

NAEMSP Board Certification Exam Review Guide
Emergency Medical Services
Clinical Practice and Systems Oversight, Second Edition



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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. EMS physicians should carefully consider their academic knowledge in each of these areas and apportion their study time appropriately. 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 physician who qualifies to sit for the exam will have a long history of success in test taking, notwithstanding the fact that many would consider themselves “good” or “bad” test-takers. Therefore, each individual would be well-advised to consider those techniques they have used that got them to this point, and to be very circumspect in considering a major change 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 in the night, then changing to study groups may not be the best strategy.

Test-taking techniques themselves can be improved. There are good online resources for this but practicing on how to read questions, considering what the actual question is, and what the “distractors” are can be valuable. Consideration of the answers and whether they are true relative to the actual question being asked, as well as discounting obviously false answers can help optimize your study efforts by being able to answer correctly using what you know. Keep in mind that the test-writers are not constructing “trick questions,” but they will try to truly challenge your knowledge, which will require careful consideration of the questions themselves.

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 success of many on the exam is evidenced by the fact that there are now more physicians board certified in EMS Medicine than any other ABEM subspecialty. Nevertheless, the passing rates on this exam have been lower than the current passing rates on the Emergency Medicine (EM) qualifying exam, but are similar to the passing rate seen in the early years of EM qualifying exam. We hope that using the strategies described here can be used to maximize one's chance of success.

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.

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

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VOLUME 1: Clinical Aspects of EMS

1: History of EMS, Textbook Page 1

Before 1966 - historical perspectives

- Medical experiences of Civil War stimulated 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]

Figure 1.1 Key findings of the 1966 NAS-NRC report. Adapted from *Accidental Death and Disability: The Neglected Disease of Modern Society*. Washington, DC: National Academy of Sciences, 1966, National Academy Press.

Inadequacies of Prehospital Care in 1966
1. The general public is insensitive to the magnitude of the problem of accidental death and injury.
2. Millions lack instruction in basic first aid.
3. Few are adequately trained in the advanced techniques of cardiopulmonary resuscitation, childbirth, or other life-saving measures, yet every ambulance and rescue squad attendant, policeman, fire fighter, paramedical worker, and worker in high-risk industry should be trained.
4. Local political authorities have neglected their responsibility to provide optimum emergency medical services.
5. Research on trauma has not been supported or identified at the National Institutes of Health on a level consistent with its importance as the fourth leading cause of death and a primary cause of disability.
6. The potentials of the U.S. Public Health Service Program in accident prevention and emergency medical services have not been fully exploited.
7. Data are lacking on how to determine the number of individuals whose lives are lost through injuries compounded by misguided attempts at rescue and first aid, absence of physicians at the scene of the injury, unsuitable ambulances with inadequate equipment and untrained attendants, lack of traffic control, or the lack of voice communication facilities.
8. Helicopter ambulances have not been adapted to civilian peacetime needs.
9. Emergency departments of hospitals are overcrowded, some are archaic, and there are no systematic surveys on which to base requirements for space, equipment, or staffing for present, let alone future, needs.
10. Fundamental research on shock and trauma is inadequately supported; medical and health-related organizations have failed to join forces to apply knowledge already available to advanced treatment of trauma, or educate the public and inform Congress.

1968 - ACEP founded

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

1. Manpower
2. Training
3. Communications
4. Transportation
5. Facilities
6. Critical care units
7. Public safety agencies
8. Consumer participation
9. Access to care
10. Patient transfer
11. Coordinated patient record-keeping
12. Public information and education
13. Review and evaluation
14. Disaster plan
15. Mutual aid

Figure 1.2 *The Fifteen Essential EMS Components*. Washington, DC: Department of Health, Education, and Welfare, Division of EMS, 1973.

- **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
- 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
- "First-Hour Quintet" from European Resuscitation Council conference
 - Out of hospital cardiac arrest (OHCA)
 - Severe respiratory difficulties
 - Severe trauma
 - Chest pain including ACS (acute coronary syndrome)
 - Stroke

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')

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 19

- 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 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 paralytic.
 - Specialized pediatric teams may have additional protocols.
- Prehospital NIPPV has been shown to decrease intubation rates, shorten hospital length of stay, and improve survival.

4: Airway Management: Special Situations, 43

- 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 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 environment including multiple ETI options, SGA, cric, etc.
- Airway management technique can affect exposure of tactical provider to an active threat.
- Operational constraints or type of injury may increase consideration of early surgical airway.

Section II: Breathing

5: Respiratory Distress, 53

- 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 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 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, 60

- **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

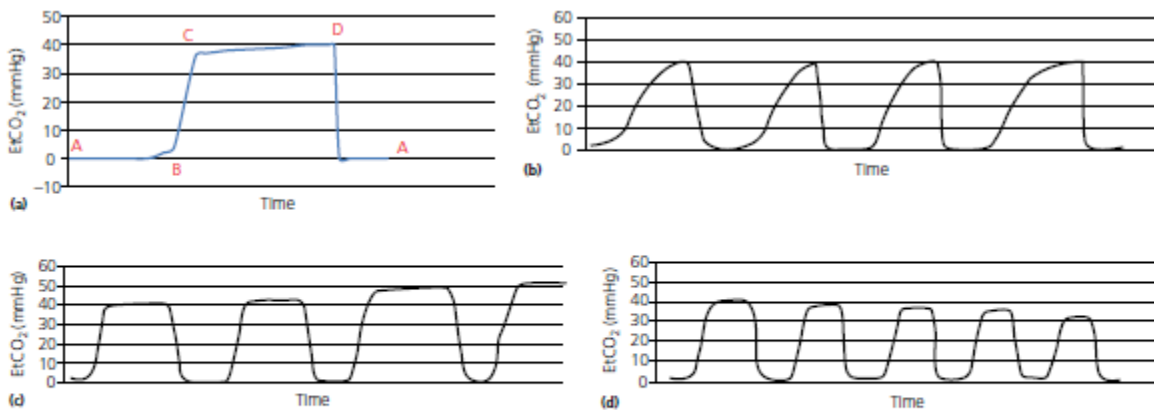


Figure 6.2 Capnography waveforms. (a) Normal waveform. Point A is beginning of expiration. A-B is expiration of dead space air. B-C shows rapid rise in level of CO₂ as air from lungs is exhaled. C-D is the plateau phase representing primarily alveolar air. D represents the value used for determination of EtCO₂. D-A represents inspiration. (b) Effect of bronchospasm. Note the slower rise in the CO₂ level leading to the so-called shark fin waveform. (c) Hypoventilation. (d) Hyperventilation.

- 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]

Table 6.2 Devices for delivery of supplemental oxygen

Device name	O ₂ flow rate (L/min)	FiO ₂ (approximate %)
Nasal cannula	1-6	24-44
Simple face mask	5-12	35-55
Partial rebreather mask	8-15	35-60
Non-rebreather mask	8-15	60-95
Venturi mask	4-15	24-50
Tracheostomy mask	10-15	35-60

- Capnography is superior to pulse oximetry as monitor of respiratory function
 - "Shark fin" pattern = obstructive airway disease, often seen in COPD or asthma
- NIPPV 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. Patient 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 test 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 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 ($P_1V_1 = P_2V_2$): Air in the pleural space will expand with decreasing atmospheric pressure associated with increasing altitude

Section III: Circulation

7: Hypotension and Shock, 69

- Clinical signs and symptoms: tachycardia, poor skin perfusion, EtCO₂ and AMS.
- Error rate of 20% for VS obtained prehospitally.
- **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 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** 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.
- Future technologies:

- POC lactate level
- Ultrasound

Table 7.1 Categories of shock

Type of shock	Disorder	Examples	Comments
Hypovolemic	Decreased intravascular fluid volume	A. External fluid loss 1. Hemorrhage 2. Gastrointestinal losses 3. Renal losses 4. Cutaneous loss B. Internal fluid loss 1. Fractures 2. Intestinal obstruction 3. Hemothorax 4. Hemoperitoneum 5. Third spacing	Hypovolemic shock states, especially hemorrhagic shock, produce flat neck veins, tachycardia, and pallor
Distributive	Increased “pipe” size: peripheral vasodilation	A. Drug or toxin induced B. Spinal cord injury C. Sepsis D. Anaphylaxis E. Hypoxia/anoxia	Distributive shock states usually show flat neck veins, tachycardia, and pallor. Neurogenic shock due to a cervical spinal cord injury tends to show flat neck veins, normal or low pulse rate, and pink skin
Obstruction	Pipe obstruction	A. Pulmonary embolism B. Tension pneumothorax C. Cardiac tamponade D. Severe aortic stenosis E. Venocaval obstruction	Obstructive shock states tend to produce jugular venous distension, tachycardia, and cyanosis
Cardiogenic	“Pump” problems	A. Myocardial infarction B. Arrhythmias C. Cardiomyopathy D. Acute valvular incompetence E. Myocardial contusion F. Myocardial infarction G. Cardiotoxic drugs/poisons	Cardiogenic shock states tend to produce jugular venous distension, tachycardia, and cyanosis

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

8: Vascular Access, 78

- 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 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.

Section IV: Medical Problems

9: The Challenge of the Undifferentiated Patient, 87

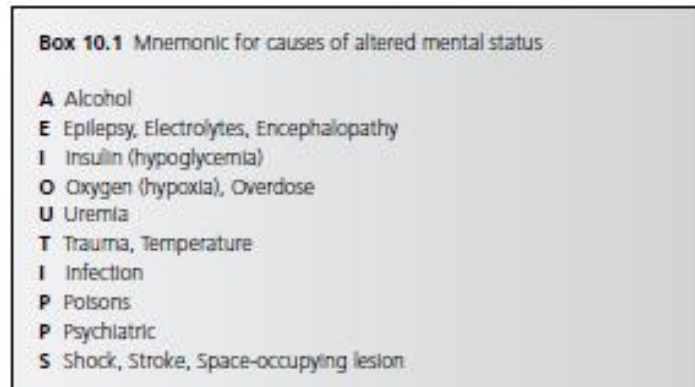
- EMS have to compile a massive amount of information in a relatively short amount of time
- For truly undifferentiated patient, review the history, diagnosis and testing used prior to transfer to ED staff
- Use witnesses or next of kin, and scan the environment for more information
- Modes of clinical 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)

10: Altered Mental Status, 92

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



- **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
- ≤ 2 mg 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

11 Cardiac arrest systems of care, 98

- Much of the sudden cardiac arrest (SCA) survival benefit is due to community-based system 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 initial rhythm in approx. 30-60% 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 such as percutaneous coronary intervention and targeted temperature management therapeutic hypothermia).
- 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 delay.
 - AEDs provide faster access to defibrillation. Need to be well placed in community with members knowing they are present and how to put them on.
 - AEDs are very safe, but still some confusion about them.
 - 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.

12 Cardiac arrest: clinical management, 109

- **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 to be of 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
 - Changing compressors (quickly) every 100–200 compressions
 - Integrating defibrillation and precharge so ready to shock
 - Minimize pauses
- **DNR and Termination of Resuscitation efforts:** Protocols are useful for addressing these situations. Direct medical oversight 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*

13 Chest pain and acute coronary syndrome, 120

- 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 STEMI*s. 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 IIa for NSTEMI; remains I in STEMI)
 - Fentanyl instead of morphine shown to be equivalent prehospitally
 - 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%

14 Cardiac dysrhythmias, 129

- 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.

15 Cardiac procedures and managing technology, 137

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.

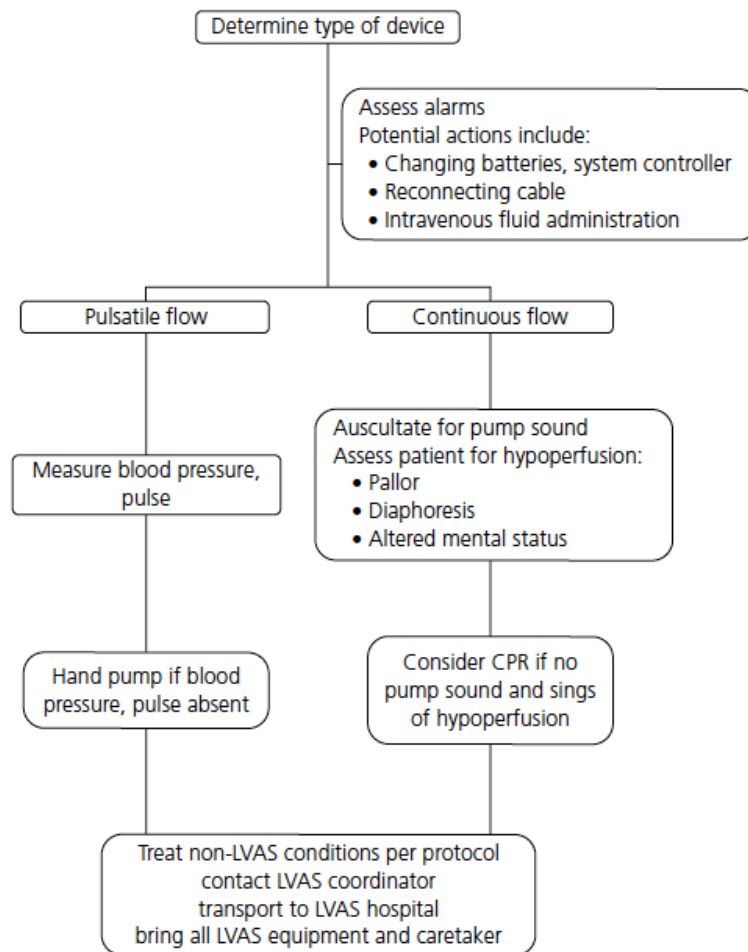


Figure 15.2 Emergency assessment of a patient with a left ventricular assist system (LVAS). CPR, cardiopulmonary resuscitation.

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

16 Abdominal pain, 144

- 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

17 Submersion injuries/drowning, 151

- 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
 - **Wet drowning:** aspiration of water, sand, and other material leading to pulmonary edema, pneumonitis, and surfactant dysfunction
 - **Dry drowning:** minimal aspiration due to *laryngospasm*
 - **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

18 Choking, 155

- 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

19 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

20 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:**
 - 3 mo-5yrs due to maturing brain
 - No other cause found for seizure
 - **Simple Febrile Seizures:** *last less than 10 min, are generalized tonic-clonic, and occur only once in 24 hours*
- **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

21 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

Box 21.2 Inclusion and exclusion criteria for Intravenous tPA [24]

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 non-stroke 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 non-compressible site within 7 days
Heparin administration within 48 h with elevated aPTT
Prothrombin time >15 s
Platelet count <100,000 μ L
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-hour treatment window

History of prior stroke and diabetes mellitus
NIH Stroke Scale >25
Oral anticoagulant use regardless of INR
Age >80 years

Source: Miller 2012.[24] Reproduced with permission of Springer.
INR, international normalized ratio; MCA, middle cerebral artery; NIH, National Institutes of Health; aPTT, activated partial thromboplastin time; t-PA, tissue plasminogen activator.

Table 21.2 Los Angeles Prehospital Stroke Scale

Criteria	Results		
Over age 45	Yes	Unknown	
No history of seizures	Yes	Unknown	
Symptoms less than 24 hours	Yes	Unknown	
Patient's baseline function is not bedridden or confined to a wheelchair	Yes	Unknown	
Blood glucose between 60 and 400	Yes	No	
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	

If exam findings are positive and answers are "yes" then LAPSS screening criteria are met and stroke is suspected. Source: Kidwell C. Stroke 2000; 31: 71–6. Reproduced with permission of Wolters Kluwer Health.

Table 21.1 The Cincinnati Prehospital Stroke Scale

Evaluate the following	Result
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 90°; 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

Source: Kothari RU. Ann Emerg Med 1999;33:373–7. Reproduced with permission of Elsevier.

22 Allergic reactions, 179

Box 22.2 Definition of anaphylaxis

Acute cutaneous and/or mucosal involvement after antigen exposure
plus:

- Respiratory compromise
 - Bronchospasm
 - Stridor
 - Hypoxia
- Cardiovascular compromise
 - Hypotension
 - Collapse
- Persistent gastrointestinal symptoms
 - Vomiting
 - Crampy abdominal pain

Box 22.1 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

- 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

23 Diabetic emergencies, 184

- 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

24 Renal failure and dialysis, 190

- 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 ≥ 0.3 mg/dL within 48 hours
 - Increase in serum creatinine ≥ 1.5 times baseline of previous 7 days
 - Urine output < 0.5 mL/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

25 Infectious and communicable diseases, 198

- 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:

Box 25.1 Centers for Disease Control and Prevention categorization of bioterrorism agents (source: www.bt.cdc.gov/agent/agentlist-category.asp)

Category A

High-priority agents include organisms that pose a risk to national security because they:

- can be easily disseminated or transmitted from person to person
- result in high mortality rates and have the potential for major public health impact
- might cause public panic and social disruption; and
- require special action for public health preparedness.

Anthrax (*Bacillus anthracis*)

Botulism (*Clostridium botulinum* toxin)

Plague (*Yersinia pestis*)

Smallpox (*variola major*)

Tularemia (*Francisella tularensis*)

Viral hemorrhagic fevers (filoviruses, e.g. Ebola, Marburg, and arenaviruses, e.g. Lassa, Machupo)

Category B

Second highest priority agents include those that:

- are moderately easy to disseminate
- result in moderate morbidity rates and low mortality rates; and
- require specific enhancements of CDC's diagnostic capacity and enhanced disease surveillance.

Brucellosis (*Brucella* species)

Epsilon toxin of *Clostridium perfringens*

Food safety threats (e.g. *Salmonella* species, *Escherichia coli* O157:H7, *Shigella*)

Glanders (*Burkholderia mallei*)

Melioidosis (*Burkholderia pseudomallei*)

Psittacosis (*Chlamydia psittaci*)

Q fever (*Coxiella burnetii*)

Ricin toxin from *Ricinus communis* (castor beans)

Staphylococcal enterotoxin B

Typhus fever (*Rickettsia prowazekii*)

Viral encephalitis (alphaviruses, e.g. Venezuelan equine encephalitis, eastern equine encephalitis, western equine encephalitis)

Water safety threats (e.g. *Vibrio cholerae*, *Cryptosporidium parvum*)

Category C

Third highest priority agents include emerging pathogens that could be engineered for mass dissemination in the future because of:

- availability
- ease of production and dissemination
- potential for high morbidity and mortality rates and major health impact
- emerging infectious diseases such as Nipah virus and hantavirus.

- 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*, *Flaviviruses*, 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

Section V: Trauma Problems

26 Trauma Systems of Care, 211

- 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, OB/GYN, OMFS, ophtho, 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, 216

- 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, 222

- 5th leading cause of death
- Extremes of age are more likely to be seriously injured
- Three-point seat belts decrease fatalities by 45% and in combination with airbags by 50%
- 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
 - 42% of 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
 - 25% of 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
 - 9% of 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

29 Penetrating trauma, 228

- 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

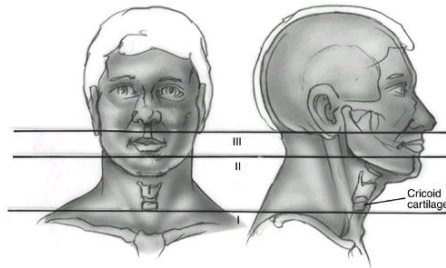


FIG. 73-8. Horizontal entry zones of the neck for penetrating injuries to the neck. (Modified from Jurkovich GJ. The neck. In: Early care of the injured patient. Moore EE, ed. Toronto: BC Becker, 1990:126.)

- Penetrating extremity trauma: vascular injuries, bony injuries, amputations
- “Scoop and Run” vs. “Stay and Play”: **Reduced mortality when scene times shorter**
- 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

30 Traumatic brain injury, 237

- TBI accounts for $\frac{1}{3}$ of traumatic deaths in US
 - Falls (35%), motor vehicle collisions (17%), direct blows to the head (16%)
 - Men > Women. children = $\frac{1}{3}$ of cases
 - Kids/elderly more likely to present to ED and also to die from injury
- Insult = direct impact, acceleration/deceleration injury, or penetrating wound
 - -> bleeding, contusion, and ultimately cell death
 - Secondary insult (*even single episode of hypotension or hypoxemia* → 150% 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
- Indications for ED evaluation of sports-related TBI: altered mental status, continued vomiting, retrograde amnesia, LOC

31 Electrical injuries, 243

- Electrical injuries have trimodal age distribution:
 - toddlers - household sockets and cords;
 - adolescents - risky behavior around electrical power lines;
 - adults - those work with electricity for living
- Most frequently, electrical injury is minor
- Electricity = flow of electrons from higher to lower concentration
- 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; in US standard household current flows at 60Hz and 110V
- Six factors determine outcome of human contact with electrical current:
 - Voltage
 - Type of current
 - Amount of current
 - Resistance
 - Pathway of current
 - Duration of contact
- Low Voltage = less than 1,000 volts
- AC exposure is 3x more dangerous than same voltage of DC current
- "Let-go current" (>10 mA) = level above which muscular tetany prevents release of the current source, flexor tetany of fingers/forearms overpower extensors
- Vfib occurs at 50-100 mA
- Ohm's law: current = voltage/resistance ($I=V/R$)
- Low resistance tissues = nerve, blood vessels
- high resistance = skin, bone, fat
- Electrical energy -> thermal energy conversion: massive internal/external burns
- SCENE SAFETY
 - Personnel should stay 10-30 feet away from source until utility company confirms off
 - Protective equipment: rubber gloves and boots
- Most common cause of death electrical injury = cardiac arrhythmia, resp arrest

- AC -> VF; DC -> asystole
- Most common EKG abnormal = sinus tach, Non-specific ST-T Wave changes (transient)
- Treatment also includes trauma and burn evaluation
 - Aggressive resuscitation (victims usually young, no CV disease)
- **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 not fatal*, 30% strikes involve more than 1 patient (hit shelter)
 - 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 -> opisthotonic muscle contractions -> fractures/trauma
 - Most common cause of death = immediate cardiorespiratory arrest
 - "Resuscitate the Dead": significant potential for resuscitation with early/sustained EMS tx
 - ***Initial care to apparently dead victims first, change in typical MCI triage***
 - 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 -> "flashover effect" = decreasing current transit through body and decreased risk of severe internal injury*
 - Lichtenberg/feathering burns = 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, 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

32 Blast injury, 248

- 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 32.1 Categories of explosive injuries

Category	Mechanism	Injury type
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
- Airway concerns mainly with burn patients - early ALS airway including potential extraglottic devices with intubation capabilities. Don't use tape to secure ETT in burn patient due to potential sloughing of skin
- Penetrating chest trauma may cause tension ptx, use a 14 g angiocath and a flutter valve, at least 3.5 cm long if possible. Use a chest seal or occlusive dressing sealed on 3-sides for open chest injuries.
- *Patients with primary blast lung are at risk for arterial gas embolism*
- In a mass casualty incident with blast and burn injuries, CPR should be withheld unless the injuries are the result of an electrical incident
- **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

33 Thermal and chemical burns, 253

- 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 33.1 Classification of burns based on depth

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

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

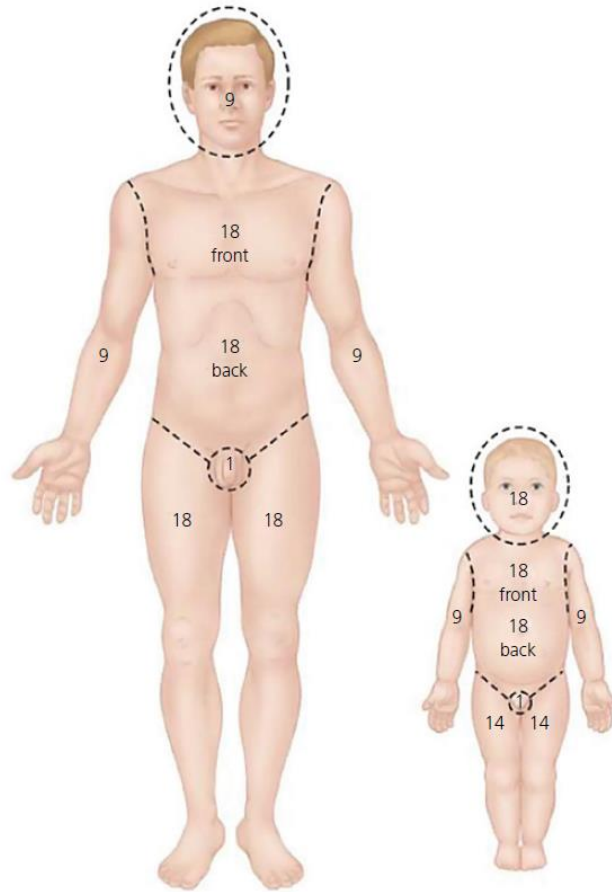


Figure 33.1 Rule of nines. Source: *Dorland's Illustrated Medical Dictionary*, 32nd edn. Philadelphia: Elsevier Saunders, 2011. Reproduced with permission of Elsevier.

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

Box 33.1 Basic fluid guidelines for burn injuries

- Fluid guidelines should be used in all adults and children with burns >20% total body surface area (TBSA)
- Common formulas used to initiate resuscitation estimate a crystalloid need for 2–4 mL/kg body weight/% TBSA during the first 24 hours
- Fluid resuscitation, regardless of solution type or estimated need, should be titrated to maintain a urine output of approximately 0.5–1.0 mL/kg/hour in adults and 1.0–1.5 mL/kg/hour in children
- Maintenance fluids should be administered to children in addition to their calculated fluid requirements caused by injury
- Increased volume requirements can be anticipated in patients with full-thickness injuries, inhalation injury, and a delay in resuscitation

Source: Data from US Army Institute of Surgical Research.

- 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
 - $\text{pH} < 3$ 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, 261

- 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, 265

- 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, 272

- 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 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.

37 Ocular trauma, 280

- 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, 284

- Recall the types of allergic reactions:

Box 22.1 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

- 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

Box 22.2 Definition of anaphylaxis

Acute cutaneous and/or mucosal involvement after antigen exposure
plus:

- Respiratory compromise
 - Bronchospasm
 - Stridor
 - Hypoxia
- Cardiovascular compromise
 - Hypotension
 - Collapse
- Persistent gastrointestinal symptoms
 - Vomiting
 - Crampy abdominal pain

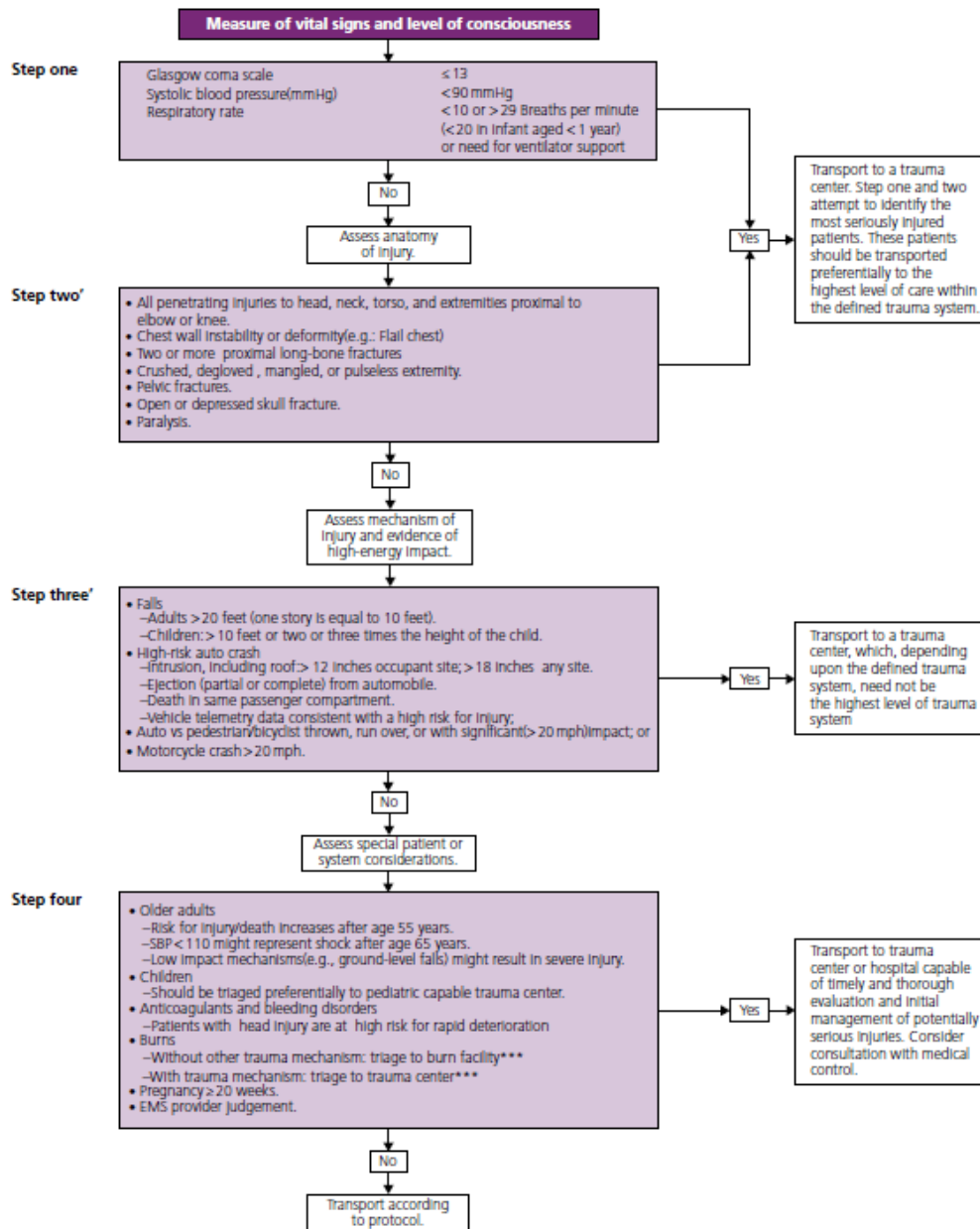
- Assessment and Treatment Approach:
 - Importance of scene safety (rescue/rx not possible if providers afflicted)
 - Determine origin of allergy
 - Exam: voice, airway edema, facial edema, lungs/wheeze, rash, hypotension
 - Prehospital treatment: IV, O2, monitor, neb prn, Epi auto injector if available, 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, 289

- 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 help 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 pediatric trauma centers, anticoagulants and bleeding disorders, burns (either to burn centers or trauma centers if concomitant trauma), pregnancy > 20 weeks, EMS provider judgement



- Abbreviations: EMS-emergency medical services.
- * The upper age limit of respiratory rate in infants is >>29 breaths per minute to maintain a higher level of overtriage for infants.
- † Trauma centers are designated level I–IV. A level I center has the greatest amount of resources and personnel for care of the injured patient and provides regional leadership in education, research and prevention programs. A level II facility offer similar resources to a level I facility, possibly differing only in continuous availability of certain subspecialties or sufficient prevention, education, and research activities for level I designations; level II facilities are not required to be resident or fellow education centers. A level III center is capable of assessment, resuscitation, and emergency surgery, with severely injured patients being transferred to a level I or II facility. A level IV trauma center is capable of providing 24-hour physician coverage, resuscitation, and stabilization to injured patients before transfer to a facility that provides a higher level of trauma care.
- § Any injury noted in step two or mechanism identified in step three triggers a "yes" response.
- ¶ Age < 15 years
- ** Intrusion refers to interior compartment intrusion, as opposed to deformation which refers to exterior damage.
- †† Includes pedestrians or bicyclist thrown or run over by a motor vehicle or those with estimated impact > 20 mph with a motor vehicle.
- §§ Local or regional protocols should be used to determine the most appropriate level of trauma center within the defined trauma system; need not be the highest level trauma center.
- ¶¶ Age > 55 years
- *** Patients with both burns and concomitant trauma for whom the burn injury poses the greatest risk for morbidity and mortality should be transferred to a burn center. If the nonburn trauma presents a greater immediate risk, the patient may be stabilized in a trauma center and then transferred to a burn center.
- ††† Patients who do not meet any of the triage criteria in steps One through four should be transported to the most appropriate medical facility as outlined in local EMS protocols.

40 Trauma-stabilizing procedures, 297

- 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 valve
 - 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 Immobilization**
 - 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.
- 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, 307

- Physiologic changes:
 - Increased blood volume, HR, RR, CO.
 - 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 and use supplemental O₂ liberally.
 - Keep a smaller than expected ETT readily available
- Increased blood volume 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 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)
 - Any neurologic findings in the mother
- Pregnant women are at higher risk for UTI

- Pregnant women are 4-5 times more likely to have DVT/PE
- *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, 312

- Pertinent historical information
 - Estimated weeks of gestation
 - Number of previous pregnancies
 - Number and type of deliveries
 - Complications of previous pregnancies (GDM, preeclampsia, preterm labor)
 - Contraction intervals, membrane rupture, and bleeding
- 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
 - 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
 - Prehospital treatment should focus on supportive care and transport to OB-capable facility

- 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 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, 318

- 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
- 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
 - Basic care of outborn neonate includes suctioning of mouth and pharynx if inadequate respirations, gentle stimulation of feet or back, drying, and warming. If warming and stimulating do not lead to adequate respirations, resuscitation via PALS or NRP algorithms should be begun.
 - 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
- 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 patient 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.

44 Childbirth emergencies, 322

- 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, 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
- **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
- **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.)

45 Perimortem cesarean section, 325

- 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
 - Outside nursing or paramedic scope of practice, even with on-line medical control
 - Rapid transport with ongoing resuscitation of the mother, especially if short transport time
- 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 prn
 - 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 PMCS
- No reported cases of infants surviving beyond early neonatal period with significant neuro disability

Section VII: Toxicological Problems

46 Principles of toxicology, 333

- 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 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 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.

Table 46.3 Examples of potential toxins associated with miosis or mydriasis

Miosis	Mydriasis
Antipsychotic agents	Anticholinergics
Carbamates	Sympathomimetics
Clonidine	Selective serotonin reuptake inhibitors
Opiates	Withdrawal syndromes
Organophosphates	
Sedative-hypnotics	

Table 46.1 Odors that suggest a toxicological exposure

Odor	Possible source
Bitter almonds	Cyanide
Fruity	Isopropanol, acetone
Garlic	Organophosphates
Gasoline	Petroleum distillates
Mothballs	Naphthalene, camphor
Pears	Chloral hydrate
Minty	Methylsalicylate
Rotten eggs	Hydrogen sulfide
Freshly mowed hay	Phosgene

- Hydrofluoric acid is 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.

Table 46.4 Toxidromes

Toxidrome	Signs and symptoms	Potential agent example
Opioid	Sedation, miosis, decreased bowel sounds, decreased respirations	Codeine, fentanyl, heroin, hydrocodone, methadone, morphine, oxycodone
Anticholinergic	Mydriasis, dry skin, dry mucous membranes, decreased bowel sounds, sedation, altered mental status, hallucinations, urinary retention	Atropine, antihistamines, cyclic antidepressants, cyclobenzaprine, phenothiazines, scopolamine
Sedative hypnotic	Sedation, decreased respirations, normal pupils, normal vital signs	Benzodiazepines, barbiturates, zolpidem
Sympathomimetic	Agitation, mydriasis, tachycardia, hypertension, hyperthermia, diaphoresis	Amphetamines, cocaine, ephedrine, phencyclidine, pseudoephedrine
Cholinergic	Miosis, lacrimation, diaphoresis, bronchospasm, bronchorrhea, vomiting, diarrhea, bradycardia	Organophosphates, carbamates, nerve agents
Serotonin toxicity	Altered mental status, tachycardia, hypertension, hyperreflexia, clonus, hyperthermia	Overdose of serotonergic agents alone or in combination (i.e. selective serotonin reuptake inhibitors, dextromethorphan, meperidine)

Table 46.5 Antidotes

Agent or clinical finding	Antidote
Acetaminophen	N-acetylcysteine
Benzodiazepines	Flumazenil*
Beta-blockers	Glucagon
Cardiac glycosides	Digoxin immune Fab
Crotalid envenomation	Crotalidae polyvalent immune Fab
Cyanide	Sodium thiosulfate*
	Sodium nitrite
	Hydroxycobalamin*
Ethylene glycol	Fomepizole
Iron	Deferoxamine
Isoniazid	Pyridoxine
Methanol	Fomepizole
Methemoglobinemia	Methylene blue
Opioids	Naloxone*
Organophosphates	Atropine*
	Pralidoxime*
Sulfonylureas	Glucose*
	Octreotide

*Antidotes that may be available to EMS personnel.

- Decontamination:
 - 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.
 - 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.
 - Gastric lavage, forced emesis, or activated charcoal are all probably inappropriate for prehospital care. Focus on supportive care and rapid transport to appropriate facility.
- 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, 341

- 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 on person) may be evacuated immediately. Eye irritation indicates need for irrigation during transport.
- Priorities include recognizing potential chemical source, adopting appropriate PPE, removing victims from exposure, and decontamination if necessary, followed by supportive care.
- **Organophosphates:** pesticides and nerve agents; cause DUMBBELLS physiology
 - PPE: *Level A required for nerve agents*; all are highly volatile (except VX).
 - For carbamate pesticides, unless the patient is drenched in pesticide, 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 stronger odor but victims can become “odor fatigued.”
 - Most tragic situations occur when initial victim enters 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.
- **Vesicants:** 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, 351

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

Table 48.1 The stages of hypothermia can be defined based on the clinical presentation, and the ability of the patient to self-rewarm if cold stress is removed

Clinical presentation	Ability to self-rewarm	Likely temperature
Mild hypothermia Shivering, general loss of fine then gross motor function with progressive loss of intellectual function and development of confusion	Good initially but limited as temperature decreases	90–95 °F/32–35 °C
Moderate hypothermia Loss of shivering, progressive vulnerability of the heart to atrial fibrillation, and progression of confusion to unconsciousness	Poor progressing to none	82–90 °F/28–32 °C
Severe hypothermia Muscular rigidity, loss of detectable vital signs, progressive cardiac vulnerability to ventricular fibrillation due to rough handling with progression to spontaneous ventricular fibrillation, coma	None	Below 82 °F/28 °C

- 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 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 *nonfreezing 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. Blanched, 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 patient 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 used.
 - Patient has ~10 min of useful activity, after which drowning will occur without 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, 358

- 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 *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 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 < 40C. 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

50 High-altitude illnesses, 363

- 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 most common altitude illness, 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, 368

- 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.
- 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.
- Crews must take into account G forces of take-off and landing, especially in fixed-wing aircraft.
- 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.
- NVG 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, 372

- 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
- **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 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.
 - **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 gases 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: Symptoms experienced on continuum, abbreviated VENTIDC (visual changes, ear ringing, nausea, tingling/twitching in the face, irritability/anxiety/agitation, dyspnea/dizziness/discoordination, convulsions).
 - Pulmonary “whole body” toxicity: 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. Redescend of a few feet should resolve symptoms, followed by careful reascent.
 - **GI barotrauma (aerogastralgia):** Expansion of bowel gas causes GI discomfort. Eructation 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, usually unsalvageable. 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.
 - **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, formication, 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 staggers”): 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.

Section IX: Special Populations

53 The special needs of children, 381

- 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.
 - Appearance: TICLS (Tone, Interactiveness, Consolability, Look/Gaze, Speech/cry). “Tickles”
 - 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, 386

- 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, 393

- 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, 397

- 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, 401

- 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 prehospitally with good sensitivity & specificity for cognitive impairment:

Box 57.2 Six-Item Screener for cognitive impairment

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?

What were the three objects I asked you to remember?

4 apple

5 table

6 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.

- **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 prehospitally:

Box 57.3 The PHQ-2

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
 - Characteristics of abuser: mental illness, alcohol abuse, dependency on the older adult
 - 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

58 Bariatric patient challenges, 407

- 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 intraabdominal 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 cmH2O) but balance with predicted drop in preload
 - TV: still use lung protective 6-8 ml/kg, but based on *ideal body weight* (height)
- 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.

Table 58.2 Dose considerations for common prehospital medications

Dosing calculation	Medication
No weight consideration	Adenosine, amiodarone, metoprolol, ondansetron, dobutamine, epinephrine
Ideal body weight	Dopamine, ketamine, lidocaine, morphine, norepinephrine, procainamide, rocuronium, vecuronium
Total body weight	Diltiazem, etomidate, fentanyl, lorazepam, midazolam, propofol, succinylcholine

- 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.

59 Behavioral health emergencies, 412

- “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
- 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.
 - Organic etiologies to address include hypoxemia, hypoglycemia, and intoxication, head trauma,

renal failure

- 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.
 - The three methods are verbal de-escalation, physical restraint, and chemical restraint.
 - The least restrictive method which is safe should be employed.
 - 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.
 - 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.

Section X: Special Considerations

60 Intimate partner violence, 423

- 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
- Many types of abuse: physical, verbal, emotional/psychological, sexual, spiritual, financial/material.
- Abuse can have a range of health effects beyond broken bones, burns or bruises:
 - Physical: Headaches, chronic (often abdominal or pelvic) pain, gastrointestinal problems
 - Emotional/psychological: anxiety, insomnia, low self-esteem, phobias, flashbacks, memory loss
 - Psychiatric: Self-harm, suicide, eating disorders, depression, dissociation, post-traumatic stress
 - Sexual effects: Unwanted pregnancies, multiple pregnancies close together, miscarriage, sexually transmitted infections, sexually maladaptive behaviors

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
- Warning signs: partner who hovers, insists on being present for assessment, answers questions for patient
- Assessment: Physical (injury patterns, defensive wounds) and behavioral assessment if medically stable
- Know if you as an EMS provider are considered a mandatory reporter in your district
- Preserve evidence and document well

61 Sexual assault, 430

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

EMS Considerations

- Maintain a professional, non-judgmental, calming demeanor
- It is important that 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, 435

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 Ethical challenges, 439

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

64 End-of-life issues, 444

- 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.

Document	Advance Directive	Do Not Attempt Resuscitation (DNR/DNAR) orders	POLST (Physician Order for Life Sustaining Treatment)
Who completes	Patient	Health professional*	Health professional*
Who needs one	All adults	Person with advanced illness	Person with advanced illness
When they apply	Future time	Pulseless and apneic person	Current time
Guide EMS	Usually not	Yes	Yes
Guide hospital	Yes	Yes	Yes

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

Figure 64.2 Comparison of advance directives, DNR/DNAR orders, and POLST. *After discussion with patient and/or surrogate decision maker and based on the patient's goals and values.

65 Termination of resuscitation in the out-of-hospital setting, 453

Starting, Withholding and Terminating Resuscitation

- There are three criteria that need to be met to start resuscitation:
 - Provider safety is assured
 - The patient is not obviously dead (See box 65.1 below)
 - The patient does not have a DNR order
- There is a validated decision rule for termination of resuscitation (Box 65.2):
 - The patient received the full resuscitation protocol and has not been transported from the scene and
 - did not receive a shock during the protocol
 - did not receive prehospital ROSC
 - did not suffer EMS witnessed OHCA
- Pediatric OHCA has less data regarding when to start and withhold resuscitation
- Traumatic cardiac arrest has no validated rules for withholding or terminating resuscitation, though signs of obvious death are still a recommended sign of withholding
 - It is important to consider a potential medical cardiac arrest being the cause of the trauma, especially if the trauma doesn't seem bad enough to cause arrest.

Box 65.1 Example of obvious death medical directive

Resuscitation is not warranted where there is evidence of obvious death as defined as:

Rigor mortis
Lividity
Transection
Decapitation
Decomposition

Box 65.2 Termination of resuscitation of non-traumatic adult OHCA at scene is recommended when:

The patient has received the full (BLS or ALS) resuscitation protocol and the patient has not been transported from the scene and:

- 1 Did not receive a shock at any time during the resuscitation, **AND**
- 2 Did not achieve a prehospital return of spontaneous circulation, **AND**
- 3 Did not suffer an EMS-witnessed OHCA.

Box 65.3 NAEMSP-ACSCOT 2012 position on withholding resuscitation in traumatic cardiopulmonary arrest

- It is appropriate to withhold resuscitative efforts for certain trauma patients for whom death is the predictable outcome.
- Resuscitative efforts should be withheld for trauma patients with injuries that are obviously incompatible with life, such as decapitation or hemicorporectomy.
- Resuscitative efforts should be withheld for patients of either blunt or penetrating trauma when there is evidence of prolonged cardiac arrest, including rigor mortis or dependent lividity.
- Resuscitative efforts may be withheld for a blunt trauma patient who, on the arrival of EMS personnel, is found to be apneic, pulseless, and without organized electrocardiographic activity.
- Resuscitative efforts may be withheld for a penetrating trauma patient who, on arrival of EMS personnel, is found to be pulseless and apneic and there are no other signs of life, including spontaneous movement, electrocardiographic activity, and pupillary response.
- When the mechanism of injury does not correlate with the clinical condition, suggesting a non-traumatic cause of cardiac arrest, standard resuscitative measures should be followed.

Source: Millin 2011 [43]. Reproduced with permission of NAEMSP.

Box 65.4 NAEMSP-ACSCOT 2012 position on TOR of traumatic cardiopulmonary arrest

- A principal focus of EMS treatment of trauma patients is efficient evacuation to definitive care, where major blood loss can be corrected. Resuscitative efforts should not prolong on-scene time.
- EMS systems should have protocols that allow EMS providers to terminate resuscitative efforts for certain adult patients in traumatic cardiopulmonary arrest.
- TOR may be considered when there are no signs of life and there is no ROSC despite appropriate field EMS treatment that includes minimally interrupted CPR.
- Protocols should require a specific interval of CPR that accompanies other resuscitative interventions. Past guidance has indicated that up to 15 minutes of CPR should be provided before resuscitative efforts are terminated, but the science in this regard remains unclear.
- TOR protocols should be accompanied by standard procedures to ensure appropriate management of the deceased patient in the field and adequate support services for the patient's family.
- Implementation of TOR protocols mandates active physician oversight.
- TOR protocols should include any locally specific clinical, environmental, or population-based situations for which the protocol is not applicable. TOR may be impractical after transport has been initiated.
- Further research is appropriate to determine the optimal duration of CPR before terminating resuscitative efforts.

Source: Millin 2011 [43]. Reproduced with permission of NAEMSP.

66 Family and bystanders, 462

- 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 Registration/ Licensure.
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, 470

- 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, 477

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 in US are regulated by FDA. **Clinical Laboratory Improvement Amendments (CLIA)** sets standards for quality assurance & categorizes 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)
 - CO: common in fireground environment. Two methods -end-exhalation breath meter and pulse co-oximeter. Can help in detection and transport decisions.
 - 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.

69 Ultrasound applications in EMS, 483

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 to 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.

Section XI: Safety and Quality

70 Culture of patient safety, 491

- 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

71 A historical view of quality concepts and methods, 500

- **Flexner report (1910):**
 - Accused the industry of medical education in North America with educational malpractice through “enormous overproduction of ill-trained medical practitioners”.
- **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
- **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:**
 - *To Err is Human - Building a Safer Health System* (1999): documented magnitude and effect of medical errors in healthcare
 - *Crossing the Quality Chasm: Creating a New Health System in 21st Century* (2001): focused on need for redesign and use of systems approach to healthcare.

72 Defining, measuring, and improving quality, 509

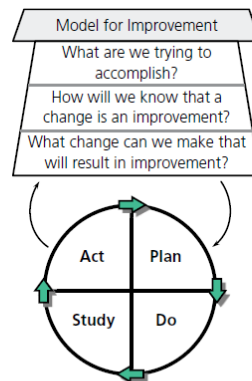


Figure 72.1 Model for Improvement. Source: Langley G, Moen R, Nolan K et al. *The Improvement Guide: A Practical Approach to Enhancing Organization Performance*, 2nd edn. San Francisco: Jossey-Bass, 2009, p.24. Reproduced with permission of John Wiley & Sons, Inc.

The Model for Improvement

- 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 diagram

- Cause and effect diagram- start with problem as head and work backwards
Example branches: Methods, Equipment, People, Materials, Measurement, Environment

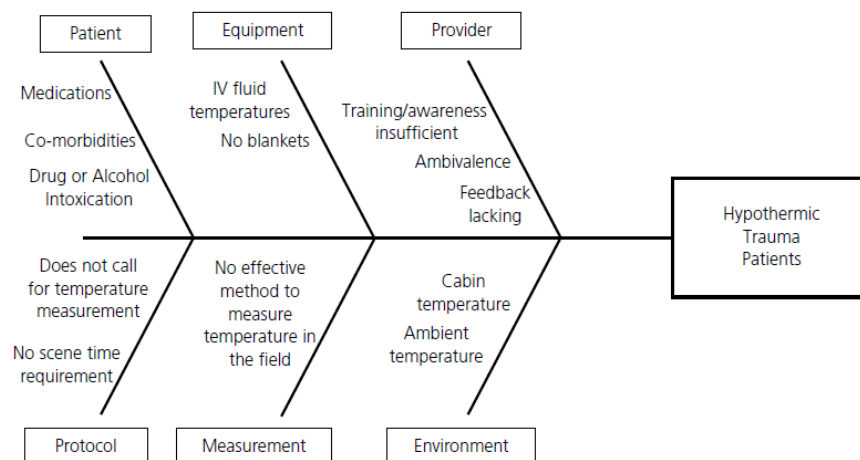


Figure 72.5 Dr Smith's fishbone diagram.

- Driver diagram: Used to organize solutions to problems identified by fishbone

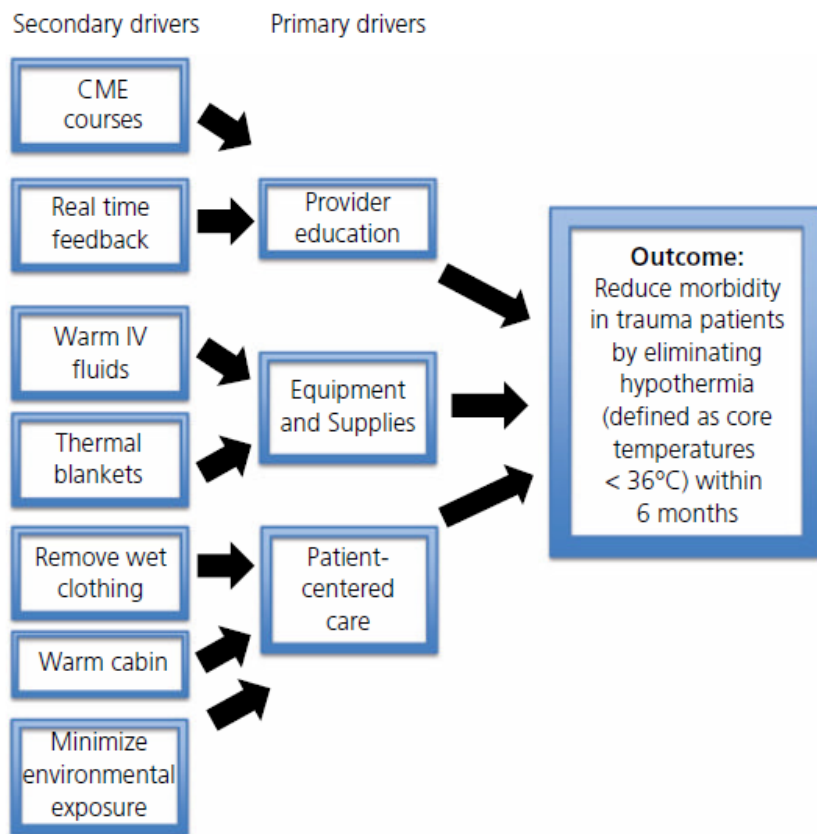


Figure 72.6 Dr Smith's driver diagram.

73 Data management and information systems, 517

- 1994, NHTSA proposed 81 data elements important to EMS information system (Uniform Prehospital Dataset)
 - Allowed EMS systems to benchmark themselves and contribute to larger data sets
 - Created a standard definition for each element
- 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
- 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
- Cardiac Arrest Registry to Enhance Survival (CARES) focus on improving out-of-hospital cardiac arrest

74 EMS quality improvement and the law, 526

- Two main legal issues presented by performing QI activities:
 - Confidentiality
 - Liability
- Approach to Confidentiality
 - Public “opposition” to confidentiality- desire for transparent process and appropriate access to info about quality of care
 - Understand existing confidentiality statutes in your practices area:
 - Who conducts protected QI (single person, single agency, multiple agency)?
 - What is the extent of confidentiality protections (absolute vs privilege that can be waived)?
- Unless QI materials are made confidential by state statute, they are likely to be:
 - subject to subpoena and other forms of pretrial discovery
 - admissible as evidence at trial
 - subject to public disclosure under the state’s freedom of information statute if they come into the possession of a state governmental agency
- Public Safety Organizations
 - Created under 2005 Patient Safety and Quality Improvement Act (PSQIA)
 - Comprehensive confidentiality for “patient safety work product,” which is defined broadly to include virtually all information
 - PSO must satisfy number of requirements to be certified by the federal government
- Types of Potential Liability
 - **Defamation:** (libel or slander) claim requires evidence that the defendant, *knowing that the information was false or at least negligently failing to ascertain the facts*, transmitted false information to a third party regarding the plaintiff which harmed the plaintiff's reputation
 - **Antitrust claim/Tortious interference:** claim of wrongful interference with business relationships by a provider who experienced licensure discipline and/or adverse publicity as a result of QI
 - **QI was performed negligently:** proper protocols were not in place or an incompetent provider was permitted to continue to practice

VOLUME 2: Medical Oversight of EMS

Section I: System Infrastructure

1 Principles of EMS system design, Textbook Page 3

- EMS system design should optimize clinical and service quality with resource use efficiency.
- Key areas of system design: clinical quality, service quality, economic efficiency, accountability, improvement and resilience.

Ground ambulance vehicle types: pros and cons

Vehicle type	Pro	Con
Type I: box on truck chassis.	• Longer service life	• Difficult to navigate through congested areas • Less fuel efficient
Type II: van chassis without box	• Agile • Good fuel economy	• Shorter service life
Type III: box on van chassis	• More agile than type I • Longer service life	• Less(ish) fuel efficient

- ALS response time within 8 minutes (arbitrary from AHA), starts from first call to dispatch to when ALS arrives on scene
- 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**
- Tiered systems:
 - 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
- Hospital destination policies:
 - *Testable* see regionalization chapter.
 - Patient should go to closest hospital equipped to provide the care needed
- Important to understand response volume by time of day and day of week, geographical location of responses, use algorithm to locate resources.
 - 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

- 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”
- 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.
 - **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. Systems that cover urban, suburban, and rural areas will use static deployment in the rural areas and dynamic deployment in the urban/suburban areas.
- 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!)
- High performance EMS system design: sole provider, control center operations, accountability, revenue maximization, flexible production strategy, status system management.
- System Assessment: Accreditation (CAAS, CAMTS, JCI). Using national EMS education and research agenda to guide policies and activities.

- CAAS: gold standard. Not tied to billing. 911 services
- CAMTS: same thing but only for interfacility
- JCI: connected to but separate from joint commission --international

2 Air medical services, 17

- 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”.
 - 2007 consensus document between NAEMSP, NASEMSO, and AAMS suggests course of action (ref p.21)
- 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.

NAEMSP: Guidelines for Air Medical Dispatch (2009)

David P. Thomson & Stephen H. Thomas

1. Does the patient require minimization of transport time?
2. Does the patient require specific or time sensitive evaluation or treatment not available at receiving facility?
3. Is the patient's location inaccessible by ground transport?
4. Is the weight of the patient + crew within the allowable range?
5. For interfacility transfer - is there a helipad available?
6. Does the patient need critical care life support during transport?
7. Would using ground transport leave the area without ALS coverage?

Overtriage for AMS is necessary to maximize utilization of this resource.

Logistical issues for AMS:

1. Access, time and distance traveled
2. System issues
 - a. Need for critical care
 - b. Sparse ALS coverage area
 - c. Disaster or MCI event
3. Clinical situations:
 - a. Trauma (has best literature support)
 - b. Non-trauma (literature support limited to logistical issues)
 - c. Misc.
 - i. Transplant
 - ii. Search and rescue

- 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.

3 Interfacility transportation, 29

- Interfacility transport 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.
- 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

4 Legislation, regulation, and ordinance, 36

- **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.
- Incorporation by reference = strategy for establishing standards in statutes 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**.”
- EMS providers are “dependent practitioners” working within a state-licensed and authorized EMS Agency.
 - They must be **authorized** by EMS physicians to apply their skills, limited to a scope of practice.
 - NOT working under medical director’s license

5 State EMS offices, 44

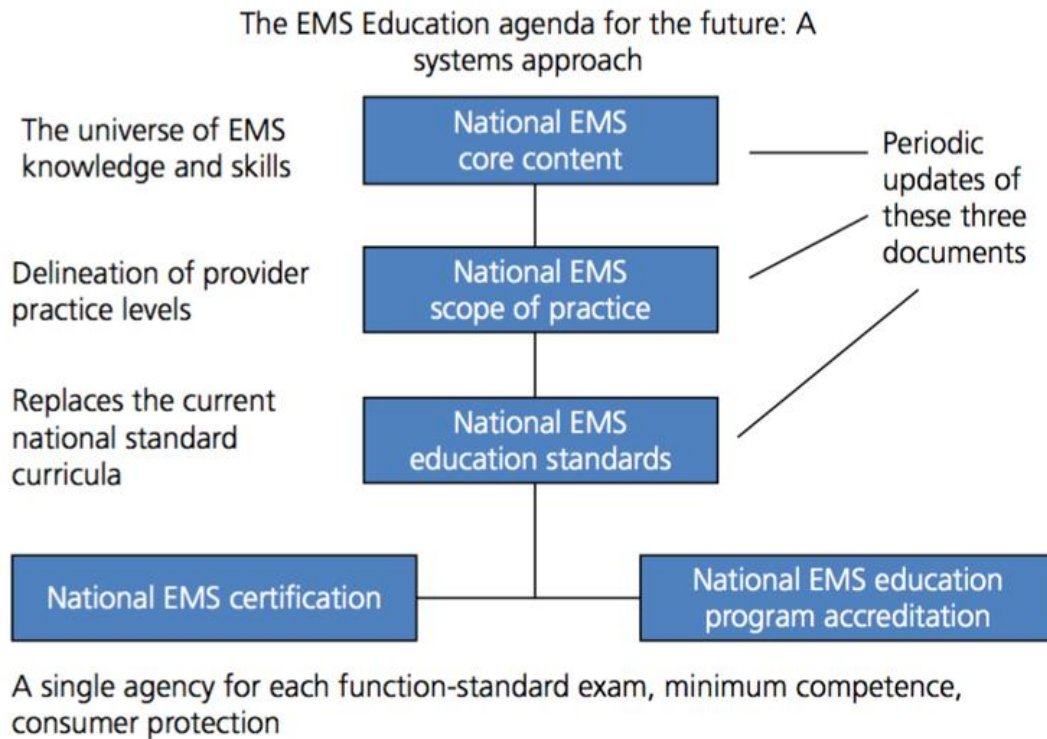
- In response to 2006 IOM report describing fragmentation in EMS systems, NASEMSO described a model EMS system organized into 10 subsystems:
 1. System leadership, Organization, Regulation and Policy
 2. Resource Management - Financial
 3. Resource Management - Human Resources
 4. Resource Management - 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
- 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 is involving 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
- Guidelines - rules set to guide behavior or offer best practice suggestions (advisory, not mandated)
- Procedure - *action* that is executed in the same manner in order to obtain the same result
- 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.
 - **Authorized** by the EMS medical director (credentialing)
 - 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:
 - Human Resources - State Statute/Lead Agency typically sets requirements for certification, licensure, and reciprocity
 - Transportation - EMS vehicles are commonly licensed by the EMS systems they operate in
 - 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.
- 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.
- 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.**
- 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.
- National EMS Information System (NEMSIS) data elements collected from EMS agencies and create national data set for research, etc.
- 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

6 EMS personnel, 51

- Emergency Medical Services Systems Act of 1973: first formal national initiative supporting EMS in the US.
- EMS Education Agenda for the Future: A Systems Approach (2000) - called for a consistent system of education, certification, and licensure for entry level EMS personnel.
 - 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 remuneration status of the individual being assessed. *Same for volunteer or paid.*

7 Principles of finance, 60

- 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, QI
- **Shared cost:**
 - 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)
- **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 used, responding to additional call means calling in another crew and vehicle etc.
- **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
- **Cost Per Capita** - Total system cost/total population served
 - Indicates cost to community, not efficiency.
- **Depreciation cost** - Loss of value over time in a tangible asset over its functional lifetime.
- **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
- **Opportunity cost**: Reflects the foregone choice.
 - e.g. \$15,000 per hour to train providers in CPR (option A) = same cost to provide 240-unit hours of ambulance coverage (option B) but at expense of the providers knowing latest CPR techniques (the value of A).
- 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)

$$\frac{U(\text{utilization})}{UH(\text{unit hours})} = \text{Unit hour utilization}$$

$$\frac{\text{Cost per unit hour}}{U / UH} = \text{Cost per transport}$$

- I.e. Cost per transport: (cost per unit hour * unit hour) / transports
- **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.

Section II: Clinical Leadership and Oversight

8 Medical oversight of EMS systems, 71

- 1960s and 1970s, medical direction of EMS became a de facto standard for ALS despite no mention in the 1966 Accidental Death and Disability paper or the 1973 EMS Act.
- 1985 first NAEMSP Hilton Head
- 1988 National Highway Traffic Safety Administration included medical direction as essential component
- 1996 EMS Agenda for the Future- need for medical direction for all levels of EMS providers, a principle that was thereafter incorporated into the US Department of Transportation's national standard curricula for EMS providers, including those for EMTs.
- State requirements for EMS medical direction
 - Generally, require medical direction for ALS, but not always BLS
- Competency - a provider's ability to safely and adequately perform patient care
- Credentialing - grants EMS provider privilege to perform a prescribed role and specific skills within a service based on competency.
- Quality assurance - ensures that performance is as it should be.
 - QA plan should prescribe corrective action, elucidate root causes, and educate providers.
- Performance improvement - monitors processes and outcomes to improve quality of patient care
- Field clinical supervision
 - Opportunity to mentor, engage in hands-on patient care, and learn firsthand about the challenges faced by providers
- Regionalization: transport of patients to the hospital that is most appropriate for a patient's condition. "right patient, to the right hospital, in the right time, with the right care"
 - medical directors must promote this for trauma, stroke, STEMI, cardiac arrest, pediatrics, burns
- EMS medical directors should promote health and wellness of providers
 - Principal causes of work fatalities for EMS providers are transportation-related
- Direct medical oversight - physician either physically or online: prehospital providers render patient care during active communication with physician. Requires good communications system:

- **VHF** channels (1970s) - limited # of federally protected channels for communications between EMS providers in field and base stations. Limited range and frequent interference.
- **UHF** channels (replaced VHF) - less interference, better reliability, enabled analog ECG telemetry
 - “Narrowbanding” = process by which the Federal Communications Commission increased available UHF channels
- All comms, regardless of radio vs cellular, should be recorded for QA/PI
- “Telepresence” with a stream of real-time patient data (waveforms, ECGs etc.) may blend online and on-scene medical direction in the future

Box 8.1 Generally accepted 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 (CME)
 - Quality assurance and performance improvement
 - Mass casualty incident/disaster response
 - Labor relations, management, and fiscal oversight
 - Public health, wellness, and prevention
 - Occupational injury and illness
- Involvement in local/regional/state/national EMS organizations

Source: Adapted from Alonso-Serra 1998 [1].

Box 8.2 Authority and resources required by an EMS medical director

Authority to:

- Grant, suspend, or revoke the medical credentials of EMS providers (with due process)
- Approve medical equipment and protocols (including emergency medical dispatch)
- Conduct quality assurance and performance improvement (including emergency medical dispatch)
- Establish continuing medical education requirements to address local and quality improvement issues
- Supervise all patient care
- Provide input on operational and budget issues that affect patient care
- Advocate for EMS providers, patients, and the EMS system
- Designate base stations, trauma and specialty centers
- Serve as the medical liaison with the community, state, and national organizations

Resources

- Response vehicle
- Communications equipment
- Medical supplies and equipment
- Personal protective equipment
- Office space
- Support staff
- Compensation sufficient to fulfill the role
- Liability coverage for administrative acts and malpractice

Appropriate title

- Medical director and/or
- A rank, such as assistant or deputy chief

9 Leadership and team building, 85

- Data gathering and interpretation:
 - **Outcome Measures** – those that come after process is complete (lagging)
 - **Process measures** – those that drive performance to produce desired outcome (leading)
- Shewhart Control charts - good for display of measures for dynamic processes.
 - bar charts and pie charts are static displays and may lead viewers to attribute special cause variation when it's actually common cause variation
 - Use control charts to make sure there are no unanticipated changes in performance and to decide what areas of the system need improvement
- **Common cause variation** – variation inherent in the process
- **Special cause variation** – variation caused by something outside the normal process.
- 3 Signs of Special Cause Variation: (Balestracci)
 - **Trend** – 6 or more consecutive data points ascending or descending
 - **Run** – 8 or more consecutive points above or below the median
 - Point outside the upper or lower control limits on a Shewhart control chart
 - (X axis: year. Month | Y axis: Dollars)

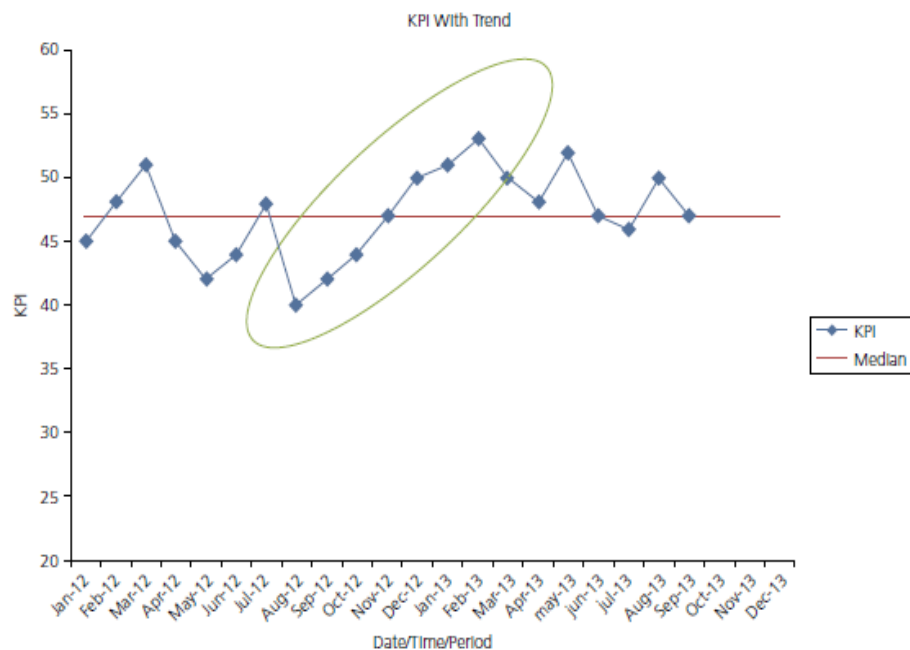


Figure 9.3 Special cause variation: a "trend."

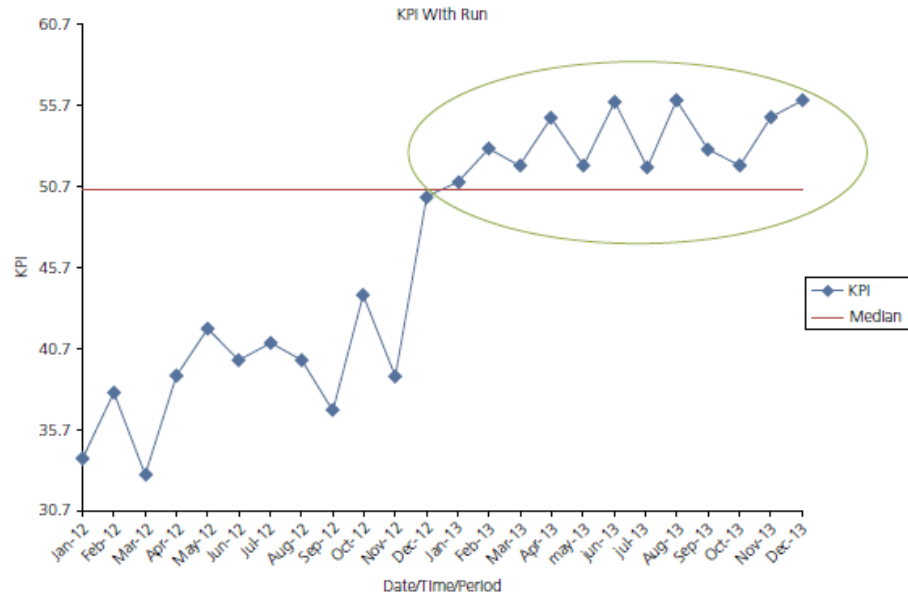


Figure 9.4 Special cause variation: a "run."

Use PDSA testing to anticipate the effect of system improvement ideas:

10 EMS dispatch, 94

- Important items:
 - Systematized, scripted formal *caller interrogation*;
 - Systematized, scripted post-dispatch and pre-arrival *instructions*;

Box 10.2 The nine myths of medical dispatch

- 1 The caller is too upset to respond accurately
- 2 The caller does not know the required information
- 3 The medical expertise of the dispatcher is not important
- 4 The dispatcher is too busy to waste time asking questions, giving instructions, or flipping through card files or using automated protocols
- 5 Phone information from dispatchers cannot help victims and may even be dangerous
- 6 More personnel and more units at the scene are always better
- 7 It is dangerous not to maximally respond or to fail to respond with lights and siren
- 8 All you need to do EMD is protocols and training
- 9 We can do this ourselves (home-grow our protocols)

- Caller Breakdown:
 - 60% of callers are 1st/2nd party (patient or someone with the patient)
 - 25% 3rd party (someone outside who witnesses)

- Medical directors must ensure dispatchers understand policy, ensure compliance, ensure correct and effective application, and correct any deficiencies identified

Quality Management Components:

- Selection-ability to read transcripts, follow instructions, carry out multiple tasks, exercise good judgment
- Continuing Dispatch Education-half-life of med knowledge is 5 years. EMD need relevant updates
- Data Generation - *random sampling of approx. 3% calls to drive review process*
- Performance evaluation or case review and feedback—Essential component of continuous improvement.
- Recertification—necessary to maintain skills and keep “skin in the game”
- Risk management—legal equivalent to preventive medicine.
- Decertification, suspension, termination-formal policies of expectations and requirements and then formal documentation of deficiencies and corrective actions needed

Supervision at Dispatch- On-site supervision to ID problems prospectively. All managers must be EMD trained as well, QM case review in part driven by on-site trend. Fundamental issue is protocol compliance.

- Case entry (primary survey)
- Key question (secondary survey)
- Selection of correct dispatch code
- Correct delivery of PDIs and PAIs

Compliance to Protocol

- Only 5-10% of centers provide completely correct PAIs from script in DLS. Medical director plays important role in maintaining compliance to formal PAIs
- #1 reason cardiac arrest missed by dispatcher is “making funny noises” aka agonal breathing

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

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

Psychological components: Drives home point of stress experience by caller and how EMD can predict these responses and mitigate. Phenomena and solutions include:

- “*Repetitive persistence*” method- dispatcher maintains control by repeating the exact same wording
- Bring the patient to the phone- speak with patient directly if able
- Re-freak event- caller may re-escalate and require regaining control
- “Nothing’s working” phenomenon- can offer appropriate encouragement and repetitive persistence
- “Paramedics aren’t coming” - reassure/reaffirm
- Relief reaction- may occur if patient improves, keep caller monitoring/re-checking on patient
- Gap theory - pauses may be perceived as lack of confidence/control by caller, can increase caller anxiety.

- Compliance with medically approved protocols decrease length and frequency of gaps.

Dispatcher Configurations:

- Horizontal: team-based; call-taker goes through protocol, radio dispatcher takes info/decides priority
- Vertical: each EMD responsible for catchment area (less effective)

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
- Not really linear but prioritization of time and skills needed

Baseline response example All actual response assignments are decided by local medical control and EMS administration		
Level	Response	Mode
ECHO	Closest apparatus—Any (includes truck companies, HAZMAT, or on-air staff)	HOT
DELTA	Closest BLS engine paramedic ambulance	HOT HOT
CHARLIE	Paramedic ambulance	COLD
BRAVO	Closest BLS engine BLS ambulance (alone HOT if closest)	HOT COLD
ALPHA	BLS ambulance	COLD
OMEGA	Referral or alternate care	

Figure 10.8 An example of baseline response choices to the determinant levels. Source: *Principles of EMD*, 5th edn, ©2000-2014 International Academy of Emergency Medical Dispatch. Reproduced with permission.

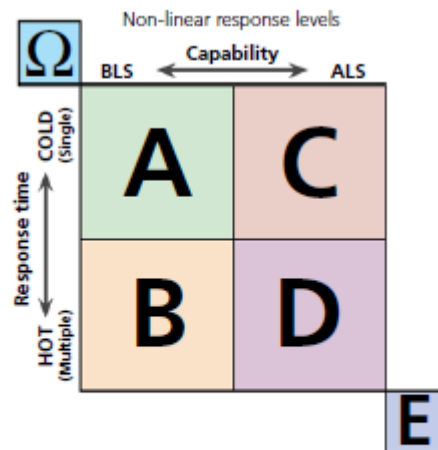


Figure 10.9 Determinant response matrix. Source: Medical Priority Dispatch System v13.0, ©1979-2014 International Academies of Emergency Dispatch. Reproduced with permission.

Determinant Terminology & considerations:

- Links chief complaint to direct level of response required as well as speed and priority (A,B,C,etc)
- Avoid response code confusion – don't use duplicate names
- Local Development – personalize local elements in determining response patterns
- Screening allows for a "no send" option (as opposed to dispatch prioritization).

- A lower priority send is medically and legally safer than sending no resources at all.
 - Exception may be alternative care such as transferring call to poison control center, nurse triage line etc.

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 saved by responding “hot”?
- What time constraints are present in system?
- When patient gets to hospital will time saved using lights-sirens be significant compared to time spent awaiting care?

11 Communications, 113

- 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 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.
- E911-system: landline calls automatically give *location* to dispatcher. Problem with cell phones—still need location discussion. The FCC is rolling out E-911 in phases:
 - **Phase 0** - Service providers must direct a 911 call to a PSAP even if the caller is not a subscriber to their service.
 - **Phase I** - The FCC's rule that a phone number display with each wireless 911 call, allowing disconnection callback.
 - **Phase II** - Requires carriers to place GPS receivers in phones. Using Automatic Number Identification (ANI), the address and location of the receiving-antenna site will be sent to the E911 Tandem. Must be accurate within 164 to 984 feet (50-300 meters).
- 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 urban environment because of better *penetrance*. Need repeaters or microwave systems.
- **Repeater**: receives low level signal and retransmits it at higher level/ power --> covers longer distance. Repeater= base station.
- 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'.
- 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 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, serves to enhance local interoperability developments.

12 Emergency care regionalization, 123

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. Should be initiated before formal facility designation occurs.
- **Designation:** is the *formal selection* for patient referral and transfer, by authority, usually both the state and specialty designation bodies. Minimum set of standards a facility must meet to become a designated center.
- **Time-critical diagnosis (TCD) system** 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:** decision to avoid transport of an out-of-hospital patient to a particular hospital facility when transport to a more distant facility will provide more optimal care in the setting of clinical time-critical diagnosis cases in which care at the more distant facility will most likely improve the patient's outcome.
- **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 (US)

- 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 innumerable 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.

13 EMS–public health interface, 134

- Surveillance: collection of data about a community to monitor disease or health status
- EMS Agenda for the Future: EMS is the intersection of public safety, public health, health care systems
- Public health relies on epidemiology to help organize the information through describing the occurrence, distribution, and control of disease in a population
- 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.

14 Political realities for the medical director, 140

- 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

15 EMS physicians as public spokespersons, 146

Basic Assumptions:

- An EMS physician is the appropriate spokesperson and has received clearance to make the statement
- In cases of specific patients, notify patient and family first
- 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

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

16 Legal issues, 160

- 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 has responsibility to properly oversee practice as a supervisor.
- 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 is the permission to perform an act that would otherwise be considered illegal, by a competent authority, 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

Areas of liability:

- failure to perform responsibilities
- negligent supervision

Summary of principles for non-transports:

- have a policy
- train on the policy
- do audits to hold accountable
- have online medical control involved
- be cautious with restraints
- use a legally correct release form

17 Due process, 182

- 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
- **Procedural** due process of law – deals with the process of procedural fairness
- **Substantive** due process – prevents government from interfering with rights

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 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.

Life, Liberty, or Property:

- Life Interest – limited to capital cases
- Liberty Interest – freedom from bodily restraint, right to the pursuit of happiness
 - o Arises when an employment action is taken that damages the employee's ability to obtain employment (ex. immorality, dishonesty, alcoholism, incompetence)
 - o 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
 - o 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 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 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 the 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

18 Risk management, 192

Internal components: safety, training, health and wellness, personnel and equipment management.

External Components: prevention, public education, perception of the public.

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

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

Elements of a 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

- 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 18.1 Major categories of alleged negligence involving prehospital care services or providers

Category*	No.	% **
Treatment and care	78	42.85
Ambulance accidents	73	40.1
Dispatch and transport	50	27.47
Training, staffing, and administrative	41	2.52

Source: Adapted from Bowers MA. Negligence cases involving prehospital care providers and the implications for training, continuing education, and quality assurance. Doctoral thesis. Ann Arbor, MI: University Microfilm International, 1992.

*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:

Box 18.1 Incident investigation checklist

- Discussions with involved EMS crew members
Name/date:
Name/date:
- Documentation of discussions with EMS crew members
- Discussions with other personnel (patient, physician, etc.)
Name/date:
Name/date:
Name/date:
- Documentation of discussion with other personnel
- Crew member incident reports
- Patient care record (delete name and assign number)
- Other appropriate documentation
Photographs
Tape transcripts
- Equipment or products causal to the incident

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

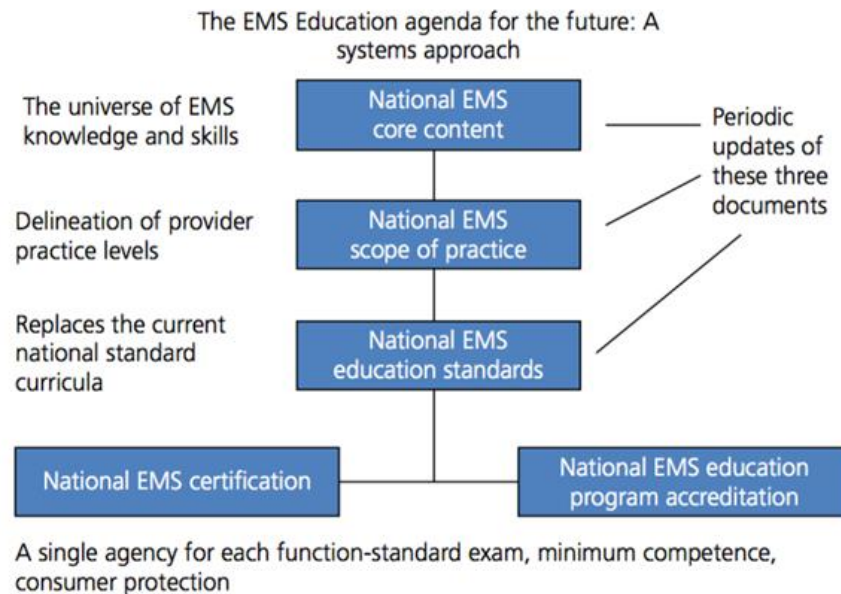
Risk Management is a proactive as opposed to a reactive strategy. A medical director's oversight should be active and ongoing - not just when a problem arises. The medical director should stay abreast of the latest EM/EMS literature in order to iteratively improve on the EMS system and thereby prevent errors before they occur

Section III: Human Resources

19 EMS provider education, 201

- 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
- Six core principles of adult learning:
 - Know the reason for learning
 - Have autonomy and self-direction
 - Incorporate prior experience
 - Be ready to learn, helps if learning has immediate relevance
 - Problem-centered, rather than subject-centered
 - Have internal motivation
- Social learning theory: adults need to have performance modelled for them, have feedback, and have successful experiences to reinforce their learning.
- Theory of Margin: $\text{margin} = \text{load}/\text{power}$. The greater the power (support and coping factors) the more load (internal/external demands placed on an individual) the student can manage.
- 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)
- 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)
- History of EMS Education
 - started in 1950's by American College of Surgeons

- 1967 American Academy of Orthopedic Surgeons -first EMT textbook.
- 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.



- January 1, 2013: paramedic candidate must graduate from a Commission on Accreditation of Allied Health Professions (CAAHEP)- accredited program in order to take the NREMT paramedic examination.
- 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

20 EMS provider wellness, 211

- 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.
 - Specific shift scheduling can help - rotating in a clockwise fashion with 48 hours off between night and day shifts. As many as 80% of EMS workers have additional employment or work overtime hours.
- Familiarize with laws governing employee relations and fitness for duty
- Collaborate with ongoing surveillance and maintenance wellness programs and interventions

21 Occupational injury prevention and management, 217

- 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
- Rate of injuries leading to lost work time more common in EMS than in fire and police, about 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.

22 Ambulance safety, 222

- 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 22.1 Haddon Matrix for emergency vehicle collisions

	Human/host	Vehicle/agent	Environment
Pre-event (preinjury)	Fatigue Poor driver training Impaired hearing Alcohol/substance abuse Non-use of seat belts Distractions Stress Poor driving skills Diesel fume exposure Smoking Speed	Poor maintenance Poor design Inappropriate tires or tire pressure Lack of functional seat belts Lack of driver's compartment airbags	Poor visibility Hazardous conditions Urban vs rural Inadequate agency policies and/or enforcement Inadequate funding for research and prevention
Event	Employee's health Resistance to energy	Protruding objects Sharp corners Unsecured equipment	Lack of vehicle restraining walls/rails on roadside
Post-event	Employee's health Priority given to other's care over self-care	Presence of hazardous materials	Availability of ambulances Trauma center

Source: Maguire BJ. *EMS Manager and Supervisor* 2003;5:4-7. Reproduced with permission of Elsevier.

- 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 59% of all EMS occupational fatalities
- 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
- Current average of 10 EMS deaths/year due to transportation related events.
- 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, implement tiered dispatch protocols to reduce

WLS. Challenge secondary to concern about not getting to critical patient 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

23 Medical surveillance of emergency response personnel, 231

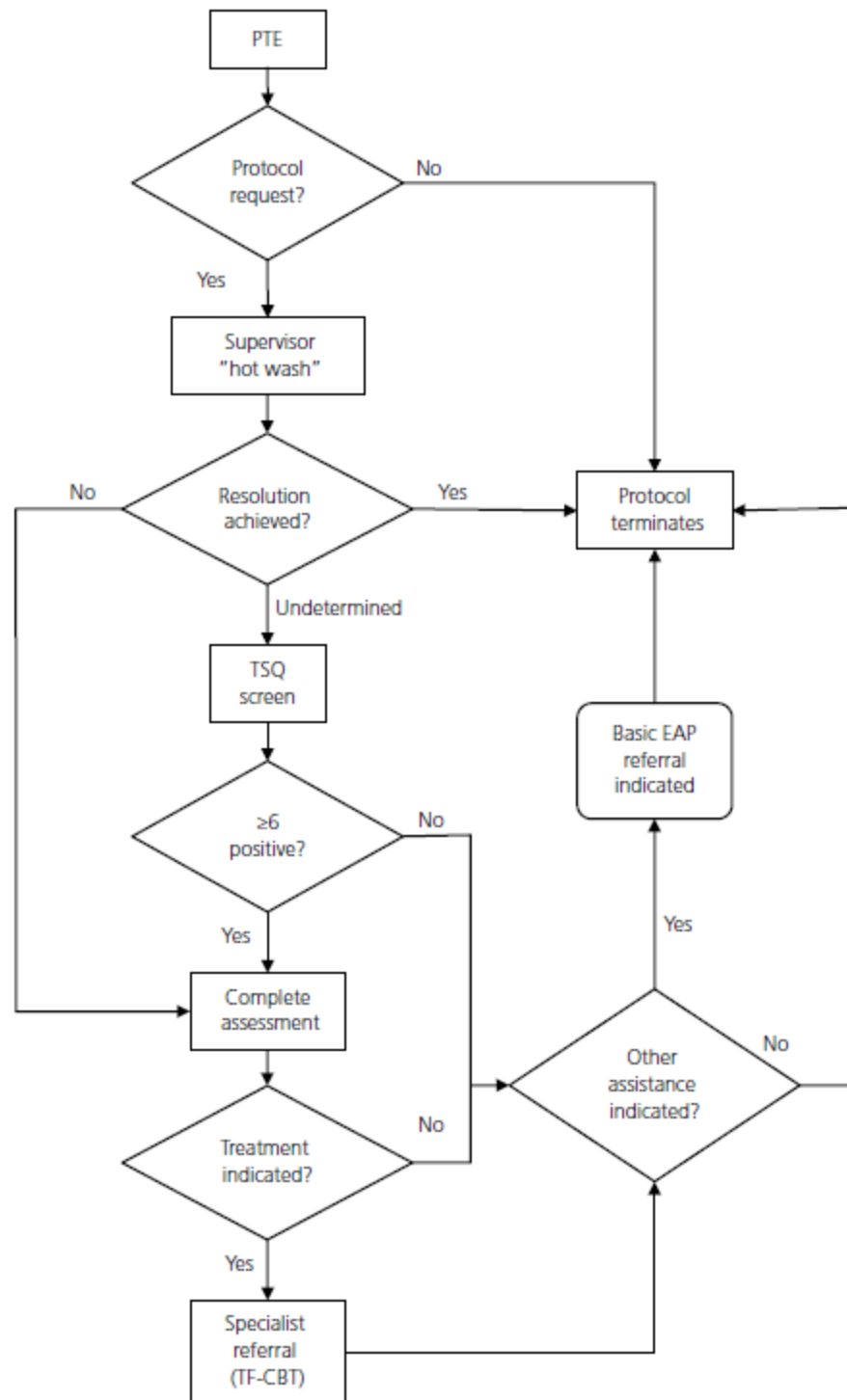
- Greater and more varied dangers facing today's EMS workforce—threatening their health and lives.
 - Examples: MCI/Active shooter, Epidemics, Toxic Inhalation (e.g. World Trade Center).
- World Trade Center Medical Monitoring and Treatment Program
 - Goals of a medical Surveillance program:
 - Early recognition of hazardous exposure-related occupational disease
 - Early intervention and treatment
 - Effective management of occupational disease process
 - Illness prevention
- Several federal regulations, agencies, documents provide guidance of design and operation of Medical Surveillance Program (OSHA, CFR, EPA, Natl Fire, etc.)
- Current OSHA Requirements for implementation of Medical Surveillance Programs (MSP):
 - 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
- 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 occ health stuff 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
- **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
- NFPA 1581 = infectious (“thou shalt have an infectious control officer”)
- NFPA 1583: health and fitness

24 Prevention and intervention for psychologically stressful events, 236

- EMS work has 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 effect (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, asks 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 24.1 PTE protocol flow chart. PTE, potentially traumatic event; TF-CBT, trauma-focused CBT



25 Protection of EMS personnel from occupationally acquired infections, 243

- HBV Vaccine now essential for providers: 3 doses then check titers.
 - If non-responder, needs boosters then check titers again.
 - If still non-responder, must be aware of status, as may need HBIG if exposed.
 - Need waiver if refuse 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
- Ryan White Act - need ICO infectious control officer. Exposures often go unreported (40-80%)
- NFPA 1582 -standards on comprehensive occupational medical program for FDs
- NFPA 1581 -standards on fire dept infectious control program
- Mandated report: believe exposure occurred; or healthcare facility identifies infectious agent
- 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 pulm 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 25.2 Clinical syndromes or conditions warranting empiric transmission-based precautions in addition to standard precautions pending confirmation of diagnosis*

Clinical syndrome or condition [†]	Potential pathogens [‡]	Empiric precautions (always includes standard precautions)
Diarrhea Acute diarrhea with a likely infectious cause in an incontinent or diapered patient	Enteric pathogens [§]	Contact precautions (pediatrics and adult)
Meningitis	<i>Neisseria meningitidis</i> Enteroviruses <i>M. tuberculosis</i>	Droplet precautions for first 24 h of antimicrobial therapy; mask and face protection for intubation Contact precautions for infants and children Air-borne precautions if pulmonary infiltrate Air-borne precautions plus contact precautions if potentially infectious draining body fluid present
Rash or exanthems, generalized, etiology unknown Petechial/ecchymotic with fever (general) — If positive history of travel to an area with an ongoing outbreak of VHF in the 10 days before onset of fever	<i>Neisseria meningitidis</i> Ebola, Lassa, Marburg viruses	Droplet precautions for first 24 h of antimicrobial therapy 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
Vesicular	Varicella zoster, herpes simplex, variola (smallpox), vaccinia viruses Vaccinia virus	Air-borne plus contact precautions Contact precautions only if herpes simplex, localized zoster in an immunocompetent host or vaccinia viruses most likely
Maculopapular with cough, coryza and fever	Rubeola (measles) virus	Air-borne precautions
Respiratory infections Cough/fever/upper lobe pulmonary infiltrate in an HIV-negative patient or a patient at low risk for HIV infection Cough/fever/pulmonary infiltrate in any lung location in an HIV-infected patient or a patient at high risk for HIV infection	<i>M. tuberculosis</i> , respiratory viruses, <i>Strep. pneumoniae</i> , <i>Staph. aureus</i> (MSSA or MRSA) <i>M. tuberculosis</i> , respiratory viruses, <i>Strep. pneumoniae</i> , <i>Staph. aureus</i> (MSSA or MRSA)	Air-borne precautions plus contact precautions Air-borne precautions plus contact precautions Use eye/face protection if aerosol-generating procedure performed or contact with respiratory secretions anticipated. If tuberculosis is unlikely and there are no air-borne infection isolation rooms and/or respirators available, use droplet precautions instead of air-borne precautions Tuberculosis more likely in HIV-infected individual than in HIV-negative individual
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	<i>M. tuberculosis</i> , severe acute respiratory syndrome virus (SARS- CoV), avian influenza	Airborne plus contact precautions plus eye protection If SARS and tuberculosis unlikely, use droplet precautions instead of airborne precautions
Respiratory infections, particularly bronchiolitis and pneumonia, in infants and young children	Respiratory syncytial virus, parainfluenza virus, adenovirus, influenza virus, human metapneumovirus	Contact plus droplet precautions; droplet precautions may be discontinued when adenovirus and influenza have been ruled out
Skin or wound infection Abscess or draining wound that cannot be covered	<i>Staph. aureus</i> (MSSA or MRSA), group A streptococcus	Contact precautions Add droplet precautions for the first 24 h of appropriate antimicrobial therapy if invasive group A streptococcal disease is suspected

Section IV: Extraordinary Circumstances

26 Incident Command System and National Incident Management System, 257

- 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.
- All responsibility for every aspect of response to an incident belongs to the **Incident Commander** until it is specifically delegated.
- Job Action Sheets should be available to each command team member to use as a documentation and decision-making reference
- Orderly transfer of command is needed when discrete phases of a response are completed.
- **Unity of command** important (each team member *reports to only one person*).
- **Unified Command** 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.
- **Span of control** dictates that no one supervises more than 3 to 7 other persons.
- **Sections** are organizational levels with responsibility for a major functional area of the incident
 - ICS **sections** are FLOP: Finance, Logistics, Operations, and Planning.
- **Divisions** are used to divide an incident geographically
 - e.g. West division. Sides of railroad track or floors in a building.
- **Groups** are established to divide the incident management structure into functional areas of operation.

- **Branches** are used when the number of divisions or groups exceed the recommended span of control, e.g. EMS branch. Service and support are branches of logistics. 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.
- **Units** are organizational elements that have functional responsibility for a specific activity
 - e.g. supply unit. Unit can be multiple strike teams or multiple strike 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. riot with cop car, 1 engine, and 2 ambulances working together.
- **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
- **Joint Information Centers** are usually established in large incidents to coordinate the efforts of the responding agency's PIOs. Usually off site.

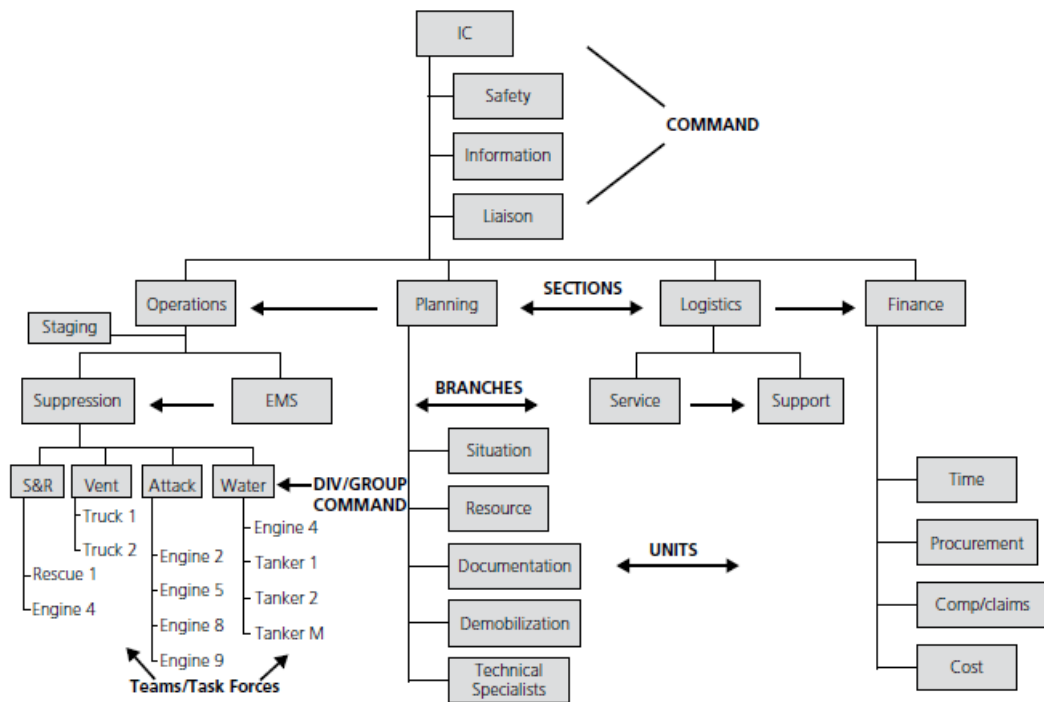


Figure 26.4 Large-scale event chart. Organizational chart for a large-scale event involving fire suppression, rescue, and medical care of civilian casualties. Standard terms for levels of management are shown in bold.

27 Medical management of mass gatherings, 264

- Definitions focus on system impact from gathering, not pure numbers of attendees
- 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)
 - 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
- 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) per 1,000 is a common metric. 0.5-2 PPR is normal
 - Frequency of demand for medical care per attendee decreases as size of event increases.
- 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
 - 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.

- 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.

28 Disaster preparedness and management, 272

- Disaster: Natural or man-made event that causes losses such that a community cannot adequately respond without outside assistance.
- Presidential Policy Directive 8 (PPD 8) - guides the nation's all-hazard response to disaster.
 - 3 sets of annexes: Emergency Support Function (**ESF**), Support, Incident
 - ESF8 includes HHS and medical response
 - 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 (see cycle)
 - Communication and information management
 - Resource management
 - Command and management (Incident Command Structure = ICS)
 - Ongoing management and maintenance (by the federal government)

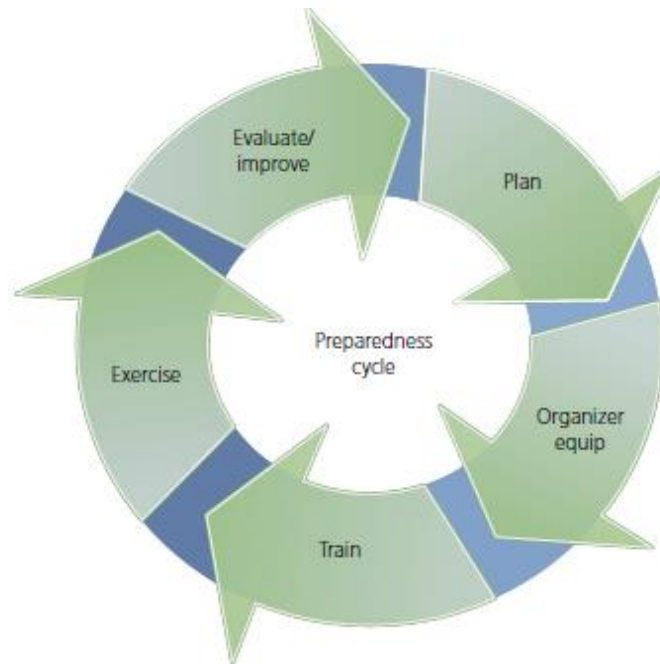


Figure 28.1 The preparedness cycle – actions taken to build preparedness for catastrophic events. Source: <http://www.fema.gov/national-preparedness-cycle>

- 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)
- Robert T Stafford Disaster Relief and Emergency Assistance Act (1988)
 - 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

29 The federal medical response to disasters, 278

- 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**
 - Began as Federal Response Plan FRP (1992) -> revised 2002 to in response to 9/11 -> changed to National Response Plan NRP in 2004 to include the new Department of Homeland Security -> updated 2006 in response to Hurricanes -> Updated and redundancies removed, changed to National Response Framework NRF 2008 -> Updated to second version NRF in 2013
 - 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
 - Tier 1:
 - 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)**
 - Tier 2:
 - Applied public health and mental health teams
 - Tier 3:
 - All US PHS officers that are active duty but not currently assigned to Tier 1 or Tier 2 response
 - Tier 4:
 - US PHS reserve corps

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 presidentially 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 this single department. FEMA had been primarily responsible for coordinating the federal response to major incidents, and was one of the entities integrated into the 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).
- **Homeland Security Presidential Directive 5 (HSPD-5): Management of Domestic Incidents**
 - 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.

- **Homeland Security Presidential Directive 21 (HSPD-21)**
 - 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, NBC attack.

30 Special considerations in disaster zones

- **Altered standard of care:** It is ethical for a physician not to persist in treating individuals “beyond emergency care,” thereby wasting scarce resources needed elsewhere.
 - Legal standard of care: HIPAA, EMTALA, state law
 - Can be altered in an emergency by an executive government official
 - Must be in a declared crisis and for a sustained period
 - Process defined in IOM report
 - Ethical standard of care, affected by limited resources
 - Utilitarian > Individualistic
 - Resource scarcity changes the relative risk of standard treatment options
- The decision not to treat an injured person on account of priorities dictated by the disaster situation cannot be considered a failure to come to the assistance of a person in mortal danger.
 - Justified when decision is intended to save the maximum number of individuals.
- Credentialing may be local or statewide, disasters require influx of outside resources and staff crossing these lines.
 - Examples of potential disaster response strategies which would require providers to operate beyond their typical scopes of practice include:
 - allowing pharmacists to give vaccinations against a pandemic influenza strain
 - permitting surgical residents or APPs to perform procedures independently
 - allowing medics to administer medications in a hospital-based emergency department
 - asking a nurse to temporarily return to clinical practice after ten years of retirement

31 Prehospital triage for mass casualties, 288

- Mass casualty triage occurs when there is more than one casualty, and 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 system, typically decided at the local level, lead to concerns about interoperability. This spurred the creation of the Model Uniform Core Criteria (MUCC)
 - 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 provider's scope of practice).

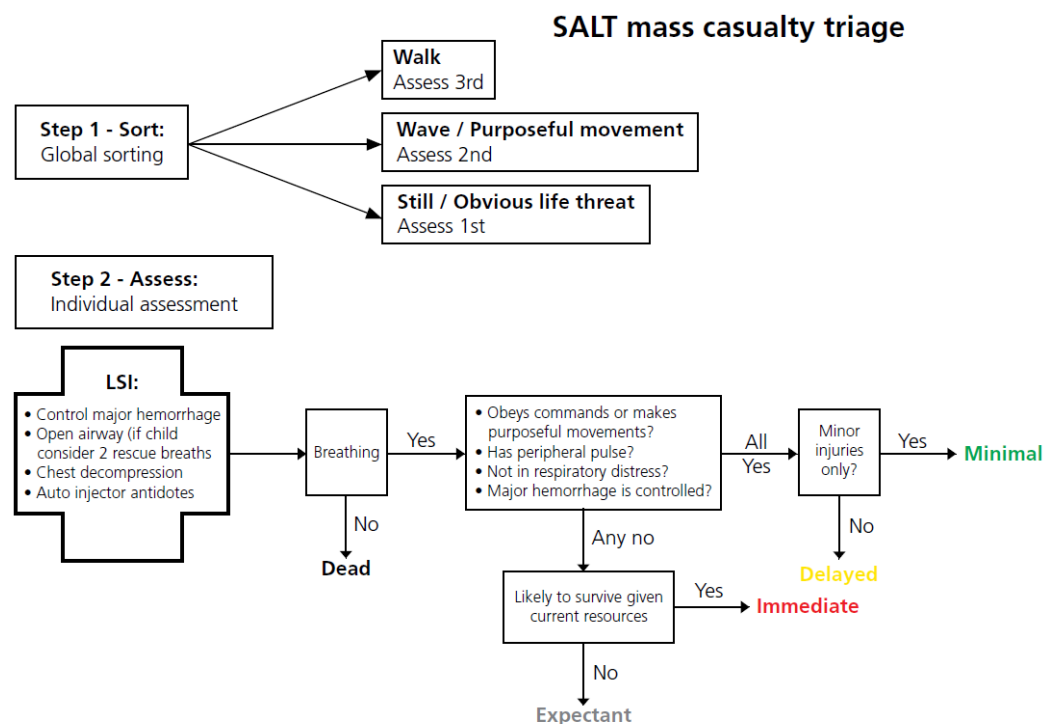


Figure 31.1 SALT triage scheme. LSI, life-saving interventions.

- START triage is currently the most widely used in the United States:

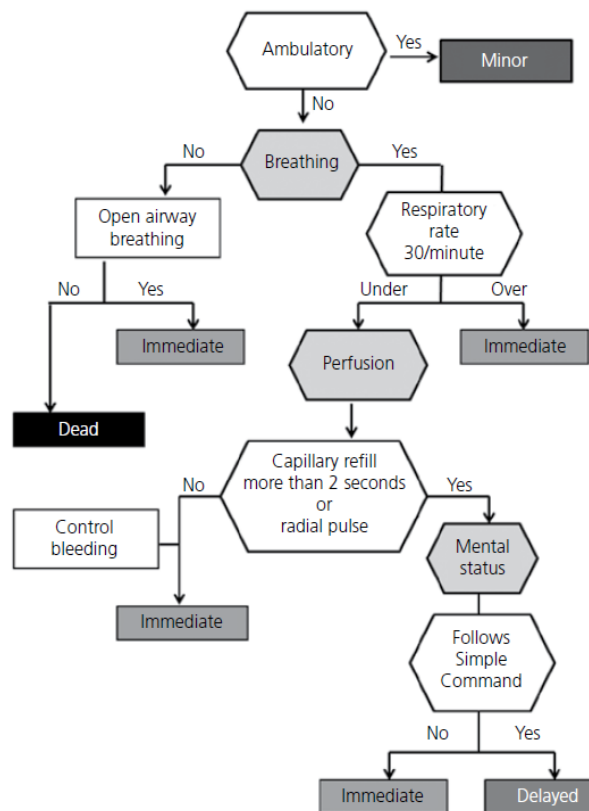


Figure 31.2 START triage algorithm.

JumpSTART Pediatric MCI triage

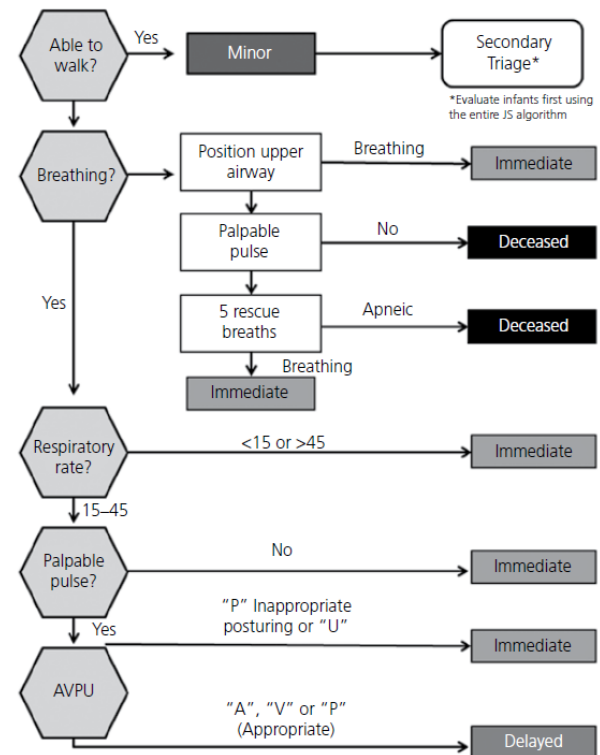


Figure 31.3 JumpSTART pediatric triage algorithm. AVPU scale: alert, voice, pain, unresponsive (used by EMS responder to determine patient's level of consciousness).

- 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.

32 Mass casualty management, 292

- The **National Incident Management System (NIMS)** provides 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
- **Medical Surge Capacity and Capability Management System** - Coordination between agencies and ESF 4&8 (fig 32.1)

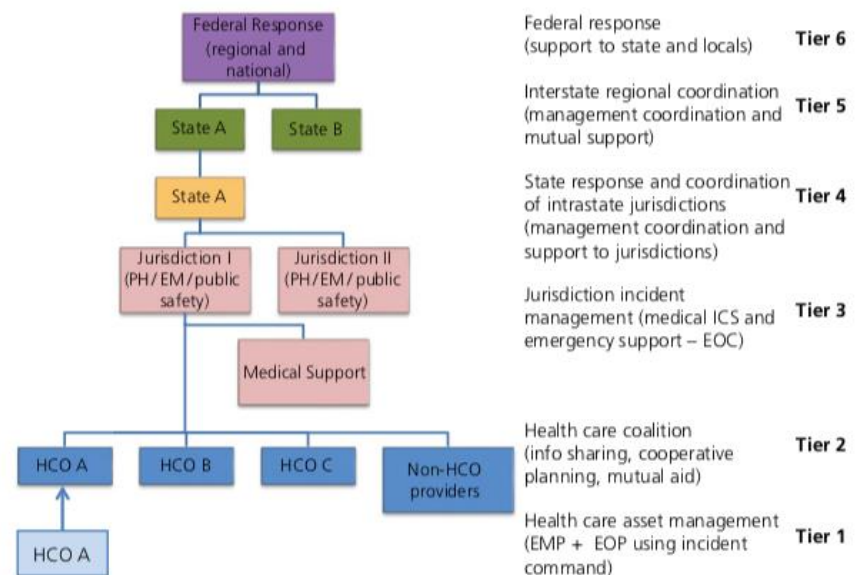


Figure 32.1 Medical surge capacity and capability management organization strategy. Source: US Department of Health and Human Services, 2007 [2].

EMP = Emergency management program
 EOP = Emergency operations plan
 PH = Public health
 EM = Emergency management
 HCO = Healthcare organization

- Medical director is usually in advisory or consulting role to incident commander during a disaster. Role also includes the responsibility for the agency's mitigation and preparedness strategy.
 - Identify key resources, personnel and agencies, and develop collaborative relationships
 - Develop policies and protocols that address daily operations as well as surge-level operations
 - Implementing communication infrastructure that is scalable during MCI

- 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.

33 Mass casualty evacuation and patient movement, 303

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 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

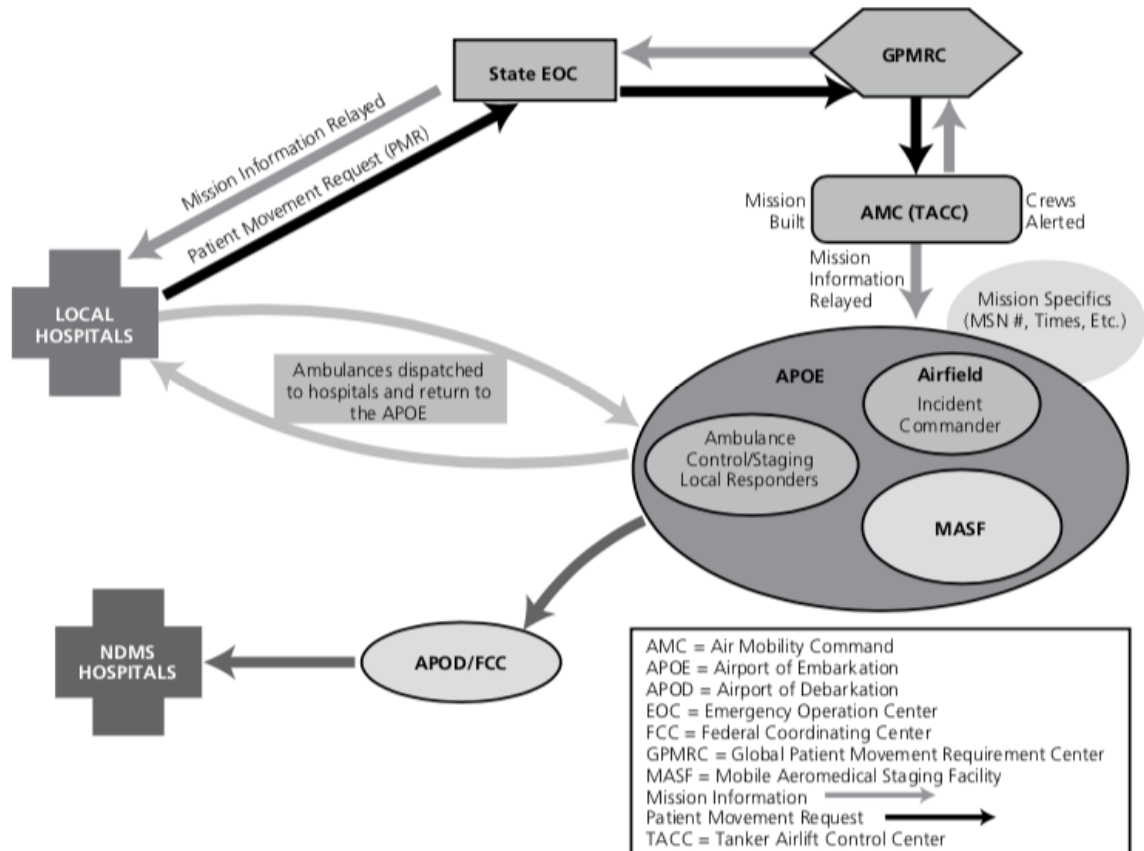


Figure 33.2 Hospital evacuation by the National Disaster Medical System.

34 Temporary treatment facilities, 313

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 V: Special Hazards

35 Medical support for hazardous materials response, 323

- 75% Hazmat events are at **fixed** chemical facilities. The few that are transportation-related are generally ground transport-related
- Approximately 2000 patients per year, usually with *respiratory or eye* exposure.
- 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 MRESA/trauma gowns
- Note: You don't need to wear any PPE while setting up decon because by definition you are in uncontaminated warm zone

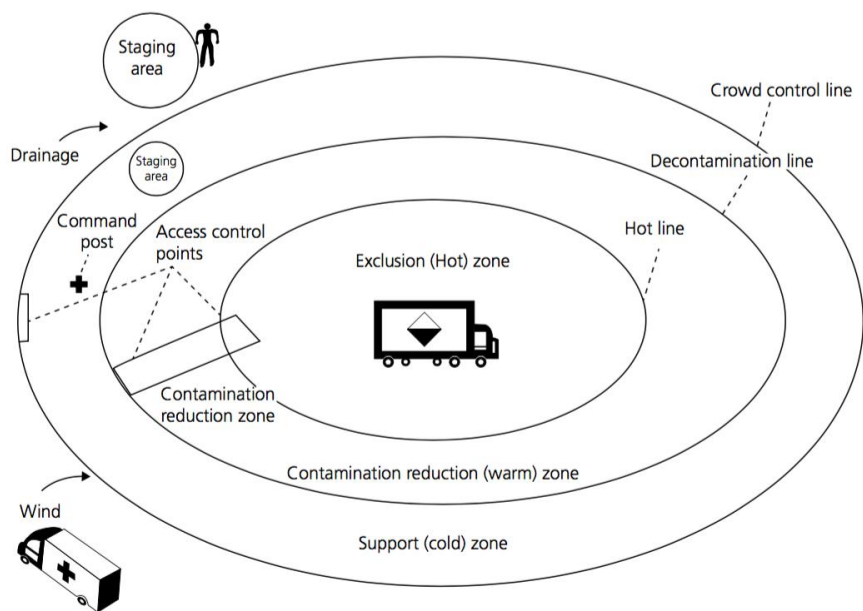


Figure 35.4 NIOSH/OSHA Decon set up illustration

- **AB**sorption = 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.”
- 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

36 Chemical properties of hazardous materials, 334

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.

37 Radiation and radiation injury, 339

- **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.

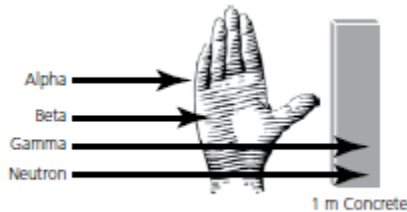


Figure 37.1 Relative penetration in human tissue of ionizing radiation.

Radiation safety officers are good sources of information for EMS/disaster planners.

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.*

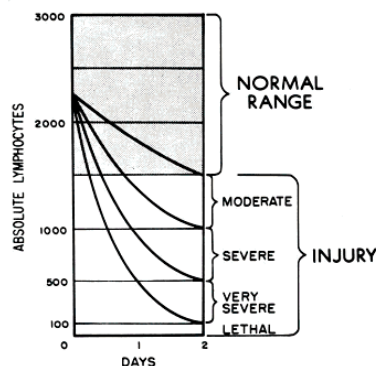


Table 37.2 Signs and symptoms of radiation exposure

Whole-body radiation from external exposure or internal absorption						
Subclinical Range		Clinical, sublethal Range		Lethal Range		
	0–100 rad	100–200 rad	200–600 rad	600–800 rad	600–3,000 rad	>3,000 rad
Nausea, vomiting	None	5–50%	50–100%	75–100%	90–100%	100%
Time of onset		3–6 hours	2–4 hours	1–2 hours	<1 hours	Minutes
Duration		<24 hours	<24 hours	<48 hours	<48 hours	Not available
Lymphocyte count	Unaffected	Minimally decreased	<1,000 at 24 hours	<500 at 24 hours	Decreases within hours	Decreases within hours
Central nervous system function	No impairment	No impairment	Routine task performance cognitive impairment for 6–20 hours	Simple and routine task performance cognitive impairment for >24 hours	Rapid incapacitation may have a lucid interval of several hours	

Source: summarized from Department of Veteran Affairs Pocket Guide, Terrorism with Ionizing Radiation General Guidance. Bethesda, MD: Armed Forces Radiobiology Research Institute, 2003.

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.

38 Weapons of mass destruction, 349

Bombings not all that rare (1,600 to 2,400 per year in US) and injuries are primarily caused by the blast:

Table 32.1 Categories of explosive injuries

Category	Mechanism	Injury type
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.)
Quinary	The intentional addition of agents that may result in injury	• Inhalation injury • Radiation • Chemical • Biological (including suicide bombers with hepatitis or HIV)

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 VI: Special Environments

39 Tactical EMS, 355

- 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
- **Unique/additional TEMS attributes (Box 39.1) and skills (Box 39.2)**

Box 39.1 Unique TEMS attributes

Zones of care
Weapons safety and less lethal weapons
Hazardous materials
Forensic evidence collection
Preventive medicine
Primary care
Special equipment
Tactical training

Box 39.2 Unique TEMS skills

Commander's medical conscience
Medical threat assessment
Remote assessment methodology
Sensory-deprived/overload patient assessment
Medicine across the barricade
Hasty decontamination procedures

- **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)

40 EMS on the fireground, 363

Greatest proportion of line-of-duty deaths and injuries to firefighters (FF) are seen in structural firefighting (due to frequency and associated hazards)

Four roles for EMS on firefighting ground:

1. Stand-by for possible illness or injury of FF
 - Stand-by regulated by federal regulations as well as industry standards
 - **HAZWOPER, 29 CFR 1910.120** regulations apply to fireground as well
2. Treatment and transport of ill/injured FF
 - **National Fire Protection Association (NFPA) 1500:** minimum of one transport-capable EMS unit must be on scene, ALS providers preferred
 - If that one ambulance responds to patient, another should replace on stand-by function since there may be **immediate danger to life and health (IDLH)**, also important that positioning is optimal for exit and also not blocking fire apparatus
 - Increased risk of cardiac events, burns, and MSK injuries (most common)
 - Most common cause of death is cardiac
 - High index of suspicion for carbon monoxide (CO) and cyanide poisoning (may be a more prevalent hazard of fire suppression than previously thought)
3. Management and staffing rehab area
 - Standards are in **NFPA 1584:** rehab is medical care for FF on scene, not civilian victims
 - Common rehab functions that require EMS medical oversight:
 - Establish VS criteria for triage to rehab area, include “general appearance”
 - Ex. HR >120, SBP <90, SBP >160, DBP >110, Temp >99.5 (oral)
 - At a minimum, FF assigned to rehab should be rested/rehydrated for 10 min
 - Establish protocols to determine which FFs require immediate transport from rehab to medical facility
 - Ex. HR >160, irregular pulse, acute chest pain
 - Ensure medical providers in rehab have designated authority to detain FF in rehab/transport as seen fit
 - Provide advice re: rehydration
 - Provide advice/guidelines re: passive and active cooling
 - Other rehab considerations:
 - Rehab operations should commence within 20 minutes of starting structural firefighting
 - Work-to-rest guidelines:
 - Company/crew level: **5-10 min** of rest/rehydration after one 30-min SCBA or after 20 min of work without SCBA
 - Formal rehab sector/area level: **10-20 min** of rest/rehydration/medical assessment after two 30-min SCBA, one 45- or 60-min SCBA, when using encapsulating hazmat suit, or after 40 min of work without SCBA

- Consider “two-zone rehab system”
 - Sample VS for retention in rehab: HR >100, SBP <90, SBP >160, DBP >100, Temp >99.5 (oral)
- Rehydration and nutritional support:
 - **1L loss in initial 20 min, 2L loss per hr during intense FF activity**
 - Prehydration
 - Additional 16 oz (500 mL) within 2 hrs. of deployment (water + meal, or if no meal then sports drink)
 - Rehydration
 - 8 oz sports drink first rotation to rehab, then 8 - 32 oz over 2 hours post-op
 - Self-monitor urine
 - Considerations for fluids: avoid temp extremes, avoid high osmolality (>350 mOsm/L)
 - Gastric emptying capacity, paradoxically, decreases as the FF becomes more dehydrated and heat stressed → could lead to emesis
 - Solid foods often necessary for prolonged support - have easily digestible foods: 30-60g complex carbs, also consider easy proteins and fats
- Setting up rehab area:
 - Site should be uphill and upwind
 - Entry should be through a single portal
 - **Figure 40.1:** The model rehab area

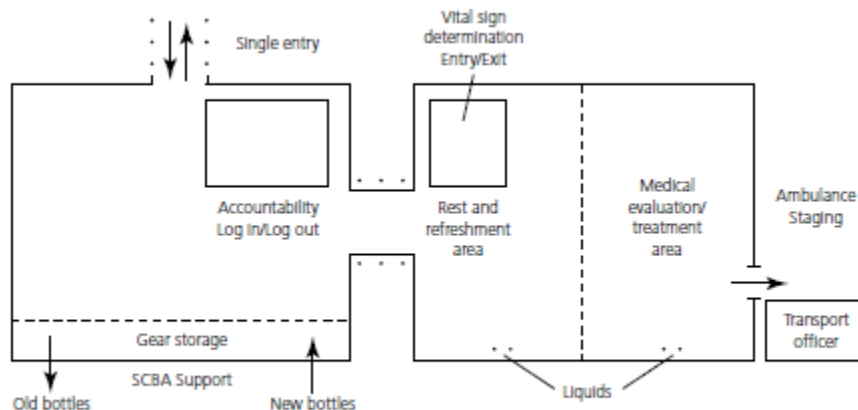


Figure 40.1 The model rehab area. This accommodates the various key functions performed in and around the rehab sector, including accountability, doffing of PPE, replenishment of SCBA cylinders while the firefighters are in rehab, medical triage, rehydration, and medical monitoring.

4. Transport and treatment of ill/injured civilians

NFPA 1582 requires that fire department physicians participate in operational safety matters and that they collaborate with EMS medical directors on procedures for medical support of firefighters at fire incidents

Physiology of structural firefighting:

- Strenuous physical work at extreme heat up to 700F, 100% relative humidity
- PPE bulky, heavy, and prevents physiological cooling, but necessary: pants, coat, hood, gloves, helmet, SCBA (self-contained breathing apparatus). PPE rated with THL and TPP:
 - **THL**: total heat loss measures evaporative heat transfer or breathability outlined in **NFPA 1971**
 - **TPP**: thermal protective performance measures thermal insulation outlined in **NFPA 1971**
 - Increasing TPP may result in decreased THL
- **Physiologic changes**
 - HR elevated starting with time of initial alarm (HR does not correlate with energy expenditure or temp rise)
 - Increased cardiovascular (CV) work and thermal stress contribute to substantial CV morbidity and mortality
 - Live exercises increase CV demand more than mock exercises - peripheral vasodilation and sweat loss lead to significantly reduced stroke volume (SV) within 20 min
 - When HR sustained at or near max plus any drop in SV → decreased cardiac output
 - Other stressors:
 - Most energy expenditure during interior structural firefighting while wearing SCBA
 - Disproportionate upper body strength needed for axe and pike pole use during “overhaul”
 - Exposure to CO and other toxins during exercise → ST changes on EKG
 - Core temp rises even after FF is no longer being exposed to heat

41 Confined space and limited access situations, 373

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

42 Care in the wilderness, 377

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):** 50-80 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):** 150 hours of 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 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)

“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

43 Telemedicine and emerging telecommunications, 392

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).

Section VII: Advancing Knowledge

44 EMS research basics, 403

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.

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

45 Informed consent for EMS research, 410

- **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 45.1

Table 45.1 Central principles of the Belmont Report and application to research

Ethical principle Identified In Belmont Report	Standard for conduct of human subject research
Respect for persons	<i>Concept: Ensure subjects have free choice to participate in research</i> 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 (children, prisoners, pregnant women, and those in subordinate positions)
Beneficence	<i>Concept: Do no harm while maximizing potential benefits and minimizing potential risks</i> 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
Justice	<i>Concept: Promote fair study recruitment</i> Risks should be distributed so that all populations both bear risks and receive potential benefits. Risks must not be borne by one population (such as economically disadvantaged individuals) while benefits are received by a different (such as economically advantaged) population

- **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.

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.

Box 45.1 Conditions under which the exception from informed consent for emergency research may be used

A life-threatening situation exists
Available treatments are unproven or unsatisfactory and scientific evidence is necessary to determine safety and effectiveness of the intervention
Consent is not feasible due to the subject's medical condition
Treatment must be given before it is possible to obtain consent from a legally authorized representative (LAR)
There is no reasonable way to identify prospectively those likely to become eligible subjects
Risks and benefits must be considered to be reasonable
Participation holds some prospect of direct benefit to the subjects
The investigation could not practicably be carried out without the waiver of prospective consent
The proposal defines the therapeutic window. The investigator will attempt to contact the LAR, if feasible, during the therapeutic window and will document these efforts for the IRB
The IRB reviews and approves the consent procedures and documents to be used
Additional protections of community consultation and public disclosure of risks and expected benefits 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
An independent data monitoring committee will be established to oversee risks and benefits
IRBs must ensure that the earliest feasible attempts are made to inform the subject or his or her LAR of the subjects inclusion in the investigation as well as the other information contained in the informed consent document
Protocols involving an exception to the informed consent requirement must be performed under a separate investigational new drug application or investigational device exemption that identifies them as including subjects who are unable to consent. The FDA must approve the application before the study may proceed
If an IRB determines it cannot approve a clinical investigation because it does not meet criteria or because of ethical concerns, the IRB must provide this information in writing to the investigator and the study sponsor. The study sponsor must disclose this information to the FDA and other investigators participating in an equivalent investigation as well as to other IRBs that have been asked to review this or an equivalent protocol

Source: Data from Food and Drug Administration, Department of Health and Human Services. Exception from Informed Consent Requirements for Emergency Research: Guidance for Institutional Review Boards and Clinical Investigators. Available at: www.fda.gov/oc/ohrt/irbs/except.html

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)

46 Cardiac arrest-related research methodology, 415

Incidence of cardiac arrest highly variable between communities, at least in part due to case definition

- Inclusions:
 - EMS provides chest compressions and/or defibrillation
 - Patient who went unresponsive is found with a pulse on EMS arrival after member of public uses AED to deliver shock
- Exclusions:

Table 46.1 Possible exclusion criteria

Etiology independent	Etiology related
Rigor mortis	Traumatic cause
Decapitation	Drowning
Dependent lividity	Accidental hypothermia
Do not resuscitate order	Asphyxia
Age <18 years	Toxic ingestion or overdose
Prisoner	Electrocution
Pregnant	Sepsis

*Patients obviously dead on EMS arrival should be tracked but excluded from survival statistics

- **Utstein criteria** (developed 1991) – gold-standard method of reporting cardiac arrest data to allow useful comparison in outcomes across systems
 - Originally called to track only arrests of cardiac etiology
- **Resuscitation Outcomes Consortium** - clinical trial network supporting cardiac arrest research.
 - Advocates to track all cases without obvious trauma regardless of etiology.
- **Consolidated Standards of Reporting Trials (CONSORT)** patient flow diagram - a standard approach for authors to report findings and describing patients who were included or excluded. For Utstein, this includes:
 - Location
 - Witness status
 - Type of EMS system
 - Population density
- **Chain of survival** - critical “links” to cardiovascular resuscitation care
 - Immediate recognition and activation of help
 - Early CPR
 - Early defibrillation
 - Effective ACLS
 - Integrated post-arrest care
- Data integrity
 - Time *intervals* are critical to cardiac arrest and resuscitation reporting (e.g. time between dispatch to first defibrillation)
 - Can be affected by source from which time was recorded (if not synchronized)

- Presenting rhythm best determined through blinded review of rhythm strips. Electronic data capture also allows assessment of the quality of chest compressions and ventilations provided to the patient.
- Commonly measured outcomes:
 - Survival
 - Clinically significant short-term survival = 4 hours after initial call
 - ROSC – not patient-centered
 - Neurological status (CPC or modified Rankin)
 - Modified Rankin Scale more rigorous but requires contact with the patient
 - Quality of life – many confounders
- **Data and safety monitoring boards (DSMBs)** - review study data for participant safety, study conduct and progress, and efficacy when appropriate, and make recommendations concerning continuation, modification, or termination.

47 Trauma-related research methodology, 420

- **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.

48 Pediatric-related research methodology, 427

- 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

49 Economic evaluation of EMS-related interventions, 433

- **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 49.1 EMS cost framework components (listed alphabetically) [26]

Category	Description
Administrative overhead	Include the cost of all of 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 - Assets/building - 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
Bystander response	Bystander response to medical emergencies (e.g. community CPR defibrillation 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
Equipment	Any equipment necessary to train, provide, maintain, or administer the EMS system (e.g. personal protective equipment, computers used for dispatch, etc). There are two types of equipment: durable (i.e. used multiple times) and consumable (i.e. used only once and discarded). This should include the cost of: 1. Durable equipment - Acquisition - Operation - Maintenance - Replacement 2. Consumables - Acquisition - Replacement (including caused by expiration)
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

Table 49.1 *Continued*

Category	Description
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
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

Source: Lerner 2007 [26]. Reproduced with permission of Elsevier.

- **“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.

50 Data handling and statistics essentials, 439

Common statistical definitions:

Term	Definition
α	The maximum p value to be considered statistically significant; the risk of committing a type I error
α error	A type I error
Alternative hypothesis	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
β	The risk of committing a type II error
β error	A type II error
Null hypothesis	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
Power	The probability of detecting the treatment effect defined by the alternative hypothesis (i.e. obtaining a p value $< \alpha$), given α , and the sample size of the clinical trial; power = $1 - \beta$
p value	The probability of obtaining results similar to those actually obtained, or results more inconsistent with the null hypothesis, assuming the null hypothesis is true
Type I error	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
Type II error	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

Post-hoc power analysis – done after conclusion of study in which one calculates the effect size that could have been found with the actual sample size. INVALID

The p value - answers the question: "Is there a statistically significant difference between the two treatments?" Does *not* give magnitude or precision of treatment difference or inform clinical relevance

- Scales of measurement:
 - **Numerical variables** (or quantitative) - the size of differences between numbers has meaning.
 - **Continuous** - e.g. age, weight, time
 - **Discrete** – e.g. # of calls per shift
 - Summarized with mean and median.
 - **Categorical variables** - qualitative
 - **Nominal** - no inherent order (e.g.: race, sex, hospital name)

- **Dichotomous** = binary
- **Polychotomous** = more than two
- **Ordinal** – inherent order, but relationship between categories may differ throughout the scale (e.g.: GCS, Apgar)
 - Categorization of continuous variables (E.g.: systolic blood pressure ≤ 90 mmHg or age by decades) requires arbitrary cut-off, reduces study power, leaves room for residual confounding.
- Types of statistical tests:
 - **Parametric** tests - used to analyze numerical data. Requires normal distribution of data and that the variance of data from each group is equal.
 - T-test for 2 groups
 - ANOVA for > than 2 groups
 - **Non-parametric** tests do not required assumption of normal distribution but there is a slight loss of power (i.e. greater chance of type II error). May require a slightly larger sample size to achieve the same desired power

Table 50.2 Common statistical tests and their assumptions

Statistical test	Description
Parametric tests	
Student's t test	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)
One-way analysis of variance (ANOVA)	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
Non-parametric tests	
Wilcoxon rank sum test (Mann-Whitney U test)	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
Wilcoxon signed rank test	Used to examine data from matched pairs, similar to the matched pairs t test, but when differences in each pair are not normally distributed
Kruskal-Wallis	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 non-normally distributed data
Chi-square test	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 of each combination of treatment and outcome, under the null hypothesis
Fisher's exact test	Used in an analogous manner to the chi-square test, Fisher's exact test may be used even when less than five observations are expected in one or more categories of treatment and outcome

- **Point estimate** – an estimate of the “true” treatment difference between groups in a study. (e.g.: one min decreases in response time). Relays the *magnitude* of the treatment difference
- **Confidence interval** - estimates a range of values between which the true treatment difference will lie with some degree of certainty (e.g. 95%). Conveys 3 key pieces of info:
 - Statistical significance: if interval excludes zero, $p < 0.05$
 - Magnitude of difference (can be helpful even if CI includes 0)

- Precision with which the study detected a true difference (wide = imprecise, narrow = precise)
 - Increasing sample size will narrow the CI, increasing precision à greater certainty of either no clinically important difference or determination of a difference that was not uncovered by an analysis of the smaller sample size.
- **Multiple comparisons** – the risk of a false positive p value (Type I error) occurs each time a statistical test is performed. The risk of obtaining at least one false positive p value when comparing two fundamentally identical groups and assuming that each result is statistically independent is a function of the number of comparisons made.
 - Types of multiple comparisons:
 - **Interim analyses** - conducted before the full sample size has been reached, to see if a final conclusion may be drawn from the data and the trial terminated early.
 - **Subgroups analysis** – Additionally, since fraction of sample, may have low statistical power, increasing the chance of type II error as well
 - **“Proper” subgroup** - defined by signs, symptoms, or other characteristics available at the initial presentation (e.g. on the arrival of EMS personnel) that are *not modified by the interventions being compared*).
- **Bonferroni correction** – corrects for multiple comparisons by reducing the overall type I error risk (the “studywise” risk) by reducing the maximum p value considered statistically significant (α) for each of the individual tests (the “testwise” risk).
 - The overall risk of a type I error that is desired (usually 0.05) is divided by the number of statistical tests to be performed, and this value is used as the maximum significant p value for each individual test.
 - Controls the overall (study wise) risk of a type I error, at the expense of an increased risk of a type II error, since there is an increased risk that each test will miss a difference as big as that defined by its associated alternative hypothesis (by yielding a p value that is non-significant using the new criteria for p).
- **Intention to treat** – attempts to account for the “real world” challenges faced in an intervention by analyzing patients for whom a procedure is initiated/ordered but cannot be completed in their original assignment group
- **Multivariable analysis** -goal is to quantify the separate effect of each independent variable on the outcome of interest (the “dependent” variable).
 - **Multivariable modeling** - Integrates several variables into the same analysis to account for the variety of factors that may influence a given outcome and to increase comparability between patient groups.
 - **Stratification** – separates sample into two (or more) groups, based on a given variable (frequently a confounder), and analyzing these groups in parallel

- **Multivariable logistic regression** - form of mathematical modeling used with a categorical outcome and multiple predictor or confounding variables. A measure of association (odds ratio) is calculated for each predictor variable, along with the confidence interval and p value for the null hypothesis that the odds ratio is 1 (i.e. no independent association).
 - The outcome is generally dichotomous or binary (e.g. survival versus death). The predictor variables can be numerical or categorical. Allows an investigator to assess how a single predictor affects the outcome of interest.

- **“Clustering”** = type of bias. Tendency of subjects who have some features in common in correlated data (e.g. the EMS agency that responds to their 9-1-1 calls) to have other characteristics in common as well (e.g. hospital disposition or receiving certain types of hospital care).
 - May exhibit similarity in patient characteristics, EMS care (e.g. a certain EMS agency or crew may have more or less experience with certain procedures than other crews), or hospital care (e.g. treatments and outcomes at certain hospitals may be better or worse than other hospitals).
 - Failing to account for these correlations can result in inappropriately narrow confidence intervals and artificially low p values (i.e. increased type I error rates).

- **Missing data** - Introduces bias in study results, decreases precision of estimates, and reduces power. One solution is to use observed values to predict plausible values for missing data, while appropriately accounting for the uncertainty (i.e. variance) inherent in this process.

Last Minute Cram Section

Note: this document 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/emsgbank), and Dr. Fowler's study guide (<http://www.doctorfowler.com/>)

Dates/Laws/Standards/Studies

- **1966 - National Academy of Sciences/National Research Council - Accidental Death and Disability: The neglected disease of Modern Society - (*The White Paper*)** 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**
 - Part 91 - General operations, flight rules
 - 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.
- **NEMSIS** - 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**
 - Baldrige - 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
 - IIa - 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

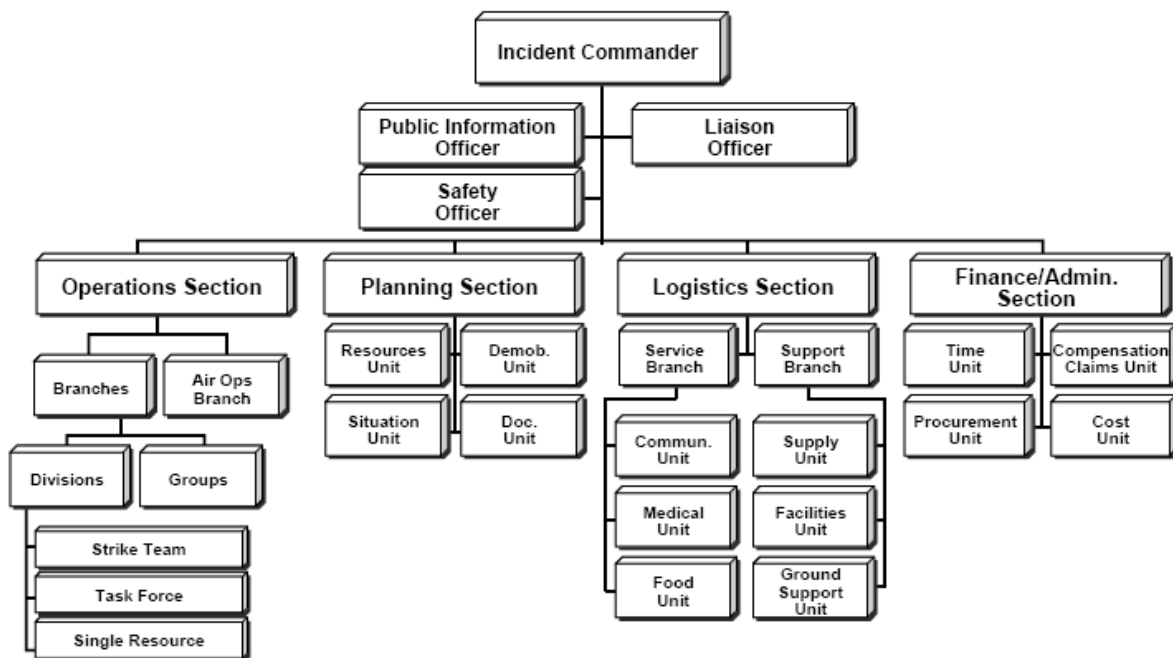
- Radiation exposure: Time exposure is linear. Distance is inverse square law. Shielding (alpha rays blocked by paper/cloth/skin). Beta by FF turnout gear. Gamma - good luck
- Remember phosgene is delayed exposure (48 hrs.) in contrast to chlorine and ammonia. Pulmonary irritant
- Lewisite is blistering 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 - Isopropanolol, 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
 - ESF 1 -Transportation (DOT)
 - ESF 2 - Communications (DHS/FEMA)
 - ESF 4 - Firefighting (USDA)
 - ESF 5 - Emergency Management; Information and Planning (DHS/FEMA)
 - ESF 6 - Mass Care, Housing, and Human Services; Shelter (DHS/FEMA)
 - ESF 7 - Logistics and Resources; e.g. NGOs (GSA, DHS/FEMA)
 - *ESF 8 - Public Health and Medical Services; NDMS, DMAT, federal assistance for medical evacuation; Money for EMS (HHS)*
 - Tiers of ESF 8
 - I - 105 members, deployable in 12 hours
 - II - Mental health teams, applied public health teams
 - III - All active-duty commissioned public health service officers not already deployed
 - IV - Inactive reserve corps
 - 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.
 - ESF 10 - HAZMAT, oil (EPA)
 - ESF 13 - Public Safety, security

- ESF 14 - Long-term Community Recovery and Mitigation.
- **NIMS**
 - NIMS 100 - Introduction to Incident Command System
 - NIMS 200 - ICS for Single and Initial Action Events
 - NIMS 700 - National Incident Management Systems (NIMS): An Introduction,
 - NIMS 800 - National Response Framework: An Introduction.

Afterword

Though countless hours have gone into compiling this compact review guide, the editors recognize it is imperfect.

Please forward any corrections or comments to ryan.coughlin@yale.edu.

Thank you and good luck!