied dangers facing today’s EMS workforce—threatening their health and lives.
  - Examples: MCI/Active shooter, Epidemics, Toxic Inhalation (e.g. World Trade Center).

- Several federal regulations, agencies, and documents provide guidance of design and operation of the Medical Surveillance Program (OSHA, CFR, EPA, Natl Fire, etc.)

- Current OSHA Requirements for implementation of Medical Surveillance Programs (MSP): OSHA 29 CFR 1910.120
  - Employees who may be exposed to hazmat at or above Permissible Limits (PELs) for 30+ days
  - In absence of PELs, for employees working at levels above published exposure levels
  - Employees who wear a respirator for more than 30 days/yr.
  - Hazmat employees
  - All employees who are injured because of exposure to hazmat

- World Trade Center Medical Monitoring and Treatment Program
  - Goals of a medical Surveillance program:
    - Early recognition of hazardous exposure-related occupational disease
    - Early intervention and treatment
    - Effective management of occupational disease process
    - Illness prevention

- MSP require dedicated staff, medical screening, periodic exams and monitoring

- Must maintain employee records for minimum of 30 years post retirement/termination of employment

- Responders entitled to access records within 15 days of request

- Initial employment exam, depends on institution—in addition to health questionnaire, Immunizations, exam might include the following:

- NFPA 1582 is general occupational health for fire.
  - VS including Ht, Wt, BP pulse, RR
  - CXR to screen for pre-existing abilities
  - PFTs
  - EKG
  - Vision Test
  - Auditory
  - Blood (liver kidney), CBC, electrolytes, UA
  - Drug testing, pregnancy, fit testing for PPE, etc.
● Annual or Periodic Examination may be stipulated by organization’s medical surveillance policy

● Baseline examination may be done when an individual is selected for a special team with higher than normal exposures, e.g. Hazmat

● On-scene medical monitoring—may depend on incident
  ○ Rest requirements
  ○ PPE may dictate additional surveillance, e.g. brief physical exam
  ○ Rehabilitation areas needed—different agencies might be primary host during incident, some variability, good record keeping important
  ○ Periodic re-exams
  ○ Range of services—include mental health

● Exposure specific and exit exams: determined by safety officer and med surveillance program MD

● Termination of incident
  ○ Completed medical monitoring documentation for each responder should be reviewed
  ○ An immediate review by the EMS branch director and/or safety officer should be followed within 24 hours by a review by the medical surveillance program medical director or his/her designee.
  ○ This review will determine whether an exposure-specific examination is needed.
  ○ Completed medical monitoring forms should be included with the incident record or entered into each responder’s medical record file, depending on applicable regulations and agency policy.

● NFPA 1584 (rehab, updated 2015) will reflect an evidence-based deemphasis on electrolyte replacement, will note a daily acceptable caffeine limitation of 400mg per member, and will recommend against any consumption of energy drinks (not to be confused with sports drinks) by emergency responders.
  ○ Applies in training too
  ○ Guidance on rest–work period ratios based either on number of SCBA bottles used or time worked intensely without SCBA

● NFPA 1581 = infectious (“thou shalt have an infectious control officer”)

● NFPA 1583: health and fitness
**Figure 78.1** The model rehab area. This accommodates the various key functions performed in and around the rehab sector, including accountability, doffing of PPE, replenishment of SCBA cylinders while the firefighters are in rehab, medical triage, rehydration, and medical monitoring.
Wellness refers to the physical and mental well-being of an individual
- Sleep hygiene, regular exercise and proper diet are rare and very important
- Those who self-rate their health as "good" have a lower death rate than those who rate their health as "poor" by a factor of 2.9.

- EMS workers rate their health as poor less frequently than the general population.
  - Approximately 75% of EMS workers are obese, 50% are sedentary and 15% smoke tobacco.
  - As many as 80% of EMS workers have additional employment or work overtime hours.

Fatigue - unpleasant symptom incorporating feelings of tiredness to exhaustion creating mental and physical conditions that interfere with the ability to function in a normal capacity
- Up to 55% in EMS reported severe mental or physical fatigue
- Collaborate with ongoing surveillance and maintenance wellness programs and interventions

Risk Management in EMS outline five recommendations for EMS employers [73]:

- 1. Use reliable and/or valid fatigue/sleepiness survey instruments to measure and monitor fatigue in EMS personnel.
- 2. EMS personnel work shifts shorter than 24 hours in duration.
- 3. EMS personnel have access to caffeine as a fatigue countermeasure.
- 4. EMS personnel have the opportunity to nap while on duty to mitigate fatigue.
- 5. EMS personnel receive education and training to mitigate fatigue and fatigue-related risks
80: Occupational injury prevention and management, 109

- Occupational fatalities among EMS workers are estimated to be 2.5 times higher than rates experienced by the general public.

- Back injuries are most common, followed by other musculoskeletal injury (abrasions, lacerations) and exposure to infectious material.

- MVC most common source of legal liability (37% of torts claims) and most common cause provider fatality, approximately half (53%) of ambulance crashes occur crossing an intersection.

- Half of drivers involved in crashes have been involved in multiple crashes.

- Approx. 5% ambulance providers have been involved in MVC, fatalities approximately 3 x more likely in rear compartment than in front compartment and may be due to use/lack of use of restraints by providers. Use of restraints, “drive cams” to moderate driving behavior, and developing an organizational culture of safety are modifiable factors to improve safety.

- Rates of injuries leading to lost work time are more common in EMS than in fire and police, and estimated 32% go unreported due to stigma and other factors.

- Injury prevention programs concentrate on core strength and flexibility building, power stretcher lifts, and stretcher features to make side-to-side (e.g. patient transfer) and stair descent easier.

- Violent patients are common and up to 60% of EMS providers have been assaulted by a patient.

- Data collection on worker injuries is problematic; EMS systems are encouraged to have mechanisms in place to capture all injuries to the workforce until a national reporting system is developed.
Prevention and intervention for psychologically stressful events,

- EMS work has a significant amount of physical and emotional strain. Long hours, low pay, burnout and PTSD.

- Critical Incident Stress Management (CISM) and CISD (debriefing) are well received, but there is little evidence that they make a difference with PTSD, and may have paradoxical effects (e.g. don’t force re-exposure.)

- Axiom: a well-managed, well-run organization will find its way through even the greatest challenges

- Healthy organization: management, command, supervision

- Psychological First Aid-contact and engagement, safety and comfort, stabilization, information gathering, practical assistance, social supporter connection, coping information, collaborative services linkage

- **NFPA 1500** (health and safety standard for fire service agencies) mandates all agencies provide an employee assistance program (EAP)-access to behavioral health assistance

- Current recommendations:
  a. Immediate assistance (psychological first aid)
  b. Early, reliable, non-intrusive assessment: Trauma Screening Questionnaire (TSQ)
  c. Stepped care (treatment matched on level of clinical need)
  d. Evidence based treatment of clinical conditions (psychological benefits of cognitive behavioral therapy)

- Basic protocol to manage stressful situations: experience of posttraumatic event (PTE)->supervisor hot wash (timeout)->TSQ screening (if > 6 positive then referral)->complete assessment->treatment by specialty clinician

- Supervisor-led “hotwash” should be routinely practiced after routine events as well as complex encounters, asking the questions: What happened? What was successful? What could have gone better? How might we improve? Who should we tell about what we have learned? It is a model of “local learning” to identify and promote successful practices and note opportunities for improvement.

- Resiliency is built by a personal wellness and fitness program, including a baseline behavior health component for addressing issues such as marital and family problems before an incident happens.
Figure 81.1 PTE protocol flow chart. PTE, potentially traumatic event; TF-CBT, trauma-focused CBT
82: EMS provider education, 124

- Medical Director’s Roles in education:
  - Approve medical and academic qualifications of the faculty and accuracy of the medical content
  - Routinely review student performance and attest to their competence prior to graduation
  - Faculty selection, curriculum development, and teaching

Theories of adult learning
- Self-directed learning (Knowles in the 1960’s: Kids and adults learn differently)
  - Andragogy (the art and science of helping adults learn) vs Pedagogy (kids)
- Six core principles of adult learning:
  - Know the reason for learning
  - Self-concept of the learner- Have autonomy and self-direction
  - Prior experience of the learner
  - Readiness to learn, helps if learning has immediate relevance
  - Orientation to learning- Problem-centered, rather than subject-centered
  - Motivation to learn

- Social learning theory: adults need to have performance modeled for them, have feedback, and have successful experiences to reinforce their learning.
  - Effective modeling: “See one, do one, teach one”

- Self-efficacy: the belief in one’s own ability to complete tasks and reach goals- arises from four sources
  - Mastery experiences, social modeling, social persuasion and psychological state

- Transformative Learning Theory: learners are engaged, critically reflecting and challenging their frames of reference.

- Frames used to provide an activating event, encourage critical reflection and discourse, and let the students test new perspectives and foster openness:
  - Cognitive (perception, knowledge, reasoning)
  - Conative (drive, impulse, action)
  - Emotional (expression, feelings, attitude)

- Context based learning- adult learning takes place in context where tools and the context intersect with interaction among people.
  - Problem-based learning

- Experiential learning: Engaging in experience to apply knowledge; critical reflection on the learning, transferring key principles into knowledge schema and applying that knowledge in future situations to test
Language of Learning

- Education delivery systems: traditional (face to face), distance education, and hybrid or blended models

- Bloom’s taxonomy of learning: learning objectives can be in three domains of activity:
  - Cognitive (knowledge)
  - Affective (attitude)
  - Psychomotor (skills)

- Learning styles- When teaching seek ways to teach to a variety of modalities
  - 3 dominant styles - One is not better than any other
    - Auditory, visual and kinesthetic
  - VARK learning styles
    - Visual learning, auditory learning, reading/writing, or kinesthetic learning

- History of EMS Education
  - Started in 1950’s by American College of Surgeons
  - First National Registry of EMT was held in 1970 to develop uniform standards to credential ambulance personnel
  - First EMT curriculum -National Highway Traffic Safety Administration (NHTSA) in 1971
  - 1975 the American Medical Association recognized paramedics as an allied health occupation and helped develop standards for Paramedic training programs to achieve accreditation (with the Joint Review Committee on Education Programs for the EMT-Paramedic).
  - First Paramedic curriculum in 1977 NHTSA.
  - EMS Agenda: 2050- EMS clinicians will be given the education and training that adequately prepares them to meet the needs of the people they are called to help,“
    - Six guiding principles: Adaptable/innovative, sustainable and efficient socially equitable, safe/effective, integrated/seamless, reliable/prepared.
  - EMS education agenda- systems approach: specified five components of the EMS education system 1) National EMS Core Content, 2) National EMS Scope of Practice Model, 3) National EMS Education Standards, 4) National EMS Program Accreditation, and 5) National EMS Certification
- 1) National EMS Core Content- intent is to describe the entire domain of knowledge and skills of out-of-hospital care.
  - Similar to physician education programs to define the scope of a specialty.
  - This project was led by physicians from NAEMSP and ACEP who worked with other stakeholders.
- 2) National EMS Scope of Practice Model- identifies “levels” of EMS clinicians and specific skills to each level
  - Scope of practice skills that were identified in this project are a floor for each practitioner level
  - States set scope of practice but this acts as a model to promote consistency and reciprocity.
- 3) National EMS Education Standards- identifies competencies, clinical behavior and judgments, educational infrastructure, and the depth and breadth of content to include in each level of education.
- 4) National EMS Program Accreditation (called one of the bookends of of education agenda- national certification is the other)
    - Primary purpose is to protect the student by ensuring that programs meet minimum standards.
  - From the agenda: a single national accreditation agency will be identified and accepted by state regulatory offices.
  - NASEMSO designated the Commission on Accreditation of Allied Health Education Programs (CAAHEP) and its Committee on Accreditation of EMS Professions (CoAEMSP) as the agency in 2010.
  - Accreditation process: Self-evaluation then peer evaluation of programs against Standards and guidelines that follow CAAHEP template. Reviewed every 5 years. (see pg 131)
  - Medical Direction: Accredited paramedic programs must have documentation of an active medical director.
    - Also need an advisory committee with physicians on it.
Certification tied to accreditation: effective January 1, 2013, a paramedic candidate must graduate from a CAAHEP-accredited program in order to take the NREMT paramedic examination.

5) National EMS Certification: The education agenda calls for a single, national certifying organization to be identified and accepted by state regulatory offices. NASEMSO designated NREMT to be that agency in 2010.

NREMT grants 2-year registration. NREMT certifies that individuals who pass the skills and cognitive exam are entry-level competent.

Important terminology:

- **Certification**: issuing a certificate by a non-governmental private agency.
- **Licensure**: granted by legislative entity, gives permission to do a job
- **Registration**: list of individuals who have achieved a status, and does not allow practice by itself
- **Accreditation**: is a non-governmental, independent, collegial process of self and peer assessment

### Terms Related to Regulatory Concepts

<table>
<thead>
<tr>
<th>Certification</th>
<th>Issuance of a certificate by a non-governmental private agency (such as NREMT) is based on adopted qualifications or competency standards. Certification affirms a knowledge and experience base for individuals who practice in a particular field, as well as for employers and the public.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Licensure</td>
<td>A license is granted by a legislative entity such as a state government, giving an individual permission to do a job or task that requires such permission. A driver’s license is an example of such permission. Generally speaking, a licensed individual in health care has a certain amount of autonomy in delivering that service.</td>
</tr>
<tr>
<td>Registration</td>
<td>Registration is a list of individuals who have attained a specific professional status, so the NREMT keeps a listing of persons who have met the criteria for practice. Registration does not allow an individual to practice in a state but may be a prerequisite for such permission to practice (licensure).</td>
</tr>
</tbody>
</table>

**Figure 82.3** Terms related to regulatory concepts.

- Continuing Education: requirements for each practitioner depend on each state, region, and department
- Glick’s model for evidence-guided education: correlates local outcome data with practice improvement.
  - focuses on identification of education priorities based on system-specific patient outcome data.
    - specific patient situations, examining errors or near misses, and morbidity and mortality conferences.
- CAPCE accreditation- reviews and accredits EMS-related continuing education. This national accreditation makes it possible for students to obtain credit outside their home states and to receive credit through distance education.
Evaluating education

- Kirkpatrick model - has 4 levels- one education session often does not lead to level 4 results
- Reaction–How did learners perceive the education?
  - This is assessed by asking them either verbally or using an evaluation form.
- Learning–Were the learning objectives met?
  - This is evaluated using activities such as assessing skill performance or having learners take a quiz.
- Behavior–Are the learners transferring the knowledge to the field?
  - Direct observation in the field, customer satisfaction surveys, or quality improvement activities measure this.
- Results–Are important outcomes in the department being affected as a result of the education?
  - Quality improvement indicators such as survival from cardiac arrest, time lost due to injury, or number of vehicle crashes could be measures used to determine results.

Remediation and workforce reentry

- Workforce reentry policies are often time-based and usually correlate to prolonged absences from operational status due to illness, injury, maternity leave, or military deployment.
- Identification of need for remediation: either from failure during orientation/internship or result of clinical errors
- Strategies: focus of the remediation should be on performance improvement and mastery of the objectives. Consider this approach:
  - What is the identified deficiency?
  - remediation plan objectives
  - what method of evaluation will be used to verify completion
  - the time frame for completion
  - the consequences of failure.
- Workforce reentry plans are similar to remediation plans in educational structure, but the focus is on ensuring readiness after prolonged absence from work.
- Evaluation: Documentation of the remediation should be done in a structured format that lists overall goals, specific objectives, and activities to achieve the objectives and assessments.

Section III: Legal and Legislation

83: Legal issues, 139

- Initial focus of legislation was immunity for the rescuer
  - Eventually laws were passed to protect the trained rescuer and professional paid responder, as well as the “Good Samaritan”
  - Governmental immunity also became a strong shield from liability for public agencies
Legal Framework of the EMT/physician relationship

- Physician-EMT legal relationship is one of supervision rather than agency. (responsibility to properly oversee the practice of another clinician)
- EMT’s are the “agents” of EMS provider agencies and the employer (agency) is liable for the actions of the EMT under the doctrine of respondeat superior - “let the master answer”
- Delegated practice - widely used misnomer to describe the relationship between physician and EMT, but in most states (except Texas), there are no statutes that authorize a physician to “delegate” skills in their practice to another health care provider

Licensure permission from a competent authority to do an act which, without such permission, [would] be illegal as opposed to a certification

Certification is the formal assertion of some fact (EMT’s would seem to be licensed, but this varies by state).

EMTs do not practice “under the license” of the medical director, but instead under their supervision, with permission of the governing body.

- EMS medical director responsibilities of training, supervision and retaining EMTs could potentially open them up to liability if performed negligently

- Two main sources of the EMS medical director’s authority:
  - Statutes/regulations and contractual provisions.
  - Imperative for the medical director to spell out authority in a well-drafted contractual agreement

Areas of liability:

- Failure to perform responsibilities
- Negligent supervision

Summary of principles for non-transport:

- Have a policy (and train on the policy)
- Do audits to hold accountable
- Have online medical control involved
- Be cautious with restraints
- Use a legally correct release form

84: Legislation, regulation, and ordinance, 161

- Statutes, aka laws, codes, legislation
  - Federal or state laws that have been created by acts of publicly elected members of Congress
  - Broad language, establish structures (such as EMS advisory councils)
    - e.g. State agency X shall establish rules/regulation surrounding Y problem.
• **Rules, aka regulations**
  - Created by a state agency *under authority provided in a state statute*. Opportunity for public input.
  - Similar enforceability as statutes, but more technically detailed.

• **Ordinances** are municipal or local laws
  - May be created by a city, county, town, village, or borough under an authority from state statute.
    - e.g. EMS matters such as cost (budget), level of service, response times, vehicle and equipment specifications, quality management provisions, and similar subjects of EMS operations.
  - **Contracts**
    - Documents between private EMS providers and cities, towns, counties etc for provision of EMS services
    - Agreement between the parties for compensation for services rendered.

• **Policies**
  - Describe expectations or requirements for daily operations

• **Incorporation by reference** = strategy for establishing standards in statues and rules
  - E.g. National EMS Scope of Practice Model: a voluntary form intended for use by individual state to establish their individual scopes of practice for EMS personnel.
    - Floor, not ceiling, to set a common expectation when personnel move between one state and another, and vague enough to avoid frequent updating
    - States that have incorporated the Scope Model by reference do not need to reopen their legislative or rulemaking processes to make updates.
  - E.g. Education Agenda: establishes national system of EMS education akin to other allied health professions
    - Verification of entry level competence by NREMT a “certification.”
      - Most states now require NREMT certification as prerequisite for licensure
    - Document issued by the state EMS authority legalizing a person to function = “license.”
85: Due process, 165

- State administrative law proceedings are less formal and can replace the need for court cases
  o Purpose is to more easily resolve issues with lesser rules on hearsay rules of evidence seen in court cases.
    Allowable as due process due to state statute defining administrative procedures act

- Fifth Amendment – prohibits federal government from depriving any individual of “life, liberty, or property without the due process of law”

- Fourteenth Amendment - prohibits state from depriving any individual of life, liberty, or property without the due process of law

- Due process of law has 2 defined components
  o Substantive due process – prevents government from interfering with rights
  o Procedural due process of law – deals with the process of procedural fairness
    ■ Procedural due process components
    ■ Unbiased tribunal
    ■ Notice of the proposed action and grounds asserted for it
    ■ Opportunity to present reasons why the proposed action should not be taken
    ■ Right to call witnesses
    ■ Right to know the evidence against you
    ■ Right to have decision based only on the evidence presented
    ■ Right to counsel
    ■ Recording of proceedings
    ■ Statement of reasons for the action taken
    ■ Due process is a flexible concept and all above are not always required.

**Governmental action:** Procedural due process of law applies only to actions taken by a government and do not extend to private conduct abridging individual rights

- Volunteer fire and ambulance companies, private ambulance companies, and medical directors may be considered to be engaged in state action and thereby are required to provide procedural due process
- Medical directors are (in many instances) considered governmental action, as they are required by state statute and therefore must follow due process.

**Medical review committees** – serve as a unique and valuable tool for conducting quality assurance and quality improvement reviews of EMS practices and procedures.

- Proceedings are often confidential to shield sensitive medical information but are often subject to due process as function under state statutes and regulations.
- They are viewed as state action and do require due process.
- Unclear exact due process required, guidance of QI procedures from the Healthcare Quality Improvement Act of 1986
Life, Liberty, or Property:

- Life Interest – limited to capital cases

- Liberty Interest – freedom from bodily restraint, right to the pursuit of happiness
  - Arises when an employment action is taken that damages the employee’s ability to obtain employment (ex. immorality, dishonesty, alcoholism, incompetence)
  - Healthcare Integrity and Protection Databank (HIPDB) – established in 2000 as a part of HIPAA – state and federal agencies are required to report licensing and certification actions, including revocations, reprimands, censures, probations, suspensions, and any other loss of license, whether by voluntary surrender, non-renewability, or otherwise.

- Property Interest – interest in employment, a license, or a certification may be qualified as property interests
  - For an employment relationship to be a property interest there must be a legitimate claim of entitlement such as tenure, a fixed-term contract, or implied promise of continued employment

- EMT License – becomes a valuable personal right and therefore cannot be denied or abridged except after due notice and a fair and impartial hearing before an unbiased tribunal. EMT cannot have a license revoked or limited without due process.

Notice – individual should be given notice of the proceedings against them, including:

- The grounds for the actions proposed to be taken
- The type of action proposed
- The provider’s rights
- Must state all the facts and circumstances on which the proposed discipline is based
- Proof of delivery: hand delivery with affidavit, certified or registered mail with signed return receipt

Time for Hearing – ideally hearing should take place before provider is deprived of the protected property interest

- In cases of public health, safety, and welfare that puts the public at significant risk, action may be taken before due process
- A summary proceeding should be held as early as possible so that there is reasonable assurance that the situation presents a significant enough threat to warrant the revocation of a property interest before the hearing.

Standard of Proof – pivotal facts supporting the decision need to be established:

- “Proof beyond a reasonable doubt” – highest burden of proof, usually only applies in criminal prosecutions
- “A preponderance of evidence” – matter is more likely than not - sufficient level for due process purposes in medical disciplinary proceedings

- Right to Counsel – no procedural due process right to counsel
- Government has no obligation to provide this counsel in these cases
Components of Prehospital Risk Management:

- Risk assessment - Monitor all high frequency, high risk encounters, e.g. Non-transports, ETI's.
- Initial Training - Build a solid foundation of knowledge, skills and attitudes
- Pre-employment screening & orientation - Assess medical knowledge and patient care skills
- Medical Supervision - Medical accountability/oversight assures quality prehospital care
- CME - Protocol changes, reviews, new info & tech, prevent degradation of knowledge & skills
- Documentation - A properly completed PCR (whether patient is transported or not) is the best defense
- Quality Management - Continuous action loop (starts & ends with protocols and education). Be proactive
- Patient Expectations - Influenced by locale, socioeconomics, cultural influences
- Other factors- examples: Ambulance involved in accident- injury to patient, or injury to EMS clinician and cant provide care to patient.

5 steps of developing an effective risk management program:

1. Identify risk exposure
2. Evaluate risk potential
3. Rank and prioritize risk
4. Determine and implement control actions
5. Evaluate and revise techniques as needed

- Develop pre-loss (e.g. protocols, education, feedback, documentation, QA program) and post-loss (e.g. good investigations, remediation/education) strategies to minimize risk exposure

- Initial training (not just CME) and frequent coordination between training program medical director and system medical director emphasized

- Robust system orientation prior to (local) accreditation is important, documentation of same is necessary for holding provider accountable for operations and patient care knowledge and providing evidence of that accountability

- For the EMS provider, documentation of the prehospital encounter is critical, especially for patient non-transports, and incident management later. For the EMS Medical Director, documentation of the patient care incident investigation is equally important, both for the protection of the patient and to show transparent due process for the EMS provider
- Patient Care Incident Management - Part of the job as medical director. This could lead to potential liability if not performed, a risk that is likely to increase in the future. Thorough documentation of the investigation is important, both for ensuring optimal patient care and to show transparent due process for the provider.

<table>
<thead>
<tr>
<th>Category</th>
<th>No.</th>
<th>Percent**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment and care</td>
<td>78</td>
<td>42.85</td>
</tr>
<tr>
<td>Ambulance accidents</td>
<td>73</td>
<td>40.1</td>
</tr>
<tr>
<td>Dispatch and transport</td>
<td>50</td>
<td>27.47</td>
</tr>
<tr>
<td>Training, staffing, and administrative</td>
<td>41</td>
<td>2.52</td>
</tr>
</tbody>
</table>

* In some cases, more than one category was identified and used in this table.
** Percent based on entire 182 cases.

- Patient Care Incident - Should have a comprehensive, systematic, standardized mechanism for dealing with these. Checklists are helpful:

- Medical director must have final authority on the evaluation of the clinical aspects of the incident

- Potential patient care incident investigation findings: Mistakes made may involve errors of omission or commission

- Risk management investigations may identify trends that require system-wide intervention. Use a root cause analysis to determine which factors were involved (i.e. the problem may be a system-wide issue and is not always a "human error")

- Medical director has final authority on medical actions in response to patient care incidents

- Risk Management is a proactive as opposed to a reactive strategy. A medical director's oversight should be active and ongoing - not just when a problem arises. The medical director should stay abreast of the latest EM/EMS literature in order to iteratively improve on the EMS system and thereby prevent errors.
Politics and advocacy for the EMS physician, 183

- EMS Physicians and Politics must interact to ensure system function
  - Denver EMS system, denver airport sponsor paramedic presence
  - Controlled Substances Act issues with standing orders that were not patient specific made protocols illegal
  - Alleviated by Protecting Patient Access to Emergency Medications act of 2017
    - Legalized protocols and standing orders including narcotics

- Advocacy
  - The act or process of supporting a cause or proposal
  - Bridges the gap of knowledge by EMS clinicians supplying enough knowledge to politicians to make informed decisions regarding care
    - Lobbying
  - AEMS (Advocates for EMS)
    - Association of the EMS associations
  - Political Action Committees
    - Main purpose is to ethically support political candidates who support EMS agenda
    - Cooperations or groups such as NAEMSP cannot make contributions directly to a candidate but can organize in a PAC, can cover costs of the PAC but cannot give funds directly.

- Power Blocs, Vectors and Pressure Points
  - Present in all communities; important to identify them in order to make changes in system
    - May consist of mayor, EMS providers, fire chief, patients, state health dept, etc.
    - Visualize power blocs as ‘power vectors’ with magnitude (force) and direction, exert pressure in ways that will realign vectors on parallel course toward desired EMS agenda

- Philosophy, Perspective and Bias – 5 political senses require mastery:
  - A sense of mission – should be defined, amalgamated and articulated
  - A sense of tradition – history of the community and the service
○ A sense of position – position of the medical director in the organization, community, and the position of the service agency
○ Humor
○ Timing – introduction of new ideas and programs should take advantage of other changes being introduced in the community, institution, or agency

● 5 spheres needed to achieve goals
  ○ Academic, operational, administrative, clinical, and community relations
Section IV: Dispatch and Communications

88: Dispatch, 195

- Public Safety Answering Points
  - Primary - public calls in
  - Secondary - more specialized dispatch (eg. EMS only)
- Emergency medical dispatch (EMD) software
  - Can help prioritize calls and gives guidance for Lights & Sirens (L&S) use
  - Early recognition of cardiac arrest and DA-CPR has improved OHCA survival outcomes
  - In early days of EMD, it was believed that pre-arrival instructions could bring medicolegal issues however it is now nearly considered negligent to fail to provide them
- Computer aided dispatch (CAD)
- Mobile data terminal (MDT)
  - Location of landline historically helpful now obsolete
  - 1977 - Medical Priority Dispatching
- NG911 - next gen 911
  - Accepts texts, photos, media, etc.
  - Crash monitoring systems in cars
  - May be able to get medical device data in future
- Systematized, scripted formal caller interrogation;
- Systematized, scripted post-dispatch and pre-arrival instructions;

<table>
<thead>
<tr>
<th>Table 88.1 Essential components of an emergency medical dispatch system</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Medical oversight</td>
</tr>
<tr>
<td>2. Prompt identification of time-sensitive emergencies with rapid dispatch of appropriate responders</td>
</tr>
<tr>
<td>3. Call prioritization, with preassigned response levels and modes</td>
</tr>
<tr>
<td>4. Scripted telephone prearrival instructions</td>
</tr>
<tr>
<td>5. Proper initial education, certification, and ongoing continuing education for telecommunicators</td>
</tr>
<tr>
<td>6. Active quality improvement process</td>
</tr>
<tr>
<td>7. Integrated process to reduce lights &amp; sirens responses</td>
</tr>
</tbody>
</table>

1 First Card

First Card Questions
1. What is the location of the emergency? Verify!
2. What is the nature of the emergency?
3. (If appropriate) How many people are sick or injured?
4. What is the patient’s age?
5. What is the patient’s sex?
6. Is the patient awake?
   - Yes— Go to the most appropriate Chief Complaint Card.
   - No— Continue to the next question.
7. Is the patient breathing normally?
   - Yes— Go to most appropriate Chief Complaint Card.
   - No or Unknown— Immediate dispatch as an ED.
Then proceed to the Medical Prearrival Cards (CPR)
Caller Categorization:
- First party: the patient
- Second party: someone with the patient, usually able to perform care and give additional information.
- Third party: passerby, driving past someone on the ground, moderate to little information.
- Fourth party: another agency, alarm company, life alert button company etc.. Usually have little to no information

Medical directors must ensure dispatchers understand policy, ensure compliance, ensure correct and effective application, and correct any deficiencies identified

Quality Improvement:
- Need for medical oversight
- Assess periodically the medical information in the protocols, change if possible, some set from EMD
- Assess periodically with QI process the appropriateness of response, including mode and units of response.
- Option for including feedback from EMS crews if changing priority or mode ect after calls.
- 4x4 matrix can be helpful to assess for over or under triage of calls

Pre-Arrival Instructions
- Important to follow scripted PAIs and minimize ad lib. Designed to be clear and direct. Helpful for EMD to maintain control and a public expectation
- #1 reason cardiac arrest missed by dispatcher is “making funny noises” aka agonal breathing
  - 73.9% sensitivity to identify cardiac arrest calls
  - 86.4% sensitivity on hospital confirmed strokes but 26% specificity

Dispatch Life Support
• Important knowledge, procedures and skills used by EMD in providing care through PAI (pre-arrival instructions) —BLS and ALS principles appropriate to each situation

Priority Dispatch Responses = Judicious and balanced use of limited resources. Requires strict adherence to protocols. Considerations for modern response systems:

• Response configuration (number and types of crews/vehicles)
• Response mode (lights and sirens)
• Referral to alternative care
• Economics and politics of response
• Responder and public safety (L&S)

Maximal Response Dilemma- Can’t send “hot”/lights and sirens response to everything, as it endangers public safety, increases risk of ambulance and other vehicle crashes. Use prioritization to make safe response time.

Tiered Response

• Goal to get the right thing/people/skills to the right patient at the right time

<table>
<thead>
<tr>
<th>Chief Complaint</th>
<th>Priority</th>
<th>Subgroup</th>
<th>Determinant Descriptor</th>
<th>First Responders</th>
<th>ALS</th>
<th>BLS</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABD</td>
<td>E0</td>
<td>A</td>
<td>Abdominal Pain – Patient is not awake (unconscious) OR Not breathing normally</td>
<td>Hot</td>
<td>Hot</td>
<td>—</td>
</tr>
<tr>
<td>ABD</td>
<td>E1</td>
<td>D</td>
<td>Abdominal Pain – With Fainting</td>
<td>—</td>
<td>Hot</td>
<td>—</td>
</tr>
<tr>
<td>ABD</td>
<td>E2</td>
<td>G</td>
<td>Abdominal Pain – With history of diabetes OR kidney stones</td>
<td>—</td>
<td>Cold</td>
<td>—</td>
</tr>
<tr>
<td>ABD</td>
<td>E3</td>
<td>I</td>
<td>Abdominal Pain – None of the above</td>
<td>—</td>
<td>—</td>
<td>Cold</td>
</tr>
</tbody>
</table>

For example: A call coded as ABD2G would generate an ALS ambulance response without lights & sirens and would be dispatched as an ABD 2.

Figure 88.3 Sample determinant codes and responses. Source: Adapted from Pittsburgh Priority Dispatch, circa 1996.

General Rules of the response planning process: Ask these questions:

• Will time make a difference in outcome?
• How much leeway exists for this problem?
• How much time is saved by responding “hot”?
• What time constraints are present in the system?
• When a patient gets to hospital, will time saved using lights-sirens be significant compared to time spent awaiting care?
89: Ambulance safety, 203

- Haddon matrix for each epidemiological factor: host, agent, environment (“triangle”).
  - These are evaluated pre-event, event, post-event. This creates a 3x3 matrix (shown below - Table 89.1)

Table 89.1: Haddon’s matrix for emergency vehicle collisions

<table>
<thead>
<tr>
<th>Timing</th>
<th>Human/Host</th>
<th>Vehicle/Agent</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-event</td>
<td>Fatigue</td>
<td>Maintenance</td>
<td>Visibility</td>
</tr>
<tr>
<td></td>
<td>Driver training</td>
<td>Vehicle design</td>
<td>Road conditions</td>
</tr>
<tr>
<td></td>
<td>Hearing impairment</td>
<td>Tire pressure/design</td>
<td>Unobstructed location</td>
</tr>
<tr>
<td></td>
<td>Alcohol/substance abuse</td>
<td>Lack of restraints</td>
<td>Agency policies and enforcement</td>
</tr>
<tr>
<td></td>
<td>Distractions</td>
<td>Lack of airbags</td>
<td>Support for research and prevention</td>
</tr>
<tr>
<td></td>
<td>Stress</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Driving skill/patterns</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Event</td>
<td>Personal health</td>
<td>Speed</td>
<td>Road banking</td>
</tr>
<tr>
<td></td>
<td>Proper restraint usage</td>
<td>Protruding objects</td>
<td>Guardrails</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sharp corners</td>
<td>Rumble strips</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equipment securement</td>
<td>Characteristics of object(s) struck</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Presence of hazardous materials</td>
<td>Availability of emergency personnel/resources</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Ability of doors to open</td>
<td>Availability of trauma centers</td>
</tr>
<tr>
<td>Post-event</td>
<td>Severity type of injury</td>
<td>Fuel/electrical system integrity</td>
<td></td>
</tr>
</tbody>
</table>

- Four E’s of Intervention:
  - Education (easiest, poor compliance),
  - Enactment (of policies/protocols to improve)
  - Enforcement (law support, punitive measures),
  - Engineering (built into equipment, no active participation)

- Ambulance crashes cause 76.5% of all EMS occupational fatalities, 4-17 EMS personnel deaths per year
- Rate of transportation-related occupational injuries for EMS personnel is more than 30 times higher than the national average
- Crashes involving ambulances produce twice as many casualties as the national average. Higher danger for those not in the ambulance (e.g. “wake effect” on civilians)
- Diesel fume exposure may cause significantly increased reaction times
- Most crashes occur during lights and sirens use, and most serious injuries are in patient compartment.
- Highest risk locations at intersections and traffic signals.

- Recommendations:
  - Fatigue (more literature points to this as major factor): shorter shifts (max 12 hours), training on fatigue, shared responsibility between employee and employer for prevention
  - Driver Training: research is needed to determine recommendations, especially around age differences associated with the different causes of crashes, and a higher rate of injuries among female EMS providers than male.
  - Distractions: may account for 20-30% of crashes radio/computer/automated warnings are causes, keep controls simple, train on focus
○ Warning Lights and Sirens (WLS) are overused, implementing tiered dispatch protocols to reduce WLS. Challenge secondary to concern about not getting to critical patients quickly if information is inaccurate, need in congested areas, patient perception to not be taken seriously.
○ Passenger Restraints: Seatbelt use is the law, but many personnel refuse to wear for patient care or other reasons, need better education and alternate risk reduction strategies such as warning driver when attendant in back is unrestrained to drive more slowly
○ Driving History: check driving record at start of employment and periodically recheck
○ Vehicular Design: lack of standards to rear compartment of ambulance, most dangerous area and least regulated, backup alarms and cameras may help + visibility devices
○ Vehicular Operations: black box-real time monitor of speed, acceleration, seatbelt use
○ Every EMS Agency should have a team dedicated to ambulance safety
90: Communications, 213

- Communications may look different from community to community.
  - Examples: Rural v urban, different geographic issues define capabilities by scenario.

- Access
  - 911 – mostly universal number in US. Improves access by improving awareness. Integrated all emergencies – health and public safety.
  - PSAP = public safety answering point or “call center”. May be centralized PSAP combined with other public safety (police, fire), or separate. Centralized dispatch can save money, pool resources. Important to use an integrated communication system and routine no matter what structure is chosen.

- Wireless Communications and Public Safety Act of 1999 (911 Act) took effect with the purpose of improving public safety by encouraging and facilitating the prompt deployment of a nationwide, seamless communications infrastructure for emergency services. One provision of the 911 Act directs the FCC to make 911 the universal emergency number for all telephone services.

- 2012, Public Law 112-96, the Middle-Class Tax Relief and Job Creation Act.- A portion of the law created the First Responder Network Authority, or FirstNet
  - Created a nationwide public safety broadband network.
  - A wireless carrier like Verizon or AT&T but reserved for the use of public safety personnel. including all types of EMS clinicians and acute care hospitals.

- Information communications technology efficiency tools: (examples)
  - Mobile data computers, system status management, and vehicle locator systems

- Demand management services - A communication system with medical oversight can navigate patients to a broad range of services other than ambulance transport to an emergency department.

- Basic 9-1-1 systems voice communications between the caller and public safety, in addition to displaying the caller’s phone number.

- Enhanced 9-1-1 (E9-1-1) systems provide location data for landline phones, wireless phones, and Voice over IP (VOIP) systems.

- “Next Generation 9-1-1” (NG 9-1-1): planning recognizes that emergency communication centers must be able to receive demands for service from
  - Automatic notification systems in vehicles (OnStar and others), homes (“I’ve fallen and I can’t get up” and an ever-increasing panoply of health and safety alerts), medical monitoring devices, and smartphones (texted messages, video, and pictures)
  - Many of these features are already available in advance of full NG 9-1-1 implementation. (See www.911.gov.)
Dispatch

- (PSAP) The public safety answering point now has the roles of:
  - call receiving, interrogation, determining response configuration and mode, delivering any appropriate pre arrival instructions to the caller. Ideally, one public safety answering point should operate in an EMS system with trained tele-communicators.

- Centralized dispatch (benefits)
  - Will usually save money, manpower, and equipment when compared to individual dispatch centers for each community.
  - Dispatch center will coordinate activities among responding vehicles, including special rescue units, support services, police, fire, utilities, and tow vehicles.

Direct medical oversight may be provided by

- A single, centralized resource hospital “base station,”
- Or each receiving hospital ED may provide its own direct medical oversight for field clinicians.

Centralized oversight model

- Becomes the responsibility of that base station to notify the receiving facility and provide updates regarding patient care and status.

Traditional direct medical oversight

- Communications between physicians and field clinicians using land mobile radio systems (LMRS; generally, VHF, UHF, or 700/800 communications systems

2020 JEMS report - implementation of video telemedicine into the ambulance has the potential to enhance quality of care.

- Benefits
  - Decreasing time to definitive care, informing destination decisions, and increasing diagnostic accuracy.
- Barriers encountered by the survey and the literature
  - Lack of broadband coverage, obtrusive/intrusive equipment issues, quality of audio and video, and interrupting patient care workflow.

Patient care records—Providers can share data of prehospital phase with hospitals.

- PCRs should be kept with patient’s hospital medical record.
- NEMSIS has helped to unify a “data dictionary” that most states have agreed to use.
- Administrative Records—important for operations of EMS crews but also for tracking and responding to quality issues, customer complaints etc.

**Major Incident Communications**
- Must be able to operate and coordinate with multi-agency response easily and under stress.
- Scaled procedures should resemble day-to-day patterns for ease of use.
- Emergency system must be able to block or shut down non-essential communications.

- FCC regulates use of radio frequencies by public safety organization, and has designated separate Emergency Medical Radio Service for several frequencies including traditional EMS channels.

- **VHF: Simplex** - can only send messages *one at a time*. Beneficial for rural, frontier, suburban. Range depends on power output, antenna height, repeater placement. Older (think “VHS” is old)

- **UHF: Duplex** - allow for two-way conversation (at once). 463-468-MH. Good in an urban environment because of better *penetration*. Need repeaters or microwave systems.

- **Repeater**: receives low level signal and retransmits it at higher level/ power --> covers longer distance. Repeater= base station.

**Land mobile radio systems = LMRS**

- include the traditional VHF and UHF frequencies
  - dispatch-to-vehicle (mobile and portable radios), vehicle-to-vehicle, vehicle-to-hospital, and hospital-to-hospital (and other facility) communications.

- Include relatively newer 700-MHz and 800-MHz trunked radio systems
  - In all systems, there should be redundancy and flexibility engineered and available.

- Transition from analog to digital technology.
  - calls suddenly “drop” rather than fade away as they once did in analog transmissions.

- **700MHz and 800MHz Trunked Systems**: Blend of two-way radio technology and computer-controlled transmitters.
  - Less interference - computer searches for open frequency when call is made. Compatibility difficulty - FCC allowed different equipment design.
  - In some areas, vehicle repeaters are not allowed, limiting functionality.
  - Have limited range and may significantly increase rural system cost to purchase more tower-based antennas.

- **HEARnet System**: VHF. Generally, for emergent/disaster hospital-to-hospital communication. Hospitals, blood bank, dispatch, EMS offices. Should have independent power supply
● Other communication options:
  ○ Land and Mobile Phone. Superior clarity. Confidential. *Will not function in disaster situations.*
  ○ 2.4-5.9-GHz Systems--“Hotspot” wireless areas. Provides fast broadband voice and data transmission. Requires ‘line-of-sight’ connection, making non-urban systems too expensive. Security and transfer speed issues abound at 2.4-GHz, whereas 4.9-GHz is secured for public safety
  ○ Fiber-optic
  ○ Land Mobile Satellite Communication - Omni-directional antenna for improved communication. Very expensive but may be alternative in rural areas.

● Future Directions: Cognitive or Software defined radio (SDR) • Will scan channels to find which are in use when transmission is needed. Will change the channel or spectrum of channels (VHF, UHF, satellite, cellular) based on which has best strength/connection. Will consolidate all devices into one ‘Smart Radio’.
  ○ Wifi
    ■ Advantages
    ● Robust broadband voice and data communications
    ● Rapidly upload data from an incoming ambulance (e.g., ePCR data to the hospital or EMS agency data system)
    ● Update vehicle software and mapping systems when the vehicle is in close proximity to the base.
    ■ Disadvantage
    ● Requiring virtually “line of sight” or close.
    ● Prohibitively expensive outside of urban areas or beyond devices networked at a single emergency scene.

● Unlicensed 2.4-GHz wifi systems (free ‘hot-spots’)
  ○ Provide citywide access to the internet on a free or “pay-to-play” basis.
  ○ Can support the cost of building out the necessary infrastructure by using these systems for EMS and public safety communications applications.
    ■ Disadvantages:
    ● Unlicensed system, access to any user,
    ● Potential interference, periodic data transfer speed slow down, and security issues.
      ○ Such systems may start up well but become impeded as general system use by the public increases.

● 4.9-GHz band (4940-4990 MHz) licensed strictly for public safety uses, including EMS.
  ○ Licenses are coordinated by regional planning committees
    ■ All of the advantages of the 2.4-GHz system without the security and interference concerns.
    ■ Largely used for urban-based, or emergency scene (ad hoc) point-to-point communications.
  ○ 5.9-GHz band- was allocated by the FCC for use in intelligent transportation system applications.
- Vehicle to vehicle, vehicle-infrastructure (e.g., roads, signs, signals, monitors), and other vehicular communications purposes.
- One segment of this band was intended for use by emergency vehicles and their tracking and alerting requirements with other vehicles during emergency vehicle operations.

- Overall increased situational awareness: Increased use of GPS, Enhanced 911 for cell & VoIP, more involvement of video and data ‘pull’ & ‘push’. Picture, video, GIS mapping, real time. Use of “reverse 911” systems to alert and give direction to the public (before they initiate access to the 911 system).

- FirstNet - (US) nationwide public safety broadband network
  - Created under Middle Class Tax Relief and Job Creation Act of 2012 (MCTRJCA) as an independent authority within National Telecommunications & Information Administration (NTIA).
  - Purpose to establish, operate, and maintain an interoperable public safety broadband network.
  - Congress allocated $7 billion and 20 MHz of valuable radio spectrum to build the network.
  - FirstNet requires there be a single point of contact for public safety broadband network development. Every state should have a SCIP (Statewide Communications Interoperability Plan), coordinated by statewide interoperability coordinator, which serves to enhance local interoperability developments.
Section V: Finance and Public Interfaces

91: Principles of finance, 227

- EMS Act initially provided federal funds, but now managed by each agency for themselves
- Most of the cost of EMS is the cost of labor
- Three truths:
  - Cost ≠ Charge ≠ Reimbursement
  - Direct cost ≠ Full cost
  - Operational efficiency ≠ Clinical quality
- **Direct cost**: can be traced to actual delivery of particular service or product
  - e.g. fuel, medical supplies, labor
- **Indirect cost**: cannot be traced directly. e.g. admin labor, taxes, HR, legal, medical director
- **Shared cost**: shared between agencies or services
  - Direct shared e.g. loaned vehicles
  - Indirect shared e.g. shared facilities such as comm center
- **Full Cost** = direct + indirect + shared
  - e.g. = direct (labor, medical supplies) + indirect (QI, admin) + shared (comm center)
- **Average Cost**: total cost divided by the number of products or services produced
  - Total cost divided by responses vs transports
- **Fixed cost**: doesn’t change with increased production or call volume over a given time period
  - e.g. medical director salary, rent (do not change with number of calls)
  - If increased unit production, fixed cost will contribute less to cost of transport (see below)
- **Step fixed costs**: Cost of production is flat until capacity is met. After max production capacity reached, meeting additional demand requires the cost of adding additional unit and its associated costs
  - e.g. ambulance purchase is a step ‘fixed’ cost. Think of calling in an extra doc in ED, helps temporarily but then creeps up again and you have to call another in, creates sawtooth pattern
- **Variable cost**: changes with each unit of production or activity e.g. fuel, maintenance, disposable medical supplies. This cost is lower for EMS than that for other industries
  - Contributes more to total costs with increased utilization or production
  - All costs become variable if analyzed over long enough timeline
• **Marginal cost**: cost of producing or providing one additional unit of a service or product
  ○ Often nonlinear and depends on capacity
    ■ e.g. ambulance with unused response capacity, being used to respond to one additional call is minimal. But if all units are used, responding to additional calls means calling in another crew and vehicle etc.

• **Depreciation cost**: Loss of value over time in a tangible asset over its functional lifetime.

• **Cost Per Capita**: Total system cost/total population served
  ○ Indicates cost to community, not efficiency.

• **Opportunity cost**: Reflects the foregone choice.
  ○ e.g. $15,000 per hour to train providers in CPR (option A) = same cost to provide 600-unit hours of ambulance coverage (option B) but at expense of the providers knowing latest CPR techniques (the value of A).

• **Sunk cost**: a cost already incurred that cannot be recovered.
  ○ Do not take sunk cost into account in decision making regarding budgeting to meet a need

**Productivity Analysis**

• Productivity = measure of output divided by measure of inputs

• Unit Hour utilization
  ○ U = Utilization: # of transports
  ○ UH = Unit hour: fully equipped and staffed ambulance(s) on response or available for one hour.
  ○ e.g. 30 ambulances available for 24 hours is 720-unit hours

• UHU = Unit hour utilization: #transports / (#ambulances * #hours)

\[
\frac{U(\text{utilization})}{UH(\text{unit hours})} = \text{Unit hour utilization}
\]

**Cost of Production**

• I.e. Cost per transport: (cost per unit hour * unit hour) / transports

\[
\frac{\text{Cost per unit hour}}{U / UH} = \text{Cost per transport}
\]

• **Economies of scale**: reduction in per unit cost secondary to increasing size or scale of operation where the cost of producing the next unit of service is less than the average cost of previous units.
  ○ e.g. comms that can manage 10 units that consolidate a five-unit and neighboring four-unit system reduces per unit costs of dispatch.
92: State EMS offices, 237

- In response to 2006 IOM report describing fragmentation in EMS systems, NASEMSO described a model EMS system organized into 10 subsystems:
  1. System leadership, Organization, Regulation and Policy
  2. Resource Management - Financial
  3. Resource Management - Human Resources
  4. Resource Management - Transportation
  5. Resource Management - Facility and Specialty Care Regionalization
  6. Public Access and Communications
  7. Public Information, Education, and Prevention
  8. Clinical Care, Integration of Care, and Medical Direction
  9. Information, Evaluation, and Research
  10. Large-Scale Event Preparedness and Response

- State EMS office should be located within a lead agency such as the Department of Health (most common) or Department of Public Safety. Four key positions:
  - State EMS System Director - execution of statutory responsibilities
  - State EMS Medical Director - a licensed physician responsible for medical oversight
  - State EMS Advisory/Authority Body - multidisciplinary board for the agency
  - State EMS Medical Committee - members provide medical expertise to the agency

- Each state oversees its own EMS standards, certification, vision etc. States may be able to waive or exempt an EMS agency or provider from requirements within its rules or regulations (usually this is for letting provider practice when in the best interest of the public).
  - Requirements of a specific state statute must be followed.
- All states’ EMS offices are members of NASEMSO (National Association of State EMS Officials).
  - NASEMSO Mission - to support members in developing EMS policy and oversight.
  - Strategy involves all states and territories as well as serving as national advocate.
  - Ultimate goal is to have orderly and coordinated EMS across the country.

- Policy - a principle or rule to guide decisions and achieve rational outcomes
- Procedure - action that is executed in the same manner in order to obtain the same result
- Guidelines - rules set to guide behavior or offer best practice suggestions (advisory, not mandated)
- Standards - requirements that must be met to achieve a designated purpose (set by government or accrediting - body; may be mandatory or voluntary)

- Scope of practice - a description of what a licensed individual legally can and cannot do (vested by state)
  - National EMS Scope of Practice Model published by NHTSA in 2007 sets consistent criteria for competencies for various levels of EMS providers across the US
  - An EMS provider is only permitted to undertake the skills and roles for which the individual has been
    - Trained (ideally at an accredited EMS education site)
    - Certified as competent (NREMT)
      - demonstrated the national entry-level standard for competence.
      - Certification exam must be “psychometrically sound and legally defensible.”
■ **Licensed** to practice (required to practice by the state)
  - Ensures any additional elements of competency as required by the state, meets educational and experiential requirements, and passes generally required background checks.

■ **Credentialed** by the EMS medical director (credentialing): the act of making a clinical determination that an EMS practitioner is competent in the knowledge, judgment, and skills required to provide patient care at a specific level within the EMS agency.
  - responsibility of local EMS leadership to ensure that EMS personnel have and maintain competence in the non-technical aspects of EMS care (reason why some systems have “check rides” with oversight before medical authorization)

- **Resource Management:**
  - Financial - funding varies among states and may include money from state tax monies, cash funds earmarked by state (i.e. MVD registration fees), licensing fees, federal funds.
  - Human Resources - State Statute/Lead Agency typically sets requirements for certification, licensure, and reciprocity
    - 2014: The EMS Compact: A state must enact legislation to approve.
      - Overseen by the Interstate Commission for EMS Personnel Practice.
      - Participation within the compact allows state EMS offices to legally recognize EMS personnel licensed in any other member state
        - 2020 EMS Compact Commission approved the use of the compact.
        - EMS personnel licensed in compact states can practice in other compact states (remote states) without getting an EMS license in the remote state.
  - Transportation - State EMS should have protocols for inspecting and licensing ground, air, and water EMS vehicles.
    - Each state EMS office develops standards for equipment carried on each licensed vehicle.
    - Every state EMS office should provide technical assistance to develop plans for transportation capabilities for mass casualty incidents and disasters.

- Facility and specialty care regionalization - in certain states, legislative authority is available for state EMS offices to assess hospital capabilities.
States generally recognize specialty receiving center using accreditation status provided by an organization or private entity (i.e. ACS verified trauma centers), but some develop internal standards.

- Public access and communication: State EMS should develop a communications plan that integrates the EMS agencies with the major communication system
  - Considerations for statewide interoperability
  - State EMS offices should ensure that the EMS system users of communication devices understand the National Incident Management System (NIMS)
    - interoperability is planned using the U.S. Department of Homeland Security SafeCom Interoperability Continuum.
- Some states have developed mandatory statewide protocols:
  - Pros: Uniform standard of care and disaster response, ease of education, up to date, evidenced based, local MD can spend time/energy into education, QI, other activities
  - Cons: Local Medical director loses control, may not recognize local needs, restricts “cutting edge” care, may not be up to date.

  - NASEMSO has suggested that the model state EMS system lead agency should “establish statewide performance measures related to patient care,” “define medical director responsibility and protection of liability through statute,” and “enforce utilizing well-defined standards, policies and procedures (including protocols) for all prehospital clinical practice.”
  - With federal funding support, NASEMSO has developed National EMS Model Clinical Guidelines, from which agencies, regions, or states may create and update their treatment protocols

Research and data: State EMS should collect data and use this to develop statewide EMS plans, when addressing EMS system issues, and when facilitating EMS performance improvement efforts and research.

- National EMS Information Systems-compliant data elements

**Large-scale event preparedness and response**

- State EMS services need to use all-hazards-approach to participate in prep for large scale events
  - All types of disasters (not separate plan for e.g. lightning strike, and hurricane, etc.).
  - Scheduled mass gatherings
  - High profile events

- Resource sharing during disaster or MCI
  - Emergency Management Assistance Compact
  - NIMS
  - Other contract agreements
Public Health:
- Focus on prevention of disease and injury
- Communities and populations
- Identify the causes of disease and disability and implement large scale solutions.

Epidemiology - the study of the distribution (frequency, pattern) and determinants (causes, risk factors) of health-related states and events (not just diseases) in specified populations.

Programs highlighting the public health and EMS intersection: (examples) car seats, bike helmets, fall prevention, mass vaccination programs, bystander naloxone administration

- Surveillance: collection of data about a community to monitor disease or health status
  - Estimate the magnitude and scope of health problems (e.g., sudden cardiac arrest),
  - Detect epidemics and changes in health behaviors (e.g., opiate use and opiate overdose in a community),
  - Identify patients and their contacts for treatment of a contagious disease (e.g., SARS-CoV-2),
  - Monitor changes in infectious and environmental agents (e.g., seasonal influenza),
  - Assess effectiveness of programs and control measures (e.g., bystander CPR on cardiac arrest survival or the use of social distancing and face coverings on COVID-19), and
  - Develop hypotheses and stimulate future research.

- Syndromic surveillance: the early identification of potential illness clusters based on symptoms before official diagnoses are confirmed and reported to public health agencies.
  - Some agencies have implemented surveillance software applications that operate in near real time to analyze threats that may be in progress.

- Cardiac arrest as an example of public health emergency:
  - Public access defibrillation (PAD) programs and crowdsourced community CPR.

- Community Paramedicine and Mobile Integrated Healthcare
  - MIHC- interdisciplinary health care network of healthcare providers
  - Programs across the country are seeking creative ways to utilize the unique skill set of paramedics and their position within the communities.
94: EMS physicians as public spokespersons, 253

Basic Assumptions:
- An EMS physician is the appropriate spokesperson and has received clearance to make the statement
- In cases of specific patients, notify the patient and family first and gain permission.
- Reporting proactively may minimize the effect of the information that is eventually disclosed to the public
- Be a sincere patient advocate

The Effective Sound Bite
- Three-part format: definitive opener, short core explanation, parting resolve
- Often only 10 seconds total—so message must be succinct
- Avoid repeating negative aspects of the question—focus on the objective you wish to communicate
  - Is it true that if we don’t get this new equipment many people will die?
    - Absolutely! (definitive opener) This equipment will make doing XYZ possible. Many lives will be saved due to this!

Dealing with Print versus Electronic Media
- Electronic media allows information to be rapidly reproduced and disseminated
- Print stories—may consider asking interviewer to call back after writing the story in order to check for accuracy and if the point was understood
- Live is more accurate, as you can not be paraphrased, however can be less ideal to get your point across without being repetitive

10 Golden Rules
- Always tell the truth, but do it in a 10 second soundbite
- Respond quickly and accurately, and become a readily available, familiar and helpful resource
- Be a human being: act like one and talk like one
- The glass is half full on issues, less optimistic on individual patients
- Make others look good and you will look good
- Provide a good “Hook;” suggest a simple valuable lesson
- Provide simple statistics and graphics
- Stay on the mark: remember the three Rs of repetition, redundancy, reiteration
- Don’t trust everyone- there is no such thing as “off the record”
- Anticipate the worst and expect mediocre
Section VI: Extraordinary Circumstances

95: Incident Command System and National Incident Management System, 265

- ICS: key to interface between EMS and public safety entities.
  - Modular and scalable
  - Connected through information networks, not necessarily physical location
  - Organizational structure is malleable and determined by needs of the incident and mission

- NIMS is designed to coordinate multi-agency, multiple jurisdictional responses to large scale emergencies.

- ICS developed in the mid-70's by Firefighting Resources of California Organized for Potential Emergencies (FIRESCOPE) to deal better with multi-jurisdictional wildland fires.
  - Fireground Command System (FCS)- developed out of FIRESCOPE for use in all fire department emergency incidents involving more than a single company response.

- All responsibility for every aspect of response to an incident belongs to the Incident Commander until it is specifically delegated.
  - In order of priority, priorities are life safety, incident stabilization, and property and environment conservation.

- Unity of command is important (each team member reports to only one person).

- Span of control no leader anywhere in the organizational structure is directly responsible for more than three to seven (optimally five) personnel or functions.

- Job Action Sheets should be available to each command team member to use as a documentation and decision-making reference

- Unified Command is utilized when multiple agencies with multiple jurisdictions respond to an incident (does not overrule the IC’s command role). Instituted with senior representatives of each stakeholder agency or government present in the command post who serve as the IC for their jurisdiction or agency.
  - The unified command speaks with one voice as the IC for the situation, and any differences in priorities or tactics are worked out among the individual ICs that make up the unified command.

- Orderly transfer of command is needed when discrete phases of a response are completed.

- Sections are organizational levels with responsibility for a major functional area of the incident
ICS sections are FLOP: Finance, Logistics, Operations, and Planning.

Head of a section = Chief (e.g. logistics section chief)

- **Groups** are established to divide the incident management structure into *functional* areas of operation.
  - Unlike sections, groups are not predefined in ICS and can be designated based on specific functions required by the incident. (e.g. search and rescue group, triage group..)
  - Lead by a group supervisor (triage group supervisor)

- **Divisions** are used to divide an incident geographically
  - e.g. West division. Sides of railroad track or floors in a building.
  - Lead by a division supervisor (triage group supervisor)

- **Branches** are used when the number of divisions or groups exceed the recommended span of control, e.g. EMS branch: Supervise multiple groups with EMS-related functions— triage group, treatment group, transport group— Think tree diagram
  - e.g. Medic treating patients on scene would be in medical BRANCH of ops SECTION.
  - e.g. Fly car EMS MD’s would be in service BRANCH of logistics SECTION.
  - Branch is led by branch director

- **Units** are organizational elements that have functional responsibility for a specific activity
  - e.g. supply unit. Unit can be multiple strike teams or multiple task forces

- **Single resources** are defined as an individual *piece of equipment* with its personnel components
  - e.g. ALS ambulance

- **Task Forces** are combinations of *mixed resources* with a common communications capability and a leader.
  - (e.g., four engine companies, four police officers, and a public health epidemiologist)

- **Strike Team** is a set number of *similar resources* with common communication and a leader.
  - E.g. 5 tankers for water supply.

- **Command staff** include Safety, Public Information and Liaison Officers. Liaison helps

  - Safety officer is only person who can override incident commander
  - Public information officer (PIO)- interacts with media personnel and the public
  - Liaison Officer- a conduit for two-way information between the IC and representatives of other responding agencies that are not part of the usual emergency response structure.

- **Joint Information Centers** are usually established in large incidents to coordinate the efforts of the
responding agency's PIOs. Usually off site.
For any mass gathering event, the overall goals of medical care include the following:

- **a)** Evaluate and stabilize injury and illness in participants, support staff, and spectators involved in the event, consistent with the standard of medical care in the surrounding local community;
- **b)** Preserve the capacity of the local public health and acute medical care systems to serve their local constituents, through pre-event hazard identification, risk assessment, and use of these results to mitigate risks, reduce morbidity, and determine appropriate levels of resources and expertise dedicated to the event;
- **c)** Optimally respond to extraordinary or catastrophic events, through use of the incident command system (ICS), as defined in the National Incident Management System guidelines for the management of MCIs.

**Challenges include**
- coordination of multiple agencies
- densely clustered populations
- Increased potential for MCI

**Risk management considerations**
- Overcrowding and crowd control
- Event access points
- Fire safety measures
- Medical preparedness
- Emergency response

**Event planning**
- Timeline (adequate time to prepare, preplanning, planning, operations and postevent review)
- Resources (based on e.g. #people, age, environment, substance use, length/nature of event)
- Stakeholders (include those with funding and authority to plan)
- Regulations
- Medical plans (minimize stress on local EMS system)
- Environmental factors
- Public Health Surveillance
- Documentation of patient encounters
- Communications
- Disaster Preparedness (have predesignated ICS roles and a plan)
- Post event Review
### Table 96.1: Mass gathering event descriptors and resource needs

<table>
<thead>
<tr>
<th>Event descriptors</th>
<th>Characteristics associated with decreased resources</th>
<th>Characteristics associated with increased resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location footprint</td>
<td>Single, fixed site (e.g., art festival)</td>
<td>Multiple sites or site moving during event (e.g., a road race)</td>
</tr>
<tr>
<td>Venue</td>
<td>Event focused, enclosed with easy access (e.g., a sports stadium)</td>
<td>Non-event focused, with access issues (e.g., a marathon through city streets)</td>
</tr>
<tr>
<td>Purpose</td>
<td>Celebratory (e.g., a seasonal sports championship competition or celebration)</td>
<td>Highly emotional focus (e.g., political protest)</td>
</tr>
<tr>
<td>Size Participants</td>
<td>Small</td>
<td>Large</td>
</tr>
<tr>
<td>Activities</td>
<td>Screened attendees with similar health profiles to the general population (e.g., charity fund-raising cycle events)</td>
<td>Unscreened attendees with potential special needs (e.g., 1970s rock band concerts with elderly fans)</td>
</tr>
<tr>
<td>Duration</td>
<td>Short, or longer duration but with frequent breaks (e.g., America's Cup several-month sailing competition)</td>
<td>Long, with no breaks for participants to rest or access normal health care (e.g., endurance athletic events)</td>
</tr>
<tr>
<td>Timing</td>
<td>Slow onset, with adequate time for planning and modification if needed due to changing risk factors (e.g., political convention)</td>
<td>Rapid onset, little or no preplanning or ability to cancel event (e.g., unexpected win by sporting team with spontaneous community celebration)</td>
</tr>
<tr>
<td>Transport to Hospitals Rate (TTHR)</td>
<td>Low stress, with ability to rest (e.g., street fair)</td>
<td>High stress for attendees (e.g., physical–warm weather event, or psychological–confrontation anticipated during event)</td>
</tr>
</tbody>
</table>

### Determining Event Resources
- Emphasis on reconnaissance and review of prior event records
- Rock concerts longer than 6 hours with mobile spectators have more medical calls.
- Patient Presentation rate (PPR) or Medical usage rate (MUR) per 1,000 (or 10,000) is a common metric. 0.5-2 PPR is normal
- Transport to Hospitals Rate (TTHR) is defined as the number of patients from the event transported to local or regional hospitals per 10,000 attendees.

### Medical risk assessment: should consider the event features, environmental factors, participant characteristics, venue characteristics, and regulations

- Medical resources may include combination of fixed and mobile medical resources as well as first-aid only and skilled (medic or physician) resources
  - EMT level of care at a minimum, may be most valuable in mobile roles
    - Guidelines suggest at least 1 mobile team per 20,000 spectators
  - one physician for 5,000-50,000 spectators, one nurse for 2,600-15,000 spectators, and one EMT for every 2,600-65,000 spectators (not evidence based)
  - BLS/first aid-trained responder within 4 minutes, an ALS responder within 8 minutes, and transport to a medical facility within 30 minutes (Alternative staffing model- also not evidence based)
  - MDs should be on site if transport limited or long, large # of spectators or high risk of injury activities. MD onsite may decrease need for transport.
  - Fixed on-site facilities must meet fire and other applicable building codes, locations announced to event participants, and have provisions for security.

### Care Teams

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Jump to Contents
● First aid teams:
  ○ Sobering team
  ○ Mobile teams (1 mobile team per 20,000 spectators)
  ○ Transportation teams

● At least 1 source of free potable water for every 1.5K participants.

● Delineation of egress/ingress routes for both medical casualties and equipment resupply encouraged.

● Converting from Mass gathering to MCI:
  ○ Activate the event emergency plan
    ■ First responders communicate: nature of incident, identified hazards, estimated potential number of patients and injury patterns, resources needed, and best route of ingress and egress.
    ■ Command center communicates with local PSAP to activate local/regional MCI plan
    ■ Each clinician will transition to the predesignated mass casualty officer role
    ■ Mobile teams will perform initial triage of patients
    ■ Predesignated staging/transport area should be activated
Disaster preparedness and management, 283

- **Disaster**: Natural or man-made event that causes losses such that a community cannot adequately respond without outside assistance.
  - Natural Hazards - flood, hurricanes, wildfires, pandemics etc
  - Technological/accidental Hazards - biological food contamination, chemical spills, dam failures, radioactive spills
  - Adversarial/human caused threats - aircraft as a weapon, bioterrorism, explosives, nuclear attacks, radioactive attacks.

- **Presidential Policy Directive 8 (PPD 8)** - guides the nation's all-hazard response to disaster.
  - Provides the "National Response Framework" with 5 defined mission goals
    - Prevention
    - Protection
    - Mitigation
    - Response (Includes public health and medical services)
    - Recovery

- **NRF and NIMS are interrelated**
  - NRF = Structures and mechanisms for incident management policy
  - NIMS = National Incident Management System = templates for management of incidents, flexible but standardized.
  - Both established via HSPD 5

- **NIMS has 5 major components. Training available through FEMA, may be required for some medical directors.**
  - Preparedness
  - Communication and information management
  - Resource management
  - Command and management (Incident Command Structure = ICS)
  - Ongoing management and maintenance (by the federal government)

- **Disaster response requires effective integration between multiple resources, i.e. federal, local, private, NGO. examples:**
  - Medical Reserve Corps (coordinated by DHHS, national network of local groups)
  - Community Emergency Response Teams (locally educated and coordinated by FEMA)

  - Major Disaster Declaration
  - Emergency Declaration (limited, can be declared in advance)
  - State resources overwhelmed, Governor requests to President -> FEMA administrator + Secretary
of Homeland Security make recommendations -> President makes declaration
  ○ The Department of Homeland Security, through FEMA, develops NDMS mission assignments in the context of the NRF, and funds NDMS operations under the Stafford Act.

- **National Disaster Medical System**
  ○ federal system coordinated by the Department of Health and Human Services (DHHS), in partnership with the Department of Homeland Security, the Department of Defense, and the Department of Veterans Affairs to provide disaster medical care
  ○ deployable response teams, patient movement, and definitive medical care.
  ○ Includes: DMAT, NMRT, IMSURT, DMORT, NVRT

- The Department of Defense (DoD) is responsible for patient movement using the US Transportation Command (USTRANSCOM).

- NDMS Team members
  ○ Volunteers, required to maintain the certifications and licensure appropriate for their discipline.
  ○ Can be activated as intermittent federal employees, which affords them pay, workmen’s compensation coverage, and protection under the Federal Tort Claims Act (any civil complaints are defended by the federal government)
  ○ Certifications and licensure are recognized in all states when members are federalized.

- **Disaster medical assistance teams (DMAT).**
  ○ DMATs are composed of professional and paraprofessional staff organized and resourced to provide medical triage, treatment, and preparation for transport when needed.
  ○ Teams are composed of 35–50 personnel, including physicians, nurses, mid-level practitioners, paramedics, behavioral health specialists, logistical support personnel, and others.
  ○ Teams are designed to be self-sufficient for 72 hours, with personnel typically deploying for 14 days.

- **National medical response teams (NMRT).** NMRTs are trained and equipped to respond to weapons of mass destruction incidents. They are designed to provide patient decontamination and specialized treatment and care for survivors of CBRNE events.

- **International medical/surgical response teams (IMSURT).** IMSURTs deploy at the request of the Department of State to treat survivors of disasters outside the borders of the continental United States.

- **Disaster mortuary response teams (DMORT).**
  ○ Deployed to provide technical assistance and personnel to identify and process deceased victims, under the guidance of local authorities.
  ○ Disciplines represented include funeral directors, medical examiners, pathologists, fingerprint specialists, forensic odontologists, mental health specialists, and others.
  ○ The federal government also maintains three deployable disaster portable morgue units (DPMUs)
• **National veterinary response teams (NVRT)** also exist to take care of the little critters

• Changing in standards of care
  ○ Governmental declarations, ethical and legal options
  ○ Credentialing changes
98: The federal medical response to disasters, 293

- Disaster Declaration (Stafford Act) confirmed by president - FEMA in charge
  - May activate additional resources and annexes

- Surgeon General via public health service has deployable resources e.g.
  - RIST - regional incident support team
  - NIST - national incident support team
  - RDF - rapid deployment force
  - EMG - emergency management group
  - IRCT - incident response coordination teams

- **Local jurisdiction responsible for organizing and managing the emergency response**

- The guiding federal document: **NRF**
  - Includes Core Document and 3 annexes, how-to guide.
    - Emergency Support Function Annexes (14 total, includes ESF8)
      - Primary operational level mechanism for federal response
    - Support Annexes (8 total)
      - Coordinating agencies (functional and administrative)
    - Incident Annexes (7 total)
      - Specific resources for types of incident (terrorist, cyber, mass evacuation, etc.)

- **ESF 8 - Public Health and Medical Services for an incident**
  - DHHS is coordinator and primary agency
  - **Incident Response Coordination Teams** (rapidly deployable, begin initial response)
  - National Disaster Medical Service (= DOD+FEMA+Dept Vet Affairs+DHHS)
  - US Public Health Service & Commissioned Corps Officers, Tiered Response
    - **RIST (rapid incident support team)**, <4hrs, local response, coordinate federal response
    - **NIST (National incident support team)**, RIST that is deployable nationwide
      - RIST+/NIST hand off to IRCT when in place
    - **RDF (Rapid deployment force) initial medical care response**
      - 125 personnel, staff federal medical stations (cached 50-100 patient sub-acute medical facility deployed on need)

**Legal Authorities**

- Emergency Management Assistance Compact
  - **Temporary recognition of licenses, certifications, and other permits from the sending state by the receiving state.**
  - Covers all US states, territories, possessions, and the District of Columbia
  - If a state’s resources are overwhelmed, that state’s governor will issue a declaration of emergency
specifically detailing the circumstances and remedies requested from other states

- **Stafford Act (Public Law 100-707)**
  - Guidance for disaster declaration. See Chapter 28 description

- **Pandemic (Public Law 109-407) and All-Hazards Preparedness (Public Law 113-5) aka PAHPRA**
  - Authorizes the Secretary of HHS to temporarily waive or modify certain provisions of those programs during a presidenally declared disaster or national emergency.

- **Social Security Act (Public Law 74-241, as amended, 42 USC 7, et seq)**
  - Created Medicare, Medicaid, DHHS
  - Authorizes modification to DHHS programs if president declares an emergency or disaster

- **Homeland Security act of 2002 (Public Law 107-296)**
  - Established the Department of Homeland Security and gave it the authority and responsibility to coordinate all federal homeland security activities.
  - Multiple agencies merged into single department. FEMA had been primarily responsible for coordinating federal response to major incidents, and was one of entities integrated into DHS.

- **National Guard (Title 32 of US Code)**
  - National Guard forces are allowed to perform civil support operations that are funded by the federal government, while remaining under the control of their governor.
    - Examples include weapons of mass destruction civil support teams (WMD-CST) and Presidential/Secretary of Defense approved operations (e.g. the Border Security Mission in the Southwest).

  - Assigns Secretary of the DHS as the principal federal official for domestic incident management in response to and/or recovery from terrorist attacks, major disasters, or other emergencies.
  - Federal government will assist state and local authorities when their resources are overwhelmed or when federal interests are involved.
  - Established NIMS and the NRF.

- **Presidential Policy Directive 8 (PPD-8): National preparedness**
  - Recognizes the shared responsibility of the government (local, state, and federal) as well as the business community and individual citizens in fostering a secure and resilient nation.

  - Addresses preparedness for natural and man-made catastrophic health events that overwhelm the capabilities of immediate local and regional response and health care systems.
    - e.g. pandemic influenza
• Mass casualty triage occurs when there is more than one casualty, and the provider must decide where to place available resources. Adapted to civilian use from military organizations.

• Nearly linear relationship between over-triage and poor patient outcome.

• Decisions regarding selection of triage systems, typically decided at the local level, lead to concerns about interoperability. This spurred the creation of the Model Uniform Core Criteria (MUCC)
  o minimum standards that triage systems should incorporate to ensure interoperability

• Most triage systems utilize the following 5 categories: immediate (red), delayed (yellow), minimal (green), dead (black) or expectant (no color given, or folded over tab).

• SALT (Sort, Assess, Lifesaving interventions, Treatment and/or transport) endorsed by ACEP, and currently the only triage system known to be compliant with MUCC. Initial life-saving rapid interventions include hemorrhage control, airway opening, needle chest decompression and auto-injector antidotes (only if within the provider’s scope of practice).

Figure 99.1 SALT triage scheme. LSI, life-saving interventions
START triage is currently the most widely used in the United States:

- Whichever system you use, needs to be able to change bidirectionally e.g. yellow to red by folding is better than previous stickers that replaced and covered up previous triage category.

- Casualties should be re-triaged at each phase and level of care. Reprioritization is dynamic and may change based on available resources, patient conditions or scene safety issues.

**Box 99.1** What principles should guide ventilator allocation?

- Basic biomedical ethical principles:
  - Respect for persons and their autonomy
  - Beneficence
  - Justice

- Specific ethical considerations:
  - Maximizing net benefits
  - number of lives saved
  - years of life saved
  - adjusted years of life saved
  - Social worth:
    - broad social value
    - instrumental value
    - Life cycle principle
    - Fair chances versus maximization of best outcome
Disaster: A situation in which the severity of damage (including to the emergency response system) or the number of patients exceeds the ability of scene responders and local management authority to provide immediate management.

Multiple casualty incident: A situation with numerous patients that does not overwhelm the routing capacity of the system.

Mass casualty incident: A large incident typically involving many victims and requiring a multiservice response that, by its volume or circumstances, overwhels or threatens to overwhelm the capabilities of the local emergency response situation.

- The National Incident Management System (NIMS) provides a consistent approach for all levels of government and the private sector to work together to prepare for, respond to, and recover from domestic incidents.

- HSPD-5 identifies core concepts of NIMS:
  - The incident command system, ICS
  - Multiagency coordination systems
  - Unified command
  - Training
  - Management of resources
  - Qualifications and certifications
  - The collection, tracking, and reporting of incident information and incident resources
Figure 100.1 Incident command system organizational chart for unified command. Source: Barbera JA, Macintyre AG. Medical Surge Capacity and Capability: A Management System for Integrating Medical and Health Resources During Large-Scale Emergencies. 2nd ed. Knebel A, Trabert E, editors. Washington, D.C.: Department of Health and Human Services, 2007.

Figure 100.3 Role of medical director.
Medical director is usually in an advisory or consulting role to the incident commander during a disaster. Role also includes the responsibility for the agency’s mitigation and preparedness strategy.

Medical director’s approach to disaster management

- 1) facilitating investment in everyday infrastructure;
- 2) integration into an interagency command structure to facilitate an effective EMS system response;
- 3) adapting to a less operational and more advisory role;
- 4) continuously advocating for and facilitating appropriate multi agency responses through preparedness and making improvements based on findings related to reviewing previous incidents.
- mitigation and preparedness strategy.

Mitigation activities involve reducing the potential for a disaster to occur or reducing the potential effects of a disaster. (Ex: Hospital is resistant to earthquakes, generator above flood line, etc.)

Preparedness activities- enhance an organization’s capabilities to respond and recover in the event that a large-scale event does occur. (ex: mass casualty training drills in hospitals)

- Identifying key resources, personnel, and agencies and establishing collaborative relationships between them.
- Developing policies and protocols that address daily operations as well as surge-level operations and training and evaluating personnel on these protocols.
- Implementing a data and communication infrastructure that addresses daily prehospital needs and that is scalable during a mass casualty incident.
- Ensuring that adequate quality assurance processes exist to review the responses to previous incidents and facilitate future improvements based on past experiences.
- Common points of failure tend to be fundamental aspects of disaster planning:
  - Communications systems
  - Resource distribution
  - Organizational structure

Policy, protocol and training development for MCI

- Well-designed MCI protocol should reinforce responder’s ability to recognize and escalate an MCI, establish roles in command structure, and appropriately triaged transportation resources
  - Quantify and define an MCI - even a small MCI can overwhelm an ED or prehospital system
  - Dispatch of appropriate transport, communication, supplies
  - Emphasis on role of triage and transportation officers
  - Triage systems
  - Patient tracking
  - Continuity of everyday 911
  - Mutual aid and interagency response

- Medical directors should plan for rare but extremely disruptive events (extreme weather, biologic attack).
- Medical director must provide training and drills
Evidence-based improvement requires periodic formal evaluation.

**Intelligence and Communication Infrastructure**
- MCI plan should account for failure of cellular systems, wireless electronic medical records systems and patient tracking systems
  - Prepare for 800mHz and VHF radios
  - Paper and pencil backups as necessary
- Interoperability may be a major issue - leading to a weak point in communication during MCI
- Medical director role in MCI communication is mainly in mitigation:
  - The medical director, as a liaison to other agencies, state agencies, health care leaders, and EDs, can use role as patient advocate to help unify technology and policy.
  - Should facilitate ability to collaborate and communicate
  - Consultant to translate issues of staffing, diversion, surge capacity, etc.

**Incident Command Structure - most commonly involved in the medical branch of ICS**
- Triage: quickly and consistently assess and catalogue patients. The simplicity of all the systems e.g. SALT, START allows them to be taught to every level of prehospital provider.
  - Establish staging areas
  - Establish patient collection points
  - Establish temporary treatment areas
- Treatment: on-scene care is necessary for both critical and noncritical patients awaiting transport.
  - Non-transporting ALS resources should be directed to treatment areas, freeing up ALS resources for critical transports.
  - Medical director should be used for advanced procedures and guidance for treatment questions
- Transport:
  - Transport officer, should attempt to distribute patients to multiple locations when possible.
  - Noncritical patients should be directed to alternative sites (level II or III Trauma centers).
  - Communication strategy should allow for continuous feedback from hospitals to EMS.

**Resource Escalation**
- Request for additional resources should be escalated up through ICS structure. It is most effective to bolster everyday activities and form collaborative partnerships. Mutual aid may help
- Recovery
  - Includes disaster aftermath up to return to normal operations.
- Patient tracking and reunification:
  - Tracking is in purview of the medical director and robust tracking mechanisms should be in plan
  - Account for failures and build in redundancies
  - Medical director should work with local and national organizations.
- Mental Health - Consider transitioning providers to employee assistance or crisis intervention resources.
● **After-action Review - critical component of MCI recovery**
  ○ Begins with fact finding and information gathering
    ■ 911 and radio communication (with dispatch, and with hospital)
    ■ Initial ICS structure and any changes
    ■ Patient contacts and times, and transport and distribution
    ■ Apparatus response

● Healthcare coalitions - create roundtable for health care partners to share and collaborate. Large metropolitan areas are increasingly using coalitions as a critical piece of MCI infrastructure.

● Social Media - EMS and healthcare agencies should have media presence for information distribution (likely through PIO). may be primary go-to for community to find information

● Vulnerable populations - MCI planning must account for vulnerable subgroups.
  ○ 2007 study - Only 13% had pediatric plans
  ○ Also have to consider dialysis patients, elderly, and patients with access or functional needs.
Three overlapping phases in a cycle of planning for mass patient movement:

- **Estimate**
  - Physical characteristics - weather, terrain, etc.
  - Transportation modes, demands, and networks
  - Casualties
  - Resources required to move patients and the resources available
  - Threat identification (pre-ID known and potential hazards)
    - Notice (hurricane) and no-notice (earthquake or accident) events
    - Threat assessment (infrastructure impact, likely injuries, etc.)
- **Plan using estimate**
- **Execute plan**

Disaster medical evacuation variables:

- Compromised medical facilities
- Incident-related injuries or illnesses
- Preexisting conditions, including those residing in medical facilities
  - Includes patient needs (can they sit? Need oxygen?)
- Exacerbated problems from disruption of care
- Impact on vulnerable populations

Casualty collection points CCPs

- May be at sites a safe distance from the immediate threat, with access to transportation networks.
- Ambulances are collocated here or staged nearby.

Ambulance Exchange Points (AXP) - casualties transferred from one mode of transportation to another.

- Should have easy access to highway or road network, loading areas, medical support, communications, security, and landing zones.
- Federal coordinating centers used to transfer patients from evacuation flights to local hospitals are AXPs
- AXP may serve as a hub, maximizing evacuation capacity by receiving from multiple casualty collection points for longer distance transport.

If demand for evacuation exceeds available resource - request for assistance passed to the state; state can:

- Coordinate deployment from intrastate areas that are not threatened
- Execute contingency contracts with EMS providers
- Activate National Guard
- Request assistance from other states using the Emergency Management Assistance Compact (EMAC).

State governor can declare a disaster and request a declaration from the President

- The Robert T. Stafford Disaster Relief and Assistance Act gives the president ability to declare a national
disaster and authorize use of federal resources.

- Federal assistance for medical evacuation falls under ESF-8 of the National Response Framework.

NDMS

- partnership between Departments of
  - Health and Human Services (HHS)
  - Defense (DOD)
    - Patient movement and evacuation
  - Homeland Security (DHS)
  - Veterans Affairs (VA)
- Managed by HHS. Activated by the HHS Secretary in response to a public health emergency.
- Began in 1980s as mechanism to bring back mass casualties from a large-scale conflict and as a way to respond to a large civilian disaster
- VA and DOD regulate patient flow through over 60 Federal Coordinating Centers (FCCs) across the country.
- Network of over 1900 civilian hospitals nationwide voluntarily —reimbursed at 110% Medicare rate for each NDMS patient

- **Global Patient Movement Requirement Center (GPMRC):**
  - responsible for regulating patients from hospital to NDMS member hospital.
  - **Patient Movement Request (PMR)** is generated at the hospital and forwarded to state or local EOC who forwards request to GPMRC.
  - GPMRC sends request to the **Tanker Airlift Control Center (TACC)**, who matches aircraft with crew and patient needs, then GPMRC coordinates with state Emergency Operations Center and federal coordination centers

![Diagram of hospital evacuation by the National Disaster Medical System](image)

*Figure 101.2  Hospital evacuation by the National Disaster Medical System.*
102: Temporary treatment facilities, 205

Historically military field hospitals were established to care for wounded during battle

- Baron Dominique Larrey (Surgeon in Chief to Napoleon)
  - considered father of modern military medicine and EMS
- Can range from collection points to fully capable EDs to full field hospitals such as the 300 bed National Mobile Disaster Hospital developed by FEMA
- The type and design vary depending on the need: commonly at events to treat and release minor issues (decreasing demand on EMS), also first responder rehab (rest/rehydration up to full-scale clinics at prolonged events like forest fires)

Planned events (Mass Gathering Events, Ch 27)

- Type of event, expected attendees, and environmental conditions play a factor in needs, but major considerations include:
  - Minimal support requirements (power, water, lighting, and adequate space)
  - Expected demographics
  - Distance from and capabilities of nearby medical facilities
  - Alcohol or other intoxicants
  - Security concerns (i.e. political events)
  - Multijurisdictional coordination

Surge capacity: The ability to manage a sudden, unexpected increase in patient volume that would otherwise overwhelm current capacity.

Temporary facilities may be used to support hospitals and EMS systems in a disaster. This concept came to the forefront during the 2009 flu pandemic

- Commonly called "alternative care facility" (ACF) or "alternative care site"
  - Goal of keeping fewer ill patients from the hospital, preserving resources for critically ill
  - Unclear whether it is best on hospital campus or in another location
- Temporary facilities take time to set up, they’re not as efficient for no-warning events
  - Best created and deployed at community or coalition level (or higher) since a single facility/organization may have trouble providing adequate staff or supplies
  - Often needed long past the acute phase of disaster, especially if infrastructure is damaged.
  - Credentialing of providers should ideally take place prior to the event.
    - Medical Reserve Corps: www.medicalreservecorps.com
    - Emergency System for Advanced Registration of Volunteer Health Professionals (ESAR-VHP): www.phe.gov/esarvhp

Basic functions and operations of temporary facilities:

- Should be a coalition level project
- SOP should have defined trigger point for activation by EMS or other components of medical system to activate a temporary medical system. Also, trigger for when to demobilize.
- Must have understanding of incident management system model for interoperability
- Designated ingress and egress for patients, staff, and transport units
- Identification of facility location and hours of operation
- System to track patients, and system for maintaining medical records
- Need plan for decontamination, sanitation needs, supplies, site security
- Communications (redundancy important in case of disaster or MCI)
  - Way for PIO to contact public regarding location and hours of facility
- Staffing - advanced training as well as just in time training
  - Scope of practice does not change during a disaster
- Fixed structures vs deployable or field temporary
  - Fixed structures require check of structural integrity and restoration of utilities
  - Temporary include: pop-up, inflatable, shipping containers
  - Predesignated location - may be subject to rules and regulation, such as the Joint Commission and Americans with Disabilities Act
  - Should expect to have to follow all the usual rules and regulations of any other facility. Some high-level officials can suspend certain regulations in a disaster, but it is not a guarantee, and should not be expected
- Some federal DMAT teams have pre-developed and cached shelter facilities available
  - DMATs designed to function self-sufficiently for 72 hours
- Perishable supplies may be able to be exchanged with supporting hospitals/agencies, and stored in a manner to protect shelf life
- Trying to get people to bring own medical support devices and caretaker to help
Section VII: Special Hazards

103: Medical support for hazardous materials response, 339

- 75% Hazmat events are at fixed facilities. The few that are transportation-related are generally ground transport-related

- LEPC = local emergency planning committee: every town should have one to track what chemicals are where in the town

- MSDS: material safety data sheets - can be used after exposure to a toxin to identify specific risks.

- Title 49 of the Federal Code of Regulations: requires hazmat placards, but they may not be readily visible to first responders

- Levels of PPE:
  - A: Vapor/Aerosol Protection. Includes SCBA → only level that includes vapor protection
  - B: Gas protection, some vapor/aerosol (with SCBA external). On test, does not provide full vapor protection.
  - C: Liquid/splash protection, e.g. PAPR. Cartridge can be chosen to match type of chemical/category. Cartridges that cover more chemicals last less time.
  - D: Consists of usual Work Attire (provides heat protection in the case of firefighters but not chemical). Includes MRSA/trauma gowns

- Note: You don’t need to wear any PPE while setting up decon because by definition you are in uncontaminated warm zone
• **Decontamination**
  ○ **Physical**
    ■ Brushing, Scraping, Vacuuming, washing/rinsing, heat/steam clean
  ○ **Chemical**
    ■ ABSorption = using pads or absorbent towels to wipe the chemical off an area
    ■ ADSorption = the use of activated charcoal or other adsorbents to minimize the effects of chemicals
      ● Adsorption is a process where the product is chemically adhered to the adsorbent material. This is not to be confused with absorption in which the product is simply “soaked up.”
    ■ Degradation, Dilution, Evaporation, Isolation/disposal, Dissolving
    ■ Surfactants - Soaps- decrease adhesion of contaminate to surfaces
    ■ Neutralization - acids and bases
    ■ Oxidation, Solidification, Disinfection/sterilization

• **Rapid Mass Decontamination**
  ○ Self-care and gross patient decontamination procedures should occur as quickly as possible. Rapid mass decontamination practices can be achieved by simply saturating contaminated victims with massive amounts of water

• **Mass Decontamination** - Extension of rapid mass decon for large numbers of victims

• **Medical Decontamination**
  ○ immediate removal of victims from the hot zone and initiating the triage process in a less-contaminated environment.
  ○ Triage for decontamination should be based on the victim's proximity to the release site: first those exposed to vapors or aerosols, followed by those exposed to liquid forms, and then those with severe complaints or injuries.
  ○ Immediate, lifesaving medical care, such as airway support, hemorrhage control, and antidotal therapy if indicated, should be a priority over patient decontamination

• **Emergency Decontamination** - Emergent decon for unplanned exposure - ex. Suit breach.

• **Medical Monitoring**
  ○ Rehab
  ○ 4 physical system- before, yearly, exit and specific to exposure
104: Chemical properties of hazardous materials, 352

Types of contamination

- **Primary (source)** contamination vs **secondary (patient contact)** contamination
- **Overt exposure** - obviously contaminated or exposure is known
- **Covert exposure** - not obvious or no immediate knowledge of contamination

Categories (CBRNE)

- **Chemical (CBRNE)** - Usually overt; patients usually need formal decontamination.
- **Biological (CBRNE)** - Biological agents including bacteria, viruses, and biological toxins.
  - Almost always covert. (Exception: anthrax scare events that occurred in the wake of the 2001 anthrax attack)
  - Consider prophylactic treatment of the biological exposure for responders
- **Radiation/nuclear (CBRNE)** - Ionizing radiation is an energized particle (alpha particle, beta particle) or wave (x-ray, gamma ray) released from a nuclear or radioactive material, capable of breaking covalent bonds.
  - Ionizing radiation can cause illness when the covalent bonds of e.g. DNA are damaged.
  - Exposure to radiation alone does not result in contamination but can cause significant tissue damage → decon and PPE not necessary
- **Nuclear events** - can result in the release of radiation as well as the release of radioactive and nuclear particles with the potential to cause contamination and radiation-related injury. Contamination with radioactive material does not represent an acute medical emergency - onset to symptoms is delayed. So, remove the nuclear material ASAP, but stabilizing medical care should not be delayed for complete decontamination.
- **Enhanced conventional weapons (CBRNE)** - thermobaric weapon such as fuel-air bomb. Produces significantly greater blast. Consider blast injuries etc.

Categories of hazardous materials - Note that solids are least likely to cause widespread contamination and require less complicated decontamination procedures and a lower level of PPE, while vapors and gases will have the greatest potential to cause morbidity and require higher levels of PPE.

- **Solids** occupy a fixed volume and shape. Large solids are less likely to cause contamination as they are easy to detect and more difficult to move. However, small solids such as dust particles may be easily transferred from a single source to another object or individual and result in both primary and secondary contamination in an overt or covert manner. Usually **Level D PPE** with a simple particulate face mask is sufficient to protect responders from secondary contamination. Decontamination requires only removal of the solid. Washing with soap and water may be required to remove very small particles of a solid contaminant (exception: solid aerosols e.g. anthrax).
  - **Melting point** = temp at which the solid becomes a liquid. Most important physical property of solid

- **Liquids** occupy a fixed volume but not a fixed shape. Usually **Level C PPE** is sufficient. Liquid hazardous
Materials can be absorbed through skin or mucous membrane → decon is critical (exception is liquid aerosols).

- **Boiling point** = temp at which liquid becomes gas. Most important physical property of a liquid.

- **Gases** do not occupy a fixed volume or a fixed shape. Unless absorbed by a liquid or porous clothing, secondary contamination is rare. Usually **Level A or B PPE** is required to protect responders.
  - **Density** relative to ambient air is most important physical property of gas as it determines tendency to either disperse or settle in low-lying areas.

- **Aerosols** are very small solid or liquid particles which, when released into the air, remain suspended for a period of time, and thus behave like a gas. Responders should assume that **Level A PPE** is required to protect them from exposure. If the solid or liquid is not absorbed through the skin, Level B or C PPE with a “clean” air supply may be sufficient. Decontamination of aerosolized liquids or solids will likely require removal of the victim from the source and full decontamination using soap and water, etc.
  - **Mass** determines amount of time these particles remain in the air.
  - **Solubility**: the ability of that substance (the solute) to dissolve in another (the solvent).
    - Determined by the relative polarity of the solute to the polarity of the solvent → “Like dissolves like.”
    - Skin is made of cell walls with a lipid bilayer, so water-soluble molecules are less likely and lipid-soluble molecules are more likely to be absorbed through the skin.
    - Mucous membranes are opposite (water soluble will be more easily absorbed)
  - **Water solubility**: Because water is the most common solvent used in the decontamination process, this is very important. Water is a polar molecule, so will dissolve any other polar molecule or water-soluble molecule. Non-polar molecules will require an emulsificant (e.g. soap) to make micelles.

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105: Radiological and nuclear response, 358

- **Irradiation**: radiation enters and passes through the body as a field
- **Contamination**: radioactive materials collect on the *outside* of the body
- **Internal exposure**: radioactive materials *enter the body*

Alpha and beta rays have low penetration ability; gamma and neutrons have higher penetration.

**Exposures:**
- Radiation received by any object decreases as the square of the distance from the source
- Defenses include decreasing exposure time, increasing distance, and employing shielding.
- 5 mSV or 5 rem (Roentgen Equivalent in Man) is the accepted baseline of exposure with acceptable risk.

**Prognostication:**
- **Absolute lymphocyte count** (less than 500 in under 24 hours) and the rapid development of nausea/vomiting are associated with the LD50 of radiation exposure (in the 200-300 REM range).
  - Rapid development of symptoms, and presence of CNS symptoms are associated with lethality
- **Bone marrow suppression is maximal at about 30 days post exposure.**
Nuclear detonations:

- In nuclear detonations, most energy is dispersed in light, thermal and mechanical energy with 5% left for immediate ionizing radiation and 10% in fallout.
- The light is long-range flash that can permanently blind people who inadvertently look at the flash or at a reflection.
  - The blink reflex takes approximately 200 milliseconds.
- The thermal pulse generated by the detonation fireball (infrared) comprises 35% of the energy from detonation.
  - Any surface exposed to a near-field thermal pulse will experience heat at a rate of 10 calories/cm², which can cause spontaneous combustion.
- Immediate fallout in the 24 to 48-hour range is highly radioactive and best protected against by sheltering in place.
● **REACTS team** should be consulted for responses
● Contaminated patients are NOT a threat to providers as long as material outside of the body is cleaned off
● **Decontamination NEVER takes priority over treatment**
● Special skills are NOT needed to treat radiation casualties.
● Greatest hazard is likely an overwhelming number of worried well. Have them put clothes in bag, take shower, and bring bag to predetermined location

**Final pearls:**
1. Prevent ingestion of radio-isotopes at all costs, even at the cost of communication.
2. Focus on time, distance, and shielding when responding to any radiological incident.
3. Time of exposure is linearly cumulative, but exposure is reduced by the square of the distance.
4. Simple decontamination means mechanical removal of materials, and most comes off the patient or the worker with removal of clothing.
106: Weapons of mass destruction, 369

Bombings not all that rare (1,600 to 2,400 per year in US) and injuries are primarily caused by the blast:

Contamination is also a consideration (e.g. biological if a suicide bomber, radiological (or “dirty bomb”) more of a logistics issue than a direct threat from radiation (due to public concern, decontamination of large numbers of people/property, etc.)

Explosions are mechanical (e.g. steam under pressure), chemical (two solids combining to form a gas with a larger volume than the solids, resulting in light, sound and pressure) or nuclear (atoms being split or fused together).

The detonation velocity is the speed with which the chemical explosive reaction takes place: if very slow this is combustion, if instantaneous it is a detonation.

Three effects of an explosion:

- **Thermal** (seen as a fireball) releasing heat, the least damaging of these components,
- **Pressure** (1st component: positive pressure wave with a visible shock front preceding it, dissipates rapidly with distance, 2nd component: negative pressure wave, as air moves in to fill the vacuum caused by the positive pressure wave--slower than 1st component but powerful; “punch and pull” effect),
- **Fragmentation**: pieces of the device or debris that are pushed by the shock waves and cause injury when striking the body.

Explosive classification based on detonation velocity: less than 1.005 meters per second are classified as “low explosives”; these are usually propellants that if not enclosed would burn not explode (e.g. pipe bombs)

“High explosives” have a faster detonation velocity and are classified according to the degree of sensitivity”, or the “insult” needed to make them detonate:

- Primary high explosives are very sensitive and are used for materials like blasting caps
- Secondary high explosives need more insult to detonate and are often “boosted” by a small amount of more sensitive explosives. Oklahoma City: blasting cap (primary) plus small amount of TNT (booster) inside of an ANFO--ammonium, nitrate, fuel oil--explosive (secondary).

**Improvised Explosive Devices** (an explosive device that has not been manufactured): need an initiator and an explosive; EOD technician needs to know how the device functions in order to disarm it.

- **Victim-activated devices** (e.g. car bomb with pressure sensor in seat) used to target specific individuals
- **Time-activated devices** (e.g. train bombs) that target classes of individuals, e.g. commuters
- **Command-activated devices** that require the bomber to be surveilling the device.

**Secondary devices**: target responders to the primary device and must be considered in any response

Bomb suits are protective but restrict movement and increase the likelihood of heat stress. The most important
factors for the medical response are preparing the technician for response periods in the suit, monitoring him/her during their time in the response, and knowing how to rapidly remove the suit to provide medical care.

Common blast injuries if the device detonates are tympanic membrane rupture, amputation, pneumothorax, air embolism, GI tract and hand injury.

Robots are being used more and more in this work; they often contain portable X-ray machines.

**Safe distances are 10’ behind, 36’ on the sides and 100’ in front.**
Section VIII: Special Environments

107: Tactical Emergency Medical Support, 377

- NAEMSP endorsed integrating EMS capability into tactical EMS teams in 2001
  - TEMS also supported by National Tactical Officers Association

- In 1995, the most common form of support for tactical teams was a civilian ambulance on standby, 94% of whose personnel had no tactical training and 78% had no medical direction

- Established TEMS protocols necessary due to: need for proper training and equipment to deal with hostile conditions in tactical arena, limited/controlled entry into operational arena/unsecured environment, functionally austere treatment environment (even in urban setting), planning for medical contingencies requires knowledge of the planned operation of the tactical team
  - Without integrated TEMS structure, EMS personnel may also compromise other aspects of the mission (e.g. Waco example of operational security compromised by pre-alerting an EMS service resulting in subsequent loss of surprise factor and death of 4 law enforcement officers)

- Goals of successful tactical medical support program: enhance mission accomplishment, avoid liability, diminish disability costs, maintain team morale

- Zones of care
  - Hot zone: hostile environment, greatest risk, immediate threat
    - Only acceptable treatments: patient extrication and control of life-threatening hemorrhage (same as “Care Under Fire” in TCCC)
  - Warm zone: potential or indirect threat
    - Medical care here is: risk/benefit ratio, ex. airway management, breathing and circulation intervention (corresponds to “Tactical Field Care” in TCCC)
  - Cold zone: standard EMS care
    - Corresponds to “Tactical evacuation care (TACEVAC)” in TCCC

- TEMS providers should be familiar with specific weapons of each tactical team’s arsenal
  - Learning weapons safety important for TEMS personnel in order to render a weapon safe if necessary when removed from a patient’s possession
  - Less Lethal Weapons (LLWs): incapacitate suspect while minimizing risk of death or serious injury
    - Chemical agents - ex. oleoresin capsicum (OC) or pepper spray and ortho-chlorobenzylidene malononitrile (CS) or tear gas: produce ocular pain, lacrimation, blepharism, as well as possible rhinorrhea and dyspnea. Focus on decontamination, removal of contaminated clothing, and irrigation (for OC), and moving air (for CS)
    - Kinetic impact projectiles - rubber bullets, etc. Treat as typical trauma
Noise/flash diversionary devices (NFDDs) - flash bangs, etc. Can produce blast trauma, tympanic membrane rupture, burns. Can also start fires

Conduction energy weapons (CEWs) - stun guns, etc. TASERs (most common brand) deliver 0.36 joules of energy at 50K volts over 5 seconds. Injury risks for these weapons include puncture wounds and blunt trauma from falls. Study found 99.7% with mild injuries or none at all

Other unique TEMS considerations
- Exposure to hazardous materials (including booby traps, clandestine labs) must be considered
- TEMS provider must have knowledge of principles and procedures used to maintain forensic evidence integrity
- Excited delirium patients may be encountered by TEMS personnel = acute onset bizarre and violent behavior accompanied by paranoia, incoherent shouting, hyperthermia, combativeness, extraordinary strength (associated with drugs or mental illness)
- Medical emergency requiring ALS transport
- TEMS providers can provide preventive and primary care to team members
- Special equipment: need tourniquets, airway adjuncts, chest seals, rapid vascular access kits; don’t recommend oxygen cylinders, fiberoptic laryngoscopes, or cardiac/code drugs
- Tactical training: ex. stealth approaches and hand signals

The tactical physician
- Categories: medical oversight, operational team member, or combination of the two

TEMS controversies
- Sworn vs civilian medics
  - Commissioned officer lessens concerns over personal security, evidence preservation, and weapons handling but may result in role confusion
  - Civilian physicians and medics increase medical knowledge but require special tactical training
- Armed vs unarmed
  - Medical providers should be stationed close to, but protected from the action and should not carry a firearm unless they have the level of training and ongoing proficiency to carry the firearm (i.e. sworn law enforcement status)
108: Technical rescue, confined space, and limited access situations, 386

Confined space medicine (CSM) = body of knowledge concerned with rescue and treatment of victims in collapsed structures or similar urban search and rescue (US&R) environments, with limited access and egress, and unfavorable environmental conditions

Confined space = not just collapsed structures, may also be underground power vaults, tanks, storage bins, manholes, pits, grain silos, process vessels, caves, and pipelines

Key points:
- Gather patient data as early as possible via family/bystanders and verbal communication
- Monitor the effects of the rescue efforts on the patient(s). Be aware of things such as dust, CO
- Secure and preposition equipment that is likely to be needed
- Begin physical assessment as soon as any physical contact is possible
- Initiate stabilization (provide dust mask, face shield, helmet), but IV access and supplemental oxygen should only be applied if clinically indicated due to issues of space, equipment, line tangles, and time
- Reevaluate the patient after each significant move, particularly if advanced airway management has been performed

Occupational Safety & Health Administration (OSHA) defines "permit-required confined space" = contains or has the potential to contain a hazardous atmosphere; contains a material that has the potential to engulf an entrant; has walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant; or contains any other recognized safety or health hazard, such as unguarded machinery, exposed live wires, or heat stress

Rescuer safety:
- Before entry, identify any physical hazards
- Before and during entry, monitor for oxygen content, flammability, toxicity or explosive hazards
- Use employer's fall protection, rescue, air monitoring, ventilation, lighting, and communication equipment
- Maintain contact at all times with a trained attendant visually, via phone, or by two-way radio (enables alert of appropriately trained rescue personnel to rescue entrants when needed)
- "Planning to rely on the 911 emergency phone number to obtain these services at the time of a permit space emergency would not comply" with OSHA regulations
- Be aware of oxygen-depleted environment (ex. mines, grain silos)
  - Nitrogen asphyxiation is a subtype of oxygen-depleted environment (ex. industrial plants, labs, trenches, manholes)

Common injuries associated with collapsed structure victims include fractures/lacerations, closed head injuries, multisystem trauma, and dehydration
Specific US&R/CSM clinical problems:

- Crush injury, which may be followed by compartment syndrome and/or crush syndrome. Vol 1, Chap 34
- Blast injuries are also fairly common, particularly in bombings. Vol 1, Chap 32
- Dust airway impaction has been reported to be the cause of death in some earthquake victims
  - Dust can come from destroyed building materials (silica, calcium, asbestos, wood, mineral fibers, masonry, sheet rock, plaster, tiles, insulation)
  - Rescue efforts (such as the use of power saws) can resuspend dust particles in the air as well
  - Humidified air or oxygen can be helpful
109: Wilderness EMS, 392

**Wilderness EMS (WEMS):** defined as a minimum 1-2-hour transport time, but also factors in the unique skills, expertise, and equipment needed to manage the patient and often complex extrication process, or need to transport specialized equipment to austere environment.

**Wilderness Medicine:** care of patients in a remote, austere, or wilderness setting (usually with limited resources and evacuation capabilities). Most often unexpected and opportunistic care. Teaching focuses on the ad hoc use of materials at hand, which may or may not have been originally purposed for medical care. There is a recognition that minimal medical equipment may be available since medical care is only one consideration among many for recreational or professional trips.

**Wilderness EMS:** there is a team that has specifically configured itself to provide medical care in specific geographic areas or missions with a specific duty and maintains a formal wilderness medicine certification to do so (subsection of wilderness medicine). WEMS retains some of the ad hoc and improvisational spirit of general wilderness medicine, but since the entire purpose of the WEMS operation is rescue and medical care, choosing the most appropriate equipment specifically for medical care, and absolute familiarity with that equipment becomes paramount. WEMS providers are functioning within the defined health care system.

Long history of wilderness medicine from different sources, starting with National Ski Patrol.

The National Park Service has provided much of the best epidemiological info on WEMS operations (ParkMedics).

The Wilderness Medical Society was founded in 1983.

**Scope of Practice more clearly defined with the following levels in 2000/2005:**

1. **Wilderness First Aider (WFA):** 16-24 hrs. of training
2. **Wilderness First Responder (WFR/ WEMR):** 60-80 hours training. Trained to recognize potentially life-threatening illness/injury, basic first aid and splinting, possibly some medication administration (e.g. epinephrine, glucose), possibly some protocol application (e.g. CPR termination, dislocation reduction)
3. **Wilderness EMT (WEMT):** 120-200 hours of EMT training + 48-80 hours wilderness training, adds on to WFR plus all components of EMT-B
4. **Wilderness Paramedic:** WFR+ EMT-P, plus other procedures (Foley catheters, etc.)
5. **Wilderness Physician:** provides “necessary care and advanced medical decision making within the limitations of surroundings”

**Direct and indirect oversight:**

- Direct is difficult due to communications.
- Indirect more likely → need for protocols, training, and regular case review (but allow for flexibility).

**Protocols:**
- Wound care (including FB extraction, administration of antibiotics)
- Termination of resuscitation (TOR) after 30 minutes (unless hypothermic)

![Figure 10.6 Wilderness EMS Incident Command.](image)

<table>
<thead>
<tr>
<th>Essential</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Navigation tool(s)</td>
<td>Map, altimeter, compass, global positioning system device, personal locator beacon or satellite communicator, extra power source(s)</td>
</tr>
<tr>
<td>2 Headlamp</td>
<td>Plus spare power source(s)</td>
</tr>
<tr>
<td>3 Sun and eye protection</td>
<td>Sunglasses, sun protective clothing, sunscreen</td>
</tr>
<tr>
<td>4 First aid</td>
<td>A first aid kit, including foot care and insect repellant if appropriate</td>
</tr>
<tr>
<td>5 Knife</td>
<td>Knife, repair kit, multi-tool</td>
</tr>
<tr>
<td>6 Fire</td>
<td>Matches, lighter and tinder, or stove as appropriate</td>
</tr>
<tr>
<td>7 Shelter</td>
<td>Can be light emergency bivouac or full shelter-like tent as appropriate</td>
</tr>
<tr>
<td>8 Extra food</td>
<td>Beyond minimum expectation</td>
</tr>
<tr>
<td>9 Extra water</td>
<td>Beyond minimum expectation, and means to purify water if appropriate</td>
</tr>
<tr>
<td>10 Extra clothing</td>
<td>Beyond minimum expectation</td>
</tr>
</tbody>
</table>

“BLS TOR rule” developed by Verbeek:
1. Arrest was not witnessed by EMS personnel
2. No shockable rhythm
3. No ROSC prior to ambulance transport

→ Showed a positive predictive value of 99.5% for death and specificity of 90% for recommending transport of survivors

- Joint reductions (focus on dislocations from indirect trauma so as to reduce likelihood of manipulating fracture, shoulder, digits, and patella)
- Selective spine immobilization/spinal motion restriction (similar to NEXUS criteria, purpose is to figure out who can walk out even with potential spine injury as having all on a backboard impractical in wilderness)
- Anaphylaxis and severe asthma management (epinephrine, also consider albuterol, prednisone, diphenhydramine)
- Parameters for Search and Rescue
- Future areas: new pain medications, snake antivenin
A joint vision statement by many of the leading national EMS organizations, including NAEMSP, defines mobile integrated health (MIH) and community paramedicine (CP) as the provision of health care using patient-centered mobile resources in the out-of-hospital environment.

Community paramedics can be integrated within a traditional 9-1-1 response or provide scheduled or unscheduled visits outside of 9-1-1.

*EMS Agenda for the Future* called for advancement and integration of EMS into healthcare system.

- Alaska has used community physician extenders for more than 100 years.

2001 was first time the term *Community Paramedic* was coined.

2006, the Institute of Medicine recommended detaching reimbursement for transportation from the assessment and medical treatment rendered by EMS and recommended the funding of demonstration projects to explore alternatives to existing models of care.

Types of programs include:

- Within the 911 system including nurse triage models to allow for:
  - Alternative destinations
  - Alternative responses
  - Alternative dispositions including treat-in-place
  - EMS referral to other services

- Unscheduled non-911 including:
  - Clinical escalation requested by other medical services for patients in their homes
  - In-home urgent care

- Scheduled/proactive visits including:
  - Readmission reduction programs
  - Transitions of care
  - Health maintenance programs

Program need certain characteristics to be successful:

- Fully integrated
- Collaborative
- Data driven
- Patient-centered
- Multidisciplinary
- Team based
- Educationally appropriate
- Consistent with the triple aim
- Financially sustainable
- Legally compliant

- “Triple Aim”
  - improving population health,
  - improving the patient’s experience of care (service and outcome),
  - lowering the costs associated with health care

- ET3 Program approved by CMMI in 2019
  - Voluntary 5 year payment model to pilot new EMS models
  - Aims:
    - providing the appropriate level of care safely and at the right time, allowing for person-centered care with increased options;
    - encouraging the appropriate utilization of services;
    - increasing the efficiency of the EMS system and allowing it to focus on high-acuity cases
  - Allows for alternate destinations, treatment in place, medical triage lines

- Telemedicine
  - Can be integrated into MIH, improve patient outcome and compliance, and allow for telemonitoring

- Education
  - Development of new MIH-CP education programs
  - International Board of Specialty Certifications and Board for CCT Paramedic Certification now offering certification in community paramedicine

- Medical Oversight
  - Requires understanding of EMS systems and effective interaction with nontraditional stakeholders
  - Duties of the medical director include:
    - 1) performing a needs assessment to identify areas of need
    - 2) guiding program goals to focus on patient care
    - 3) coordinate stakeholders and experts for more effective care,
    - 4) ensuring the program is compliant with state statutes and regulations,
    - 5) ensuring the safety and quality of the MIH program,
    - 6) ensuring proper documentation and reporting of any interventions
    - 6) ensuring the community paramedics and health care team are adequately educated to perform the requested tasks.

- Integrating with the healthcare system often involves a community needs assessment
Section IX: Safety and Quality

111: Patient safety culture, 415

● 1999 IOM report: “To Err is Human: Building a Safer Health System” brought to light medical errors

● **Adverse event**: Occurrence that results in unintended patient harm

● **Active failure**: errors committed by individuals

● **Latent failure**: systemic flaws in design or process that allow errors to be present

● **Human factors**: traits that contribute to adverse events
  ○ **Task fixation**: focusing on critical step that allows for downstream actions to be forgotten

● Important to have error-reporting systems and immunity from punitive action towards reporters
112: The evolution of quality concepts and methods, 424

- Manufacturing: Shewhart, Deming and Juran
  - Common Causes (Chance Causes)
    - Inherent in the system
  - Special Causes (Assignable Causes)
    - Not part of the system but rather circumstantial
  - Deming - Learning and improvement cycle
    - Plan-Do-Study-Act
  - System of profound knowledge
    - Appreciation for a system, knowledge about variation, theory of knowledge, psychology
    - Applied to the idea of management and quality of building

- Hand washing was first QI in healthcare

- Professional Education Reform
  - Flexner report (1910):
    - Accused the industry of medical education in North America with educational malpractice through "enormous overproduction of ill-trained medical practitioners".
    - One third of early medical schools should be closed due to lack of quality
  - Osler - Science of learning - learn more from observations and conversations with patients than textbooks
    - M&M, Grandrounds, CPC

- Codman (1910), "End Result System of Hospital Standardization"
  - tracked patient outcomes by the attending physician and investigated the cause of poor outcomes.
  - Led to development of minimal standard for hospitals and investigation of hospitals by ACS

- Public reporting and pay for performance
  - CMS and AAMC public reporting data initially voluntary but tied to money made 98% of hospitals enroll intilially
  - Eg of value based performance pay e.g. STEMI door to balloon time < 90 min 90% of the time give hospital system bonus

- Joint Commission on Accreditation of Healthcare Organizations (JCAHO)
  - 1960s: accreditation required to be eligible for Medicare/Medicaid
  - 1980s: quality assurance plan becomes part of JCAHO inspection

- Institute of Medicine/ National Academy of Medicine
  - To Err is Human - Building a Safer Health System (1999): documented magnitude and effect of medical errors in healthcare
- Safe, Effective, Patient-centered, Timely, Efficient, Equitable

- Quality Improvement Framework
  - Six Sigma - 3 SD in each direction
    - Define, Measure, Analyze, Improve, Control
    - Lean- control of waste
  - Model for Improvement

- EMS QA/CQI
  - NAEMSP 2018 Statement- Defining Quality in EMS
    - Forward-looking culture of QI
  - EMS Compass
  - NEMSQA
  - EMS Agenda 2050
113: Defining, measuring, and improving quality, 432

- **Vision: Defining Quality**
  - Priorities shifting from times and responses to clinically orient things.
- The Model for Improvement

![Model for improvement diagram](image)


- **Aim:** What are we trying to accomplish?
- **Measure:** How will we know that a change is an improvement?
- **Change:** What changes can be made that will result in an improvement?

Fishbone (Ishikawa) diagram

- Cause and effect diagram - start with problem as head and work backwards
  
  Example branches: Methods, Equipment, People, Materials, Measurement, Environment
Driver diagram: Used to organize solutions to problems identified by fishbone

---

**Figure 113.4** Sample fishbone or Ishikawa diagram. AHA, American Heart Association; HPCPR, high-performance CPR.

**Figure 113.5** Sample driver diagram. This diagram shows a driver diagram accompanying the clinical question from Figure 113.4. HPCPR, high-performance CPR.
- Run Chart - process over time
- Control Charts - Run charts with SD lines (control lines) above and below depicting common cause vs special cause variation better
- Direct Observation, Chart review, Hospital outcomes, Patient Feedback
  - All parts in a successful diverse CQI system
114: Information systems, 446

- 1996 NHSTA EMS Agenda for the future- one of the 14 recommendations was regarding information systems- specifically
  - 1. adopt a uniform set of data elements and definitions to facilitate multisystem evaluations and collaborative research.
  - 2. develop mechanisms to generate and transmit data that are valid, reliable, and accurate.
  - 3. develop and refine information systems that describe the entire EMS event so that patient outcomes and cost-effectiveness issues can be determined.
  - 4. collaborate with other health care providers and community resources to develop integrated information systems.
  - 5. Information system users must provide feedback to those who generate data in the form of research results, quality improvement programs, and evaluations.

- 2001, formation of NEMSIS (National EMS Information System), with a goal to establish:
  - Standardized national EMS dataset
  - Electronic EMS documentation system
  - State EMS database
  - National EMS database

- NEMSIS has also been incorporated into
  - Health Level 7 (HL7): a standards-developing organization that integrates data definitions and transmission methods across all of health care.
  - NEMSIS uses the current version of the International Classification of Diseases, known as ICD-10.

- IOM Report “Emergency Medical Services at the Crossroads” in 2006 addressed the need for standardized EMS data and information systems including:
  - Evidence-based categorization systems for EMS, EDs, trauma centers based on adult and pediatric service abilities
  - Evidence-based model prehospital care protocols
  - Evidence-based indicators for emergency and trauma system performance
  - Development and integrated hospital, public health, EMS, EMA, public safety data systems
  - Federal agencies funding emergency and trauma care research should target an increased share to EMS research with emphasis on systems and outcomes

- ET3: 2019, the Centers for Medicare and Medicaid Services (CMS)
  - Has a data requirement for participating EMS systems
Existing registries and healthcare databases

- **National Trauma Data Bank (NTDB)**
  - Maintained by American College of Surgeons Committee on Trauma
  - Standardized dataset based on the National Trauma Data Standard.
  - Developed in cooperation with NEMSIS and incorporates the pertinent NEMSIS data elements related to trauma.
- **Paul Coverdale National Acute Stroke Registry**
  - CDC
  - Active in 9 states
- **Cardiac Arrest Registry to Enhance Survival (CARES)**
  - Housed at Emory university
  - Originally funded by CDC, now funded by state, nonprofit and for-profit groups
  - 28 statewide registries as well as additional EMS systems within 13 other states
  - 2019 database includes data on over 100,000 OHCA patients from a population base of 140,000,000.
  - Over 1,800 EMS systems and 2,200 hospitals participate.

Law enforcement databases

- **Motor vehicle crash data**
  - Collected and maintained through either the U.S. Department of Transportation or through law enforcement.
- **Crash Outcome Data Evaluation System (CODES)**
  - Developed in 1992 (NHTSA)
  - Generate medical and financial outcome information relating to motor vehicle crashes, and use these outcome-based data as the basis for decisions related to highway traffic safety.
  - 15 states participating

Public Health surveillance data

- Most states maintain some type of public health surveillance data system
  - Poison center call data, EMS event data, emergency department data, pharmacy sales data, and school attendance data.

EMS Information system design

- **Triple Aim**: improve population health, the patients experience, and control costs.
- **Learning Health System**: accomplished by generating information and knowledge from data captured and updating it over time. Contributions from individuals, care delivery systems, public health programs, and clinical research are required.
  - This is defined by the Learning Health Community organization and adopted by the Office of the National Coordinator for Health Information Exchange.
Ease of incorporating medical device data into health record - a work in process
EMS information should be incorporated into billing in a manner that interacts with billing software and meets government regulations (medicare)

EMS system types

- predictive and real-time data analysis within dispatch and administrative software to manage resources on a case-by-case basis.

EMS operations from a data perspective

- Timestamps: each “action” during EMS response
  - Call (dispatch) → responders alerted → roll out of station → arrive at call → at patient side → transporting → arrived at destination → back in service

Public safety answering point (PSAP)

- Questions from dispatch determine priority of call - if multiple responders or agencies
  - EMD: Question and answer approach to dispatch to ask key questions to determine level of EMS response and call priority (and pre-arrival instructions such as CPR)
- measure of system effectiveness is a reasonable and consistent response interval.
  - GPS + modern CAD can help find the closest unit and shortest response route
- automatic collision notification (ACN)
  - ACN company can directly contact PSAP
    ■ Data from sensors in vehicle can predict severity of collision

EMS information system components

Dataset (5 categories)

- Situational information: location, response information, access
- Patient information: demographics, billing information, medical history
- Surveillance data: injury risk/mechanism, cardiac arrest, review of systems
- Current diagnostic/physiological monitoring: vital signs, physical exam
- Interventional: procedures and treatment (pharmacology), disposition

Hardware: computer/laptop, mobile phone, cloud computing

Software

- Front-end: users interact with the information system to view or enter information. (User interface)
- Database: nerve center for the storage and retrieval of information.
- Back-end: provides a user interface for report generation and data analytics.
  - Maintenance: All computers and computer software require ongoing maintenance and support. Considerations for backups, updates.
● Security:
  ○ HIPAA divides security and confidentiality into four major components:
    ■ Patient privacy and confidentiality,
    ■ User policy and procedure
    ■ Physical security
    ■ Software security.
  ○ Any health care data or information system must have a detailed policy and procedure describing who, when, where, how, and why any personnel can access the system.
Every research question should pass the “So what?” test and be clear and focused.

- **Hypothesis** is a declaration to be proved or disproved.
- **Null hypothesis** = no difference exists between two (or more) groups being studied
- **Alternative hypothesis** = a difference between groups exists
- **Randomized controlled trial (RCT)** is *not always possible or desirable in EMS*

Outcome measures should be:

- Directly tied to the specific aims and capable of measuring the outcomes of interest
- Patient-oriented

Lit review: MEDLINE and CINAHL (Cumulative Index to Nursing and Allied Health) databases best for EMS

**Study Design Questions**

1. Does the study follow participants over time? (Cross-sectional or longitudinal)
2. Does the study intervene with participants? (observational vs interventional)
3. Does the study look at events that already occurred or as they occur? (prospective or retrospective)

- **Cross-sectional** - measures all study variables at the same point in time (or during a brief interval, perhaps a week or a month), providing a “snapshot” of data. e.g. surveys

- **Longitudinal** - examines variables over time by following patients. Very few studies follow patients through multiple EMS encounters over time

- **Observational** - monitors what is happening but makes no attempt to influence outcomes or otherwise intervene in the events being studied.

- **Interventional** - imposes a change and studies the effects

- **Prospective** - events of interest have not yet occurred at time of patient identification

- **Retrospective** - events of interest have already occurred at time of patient identification

- **Descriptive** - simplest. e.g. correlational, case report, case series, and cross-sectional survey

- **Correlational** (aka aggregate, ecologic) - assesses rates for a population
  - Ecological fallacy - group characteristics assumed for individual subjects (you cannot draw this causal conclusion in correlational studies)
• **Case study** - only one individual with a presentation or disease

• **Case series** - multiple patients with a presentation or disease

• **Cross-sectional survey** - aka prevalence study. Exposure (risk factor) and disease status (outcome) of participants are measured at the same time as a snapshot. Not usually possible to establish a cause–effect relationship

• **Case–control study** - patients are identified by their outcome (e.g. survivors versus non-survivors of major trauma). Usually retrospective.
  - Pros: Best design for common exposure/rare outcome e.g. cardiac arrest survival. Care must be taken to develop a hypothesis prior to analyzing the data.
  - Cons: Temporal relationship challenging to establish (chicken or egg), sampling and measurement bias, hard to identify controls

• **Cohort study** - the group starts out together (with or without the exposure) and moves forward through time toward an objective (the outcome). Cannot already have the outcome of interest at the time of selection.
  - Pros: best design for rare exposure/common outcome with short latency period; prospective, so temporal sequence can be established; can study exposure’s effect on multiple outcomes, limits measurement bias
  - Bad for rare outcomes; groups should be the same aside from the exposure (easily confounded); expensive (to follow subjects over time); loss to follow up

• **Before–after study** - data are collected both before and after some sort of change is implemented
  - Purely observational if researchers have no role in implementing the change
  - Quasi-experimental if researchers implement the change then study it

• **Experimental aka clinical trials** - Similar to cohort studies, except exposure status is specifically assigned. After identifying potential participants, measuring baseline characteristics, and checking to be certain the outcome does not already exist, the participants are each randomly assigned to either receive or not receive the study treatment or intervention and followed over time to see which develop the outcome or disease of interest. Ethically, the researcher must be confident that there is not a clear benefit or harm from receiving the study intervention based on current knowledge (recognizing the trial may detect said difference).

• **Randomized assignment** - at the time each potential candidate is identified, he or she has an equal chance of being assigned to any treatment arm based on a non-systematic process. Can be logistically difficult.
  - Pseudo-randomization techniques (attempt to simplify logistics while still equalizing subjects).
    - E.g. Every other time interval (e.g. every other day)
- **Cross-over trial** - each participant gets the treatment for a certain period of time and, after a washout period (i.e. a period of time where the effects of the treatment are removed), each enters the other arm of the study. Can account for both known and unknown factors that might affect outcome. Costly and time consuming

**Note:** longitudinal, interventional, and prospective studies are of greater value in assessing causal relationships; but are generally harder to perform, are often more expensive, and are usually more time consuming.

- Platform research trial- allows some or all domains to be studied simultaneously and with advanced planning. The platform allows the interventions to change, some dropped or added based on discrete observations and become the next trial–creating an ongoing approach.
- Adaptive research design- (often coupled with platform research trial). uses existing information coupled with expert design and analytic input to model what expected ranges of possibilities and then uses these targets and the ongoing trial results to change or stop enrollment in arms that are unlikely to succeed.

![Figure 115.3 Adaptive design planning process. Source: Thorlind K, Haggstrom J, Park JJH, Mills EJ Key design considerations for adaptive clinical trials: a primer for clinicians. BMJ 2018; 360:k698. Reproduced without modification. Licensed under CC BY 4.0.](image)

**Other important terms:**

- **Data mining** - analysis for patterns prior to formation of hypothesis and study parameters (prone to bias)

- **Sampling bias** - can occur e.g. if subjects are identified through a single source (e.g. trauma patients from a single hospital trauma registry) which may miss cases who do not present to that source. Controls should be the same as cases in all respects except presence of the disease.
• **Measurement bias** - presence of the disease influences the retrospective assessment of exposure. e.g. cases may be more likely to remember an exposure than controls because they are sick (recall bias).

• **Assessment bias** - beliefs held prior to or outside the experimental question that influence judgment regarding the subject's outcome

• **Wash out period** - When studying new therapy, may wait until new therapy has been fully integrated into the EMS system of care. Time period is not studied, which helps to remove any inaccuracies that may influence the study outcome as a result of incomplete or inaccurate adoption of the treatment being studied as the system and providers become accustomed to it.

• **Blinding** - used in clinical trials to limit assessment bias

• **Single-blind** - subjects cannot tell which therapy is being used

• **Double-blind** - both subject and outcome assessor do not know participant's group assignment

• **Triple-blind** - subject, assessor, and care provider unaware of the participant's group assignment
116: Informed consent for EMS research, 467

- **1974 National Research Act**: first public bioethics policy in the US (response to Tuskegee syphilis study)

- **1979: Belmont Report**: led to the development of the first guidelines for human subject research and also defined institutional review boards (IRBs). Identified the ethical principles in chart 116.1

<table>
<thead>
<tr>
<th>Ethical principle identified in Belmont Report</th>
<th>Standard for conduct of human subject research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Respect for Persons</td>
<td>Concept: Ensure subjects have free choice to participate in research The right to make an informed free choice to participate in research AND: The need for special protections for those potential research subjects with diminished autonomy (ex. children, prisoners, pregnant women, and those in subordinate positions).</td>
</tr>
<tr>
<td>Beneficence</td>
<td>Concept: Do no harm while maximizing potential benefits and minimizing potential risks Potential risks to subjects (physical, psychological, legal, economic, or social) should be as minimal as possible while accomplishing research objective AND: Potential benefits may be difficult to quantify and are often greatest for society or future patients. When possible benefits should be maximized.</td>
</tr>
<tr>
<td>Justice</td>
<td>Concept: Promote fair study recruitment Risks should be distributed so that all populations bear both risks and receive potential benefits. Risks must not be borne by one population (ex. economically disadvantaged individuals) while benefits are received by a different (ex. economically advantaged) population.</td>
</tr>
</tbody>
</table>

- **Common Rule (1991)**: the defining federal policy for the protection of human subjects. Standard of ethics to which nearly all academic institutions hold their researchers regardless of funding source. Research involving drugs or devices may be subject to additional FDA regulations

- **Institutional review board**: required for all research involving human subjects. Local IRBs establish processes to comply with the US Dept of Health and Human Services regulations (per the Common Rule)

- **Exception from Informed Consent in emergency research (EICER/EFIC)**: designed to protect patients but also to facilitate research for conditions when subjects may not be able to consent due to the nature of their illness.
  - In 1993, an investigation of various incidents prompted PPD issuing a call for IRBs to stop all federally funded studies that did not involve obtaining prospective informed consent, and FDA also halted all resuscitation research in the United States for almost 4 years.
Table 116.2 Exception from informed consent

<table>
<thead>
<tr>
<th>Conditions under which the EFIC for emergency research may be used</th>
</tr>
</thead>
<tbody>
<tr>
<td>A life-threatening situation exists.</td>
</tr>
<tr>
<td>Available treatments are unproven or unsatisfactory.</td>
</tr>
<tr>
<td>Collection of valid scientific evidence is necessary to</td>
</tr>
<tr>
<td>determine the safety and efficacy of the intervention.</td>
</tr>
<tr>
<td>Consent is not feasible due to the subject's medical condition.</td>
</tr>
<tr>
<td>Treatment must be given before it is possible to obtain</td>
</tr>
<tr>
<td>consent from a legally authorized representative.</td>
</tr>
<tr>
<td>There is no reasonable way to identify prospectively those</td>
</tr>
<tr>
<td>likely to become eligible subjects.</td>
</tr>
<tr>
<td>Risks and benefits must be considered to be reasonable.</td>
</tr>
<tr>
<td>Participation holds some prospect of direct benefit to the</td>
</tr>
<tr>
<td>subjects.</td>
</tr>
<tr>
<td>The investigation could not practicably be carried out</td>
</tr>
<tr>
<td>without the waiver of prospective consent.</td>
</tr>
</tbody>
</table>

Additional protections pre and post study

Community consultation and public disclosure of risks and expected benefits must be made to the communities from which the subjects may be expected. Community consultation and public disclosure will be conducted prior to study enrollment, and disclosure of demographic information and results will be made to the community and other researchers following completion of the study (for both EFIC and WIC). Protocols involving an exception to the informed consent requirement must be performed under a separate IND application or IDE that identifies them as including subjects who are unable to consent. The FDA must approve the application before the study may proceed (for Drug or Device Studies under EFIC).

Final Rule (1996) - a response to the above. Created a mechanism by which prospective research can occur in emergency situations if it meets certain conditions.

Table 116.3 Waiver of informed consent and waiver of documentation of informed consent

<table>
<thead>
<tr>
<th>Conditions required for Waiver of Informed Consent (45 CFR 46.116)</th>
</tr>
</thead>
<tbody>
<tr>
<td>The research involves no more than minimal risk to subjects.</td>
</tr>
<tr>
<td>The waiver will not adversely affect the rights and welfare of the</td>
</tr>
<tr>
<td>subjects.</td>
</tr>
<tr>
<td>The research could not be practicably be carried out without the</td>
</tr>
<tr>
<td>waiver and Whenever appropriate the subjects will be provided with</td>
</tr>
<tr>
<td>additional pertinent information after participation.</td>
</tr>
</tbody>
</table>

<p>| Condition required for Waiver of Documentation of Informed        |</p>
<table>
<thead>
<tr>
<th>Consent (45 CFR 46.117)</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the IRB finds that the only record linking the subject and the</td>
</tr>
<tr>
<td>research would be the consent document and the principal risk would</td>
</tr>
<tr>
<td>harm resulting from a breach of confidentiality</td>
</tr>
</tbody>
</table>

Community consultation: discourse between investigators and community members and reps (e.g. town hall meeting). Must occur prior to the enrollment of any subjects. Goals:

- Get input from community
- Ensure transparency
- Provide an opt out mechanism for community members

Public disclosure: a one-way transfer of information to the community. Both prior to start of study and after it is complete. It generally includes a notice that the study is planned, describes the nature and purpose of the research including the fact that consent will not be prospectively obtained, and presents the possible risks and expected benefits that might result. This should include:
• The intent to conduct the research without prospective informed consent
• A description of the treatment under study as well as its risks and benefits
• A synopsis of the protocol and study design
• Information about how subjects will be identified
• A list of sites participating in the research
• Description of future attempts to contact each subject’s legally authorized representative

Public disclosure to the community and to other researchers following completion of the study should include the aggregate demographics and results (Example: press releases)
117: Out-of-hospital cardiac arrest research, 473

Clinical cardiac arrest research is primarily performed within observational analyses and RCTs.

One of the key challenges with RCTs is generalizability to other settings, primarily due to differences in EMS systems, communities, and medical management.

Observational research is limited to conclusions of associations between exposures and outcomes.

- Unable to estimate causation.
- Before-and-after or time-series designs may help infer outcome changes after an intervention,
  - limited by changes in other confounders and outcomes over time that are unrelated to the study

Utstein: standard variable definitions and data reporting style of OHCA research

- EMS-treated cases and EMS-assessed cases

There is regional variation in reported incidence of OHCA. May be related to both actual incidence and community characteristics impacting reporting.

- Also impacted by local practices and data-collection techniques

Many cardiac arrest registries track all cases without obvious trauma regardless of apparent etiology.

- Often cases are classified within registries as “obvious cause identified” or “no obvious non cardiac cause” based on EMS records rather than classifying as “cardiac etiology.”

<table>
<thead>
<tr>
<th>Table 117.1 Cohort characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data level</strong></td>
</tr>
<tr>
<td>Demographics</td>
</tr>
<tr>
<td>Location</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Witnesses</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Bystander efforts</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>Cardiac arrest</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>EMS response</td>
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<td></td>
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<td></td>
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<tr>
<td></td>
</tr>
<tr>
<td>Etiology</td>
</tr>
</tbody>
</table>

### Table 117.2 Outcome measures

<table>
<thead>
<tr>
<th>Outcome level</th>
<th>Core data</th>
<th>Additional data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prehospital</td>
<td>ROSC</td>
<td>EMS arrival to ROSC interval, “sustained” ROSC, re-arrest (and timing)</td>
</tr>
<tr>
<td></td>
<td>On-scene termination of resuscitation</td>
<td>EMS arrival to termination interval</td>
</tr>
<tr>
<td></td>
<td>Transport to hospital</td>
<td>EMS arrival to scene departure interval, scene departure to hospital arrival interval, pulse present at transport initiation, during transport, and hospital arrival</td>
</tr>
<tr>
<td>Emergency Department</td>
<td></td>
<td>ED survival, pulse at initial ED assessment, survival to ward admission, time of death or hospital admission</td>
</tr>
<tr>
<td>Hospital</td>
<td>Hospital survival</td>
<td>Duration in critical care, time of death of discharge or duration, functional status at hospital discharge, discharge disposition (rehabilitation facility, assisted living or care home facility, home with home supports, home and independent)</td>
</tr>
</tbody>
</table>

### Table 117.3 Cerebral performance category score

<table>
<thead>
<tr>
<th>Category</th>
<th>Level of function</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Good cerebral performance</td>
<td>Conscious, alert, able to work and lead a normal life. May have minor psychological or neurological deficits (mild dysphagia, hemiparesis, or minor CNS abnormalities).</td>
</tr>
<tr>
<td>2. Moderate cerebral disability</td>
<td>Conscious, sufficient cerebral function for part-time work in sheltered environment or independent activities of daily life (e.g., dressing, traveling on public transportation, preparing food). May have hemiplegia, seizures, ataxia, dysarthria, dysphagia, or permanent memory or mental changes.</td>
</tr>
<tr>
<td>3. Severe cerebral disability</td>
<td>Conscious, dependent on others for daily support because of impaired brain function (i.e., lives in an institution or at home with exceptional family effort). At least limited cognition, includes a wide range of cerebral abnormalities from independent existence to paralytic and able to communicate minimally.</td>
</tr>
<tr>
<td>4. Comatose, vegetative state</td>
<td>Not conscious; unaware of surroundings, no cognition; no verbal or psychological interactions with environment.</td>
</tr>
<tr>
<td>5. Death or brain death</td>
<td>Death, brain death/organ donation candidate</td>
</tr>
</tbody>
</table>

118: Trauma research methodology, 481

- **NEMSIS** - national compilation of EMS data, supplied by participating state EMS offices, and offers the broadest overview of EMS nationally.
  - According to NEMSIS, trauma accounted for ~15% of EMS calls in 2012

- **Joint Theater Trauma Registry (JTTR)** – database of individuals injured or killed in Iraq and Afghanistan, marked improvement in military trauma data collection and analysis. Changes that came from this:
  - Tourniquet use for improved survival from blast injuries
  - Restricted use of factor VIIa after increase in thromboembolic events

- To consider with inclusion/exclusion re EMS trauma studies:
  - Blunt vs penetrating
  - Define criteria such as “hemorrhagic shock”, “pediatric”, “geriatric”
  - Consider excluding traumatic arrests and patients whose injuries make them highly unlikely to survive as this may mask any potential effect of intervention

- Commonly controlled for:
  - Age, mechanism, presence of head trauma, ISS, RTS, shock index, lactate

- **Outcome measures**:  
  - Survival
  - CPC
  - PROM (patient reported outcome measures—usually via questionnaire)
  - TRISS (see definition below)

- **Trauma Score-Injury Severity Score (TRISS)** - method for predicting outcome in trauma; includes age as a factor in its calculation. Survival of a patient treatment group can be estimated using the TRISS method, and this estimated survival compared to the survival of the treatment group that receives the intervention or therapy under study.

- **Revised Trauma Score** - assesses initial patient status based on the GCS and vital signs recorded by EMS

- **Injury Severity Score (ISS)** – compilation score including patient’s worst injuries in different organ systems. Correlates with subsequent measures of severity including morbidity and mortality. Cannot be calculated in the field or ED.
119: Pediatric research methodology, 488

- Ontario Prehospital Advanced Life Support (OPALS) study group on pediatric cardiac arrest:
  - More likely to have unwitnessed cardiac arrests
  - Less likely to receive bystander CPR.
  - Most common arrest etiologies reported: trauma, sudden infant death syndrome, respiratory disease.

- 40% decrease in pediatric death from injury since establishment of EMSC (Federal Emergency Medical Services for Children) program

- Federally-funded multicenter networks for peds emergency care research:
  - PECARN
  - ROC

- Challenges to pediatric research
  - Defining a “pediatric” patient – Physiologically? Psychosocially? Legally?
  - Limited numbers seen by a typical EMS agency - pediatric account for 5 - 10% of EMS calls; only 10–20% have critical complaints
  - IRB approval: protected population
  - Consent: subject (assent) AND subject’s legal guardian must consent
    - Consent may have to be written to target different cognitive levels

- Research priorities:
  - Provider pediatric assessment and treatment skill quality and maintenance
  - Off-label medication use effectiveness
  - Management of respiratory disease
  - Undertreatment of disease compared to adult equivalent
  - Neonatal and critical care transport
  - Disaster/MCI preparedness
120: Cost analysis research, 494

- **Costs** - actual resources consumed to produce a good or service.
  - Should be used (vs charge) when calculating from societal perspective.
  - For EMS, includes actual costs, and cost of readiness

- **Charge** - includes cost plus taxes and any profit from providing the goods/service. Usually charge > cost.

- **Types of cost analyses:**
  - **Cost-benefit** - measures the outcome or the effect of an intervention, in dollars. (Example: annual cost for EMS system was $8.3 million, and outcome from providing EMS care was $44.3 million in socioeconomic cost savings to the community)
  - **Cost-effectiveness** - measures a common effect (Example: lives saved). Result in terms of effect per unit of cost.
    - E.g.: police AED estimated to cost from $23,542 to $70,342 per life saved with cost per year of life saved ranging from $1,582 to $16,060.
  - **Cost-utility** - effect measured in quality-adjusted life-years. E.g.: mean incremental cost per quality-adjusted life-year for lay responder defibrillation was $46,700 per QALY.
    - Published standards consider $200,000 per additional good outcome and $50,000 per QALY to be the limit at which benefits are worth the related costs.
  - **Cost-minimization** - compares two equivalent treatments and determines which has the lowest cost.

- **Societal perspective** aka community’s perspective – a way of evaluating costs based on a comprehensive view of the cost of patient’s treatment. Accounts for all costs regardless of who pays.

- **EMS Cost Analysis Project (EMSCAP)** - (see Table 49.1)
  - Excludes (charges rather than true costs)
    - Taxes
    - Prevention
    - Mutual aid
    - Sunk costs (e.g. roads)
    - Special events requested by planners (i.e. not due to anticipated surge)
    - Revenue generation (billing)
### Table 120.2 EMS cost framework components (listed alphabetically)

<table>
<thead>
<tr>
<th>Category</th>
<th>Description</th>
</tr>
</thead>
</table>
| **Administrative overhead** | Include the cost of all the following:  
  - Quality assurance of system  
  - Occupational safety (e.g., fit testing, vaccinations)  
  - Occupational health services  
  - Janitorial  
  - Laundry  
  - Water, sewer, and electric utilities  
  - Billing, collections  
  - Insurance  
  - Liability  
  - Workers’ compensation  
  - Vehicle  
  - Asset/Vending  
  - Secretarial  
  - Legal  
  - Human resources  
  - Regulatory compliance  
  - Office equipment, consumable and durable  
  - Personnel recruitment  
  - Accreditation (Commission on Accreditation of Ambulance Services, etc.)  
  - Travel  
  - Accounting and auditing  |
| **Human resources**   | All personnel involved in organized EMS response, whether paid or unpaid, including any labor costs associated with any of the listed cost categories (e.g., field providers, dispatchers, maintenance, billing, training personal, etc.).  
  This should include the cost of:  
  - Salaries  
  - Benefits  
  - Overtime  
  - Training (overtime pay, stipend, etc.)  |
| **Information systems** | This could include but is not limited to medical record systems and billing systems. This should include the cost of:  
  - Acquisition  
  - Operation  
  - Maintenance  
  - Replacement  |
| **Medical oversight** | A physician may be employed by the EMS agency in which case the cost may be accounted for in human resources; otherwise, estimate cost, not simply charges; also consider that administrative overhead may be borne by other entities, but should be accounted for (e.g., malpractice insurance, travel, communication equipment).  
  Include the cost of all of the following:  
  - Quality assurance/quality improvement of out-of-hospital emergency care  
  - Direct medical oversight  
  - Indirect medical oversight  |
| **Bystander response** | Bystander response to medical emergencies (e.g., community CPR certification or first aid). Include the cost of all of the following:  
  - Training (e.g., instructor, location, equipment)  
  - Equipment  
  - Retraining  |
| **Communications**    | Include the cost of all of the following:  
  - Public safety answering point equipment and facilities  
  - Dispatch center software (e.g., computer aided dispatch system), equipment and facilities  
  - In-vehicle communication devices portable/wireless devices, including radios and cell telephones  
  - Medical oversight/hospital communication devices EMS communication infrastructure (e.g., trunk system, telephone system, or satellite (but not cell telephone towers, etc. because these are sunk costs))  
  For each include the cost of:  
  - Acquisition  
  - Operation  
  - Maintenance  
  - Replacement  |
| **Physical plant**     | Any buildings necessary to train, provide, maintain, or administer the EMS system. This should include the cost of:  
  - Acquisition  
  - Operation  
  - Maintenance  
  - Replacement  |
| **Training**          | Any training provided including:  
  - Initial training (e.g., instructor, location, durable and consumable equipment)  
  - Continuing education (e.g., instructor, location, durable and consumable equipment)  |
| **Vehicles**          | Any vehicle used to train, provide, maintain, or administer the EMS system, including those that travel by ground, air, or water. This should include the cost of:  
  - Acquisition  
  - Operation  
  - Maintenance  
  - Replacement  |

- “Joint production” problem – attributing costs for an activity when an agency plays multiple roles in a community, e.g. fire department also responding medically. Difficult to determine how to attribute the cost; no consensus.
Table 121.1 Definitions of terms commonly used in classical statistical testing

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>The maximum p-value considered statistically significant; the risk of committing a type I error</td>
</tr>
<tr>
<td>$\alpha$ error</td>
<td>A type I error</td>
</tr>
<tr>
<td>Alternative hypothesis</td>
<td>The hypothesis that is considered as an alternative to the null hypothesis; the hypothesis that there is an effect of the studied treatment, of a given size, on the measured variable of interest; the hypothesis that there is a difference between two or more groups of a given size, on the measured variable of interest; sometimes called the test hypothesis</td>
</tr>
<tr>
<td>$\beta$</td>
<td>The risk of committing a type II error</td>
</tr>
<tr>
<td>$\beta$ error</td>
<td>A type II error</td>
</tr>
<tr>
<td>Null hypothesis</td>
<td>The hypothesis that there is no effect of the studied treatment on the measured variable of interest; the hypothesis that two or more groups are the same with respect to the measured variable of interest</td>
</tr>
<tr>
<td>Power</td>
<td>The probability of detecting the treatment effect defined by the alternative hypothesis (i.e., obtaining a p-value &lt; $\alpha$), given $\alpha$ and the sample size of the clinical trial; power = 1 – $\beta$.</td>
</tr>
<tr>
<td>p-value</td>
<td>The probability of obtaining results similar to those actually obtained, or results more inconsistent with the null hypothesis, assuming the null hypothesis is true</td>
</tr>
<tr>
<td>Type I error</td>
<td>Obtaining a statistically significant p-value when, in fact, there is no effect of the studied treatment on the measured variable of interest or that the groups being compared are not different; a false positive</td>
</tr>
<tr>
<td>Type II error</td>
<td>Not obtaining a statistically significant p-value when, in fact, there is an effect of the treatment on the measured variable of interest that is as large or larger than the effect the trial was designed to detect, or that there is a difference between the groups that is as large or larger than the treatment effect tested; a false negative</td>
</tr>
</tbody>
</table>


- Parametric tests: analyze numerical data, require normal distribution and equal variance
- Nonparametric tests: analyze numerical data that is either normal (like parametric) or NONnormally distributed.
  - Tradeoff is slight loss of power for detecting true difference between groups (increased chance of type II error).
- Confidence interval:
  - "True" treatment difference between groups is the point estimate. CI is the estimated range of values (typically with 95% confidence) in which this "true value" will be located.
  - Width of confidence interval gives information on precision of point estimate. (wider = less precise).
  - Including Zero: cannot make any definitive conclusions. Need to repeat study with increased sample size.
Table 121.2 Common statistical tests and their assumptions

<table>
<thead>
<tr>
<th>Statistical Test</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Parametric Tests</strong></td>
<td></td>
</tr>
<tr>
<td>Student’s t-test</td>
<td>Used to test whether the means of a continuous variable from two groups are equal, assuming that the data are normally distributed and that the data from both groups have equal standard deviation or variance. A less common form of the t-test can be used to analyze data from matched pairs (e.g., before and after measurements on each patient).</td>
</tr>
<tr>
<td>One-way ANOVA</td>
<td>Used to test the null hypothesis that three or more sets of continuous data have equal means, assuming the data are normally distributed and that the data from all groups have equal standard deviations or variances. The one-way ANOVA may be thought of as a t-test for three or more groups.</td>
</tr>
<tr>
<td><strong>Nonparametric Tests</strong></td>
<td></td>
</tr>
<tr>
<td>Wilcoxon rank sum test (Mann-Whitney U test)</td>
<td>Used to test whether two sets of continuous data have the same median. These tests are similar in use to the t-test, but do not assume the data are normally distributed.</td>
</tr>
<tr>
<td>Wilcoxon signed rank test</td>
<td>Used to examine data from matched pairs, similar to the matched pairs t-test, but when differences in each pair are not normally distributed.</td>
</tr>
<tr>
<td>Kruskal-Wallis</td>
<td>This is a test analogous to the one-way ANOVA, but no assumption is required regarding normality of the data. The Kruskal-Wallis test may be thought of as a Wilcoxon rank sum test for three or more groups or as a one-way ANOVA for nonnormally distributed data.</td>
</tr>
<tr>
<td>Chi-square test</td>
<td>Used with categorical variables (e.g., two or more discrete treatments or groups with two or more discrete outcomes) to test the null hypothesis that there is no association between treatment and outcome. The chi-square test assumes at least five expected observations (patients) of each combination of treatment and outcome under the null hypothesis.</td>
</tr>
<tr>
<td>Fisher’s exact test</td>
<td>Used in an analogous manner to the chi-square test, Fisher's exact test may be used even when fewer than five observations are expected in one or more categories of treatment and outcome.</td>
</tr>
</tbody>
</table>

ANOVA = analysis of variance.

<table>
<thead>
<tr>
<th>Injury severity</th>
<th>Level I or II TC</th>
<th>Level III or IV TC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe (Requires level I or II)</td>
<td>a</td>
<td></td>
</tr>
<tr>
<td>Not severe (Requires level III or IV)</td>
<td>b</td>
<td>d</td>
</tr>
</tbody>
</table>

Sensitivity = \( a(a + c) \)
Specificity = \( d(b + d) \)
Rate of undertriage = \( c(a + c) \)
Rate of overtriage = \( b(d + b) \)
Positive predictive value = \( a(a + b) \)
Negative predictive value = \( d(c + d) \)

* In this figure, “a,” “b,” “c,” and “d” represent injured patients, categorized by severity of injury and destination.
* Trauma center.

Figure 39.2 Measures of field triage accuracy. Source: Sasser SM. Guidelines for field triage of injured patients, recommendations of the National Expert Panel on Field Triage. MMWR Recomm Rep. 2009; 58:1–35.
Last Minute Cram Section

This section was created by an individual as his personal study guide and so does not include proper citations. Sources include the NAEMSP textbook, the Buffalo EMS Question Bank (www.ubmdems.com/emsqbank), and Dr. Fowler's study guide (http://www.doctorfowler.com/)

Dates/Laws/Standards/Studies

  Identified trauma as not properly cared for. It listed 24 proposed recommendations. Blueprint for EMS development.

- **1966 - Highway Safety Act of 1966 - Established National Highway Traffic Safety Administration (NHTSA) within the Department of Transportation (DOT).** NHTSA was given authority to fund improvements in EMS. NHTSA developed a national EMS education curriculum and identified ideal EMS legislation. $142 million made available for regional EMS systems. The Highway Safety Act of 1966 was the **first large federal effort to fund EMS systems.**

- **1973 - The Emergency Medical Services System Act** - grant funds available to help establish local EMS systems. EMS regions were to become financially self-sufficient. Emphasized regional systems, trauma orientation. The Emergency Medical Services Systems Act of 1973 was the first comprehensive federal approach to regional development of EMS systems. It listed 15 mandatory components of EMS systems, serving as a template for program planners.

- **The Omnibus Budget Reconciliation Act of 1981** was a comprehensive cost containment act that converted 25 Department of Health and Human Services (DHHS) funding programs into seven consolidated block grants. EMS was included in the Preventative Health Block Grant.

- **The 1976 Forward Plan for the Health Services Administration** established that, by 1982, all federal EMS system financial support would end and regional EMS programs would be the responsibility of the regional agencies.

- **The EMSC program** was first authorized and funded by Congress in 1984 under the Preventative Health Amendments Act of 1984. This program is jointly shared by the Health Resources and Services Administration's Maternal and Child Health Bureau and the NHTSA.

- **The Trauma Care Systems Planning and Development Act of 1990** brought trauma research and systems development at a federal level.

- **Trauma Systems Planning and Care Act of 1990** - designated trauma systems of care

- **1996 - Emergency Medical Services Agenda for the Future** - put forth ideal EMS system that emphasizes clinical care and integration with health-care system. System should be funded, accessible, etc. Also discusses research (uniform datasets e.g. Utstein, focusing on outcomes, etc.). 14 attributes of an EMS system
- **EMS Education Agenda for the Future** - National core content, scope of practice, certification, education standards, education program accreditation

- **2006- EMS at the Crossroads** - IOM 2006 - EMS of future will be community-based health management that is fully integrated with the overall health system. Increased access to emergency care, public education of warning signs for stroke etc., partnerships for substance abuse/treatment

- **Aviation Medical Assistance Act** - federal good Samaritan law immunizes qualified individuals responding to in-flight emergencies

- **Federal Civil Rights Statute 42 USC 1983** - provides that any individual who impacts another individual's constitutional rights may be liable. Affects med director around discipline/suspension of privileges. Must offer due process and not be discriminatory.

- **1971 Bell vs Burson** - Court case. License is a property right subject to due process protection. Thus, in assessment of a provider, medical director held to due process.

- **FAR - Federal Aviation Regulations**
  - o Part 91 - General operations, flight rules
  - o Part 135 - Pilot rest, training; holder can be different from owner

- **NFPA 1221** - from call receipt until alert of responding units - less than 90 seconds 90% of time.

- **NFPA 1500** - requires a transport-capable EMS unit at all fireground and hazmat incidents. Also covers behavioral health incident debriefs

- **NFPA 1582** - requires fire departments to designate a department physician to provide medical oversight Requires fire departments to establish a comprehensive medical program to address worker health and safety, and include reimbursement to workers for basic medical evaluations and vaccinations

- **NFPA 1584 - Standard on the Rehabilitation Process for Members during Emergency Operations and Training Exercises** - 5 to 10 min rest after one 30 min SCBA container or 20 min of exertion. 20 min rehab after consuming two 30-min SCBAs or 45 min heavy exertion.

- **NFPA 1710 - Standard Number 1710** - Requires BLS response in 4 minutes 90% of time. ALS in 8 minutes 90% of time. Transport within 8 minutes 90% of time. 50% of shocks take place within 5 minutes. Turnout time - from receipt of unit notification until wheels rolling. Goal is <60 seconds 90% of time. Based on cardiac arrest data. Response time is from wheels rolling to scene.

- **Ryan White Act 1990 Extension 2009 - Part G** - provides framework for emergency response employee to be informed by a receiving facility if they have been exposed to an infectious disease. Protects them from HIPAA Issue. Goal is 0% occupational injury

- **OSHA Bloodborne Standard 1910** - all employers must establish written exposure control plan to eliminate or minimize exposure. Provide no cost to employee PPE. Provide testing for TB and resources for protection against exposure or risk of infection (e.g. face masks)

- **HAZWOPER regulation** - governs any incident requiring PPE to work in an immediate dangerous to life and health (IDLH) environment. Need transport-capable unit present
- **1999 - To Err is Human: Building a Safer Health System** - sentinel document that discussed risks and harms health care systems can inflict on patients. Led to research on patient safety
- **Common Rule** - uniform *federal* regulations on conduct of human subject research that provides 3 levels of protection -
  - Federal (Institutional Assurance of Compliance, Federal Wide Assurance (FWA),
  - Institutional (IRB)
  - Investigator (informed consent)
- **Belmont Report** - sets ethical standards for US research. Three principles
  - Respect for persons - free choice to participate
  - Beneficence - minimizes risk to subject
  - Justice - risks not borne by one population while another gets the benefit
- **1996- Final Rule** - provides mechanism for Emergency Research. Allows for *Exception from Informed Consent (EFIC)* - different from a waiver of informed consent.
- **RAMPART Study** - giving IM midazolam is non-inferior to IV Ativan for seizures
- **OSHA 1904** - Requires employers to keep records and report on work-related fatalities, injuries, and illnesses
- **OPALs** - ALS does not equate to improved cardiac arrest survival
- **Stafford Act 1988** - allows for declaration of federal disaster by the president. Allows for federal assistance. Also allows for major disaster declarations which allow for federal assistance to disasters. Major declarations allow for assistance after a disaster while an emergency declaration provides for more limited assistance before a disaster.
- **Posse Comitatus** - federal military cannot act as police/surveillance. Exception is martial law, civil defense operations authorized by statute, acting in defense of country, and does not apply to national guard)
- **Restoration Act** - president can use federal forces to restore law and order to a state in a major public emergency but must notify congress and repeat every 14 days.
Terms

- Statute - law, code, legislation --supersedes rules/regulations
- Regulation - e.g. rule
- Ordinance - local/municipal
- Common law - judicial precedent or case law
- **PSAP - Public Safety Answering Point.** First link in chain of survival by EMS Medical Dispatch.
- **Unit Hour Utilization (UHU) =** Utilization/unit hours. Number of transports divided by total hours unit is staffed. So, if one truck responds to 5 calls in 10 hours, UHU is 0.5. Optimal 0.55-0.45; Avg 0.35-0.25
- **Cost per transport =** cost per unit hour / [U/UH]
- **Cost per capita =** total EMS costs / population
- **System Status Management (SSM) -** defines how you staff and deploy ambulances. Tries to ideally distribute resources to impact patient outcome.
- **NEMESIS - National EMS Information System -** standard national dataset that defines EMS data with specific parameters. Managed out of University of Utah and National Highway Safety Administration. More than 400 data elements. Currently in version 3. 90% of states and territories are compliant.
- **NDMS - National Disaster Medical System -** part of HHS which has administrative and operational control. DOD, VA, DHS are partner agencies. Military will provide transportation assets.
- **Utstein Template -** first published in 1991 by AHA for cardiac arrest performance benchmarking. First data tool that called for integration of PSAP, EMS, hospital, and patient outcome data. Revised in 2004 with simplified data definitions. Considered the minimum data set for EMS cardiac arrest analysis. *Basically, a standardized way to talk about cardiac arrest for research and QA activities.* Elements of 2004 revision include % bystander CPR, witnessed, any shock?, initial rhythm ROSC, survival, CPC score
- **CPC Score -** measures functional status after arrest. 1 - normal, 2 - minimal deficits, 3 - needs assistance with ADLs, 4 - persistent vegetative state, 5 - death
- **Enumerative studies (Clinical Studies) -** examine a data set over a fixed time/frame. Looks at one action on the study population.
- **Analytical studies (Performance Studies) -** examines performance in an ongoing manner. Evaluate the effect of provider’s action on a process. Judge data, make changes, rejudge data, so basically quality improvement.
- **Special Cause Variation vs Common Cause Variation -** special cause actually is due to system change vs common cause which is performance due to natural variation (e.g. snow leads to longer response times)
- **Exception from Informed Consent -** Must be life threatening condition with unfeasible consent. No good treatment options available. No reasonable way to anticipate subject availability ahead of time. Can be used for higher risk prospective studies. Also requires community consultation and public disclosure.
• **Waiver of Informed Consent** - IRB may waive requirement for consent for low risk studies

• **P-value** - probability of obtaining the alternate hypothesis if null hypothesis is true. Probability you obtained results by accident. Usually P<0.05 allows you to reject null hypothesis.

• **Type I error (alpha)** - probability of false positive result

• **Type II error (beta)** - probability of false negative

• **Power** = Probability of detecting a treatment effect given alpha and a sample size = (1-beta)

• **Types of data**
  - Numerical - continuous, like blood pressure, body weight, etc.
  - Categorical - red/white/blue, race, etc.
    - Ordinal - type of categorical but limited and particular order (small medium large), GCS, CPC
    - Binary - yes/no

• **Statistical Tests**
  - Continuous Data (normally distributed; parametric) - If 2 groups, use T-test. If 3 or more, ANOVA.
  - Ordinal Data (or non-normally distributed; non-parametric) - If 2 groups, Wilcoxon rank-sum, if 3 or more, Kruskal-Wallis test
  - Categorical or Binary (non-normally distributed; non-parametric) - If 2 groups, Chi-squared. If 3 or more, still chi-squared. Fisher if one box has less than 5 data points.

• **Intention to Treat Analysis** - randomized control trial but subject must stay in assigned group regardless of treatment actually received.

• **Trial types:**
  - **Randomized Control Trial** - Gold standard for research. Need informed consent or Exception from Informed Consent. Cannot do this with a waiver.
  - **Prospective Observational Study** - data collection as you go. RCT is type of prospective trial but has interventions. Observational studies have no interventions, they simply monitor and track outcomes. In these studies, can sometimes get waiver as they are generally low risk.
  - **Retrospective** - a review of data that has already been collected. Much faster, cheaper, and easier. Consent is typically not required. Results are not as reliable.
    - **Case control** - divides subjects based on outcome. So, all who lived in one group, all who died in another.
    - **Cohort** - divides subject based on initial exposure. Hiroshima is example. Generally, more reliable than case control.

• **Hospital Categorizations**
  - Regionalization - Forming a coordinated system of care across a geographic area to optimize outcomes (e.g. trauma system)
  - Categorization: Comparison to established standards to classify hospital capabilities - e.g. ACS Level I Trauma Center
Designation - selection for patient referral and transfer by medical director. Minimum standards must be met to be designated as a specialty receiving center (E.G. local “STEMI Hospital”) vs verification (unbiased outside assessment of a hospital’s trauma care). Local EMS agencies designate trauma centers. The American College of Surgeons (ACS) verifies trauma centers.

**Trauma Center Levels**
- 4: Community hospital; can stabilize and transfer
- 3: ER + immediately available surgeon + ortho/plastics/anesthesia/rads on call
- 2: +NSG/OB/ophtho/hand/OMFS/thoracic/critical care
- 1: +coronary bypass capable/microvascular +OR staff in house +teach ATLS +regional referral center +residents +research

**Concepts of Medical Performance**
- Baldridge - Passed under Reagan Administration. Utilized to evaluate quality in medical facilities.
- Six Sigma - Six Sigma was created in 1986, by a Motorola employee and is a set of techniques and tools for process improvement. Each sigma level is like a standard of deviation, so 4 sigma is good, 5 better, 6 is best.
- Highly Reliable Organizations - e.g. Airline industry. Occurs where failure can lead to catastrophe. These industries are “preoccupied with failure”

**Value quotient** = Performance Indicator/Cost. So, for instance community A has a cardiac arrest survival rate of 40% and a per capita EMS cost of $25. 0.4/25. Higher value quotients are better

**Levels of Evidence**
- I - Well designed RCT
- Ila - Well designed, controlled, no randomization
- IIb - Well designed, case control/cohort
- IIc - multiple or overwhelming data from less well-designed trials
- III - expert opinion

**Classes of Recommendation (COR)**
- Level A - Good evidence
- Level B - Fair evidence
- Level C - Fair evidence - clinical benefits and risks are equivocal
- Level D - Fair evidence - risks outweigh benefits
- Level I - insufficient evidence to make recommendation

**Stroke Scales**
- Cincinnati
  - Facial droop - asymmetry in face
  - Arm drift - unilateral only
  - Abnormal speech - slurred or inappropriate words
- Los Angeles Prehospital Stroke Scale
  - The Los Angeles Prehospital Stroke Scale is a validated prehospital stroke scale that asks EMS providers to examine for asymmetry of the following: facial droop, grip strength, arm strength (by downward drift) and unilateral findings. Patients must also meet the following criteria:
over the age of 45, no history of seizures, symptoms less than 24 hours, patient's baseline function is not bedridden or confined to a wheelchair, and blood glucose is between 60 and 400

**Important Pearls to Memorize**

- Radiation exposure: Time exposure is linear. Distance is inverse square law. Shielding (alpha rays blocked by paper/cloth/skin). Beta by FF turnout gear. Gamma - good luck
- Remember phosgene is delayed exposure (48 hrs.) in contrast to chlorine and ammonia. Pulmonary irritant
- Lewisite is blistering agent (geraniums, BAL). Phosphene is pulmonary irritant
- Paint stripper has methylene chloride. It is absorbed dermally and converted to carbon monoxide. CO level may continue to rise even when out of exposure
- Respondeat Superior vs Negligent Supervision - Respondeat Superior - "Let the Master Answer" - applies to EMS agency, not medical director, unless he owns the EMS agency or has administrative oversight. Negligent supervision is the responsibility of medical director - applies when medical director initially credentials or allows a provider to continue to practice who is incompetent.
- **Criteria for ALS TOR in Adult**: Does not apply to VF or hypothermia. Logistical concerns may override TOR criteria
  - Failure to regain pulses in 20-25 minutes if unwitnessed arrest (30 minutes if witnessed)
  - Asystole
  - Persistent ETCO2 <10 mmHg
- **Criteria for adult BLS TOR**
  - 3 rounds of CPR
  - 3 AED analyses without shock
  - No ROSC
- **Criteria for blunt trauma TOR** (can be waived if injuries not compatible with life)
  - An appropriate mechanism
  - Evaluation for reversible blocked airway
  - Evaluation for VF/pulseless VT
- **Criteria for penetrating trauma TOR**
  - No signs of life
  - Intact airways
  - Found in or develop asystole
- **PPE levels**
  - Level A - entirely encapsulated self-contained suit. Breathing apparatus is on inside. Vapor resistance distinguishes this.
  - Level B - Uses SCBA but this may be on outside. Buzzword is splash resistance. Not vapor resistance.
Level C - Filtered mask rather than SCBA but uses level B type suit. Cannot be used in O2 deficient environment. Can only be used when you have identified agent.

Level D - standard bunker gear (even if includes SCBA).

- **Blast injuries**
  - Primary - pressure wave
  - Secondary - shrapnel
  - Tertiary - casualty becomes a missile and is propelled
  - Quaternary - All other explosive related injuries (burns, crush, inhalation injury, e.g. asthma exacerbation)
  - Quinary - intentional additive agent to bomb (radioactive, chemical, biological)

- **Strategic National Stockpile** - meds, antidotes, etc. Distributed in Regional ChemPacks

- **Metropolitan Medical Response System (MMRS)/Urban Area Security Initiative (UASI)** provide funds for training, caches of medical equipment and medications

- **TCCC Zones of care**
  - **Hot** - active risk of injury. Tourniquet and opening airway are only care maneuvers
  - **Warm** - potential but not immediate or direct threat. Needle decompression, airway interventions, breathing and circulatory assessments and interventions. Can consider spinal immobilization etc. here.
  - **Cold** - No significant danger or threat

- **TCCC Phases**
  - Care Under Fire
  - Tactical Field Care
  - Tactical Evacuation Care

- **Meningococcus PEP**: options include ceftriaxone 250mg IM once, ciprofloxacin 500 mg PO once, or rifampin 600 mg PO BID x 2 days, and should ideally be started within 24 hours (though may be effective up to 10 days post-exposure).

- **Radiation** - 3 clinical ranges. Note 1 GY = 100 rads. At 48 hours post incident: >1500 = normal; 1000-1500 = survival without treatment; 500-1000 = survival with treatment; and <500 = very severe or lethal exposure.
  - **Subclinical** - up to 200 rads. ½ with nausea/vomiting within 2-6 hrs. Minimally decreased lymph count. No CNS involvement. Full recover
  - **Clinical-sublethal** - 200-800 rads. Up to 100% with nausea/vomiting, 1-4 hrs. in. Decreased lymphocyte count as low as <500 at 24 hrs. May experience cognitive impairment for more than 24. Prognosis based on ALL at 48 hrs.
  - **Lethal** - >600 rads. Nausea/vomiting within 1 hr. The lymphocyte count decreases within hours, and one would expect rapid decline of central nervous function. These patients are not expected to survive. Once the dose reaches >3000 rad, there is rapid incapacitation, with some patients having a lucid interval of several hours before becoming unconscious or comatose.

- **Radiation Treatment**: Prussian blue (not methylene blue) can decrease uptake of several isotopes, including cesium, rubidium, and thallium. Uranium clearance can be
increased by urinary alkalization. DTPA and other chelating agents may also be effective with binding and decreasing uptake of several radioactive isotopes. Potassium iodide functions by saturating the thyroid and thus preventing radioactive iodide from binding to the thyroid tissues. This decreases the exposure of the thyroid to radiation and thus decreases the likelihood of resultant thyroid cancers secondary to radiation. It should be administered within 1-2 hours of exposure for maximal benefit.

- **Types of Ambulances:**
  - Type I - truck with traditional cab and modular box ambulance body on back
  - Type II - Van
  - Type III - same as I but mounted on van chassis
- **Dispatch** -
  - *System Status Management* moves ambulances based on geographic demand.
- **Radio frequencies:**
  - VHF frequencies are the longest range of frequencies typically used for EMS and are the predominant choice in frontier, rural, and suburban systems; range is also dependent on power output of individual radios, antenna height, and any repeaters used. VHF systems are simplex, thereby only permitting one-way communication.
  - UHF systems have improved penetration through buildings compared to VHF systems, however, do not have the range of VHF systems.
- **Types of Calls**
  - First-party calls are when a patient calls 911 for themselves.
  - A second-party caller is someone with the patient.
  - A third-party caller is someone who is not with the patient, such as a motorist who calls 911 as he drives by
- **Response codes**
  - Alpha level requests a BLS unit to respond cold.
  - Bravo level requests a BLS unit to respond hot.
  - Echo level requests all units (ALS/BLS/first responders) to respond hot.
  - Omega level response can be safely and more effectively handled by non-traditional response means. Examples are: nurse advice line service, poison control, or wheelchair van.
- **Hazardous material responders**
  - Awareness level - recognize problem, protect him or herself, secure area, call for help
  - Operational level responders - protect nearby persons/property, control scene, initial containment. Do not don PPE.
  - Technician level responders - control substance release. PPE. Etc.
- **Fire Diamond Placard** (based upon NFPA 704) - Numbers range from 0 to 4 with 0 being not hazardous, 4 being severe
  - Blue - Health hazard
    - 0 = No hazard
    - 1 = Slightly hazardous
    - 2 = Hazardous
- 3 = Extremely hazardous
- 4 = Deadly

- Yellow – Reactivity
  - 0 = Stable
  - 1 = Unstable if heated
  - 2 = Violent chemical
  - 3 = Shock or heat may detonate
  - 4 = May detonate

- Red - Fire hazard, the numbers indicate the flash point:
  - 0 = Will not burn; concrete is an example
  - 1 = Above 200 degrees F (93 C); paper and wood are examples
  - 2 = Below 200 degrees F
  - 3 = Below 100 degrees F (38 C)
  - 4 = Below 73 degrees F (23 C)

- White - Specific hazard
  - W – reacts with water
  - OX – Oxidizer
  - ACID
  - ALK – Alkali
  - COR – Corrosive
  - SA – asphyxiant gas (nitrogen, helium, neon, argon, krypton, xenon)

- CO poisoning cutoffs: Patients with carboxyhemoglobin levels greater than 25%, or greater than 15% in pregnant patients, should be transported to a hyperbaric center.

- Odors
  - Fruity - Isopropranolol, acetone
  - Garlic - Organophosphates, mustard gas
  - Almonds - Cyanide
  - Mothballs - Naphthalene, Camphor
  - Freshly Mown Hay - Phosgene
  - Geranium - Lewisite

- Nerve Agents
  - G-agents -- Volatile, non-persistent, vapor and liquid threat. Tabun (GA), Sarin (GB; 4-6 hours aging), Soman (GD; 2 minutes aging)
  - VX -- Non-volatile, persistent, liquid threat; increased exposure. 60 hours aging

ICS structure - purpose is to do this the same across the country
- **Incident Commander** - the one person identified as overseeing incident
- **Unified Command** - senior representatives (basically the cabinet) for the incident commander
- **Incident Commander priorities** - Life safety, incident stabilization, property conservation
- **Unity of command** - every member reports to incident commander
- **Span of control** - no leader should be responsible for more than 7 personnel or functions
- **Sections** - organizational levels with the responsibility for a major functional area of the incident. Person in charge of a section is a **chief**. The FLOP - finance, logistics, operations, planning
- **Officers (general staff)**
  - Public Information Officer - Talks to public/press
  - Safety Officer - maintains safety of scene and safety for responders/civilians.
  - Liaison Officer - chief of staff. Conduit for two-way info exchange between IC and representatives of other agencies
- **The FLOP**
  - Operations - tactics (not strategy). Execute the tasks defined by the incident commander during the operational period.
  - Planning - draft incident action plan (IAP). Basically, they determine what is needed for next step of incident in contrast to operations which is working in the now
  - Logistics - responsible for supply chain
  - Finance - staffed when significant procurement capabilities are needed. This is the last fully staffed position.
• **Section** - major organizational level e.g. Logistics (FLOP)
• **Branch** - Split groups/divisions into branches to maintain span of control. divides by discipline and has a **director**. E.G. EMS branch director, Fire branch director, Police branch director. As example, fly car EMS MD’s would be in service BRANCH of logistics SECTION. Medic treating patients on scene would be in medical BRANCH of ops SECTION
• **Groups** - Divide into functional areas of operation. Led by supervisor
• **Divisions** - geographical distributions. Run by **supervisors**. E.G. East division
• **Units** - functional responsibility with a specific activity. E.G. the supply unit
• **Task force** - A combination of mixed resources with a singular mission. Different then units which have one specific expertise. So, rescue task force includes LEO, firefighters, EMS, etc. vs police unit
• **Single resource** - individual or single piece of equipment with its personnel. E.g. engine truck. Crew with identified supervisor
• **Strike team** - set number of similar resources - engine strike team.
• **IS 100 and 200** - Incident Command - deals with life safety, incident stabilization, property conservation
• **IS 700** - NIMS (National Incident Management System) - provides a consistent nationwide template to enable all government, private sector, and nongovernmental organizations to work together during domestic incidents. Outlines terms, concepts, management approaches.
• **IS 800** - National Response Framework. Consists of 5 parts (who, what, how, planning, additional resources).
• **ESF** - Emergency Support Function of the National Response Framework  
  o ESF 1 -Transportation (DOT)  
  o ESF 2 - Communications (DHS/FEMA)  
  o ESF 4 - Firefighting (USDA)  
  o ESF 5 - Emergency Management; Information and Planning (DHS/FEMA)  
  o ESF 6 - Mass Care, Housing, and Human Services; Shelter (DHS/FEMA)  
  o ESF 7 - Logistics and Resources; e.g. NGOs (GSA, DHS/FEMA)  
  o **ESF 8** - *Public Health and Medical Services; NDMS, DMAT, federal assistance for medical evacuation; Money for EMS (HHS)*  
    1. **Tiers of ESF 8**  
      1. I - 105 members, deployable in 12 hours  
      2. II - Mental health teams, applied public health teams  
      3. III - All active-duty commissioned public health service officers not already deployed  
      4. IV - Inactive reserve corps  
  o ESF 9 - Search and Rescue; (DHS/FEMA; DOD). USaR teams must be self-contained. Physician on team does occupational health, patient care, etc. USaR does canine and electronic searches, emergency medical and ALS care, etc.
  o ESF 10 - HAZMAT, oil (EPA)
• ESF 13 - Public Safety, security
  o ESF 14 - Long-term Community Recovery and Mitigation.

• NIMS
  o NIMS 100 - Introduction to Incident Command System
  o NIMS 200 - ICS for Single and Initial Action Events
  o NIMS 700 - National Incident Management Systems (NIMS): An Introduction,
  o NIMS 800 - National Response Framework: An Introduction.