Intravenous Certification

Fall, 2012

Janice Ankenmann RN MSN CCRN FNP-C
Intravenous Therapy Class

**Purpose:** To teach licensed personnel (whom IV starts and care are part of their scope of practice) the fundamental principles and competencies required to begin, maintain and discontinue intravenous therapy.

**Objectives:** At the completion of 30 total hours of training (24 hours didactic and 6 hours of clinical practice), the participant will be able to:

1. demonstrate understanding and knowledge of the venipuncture procedure and intravenous therapy as evidenced by the successful completion of the written objectives for each of the four sessions,
2. demonstrate competency in starting, maintaining, and discontinuing IV therapy as evidenced by three individually supervised successful IV starts on live subjects with demonstrated ability to maintain and discontinue IV therapy utilizing appropriate aseptic technique.

**Methods:** Methods employed to teach the fundamentals of venipuncture and IV therapy will include lecture, participative discussion, visual aids, written materials and review, as well as, clinical laboratory experience using practice, actual equipment/supplies and live subjects.
LEARNING OBJECTIVES

1. Define the terms “intravenous fluids” and “superimpose” as stated under article 8 of the Vocational Nursing Practice Act.

2. Identify two documents that govern the practice of individual LVN’s regarding IV therapy.

3. Understand clearly that LVN’s do not give IV meds under any circumstances.

4. Identify five factors to be considered in selecting appropriate sites for IV catheter placement.

5. Identify why the lower extremities are not routinely used for IV therapy.

6. Define “electrolytes” and give four examples.

7. Identify five signs and symptoms that could indicate fluid/electrolyte imbalance.

8. Identify three clinical situations where you would suspect a patient may be at risk for fluid/electrolyte imbalance.

9. Name four methods of transport across the semi-permeable cell membrane.

10. List five indications for IV therapy.

11. Identify the differences between isotonic, hypotonic and hypertonic solutions and give two examples each.

12. Name three ways to identify veins vs. arteries.
LEARNING OBJECTIVES

1. Identify three reasons why you might use a butterfly versus an angiocath when starting an IV.

2. Identify three benefits to using the antocath.

3. Identify two reasons you would use an IV pump.

4. Identify two situations where you would use a microdrip tubing vs. macrodrip. Why?

5. Describe infection control guidelines pertaining to IV therapy/venipuncture.

6. Know your workplace policy regarding IV site care and who may do what with central lines.

7. Describe the potential clinical findings that could be observed when caring for a patient receiving IV therapy.

8. List five nursing responsibilities related to the care of the IV system.

9. Under direct supervision by an instructor, demonstrate appropriate technique for:
   - choosing a venipuncture site,
   - cleansing the skin,
   - choosing an appropriate IV device,
   - utilizing a tourniquet,
   - inserting the IV device,
   - securing the IV device,
   - attaching IV tubing/peripheral lock and dressing the site.
LEARNING OBJECTIVES

1. Identify the three most frequently used anatomical sites used for venipuncture in the infant.

2. Describe the preparation and approach to the pediatric client and parent(s) used prior to venipuncture.

3. Describe two considerations to be evaluated prior to starting an IV on the geriatric patient.

4. Identify three patient populations that may be anticoagulated. How might this affect the venipuncture procedure?

5. Identify three important nursing considerations to remember when administering IV solutions that contain KCl.

6. Demonstrate the ability to accurately calculate IV drip rates given a set of hypothetical clinical scenarios.

7. Under direct supervision of an RN instructor, demonstrate on live subjects the correct procedure for:
   - venipuncture with an angiocath,
   - dressing an IV site,
   - flushing a peripheral lock,
   - hanging IV fluid as ordered and calculating drip rates, and
   - discontinuing IV therapy and angiocath.
LEARNING OBJECTIVES

1. Identify the signs, symptoms and usual treatment of four local complications of venipuncture and IV therapy.

2. Identify the signs, symptoms and usual treatment of four systemic complications of venipuncture and IV therapy.

3. Identify two measures that can be employed to prevent local and/or systemic complications.

4. Discuss the differences between TPN and PPN.

5. Identify three reasons for the use of parenteral nutrition.

6. Explain why parenteral nutrition poses a high risk for infection.

7. Identify four potential symptoms of transfusion reaction.

8. Identify five “rules” to follow for safe blood administration.
HOW ARE YOU FEELING TODAY?
Resources


(Plus articles contained within class materials)
Indications For IV Therapy
INDICATIONS FOR I.V. THERAPY

A. To establish or maintain fluid and electrolyte balance.
B. To administer continuous or intermittent medication.
C. To administer a bolus injection.
D. To administer blood and/or blood component therapy.
E. To administer intravenous anesthetics.
F. To maintain or correct a patient’s nutritional state.
G. To administer diagnostic substances.
H. To monitor hemodynamic function of central venous circulation.
Legal Aspects
LEGAL ASPECTS OF IV THERAPY/BLOOD WITHDRAWAL

CONSIDERATIONS:

NEGligence

ASSAULT and BATTERY

FALSE IMPRISONMENT

SLANDER and LIBEL

MALPRACTICE

PERSONAL LIABILITY

* PATIENT BILL OF RIGHTS

* CALIFORNIA VOCATIONAL NURSING PRACTICE ACT

* CALIFORNIA CODE OF REGULATIONS

Ruling regarding LVN’s and

IV MEDS

CENTRAL LINES

TPN/PPN

LOCAL ANESTHETICS

PERIPHERAL LOCKS
Legal Aspects of IV Therapy/Phlebotomy
In California

In 1985, eighteen states had rulings allowing LVN’s to administer IV Therapy. Other states believe that the understanding for IV Therapy cannot be built on the scope of knowledge required for the basic practice nurse education. California is one of those states who do allow LVN’s to administer IV Therapy.

Considerations

1. **Negligence**: Failure to do something or doing something that a responsible person would not do. Not acting in a reasonable and prudent manner with resultant damage to a person or his property.

2. **Assault and Battery**: Assault is an attempt or threat to physically injure a person. Battery is the unauthorized touching of a person. “Coercion on a rational adult patient in order to insert a cannula constitutes assault and battery”. (1)

3. **False Imprisonment**: The act of confining or restraining a person without his consent for no clinical or legal reason.

4. **Slander and Libel**: Slander is the oral statement made with intent to dishonor or defame another person when made in the presence of a third person. Libel is a false or malicious writing that is intended to defame or dishonor a person and is published so other people can see it.

5. **Malpractice**: Is the negligent conduct of professional persons. The professional misconduct, or unreasonable lack of skill of professional duties.

6. **Personal Liability**: “Every person is liable for his own conduct (his own wrongdoing).” (2) The physician cannot protect the nurse by giving a verbal or written order. We are directly responsible for what we each do as nurses, regardless of who ordered it done.

   A. Observation is the legal and professional responsibility of the nurse. Frequent observation is imperative for early detection and prevention of a problem (ISMP).

   B. Nurse-Patient Relationship Role is significant in the prevention of initiating legal liability against the nurse. Take time to develop an efficient, interpersonal relationship. A patient that is resentful, uncooperative, and dissatisfied with his care is the one most likely to take legal action when a problem arises. By giving skilled efficient care along with genuine respect and concern for the patient, a nurse may be more likely to avoid malpractice claims.

   C. Be aware of your institution’s policies and procedure.
Article 8. Intravenous Therapy

2542. Definition.

As used in this Article:

(a) "Intravenous fluids" means fluid solutions of electrolytes, nutrients, vitamins, blood and blood products.

(b) "Superimpose" means to connect a container of intravenous fluid to tubing through which another container of intravenous fluid has just been administered.

(c) "Primary infusion line" means the line which provides a direct infusion between the container and the peripheral vein.

(d) "Secondary infusion line" means a line which provides infusion through a lateral access into a primary infusion line.

Note: Authority cited: Section 2844, Business and Professions Code. Reference: Sections 135 and 2850.5, Business and Professions Code.

History:
1. New article 8 (sections 2542-2542.5) filed 12-4-77; effective thirtieth day thereafter (Register 78, No. 49).
2. New subsections (c) and (d) filed 3-24-92; operative 4-23-92 (Register 92, No. 10).
3. Amendment of section heading, section and Note filed 1-29-2003, operative 2-26-2003 (Register 2003, No. 5).
4. Change without regulatory effect approving 1-29-2003 amendments filed 11-30-2005 pursuant to section 100, title 1, California Code of Regulations (Register 2005, No. 46).
2542.1. Intravenous Therapy.

The Board will consider a licensed vocational nurse as competent to start and superimpose intravenous fluids via primary or secondary infusion lines who has completed one of the following:

(a) A course in intravenous therapy approved by the Board, as defined in Section 2542.3.
(b) Submitted certification, satisfactory to the Board, by one of the persons specified in Section 2542.4, that the licensee has been instructed in the subject areas specified in Section 2542.3 and that the licensee has the knowledge, skills and abilities to safely practice venipuncture. For further limitations, see Business and Professions Code section 2860.5.

Note: Authority cited: Section 2854, Business and Professions Code. Reference: Section 2860.5, Business and Professions Code. History: 1. Amendment of subsection (b)(3) filed 10-7-77; effective thirtieth day thereafter (Register 77, No. 41).
2. Amendment of subsection (b)(3) filed 1-11-79; effective thirtieth day thereafter (Register 79, No. 2).
3. Amendment of subsection (b) filed 4-22-81; effective thirtieth day thereafter (Register 81, No. 17).
4. Amendment filed 11-16-83; effective upon filing pursuant to Government Code section 11346.2 (d) (Register 83, No. 47).
5. Amendment of first paragraph and subsection (b) filed 3-24-92; operative 4-23-92 (Register 92, No. 13).
7. Change without regulatory effect repealing 1-29-2003 amendments filed 11-30-2005 pursuant to section 100, title 1, California Code of Regulations (Register 2005, No. 48).

2542.2. Procedure for Certification Course Approval.

(a) A person or institution applying for approval of a certification course in intravenous therapy must complete and submit an application form supplied by the Board entitled, “Application to be a Certification Course Provider in Intravenous Therapy for Licensed Vocational Nurses” (Form 55ED-0; 09/05), hereby incorporated by reference.
(b) A course of instruction must be approved by the Board before it is offered by the provider.
(c) A course will not be approved for more than a two-year period.
(d) Approval of a licensed vocational nurse intravenous therapy certification course may be withdrawn if the Board later discovers misrepresentation in an advertisement or in any information required by the Board in accordance with this Article.

Note: Authority cited: Section 2854, Business and Professions Code. Reference: Section 2860.5, Business and Professions Code. History:
1. Amendment of subsection (c) filed 1-11-79; effective thirtieth day thereafter (Register 79, No. 2).
2. Amendment of subsections (a) and (b) filed 4-22-81; effective thirtieth day thereafter (Register 81, No. 17).
3. Amendment of section heading and section filed 5-4-2007, operative 5-3-2007 (Register 2007, No. 16).

2542.3. Approval of Course Content.

(a) A course in intravenous therapy shall be taught by an instructor approved as provided in Section 2542.4, shall have a maximum of 15 students for each instructor for clinical experience; and shall be at least 30 hours in length, including 24 hours theory and 6 hours clinical experience, including at least 3 individually supervised successful venipunctures by each student on live human subjects. The theory shall include, but not be limited to the following:

1. The requirements contained in Section 2860.5(c) of the Code necessary for a nurse to start and superimpose intravenous fluids;
2. Psychological preparation of the patient;
3. Universal precautions for infection control; and
4. Intravenous therapy:
   (A) Indications for intravenous therapy
   (B) Types of venipuncture devices
   (C) Types of delivery systems
   (D) Types of intravenous fluids
   (E) Preparation and immobilization of the venipuncture site
   (F) Observation of the patient
   (G) Regulation of the fluid flow
(H) Local and systemic reactions

(b) Intravenous therapy clinical experience must include:
   (1) Preparation of equipment;
   (2) Safety factors;
   (3) Choice of vein;
   (4) Choice of device for intravenous therapy;
   (5) Techniques of venipuncture;
   (6) Universal precautions for infection control.

Note: Authority cited: Section 2854, Business and Professions Code. Reference: Section 2860.5, Business and Professions Code

2542.4. Approval of Course Instructors.

To be approved by the Board, a certification course must be taught by one of the following persons:

(a) A physician and surgeon licensed by the Medical Board of California or the Osteopathic Medical Board of California who within the previous five years:
   (1) Has had a minimum of six months of experience starting and superimposing intravenous fluids in an "organized health care system," as defined in Section 2860.5(c)(2) of the Code; or
   (2) Has had experience teaching courses in intravenous therapy.

(b) A nurse licensed by the California Board of Registered Nursing who within the previous five years:
   (1) Has had a minimum of six months of experience starting and superimposing intravenous fluids in an "organized health care system," as defined in Section 2860.5(c)(2) of the Code; or
   (2) Has had experience teaching courses in intravenous therapy; or
   (3) Has met the requirements for faculty of a Registered Nursing or Vocational Nursing program.

Note: Authority cited: Section 2854, Business and Professions Code. Reference: Section 2860.5, Business and Professions Code

2542.5. Reports to Board.

(a) The certification course provider in intravenous therapy for licensed vocational nurses must submit to the Board a copy of the certificate issued to the licensee, entitled, "Certificate of Completion Intravenous Therapy For Licensed Vocational Nurses" (Form 55ED-7; 09/05), hereby incorporated by reference, which shall include:
   (1) Course Title;
   (2) Date of course completion;
   (3) Licensee's name, address, telephone number and vocational nurse license number;
   (4) Code number issued by the Board; and
   (5) Number of course hours, specified as theory and clinical hours.

(b) The certification course provider shall maintain a list of all licensed vocational nurses who have completed the intravenous therapy certification course within the preceding four years.

(c) A licensed vocational nurse is deemed to be Board-certified in intravenous therapy upon written
PATIENT BILL OF RIGHTS

The "patients bill of rights" described below is a general bill of rights ratified a few years ago for the entire health industry. You will encounter this in many arenas.

1) The patient has the right to considerate and respectable care.
2) The patient has the right to and is encouraged to obtain from physicians and other direct care givers relevant, current, and understandable information concerning diagnosis, treatment, and prognosis.
   Except in emergencies when the patient lacks decision-making capacity and the need for treatment is urgent, the patient is entitled to the opportunity to discuss and request information related to the specific procedures and/or treatments, the risks involved, the possible length of recuperation, and the medically reasonable alternatives and their accompanying risks and benefits.
   Patients have the right to know the identity of physicians, nurses, and others involved in their care, as well as when those involved are students, residents, or other trainees. The patient also has the right to know the immediate and long-term financial implications of treatment choices, insofar as they are known.
3) The patient has the right to make decisions about the plan of care prior to and during extent permitted by law and hospital policy and to be informed of the medical consequences of this action. In case of such refusal, the patient is entitled to other appropriate care and services that the hospital provides or transfer to another hospital. The hospital should notify patients of any policy that might affect patient choice within the institution.
4) The patient has the right to have an advance directive (such as a living will, health care proxy, or durable power of attorney for health care) concerning treatment or designating a surrogate decision maker with the expectation that the hospital will honor the intent of that directive to the extent permitted by law and hospital policy.
   Health care institutions must advise patients of their rights under state law and hospital policy to make informed medical choices, ask if the patient has an advance directive, and include that information in patient records. The patient has the right to timely information about hospital policy that may limit its ability to implement fully a legally valid advance directive.
5) The patient has the right to every consideration of privacy. Case discussion, consultation, examination, and treatment should be conducted so as to protect each patient's privacy.
6) The patient has the right to expect that all communications and records pertaining to his/her care will be treated as confidential by the hospital, except in cases such as suspected abuse and public health hazards when reporting is permitted or required by the law. The patient has the right to expect that the hospital will emphasize the confidentiality of the information when it releases it to any other parties entitled to review information in these records.
7) The patient has the right to review the records pertaining to his/her medical care and to have the information explained or interpreted as necessary, except when restricted by law.
8) The patient has the right to expect that, within its capacity and policies, a hospital will make reasonable response to the request of a patient for appropriate and medically indicated care and services. The hospital must provide evaluation, service, and/or referral as indicated by the urgency of the case. When medically appropriate and legally permissible, or when a patient has so requested, a patient may be transferred to another facility. The institution to which the patient is to be transferred must first have accepted the patient for transfer. The patient must also have the benefit of complete information and explanation concerning the need for risks, benefits, and alternatives to such a transfer.

9) The patient has the right to ask and be informed of the existence of business relationships among the hospital, educational institutions, other health care providers, or payers that may influence the patient’s treatment and care.

10) The patient has the right to consent to or decline to participate in proposed research studies or human experimentation affecting care and treatment or requiring direct patient involvement, and to have those studies fully explained prior to consent. A patient who declines to participate in research or experimentation is entitled to the most effective care that the hospital can otherwise provide.

11) The patient has the right to expect reasonable continuity of care when appropriate and to be informed by physicians and other care givers of available and realistic patient care options when hospital care is no longer appropriate.

12) The patient has the right to be informed of hospital policies and practices that relate to patient care, treatment, and responsibilities. The patient has the right to be informed of available resources for resolving disputes, grievances, and conflicts such as ethics committees, patient representatives, or other mechanisms available in the institution. The patient has the right to be informed of the hospital’s charges and available payment methods.
Site Selection
SITE SELECTIONS FOR I.V. THERAPY

I. Factors to Consider

A. Patient’s medical history
B. Patient’s age, size, general condition
C. Condition of patient’s veins
D. Type and rate of I.V. fluid or medication to be infused
E. Expected duration of I.V. therapy

II. Options in Adults:

A. Veins in the hand: Metacarpal and digital veins.
B. Veins in the lower arm: Cephalic and basilica veins – larger arm veins do not become phlebotic as quickly as hand veins.
C. Veins in upper arm (above antecubital fossa) – these are deeper veins; good choice for infusing irritating solutions because they are less prone to phlebitis than lower veins.
D. Veins of the inner aspect of the arm and wrist – use only if absolutely necessary. They are thin walled, and are often associated with bruising, phlebitis, and infiltration.
E. Veins of legs, feet and ankles – generally used only with doctor’s approval. Using them may compromise circulation in the legs and cause thrombophlebitis or embolism.
F. Avoid using the following sites:
   ▪ Veins below a previous I.V. infiltration
   ▪ Veins below a phlebotic area
   ▪ Sclerosed or thrombosed veins
   ▪ Areas of skin inflammation, disease, bruising or breakdown
   ▪ An arm affected by radical mastectomy, edema, blood clot or infection
   ▪ An arm with arteriovenous shunt or fistula
G. Avoid arteries:
   ▪ Generally located deeper than the veins
   ▪ Risk greater in the antecubital fossa because arteries and veins lie close together
   ▪ To locate nearby arteries, palpate for pulsation
   ▪ Unlike superficial veins, arteries do not look bluish
Superficial veins of the forearm

Cephalic vein

Basilic vein

Accessory cephalic vein

Median cubital vein

Basilic vein

Median antebrachial vein

Basilic vein

Cephalic vein

Metacarpal veins

Dorsal venous arch
Infection Control
"Agnes, this AIDS business makes me think we should stop sharing needles."
STOP the spread of germs…
WASH YOUR HANDS

PROPER HAND WASHING TECHNIQUE

1. Use continuously running water.
2. Use plenty of soap.
3. Apply soap with vigorous contact on all surfaces of hands.
5. Keep hands down at all times, so any run off will go into the sink, and not down the arms.
6. Avoid splashing, rinse thoroughly.
7. Dry well with paper towels.
8. Discard the towels into a bag provided for that purpose.
9. Use a paper towel to turn off faucet.

Good handwashing is the single most effective means of preventing the spread of infection.
UNIVERSAL PRECAUTIONS

All patients should be assumed to be infections for blood-borne pathogens.

Gloves must be worn when handling a patient’s body fluids. Protective mask, eye goggles, and gown should also be worn if there is potential for mucous membrane exposure to blood or other body fluids.

Take care to prevent injuries when using needles, scalpels, and other sharp instruments or devices. Never recap needles. Always dispose of needles immediately in a biohazard container.

Immediately and thoroughly wash hands and other skin surfaces that are contaminated with blood, body fluids containing visible blood, or other body fluids to which universal precautions apply.

Review your institutional guidelines for observing universal precautions.
ASEPSIS / SAFETY

ASEPSIS: a condition free from germs; free from infections; sterile, free from any form of life (Tabers Cyclopedic Medical Dictionary)

Universal Precautions

Handwashing

Potential Sources of Infection with Venipuncture and IV Catheters

1. autoinfection
   external spread
   hematogenous seeding
2. hands of medical personnel
3. contaminated disinfectants
4. contaminated equipment

IV Site Dressings........

1. Should be occlusive (according to institutions policy; transparent dressing; sterile 2x2 securely taped).
2. Should allow visualization of the site or the dressing should be changed daily.
3. Should be changed when wet or appears soiled.

SAFETY>>>>>>>>>

1. Never re-cap a dirty needle! Use needleless systems or the safety!!
2. Pay attention to what you are doing…sticks often occur because the phlebotomist is distracted.
3. If your patient is unable to co-operate, get assistance. (remember patient rights!)
4. Always properly dispose of sharps in a sharps container, bloody supplies in a biohazardous waste container.
**What to do if you stick yourself......**

If you are with a patient, excuse yourself, making sure that they are safe (no tourniquet on their arm, etc.) and let them know if that someone else will be in to finish the procedure.

1. Remove your contaminated gloves and dispose of them properly.
2. Squeeze the puncture site to promote bleeding.
3. Wash the area well with soap and water.
4. Record the patient's name and identification number.
5. Immediately report the incident to your supervisor and follow your institutions policy/procedure regarding reporting, treatment and follow up.

**What to do if you splash blood on your skin or into your eye.....**

6. If you are with a patient, excuse yourself, making sure that they are safe (no tourniquet on their arm, etc.) and let them know if that someone else will be in to finish the procedure.

Wash the area with generous quantities of water.

Wipe up any spilled blood with paper towels and disinfectant (10% bleach or other). Dispose of paper towels in a biohazardous waste container.

Record the patient's name and identification number.

Immediately report the incident to your supervisor and follow your institutions policy/procedure regarding reporting, treatment, and follow-up.
Intravenous Access Taping Methods

Using the transparent dressing shown you can secure the vascular cannula with tape using the U, H, or chevron method, as illustrated below.

**The U method**

**The H method**

**The chevron method**

Here's how to do the chevron, or criss-cross, method of taping. You can use this method to secure both over-the-needle catheters and inside-the-needle catheters. It can also be adapted for winged-tip catheters.

Begin by applying antimicrobial ointment to the site as soon as you've completed venipuncture. Then cover the site with an adhesive bandage strip or a 2" x 2" sterile gauze pad. Cut a long strip of 1/4" tape and wrap it around the needle hub as shown.

Cut three smaller strips of 1/4" tape and use them to secure the longer tape strips and tubing as shown.
Complications of IV Therapy
COMPLICATIONS OF I.V. THERAPY

I. Local Complications

A. Hematoma: a pooling of blood into the subcutaneous space.

1. Signs and symptoms
   a. discoloration
   b. swelling
   c. tenderness

2. Treatment
   a. firm pressure
   b. elevated extremity on pillow

3. Prevention
   a. insert I.V. cannula at correct angle
   b. when discontinuing an I.V. cannula, correct application of pressure

B. Infiltration: the extravasation of injected fluid into the subcutaneous tissue.

1. Signs and symptoms
   a. swelling at site or dependent areas
   b. slowing of infusion rate
   c. blanching in severe cases
   d. patient discomfort at site
   e. coolness of area

2. Treatment
   a. exercise unless contraindicated
   b. if severe, frequent assessment of capillary refill
   c. if chemical composition of infusate causes tissue damage, an antidote may need to be administered
   d. warm compresses

3. Prevention
   a. appropriate selection of I.V. site and cannula
   b. proper stabilization of I.V. cannula
   c. use of tension loop
   d. proper placement of restraints
   e. validation of proper placement of cannula before administration of an I.V. medication
C. **Phlebitis/Thrombophlebitis**

1. Phlebitis is an inflammation of the vein
2. Thrombophlebitis is a clot formation with phlebitis
3. Signs and symptoms
   a. tenderness
   b. redness
   c. heat
   d. edema
   e. palpable venous cord
4. Treatment
   a. relocate I.V. site
   b. elevate affected extremity
   c. vigorous exercise contraindicated with thrombophlebitis
5. Prevention
   a. proper selection of site and I.V. cannula size
   b. proper prepping of site before insertion of cannula
   c. avoiding multiple venipuncture
   d. adequate taping of I.V. cannula
   e. adequate hemodilution of caustic solutions or medications
   f. adequate reconstitution of medications
   g. adequate flushing of I.V. line between incompatible medications
   h. following institutional policy related to I.V. infusion, I.V. tubing, I.V. dressing, and I.V. site changes

D. **Infection**: is the result of an invasion of pathogens that are localized in the surrounding tissues

1. Signs and symptoms
   a. purulent drainage
   b. tenderness
   c. swelling
   d. erythema
   e. induration
2. Treatment
   a. establish a new I.V. site
   b. remove old I.V. and send catheter tip for culturing along with any portion of administration set or solution that is suspected as being a part of the causative factor
   c. monitor patient over next 48 hours for development of sepsis
   d. follow institutional policy related to I.V. infusion, I.V. tubing, I.V. dressing, and I.V. site changes
   e. instruct patient in their role of maintaining integrity of the I.V. system
II. **Systemic complications**

A. **Septicemia**: is a systemic proliferation of pathogens

1. **Signs and symptoms**
   a. gradual or sudden rise of temperature
   b. shaking chills
   c. tachycardia
   d. headache
   e. gastric symptoms
   f. can progress to septic shock

2. **Treatment**
   a. relocate I.V. site using different lot number for all medical equipment used in establishing the I.V.
   b. collect and culture appropriate specimens from catheter, tubing, and/or solution; separate blood cultures must be obtained

B. **Air embolism**: is when air inadvertently enters the venous system. This is more frequently associated with central lines

1. **Signs and symptoms**
   a. chest pain
   b. shortness of breath
   c. cyanosis
   d. low back pain
   e. hypotension
   f. weak thready pulse
   g. loss of consciousness
   h. loud churning murmur over precordium

C. **Catheter embolism**: occurs when a portion of the catheter breaks off and flows into the vascular system

1. **Signs and symptoms**
   a. depends on size of catheter embolism and final destination in vascular system
   b. range from no symptoms to massive pulmonary embolism symptoms

2. **Treatment**
   a. apply tourniquet to most proximal joint of the torso
   b. further treatment depends on patient’s clinical status

3. **Prevention**
   a. never restylet over-the-needle catheters
   b. never withdraw through-the-needle catheters through the introducer needle
   c. never use scissors during dressing change or removal of the dressing of either a peripheral or central I.V. catheter
D. **Speed shock**: results from a rapid introduction of a medication into the circulatory system

1. Signs and symptoms may vary depending on the patient and can include:
   a. flushing of faces
   b. headache
   c. severe shock to death
2. Treatment depends on the patient’s clinical status
3. Prevention
   a. appropriate reconstitution of all drugs
   b. appropriate adding of drugs to an I.V. solution already hanging
   c. appropriate hemodilution of all drugs given I.V.

E. **Circulatory overload**: is decompensation of the circulatory system due to excessive volume of fluid

1. Signs and symptoms vary according to the patient’s age, patient’s excessive volume of fluid
   a. hypoxemia
   b. dyspnea
   c. productive cough
   d. frothy sputum
   e. jugular vein distention
2. Treatment
   a. reduce infusion rate to keep open rate
   b. place patient in high Fowlers
   c. observe vital signs
   d. administer oxygen and diuretics according to the physician’s plan of care
3. Prevention
   a. frequent monitoring of I.V. flow rate
   b. assessment of the patient’s fluid and electrolyte balance
   c. use of intermittent infusion or mechanical devices

III. **Nursing documentation related to complications includes**

A. Patient signs and symptoms
B. Nursing care implemented
C. Patient outcome evaluated
Nursing Responsibilities
PATIENT TEACHING

- always explain what procedure you will be performing on a patient and why, prior to starting any part of the procedure (unless emergent)
- patients and families also need to know any activity restrictions that may be imposed, as well as what to report to the nurse (soreness, redness, swelling, pain, a cool or numb sensation at the insertion site)
- stress the importance of keeping the site clean, the dressing intact, not attempting to adjust the IV fluid rate if applicable, and the need to not kink the IV tubing
- be honest about the fact that venipuncture does hurt and reassure them that the discomfort will be of short duration…allay anxiety….in a very anxious patient, their own level of adrenalin in reaction to fear will cause vasoconstriction, thereby making venipuncture difficult

INFECTION CONTROL GUIDELINES

- handwashing
- adhere to universal precautions
- adhere to facility policies re: venipuncture, IV dressing changes (every three days and prn), IV tubing changes (usually every 72 hours of routine IV’s), etc.
- change IV solutions every 24 hours
- maintain a closed IV system
- frequently monitor site/extremity for signs and symptoms of infection
- do not re-cap sharps; utilize the safety; and dispose of them in sharps containers
- maintain aseptic technique when initiating/discontinuing venipuncture procedures and/or handling any parts of the IV system

PATIENT OBSERVATION

*reported to the MD and/or RN, as appropriate
*documented in the medical record as per facility policy

- site
- lung sounds
- jugular vein distention
- urine output
- skin turgor
- appearance of mucous membranes
- laboratory reports
- radiology reports
- mental status
Special Clients
CONSIDERATIONS WITH THE AGED PATIENT REGARDING IV THERAPY AND PHLEBOTOMY

As we age, our body structures change with decreasing body function and decreased ability to recuperate from injury and stress.

We experience diminished pulmonary, renal, cardiac, and GI function. This is turn creates the tendency to have difficulty maintaining homeostasis….fluid and electrolyte imbalances are common.

Considerations:

- Mental function: does the patient understand what you are saying to them? are they confused normally or is this a symptom of electrolyte/fluid imbalance?
- Senses: can the patient hear your explanation of treatment? can they see what you are doing or do you need to explain each stop so as to not surprise them?
- Cardiac: do they have dependent edema? arteriosclerosis? Is this affecting peripheral pulses or the lumen of the veins?
- Musculoskeletal: does the patient have decreased range of motion affecting their ability to position their limb for venipuncture? will the placement of an IV inhibit their ability to provide self care? site affect their ability to provide self care?
- Skin: muscle atrophy and decreased skin turgor may affect your ability to access veins (they may "roll"); skin may have rashes/abrasions/etc. due to medications and poor healing…this may affect your ability to secure a dressing over an IV site without harming the skin further.
CONSIDERATIONS WITH THE ANTICOAGULATED PATIENT REGARDING IV THERAPY AN PHLEBOTOMY

ANTICOAGULANT: 1) delaying or preventing blood coagulation, 2) an agent which delays or prevents blood coagulation (Taber’s Cyclopedic Medical Dictionary)
Examples: HEPARIN, ASPIRIN, COUMADIN, PLAVIX, LOVENOX, FRAGMIN

CONSIDERATIONS:

- use as small a needle/angiocath as possible to meet the patient’s needs
- always observe for hematoma and continued bleeding in high risk patients….apply pressure to the site for 5-10 minutes or longer prn to stop the bleeding
- access patients as distal as possible…if the vein blows or hematoma forms, it will allow access the same vessel higher up the extremity
- consider the use of a central line or arterial line to access specimens rather than providing an additional puncture
INTRAVENOUS INFUSIONS IN PEDIATRICS

OUTLINE

I. Indications for Intravenous Therapy
   • fluid replacement
   • open line (emergency)
   • blood withdrawal
   • diagnostic testing
   • medications

II. Physical Considerations
   • size (weight)
   • activity level
   • LOC
   • physical assessment

III. Other Considerations
   • parents
   • communication different
   • expectations different

IV. Site Selection
   • activity
   • length of time
   • what’s infusing
   • why needed
   • history

V. Selection of Device
VI. Equipment Needed
VII. Intravenous Insertion Techniques
VIII. Care and Maintenance of Intravenous Sites

MAINTENANCE INTRAVENOUS FLUIDS

<table>
<thead>
<tr>
<th>CHILDS WEIGHT</th>
<th>CC/KG/24 HOURS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 10 KG</td>
<td>100 CC/KG/24 HOURS</td>
</tr>
<tr>
<td>11-20 KG</td>
<td>1000 CC + 50 CC/KG EACH KG OVER 10 KG/24 HOURS</td>
</tr>
<tr>
<td>21-30 KG</td>
<td>1500 CC + 25 CC/KG EACH KG OVER 10 KG/24HOURS</td>
</tr>
</tbody>
</table>

OR

HOURLY INTRAVENOUS FLUIDS

4 CC/Kg for the first 10 Kg
40 cc + 2 cc/Kg for each Kg over 10 Kg (up to 20 Kg)
60 cc + 1 cc/Kg for each Kg over 20 Kg
IV Equipment
EQUIPMENT FOR I.V. THERAPY

I. Cannula:

A. Types

1. **Steel needle** (scalp vein or butterfly): greatly increases the risk of vein injury and infiltration.

   Uses:
   - short term IV therapy – only few hours
   - dye injections
   - bolus injections not requiring an IV line
   - short term chemotherapy

2. **Over-the-needle catheters** (angiocath, winged-cannula): varies from 3/4” to 1” long; diameters range from 16 gauge to 24 gauge.

   Uses:
   - short or long term therapy
   - delivery of viscous fluid
   - intermittent therapy

3. **Inside the needle catheters**: longer in length than over-the-needle catheters.

   Uses:
   - long term therapy
   - delivery of viscous fluid
   - delivery of fluid or medication via a central line

4. **Peripheral Locks** (Heparin Lock; Saline Lock) for intermittent administration of medications or fluids

   Uses:
   - to keep an intravenous access without fluid administration

B. **Choosing the right size.** Consider using:

   - to reduce the risk of phlebitis, catheter should be as small in diameter as possible
   - 24 gauge cannula for infants, children, and adults with extremely small veins
   - 20-22 gauge for medical patients (larger gauge catheter if larger vein is used to infuse caustic or viscous solution)
   - 18 gauge for surgical patients and blood administration
   - 16 gauge for trauma patients and those undergoing major surgery
II. IV Solutions:

A. Correct as prescribed
B. No leaks, particulate matter, discoloration
C. Compatabilities

III. IV Tubings:

A. Macrodrip – 10 gtts/cc or 15 gtts/cc
B. Microdrip/ Pediatric – 60 gtts/cc
C. Secondary lines – for IVPB
D. Volutrol/Metri-set
E. Blood Tubing- 10gtts/cc

IV. Pumps and Controllers

A. Pumps deliver IV fluids using positive pressure. They are used in most acute care facilities on all IV’s. “Smart pumps” are also available. These smart pumps allow the user to label the IV lines with the name of the fluid/ medication infusing and can even help to calculate drip rates/ drug dosing. Remember to use the specialty tubing for the specific pump being used!

B. Controllers deliver IV fluids using gravity as the source of infusion pressure.

V. Venipuncture Set: (includes prepping solution, tourniquet, dressing, label, tape)
Additional equipment/supplies: IV pole, armboard or handboard, gloves, additional lighting, if needed.

VI. Peripheral Locks/ Extension Tubing:

A. Peripheral locks: A “dead space” whereby patency is maintained with NS or Heparin.
   Used for intermittent medications, emergency vascular assess, and intermittent blood withdrawal.

   Can be positive pressure (to prevent backflow into the catheter tip).

B. Extension Tubing: used to extend the length of the IV tubing to allow better movement for the patient or more access ports for the caregivers.

VII. Filters:

A. Incorporated into IV tubing; “membrane”.
B. Used to filter particulate matter from solutions, medications and blood products infused into the patient.
C. Refer to your facility policies for use.
Central Lines

The following is intended as a general overview of central lines. For more detailed information, further resources will need to be accessed.

There are many types of central lines commonly used—tunneled, non-tunneled, and access ports that are surgically placed. The type of line used is determined by the physician based on patients needs: length of time catheter will be needed, purpose of its use, age and mobility of the patient, immune response of the patient, to name a few.

There are many risks of central lines including infection, catheter migration/emboli, air emboli, hemorrhage, nerve damage, pain, and on insertion, pneumothorax.

The advantages of central lines are that they:
- prevent frequent painful sticks for a patient who needs frequent access,
- the lines are longer and often placed in larger vessels so that more caustic infusions will not cause phlebitis and damage to the vessels
- they can be used for blood draws as well as administration of medications and fluids.

There are also PICC lines (peripherally inserted central venous catheters) that are placed by specially trained RN’s in the client’s room, but under sterile conditions. These lines can be used for intermittent or continuous use (one to two months on average), and can be used either in the acute care facility or at home. One of the advantages of PICC lines is that it does not require a surgical procedure and can be placed by a nurse, which significantly lowers the cost of insertion. Safety precautions with a PICC lines includes never administering medications IV bolus with a syringe smaller than a 10ml volume and to use a turbulent flow technique when flushing the line.

The insertion, care, use, monitoring and discontinuation of central lines is not within the scope of practice of the Vocational Nurse.

Common uses of central lines may include frequent blood draws, administration of chemotherapy and administration of TPN. PICC lines may be used for the administration of PPN, IV fluids, and IV antibiotics.
Common Central Line Access Sites

Dual-lumen Hickman catheter. (Courtesy: Davol, Inc., Subsidiary CR Bard Inc., Salt Lake City, UT)

Lifevic PIC Catheter (Courtesy: Vygon Corporation, East Rutherford, NJ)

Per-O-Cath (Courtesy: Gesco International, San Antonio, TX)

P.A.S. PORT® Peripheral Venous Access System
(Property of Pharmacia Deltec Inc., St. Paul, MN)
Starting and Discontinuing IV’s
VENIPUNCTURE PROCEDURE

1. **Getting Started:**
   a. check the physician's order
   b. wash your hands
   c. assemble your equipment
   d. know the patient

2. **Approach the Patient:**
   a. introduce yourself
   b. check the patient's ID band/check allergies
   c. let the patient know what you plan to do and why
   d. obtain the patient’s consent (verbally)
   e. set up your equipment
   f. observe the patient’s arms and hands; ask which is their dominant hand (it is better to stick the non-dominant extremity for long term IV sites, if possible, for patient comfort)

3. **Dilate the vein:**
   a. apply the tourniquet
   b. palpate the vein
   c. choose the appropriate equipment (vacutainer, butterfly, etc., gauge of needle/catheter) for the patient
   d. techniques for vein dilatation include lowering arm to the level of the heart; lightly tap on the vein; have patient open and close fist; apply warm, moist towels

4. **Prepare the site:**
   a. use scissors to cut excessive hair and/or use a hair clipper
      **check your hospital policy/procedure**
   b. put on clean gloves
   c. cleanse the insertion site with antiseptic (per facility policy)……..most facilities utilize povidone iodine x 30 seconds of contact and/or ethyl alcohol 70% x one minute vigorous scrub and allow to dry

5. **Insertion:**
   a. inspect sharp
   b. hold skin taut
   c. angle sharp to skin
      1. superficial veins- 15 degrees
      2. deeper veins- 20-30 degrees
   d. entry methods
      1. ONE STEP…..usually used with steel sharps
         - enter skin and vein in one smooth step
         - observe for flashback
         - obtain specimen (or if using an angiocath or butterfly, reduce insertion angle until the sharp is almost parallel with the skin and carefully thread the cannula into the vein lumen)
2. TWO STEP…..can be used with over-the-needle or through-the-needle catheters
   - enter skin along side the vein
   - lower cannula until it’s almost parallel with the skin
   - aim directly into and enter the vein
   - observe for flashback
   - if using an over-the-needle catheter, carefully advance the entire unit approximately 1/4 inch to assure full catheter tip entry into the vein lumen before threading…….NEVER REINSERT STYLET NEEDLE INTO AN OVER-THE NEEDLE CATHETER

6. Withdrawal of the sharp
   a. release the tourniquet
   b. apply digital pressure to the puncture site or just above it if using a catheter with stylet
   c. slightly withdraw the sharp from the vein (leaving the cannula in place) and click to retract the sharp from the cannula into the safety chamber, with a careful, even motion at the same angle you inserted it…..be sure to discard the sharp directly into a sharps container
   d. connect IV tubing and/or peripheral lock and secure; apply dressing per facility policy
      or
      if sampling blood, continue holding pressure to the site until there is no further bleeding (one to three minutes on most patients) and apply a bandaid, cotton ball or sterile gauze to the site
      *if an antecubital stick for blood sampling, do not have the patient bend their arm at the elbow to compress the site*

PROBLEMS WITH INSERTION

*high skin resistance
- angle of cannula too low
- skin tautness not being maintained during insertion
- extremely tough skin

*catheter threading resistance due to decreased blood flow
- remove tourniquet
- attach IV tubing to catheter and slowly initiate infusion
- if unsuccessful, remove sharp (or catheter and stylet together)

*peelback with over-the-needle catheters
- use proper angle
- hold stylet, not hub
- after flashback, advance entire unit (needle and catheter) approximately 1/4 inch to assure that catheter tip is inside the vein lumen
*infiltration
  ▪ causes include unsuccessful entry into the vein; puncture of the posterior wall of the vein; needle or catheter dislodged from the vein lumen
  ▪ actions include stop the IV infusion; remove IV canula; apply pressure at the insertion site to prevent hematoma; apply dressing to site

*hematoma
  ▪ causes include puncture of the posterior wall of the vein; puncture of an artery; needle or catheter dislodged from the vein lumen; increased pressure on a friable vessel from the tourniquet has caused the vessel to “blow”
  ▪ actions include hold pressure to the site until bleeding has stopped; check for patency of the IV site…if not patent remove IV canula; observe site at intervals of about 5-10 minutes after bleeding has stopped to be sure hematoma is not getting larger; if veins “blow” during insertion, try venipuncture without using a tourniquet

BEFORE DECIDING WHICH SHARP/CATHETER TO USE CONSIDER THE FOLLOWING:

1. the purpose of the venipuncture or IV start
2. the patient’s history
3. solution to be infused, if any
4. vein depth and amount of subcutaneous tissue over the vein
5. the patient’s level of activity
6. the length of time the catheter may be in place.

Advantages of butterflies (wing tipped devices)
  ▪ easier to insert than angiocaths
  ▪ easier to insert in children and the elderly with small, short or tortuous veins
  ▪ lower risk of infection than angiocaths…..more than vacutainer or needle and syringe

Advantages of angiocaths (over-the-needle catheters)
  ▪ more comfort for the patient once inserted
  ▪ less trauma to the vein
  ▪ lower risk of infiltration and thrombus formation
  ▪ ability to administer more viscous fluids into larger veins with less trauma to the vessel and discomfort for the patient
1. Explain procedure and rationale to patient/family

2. Wear clean gloves

3. Remove dressing

4. Place sterile gauze pad over catheter site immediately after withdrawal of the catheter

5. Withdraw catheter in an even, continuous manner, nearly flush with the skin

6. Visually check that the cannula removed corresponds with the length of catheter inserted

7. Apply firm pressure until bleeding has stopped (about 1 – 3 minutes)

8. Place a bandaid over the site

9. Document as per your facility policy (usually the reason for discontinuation, that the catheter was intact on removal, what the site looks like, the amount of fluid infused and the patient’s response).
Fluids and Electrolytes and IV Solutions
1) **HOMEOSTASIS**
   definition:

2) **FLUID BALANCE**
   definition:

3) **BODY WATER DISTRIBUTION**
   a) intracellular
   b) extracellular
   c) total body water
      i) variables
      ii) men
      iii) women
      iv) infant

4) **BLOOD VOLUME**
   a) average adult
   b) plasma
   c) cells

5) **COMPOSITION of BODY FLUID**
   a) solutes:
      i) non-electrolytes
      ii) electrolytes
         (1) ions
            (a) cations
            (b) anions
6) **COMPOSITION OF INTRACELLULAR AND EXTRACELLULAR FLUID**
   a) Na+
   b) K+
   c) Ca-
   d) Mg++
   e) Cl-
   f) HCO3
   g) Glucose

7) **PURPOSE of ELECTROLYTES**
   a) 
   b) 
   c) 

8) **FLUID REPLACEMENT**
   *remember weight gains or losses are significant*
   a) Considerations
      i) –
      ii) –
      iii) –
      iv) –

9) **MOVEMENT of WATER and SOLUTIONS**
   a) diffusion
   b) active transport
   c) filtration
   d) osmosis
10) **OSMOLALITY**

11) **TONICITY**
   a) isotonic
   b) hypotonic
   c) hypertonic

12) **IMBALANCES**
   a) dehydration/hypovolemia
   b) overhydration/hypervolemia
   c) diuretic therapy
   d) electrolyte imbalances
   e) nursing observations
## IV Solutions

<table>
<thead>
<tr>
<th>Fluid</th>
<th>Osmolality</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>D5W 5% dextrose in water</td>
<td>278mOsmo/L</td>
<td>Provides free water and no electrolytes; 170 calories/L</td>
</tr>
<tr>
<td>10% dextrose in water</td>
<td>Isotonic</td>
<td></td>
</tr>
<tr>
<td>D10 W</td>
<td>556 mOsmo/L</td>
<td>Provides free water, no electrolytes; 340 calories/L</td>
</tr>
<tr>
<td></td>
<td>Hypertonic</td>
<td></td>
</tr>
<tr>
<td>½ NS 0.45% Normal Saline</td>
<td>154 mOsmo/L</td>
<td>Provides free water, sodium and chloride. No calories.</td>
</tr>
<tr>
<td></td>
<td>hypotonic</td>
<td></td>
</tr>
<tr>
<td>NS 0.9% Normal Saline</td>
<td>308mOsmo/L</td>
<td>Used to expand intravascular volume and replace extracellular fluid losses; contains Cl and Na in excess of plasma levels; provides no free water, no calories and no lyes.</td>
</tr>
<tr>
<td></td>
<td>Isotonic</td>
<td></td>
</tr>
<tr>
<td>D5 ¼ NS Dextrose &amp; 0.25% Normal Saline</td>
<td>355 mOsmo/L</td>
<td>Provides Na, Cl, free water; 170calories/L.</td>
</tr>
<tr>
<td></td>
<td>Isotonic</td>
<td></td>
</tr>
<tr>
<td>D5 ½ NS Dextrose &amp; 0.45% Normal Saline</td>
<td>432 mOsmo/L</td>
<td>Provides free water, Na, Cl. 170 calories/L.</td>
</tr>
<tr>
<td></td>
<td>Hypertonic</td>
<td></td>
</tr>
<tr>
<td>D5NS Dextrose &amp; &gt;09% Normal Saline</td>
<td>586 mOsmo/L</td>
<td>Provides free water. 170 calories/L.</td>
</tr>
<tr>
<td></td>
<td>Hypertonic</td>
<td></td>
</tr>
<tr>
<td>LR Lactated Ringers</td>
<td>309 mOsmo/L</td>
<td>Used as an intravascular volume expander. Similar to plasma, with no HCO3, higher levels of Cl and Mg; No free water, no calories.</td>
</tr>
<tr>
<td></td>
<td>Isotonic</td>
<td></td>
</tr>
</tbody>
</table>
POTASSIUM

K+ composition of body fluid:
- 5 meq/l intravascular
- 4 meq/l interstitial
- 141 meq/l intracellular

Functions in the body include:
- Neuromuscular
  - transmission and conduction of nerve impulses
  - contraction of skeletal and smooth muscle
- Cardiac
  - nerve conduction
  - contraction of the myocardium
- Cellular
  - enzyme action for cellular energy production
  - deposits glycogen in liver cells
  - regulates osmolality of intracellular fluids

ADMINISTRATION of IV POTASSIUM CHLORIDE

Indication: Prevention and treatment of hypokalemia

Usual Dosage: 40 meq/liter of fluid over six or more hours via IV pump

Side Effects/Adverse Reactions:
- confusion
- bradycardia
- dysrhythmias
- nausea/vomiting
- diarrhea
- oliguria
- pain at infusion site

NURSING CONSIDERATIONS

1. Monitor K+ level, I&O, EKG (look for peaked t waves)

2. Administer through larger veins to decrease pain/inflammation

3. Administer slowly when possible

4. **NEVER GIVE IM or IV BOLUS**

5. May lead to hyperkalemia, especially if pt is receiving potassium sparing diuretics
FACTORS AFFECTING IV FLOW RATE

- Height of solution in relation to the patient’s heart
- Clot in the cannula
- Change in position of the cannula
- Vasoconstriction
- Trauma to the vein
- Clogged or closed vent
- Impinged tubing
- Out of order pump/controller if applicable

CARE OF THE IV SYSTEM

- Height of the IV container
- Correct IV solution and properly labeled per facility policy, with a current expiration date
- Intact container
- Correct flow rate
- Absence of particulate matter/precipitates
- Drip chamber 1/3 to 1/2 full
- Dressing intact and per policy
- IV tubing and site properly labeled and currently dated as per policy

ALTERATIONS IN FLOW RATE

- Observe for infiltration/hematoma
- Check for fluid level in the bottle/bag
- Check for kinking in the tubing
- Make sure the clamp is open
It is understood that the majority of facilities now use IV pumps and even smart pumps for all IV infusions, where calculation of drip factors is unnecessary. The ability to double check volume to be administered per hour is recommended as there can be mechanical errors. The ability to determine appropriate tubing size and therefore flow of IV fluids for safe administration without a pump in case of emergency is a good skill to have and we will therefore be practicing this in class.
CALCULATING DRIP FACTORS

DRIP FACTORS

Microdrip (pediatric) tubing  60 gtts/cc

Macrodrip (regular) tubing  15 gtts/cc
*Some brands are 10gtts/cc and some are 20gtts/cc; be sure to check the package label to know what your facility uses*

Blood administration sets  10gtts/cc

FORMULA

\[
\text{Amount to be infused} \times \frac{\text{drop factor}}{60} = \# \text{ drops/minute}
\]

SAMPLE CALCULATIONS

MD Order: Lactated Ringers 1000cc at 75 cc/hr. How many drops per minute would you infuse this at?

Calculation:

\[
\frac{75}{60} \times 15 \text{gtts} = ?
\]

\[
1.25 \times 15 = 18.75 \text{ or } 19 \text{ gtts/minute}
\]

HELPFUL HINTS

- When using microdrip tubing, the # cc/hour = # drops/minute

- If your IV set has a drip factor of 10 gtts/cc, the # gtts/minute = \(\frac{\# \text{ cc/hour}}{60}\)

- If your IV set has a drip factor of 15 gtts/cc, the # gtts/minute = \(\frac{\# \text{ cc/hour}}{4}\)

- If your IV set has a drip factor of 20 gtts/cc, the # gtts/minute = \(\frac{\# \text{ cc/hour}}{3}\)
CALCULATING DRIP FACTORS

PROBLEMS

1. D5 .45 1000cc with 40 meq KCL – Infuse at 70 cc/hr.
   Macrodrip:  
   Microdrip:  

2. D5W 500cc – Infuse over 24 hours.
   Macrodrip:  
   Microdrip:  

3. NS 1 liter with 20 meq KCL – Infuse over 8 hours.
   Macrodrip:  
   Microdrip:  

4. Lactated Ringers 2 L in 24 hours.
   Macrodrip:  
   Microdrip:  
CALCULATING DRIP FACTORS

5. PPN at 125 cc/hr.
   Macrodrip:  
   Microdrip:

6. pRBC’s, one unit (300 cc) over 2 hours.
   Macrodrip:  
   Microdrip:

7. NS, 3 L in 24 hours.
   Macrodrip:  
   Microdrip:

8. 5% dextrose in water 1 liter in 4 hours.
   Macrodrip:  
   Microdrip:
TPN
&
PPN
TPN/PPN COMPOSITION

DEXTROSE IN WATER: Provides calories for metabolism

AMINO ACIDS: Provides protein necessary for tissue repair

POTASSIUM: Needed for cellular activity and tissue synthesis

FOLIC ACID: Necessary for DNA formation; promotes growth and development

VITAMIN D: Essential for bone metabolism and maintenance of serum calcium levels

TRACE ELEMENTS: (i.e. zinc, manganese, cobalt) Helps in wound healing and red blood cell synthesis

SODIUM: Helps control water distribution and maintain a normal fluid balance

CHLORIDE: Regulates the acid-base equilibrium and maintains osmotic pressure

VITAMIN B COMPLEX: Helps in final absorption of carbohydrates and protein

CALCIUM: Needed for bone and teeth development; aids in blood clotting

PHOSPHATE: Minimizes the threat of peripheral paresthesias

MAGNESIUM: Helps absorb carbohydrates and protein

ACETATE: Added to prevent metabolic acidosis

VITAMIN K: (optional) Helps prevent bleeding disorders

VITAMIN C: Helps in wound healing
PARENTERAL NUTRITION

Total Parenteral Nutrition (TPN)
The intravenous administration of protein, calories, electrolytes, minerals, and vitamins to achieve tissue synthesis and anabolic status in a patient whose condition precludes adequate oral/enteral intake. Indications are GI fistulas, inflammatory bowel syndrome, short bowel syndrome, pancreatitis, acute renal failure, prolonged ileus, trauma, large burs, large nitrogen loss from infected wound, respiratory failure, sepsis, hepatic failure, cancer.

Composition
- Carbohydrate in form of dextrose (40-50%)
  - To provide calories and prevent gluconeogenesis (breakdown of protein for energy).
- Amino Acids
  - Synthetic crystalline amino acids provide nitrogen that is essential for tissue growth and repair
    - Positive nitrogen balance = anabolism = protein “spared” for tissue maintenance
    - Negative nitrogen balance = catabolism = protein is used for cell energy
- Electrolytes
  - Type and amounts determined by patient need
- Water and fat-soluble vitamins
  - Usually added; more research is usually needed to determine accurate IV vitamin requirements
- Fat emulsion
  - To prevent essential fatty acid deficiency and help control hyperglycemia; can be given as 3 in 1 solution

Partial (Peripheral) Parenteral Nutrition
Provides nutrient concentration capable of infusing in peripheral veins (i.e. glucose ≤ 15%) Use is limited to supplemental therapy because sufficient calories cannot be provided peripherally. Fat emulsion can be administered via peripheral vein because it is an isotonic solution.

<table>
<thead>
<tr>
<th>Differences between TPN and PPN</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>TPN</strong></td>
</tr>
<tr>
<td>Administered only by RN’s</td>
</tr>
<tr>
<td>Given only via central line</td>
</tr>
<tr>
<td>Contains more glucose and amino acids</td>
</tr>
<tr>
<td>Often has insulin added</td>
</tr>
</tbody>
</table>
PARENTERAL NUTRITION

OBJECTIVES OF THERAPY

<table>
<thead>
<tr>
<th>The average American diet is:</th>
<th>10-15% proteins</th>
<th>40-45% carbohydrates</th>
<th>40-45% lipids/fats</th>
</tr>
</thead>
</table>

- Meet energy needs
  - Metabolism of carbohydrates
    - The body metabolizes CHO for immediate use and storage. Approximately half the CHO we ingest is converted to glucose which circulates in the blood and is taken in by the cells to be utilized for energy. All the other sugars are stored for quick energy reserves. This is the body’s primary source of immediate energy.
  - Metabolism of lipids
    - This is the chief stored energy source. One gram of fat produces 9 kcal. After hydrolysis, the lipoproteins take on one of two paths. Some are modified and are distributed among the adipose tissues which can be released as free fatty acids to the heart, kidney, muscle, and other cells where they are oxidized for energy. The rest of the lipoproteins are distributed in the adipose tissue cells.
  - Metabolism of protein
    - If the energy needs of the body are met by CHO and lipid intake, the protein intake is used for the replacement, growth, and repair of tissues, the maintenance of circulating proteins, and the production of enzymes

- Meet metabolic needs
  - Maintenance
  - Tissue repair
  - Suppressing bowel function if necessary (bowel rest)

- Correct imbalances

CRITICAL POINTS IN MANAGEMENT

- Start and discontinue therapy slowly
- Always use IV pump
- Monitor serum glucose (accu-checks)
- Obtain accurate daily weights and I&O
- **Asepsis, Asepsis, Asepsis** – all throughout therapy!
- Report any problems to RN or MD immediately
- IV tubing changes per facility policy (usually every 24 hours)
- Use in line filters per facility policy
- Consider using a dedicated line for TPN/PPN, as per facility policy
**PARENTERAL NUTRITION**

**INTRAVENOUS NUTRITIONAL SUPPLEMENTATION**

**REMEMBER** those SIGNS and SYMPTOMS........

<table>
<thead>
<tr>
<th>HYPOGLYCEMIA</th>
<th>HYPERGLYCEMIA</th>
</tr>
</thead>
<tbody>
<tr>
<td>generalized muscle weakness</td>
<td>headache</td>
</tr>
<tr>
<td>faintness</td>
<td>frequent urination</td>
</tr>
<tr>
<td>pounding of heart</td>
<td>heavy, labored breathing</td>
</tr>
<tr>
<td>impaired vision</td>
<td>nausea</td>
</tr>
<tr>
<td>irritability</td>
<td>confusion</td>
</tr>
<tr>
<td>excessive sweating</td>
<td>increased thirst</td>
</tr>
<tr>
<td>hunger</td>
<td>weakness</td>
</tr>
<tr>
<td>trembling</td>
<td>loss of appetite</td>
</tr>
<tr>
<td>headache</td>
<td>generalized aches</td>
</tr>
<tr>
<td>personality changes</td>
<td>“fruity” breath</td>
</tr>
</tbody>
</table>
BLOOD
and
Blood product
Administration
TRANSFUSION THERAPY

Main Objectives
- Maintenance of blood volume
- Maintenance of oxygen-carrying capacity of blood
- Maintenance of coagulation

Principles of Replacement
- Identify cause of deficiency
- Replace only the deficient component
- Maintain safety

Blood and blood components

- **Whole Blood**
  - 1 unit = 500cc
  - 45% RBC
  - “Fresh” <= 24 hour hold
  - Lifespan
    - RBC in our body – 120 days
    - Banked blood, preservative solution added (usually acid-citrate-dextrose), stored 1-6 degree C – shelf-life up to 35 days
  - Uses
    - Replacement of blood volume lost in massive bleeding
    - Exchange transfusions
  - Limitations
    - Deficient in platelets clotting factors, granulocytes
    - Large volume
    - Preservatives bind calcium

- **Packed Red Blood Cells**
  - 1 unit = 250-300cc
  - 2/3 of plasma removed by centrifugation
  - Preservative added – shelf life up to 42 days
  - 1 unit can increase Hct. Approximately 3% (usually not evident until 1-2 hours after transfusion)
  - Uses
    - To increase oxygen-carrying capacity in chronic anemia and slow hemorrhage
    - Reduces danger of hypervolemia
  - Limitations
    - No viable platelets or granulocytes

- **Leukocyte-poor Red Blood Cells**
  - 70-90% of leukocytes, platelets, and debris removed by centrifugation or filtration
• **Leukocyte-poor Red Blood Cells** (continued)
  ▪ **Uses**
    ▪ Reduces risk of nonhemolytic febrile reactions in susceptible individuals
  ▪ **Limitations**
    ▪ Preparation may reduce red cell mass to 70%
    ▪ 24 hour shelf life

• **Plasma**
  ▪ 1 Unit = 225cc
  ▪ Liquid remaining after RBC’s removed from whole blood
  ▪ Stored liquid form or frozen (up to 5 years)
  ▪ **Uses**
    ▪ Replaces plasma protein without overloading circulation with RBCs
    ▪ Replacement of clotting factors
    ▪ Supplies other components/derivatives: platelet concentrates, cryoprecipitate, serum albumin, plasma protein fraction, factor VIII and IX concentrates, immune serum globulins (i.e. HBIG)

• **Platelets**
  ▪ 1 unit (suspended in 30-50cc plasma) can increase platelet count by 5,000-10,000
  ▪ **Uses**
    ▪ Thrombocytopenia
    ▪ Platelet dysfunction

**Rules for Safe Blood Administration**

• **Inspect the blood bag** for tears or inadequately sealed closures; if there is a problem, return to blood bank
• **Inspect the blood** for discoloration or gas bubbles; if these are present, the blood is probably contaminated and should be discarded (look for a purple, red, or brown color to the plasma; indicative of hemolysis).
• **Proper Identification**
  ▪ Cross check the blood identification data against the patient’s identification to assure giving the right blood to the right patient. Identify the patient by asking for a name and date of birth (or other identifier specified by facility) by checking the wrist ID band.
  ▪ **Use particular caution** when the patient has a common name; many errors have occurred by not checking beyond the last name and the first initial.
  ▪ **Always** check patient identifiers, blood type and the expiration date of the blood with another registered nurse or a physician for validation
Rules for Safe Blood Administration (continued)

- Check the assigned blood bank number on the unit with the number on the requisition, in addition to the blood type, Rh factor, and the expiration date and double check this with another licensed person.
- Be aware that a unit of blood (500ml) can usually be administered to an adult in a 1 1/2 to 2 hour period.
- Unless the patient is severely hypovolemic, blood should not be given faster than 500ml in 30 minutes.
- Patients with cardiac, renal, or liver damage may require a much slower than normal rate (such as 1 unit over a 3-4 hour period).
- Use a small container of isotonic saline (0.9% NaCl) as a starter solution for blood administration.
  - Do not use dextrose and water solutions since they cause aggregation of red blood cells (rouleaux formation). Do not use calcium containing solutions (such as lactated Ringer’s) since they may cause formation of clots in the in the blood administration set.
- Collect baseline data (temperature, pulse, respiration, lung sounds, complaints of pain, and urine color) prior to starting the transfusion. This data serves as a comparison for changes occurring during the transfusion.
- Start blood within 30 minutes after it is delivered to the nursing unit – do not store it in the unit refrigerator.
  - Rapid deterioration of RBCs occurs after blood has been exposed to room temperature for more than 2 hours. If the patient requires a slow administration rate, the time of exposure to room temperature becomes critical. Unit refrigeration is inadequate for storage of blood because it is not controlled and has no alarm to fluctuations in temperature (accidental freezing of blood renders it unsuitable for use).
- Give blood through a blood filter to remove the particulate matter formed during storage
  - All blood administration sets are equipped with standard filters to trap particulate matter
  - A condition know as post-transfusion lung syndrome can occur when multiple units have been transfused through a standard (170 micron) filter (allowing particulate matter to enter the pulmonary system).
  - It has been recommended that microaggregate filters (40 micron and smaller) be used when more than 2 units of blood are to be given in 1 day and in all patients with respiratory insufficiency.
- The first 15 minutes of the transfusion is a critical time and the patient should be carefully monitored for adverse reactions. (see section dealing with complications). After the first 50ml has infused with no adverse reactions, the rate may be increased to allow the blood to infuse in a 1 1/2 to 2 hour period (unless a slower rate is indicated).
Rules for Safe Blood Administration (continued)

- Check the patient at least every 30 minutes (including vital signs as indicated) throughout the transfusion for adverse reactions.

- **If a reaction occurs:**
  - Stop the transfusion
  - Keep the vein open with the starter solution (usually isotonic normal saline).
  - Contact the physician to report the patient’s condition and to receive treatment orders
  - Other procedures vary with the type of reaction (discussed later).
  - Document in the patient’s medical record time of reaction, symptoms, MD notification, lab notification, urine specimen sent to lab, transfusion set-up sent to lab, transfusion reaction study (incident report form) completed, treatment of patient condition.

- **Be aware that a unit of blood should not be infused longer than 4 hours.** If the transfusion of 1 unit will take longer than 4 hours, the unit should be divided by the blood bank into 2 containers to avoid prolonged exposure to room temperature.

- Warm blood, when indicated, by means of a mechanical blood warmer or a warm-water coil apparatus. Never use hot water or a microwave to warm blood since excessive heat destroys red blood cells.

- Change the IV tubing every 2 to 4 units of blood and not less often than every 24 hours.

- Record vital signs immediately post-transfusion and 30 minutes later.

**Transfusion Reactions**

<table>
<thead>
<tr>
<th>Febrile, Non-Hemolytic</th>
<th>Anaphylaxis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>Circulatory Overload</td>
</tr>
<tr>
<td>Chills</td>
<td>Sepsis</td>
</tr>
<tr>
<td>Headache</td>
<td>Hepatitis B</td>
</tr>
<tr>
<td>Apprehension</td>
<td>Hepatitis C</td>
</tr>
<tr>
<td>Anxiety</td>
<td>HIV</td>
</tr>
<tr>
<td>Facial flushing</td>
<td>Iron Overload</td>
</tr>
</tbody>
</table>

Mild Anaphylaxis

<table>
<thead>
<tr>
<th>Flushing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Itching</td>
</tr>
<tr>
<td>Hives</td>
</tr>
</tbody>
</table>
When a Transfusion Reaction Occurs

1. **STOP THE TRANSFUSION.**
2. Keep the IV open with 0.9% normal saline.
3. Report the reaction to both the transfusion service (lab) and attending physician immediately.
4. Treat symptoms per physician’s orders and monitor vital signs.
5. Do clerical check at bedside of identifying tags and numbers.
6. Send blood bag with attached administration set and labels to the transfusion service.
7. Collect blood and urine samples and send to lab.*
8. Document thoroughly on transfusion reaction form and in patient chart.

*Check with the transfusion service to determine the specific blood and urine samples needed to evaluate reactions.
CLINICAL SCENARIOS
**IV Therapy Clinical Scenarios**

1. Your Charge Nursed asked you to superimpose a liter of D5/0.45 NaCl on one of your patients, Greg Smith. When you walked into Mr. Smith’s room, you noted two bags of solution are infusing:

   ![Almost Empty](image1)
   ![About 50cc in the bag: still infusing](image2)

   What will you do?

2. The doctor ordered Ringers Lactate, 1000cc, to infuse at 200cc/hour. What kind of IV tubing will you use? What should the flow rate be – gtt/min?

3. In report, you were told that your patient is receiving D5W TKO and that a new 500cc bag was hung an hour ago. When you made your rounds, you noted that there’s 250cc’s left in the bag. What will you do?
4. Your patient has been quite restless. When you make your rounds, you note that blood has backed up in the IV tubing and the flow has stopped. What will you do?

5. Your patient was supposed to receive D5/NS at 125cc/hour. In report you were told that a new bag was hung 3 hours ago. When you make your rounds, you note that the bag still contains 1000cc's and the IV is infusing very slowly. What will you do?

6. Your patient is very upset because there are some small bubbles in the IV tubing. What will you do?

7. The doctor ordered an IV of NS, 2000cc over 12 hours. What kind of tubing will you use? What should the flow rate be – gtts/min?

8. In moving your patient from the wheelchair to his bed, the IV tubing was accidentally disconnected from the hub and the end of the tubing landed on the wheelchair. What will you do?
9. Your patient is receiving 0.45 NaCl at 150cc/hour. She complained of discomfort at the site. Upon inspection, you note that the area is slightly reddened and tender. She has poor veins. What will you do?

10. Your 70 year old patient is receiving D5/NS at 125cc/hour. He started complaining of increasing difficulty in breathing. He is tachypneic and on auscultation you can hear crackles (gurgling sounds). His neck veins are distended in spite of the fact that you have elevated the head of the bed 90 degrees. What will you do?

11. When you entered the room on your rounds you noticed that the bag of D5W hanging has an expiration date of January 2011. What will you do?

12. You have entered Mrs. Johnson's room to check the flow rate of her IV. When you check the bag, you note “D5NS #5” is hanging. On the MAR, it is indicated that bag #5 should be is D5/1/2 NS. What will you do?
13. Your patient is receiving Normal Saline as a maintenance IV & another solution with medication. As you are adjusting the flow rate of the NS you note that the solution is cloudy with particles floating in it. What will you do?

14. When you observe the IV site of your patient, you note a white, raised area about 3” in diameter, cool to touch & tender. What would you suspect? What will be your action(s)?

15. The patient arrives from ER with a glass bottle of D5 W with Nitroglycerin in it. As you inspect the bottle for labeling, you note a hairline crack in the bottle, possibly due to transfer efforts. What will your actions be and why?

**OR:** your pt arrives with a bag of the same IV fluids and Medication, but the patient does not seem to be obtaining relief of his pain……what might you consider checking?

16. Your IV pump just broke down and you cannot find a replacement machine, so you must run the IV off the pump until you can get another one. The IV tubing set in use is a macrodrip set (15 drops/cc). You need to deliver the IV at 75cc/hr. What should the flow rate be— in gtts/min?
17. The pediatrician orders 500cc NS to be infused in 8 hours. What kind of IV tubing will you use? What should the flow rate be—gtts/min?

18. The physician order reads “run IV 100cc D5/.45% NS at an 8 hour rate”. What kind of IV tubing will you use? What should the flow rate be—gtts/min?

19. A 6 y/o male was brought to ER with fever, dehydration, & lethargy. You need to start an IV. How would you prepare the patient & parents?

Where would you look for a phlebotomy site? Why?

20. An 87 y/o woman with CHF is brought to the clinic on a 103 degree day. Her daughter states she is lethargic, won’t eat/drink, & hasn’t used the bathroom all day. What symptoms would you expect to observe for?

What labs would you be expected to draw?

What IV solution might you be starting?

What treatment would you expect?
Pediatric IV therapy: Soothing the patient

Starting an IV on a small child takes more than technical skill. The child—and her parents—will also need a good deal of support through a procedure they may well view as an ordeal. Here we address both concerns in two articles on pediatric IV therapy. In the first, we review the emotional needs of these young patients and give you ways to meet those needs. In the second, we focus on how to do the procedure as quickly and painlessly as possible.

Infants and toddlers need peripheral IV therapy for all of the reasons adults need it: to receive medications, transfusions, fluids, or parenteral nutrition. But their response to the start of therapy is generally much more dramatic, and it can complicate the procedure. Even the most experienced IV therapist may have trouble inserting a catheter into a distraught child.

These littlest patients haven't developed the skills adults use to cope with pain, or what they think will be painful. A toddler, for example, may start to cry or struggle because she does not have the words to express her fears. A parent's apprehension may heighten the child's anxiety, making the situation more difficult.

Taking the time to allay a parent's concerns and prepare the child won't eliminate the pain of venipuncture, but it can make the procedure less traumatic—for all of you.

For parent and child alike: Keep preparation simple

Well-informed parents are more likely to stay calm, and their infant or toddler will pick up on that and be less apprehensive, too. Encourage them to ask questions. If it's not an emergency, go over the procedure step by step, explaining what IV therapy is and why the child needs it. Most parents, for instance, are usually relieved to learn that we use just a small needle, and that only a soft plastic catheter will remain in the child's body.

If you're going to have to use a scalp vein, be sure to tell them that the needle won't penetrate the infant's skull or brain tissue. Save any hair that's shaved. That will probably be the baby's first haircut, and parents will appreciate the keepsake.

Much of what you tell the parents will also make sense to a 2- or 3-year-old. Nevertheless, age-appropriate teaching aids will get the message across to a toddler—and help calm her down—

VICKI FREDERICK is a parenteral support nurse at Le Bonheur Children's Medical Center in Memphis, Tenn. As the mother of two young children who once needed frequent IV therapy, she has special insight into the emotional needs of patients and parents.

STAFF EDITOR:
Mary Lou Harley
better than a straight verbal explanation. When there's enough time, we always prepare the child slowly, using coloring books with stories about hospitals and IV therapy.

Although she can understand things pretty well, the toddler still lacks the necessary language skills for asking questions about something as technical as IV therapy. She can express her uncertainties, though, through play. For that reason, we often show how the therapy works by inserting an IV catheter in a doll or stuffed animal. It’s not unusual to see the child then pretend to start an IV on the doll herself. We use puppets, too, to get her to talk about her fears. For example, a puppet on a nurse’s hand might “tell” the child of her own fear of getting a needle; the child usually responds “Me, too!”

Since a child this age has a short attention span and is more likely to become anxious if prepared too far in advance, we explain the procedure and let her touch the equipment immediately before we actually start the IV.

When that time comes, try to let the child have as much control as possible but don't offer a choice unless you are prepared to go along with the one she makes. Be careful to avoid questions such as: “It’s time to start your IV, OK?” The answer will almost certainly be “No.” It’s better to say, “Let’s get your IV started and then we’ll color afterward.”

If at all possible, we do most of the teaching and explanation about the procedure right in the child’s room, but we take her to a treatment room to perform the actual procedure. That allows the child to see her room as a safe place, a haven from frightening or painful procedures. After the IV is started, we try to get her back to her room as soon as we can.

**Should the parents be there or not?**

Let the parents decide whether or not they want to be present for the procedure. Some feel it’s essential to be on hand to comfort their child, while others know they’ll just get upset and make her more afraid. Whatever their decision, respect it. Those who stay aren't better parents than those who don’t.

For parents who choose not to stay, suggest that they take a coffee or soda break in the cafeteria so they won’t see or hear the child cry. For those who do choose to stay, leave the child in their arms as long as possible. Encourage them to remain close throughout the procedure and comfort the child by touching,
carressing, talking, or singing. Have them sit or stand by her head, so she can see them and they can focus on her emotions rather than the insertion.

Never ask them, though, to help restrain the child. If you need help, call in another healthcare professional, and tell the child this person is there to help her stay still.

Don't tell the child that the parents' presence hinges on her behavior. You shouldn't say, for example, "If you're good and hold still, Mom can stay, but if you don't cooperate, she'll have to leave." Remember that a small child isn't bad because she cries and fusses. It's just her way of coping. Comfort her by telling her it's OK to cry.

Whether or not the parents are present, a pacifier, a special blanket, a music box, or a favorite toy may help ease the child's anxiety. These diversions won't keep her from crying, but they may make her feel better while she cries. Don't give her a bottle or food, though, because she might choke.

Making venipuncture easier on the child

If she finds comfort in sucking a thumb or has a dominant hand, we avoid using that hand for the IV unless we have no other choice. Even then we try to leave the thumb or preferred finger accessible when we secure the catheter.

Before venipuncture, we often secure the arm or leg to a padded board with tape to make the procedure go faster. We talk quietly and soothingly throughout the procedure, telling the child, for example, "Now, you'll feel a little stick. It'll just hurt for a minute. Then we'll take the needle out and leave in a small tube." She may not understand your words, but she'll be comforted by your tone.

To protect our pediatric patients from countless attempts at venipuncture, our hospital recently set a limit of six. The protocol goes as follows: The child's primary nurse tries twice to insert a catheter: if she doesn't succeed, she calls in a more experienced nurse, who also has two opportunities. Next a paracentral support or ICU nurse has two tries. If all these attempts fail, we notify the physician, who tries himself, inserts a central line, or, if possible, changes the medication to IM or PO.

The standards of the Intravenous Nurses Society are much stricter, however: They recommend no more than two attempts at venipuncture in any patient. If your hospital doesn't have a policy, you and your colleagues may want to speak to your supervisor or the nursing advisory committee about developing one. If there isn't an advisory committee in your department or hospital, try to start one. Your young patients and their families will be grateful for your advocacy.

Continue to make the child comfortable afterward

Once you've inserted the IV catheter, reassure the child that the worst is over as you cover it with a sterile dressing that allows visibility of the site and surrounding tissue.

If the parents are staying with the child—and most do at this point—explain how they can protect the IV. They're usually grateful to learn there's something they can do to help. Tell them to keep the child from bumping it and from sleeping in positions that impede circulation in the limb. Stress that the child must not tug or play with the IV.

Sometimes, restraints are necessary, especially when parents are unable to supervise. We use the kind that are soft and comfortable, putting them on only the affected extremity. We also keep them loose enough to allow for some movement, taking them off frequently to let the child play.

When the IV is secure, continue to provide emotional support. Cuddle the small baby, play peek-a-boo with the 10-month-old, and listen to a toddler's description of getting "stuck." We also let the toddler play with toys that help him release some of his anger. A child with an IV in his left arm, for example, can still throw a ball with his right or give a right uppercut to a punching bag.

Answer the parents' questions about keeping the child still, ongoing therapy, or his next treatment. By showing that you care, you make the start of IV therapy a bit easier on everyone.

REFERENCES

Pediatric IV therapy: Starting the line

Now that you've prepared your small patient for IV therapy and calmed his parents, it's time to start the procedure. Selecting a vein, distending it, and puncturing it without infiltration can be difficult, but taking time to comfort the child during the procedure will help make things go smoothly.

Your young patient may protest loudly despite your best efforts. But if you keep in mind the following advice, you'll increase your chances of success.

Choosing the site that's most promising

As with adults, always select a site at the most distal point on a limb, reserving sites higher up in case you need them later. Avoid those areas below previous sites that have infiltrated or are inflamed.

You also try to avoid the joints because of the risk of infiltration with arm movement. This is an even bigger concern with children, since they wriggle more. However, when a child's veins are small and hard to locate, or they have been damaged by earlier IVs or failed attempts, you may need to use whatever veins are best even if they're in the antecubital fossa or at the wrist.

Start your search for a good vein at the hands and forearms. A good choice is the dorsal venous arch on the back of the hand. Other options include the cephalic vein, which starts just above the thumb, and continues around to the inside of the arm and up to the antecubital fossa. Sometimes overlooked, it is a large vein that is well-secured to the fascia.

If you must use a vein in the inner wrist, be sure you palpate very carefully to determine how deep the vessel is—puncturing radial and ulnar arteries or nerves with catheter insertion could seriously damage blood supply to the area.

Even when an earlier IV has infiltrated in the forearm, you may still be able to find a usable vein in the upper part of the arm. If you use a vein close to a previous infiltration, make sure that venous flow will be clear above that point. Another option is to find an alternative vein in another extremity.

Other good sites are the feet and lower legs, although mobility problems would have to be your guiding consideration in a child who's already walking. The dorsal arch, formed by the dor-
sal and digital veins, on the top of the foot is a good possibility if you do use a site on the foot. In a chubby infant or toddler, consider the great saphenous vein. Look for it 1 cm above the inner ankle bone, running up the inside of the leg. Like the cephalic vein in the arm, it is large and well-secured by connective tissue, making it less likely to move when you attempt to insert the needle.

Scalp veins, which are closer to the surface and easier to see than those in the limbs, can be used in infants up to the age of 9 months. At some hospitals scalp veins are used routinely; at others, they are used only when other veins are inaccessible. Although temporal veins in front of the ear are the largest and easiest to locate, there’s a good possibility of hitting an artery, so you may want to think about using a vein behind the ear instead. The frontal vein, down the middle of the forehead over the anterior fontanel, is another good choice.

**Tips on making veins easier to see**

It may be difficult to locate your patient’s tiny veins through palpation alone. If the child has dark skin, wipe the area you’ve selected with povidone-iodine (Betadine) to help make veins visible. With a chubby baby or toddler, try pressing an alcohol wipe several times along the suspected path of the vein. You may see the vein for a second as it fills up with blood. Once you have found it, leave the pad 1 to 2 cm above your intended insertion site, with a corner on the line of the vein. This marker points the way for you and prevents you from losing your place.

Another tip: If you’re using a vein in the antecubital fossa, rotate the forearm while palpating the area to distinguish a vein from a tendon. A tendon will roll as you rotate the arm.

With a very thin child or a newborn, try turning off the lights and putting a flashlight under the hand or wrist to illuminate the tiny veins. This technique is also helpful in finding veins in a hand darkened by hematomas from prior sticks. The vein should still look darker than the hematoma.

You can also make veins easier to see by distending them. Gently tap a vein with your fingers, apply a tourniquet, or let the arm or leg hang below heart level. If, with all this maneuvering, you still can’t find a vein, wrap the limb in a warm washcloth or diaper for five minutes. Just be sure it’s not too hot.

**Preparing the child for the venipuncture**

Have at least one colleague on hand to help you keep the limb stable and hold down the child, if necessary. To immobilize an infant’s hand while attempting the dorsal arch, flex his fingers toward the inner arm, placing your thumb over the fingers and your fingers around the wrist. A toddler can fight this process pretty forcefully, so it may be better to tape the hand down to a padded board before beginning. Doing so helps the child keep it still during insertion and tapping.

If you’re going to use the great saphenous vein, point the toes down and then tape the leg to a board. To immobilize the child’s limb, have another nurse hold the upper leg down firmly.

To keep the head steady for safe insertion in a scalp vein, have one colleague hold the infant from behind, placing her hands on either side of the head. Ask a third nurse to keep the infant’s body still. Wrapping the child’s body with a sheet or baby blanket may help.

Although you can use a tourniquet to distend arm and leg veins just prior to venipuncture, use a rubber band for scalp veins. Attach a piece of tape as a handle, but remember that infant veins are fragile and may rupture from the pressure. You are more likely to prevent rupture by using a finger instead of a rubber band to occlude the vein.

**Adjusting your technique to the child’s small vessels**

Once the patient is ready, you’ll turn to the actual insertion. Your supplies, including the properly sized over-the-needle plastic catheters, should already be on hand. For infants and young children, the proper gauge usually ranges from 20 to 24, depending on the size of the vein and the type of fluids or medications to be given. Some hospitals now use a new catheter that expands once it’s inside the vein of an infant.

You’ll also need a T connector and saline flush and either a heparin lock or IV solution, tubing, and pump. Other necessary supplies include several quarter-inch strips of tape and a sterile dressing for the site.

Always follow universal precautions. Wash your hands and put on gloves. Clean the site according to hospital protocol. We use povidone-iodine, though al
Where to place the needle

The hands, forearms, feet, and scalp are the most common sites used for IV therapy in infants and children. Some of the veins used most often are shown here.
cohol is also an option. Just be sure you don’t use alcohol after you’ve already wiped an area with povidone-iodine, since alcohol cleans everything off. If the vein is small relative to the catheter, some nurses turn the needle so the bevel is down. This minimizes the chance of cutting through the far side of the vein and causing extravasation. Normally, you’d turn it up to lessen trauma to the skin and vein. As with adults, insert the catheter at a 30° to 45° angle through the skin and tissue. If you have not pierced the vein with the initial puncture, reduce the angle of the catheter so it is almost parallel to the skin for the venipuncture itself.

After you see blood in the flash container of the catheter, you need to advance the needle a little to make sure it’s in the lumen of the vein. With an adult, you might continue for another three-quarters of an inch, but with a newborn, even 2 mm could damage the vein’s far wall. Hold the needle steady and try advancing just the catheter with the thumbnail of your free hand.

To prevent blood loss, press your finger on the vein just proximal to the catheter after you remove the needle, and attach the T connector to the hub of the catheter. Discard the needle in a sharps container immediately, without recappping it. If you think you’re in the vein, but the catheter won’t advance, attach a syringe filled with saline to the T connector and flush the catheter at the same time you advance it. The catheter may have been up against a valve in the vein; this technique will open the valve and allow the catheter to pass through.

Next place a short piece of tape over the hub of the catheter. The child may still be struggling and the tape will help stabilize the catheter. Flush with saline and check to see if there is a blob at the insertion site—evidence that the line has infl-

---

**How to start an IV in a child**

Whether you’re experienced or a novice in IV therapy, this step-by-step box, using the chevron method of taping, makes a handy reference for a quick review or to pass on to a colleague.

1.

To access a vein on the top of a child’s hand, flex her fingers towards her inner arm and hold them in place.

4.

Hold the needle steady and advance the catheter slowly with the thumbnail of your other hand.

5.

Remove the needle and press your finger on the vein just above the catheter to stop bleeding.
trated and the saline is leaking into surrounding tissue. You may apply an antibacterial ointment before covering the site with a sterile, transparent dressing.

Finally, begin taping. We put one piece of tape over the catheter at the insertion site. Then we place another piece—with the sticky side up—underneath the catheter and fold it parallel to the catheter in an H pattern or across it in a chevron or V pattern. We secure the catheter by adding a horizontal piece of tape and repeating the pattern once or twice more. It should be held firmly, but don't tape all the way around the limb, as this will obstruct blood flow. Attach either the heparin lock or IV tubing to the T connector and tape the tubing to the child's arm.

After you've started the IV, monitor the child's status at least once an hour. Continue to check the insertion site for swelling, redness, pain, and signs of infiltration, phlebitis, or leakage at the site. Be sure you use a pump for continuous infusion and carefully monitor to avoid fluid overload. Watch for other systemic complications of IV therapy, including signs of sepsis, and air or catheter embolism. Check for side effects of IV medications, too, keeping in mind that the parenteral route is the most direct administration and the one most prone to adverse reactions.

Your attention to detail at the start of therapy will make your small patient as comfortable as possible and minimize the risk of complications later on.

REFERENCES