EMT-Special Skill Curriculum

Intravenous Therapy Endorsement

DOH 530-136 Update May 2022

Contents

Course Guide

Background / Scope

The IV therapy endorsement created to provide specific, limited life-saving skills to rural areas that are unable to develop or maintain full ALS level service. This EMT- IV Therapy Special Skill Curriculum represents the minimum required information to be presented within a course leading to endorsement for EMT-IV Therapy. The EMT IV endorsement is not a substitute for ILS or ALS level care in existing services.

People who successfully complete the training are allowed to use the skills when the endorsement is added to the EMTs credential and upon approval of the County Medical Program Director (MPD). Refer to local department and MPD approved protocol regarding use of IV therapy skill.

The curriculum is designed with four lessons of instruction content. Each unit has terminal objective represents the desired outcome of completion of the block of instruction. In most cases it is a very high-level objective, which can make it difficult to evaluate. This global objective represents the desired competency following completion of the section. Although this objective may be viewed as the aggregate of lower level objectives, in many cases, the whole is greater than the sum of the parts.

Objectives

These are the individual objectives of the curriculum. Mastery of each of these objectives provides the foundation for the higher order learning that is expected of the entry level provider. The instructor and student should strive to understand the complex interrelationships between the objectives. These objectives are not discrete, disconnected bits of knowledge, but rather fit together in a mosaic that is inherently interdependent. The objectives are divided into three categories: Cognitive, Affective, and Psychomotor.

Declarative

This material is designed to provide program directors and faculty with clarification on the depth and breadth of material expected of the entry level EMT with IV endorsement. The declarative material is not all-inclusive. The declarative sections of the curriculum lack much of the specific information that must be added by the instructor. The declarative information represents the bare minimum that should be covered, but the instructor must elaborate on the material listed. Every attempt has been made in development of the declarative material to avoid specific treatment protocols, drug dosages or other material that changes over time and has regional variations. It is the responsibility of the instructors to provide this information.

Specifically, the declarative material is used to help instructors develop lesson plans and instructional strategies. It is also designed to assist examination and publishers in developing appropriate evaluation materials and instructional support materials. It is of utmost importance to note that the declarative material is not designed to be used as a lesson plan, but rather it should be used by instructors to help develop their own lesson plans.

Participant Requirements

To take this endorsement course an emergency medical technician (EMT) must have completed one year of certification as an EMT with a licensed EMS service, have an EMS agency recommendation, and MPD approval.

Course Length

EMT with IV training should be based on the competency of the individual and not the length of the training. The time involved in educating an EMT-IV endorsed provider to an acceptable level of competence depends on many factors. It is expected that the average program, with average students, will achieve results that meet the standard in approximately 42 hours.

Course Completion Requirements

1. Required Lessons

- Lesson 1: Patient Assessment & Clinical Decision Making
- Lesson 2: Overview of Human Systems
- Lesson 3: Assessment and Management of Shock
- Lesson 4: Intravenous & Intraosseous Line Placement and Infusion

2. Clinical Internship Requirements

- Successful completion of 10 IV insertions on humans.
    - At the option of the MPD, 5 may be performed on training aids.
- Lab skill proficiency required in: IO line placement

NOTE: It is recommended that some IV insertions be accomplished during the field internship. The County Medical Program Director determines competency for all skills.

3. Field internship

- Competency determined by the County Medical Program Director.

4. Evaluations/Examinations

- Practical Skill Evaluations as identified in Appendix B
- Written course completion examination approved by the MPD.

Washington State Clinical/Field Internship Rotation Requirements

In addition to the hours of instruction and practical skill evaluations, this course requires that the student successfully complete patient interactions in a clinical/prehospital setting. Any combination of the resources listed in the EMS Training Program and Instructor Manual may be used to meet the requirements.

Intravenous Therapy Training Endorsement

The Washington State Department of Health requires specific evaluation of knowledge and psychomotor performance prior to course completion to obtain official endorsement as an

EMT-IV provider. These evaluations are conducted throughout the course and as a final course comprehensive practical evaluation, prior to course completion.

Education / Training Maintenance Requirements

This curriculum is intended to prepare a medically competent EMT-IV Therapy provider to operate in the field. Continuing education is required to maintain an EMT-IV Therapy provider's endorsement and continued MPD approval to use the skill.

Washington State Training Course Forms

To conduct an IV therapy course, submit a course application through an approved training program. The course application can be found on here.

Course Schedule

The EMT-IV Therapy Special Skill Course Schedule, must be completed and submitted with the Training Course Application.

Educational Materials

This curriculum is on the DOH website. It can also be requested by contacting DOH Emergency Care System at 360-236-2840 or by sending an email to HSQA.EMS@doh.wa.gov.

Course Completion Forms

EMS Course Completion Verification Form

The verification form should be completed by indicating all students enrolled in the class (whether they successfully completed or not) and submitted to the department. It can be found here.

Certificate or Letter of Course Completion

The Lead Instructor must document successful course completion. Prior to issuing a certificate of course completion, the Lead Instructor must verify the student's:

- Comprehensive cognitive, affective and psychomotor abilities.
- Successful completion of the clinical/field rotations.

The Certificate or Letter of Course Completion:

- Is provided by the lead instructor to students who successfully complete the EMT-IV provider course as outlined in the EMS Training Program and Instructor Manual
- For intravenous therapy EMT endorsement courses the SEI/LI/training program director needs to send a copy of the course completion certificate to the department at the conclusion of the course when all course requirements are completed. This allows the endorsement to be added to the EMTs credential.

Instructor

Training is conducted by people with the depth and breadth of knowledgeable in the intravenous skill, experienced in the delivery of EMS education, and in practical application of scene and patient management, such as senior EMS instructors or other people approved by the medical program director to teach continuing education.

The lead instructor must be:

- An Advanced EMT who has their SEI, or
- A certified paramedic, or
- Paramedic Training Program instructional staff, when training is provided by an accredited paramedic training program, or
- An RN, and
- Approved by the Medical Program Director.

The Lead Instructor/SEI should have training and education in education and evaluation and be knowledgeable in administration of education for EMS providers. The Lead Instructor/SEI should assume ultimate responsibility for the administration of the didactic, clinical, and field internship phases of the program. It is the Lead Instructor/SEI's responsibility to monitor all phases of the program and assure that they are appropriate and successful.

Medical Direction

Medical direction is an essential component of out-of-hospital training and physician involvement should be in place for all aspects of EMS education. The Course Medical Director should be the County Medical Program Director (MPD) or an MPD delegated training physician. All program faculty should work closely together in the preparation and presentation of the program.

The Course Medical Director can assist in settling questions of medical protocol and acting as a liaison between the course and the medical community. During the program the Medical Director will be responsible for reviewing the quality of care rendered by the EMS provider student in the clinical and field setting. The Course Medical Director should review all course content material and examinations. The medical director should periodically observe lectures and practical laboratories, field and clinical internships. The medical director should participate in clinical instruction, student counseling, psychomotor and oral testing, and summative evaluation.

Most importantly, the Course Medical Director is responsible to verify student competence in the cognitive, affective and psychomotor domains. Students should not be awarded course completion certificates unless the medical director and program director can assure through documentation of completion of terminal competencies that each student has completed the full complement of education.

Lesson 1: Patient Assessment & Clinical Decision Making

Objectives

Cognitive Objectives

At the completion of this topic, the EMT-IV student will be able to:

1. Explain and demonstrate critical thinking skills
2. Explain and demonstrate decision-making skills
3. Explain and demonstrate assessment Based Patient Care

Introduction and key concepts

A. The cornerstones of effective EMT-IV practice
   1. Gathering, evaluating, and synthesizing information
   2. Developing and implementing appropriate patient management plans
   3. Apply judgment and exercise independent decision-making
   4. Thinking and working effectively under pressure

B. The pre-hospital environment
   1. Unlike other environments where medical care is traditionally rendered
   2. Unique - heavily influenced by factors that do not exist in other medical settings.

C. The spectrum of patient care in pre-hospital care
   1. Obvious, critical life threats
      a) Major, multi-system trauma
      b) Devastating single system trauma
      c) End stage disease presentations
      d) Acute presentations of chronic conditions
   2. Potential life threats
      a) Serious, multi-system trauma
      b) Multiple disease etiologies
   3. Non-life-threatening presentations

D. Providing guidance and authority for EMT-IV action and treatments
   1. Protocols, standing orders, and patient care algorithms
      a) Can clearly define and outline performance parameters
      b) Promote a standardized approach
   2. Limitations of protocols, standing orders & patient care algorithms
      a) Only addresses “classic” patient presentations
         (1) Non-specific patient complaints do not follow model
         (2) Limited clarity of presenting patient problems
      b) Don’t speak to multiple disease etiologies
      c) Don’t speak to multiple treatment modalities Page 12
      d) Promotes linear thinking, “cookbook medicine” providers

Components, stages, and sequence of Critical Thinking process for EMT-IVs

A. Concept Formation
   1. Mechanism of injury (MOI)/scene assessment
   2. Primary assessment
   3. Chief complaint
   4. Patient history and secondary assessment
   5. Patient affect

6. Diagnostic tests

B. Data interpretation
   1. Data gathered
   2. EMT-IV knowledge of Anatomy, Physiology, and pathophysiology
   3. EMT-IV attitude
   4. Previous experience base of EMT-IV

C. Application of principle
   1. Field impression/working diagnosis
   2. Protocols/standing orders
   3. Treatment/intervention

D. Evaluation
   1. Reassessment of patient
   2. Reflection in action
   3. Revision of impression
   4. Protocol/standing orders
   5. Revision of treatment/intervention

E. Reflection on action
   1. Run critique
   2. Addition to/ modification of experience base of EMT-IV

Fundamental Elements of Critical Thinking for EMT-IVs

A. Adequate fund of knowledge
B. Ability to pay attention
C. Ability to gather and organize data and form concepts
D. Ability to identify and deal with medical ambiguity
E. Ability to differentiate between relevant and irrelevant data
F. Ability to analyze and compare similar situations
G. Ability to recall contrary situations
H. Ability to articulate decision making reasoning and construct arguments

Considerations with Field Application of Assessment Based Patient Management

A. The Patient Acuity Spectrum
   1. EMS is activated for countless reasons
   2. Few pre-hospital calls constitute true life-threatening emergencies
      a) Minor medical and traumatic events require little critical thinking and have relatively easy decision making
      b) Patient's with obvious life threats pose limited critical thinking challenges
      c) Patients who fall on the acuity spectrum between minor and life threatening pose the greatest critical thinking challenge

B. Thinking under pressure
   1. Hormonal influence i.e. "fight or flight" response impacts EMT-IV decision making both positively and negatively
      a) Enhanced visual and auditory acuity
      b) Improved reflexes and muscle strength
      c) Impaired critical thinking skills
      d) Diminished concentration and assessment ability

2. Mental conditioning is the key to effective performance under pressure
    a) Skills learned at a pseudo-instinctive performance level
    b) Automatic response for technical treatment requirements

C. Mental checklist for thinking under pressure
    1. Stop and think
    2. Scan the situation
    3. Decide and act
    4. Maintain clear, concise control
    5. Regularly and continually reevaluate the patient

D. Facilitating behaviors
    1. Stay calm, don't panic
    2. Assume and plan for the worst; err on the side of the patient
    3. Maintain a systematic assessment pattern
    4. Balance analysis, data processing and decision-making styles
        a) Situation analysis styles: reflective vs. Impulsive
        b) Data processing styles: divergent vs. Convergent
        c) Decision making styles: anticipatory vs. Reactive

E. Situation awareness
    1. Reading the scene
    2. Reading the patient

F. Putting it all together - "The Six R's"
    1. Read the patient
        a) Observe the patient
            (1) Level of responsiveness/consciousness
            (2) Skin color
            (3) Position and location of patient - obvious deformity or asymmetry
        b) Talk to the patient
            (1) Determine the chief complaint
            (2) New problem or worsening of preexisting condition?
        c) Touch the patient
            (1) Skin temperature and moisture
            (2) Pulse rate, strength, and regularity
        d) Auscultate the patient
            (1) Identify problems with the lower airway
        e) Status of ABC's-identifying life threats
        f) Complete and accurate set of vital signs
            (1) Use as triage tool to estimate severity
            (2) Can assist in identifying the majority of life-threatening conditions
            (3) Influenced by patient age, underlying physical and medical conditions, and current medications
    2. Read the scene
        a) General environmental conditions
        b) Evaluate immediate surroundings
        c) Mechanism of injury

3. React
    a) Address life threats in the order they are found
    b) Determine the most common and statistically probable that fits the patient's initial presentation
    c) Consider the most serious condition that fits the patient's initial presentation
    d) If a clear medical problem is elusive, treat based on presenting signs and symptoms
4. Reevaluate
    a) Focused and detailed assessment
    b) Response to initial management/interventions
    c) Discovery of less obvious problems
5. Revise management plan
6. Review performance at run critique

NOTES:

Lesson 2: Overview of Human Systems

LESSON TERMINAL INSTRUCTIONAL OBJECTIVE
At the end of this lesson the EMT-IV student will be able to explain how the anatomy and physiology of each body system relates and provides the foundation for the clinical practice of out of hospital emergency medicine.

Objectives

Cognitive Objectives
At the completion of this lesson, the EMT-IV student will be able to:

Organization and General Plan of the Body

1. Define homeostasis and use an example to explain.

The Integumentary System

2. Name the two major layers of the skin and the tissue of which each is made.
3. Describe how the arterioles in the dermis respond to heat, cold, and stress.
4. Name the tissues that make up the subcutaneous tissue and describe their functions.

The Nervous System

5. Explain how the sympathetic division of the autonomic nervous system enables the body to adapt to a stress situation.
6. Explain how the parasympathetic division of the autonomic nervous system promotes normal body functioning in relaxed situations.

The Senses

7. Explain referred pain and its importance.
8. Explain the importance of baroreceptor.

Blood

9. Describe the composition and explain the functions of blood plasma.
10. State the function of red blood cells, including the protein and the mineral involved.
11. State what platelets are and explain how they are involved in hemostasis.

The Heart

12. Describe the cardiac cycle.
13. Explain stroke volume, cardiac output.

The Vascular System

14. Describe the structure of arteries and veins and relate their structure to function.
15. Describe the structure of capillaries and explain the exchange processes that take place in capillaries.
16. Describe the pathway and purpose of pulmonary circulation.
17. Name the major systemic veins, and the parts of the body they drain of blood.
18. Define blood pressure.
19. Explain how the heart and kidneys are involved in the regulation of blood pressure.

The Respiratory System

20. State the general function of the respiratory system.

21. Describe the structure of the alveoli and pulmonary capillaries and explain the importance of surfactant.
22. Name and describe the important air pressures involved in breathing.
23. Describe normal inhalation and exhalation and forced exhalation.
24. Explain the diffusion of gases in external respiration and internal respiration.

Anatomy and Physiology - Focused on IV therapy

Tissues

A. Epithelial tissue and glands
B. Connective tissue
    1. Blood
        a)Plasma
        b) Blood cells
            (1) Red blood cells
            (2) White blood cells
            (3) Platelet
    2. Cardiac muscles
        a)Involuntary muscle

Integumentary system

A. The epidermis

B. The dermis
    1. Receptors
    2. Glands
    3. Blood vessels

C. Subcutaneous tissue

D. Nervous system
    1. Afferent impulses
    2. Efferent impulses
    3. Divisions of the spinal cord
        a) Cervical
        b) Thoracic
        c) Lumbar
    4. Level of injury or disease of spinal cord
        a. More serious the closer to the brain stem they occur
        b. Dynamics of neurogenic shock
    5. Nerve root control
        a. Cervical (shoulder girdle C5)
        b. Thoracic
            (1) Sensation at nipple level (T4)
            (2) Sensation at the umbilicus level (T10)
        c. Lumbar
        d. Sacral

The peripheral nervous system

A. Peripheral Nerves
   a. Categories
      (1) Somatic sensory
         (a) Pain
         (b) Temperature
         (c) Touch
         (d) Pressure
         (e) Position or muscle sense
      (2) Somatic motor
      (3) Visceral sensory - from glands and structures composed of somatic or cardiac muscle
      (4) Visceral motor
   b. Brachial plexus
      (1) collection of nerves at the posterior triangle of the neck
      (2) May be injured at birth, or in injuries causing permanent disability
      (3) Major nerves

The autonomic nervous system

1. Function - beyond conscious control
2. Division and effects of each
   a) Sympathetic division
      (1) More widespread effects
      (2) Stimulation causes increased heart rate, increased BP, rise in blood sugar, bronchodilation
      (3) "Fight or flight"
   b) Parasympathetic division
      (1) Effects more apparent in quiet state
      (2) Body conservation processes, i.e., digestion and storage of materials for well-being
      (3) Complementary effects

Blood

A. Characteristics of blood
   1. Amount
   2. Color
B. Plasma
C. Blood cells
   1. Red blood cells
      a) Function
      b) Production and maturation
      c) Blood types
   2. White blood cells
      a) Functions
   3. Platelet
      a) Function
4. Blood clotting

The heart

A. Chambers, vessels, and valves
   1. Right atrium
      a) Vena cava

i. Superior vena cava
ii. Inferior vena cava
b) Tricuspid valve

2. Left atrium
   a) Pulmonary veins
   b) Mitral valves/bicuspid
3. Right ventricle
   a) Pulmonary artery
   b) Pulmonary semilunar valve
4. Left ventricle
   a) Aorta
   b) Aortic semilunar valve
5. Coronary vessels

B. The cardiac cycle
1. Systole
2. Diastole

C. Cardiac output
1. Heart rate
   a) Baroreceptor - sensory nerve endings that adjust blood pressure as a result of vasodilation or vasoconstriction
2. Stroke volume
   a) The amount of blood pumped into the cardiovascular system as a result of one contraction

The vascular system

A. Layers of blood vessels
1. Tunica intima/endothelium
2. Tunica media
3. Tunica externa

B. Arteries

C. Veins
1. Valves

D. Capillaries

E. Exchange in the capillaries
1. Gas exchange
2. Fluid exchange

F. Blood pressure

Respiratory system

A. The mechanics of breathing
1. Inhalation
2. Exhalation

B. Exchange of gases
1. Diffusion of gasses

C. Transportation of gases in the blood

D. Pulmonary volumes
    1. Tidal volume
    2. Minute respiratory volume
    3. Inspiratory reserve
    4. Expiratory reserve
    5. Vital capacity
    6. Residual air

E. Regulation of respiration
    1. Nervous control
    2. Chemical control

NOTES:

Lesson 3: Assessment and Management of Shock

LESSON TERMINAL INSTRUCTIONAL OBJECTIVE

At the end of this lesson, the EMT-IV student will be able to utilize the assessment findings to formulate a field impression and implement the treatment plan for the bleeding patient or the patient in shock.

Objectives

Cognitive Objectives

At the conclusion of this lesson, the EMT-IV student will be able to:

GENERAL

1. Describe the epidemiology, including the morbidity/mortality and prevention strategies, for shock and hemorrhage.
2. Discuss the anatomy and physiology of the cardiovascular system.
3. Predict shock and hemorrhage based on mechanism of injury.
4. Discuss the various types and degrees of shock and hemorrhage.
5. Emphasize that placing an IV should not delay transport of the patient.

PATHOPHYSIOLOGY, ASSESSMENT AND MANAGEMENT - Cardiovascular System

6. Discuss the pathophysiology of hemorrhage and shock.
7. Discuss the assessment findings associated with hemorrhage and shock.
8. Identify the need for intervention and transport of the patient with hemorrhage or shock.
9. Discuss the treatment plan and management of hemorrhage and shock.

SPECIFIC PATHOPHYSIOLOGY, ASSESSMENT AND MANAGEMENT - Hemorrhage

10. Describe the incidence, morbidity, and mortality of hemorrhage.
11. Discuss the management of external hemorrhage.
12. Differentiate between the administration rate and amount of IV fluid in a patient with controlled versus uncontrolled hemorrhage.
13. Relate internal hemorrhage to the pathophysiology of compensated and uncompensated hemorrhagic shock.
14. Relate internal hemorrhage to the assessment findings of compensated and uncompensated hemorrhagic shock.
15. Discuss the management of internal hemorrhage.

SPECIFIC PATHOPHYSIOLOGY, ASSESSMENT AND MANAGEMENT - Shock

16. Describe the incidence, morbidity, and mortality of shock.
17. Describe the body's physiologic response to changes in perfusion.
18. Discuss the assessment findings of hemorrhagic shock.
19. Relate pulse pressure changes to perfusion status.
20. Relate orthostatic vital sign changes to perfusion status.
21. Define compensated and uncompensated hemorrhagic shock.
22. Discuss the pathophysiological changes associated with compensated shock.
23. Discuss the assessment findings associated with compensated shock.
24. Identify the need for intervention and transport of the patient with compensated shock.
25. Discuss the treatment plan and management of compensated shock.
26. Discuss the pathophysiological changes associated with uncompensated shock.
27. Discuss the assessment findings associated with uncompensated shock.
28. Identify the need for intervention and transport of the patient with uncompensated shock.

29. Discuss the treatment plan and management of uncompensated shock.
30. Differentiate between compensated and uncompensated shock.
31. Relate external hemorrhage to the pathophysiology of compensated and uncompensated hemorrhagic shock.
32. Relate external hemorrhage to the assessment findings of compensated and uncompensated hemorrhagic shock.
33. Differentiate between the administration of fluid in the normotensive, hypotensive, and profoundly hypotensive patient.

INTEGRATION

34. Apply epidemiology to develop prevention strategies for hemorrhage and shock.
35. Integrate the pathophysiological principles to the assessment of a patient with hemorrhage or shock.
36. Synthesize assessment findings and patient history information to form a field impression for the patient with hemorrhage or shock.
37. Develop, execute and evaluate a treatment plan based on the field impression for the hemorrhage or shock patient.

Psychomotor Objectives

38. Demonstrate the assessment of a patient with signs and symptoms of hemorrhagic shock.
39. Demonstrate the management of a patient with signs and symptoms of hemorrhagic shock.
40. Demonstrate the assessment of a patient with signs and symptoms of compensated hemorrhagic shock.
41. Demonstrate the management of a patient with signs and symptoms of compensated hemorrhagic shock.
42. Demonstrate the assessment of a patient with signs and symptoms of uncompensated hemorrhagic shock.
43. Demonstrate the management of a patient with signs and symptoms of uncompensated hemorrhagic shock.
44. Demonstrate the assessment of a patient with signs and symptoms of external hemorrhage.
45. Demonstrate the management of a patient with signs and symptoms of external hemorrhage.
46. Demonstrate the assessment of a patient with signs and symptoms of internal hemorrhage.
47. Demonstrate the management of a patient with signs and symptoms of internal hemorrhage.
48. Presentation

Pathophysiology, Assessment, and Management of Hemorrhage

A. Hemorrhage
    1. Epidemiology
        a) Incidence
        b) Mortality/morbidity
        c) Prevention strategies
    2. Pathophysiology
        a) Location
            (1) External
            (2) Internal
                (a) Trauma
                (b) Non-trauma

(i) Common sites
(ii) Uncommon sites

b) Anatomical type
(1) Arterial
(2) Venous
(3) Capillary

c) Timing
(1) Acute
(2) Chronic

d) Severity
(1) Amounts of blood loss adults, children and infants can tolerate

e) Physiological response to hemorrhage
(1) Clotting
(2) Localized vasoconstriction

f) Stages of hemorrhage
(1) Stage 1
(a) Up to 15% intravascular loss
(b) Compensated by constriction of vascular bed
(c) Blood pressure maintained
(d) Normal pulse pressure, respiratory rate, and renal output
(e) Pallor of the skin
(f) Central venous pressure low to normal

(2) Stage 2
(a) 15-25% intravascular loss
(b) Cardiac output cannot be maintained by arteriolar constriction
(c) Reflex tachycardia
(d) Increased respiratory rate
(e) Blood pressure maintained
(f) Catecholamines increase peripheral resistance
(g) Increased diastolic pressure
(h) Narrow pulse pressure
(i) Diaphoresis from sympathetic stimulation
(j) Renal output almost normal

(3) Stage 3
(a) 25-35% intravascular loss
(b) Classic signs of hypovolemic shock
(i) Marked tachycardia
(ii) Marked tachypnea
(iii) Decreased systolic pressure
(iv) 5-15 ml per hour urine output
(v) Alteration in mental status
(vi) Diaphoresis with cool, pale skin

(4) Stage 4
(a) Loss greater than 35%
(b) Extreme tachycardia
(c) Pronounced tachypnea

(d) Significantly decreased systolic blood pressure
(e) Confusion and lethargy
(f) Skin is diaphoretic, cool, and extremely pale

3. Assessment
   a) Bright red blood from wound, mouth, rectum or another orifice
   b) Coffee ground appearance of vomitus
   c) Melena and hematochezia
   d) Dizziness or syncope on sitting or standing
   e) Orthostatic hypotension
   f) Signs and symptoms of hypovolemic shock
4. Management
   a) Airway and ventilatory support
   b) Circulatory support
      (1) Bleeding from nose or ears after head trauma
         (a) Refrain from applying pressure
         (b) Apply loose sterile dressing to protect from infection
      (2) Bleeding from other areas
         (a) Control bleeding
            (i) Direct pressure
            (ii) Tourniquet
            - Recognize characteristics of MAJOR bleeding and the need to possibly apply a tourniquet as a first intervention in some cases.
            (iii) Packing of large gaping wounds with sterile dressings
            (iv) Splinting
         (b) Apply sterile dressing and pressure bandage
         (c) Transport considerations
         (d) Psychological support / communication strategies

Shock

A. Epidemiology
   1. Mortality/morbidity
   2. Prevention strategies
   3. Pathophysiology
      a) Stages of shock
         (1) Compensated or nonprogressive
            (a) Characterized by signs and symptoms of early shock
            (b) Arterial blood pressure is normal or high
            (c) Treatment at this stage will typically result in recovery
         (2) Decompensated or progressive
            (a) Characterized by signs and symptoms of late shock
            (b) Arterial blood pressure is abnormally low
            (c) Treatment at this stage will sometimes result in recovery
         (3) Irreversible
            (a) Characterized by signs and symptoms of late shock
            (b) Arterial blood pressure is abnormally low
            (c) Even aggressive treatment at this stage does not result in recovery

b) Etiologic classifications
(1) Hypovolemic
(a) Hemorrhage
(b) Plasma loss
(c) Fluid and electrolyte loss
(d) Endocrine
(2) Distributive (Vasogenic)
(a) Increased venous capacitance
(b) Low resistance, vasodilatation
(3) Cardiogenic
(a) Myocardial insufficiency
(b) Filling or outflow obstruction (obstructive)

4. Assessment - Hypovolemic shock due to hemorrhage
a) Early or Compensated Shock
(1) Tachycardia
(2) Pale, cool skin
(3) Diaphoresis
(4) Level of consciousness
(a) Normal
(b) Anxious or apprehensive
(5) Blood pressure maintained
(6) Narrow pulse pressure
(a) Pulse pressure is the difference between the systolic and diastolic pressures, i.e., Pulse pressure = systolic - diastolic
(b) Pulse pressure reflects the tone of the arterial system and is more sensitive to changes in perfusion than the systolic or diastolic alone
(7) Orthostatic hypotension
(8) Dry mucosa
(9) Complaints of thirst
(10) Weakness
(11) Possible delay of capillary refill
b) Late or Progressive Shock
(1) Extreme tachycardia
(2) Extremely pale, cool skin
(3) Diaphoresis
(4) Significant decrease in level of consciousness
(5) Hypotension
(6) Dry mucosa
(7) Nausea
(8) Cyanosis with white waxy looking skin

5. Differential shock assessment findings
a) Shock is assumed to be hypovolemic until proven otherwise
b) Cardiogenic shock is differentiated from hypovolemic shock by one or more of following
(1) Chief complaint, e.g., Chest pain, dyspnea, tachycardia
(2) Heart rate, i.e., Bradycardia or excessive tachycardia
(3) Signs of congestive heart failure, i.e., Jugular vein distention (JVD), rales
(4) Dysrhythmias

c) Obstructive shock (filling or outflow obstruction) is differentiated from hypovolemic shock by presence of signs and symptoms suggestive of
(1) Cardiac tamponade
(2) Tension pneumothorax
(3) Pulmonary Embolism

d) Distributive shock (Vasogenic) is differentiated from hypovolemic shock by presence of one or more of following
(1) Mechanism that suggests vasodilatation, e.g., Spinal cord injury, drug overdose, sepsis, anaphylaxis
(2) Warm, flushed skin, especially in dependent areas – and possibly normal to "Shocky" skin findings in areas not affected by the spinal cord injury.
(3) Lack of tachycardia response (not reliable, though, since significant number of hypovolemic patients never become tachycardic)

B. Management/Treatment Plan

1. Airway and ventilatory support
   a) Ventilate and suction as necessary
   b) Administer high concentration oxygen
2. Circulatory support
   a) Hemorrhage control
   b) Intravenous volume expanders
      (1) Types
         (a) Isotonic solutions
      (2) Rate of administration
         (a) External hemorrhage that can be controlled
         (b) External hemorrhage that cannot be controlled
         (c) Internal hemorrhage
            (i) Blunt trauma
            (ii) Penetrating trauma
3. Fluid Replacement.
   a) Hypovolemic shock
      (1) Volume expanders
   b) Cardiogenic shock
      (1) Volume expanders
   c) Distributive (vasogenic) shock
      (1) Volume expanders
   d) Obstructive shock (filling or outflow obstruction)
      (1) Volume expanders
4. Psychological support/Communication strategies
5. Transport considerations
   a) Indications for rapid transport
   b) Indications for transport to a Trauma Center

NOTES:

Lesson 4: Intravenous & Intraosseous Line Placement and Infusion

Objectives

Cognitive Objectives

At the end of this lesson, the student will be able to:

1. Define the term intravenous cannulation.
2. Describe universal precautions and body substance isolation (BSI) procedures when performing an intravenous cannulation.
3. Discuss medical asepsis.
4. Differentiate among the different solutions and intravenous cannulation devices used when administering intravenous cannulations for the management of trauma and medical emergencies.
5. Identify anatomic landmarks utilized in administering intravenous cannulations.
6. Correctly locate three appropriate sites for intraosseous needle insertion.
7. Describe the equipment needed, indications, contraindications, complications, and procedures for the preparation and administration of intravenous cannulations, including saline locks.
8. Identify the equipment needed and procedures used for discontinuing an intravenous cannulation.
9. Describe the procedures, the preparation and administration of a fluid challenge.
10. Describe on-line and off-line medical direction/control for intravenous cannulation.
11. State the indications and contraindications for insertion of an intraosseous line.
12. List the necessary equipment for an intraosseous insertion.
13. Describe the steps required for intraosseous needle insertion and confirmation of correct placement.
14. Describe the process of securing the intraosseous needle.
15. Compare the rate of fluid infusion through a peripheral line versus an intraosseous line, and describe methods of increasing the rate of infusion through an intraosseous line.
16. Describe the concept of fluid limitation in patients under 100 pounds.
17. State the potential complications of intraosseous needle insertion and infusion.
18. Differentiate among the different techniques for obtaining a blood sample.
19. Identify locations utilized in obtaining a blood sample.
20. Describe the equipment needed, techniques utilized, complications, and general principles for obtaining a blood sample.
21. Describe disposal of contaminated items and sharps.

Affective Objectives

22. Comply with universal precautions and body substance isolation (BSI).
23. Serve as a model for disposing contaminated items and sharps.

Psychomotor Objectives

24. Perform universal precautions and body substance isolation (BSI) procedures.
25. Perfect clean technique during intravenous cannulation, blood draws and glucose monitoring.
26. Demonstrate preparation and techniques for performing an intravenous cannulation.
27. Demonstrate the procedures, the preparation and administration of a fluid challenge.
28. Demonstrate preparation and techniques for performing an intraosseous needle insertion and confirmation of correct placement.
29. Locate sites utilized in obtaining a blood sample.
30. Demonstrate preparation and techniques for obtaining a blood sample.

31. Perfect disposal of contaminated items and sharps.

Intravenous Cannulation

A. Definition:
   1. The placement of a catheter into a vein. It is used to administer fluids, or medications directly into the circulatory system. It can also be used to obtain venous blood specimens for laboratory determinations.
   2. Because IV fluids are drugs, on-line medical direction/control or standing orders are required for the EMT-IV to administer IV fluids.

B. Indications
   1. Replacement of circulatory volume
   2. To establish a medication administration route

C. Contraindications - Cannulation of a particular site is contraindicated in:
   1. Sclerotic veins
   2. Burned extremities

D. Universal Precautions and Body Substance Isolation (BSI) in Medication Administration

E. Equipment
   1. Intravenous (IV) solutions
      a) Types of solutions
         (1) Crystalloids
         (2) Colloids - Informational only - not for field use
      b) Types of containers
      c) Variety of volumes
   2. Intravenous (IV) administration sets
      a) Components
         (1) Piercing spike
         (2) Drip Chamber
            (a) Macrodrip chamber-type
            (b) Microdrip chamber-type
      b) Flow clamp
      c) Drug administration port
      d) Connector end
      e) Variety of extensions and other pieces of equipment
   f) Some IV administration sets are manufacturer specific – aren't they all? What does this mean?
   3. Needles/Catheters
      a) Types
         (1) Over the needle
      b) IV catheter size
   4. Supplies and materials
      a) Personal protective equipment to maintain BSI
      b) Tourniquet
      c) Chlorhexidine /Alcohol/povidone/iodine:
      d) Sterile dressings
      e) Tape
      f) Arm boards – if necessary
      g) Vacutainer holder and assorted blood collection tubes for blood samples – protocol/area dependent.

F. Sites for peripheral venous cannulation
   1. Structure of veins
   2. Difference between arteries and veins
   3. The skin
      a) Epidermis
      b) Dermis
   4. Sites used in non-critical, routine situations:
      a) Distal veins on the dorsum of the hand and arms
      b) If available, the EMT-IV should use a vein that is:
         (1) Fairly straight
         (2) Easily accessible
         (3) Well-fixed, not rolling
         (4) Feels springy when palpated
      c) Avoid
         (1) Sclerotic veins
         (2) Veins near joints
         (3) Areas where an arterial pulse is palpable close to the vein
         (4) Injured or swollen extremities
   5. Other sites include peripheral leg veins

G. Procedure for performing IV cannulation - The EMT-IV must do the following:
   1. Explain the need for IV cannulation and describe the procedure to the patient.
   2. Ask if the patient has any allergies (especially to iodine if using iodine pads to cleanse the skin).
   3. Select IV solution to be used and check to make sure it is:
      a) The proper solution
      b) Clean, without particulate matter
      c) Not outdated
      d) Not leaking
      e) Warmed or cooled as indicated
   4. Select an appropriate size catheter:
      a) 14 to 16 gauge for trauma, volume replacement, or cardiac arrest
      b) 18 to 20 gauge for medical conditions
      c) 22 to 24 gauge for pediatrics and geriatrics
   5. Select the proper administration set:
      a) Macro for trauma
      b) Micro for medical conditions and drug administration
   6. Prepare the IV bag and administration set using an aseptic technique to prevent contamination.
      a) Remove IV bag from its protective envelope and gently squeeze to detect any punctures or leakage.
      b) Steady the port of the IV bag with one hand and remove the protective cap by pulling smoothly.
      c) Remove the administration set from its protective wrapping or box
      d) Slide the flow control valve close to the drip chamber.
      e) Close off the flow control valve.
      f) Remove the protective cap from the spiked piercing end of the administration set.
      g) Invert the IV bag.

h) Using sterile technique, insert the spiked end of the administration set into the tubing insertion port of the IV bag. Use one quick, smooth motion. Careful not to side-puncture the insertion port.
i) Turn the IV bag right side up and squeeze the drip chamber two or three times to fill it half-way.
j) Open the control valve to flush IV solution through the entire tubing, which should force out all the air.

7. Cut or tear several pieces of tape of different lengths.
8. Employ Standard Precautions
9. Talk to the patient, let them know what you are doing and what to expect.
10. Make sure you are using the correct IV solution, correct gauge needle, and the correct location.
11. If possible, place the patient into a suitable position with the selected extremity lower than the heart. This positioning helps distend the distal veins.
12. Apply a tourniquet.
    a) Many elderly patients and patients on prednisone have very delicate skin. Use caution when applying and removing the tourniquet.
13. Select a suitable vein by palpation and sight.
    a) Avoid areas of the veins where a valve is situated.
    b) Avoid using Fistulas, shunts or graphs. Keep in mind, that these may be used at last resort...
    c) Standard practice is to look at distal (hand) veins first and work your way up the arm. If you are using a hand vein, place the tourniquet near the hand.
    d) If the vein rolls, or feels hard or rope-like, select another vein.
    e) Veins can be distended for easier cannulation by:
        (1) Having the patient open and close their fist tightly five or six times.
        (2) Flicking the skin over the vein with one or two sharp snaps of the fingers.
        (3) Rubbing or stroking the skin upward toward the tourniquet.
    f) If a suitable vein cannot be found, or if the vein still feels small and uniform, release the tourniquet and apply it closer to the IV site.
    g) IF you are not seeing a vein that you are confident you can cannulate, don't hesitate to look at the other arm.
14. Stabilize the vein by anchoring it with the thumb and stretching the skin downward.
15. Perform the venipuncture without contaminating the equipment or site.
    a) Tell the patient there will be a small poke or pinch as the needle enters the skin.
    b) Hold the end of the venipuncture device between thumb and the index/middle fingers:
        (1) Maintain visualization of the flashback chamber.
        (2) Avoid touching any portion of the catheter, because a contaminated device is not usable.
    c) Depending on the type of venipuncture device and manufacturer recommendations, hold the needle at a 15, 30- or 45-degree angle to the skin.
    d) Penetrate the skin with the bevel of the needle pointed up.
        (1) If significant resistance is felt, do not force the catheter.
        (2) Instead, withdraw the needle and catheter together as a unit.
    e) If possible, penetrate the vein at its junction or bifurcation with another vein, because it is more stable at this location.
    f) Enter the vein with the needle from either the top or side.
        (1) Normally, a slight "pop" or "give" is felt as the needle passes through the wall of the vein.

(2) Be careful not to enter too fast or too deeply, because the needle can go through the back wall of the vein.

g) Note when blood fills the flashback chamber.

h) Lower the venipuncture device and advance it another 1 to 2 mm until the tip of the catheter is well within the vein.

i) Advance the catheter into the vein following the manufacturer's recommendations.

j) Once the catheter is within the vein, apply pressure to the vein beyond the catheter tip with a finger to prevent blood from leaking out of the catheter hub once the needle is completely withdrawn.

a. If using a valved catheter – pushing on the vein to prevent bleeding from the hub may be unnecessary.

k) It may be necessary to use the drawback technique to determine patency.

16. If necessary or directed by protocol you may need to draw a blood sample. The tourniquet should be left in place while drawing blood samples.

a) Stabilize the catheter with one hand and attach a Vacutainer holder with a multi-sample IV Luer-lock adapter or a syringe to the hub.

(1) Be careful not to disrupt the catheter placement while connecting the Vacutainer or syringe.

(2) Once the device is connected, release the finger pressure at the distal tip of the catheter

b) If using a Vacutainer device, insert the blood collection tube fully into the holder and allow its internal vacuum to draw blood out of the vein.

c) If using a syringe, slowly withdraw the plunger to fill the syringe with blood.

(1) If blood flow into the syringe stops, it usually means that the sucking pressure of the syringe is collapsing the vein.

a. Also, pulling back to forcefully may cause cellular lysis and negate the benefit of collecting the sample to begin with.

(2) To correct this problem, slow the rate at which the plunger is being withdrawn.

17. Once enough blood collection tubes have been filled or the syringe is completely full, release the tourniquet from the patient's arm.

a) Next reapply pressure to the vein beyond the catheter tip with a finger to prevent blood from leaking out of the catheter hub once the blood drawing device is disconnected.

a) At this step, regardless of using a valved hub, or not – you will need to apply pressure to the vein just beyond the catheter tip.

b) Disconnect the syringe or Vacutainer device from the hub of the catheter by holding the hub between the first finger and thumb and pulling the device free with the other hand.

18. Connect the IV tubing to the catheter hub. Be careful not to contaminate either the hub or connector prior to insertion.
19. Open the IV flow control valve and run the IV for a brief period of time to ensure the line is patent. To ensure proper IV flow rates, the IV fluid container must hang at least 30 to 36 inches above the insertion site.
20. Cover the IV site with a sterile dressing or a bandage – preferably one that is transparent.
21. Secure the catheter, administration set tubing, and sterile dressing in place with tape.

a) Tubing should be looped and secured with tape above the IV cannulation site.

b) This gives the tubing more play, making the catheter less likely to be dislodged by accidental pulls on the tubing.

c) Do not make the loop so small that it kinks the tubing and restricts fluid flow.

22. Adjust the appropriate flow rate for the patient's condition.
23. Dispose of the needle(s) in a proper biomedical waste container.

24. If a syringe was used to draw the blood:
    a) The necessary blood collection tubes must be filled by attaching needle to the syringe and inserting it into each blood tube.
    b) The tubes should then be labeled and stored in a safe location.

H. Using an armboard.
Armboards may be:
1. Avoided simply by choosing a venipuncture site well away from any flexion areas.
2. Necessary when a venipuncture device is inserted near a joint or in the dorsum of the hand
3. Used along with restraints in confused or disoriented patients.
4. Useful with pediatric patients.

I. Regulating fluid flow rates
1. Flow rates should be adjusted as ordered by medical control/direction and local protocol.
2. Fluid resuscitation guidelines should be 20ml/kg boluses for adults, children, and infants. Newborns or neonates should be 10ml/kg boluses. Targets for treatment are return of distal pulses, not to exceed minimum systolic blood pressure ranges, appropriate for age.
3. The EMT-IV must know the volume to be infused, the period of time over which the fluid is to be infused, and the number of drops per milliliter the infusion set delivers.
    a) The following formula can be used to calculate IV solution drip rates per minute
    b) Drops per min. = volume to be infused x drops/ml of administration set, divided by total time of infusion in minutes.
4. After determining the rate, open the clamp slowly to start fluid dripping into the drip chamber.
    a) Determine drops per minute and adjust the flow clamp as needed to obtain the correct drip rate.
    b) Check the flow rate periodically.
5. Various types of infusion pumps

J. Documenting IV cannulation
1. Depending on local protocol, when an IV is started, the following must be documented on the run report:
    a) Date and time of the venipuncture
    b) Type and amount of solution
    c) Type of venipuncture device used, including the length and gauge
    d) Venipuncture site
    e) Number of insertion attempts (if more than one)
    f) IV flow rate
    g) Any adverse reactions and the actions taken to correct them
    h) Name or identification number of the EMT-IV initiating the infusion
2. In addition to documenting correct IV placement, unsuccessful attempts also should be documented
3. Follow local protocol regarding any additional documentation requirements.

K. When the IV does not flow
1. Was the venous tourniquet removed?
2. Is there swelling at the cannulation site?
3. Is the flow regulator or clamp in an open position?
4. Is the tip of the catheter positioned against a valve or wall of the vein?

5. Is the IV bag high enough?
6. Is the drip chamber completely filled with IV solution?

L. Complications
1. Pain
2. Catheter shear
3. Cannulation of an artery
4. Hematoma or infiltration
5. Phlebitis or infection
6. Extravasation
7. Air in tubing/air embolism
8. Circulatory overload and pulmonary edema
9. Allergic reaction
10. Pulmonary embolism
11. Failure to infuse properly

M. Steps in changing to the next container of IV solution

N. Steps to discontinue an intravenous infusion
1. Equipment
   a) Gloves
   b) Sterile gauze pad
   c) Adhesive bandage
2. Technique
   a) Close the flow control valve completely
   b) Taking care not to disturb the catheter, carefully remove all tape, and remove the dressing
   c) Hold the sterile gauze pad just above the site to stabilize the tissue and withdraw the catheter by pulling straight back until the catheter is completely out of the vein
   d) Immediately cover the site with the sterile gauze pad and hold it against the puncture site until the bleeding has stopped
   e) Tape the dressing in place or cover with an adhesive bandage

Drawing Blood

A. Purpose - to obtain blood samples from a patient for analysis

B. Equipment needed for obtaining a blood sample:
1. Variety of sizes and types of blood tubes are available to collect and store blood samples.
   a) The rubber caps on the tubes come in several colors and patterns denoting the specific tests that are conducted with the blood that is stored in them
   b) Most commonly used in the field are the red, purple, green, or “jungle” blue, and gray tops
      (1) Blood collection tubes may vary by manufacturer.
      (2) Check with your local medical facility.
   c) Some tubes have small amounts of liquids or agents inside the tube to prevent blood coagulation or to aid in preserving the blood in a way necessary for a particular type of test
   d) During manufacture of blood tubes, a vacuum is created in the tube that acts to “suck blood” into the tube

C. Locations from which to obtain a blood sample
   1. Anatomical sites
   2. From the established intravenous catheter
   3. Other locations

D. Steps to preparing equipment for obtaining a blood sample

E. Techniques for obtaining a blood sample
   1. When drawing blood, each tube should be filled completely
   2. Blood samples should be acquired prior to flushing line or administrating fluid to prevent diluting sample.
   3. Blood should be withdrawn from IV angio-catheters sized 20 gauge or larger using a Leur-lock syringe or vacutainer device (it may be necessary to use a smaller gauge angio-catheter in pediatric patients).
   4. Transfer blood into collection tubes using a needle free device or vacutainer blood transfer device
   5. Transfer blood into collection tubes using a needle free device or vacutainer blood transfer device
      a) Once the blood is obtained, the outside of the tube should be labeled with the patient's name, date, time drawn and by whom
      b) In addition, any information that may be useful, such as, "drawn before the administration of 50% dextrose"
      c) During the transportation of the patient to the hospital, the filled blood collection tubes should be stored in an appropriate bag to prevent contamination from accidental breakage.

F. Complications

G. Refer to the local Medical Program Director protocols regarding the blood draw process and procedures for law enforcement blood draw requests.

Saline Intravenous Access Locks

A. Saline lock devices maintain intravenous access while avoiding the risk of inadvertent rapid-fluid administration and the inconvenience of manipulating IV tubing and fluid bags while moving and handling patients

B. Equipment
   1. Infusion adapter device
   2. Vial of normal saline for injection
   3. Syringe with needle
   4. Alcohol wipe

C. Candidates for saline locks:
   1. Patients who would have an IV placed to establish venous access prophylactically
   2. Patients who would have an IV placed to administer medication
   3. Patients who will need to have continued IV access AFTER a solution or medication has been fully administered.

D. Candidates for conventional IV therapy with appropriate solutions and administrations sets:
   1. Patients requiring volume resuscitation
   2. Patients requiring continuous drip infusion of medication. Patients with medications other than IV fluids are beyond the scope of EMT-IV Therapy providers.
   3. Patients requiring cardiac or other resuscitation with frequent medications in sequence

E. If, at any time, the patient's condition deteriorates and it is felt a conventional IV is necessary, it may be established by piggybacking into the injection port using a needle no larger than 18 Ga. due to possible injection port coring with larger sizes

F. Procedure

Fluid Challenge for Cardiogenic Shock

A. Following intravenous cannulation of normal saline at a KVO rate give a 250 to 500 cc fluid challenge if called for by medical direction/control or local protocols

Intraosseous Line Placement and Infusion.

A. The chief indications for intraosseous line insertion are:
   1. Compensated and Uncompensated Shock
      a) Shock is usually the result of:
         (1) Hypovolemia
         (2) Sepsis
         (3) Cardiac problems
      b) Children respond to shock by:
         (1) an increase in heart rate
         (2) an increase in respiratory rate
         (3) peripheral vasoconstriction
      c) Signs of compensated (early) shock are:
         (1) Tachycardia
         (2) Tachypnea
         (3) cool clammy extremities
      d) Note 1: The child's blood pressure does not decrease until later, when the child is no longer able to compensate by an increase in heart rate and vasoconstriction.
      e) Note 2: Major symptoms to indicate a need for intervention with IV/IO fluids would include:
         (1) "Quiet" tachycardia (rate over 170)
         (2) Altered level of consciousness
         (3) Decreased perfusion
      f) Signs of uncompensated shock are:
         (1) Decreased level of consciousness
         (2) Weak or absent pulses
         (3) Hypotension

   2. Cardiac Arrest:
      a) A protocol for obtaining vascular access is helpful in making a decision about the use of an intraosseous line when venous access cannot be obtained rapidly. An intraosseous line is usually attempted after other means of vascular access are unsuccessful or unavailable. Local protocols will dictate when IO access can/should be attempted.

(1) Peripheral intravenous access often requires more time to insert than an intraosseous line. A median time of 10 minutes is required to achieve peripheral vascular access during cardiac arrests; only 18% of these attempts are successful within 90 seconds.
(2) If peripheral access is not achieved within 90 seconds, attempts to insert an intraosseous line should be initiated.
(3) The intraosseous route delivers fluids and medications into the bone marrow cavity, which acts as a non-collapsible vein and permits access to the central circulation. Medications other than IV fluids are beyond the scope of EMT-IV Therapy providers.
(4) All fluids and medications that are administered through a peripheral IV can be administered through an intraosseous line. It is generally recommended that hypertonic and alkaline solutions be diluted prior to infusion.

B. Contraindications for insertion of an intraosseous line
1. An intraosseous line should not be inserted when there is a known fracture of the bone chosen for line placement.
2. An intraosseous line should not be inserted when there is infection present in the leg chosen for line placement.
3. Insertion of an intraosseous needle should not be attempted on the same leg two times, as the hole made by the attempted insertion does not close rapidly and fluid will extravasate.

C. Sites for Intraosseous Needle Insertion
1. There are four potential sites for intraosseous needle insertion:
i. Refer to local protocols to determine sites to be utilized for IO access.
a) Proximal Tibia
(1) The proximal tibia is the preferred location for intraosseous insertion in a child six years and under because:
(a) The site is easily identified.
(b) A large marrow cavity exists with no adjacent structures that are likely to be damaged.
(2) The site of insertion is on the flat medial surface of the anterior tibia, one to two finger breadths below and medial to the tibial tuberosity.
b) Distal Femur
(1) The site of insertion is midline, approximately three centimeters above the lateral condyle.
c) Distal Tibia
(1) The site of insertion is just above the medial malleolus.
d) Proximal Humerus
(1) The insertion site is the tuberosity at the proximal head of the humerus.

D. Equipment for Intraosseous Infusion
1. Needles:
a) Either an intraosseous or bone marrow aspiration needle may be used. Multiple commercial forms of IO needles are available, in either manual or power (drill) operated. It's essential that the EMT-IV knows what is available/allowed for the patient they might be treating, and how to effectively use that equipment.
(1) They may contain a trocar or stylet, which minimizes the risk of occlusion from bone marrow.

(2) They are shorter, sturdier and less flexible.
(3) They are less likely to be dislodged in transport because they are threaded and shorter.
(4) Some of these needles have side infusion ports within the threads so a stylet or trocar is not necessary.
(5) Some needle lengths can be adjusted.

b) A spinal needle can be substituted when an intraosseous or bone marrow needle is not available; however, it is less stable because of the needle's length and flexibility.

2. Other Equipment:
   a) Chlorhexidine or Iodine solution - for cleaning insertion site-
   b) Sterile towels and gloves - to maintain sterility during insertion
   c) 4x4 gauze pads - for cleaning and for use in applying pressure if needle is withdrawn
   d) Two 5 or 10 cc syringes - to aspirate bone marrow and to infuse saline
   e) IV solution (normal saline or lactated Ringer's solution) and administration tubing
   f) Towel/blanket, or rolls of gauze, or another small IV bag - for stabilizing leg during and after insertion of the intraosseous needle
   g) Blood tubes - for bone marrow aspirate
   h) Pressure infusion bag
   i) Volume limiting device

E. Four steps for intraosseous needle insertion
   1. Step one - Stabilize the extremity
      a) Position the leg with the knee slightly bent.
      b) Place a support of preference under the knee for support, and to prevent movement.
      c) Tape in place if necessary.
   2. Step two - Prepare the insertion site
      a) Clean the skin with iodine solution and 4x4 gauze pads.
      b) Wipe in a circular motion starting at the planned insertion site and moving outward.
      c) Wipe the area dry with a sterile 4x4 gauze pad.
   3. Step three - Insert the needle
      a) Check the needle packaging for additional instructions. Some needles require back and forth or a clockwise motion.
         (1) Use aseptic technique.
         (2) When using the tibial site, the needle should be directed slightly away from the knee in order to decrease the risk of insertion into the growth plate.
         (3) Apply pressure to the top of the needle in order to push through the cortex of bone.
         (4) A slight give will be felt as the tip enters the marrow cavity.
         (5) If the needle is properly inserted, it will stand without support.
      b) Caution: If too much pressure is applied, the needle may exit through the bone on the other side.
         (1) If this occurs:
            (a) Fluid will infiltrate into the tissue and Compartment syndrome may develop.
            (b) Remove the needle
            (c) A site on the other extremity must be chosen for the next insertion attempt.
   4. Step four - Confirm needle placement
      a) Remove the stylet from the needle.
      b) Connect a syringe to the hub of the needle.

c) Aspirate approximately I cc of bone marrow. Marrow may not always be aspirated.
d) Bone marrow aspirate can be used for various lab studies such as hemoglobin, electrolytes, bilirubin, glucose, creatinine and bicarbonate.
e) 5 - 10 cc of normal saline may be used to initially flush the syringe and intraosseous needle while observing for extravasation. This fluid should flush easily. If no extravasation occurs, placement is confirmed.
f) If the needle placement cannot be confirmed, remove the needle.
g) Do not attempt to re-insert the needle on the same site, as this will cause leakage of fluids from the insertion site into the surrounding tissue.
h) If the needle is removed, apply pressure for 5 minutes and cover the insertion site with a sterile dressing.

F. Securing the intraosseous needle
1. Connect the IV tubing to the hub of the correctly placed needle.
a) IV fluid should flow without obstruction when the needle is correctly positioned.
b) IF the IV fluid is not flowing and correct insertion cannot be verified, remove the intraosseous needle and attempt insertion at another location.
2. When correct insertion is confirmed, tape the tubing onto the patient's leg (or arm in the case of proximal humerus) to assist in preventing dislodgment.
3. Carefully monitor the insertion site for signs of infiltration.
a) Remove the needle if infiltration is observed.
b) The needle should not be left in place for over 12 hours.

G. Increasing the Rate of Infusion
1. The flow rate through the intraosseous needle may be a little slower than through a peripheral line. If fluids need to be administered rapidly, two methods may be used to increase the flow rate:
a) Pressure bag
(1) To increase the rate of fluid infusion, a pressure bag may be applied to the IV solution and inflated to 300 torr.
b) A syringe with a three-way stopcock directly attached to the IV line flowing to the intraosseous needle will allow administration of fluid boluses.
(1) Attach an empty 30 or 60 cc Luer-Lok™ syringe (with the plunger depressed) to the three-way stopcock.
(2) Close the stopcock valve allowing IV flow to the patient and open the valve from the IV bag to the syringe.
(3) Withdraw the plunger to fill the syringe with the desired amount of IV fluid from the IV bag.
(4) Close off the flow to the IV bag and open the valve allowing fluid to flow from the syringe to the patient.
(5) Depress the plunger of the syringe to administer the desired amount of IV fluid to the patient.
(6) Repeat steps (2)-(5) above as necessary until the full amount of fluid bolus has been administered.
(7) Reopen the valve to the patient so that the IV continues to flow; check flow rate.
(8) Reassess the patient to determine need for additional fluid, repeating steps (2)-(6) above, if appropriate.

2. Carefully monitor the amount of fluid administered to the pediatric patient to prevent fluid overload. The use of small volume IV bags (i.e., 250-500 cc bags) may be helpful in this monitoring process.
3. A child in shock may require several 20 cc/kg boluses of fluid. Frequent reassessments are necessary.

H. Potential Complications
   1. Potential complications from intraosseous insertion and infusion include:
      a) Extravasation of fluid:
         (1) This is generally the result of improper needle placement or multiple insertion attempts.
         (2) Collection of fluid in the tissue can lead to compartment syndrome.
      b) Skin infection:
         (1) The infection rate for intraosseous is lower than that found with intravenous cannulation.
         (2) Osteomyelitis (very rare).
   2. Overall, complications from intraosseous insertion and infusion are rare.

Disposal of Contaminated Items and Sharps

Follow local protocol for disposition of contaminated items and sharps

APPENDICES

Appendix A - EMT-Intravenous Therapy Special Skill Estimated Course Hours

Lesson Topic	Didactic	Practical Lab / Evalutation
Section 1 - Essentials		
Lesson 1: Patient Assessmen and Clincal Decision Making	9	3
Lesson 2: Human Systems	8	1
Lesson 3: Assessment and Management of Shock	4	1
Lesson 4: Intravenous & Intraosseous Line Placement and Infusion	7	3
Estimated Totals for Didactic, Practical Lab, and Evaluation Hours - 36	28	8
End of Course Evaluations / Examinations – See Appendix B		
Practical skill evaluations during the course and individual comphrensive end of course practical skill evaluations as identified in the appendices	-	Approx 3
End of course knowledge examination approved by the county medical director following course completion	-	Approx 2
Clinial / Field Internships – See Appendix B	Clinical	Field
Clinical Internship requirements Note: It is recommentded tat some IV insertions are accomplished during the field internship. Hours may vary. Competency for all skills is determined by the county medical program director.	Varies	Varies
Field internship requirements Note: Hours may vary, compentence determined by the county medical program director.	Varies	Varies
Total estimated didactic, practical lab, and evaluation hours - 42	Didactic Only 28	Practical Lab / Eval 14

Appendix B – Approved EMT-IV Practical Evaluation Guidelines and Clinical / Field Requirements

PRACTICAL SKILL EVALUATIONS

The practical skill evaluation sheets identified below are to be used in conjunction with the core curriculum. They should be copied and provided to each student at the beginning of the training course and are to be used to document the performance of required skills evaluations throughout the field training course. MPD-approved Evaluators must complete all evaluations. Evaluator names and signatures must appear on each evaluation.

Skill sheets are in the EMR, EMT, & AEMT Level Practical Evaluation Skill Sheets Document. DOH 530-226.

Students must demonstrate proficiency on the practical skills identified in Table A. Students must achieve the required score for each skill listed in Table A and receive NO check marks in the Critical Criteria section of the skill sheet.

Table A:

Practical Skill	Points Possible	Points Required to Successfully Complete Practical Skill
Patient Assessment - Medical	48	39
Patient Assessment - Trauma	42	34
Bleeding Control/Shock Management	7	6
Intravenous Therapy	22	18
Intraosseous Line Placement	22	18

CLINICAL/FIELD ROTATIONS

In addition to the hours of instruction and practical skill evaluations, this course requires that the student successfully complete patient interactions in a clinical setting. The training course may utilize emergency departments, clinics or physician offices.

The program director or medical director must establish appropriate relationships with various clinical sites to assure adequate contact with patients and initiate written agreements with each clinical/field site.

The student should interview and asses the minimum number of patients of the clinical/field experiences listed below. In addition, the student should record the patient history and assessment on a prehospital care report; i.e., Washington State Medical Incident Report (MIR), just as if interacting with this patient in a field setting.

The prehospital care report should then be reviewed by the primary instructor to assure competent documentation practices in accordance with minimum data requirements. The training course must establish a feedback system to assure that students have acted safely and professionally during their training. Students should receive a written report of their performance by clinical or ambulance staff.

Students who have been reported to have difficulty in the clinical or field setting must receive remedial training. Students are required to repeat clinical or field setting experiences until they are deemed competent by meeting the standards of the County Medical Program Director.

Clinical / Field Internship Requirements	
Internship Type	EMT- IV Therapy Special Skill Endorsement
Clinical Internship Requirements: Competency determined by the county MPD.	10 IV insertions on humans. At the option of the MPD, 5 may be performed on training aids Lab skill proficiency required in: IO line placement
Field Internships Requirements: Competency determined by the county MPD.	Note: It is recommended that some IV insertions are accomplished during the field internship.

Appendix C - Possible Abandonment Situations - Student Handout

Highest Level of Skill Performance Indicated by Current or Anticipated Clinical Procedures:	**Abandonment can exist when**
Paramedic	Care is released to AEMT personnel after drugs have been administered that are not within the AEMT scope of training or after an ET has been placed in the patient and is required to maintain the continuum of care.
Advanced EMT	Care is released to an EMT with IV or supraglottic airway (SGA) endorsement when drug administration, or when an IV or supraglottic airway has been initiated the EMT does not have the appropriate endorsement and is required to maintain the continuum of care.
EMT with an IV or SGA endorsement	Care is released to an EMT without the appropriate endorsement or a Emergency medical responder (EMR) when an IV or SGA has been initiated and is required to maintain the continuum of care.
EMT	Care is released to an EMR who then occupies the patient compartment. State law requires a minimum of an EMT during patient transport.