Intravenous Monitoring Program

Provider Guide

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Ministry of Health and Long-Term Care
Emergency Health Services Branch

Ontario

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Basic Intravenous Monitoring Program

Purpose

To provide the Emergency Medical Attendant with the knowledge and skills required for the care of a stable adult patient (12 years of age or older for purposes of this program) receiving intravenous fluid to keep a vein open or for fluid replacement, during land ambulance transport. This includes stable patients who are receiving Potassium Chloride, Thiamine and/or multivitamins and those patients who have established heparin or saline locks.

The program will not train EMAs in the care of patients whose intravenous therapy includes medications or blood products. The program will not train EMAs in the care of paediatric or neonatal patients receiving intravenous therapy of any kind (see Program Limitations section of this guide).

Objectives

Upon completion of this program the Emergency Medical Attendant will be able to:

a) Define the difference between arteries and veins.

b) List the common intravenous sites used and explain the advantages/disadvantages of each.

c) List the purposes of intravenous therapy.

d) List the local, systemic and mechanical complications and their causes.

e) Identify and demonstrate the use of the different types of intravenous equipment, solutions, administration sets and heparin or saline locks.

f) Describe the importance of aseptic technique when using I.V. equipment.

g) Explain and demonstrate how to calculate the rate of flow ordered and to regulate the flow using the various administration sets.

h) Describe the signs of infiltration and/or irritation at an I.V. insertion site.

i) Describe the action(s) to be followed for infiltration at an I.V. insertion site and removal of I.V. line if indicated.

j) Demonstrate the technique for changing the solution container.

k) Describe what should be checked when problems in adjusting the flow rate are encountered.

l) Demonstrate the technique for affixing the needle/cannula using adhesive tape.

m) Describe the responsibilities of the Emergency Medical Attendant before, during and after transport.

Background Information about Intravenous Fluid Therapy

Intravenous fluids are administered for the purpose of providing nutrition, restoring lost fluids, electrolytes, vitamins and minerals, maintaining fluid balance during surgical and comatose conditions, and for administering medications directly into the circulatory system.

The type and volume of the intravenous solution selected for administration is based on the fluid and electrolyte needs of the individual patient. Monitoring of a patient's response to the fluids being received is essential. Alterations to the volume administered and the composition of the I.V. solution are made following careful assessment of the patient's condition. The principal focus of I.V. administration is on maintenance and replacement.

Maintenance:

Maintenance therapy involves the provision of fluids, electrolytes, nutrients, and vitamins according to the needs of the individual patient. A goal of I.V. administration is to establish/maintain a state of fluid equilibrium in a patient.

Replacement:

Replacement therapy involves providing the components lost due to surgery, trauma, burns, shock, vomiting, diarrhea, tubular drainage, wound and burn drainage and diuresis.

Relevant Anatomy

The circulatory system has three main components, arteries, capillaries and veins.

1. **Arteries**

   Arteries are vessels with thick muscular walls that carry blood from the heart:

   Arteries carry oxygen poor blood from the right ventricle of the heart to the lungs and oxygen rich blood from the left ventricle of the heart to all parts of the body.

   Arteries have THREE LAYERS that make up the arterial wall.

   - INNER (tunica intima) is thin and smooth.
   - MIDDLE (tunica media) is thick and muscular.
   - OUTER (tunica adventitia) white fibrous.

2. **Capillaries**

   Capillaries are thin walled bundles of very small vessels that allow an exchange of gases (oxygen and carbon dioxide) and nutrients between the circulatory system and organ tissues.

3. **Veins**

   Systemic veins transport oxygen poor blood to the heart. Veins have walls consisting of THREE LAYERS. They differ from arteries in that veins have a larger volume capacity (they can hold more fluid) and there are many more veins than arteries.

   Pressure within veins is much lower than in arteries. In addition to their thin walled construction, veins are equipped with valves which prevent backward circulation.

4. **Common Intravenous Sites**

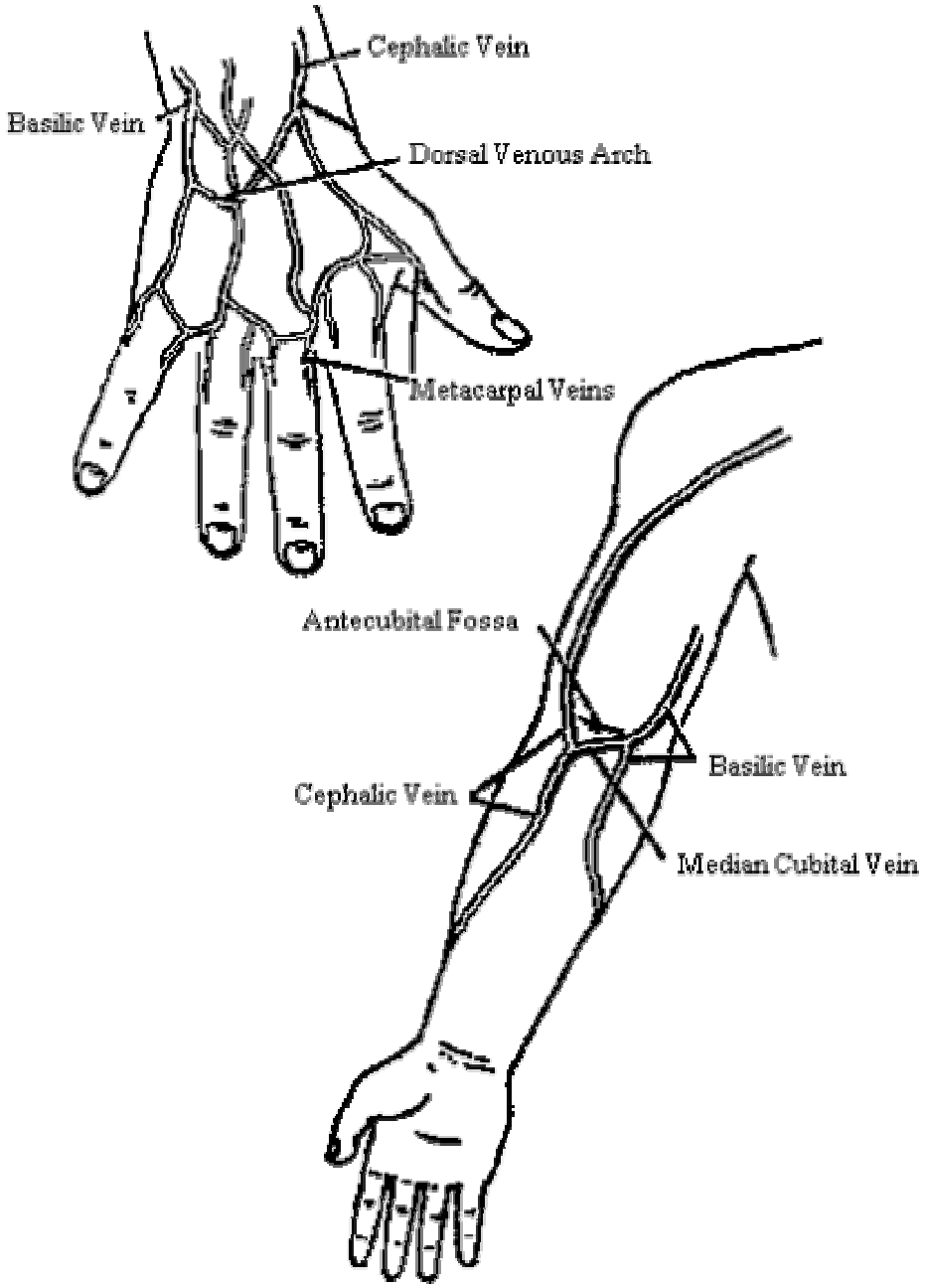
   The most common sites for I.V. administration are located on the forearms or in the hollow of the elbow (antecubital fossa).

   The veins involved are:

   - metacarpal veins
   - cephalic vein
   - basilic vein

   Hospital staff select veins based on how visible the vein is, how stable the site will be e.g. does the area remain relatively still naturally or with a splint, and considerations for further I.V. sites as the care of the patient progresses.

   The locations of common veins used in I.V. therapy are shown in the following diagram.
   (see next page).


Cephalic Vein
Basilic Vein
Dorsal Venous Arch
Metacarpal Veins
Antecubital Fossa
Basilic Vein
Cephalic Vein
Median Cubital Vein

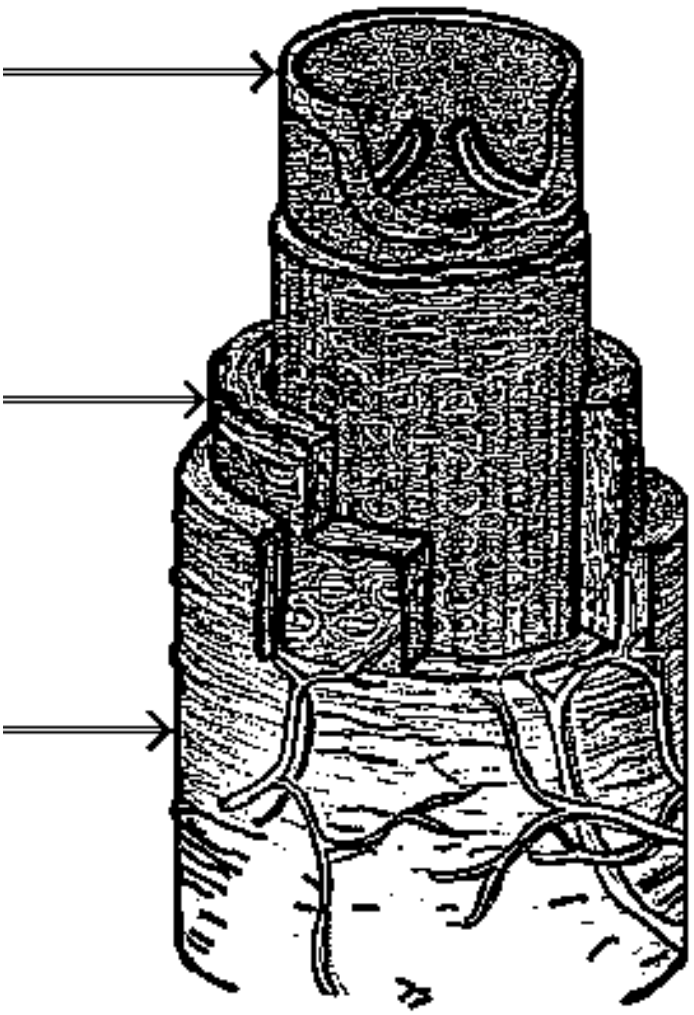
Veins have a wall construction consisting of three layers:

Veins

1. **TUNICA INTIMA (innermost layer)**
   - endothelial lining forms valves along veins; this promotes unidirectional blood flow toward the heart and prevents backward flow of blood

2. **TUNICA MEDIA (middle layer)**
   - less developed
   - nerve endings, elastic tissue, located here
   - weaker muscle coat therefore collapsible when B.P. falls

3. **TUNICA ADVENTITIA (outermost layer)**
   - thinner, less elastic
   - superficial: don't pulsate



Equipment And Supplies

Needles and Cannulae

Most needles are made of stainless steel while cannulae are made of plastic. Plastic cannulae are coated with a material that assists in reducing clot formation on the catheter. Plastic cannulae are produced with a stainless steel trocar core which is used to provide for ease of insertion. The trocar is removed from the lumen of the cannulae following insertion into the vein. Most plastic cannulae are made so that x-rays will not pass through. This is essential for verification of placement and location in case the catheter is lost in the patient. Plastics are best for long-term therapy, when veins are few in number and to assure that a vein will remain open.

Stainless steel needles are coated with silicone which prevents corrosion, facilitates ease of insertion, and retards thrombi formation. They are used for short-term and intermittent therapy. According to the Centre for Disease Control, stainless steel needles are preferred to plastic cannulae. Studies show a greater incidence of site infection with plastics, since there is a greater incidence of fungal overgrowth. Trauma to the vein is less severe with stainless steel since the needle gauge is smaller and the material is smoother, however there is more risk of vein puncture with movement of steel needles. The scalp vein or butterfly needle is more often preferred to a straight needle because it is easier to insert.

The usual needle sizes are 14, 16, 18, 20, 22, 24, gauge. Needle gauge refers to the lumen of the needle; the higher the number, the smaller the diameter.

Heparin and Saline Locks

It is possible that EMAs will encounter patients who have Heparin and Saline locks instead of continuous I.V.'s. These "locks" are used by hospital staff to maintain access to a vein where repeated doses of an intravenous drug may be required. These patients may not need an intravenous line far the continuous infusion of fluids. The locks consist of a plastic cannula that has been filled with heparin or saline, and a short length of tubing (2-3 inches) that terminates in an airtight injection port. The heparin or saline prevents clotting at the I.V. site. The lock provides several advantages:

a) The risk of fluid overload is eliminated because fluid is not continuously infused.

b) Chance of electrolyte imbalance is minimized.

c) Greater freedom of movement allows the performance of normal daily activities.

d) The patient is spared the discomfort of having a separate venipuncture each time a dose of the medication is required.

Intravenous Fluid

Once the prescribed intravenous fluid is selected by the sending institution's medical staff, the I.V. tubing should be inspected to confirm there are no air bubbles and the container should be inspected for cracks or tears, foreign matter, cloudiness, precipitation and any other sign of contamination. Should any of this be apparent, the fluid must not be used. The fluid must not have reached its expiry date. The expiry date is printed on the fluid container.

The most commonly used solutions are:

a) NORMAL SALINE (N/S)	- 0.9% sodium chloride in water.
b) RINGER'S LACTATE (Lactated Ringers)	- Sodium, chloride, potassium, calcium and lactate.
c) D5W (5% Dextrose in water)	- 5 grams of dextrose per 100 mls of water.

Solutions are available in volumes of 50, 100, 250, 500, 1000ml bags and are sealed in an outer plastic wrap to help prevent contamination.

Potassium chloride, Thiamine and multivitamins

Frequently, stable patients are transported after the sending institution has added potassium chloride (KCl) to the IV solution. The KCl is usually intended to replace lost KCl due to vomiting, diarrhea or urinary losses due to the use of diuretics.

Frequently, stable patients are transported after the sending institution has added thiamine or multivitamins to the IV solution. These are intended to correct vitamin deficiencies.

Monitoring of the infusion site is required because in the event the IV becomes interstitial, the KCl or vitamin(s) may corrode soft tissue in the area.

Intravenous Tubing

The intravenous tubing may be a macrodrip solution administration set that delivers 10 or 15 drops/ml, or a microdrip set of the burette type that delivers 60 drops/ml.

Macrodrip sets are used for routine infusions. Microdrip sets are used in pediatric and neonatal care and when relatively small amounts of fluids are to be administered over a long period of time. As noted earlier, pediatric and neonatal IV care is beyond the scope of this course.

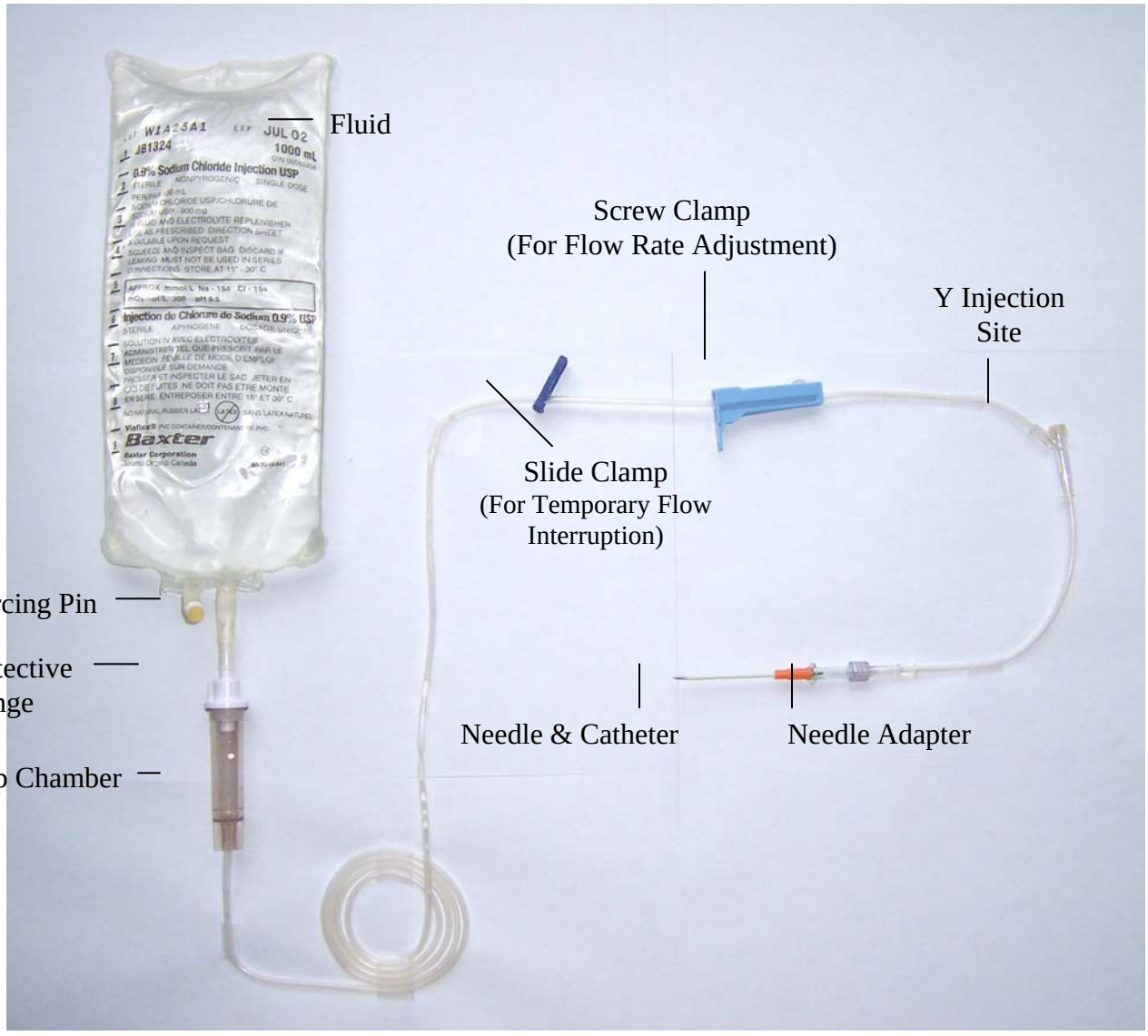
The infusion tubing drip chamber will achieve maximum flow rate when suspended approximately three feet above the site of injection due to the force of gravity. The greater the height, the greater the force of flow due to the weight of the fluid column.

Tape

One-half-inch adhesive, silk or paper type should be used to anchor the needle or cannulae to the skin. The tape should be placed in such a manner as to prevent any movement of the device. Crisscrossing the tape at the needle hub or wing taping are effective methods of securing the device. It is advisable to avoid placing tape over the venipuncture site making it difficult to carry out I.V. site care.

Additional taping is necessary to secure the arm or hand board, to secure a loop of tubing and to secure the site dressing. One-inch tape is recommended for this purpose. Use caution in taping in order to prevent nerve damage to the limb, or circulatory impairment caused by excessive pressure.

Parts of the IV Set



Flow Rate

In order to ensure therapeutic effectiveness of intravenous fluids infusing into the patient's circulatory system, maintenance of a constant, even flow is necessary. There are several factors that may alter the flow rates:

1. **Venous Pressure/Patient Positioning**
   - Infusion tubing drip chamber may not be 3 feet above injection site, thereby reducing the flow rate.
2. **Vein Spasms**
   - Irritating or chilled fluids may cause a reflex action which causes the vein to go into spasm at or near the intravenous infusion site.
3. **Development of Phlebitis and Thrombi**
   - This may be caused by the initial decrease in flow rate due to spasm or the presence of the needle in the vein.
   - As the clot forms, a substance called serotonin is released which causes smooth muscle in the vein to contract more.
4. **Viscosity and Specific Gravity of Fluid**
   - High concentrations of dextrose tend to flow at slower rates.
5. **Amount of Fluid in Container**
   - The declining weight of remaining fluid in the I. V. bag causes the rate of flow to decrease because it is not exerting as much pressure on the fluid in the I.V. tubing.
6. **Height of Fluid Container**
   - The greater the height, the greater the force of flow.
7. **Tubing Occlusion**
   - May occur through kinking or bending of the tubing.
   - May become pinched due to bending or being caught in or under other equipment or the patient.
   - Occurs when air vents clog.
8. **Needle or Cannula Gauge/diameter**
   - The smaller the needle or cannula, the slower the fluid will flow.
9. **Needle or Cannula Position**
   - Should the bevel of needle or cannula contact the wall of vein, the flow of fluid will be interrupted.
10. **Infiltration**
    - Should a needle or cannula slip out of a vein or puncture the wall of a vein, the fluid will leak into surrounding tissue, edema will occur, tissue space will fill causing the flow to cease.

Formulas for Calculating I.V. Flow Rates

There are two methods of calculating flow rates:

- the number of millilitres per hour and
- the number of drops per minute.

Commercial brands of intravenous equipment differ and there are variations in the size of openings of drip chambers and consequently in the number of drops per millilitre. Drops per millilitre are indicated on the container boxes of I.V. infusion sets. Common drip factors are:

- 10, 15 and 20 drops per millilitre for MACRODRIPS
- 60 drops per millilitre for MICRODRIPS e.g. Buretrol

1. ml/hour:

The hourly rate of infusion can be calculated by dividing the total infusion volume by the total infusion time in hours.

TOTAL ML FLUID TO BE GIVEN = ML Hour
TOTAL HOURS TO BE GIVEN IN

Example:

1000 ML = 125 ML/HOUR
8 HOURS

2. Drops/minute:

The drops per minute must be regulated to ensure that the prescribed amounts of solution will infuse. Drops per minute are calculated by the following formula:

DROPS/ML X AMOUNT OF FLUID TO BE INFUSED = DROPS/MINUTE
TOTAL TIME OF INFUSION (in minutes)

Example:

If the order for the I.V. is 100 ml/hour the formula is:

Macrodrip

10 DROPS/ml X 100ml = 16.7 drops/min.
60 minutes

Microdrip

60 DROPS/ml X 100ml = 100 drops/min.
60 minutes

Drip flow regulation is controlled by tightening or releasing the roller clamp (white plastic clamp) and counting the drops falling into the drip chamber.

For microdrip administration sets note that: drops/minute = mls/hour.

Complications of Intravenous Therapy

The complications of intravenous therapy are categorized as local, systemic and mechanical.

Local Complications

Local complications are those that occur in and around the venipuncture site.

Extravasation, which is a leaking of fluid into the tissues around the I.V. site, occurs when the vein wall is punctured or when the fluid is flowing into the surrounding tissue rather than into the vein, as occurs when the needle or cannula inadvertently slips out of the vein. Infiltration is the accumulation of fluid, causing the tissue to swell; giving the area involved a puffy appearance. The skin appears white in colour and may feel hard and cool to touch. The patient may feel pain and burning and no blood return will be observed when the I.V. container is momentarily lowered below the infusion site.

Phlebitis, thrombophlebitis and sclerosis (see abbreviations and definitions section) occur as a result of vein irritation and inflammation but are not typically observed in short term therapy.

Systemic Complications

Systemic Complications occur apart from the local complications. Watch for specific signs and symptoms such as chills, fever, headache, backache, nausea, vomiting, shortness of breath, cyanosis, syncope, paralysis and shock like states. Pyrogenic (fever producing) reactions include septicemia and bacteraemia resulting from the use of contaminated equipment or solutions.

Pulmonary embolism is an obstruction of the pulmonary artery or its larger branches by a clot originating in the peripheral veins. Sudden death may follow. The signs of pulmonary embolism include chest pain, coughing up blood-tinged sputum, shock.

Air embolism is a condition where a given amount of air inadvertently enter the vascular system, reaches the heart and produce cardiac arrest. The administration of up to 10 mls of air intravascularly can have serious if not fatal effects. Safe practice dictates the avoidance of any air entering the vascular system through the IV equipment; however, small bubbles of air may be tolerated by most patients. To prevent air embolism, use closed-system infusion sets, assure that the tubing drip chamber is one-half full at all times, and remove all air from tubing prior to connecting them to the patient. Make sure that all connections are tight.

Catheter embolism occurs when a portion of a plastic cannula breaks off and flows into the vascular system.

Pulmonary edema generally follows circulatory overloads. Symptoms include headache, hypertension, coughing, dyspnea, crackles at lung bases and restlessness. During the acute phase, the infusion should be slowed to a rate that will maintain a patent I.V. route.

Mechanical Complications

Mechanical complications occur as a result of:

- changes in the position of the needle in the vein,
- height of the solution,
- amount of solution remaining in the container,
- venospasm,
- position of patient,
- kinked tubes,
- disconnected tubes,
- plugged air vents and plugged needles or cannulae.

Management of mechanical failures centres around observation and assessment of the functioning of the entire system.

BIAS IV Procedures

Aseptic Technique

Always use aseptic technique when working with I.V. equipment. If prior to use, an I.V. administration set or container becomes contaminated by being in contact with a non-sterile surface, it should be replaced with a new one to prevent introducing bacteria or other contaminants into the system.

Reminder: "An I.V. in a patient's vein is like having an open door to his/her circulatory system."

- Make sure your equipment is sterile and take care not to contaminate it.
- Cleanse your hands thoroughly.
- Examine the label of the I.V. fluid container.
- Check the expiration date of the I.V. fluid.
- Examine the container for damage or leaks.
- Examine the solution to see if it appears clear and without contaminants.

To Prepare an I.V. Bag

- Place I. V. fluid bag on a flat surface.
- Remove outer protective bag (if present)
- Remove protective cap or tear top from insertion port.

To Change an I.V. Bag

- Verify the new solution for clarity, expiry date, type of solution and volume.
- Document the time the new container is hung and the amount absorbed from the old container.
- Clean hands with alcohol wipes or antiseptic cleaner.
- Tightly close the clamp on the administration set.
- Remove stopper from new container using aseptic technique (see "Prepare an IV Bag" above).
- Remove spike from old container being careful to avoid contamination and insert spike into new container. Squeeze the drip chamber (if necessary) until it is half full.
- Hang up container, and check/ensure drip chamber is half full.
- Open clamp and adjust flow to the rate ordered.

To Manage a Dislodged I.V.

- Shut off the flow of fluid by closing the roller clamp on I.V. tubing line.
- Carefully remove the needle from the site.
- Apply moderate pressure to I.V. site using a sterile dressing.
- Cover I.V. site with a sterile dressing.
- Document the time, amount of fluid remaining in the bag and amount of fluid absorbed.
- Document description of I.V. site, condition of cannula after withdrawal from vein.
- Retain equipment for the receiving hospital.

To Manage an Interstitial I.V.

- Shut off the flow of fluid by closing the roller clamp on I.V. tubing line.
- Carefully remove the needle from the site.
- Apply moderate pressure to the I.V. site using a sterile dressing.
- Cover the I.V. site with a sterile dressing.
- Document the amount of fluid remaining in the bag.
- Document description of I.V. site and surrounding area.
- Retain equipment fur the receiving hospital.

To Manage a Loose I.V. Tubing Connection

- Shut off the flow of fluid by closing the roller clamp on the I. V. tubing.
- Remove securing tape at connection site.
- Clean ends of tubing with alcohol swab.
- Re-connect and/or tighten I.V. tubing at connection site.
- Re-tape connection site.
- Regulate flow rate as ordered by sending facility staff.

To Manage a Flow Rate Problem

- Check height of tubing drip chamber. Try to position the drip chamber approximately 3 feet above the injection site whenever possible.
- Check I.V. bag fluid level to ensure fluid remaining. Change the bag when there is approximately 150 mls of solution remaining.
- Check for signs of infiltration.
- Ensure that the roller clamp is open.
- Check tubing for kinking or clot formation.
- Check needle or cannula position - position of patient.
- Adjust tape and/or reposition arm board.

IV Monitoring Program Limitations

1. When a stable patient (12 years of age or older) has an intravenous line to keep the vein open (TKVO), or for fluid replacement, that is running at a prescribed rate and contains normal electrolyte solution or contains added potassium chloride, thiamine and/or multivitamins, an Emergency Medical Attendant who has successfully completed the IV Monitoring Training course, may transport the patient without a sending facility escort. The EMA may also transport a patient with an established heparin or saline lock.
2. An unescorted Emergency Medical Attendant is not authorized to:
   - transport patients receiving blood or blood products
   - transport patients receiving I. V. medications (except potassium chloride, thiamine and multivitamins)
   - transport patients receiving I.V. fluids via an electronic infusion pump or other pressurised administration devices
   - transport patients receiving I.V. fluids via subclavian catheters, central venous pressure lines, jugular lines, cut down catheters, renal or chemotherapy shunts
   - initiate an intravenous
   - re-start an interstitial intravenous.
   - transport neonate or pediatric patients with I.V.'s

The above listed situations require sending facility escorts to perform the appropriate patient care related to the I.V. therapy.

Summary of EMA IV Related Responsibilities

Pre-Transport

The Emergency Medical Attendant will:

- Ensure that any required equipment is available and functional; equipment or supplies not normally provided by the ambulance service will be obtained from the sending facility.
- Confirm that the patient is stable.
- Confirm physician's I.V. order with sending health facility staff.
- Determine I.V. solution, flow rate, cannula or needle gauge and length and site.
- Note condition of I.V. site prior to transport.
- Confirm amount of fluid remaining in bag.
- Determine amount of fluid required for complete transport time and obtain more fluid if applicable.
- Document all pre-transport I.V. information on the Ambulance Call Report.

During Transport

- Monitor and maintain I.V. at the prescribed rate
- Document on the Ambulance Call Report, all actions taken during transport.

Post-Transport

Report to receiving facility (and document on Ambulance Call Report form):

- type of solution infusing
- rate of flow
- amount of fluid infused during transport
- amount of fluid remaining in bag (IV container) post transport
- any problems encountered during transport
- any urinary fluid output that occurred during transport

If an I.V. becomes dislodged during transport, provide receiving facility (nursing) staff with remaining I.V. fluid, and tubing. If the patient voids during transport, record and report the volume.

Abbreviations and Definitions

Electrolyte:	• A solution which conducts an electric current and is decomposed by the passage of an electric current. • Acids, bases and salts.
Intermittent:	• Ceasing at intervals.
Antecubital Fossa:	• Triangular area lying anterior to and below the elbow.
Thrombus:	• A blood clot obstructing a blood vessel or a cavity of the heart.
Radiopaque:	• Impenetrable to the x-ray i.e. is visible on x-ray films.
Therapeutic:	• Having medical or healing properties.
Phlebitis:	• Inflammation of a vein
Thrombophlebitis:	• Inflammation of a vein with a clot formation.
Serotonin:	• A brain hormone with vasoconstricting principles.
Viscosity:	• Resistance to flow.
Occlusion:	• State of passage being closed.
Extravasation:	• Escape of fluids into the surrounding tissue.
Infiltration:	• Process of a substance passing into and being deposited within a cell, tissue or organ.
Edema:	• Condition in which body tissues contain an excessive amount of tissue fluid.
Cyanosis:	• Slightly bluish, grey-like or dark purple discoloration of the skin due to reduced oxygen content of haemoglobin in the blood.
Syncope:	• A transient form of unconsciousness (fainting).
Pyrogenic:	• Producing fever.
Septicemia:	• Morbid condition from absorption of septic products into the blood and tissues.
Bacteraemia:	• Bacteria in the blood.
I.V.:	• Intravenous
Pulmonary Edema:	• Increased fluid in lungs
Dyspnea:	• Air hunger resulting in laboured breathing.
Aseptic:	• Free from germs.
Interstitial:	• Occupying space between essential parts of an organ.
Rate of Administration:	• Equals FLOW RATE

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Section 2

Pre-test, Pre-test answers, and Sample IV flow rate calculations

EMAs are encouraged to complete this section prior to attending the IV training program, in order to use classroom time more efficiently.

I.V. Monitoring Program – Pre-Test – October 1993

A. List five separate reasons why I.V. fluids are administered.

1. _____
2. _____
3. _____
4. _____
5. _____

B. Briefly describe the structure of a vein.

1. _____
2. _____
3. _____

C. Describe some characteristics of stainless steel needles and plastic cannulae.

1. _____
2. _____
3. _____
1. _____
2. _____
3. _____

D. Describe a heparin lock in terms of its construction and four advantages.

_____
_____
_____
_____
_____

E. I.V. fluid and its container should be carefully checked before use. What should you look for?

_____
_____
_____

F. List the two types of drip sets, describing when each is used.

1. _____
2. _____

G. List ten factors that may alter I.V. flow rates.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

H. Calculate the number of drops per minute required to administer 50ml per hour using a microdrip chamber. (show your calculations.)

_____
_____
_____

I. Calculate the number of drops per minute required to infuse a 1000cc bag of fluid in 8 hours. Assume a drip set that delivers 10 drops to a ml.

_____
_____
_____

J. List signs and symptoms of local infiltration.

_____
_____

K. List six measures designed to prevent the introduction of microorganisms into the circulatory system of the patient.

1. _____
2. _____
3. _____
4. _____
5. _____

L. Describe the 3 steps for preparing an I.V. bag. Describe the 8 steps in changing an I.V. bag.

1. _____
2. _____
3. _____
1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____

M. Describe the actions to be taken in the event the I.V. needle becomes dislodged from the vein.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____

N. Describe the actions to be taken in the event that the I.V. tubing connection becomes loose.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

O. Describe the information that should be reported to the receiving facility and documented on the Ambulance Call Report.

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Answer Key – I.V. Monitoring Program – Pre-Test – October 1993

Short Answer Format

For use with the Short Answer Pre-Test Questions

Answer	Provider Guide Page Reference
A. Reasons why I.V. fluids are administered:	
To: provide nutrition, fluid replacement, maintain fluid levels, provide nutrients, administer medications	Page 3
B. Describe the structure of a vein:	
Consist of three layers. Thin walled. Contain valves.	Page 4
C. Describe some characteristics of plastic cannulae and steel needles.	
Plastic:	
coated to prevent clot formation, not x-ray permeable - therefore they appear on x-ray films, contain a steel trocar that is removed after placement, best for long term therapy	
Steel:	
coated with silicone to prevent clot formation; best for short and intermediate term therapy; less incidence of infection	Page 7
D. Describe a heparin lock and it's four advantages:	
consists of a plastic cannula filled with HEPARIN to prevent clotting; a short length of tubing that terminates in an airtight injection port.	
ADVANTAGES ARE:	
1. risk of fluid overload is eliminated	
2. chance of electrolyte imbalance is minimised	
3. allows greater freedom of movement for patient	
4. avoids discomfort of having separate venipuncture for each medication administration	Page 7
E. What to look for when inspecting I.V. sol'ns and containers:	
Inspect for:	
no air bubbles in tubing, clarity; expiry date, type of solution, volume; cracks and /or tears; foreign matter; precipitation	Page 8

F. List 2 types of drip sets:

macrodrips - 10 OR 15 DROPS PER MINUTE

microdrips - 60 DROPS PER MINUTE Page 8

G. List ten factors affecting I.V. flow rates:

venous pressure, vein spasm, thrombi; fluid viscosity; amount of fluid in container;

height of container above patient, tubing occlusion, needle or cannula size, needle or cannula position, infiltration Page 9

H. 60 **DROPS**/ML X 50 ML = 50 DROPS/MIN.
60 MINUTES Page 10

I. i. **1000** ML/8HRS = 125ML/HR
ii. (10 DROPS/ML X 1000ML)/(8HRS X 60 MIN)
10000/480 = 21 DROPS PER MINUTE Page 10

J. List signs and symptoms of infiltration.

S/Symp: swollen tissue that is hard and white in appearance. Page 13

K. List 6 measures to prevent introduction of micro-organisms into the circulatory system.

1. Make sure your equipment is sterile and take care not to contaminate it.
2. Cleanse your hands thoroughly.
3. Examine the label of the I.V. fluid container.
4. Check the expiration date of the I.V. fluid.
5. Examine the container for damage or leaks.
6. Examine the solution to see if it appears clear and without contaminants. Page 13

L. List steps involved in preparing I.V. bags and changing an I.V. bag.

<u>To Prepare an I.V. Bag</u>

1. Place I.V. fluid bag on a flat surface.
2. Remove outer protective bag (if present)
3. Remove protective cap or tear top from insertion port.

To Change an I.V. Bag

1. Verify the new solution for clarity, expiry date, type of solution and volume.
2. Document the time the new solution container is hung and the amount absorbed from the old container.
3. Clean hands with alcohol wipes or antiseptic cleaner.
4. Close the roller clamp on the administration set.
5. Remove stopper from new container using aseptic technique.
6. Remove spike from old container being careful to avoid contamination. Insert spike into new container.
7. Hang up container, check/ensure drip chamber is half full.
8. Open clamp and adjust flow to the rate ordered. Page 13

M. List steps involved in managing a dislodged I.V.

To Manage a Dislodged I.V.

1. Shut off the flow of fluid by closing the roller clamp on I.V. tubing line.
2. Carefully remove the needle from the site.
3. Apply moderate pressure to I.V. site using a sterile dressing.
4. Cover I.V. site with a sterile dressing.
5. Document the time, amount of fluid remaining in the bag and amount of fluid absorbed.
6. Document description of I.V. site, condition of cannula after withdrawal from vein.
7. Retain equipment for the receiving hospital. Page 13

N. Describe the actions to be taken in the event that I.V. tubing connection becomes loose.

To Manage a Loose I.V. Tubing Connection

1. Shut off the flow of fluid by closing the roller clamp on the I.V. tubing.
2. Remove securing tape at connection site.
3. Clean ends of tubing with alcohol swab.
4. Re-connect and/or tighten I.V. tubing at connection site.
5. Re-tape connection site.
6. Regulate flow rate as ordered by sending facility staff. Page 14

O. Describe the information that should be reported to the receiving facility and documented on the ACR form following an I.V. call.

Report to receiving facility:

- type of solution infusing
- rate of flow
- amount of fluid infused during transport
- amount of fluid remaining in bag post transport
- any problems encountered during transport
- any urinary output that occurred during transport.

If I.V. became dislodged during transport, provide receiving facility (nursing) staff with remaining I.V. fluid and tubing. Page 16

Sample Flow Rate Calculations

A. Using the formula from the provider guide, calculate drops per minute for the following:

Drops/ml	Amount to be infused	Time of infusion	Drops/min
1. 10	1000cc	8hrs	
2. 60	75cc	1hr	
3. 10	4000cc	24hr	
4. 60	50cc	1/2hr	
5. 10	125cc	1hr	
6. 10	250cc	1hr	

B. Using the formulas from the provider guide, calculate the ml/hr for the following:

Amount of fluid	Time	ml/hr
1. 1000cc	4hr	
2. 250cc	4hr	

Sample Flow Rate Calculations – Answers

QUESTION A	DROPS/MIN
1.	21
2.	75
3.	28
4.	100
5.	21
6.	42

QUESTION B	ML/HR
1.	250
2.	63

IV Monitoring Program – Student Performance Checklist

SKILLS TO BE ASSESSED	YES	NO
1. CHANGING THE SOLUTION CONTAINER:		
verbalise cleaning of hands removes outer bag verify date/solution type/volume tightly closes clamp remove protective cap remove spike from old container insert spike into new *container* squeeze drip chamber (if needed) hang up *container* ensure drip chamber is half full open clamp and adjust flow rate		
2. SHUT OFF A DISLODGED IV		
shut off flow with roller clamp apply dressing with moderate pressure carefully remove catheter maintain pressure until bleeding stops apply bandage		
3. TIGHTEN LOOSE IV TUBING (completely disengaged)		
shut off flow with roller clamp remove securing tape at connection site clean ends of tubing with alcohol swabs reconnect and/or tighten iv tubing retape connection site regulate flow rate per orders		

PARTICIPANT:	EHS#:
SERVICE:	DATE:
INSTRUCTOR:	EHS#:

Remedial training record

Deficient areas identified on the performance checklist and written test were reviewed with the participants and the participant's level of competence on this training is acceptable.

INSTRUCTOR:	EHS#:
DATE:	

Section 3

IV Monitoring – Multiple Choice Post Test

INSTRUCTIONS:

MARK ONE ANSWER ONLY FOR EACH QUESTION. DO NOT WRITE ON THE QUESTION BOOKLET. USE THE ANSWER SHEET PROVIDED TO RECORD YOUR ANSWERS.I.V. MONITORING – MULTIPLE CHOICE POST TEST

Mark one answer only for each question.

1. Intravenous fluids are administered for the purpose of:
   a) restoring lost fluids, electrolytes and minerals.
   b) providing nutrition.
   c) maintaining fluid balance
   d) all of the above
   e) only “a” and “c” are correct.

2. Veins:
   a) have thin muscular walls.
   b) carry blood away from the heart.
   c) have thick muscular walls.
   d) all of the above are correct
   e) none of the above are correct.

3. Needles and cannulae for IV therapy:
   a) are usually made of plastic or stainless steel
   b) are usually made of radio opaque materials so that x-rays will not pass through.
   c) are sized by guage; the higher the number, the smaller the diameter.
   d) all of the above answers are correct.
   e) only “a” and “b” are correct.

4. Locks are devices which:
   a) allow the administration of repeated doses of IV drugs.
   b) are filled with a heparin or saline solution.
   c) allow less freedom of movement for the patient.
   d) are used for patients who require the constant administration of fluids.
   e) only “a” and “b” are correct.

5. A “microdrip” infusion set delivers solution at drops per milliliter.
   a) 60
   b) 10
   c) 15
   d) 100
   e) 125

6. A factor not affecting the flow rate is:
   a) amount of fluid in container.
   b) aseptic technique
   c) height of the fluid container above the infusion site.
   d) vein spasms.
   e) needle or cannula position.

7. A patient that you are escorting is to receive IV fluids at a rate of 125ml per hour. A microdrip infusion set has been set up at the hospital. Enroute, you should maintain the flow rate at approximately _____drops per minute in order to deliver the required volume of fluid.
   a)
   b) 12
   c) 21
   d) 125
   e) 32
   f) 80

8. 8The patient in question #7 complains of significant pain at the infusion site approximately ½ hour into the trip. The IV appears to be running normally and blood return is observed when the IV bag is lowered. The appropriate action would be to:
   a) check the rate of flow against that ordered.
   b) stop and re-start infusion.
   c) if the flow rate is as prescribed, stop the infusion by closing the roller clamp and document your actions.
   d) all of the above answers are correct.
   e) “a” and “c” only are correct.

9. Prevention of contamination of IV equipment is extremely important. Which of the following considerations is not related to cross-contamination concerns?:
   a) Clean your hands prior to handling.
   b) Calculation and monitoring of I.V. flow rate.
   c) Examine the solution for cloudiness or discoloration.
   d) Examine the container for damage or leaks.
   e) Always check I.V. label and the expiry date of the fluids.

10. An “interstitial” IV is one that allows the IV fluid to infiltrate into the tissues surrounding the puncture site. Signs and symptoms of infiltration include:
    a) Pain and burning at the site.
    b) Swelling and whitish discoloration to the area surrounding the site.
    c) Difficulty in maintaining the proper flow rate.
    d) Only “a” and “b” are correct.
    e) “a”, “b”, and “c” are correct.

Answer Key –IV **Theory Test**

1. D
2. A
3. D
4. E
5. A
6. B
7. C
8. E
9. B
10. E

IV Monitoring – Multiple Choice Post Test

EMA NAME: _____

SERVICE NAME: _____

DATE: _____

Answer Sheet

Question No. **Answer**

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____