Calculating IV Drips Accurately

NYSNA Continuing Education

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Declaration of Vested Interest: None

NYSNA wishes to disclose that no commercial support of sponsorship was received.

NYSNA course planners and authors declare that they have no conflict of interest in this course.

How to Take This Course

Please take a look at the steps below; these will help you to progress through the course material, complete the course examination and receive your certificate of completion.

1. **REVIEW THE OBJECTIVES**

   The objectives provide an overview of the entire course and identify what information will be focused on. Objectives are stated in terms of what you, the learner, will know or be able to do upon successful completion of the course. They let you know what you should expect to learn by taking a particular course and can help focus your study.

2. **STUDY EACH SECTION IN ORDER**

   Keep your learning by reviewing the materials in order. This will help you understand the sections that follow.

3. **COMPLETE THE COURSE EXAM**

   After studying the course, click on the "Course Exam" option located on the course navigation toolbar. Answer each question by clicking on the button corresponding to the correct answer. All questions must be answered before the test can be graded; there is only one correct answer per question. You may refer back to the course material by minimizing the course exam window.

4. **GRADE THE TEST**

   Next, click on "Submit Test." You will know immediately whether you passed or failed. If you do not successfully complete the exam on the first attempt, you may take the exam again. If you do not pass the exam on your second attempt, you will need to purchase the course again.

5. **FILL OUT THE EVALUATION FORM**

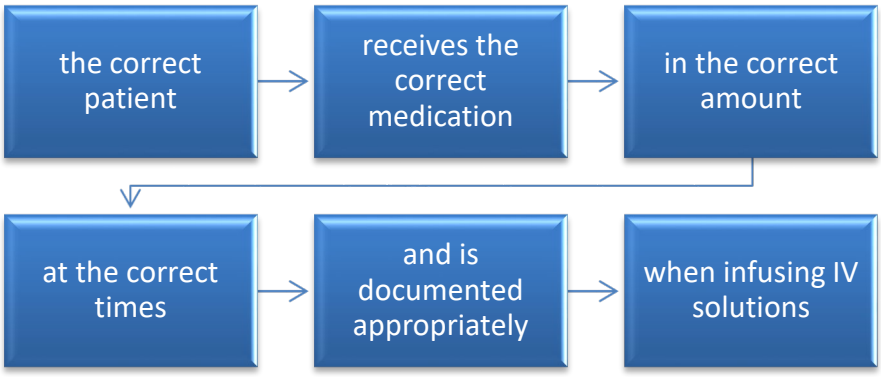
   Upon passing the course exam you will be prompted to complete a course evaluation. You will have access to the certificate of completion **after you complete the evaluation**. At this point, you should print the certificate and keep it for your records.

Introduction

Many medications are delivered intravenously (IV). Like all other medication administration procedures, the "Eight Rights" are essential:

1. Right Patient
2. Right Medication
3. Right Dose
4. Right Time
5. Right Route
6. Right Documentation
7. Right Reason
8. Right Response

IV fluids with or without additives are medications. Therefore, *it is essential that…*



The Joint Commission, Standard **MM.06.01.01** The hospital safely administers medications, states:

Before administration of medications, the individual administering medications should do the following:

- Verify that the medication selected matches the medication order and product label;
- Visually inspect the medication for particulates, discoloration, or other loss of integrity;
- Verify that the medication has not expired;
- Verify that no contraindications exist;
- Verify that the medication is being administered at the proper time, in the prescribed dose, and by the correct route; and
- Discuss any unresolved concerns about the medication with the patient's licensed independent practitioner, prescriber, and/or staff involved with the patient's care, treatment, and services.
- Before administering a *new* medication, the patient or family is informed about any potential clinically significant adverse drug reactions or other concerns regarding administration of a new medication.

(Joint Commission Resources, 2017.)

Many nurses today work in facilities where electronic devices automatically calculate drip rate factors and deliver the amount of fluid/medication needed as scheduled. The nurse uses the device's built-in computer, entering the amount of fluid and the time it is to run; the infusion machine then calculates the rate of infusion. The nurse generally relies on the machine and never calculates a drip rate themself. They believe the days of "counting drops" are long gone; they may even have forgotten how to calculate and measure intravenous drug dosages. In fact, many nurses lack confidence in performing basic math calculations. This has been identified as a patient safety issue among nursing students and Registered Nurses (Lee, 2009).

New devices and “smart pump” technology has entered the market. Hospitals now regularly rely on technology, such as infusion pumps with built in software at the point of interaction with the nurse. The use of such equipment can reduce medication errors. It should be noted that one of the National Patient Safety Goals, identified by The Joint Commission, is to improve the safety of using infusion pumps and ensure free-flow protection on all general-use and patient controlled analgesia (PCA) infusion pumps used in an organization.

It is important to remember that even in facilities where the use of electronic devices is standard, the nurse has the obligation of administering medications correctly and therefore must be knowledgeable and competent in the calculation of doses and IV flow rates. The nurse is responsible for double-checking all drug and IV drip calculations (McMullen, Jones, & Lea, 2010).

- ✓ What if there suddenly are not enough pumps to go around?
- ✓ What if the pump breaks and there is no replacement available?
- ✓ What if you change jobs and infusion pumps aren’t used in the new place?
- ✓ What if the pumps battery dies while in transit to a procedure?
- ✓ What if the electricity is out for long periods of time during a disaster?

If this happens, there may not be time to look up a formula.

It’s never enough to rely on electronic devices; nurses must be prepared to administer IV solutions accurately with or without a pump. The ability to calculate accurate administration rates is essential. Errors that occur in IV medication/solution administration have the potential to be more deadly even quicker than other medication errors. Ignorance is not an acceptable excuse or defense.

In an article in *Nursing 97* (1997), the author tells of her experience as a new nurse who was anxious about calculating an IV drip rate. Rather than calculate the drip rate, she consulted the pharmacist who calculated for her. When she returned to work the next day an incident report had been filed because the patient had received half the required dose of dopamine. There is no acceptable defense for this and the author learned that there is also no substitute for doing one’s own drug calculations and double checking them. Even if IV solutions come from the pharmacy with labeled directions for flow rates, the nurse administering the solution, as the individual responsible for the administration, must do the calculation and verify that it is correct before hanging.

This course covers basic principles of administration of IV fluids and calculation of IV drip rates. Mathematical calculations will be demonstrated and opportunities for self-assessment are included.

Objectives

After reviewing this self-study module, the learner should be able to:

- Describe general principles for the administration of intravenous therapy.
- Discuss the use of infusion devices for intravenous therapy.
- Calculate drip rates for IV infusions correctly.
- Explain the nurse's responsibility during administration of fluids.

About the Author

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Dr. Garrett was a past Director of the Nursing Education Program for the New York State Nurses Association. She received a master's degree in Mental Health-Psychiatric Nursing from the Medical College of Georgia School of Nursing, and a Post Master's in Nursing, Psychiatric Mental Health Nurse Practitioner Certificate from Sage Graduate School as well as a PhD from the State University of New York at Albany. Dr. Garrett's background includes teaching in a baccalaureate nursing program, staff development, and continuing education programs. Her experience includes development of IV therapy CE courses for nursing staff at a tertiary care medical center.

In November 2010, this course was updated by **Barbara Fane, RN, MS, APRN-BC**. She received her bachelor's degree, master of science in Nursing, and post-graduate certificate for Adult Nurse Practitioner from the Sage Colleges in Troy, NY.

In November 2012, a new course was developed reflecting the most recent evidence in practice by **Halya Hebert, MS, RN**.

In August 2017, this course was reviewed and revised by **Lucille Contreras Sollazzo, BSN, RN-BC, NPD**, the Associate Director of the Nursing Education and Practice program of the New York State Nurses Association. Ms. Contreras Sollazzo has been a nurse for over 30 years, is in the Masters of Nursing Education Program at Excelsior College and has been working in the NEP program for over four years.

This course originates from the e-leaRN™ course, *No Infusion Pump? You Can Calculate IV Drip Rates Accurately,* originally written by **Barbara Garrett, PhD, RN, C, NPP**.

The planners and authors declare they have no vested interest.

Overview

There are many occasions when patients will need fluids and/or medication administered intravenously (IV). IV therapy is initiated for fluid and electrolyte balance, to replace fluids, to administer medications, to administer blood or blood products, to keep a vein open (KVO) and ready for use, to administer diagnostic agents, to administer anesthesia, and for hemodynamic monitoring. In order to initiate and maintain IV therapy, the Registered Nurse must understand basic principles of intravenous therapy.

Including:

- Knowing and understanding the legally authorized scope of practice for registered nurses;
- Knowing and understanding how to accurately use infusion devices;
- How to calculate and set a flow rate.

This course covers basic principles of administration of IV fluids and calculation of IV drip rates. It also provides resources for information about the scope of practice of registered professional nurses. The primary focus will be on calculating flow rates accurately if/when an electronic pump is not available.

Throughout the course you will be asked to complete practice questions pertaining to the subject material. A worksheet has been created for you to write your calculations on (located in Course Library). Please be sure to print and use this learning aid as you make your way through the material!

RN Scope of Practice and Administration of Intravenous Medications

It is within the scope of practice of registered nurses (RNs) in New York State to initiate and monitor administration of intravenous fluids and medication. Licensed practical nurses (LPNs) may also administer medications intravenously if they meet qualifications as identified by the New York State Education Department (NYSED).

Answers to questions about the scope of practice, education, and updates required are available from the NYSED, Office of the Professions, Board for Nursing. Their Web site, www.op.nysed.gov/prof/nurse/, contains valuable information and telephone numbers for nurses in New York. NYSED Practice Alerts and Guidelines regarding practice of IV therapy by LPNs can also be found at the Web site, http://www.op.nysed.gov/prof/nurse/nurse-rnlpnissues.htm.

For persons outside of New York State, the applicable state board of nursing may be accessed on the Web site of the National Council of State Boards of Nursing (NCSBN), http://www.ncsbn.org/.

In addition, the Infusion Nurses Society (INS), http://www.ins1.org/, is a good resource for infusion therapy policies and procedures. They publish standards of practice for infusion therapy.

Definitions

Aseptic Technique – using techniques that maintain sterility of sterile items and avoids introduction of pathogens into an environment or body.

Intravenous Therapy – the administration of fluids or medications directly into a vein. IV is a commonly used abbreviation.

Infusion Pump – an electronic device that delivers intravenous fluid under pressure and controls the rate of administration of fluid into the vein.

Nonvolumetric Pump – an electronic infusion device that delivers a certain number of gtts per minute.

Volumetric Pump – an electronic infusion device that delivers fluid in milliliters (ml) or cubic centimeters (cm) per hour.

Macrodrip IV Set – an intravenous tubing set that delivers 15 drops per ml. (Note: Some manufacturers may label their 10 or 20 drop sets as macrodrip.)

Microdrip or Mini-Drip IV Set – an intravenous tubing set that delivers 60 drops per ml.

Infiltration – a complication of IV therapy in which the needle becomes dislodged or pierces the wall of the vein and the fluid collects under the skin.

Extravasation – a complication of IV therapy in which the fluid being administered seeps from the vein into the surrounding tissue.

Pyrogenic Reactions – an infectious response during IV therapy. Fever and chills are often present.

Abbreviations

Abbreviation	Meaning
IV	intravenously
ml	milliliter
gtts	drops
mEq	milliequivalent
KVO	keep vein open

In 2001, The Joint Commission issued a *Sentinel Event Alert* on the subject of medication abbreviations and the following year its Board of Commissioners approved this as a National Patient Safety Goal that all accrediting institutions must implement. The “Do Not Use” list must be a part of practice for all staff members and adherence is assessed during accreditation visits. View https://www.jointcommission.org/facts_about_do_not_use_list/ for a complete list.

Indications for Intravenous Therapy

The intravenous route of administration is used when immediate pharmacological treatment is needed.

IV therapy is used to:

- add fluid volume;
- replace lost fluids;
- maintain homeostasis;
- replace blood; and
- keep a vein open so that it is available immediately if needed.

There are three different kinds of fluids that can be administered.

Each type of fluid has its specific uses. The prescribing provider should specify the kind of fluid, the amount, and the amount of time it will take to administer it.

When rapid onset of action is needed, medications are administered intravenously, either as a bolus or as an additive to intravenous fluids. Medications can be administered intermittently or continuously. Again, specific patient related orders are required.

IV fluids and intravenous administration of electrolytes are used to restore or maintain fluid and electrolyte balance. Maintenance of nutritional status and monitoring of hemodynamic functions can also be accomplished with IV therapy.

Other indications for IV administration are not so frequently used by registered nurses. They include administration of radiologic diagnostic agents and administration of intravenous anesthesia.

It is imperative that the nurse understand the indications for IV therapy, the potential for quick action, and the sometimes irreversible consequences of intravenous injections. There must be a thorough understanding of fluids and medications used as well as the legal scope of practice for nurses.

Infusion Pumps

The purpose of this course is to assure accurate calculation of IV drip rates when a pump is or is not used. For this reason an overview of the use of infusion pumps is included here. There are a number of things to know and keep in mind.

- Most facilities now use electronic infusion devices to maintain intravenous therapy.
    - These devices, or "pumps," maintain a more accurate flow than is possible with the IV set clamps and gravity flow.
    - While "smart pump" technology has entered health care already equipped with drug error reduction software (Kaufman, 2009), **this does not absolve the nurse from ensuring its accuracy.**

- The Joint Commission's National Patient Safety Goals requires the use of free-flow protection infusion sets.
    - Intrinsic, or built-in protections, have been required for infusion devices by the Joint Commission since 2004.
    - The majority of IV pump manufacturers are now providing intrinsic free-flow protection.

- Some factors that indicate when an IV pump should be used instead of IV drip:
    - Drugs with narrow therapeutic margin;
    - drugs with short half-life;
    - any infusion given to neonates;
    - total parenteral nutrition (TPN); and
    - patients sensitive to volume (Lee, 2015).

A careful review of the instructions provided with infusion pumps and administration sets is an essential first step in the administration of IV fluids. **Short cuts here can lead to errors!**

- In order to determine whether an infusion pump has free-flow protection the following procedure can be followed.
    - Turn the power off with the infusion set primed and loaded in the device.
    - With all tubing clamps open and the fluid container as high above the device as the tubing will allow, verify that no fluid flows out of the set as it hangs straight down from the device.
    - Remove the set from the device (tubing clamps still open) and again verify that no fluid flows out of the set.

- **Nonvolumetric** pumps are designed to administer a set number of drops per minute.

- **Volumetric** pumps (most common) are designed to deliver a set amount of fluid in a set amount of time. Volumetric pumps should have the following features:

    - Automatic alarm and shut-down (this is triggered if air enters the system, an occlusion is detected or the reservoir or bag is empty);
    - Pre-set control of the total volume to be infused and digital read-out of volume infused;
    - Automatic switching to keep the vein open (KVO) rate at the end of infusion;
    - Automatic switch to internal battery operation if the mains supply fails (battery power able to be used if no mains power);
    - Error log to record events, alarms and errors.

      (Lee, 2015.)

- ✓ With either system, air should be flushed out of IV tubing before connecting because the danger of air embolism is greater particularly when the fluid is being infused under pressure.

- Controllers monitor the preset rate of administration and an alarm goes off if the rate falls below or exceeds the rate set.
    - This beeping alarm is a signal for the nurse to assess the situation and initiate corrective action.
    - Alarms must not be turned off.
    - A beeping alarm must be attended to and determined the cause with appropriate action taken immediately.
    - Some machines stop the infusion if the alarm signals and this can lead to clogged lines and unnecessary venipunctures.

Preventive maintenance and testing of the alarm system is a requirement of The Joint Commission. Patients and family members must know that they are **not to touch** any alarming devices.

- Verifying the flow rate and checking the IV site is part of a patient assessment.

  This is a responsibility that:

    - ✓ directly affects the effectiveness of therapy
    - ✓ prevents complications
    - ✓ cannot be ignored

    - Healthcare facilities will have policy statements identifying the expected frequency of checking/verifying IV rates.
    - The use of a pump and the absence of an alarm do not guarantee continued, correct infusion. The pump will continue even if there is infiltration, pain, infection, etc.

- There is no substitute for nursing observation and assessment.

    - If multiple IV lines are in place, the pumps and the IV lines must be labeled clearly and documented.

General Principles of IV Administration

There are a number of general principles to remember when administering IV fluids and medications. Each of the following principles must be adhered to whenever administering IV therapy. Learn and practice them until they are a part of your everyday nursing practice.

1. Know your agency's policies and procedures and follow them.

   While every facility may have policies and procedures that address the same principles and methods, there are subtle differences. You are responsible for following the procedure in your agency. It doesn't matter if your last employer had a procedure you liked better.

2. Be sure you have been properly educated on equipment and devices to be used.

   It is the responsibility of the agency to provide in-service education and orientation so that employees know about the equipment in use. However, that doesn't mean that the individual nurse has no responsibility. You should never operate unfamiliar equipment. It is the *professional's* responsibility to maintain competency and to seek education if needed.

3. Use strict aseptic technique.

   When starting intravenous infusions, aseptic technique should be used in opening and handling equipment. Sterility of needles, cannulas, etc. must be maintained.

4. Incorporate use of standard isolation precautions in all procedures.

   The Centers for Disease Control (CDC) have identified standard isolation precautions that should be used at all times, for all patients. The precautions, formerly known as "Universal Precautions" essentially treat all body substance fluids as potentially infectious. The type and use of protective equipment is based on the potential for exposure. For phlebotomy or starting IV infusions, gloves are used to prevent contamination with blood. Fluids that are cloudy or have visible precipitate should not be used.

5. Solutions should always be examined closely.

   Any unusual color, odor, cloudiness, etc. should be questioned. The pharmacist is a good source of information. Never administer a questionable solution. The expiration date on the fluid container should be checked and outdated fluids cannot be given.

6. Select the appropriate equipment.

   Equipment changes continuously and the manufacturer's instructions should be made available for all equipment. If specific equipment is recommended for specific infusion pumps, it should be used. Equipment considerations include selection of needles and catheters, choice of needle gauge, and use of appropriate administration set.

   Speaking of equipment, let's dig a little deeper…

Needles and Catheters

Needles come in various styles:

- steel needles
- over-the-needle catheters
- inside-the-needle catheters

✓ Catheters are flexible, safer, and more comfortable for patients.
✓ Generally, over-the-needle catheters and cannulas are used for long-term therapy and for children.

Needleless devices are now mandated and should be used in order to prevent needlestick injuries. The Occupational and Safety Health Administration (OSHA) is now imposing monetary fines to institutions not routinely using needleless devices (OSHA, n.d.).

There is much information available on the prevention of needlestick injuries - one of the most common means of transmission of bloodborne pathogens. Visit OSHAs bloodborne pathogen page (https://www.osha.gov/SLTC/bloodbornepathogens/enforcement.html) and their FAQs page on Needlestick Safety (https://www.osha.gov/needlesticks/needlefaq.html), as well as the Center for Disease Controls page (https://www.cdc.gov/niosh/topics/bbp/sharps.html) for more information.

Needle gauge

Needles and catheters are produced in standard sizes (or gauges):

- 16 gauge
- 18 gauge
- 20 gauge
- 22 gauge
- 25 gauge

The larger the gauge, the smaller the diameter of the needle.

Larger gauge needles are used to administer fluid more quickly; smaller gauge needles administer fluid more slowly. The gauge of the needle is determined by the type and viscosity of the fluid/medication to be administered and the vein to be used. The smallest possible gauge needle should be used.

Typically, an 18 or 20 gauge needle is used to administer IV fluids.

IV Administration sets

IV administration sets generally come in two basic sizes: Macrodrip and Microdrip.

Macrodrip sets will provide 10-15 drops per ml. These sets are routinely used for IV fluids and are good for rapid delivery of fluids.

Microdrip sets provide 60 drops per ml. Microdrip sets are good for administering medication in IV fluids and are used for pediatric IV fluid administration.

Information is printed on the wrapping of each administration set that identifies the number of drops per ml that flow into the drip chamber.

7. Equipment should be maintained in good working order and properly cleaned. Disposable equipment should not be reused.

8. Fluids must be clearly labeled.

   It is the responsibility of the nurse starting an IV or adding fluids to be sure that there is labeling that provides complete documentation. The label should inform other workers what medication is administered, the timing, and who initiated the procedure. The name of the patient on the solution container also assures that the "right medication" is given to the "right patient." Some labeling is done by the manufacturer, some by the pharmacy, and some must be done by the nurse. Regardless of who completes the labeling, the following documentation **must** be on the IV solution container.

   1. Name of solution and additives
   2. Patient's identification data
   3. Date and time started
   4. Infusion rate
   5. Initials of the nurse

9. Patients must be monitored carefully during IV infusion for response and possible side effects or complications related to the medication or the procedure.

   It is essential that nursing observation and assessment continue throughout the infusion period and post treatment. There is no substitute for nursing judgment.

   Complications that can occur and must be recognized early include:

   - Infiltration
   - Extravasation
   - Thrombophlebitis
   - Pain
   - Pyrogenic reactions
   - Allergic reactions
   - Tissue necrosis
   - Electrolyte imbalance
   - Fluid overload

10. Documentation of the type and amount of IV fluids, medications administered, and the patient's reaction is essential.

    The name of the solution and additives, the rate of infusion, and the patient's response to the infusion must be documented in the patient's record. Whether electronic or handwritten charting is used, this information must be documented. *Remember,* "If it's not charted, it's not done." This is a good time to remember that the patient's response to the therapy and any untoward effects must be documented promptly and accurately, but not **before** fluid is administered. This documentation provides not only direction to other staff; it can provide valuable protection in the event of any legal action.

11. Patient education must be provided, must be thorough, and must be documented.

    Both the nature of the medication and the equipment used need to be thoroughly explained to the patient. Patient education also provides an opportunity to relieve anxiety associated with the intravenous stick. It is the nurse's responsibility to explain the infusion of the solution, the equipment used, and to teach the side effects or reactions to report. The education must be documented in the patient record.

12. Know your mathematics and the formula for calculating flow rates of intravenous solutions!

Practice problems are in all nursing pharmacology textbooks and drug reference books. Periodic refreshers are good for everyone and reinforce earlier learning. When you are sure you're proficient with basic math, practice IV drip rate problems (again, they are in textbooks and drug references). Have a colleague check your calculations, in turn check theirs. It's useful to use the same formula for all drip rate calculations; use it even when you "can do it in your head." This will reinforce your understanding, and help develop good practice habits.

Mathematics – Keep it Simple

Because mathematical errors are often the cause of medication errors, it is good to talk about some basic math before getting into calculation of IV drip rates. This review will focus on ways to simplify the math and decrease the chance for error.

Dealing with Decimals

1. Never lead with a decimal point. Always put a zero in front.

   Correct 0.3 or 0.35 or 0.3456

   Incorrect .3 or .35 or .3456

2. When adding or subtracting numbers with decimals, be sure to line up the decimal points **FIRST.**

   Correct
   436.67
   + 43.97
   480.64

   Incorrect
   436.67
   + 43.97
   876.37

   There is a **big difference** in these responses. In calculating a medication dosage this miscalculation can be deadly.

   Try this: 4.245 + 235.89

   Which is the answer?
   a. 278.34135
   b. 240.135
   c. 2401.35
   d. 0.66039

   Did you answer *b*? If not, line up the decimals and try again.

3. When multiplying decimals:

   Do the multiplication.

   Count the total number of places after the decimals (to the right of the decimal point) in both numbers.

   Place the decimal point that total number of places to the left of the answer. Add zeros if necessary.

   Here's how that works: 0.2 X 0.75
   Do the multiplication: 2 X 75 = 150
   Count the number of places after the decimals: a total of 3
   Place the decimal 3 places to left: 0.150 or 0.15

Examples:

54.36 X	34.163 =	185710068 =	1,857.10068	(total of 5 numbers after decimal)
3.2 X	1.5 =	480 =	4.80	(total of 2 numbers after decimal)
3.2 X	15 =	480 =	48.0	(only 1 number after decimal)
.32 X	.15 =	480 =	0.0480	(total of 4 numbers after decimal)

Again, there is a **big difference** and the error can be deadly.

Try this: 4.245 X 235.89

Which is the answer?

a. 100.13530
b. 1,001.35305
c. 1,000,353.05
d. 100,135.205

Did you answer *b*? If not, multiply the two numbers, then count the total number of numbers to the right of the decimal point and put the decimal point in the answer that same number of places to the left.

Hint *– The decimal is three places to the right in the first number and two places to the right in the second for a total of five places to the left in the answer.*

Dealing with Fractions

1. A fraction (ex. ½) is expressed in terms of a numerator and a denominator. These represent a portion of a whole number and for purposes of this review can be remembered simply as the number on top (numerator) and the number at the bottom (denominator) in the fraction.

   A. Numerator

   In the fraction 2/4, the numerator is 2.
   In the fraction 16/98, the numerator is 16.

   B. Denominator

   In the fraction 2/4 the denominator is 4.
   In the fraction 16/98, the denominator is 98.

Try this:

In the fraction 23/89 the numerator is_____ the denominator is _____.

Did you answer 23 for numerator and 89 for denominator?

In the fraction 7/10 the denominator is _____ the numerator is_____.

Did you answer 10 for denominator and 7 for the numerator?

2. Reduce a fraction to the lowest common denominator. To reduce the numbers using common denominators the largest number that can be divided into both the numerator and denominator is divided into both numbers.

2/4 =	½	(both the numerator and denominator are divided by 2)
6/8 =	¾	(both the numerator and denominator are divided by 2)
15/25 =	3/5	(both the numerator and denominator are divided by 5)
480/60 =	8/1	(both the numerator and denominator are divided by 60)

Try this:

Reduce these fractions to the lowest common denominator:

27/45, 9/18, 45/63

Are the answers 3/5, ½, and 5/7? If not, go back and divide every number by nine.

3. If fractions have zeros at the end of the numerator and the denominator, cross off the same number of zeros in each.

20/40 =	2/4	One zero is removed from the end of 20 and 40.
6,700/32,000 =	67/320	Two zeros are removed from the end of 6,700 and 32,000.
30/1,000 =	3/100	One zero is removed at the end of 30 and 1,000.

Try this:

Reduce these numbers:

50/100, 60/4,500, 3,800/245,000

Are the answers 5/10, 6/450, and 38/2,450? If not, go back and remove equal number of zeros in each fraction (1 in the first two examples and 2 in the third).

4. To multiply fractions, multiply the numerators, and then multiply the denominators. Take the new fraction and divide the numerator by the denominator.

$$\frac{2}{5} \times \frac{7}{9} = \frac{14}{45} = 14 \div 45 = 0.3 \text{ (or approximately 1/3)}$$

$$\frac{12}{20} \times \frac{4}{5} = \frac{48}{100} = 48 \div 100 = 0.48 \text{ (or approximately ½)}$$

Friendly Tip: Answers to fractions that are **multiplied** will always be smaller than either fraction in the original problem.

Try this:

Multiply the fractions:

$$\frac{3}{5} \times \frac{1}{3}$$

Which is the answer?

a. 15/3
b. 8/3
c. 9/5
d. 3/15

Did you answer *d*? If not, go back and multiply the numerators and put that answer on the top. Then multiply the denominators and put that answer on the bottom of the new fraction – the answer is 3/15.

5. It is important to review the work and verify the answer at least twice.

6. It should also make sense, so an answer that seems logically incorrect, probably is incorrect.

Calculating IV Drug Dosage Administration

In an ideal world, each order for an IV infusion would specify:

1. the drug dose,
2. the type of fluid,
3. the amount of fluid, and
4. the number of drops to be infused each minute.

What really happens is that orders specify a medication dose or the amount of drug or fluid to be administered in a given time period. The nurse using a nonvolumetric pump or gravity drip (IV pole) will calculate the correct volume of fluid in ml's to be administered in a specified time allotment. They will then select the appropriate equipment and calculate the number of drops of solution to be delivered each minute based on the equipment used.

There are several steps that must be followed for all IV infusion calculations. Although some are basically a 1:1 ratio or division, all steps should be used to ensure accuracy and reduce the potential for mathematical errors or careless mistakes.

Step 1:

Check the medical order to determine the dose of drug and/or amount of fluid to be delivered and the amount of time the delivery is to take.

Step 2:

Select the IV administration set to be used and determine the drop factor.

IV sets have different size openings in the drip chambers.
The size of the openings determines the size of the drops of fluid.
The size of the drops determines the number of drops in a ml.
Packaging is always clearly labeled with the number of drops per milliliter or ml.
IV sets come in 10, 15, 20, and 60 drops per ml.
Never use a set if you do not see the drop factor labeled on the package.

Step 3:

Calculate the number of drops of the solution to be given per minute.

If the order is for an identified amount of solution or drug over a specified time frame, and the set to be used has been selected, the following formula can be used:

The amount of fluid to be given divided by the time in minutes the solution is scheduled to run and multiplied by the drip factor of the set being used = drops per minute.

↓

Amount of fluid to be given ÷ time in minutes the solution is to run **X** drip factor of IV set to be used **=** drops per minute.

↓

$$\frac{\text{Amount of fluid}}{\text{Time in minutes}} \quad \mathbf{X} \quad \text{drip factor of IV set } \mathbf{=} \text{ drops per minute}$$

Some examples:

If the order is for 1,000 ml of D5W to be given over 8 hours with a 15 drop set

$$\frac{\text{1,000 ml (the amount of fluid ordered)}}{\text{480 (8 hours x 60 minutes)}} \times 15 \text{ (drip factor of IV set)} = \frac{15{,}000}{480}$$

$$\frac{15{,}000}{480} = 31.24 \text{ or } 31 \text{ gtts/minute}$$

If the order is for 1,000 ml of D5W to be given over 8 hours with a 60 drop set

$$\frac{\text{1,000 ml (the amount of fluid ordered)}}{\text{480 (8 hours x 60 minutes)}} \times 60 \text{ (drip factor of IV set)} = \frac{60{,}000}{480}$$

$$\frac{60{,}000}{480} = 125 \text{ gtts/minute}$$

Checking/Rechecking Answers

In order to minimize medication errors by using a consistent approach to calculation of IV doses and reducing the number of mathematical steps involved, nurses are encouraged to follow the steps outlined earlier.

Many nurses learned to do IV calculation problems in a way that reduces the time so that it is always 60 minutes. To do that it, it is necessary to determine the amount of fluid to be given in each 60 minute period.

In that case…

First - divide the amount of fluid needed by the number of hours and derive the amount of fluid to be delivered in 60 minutes

Second - multiply by the drop factor of the set to be used

The following information is provided as a review for nurses and as a method of verifying answers.

Some examples:

1,000 ml D5W ordered for 8 hours using a 15 drop set

1,000 ml ÷ 8 hours = 125 ml to be given in 1 hour or 60 minutes

$$\frac{125 \text{ ml}}{60 \text{ minutes}} \times 15 \text{ drop set} = \frac{1{,}875}{60} = 31.25 = 31 \text{ gtts/minute}$$

1,000 ml D5W ordered for 8 hours using a 60 drop set

1,000 ml ÷ 8 hours = 125 ml to be given in 1 hour or 60 minutes

$$\frac{125 \text{ ml}}{60 \text{ minutes}} \times 60 \text{ drop set} = \frac{7{,}500}{60} = 125 \text{ gtts/minute}$$

500 ml of Ringer's Lactate to be given in 4 hours using a 20 drop set

500 ml ÷ 4 hours = 125 ml to be given in 1 hour or 60 minutes

$$\frac{125 \text{ ml}}{60 \text{ minutes}} \times 20 \text{ drop set} = \frac{2{,}500}{60} = 41.66 = 42 \text{ gtts/minute}$$

1,000 ml Normal Saline to be given in 12 hours using 15 drop set

1,000 ml ÷ 12 = 83.33 ml per hour

$$\frac{83 \text{ ml}}{60 \text{ minutes}} \times 15 \text{ drop set} = \frac{1{,}245}{60} = 20.75 = 21 \text{ gtts/minute}$$

Now you can see that it doesn't matter what volume is ordered, how long it is to run, or the drop factor of the IV set; the mathematical calculations follow exactly the same steps. If you use these steps for all calculations you will calculate the correct number of drops for each minute and administer the correct amount/dosage.

What to Do if You Don't Know the Amount of Fluid Needed?

Drug dosage calculations may need to be done before you begin to calculate the IV drip rate.

- Take time to read all orders very carefully.
- If the order specifies a drug dosage and the solution available specifies the dose of medication per a designated volume of solution, it will be necessary to set up a proportion and calculate the desired amount of fluid before calculating the drip rate.

Although the problems may appear to be complex, they are very manageable if broken into steps.

Study these examples:

> The order reads: Give Heparin 5,000 units over 60 minutes. The IV solution contains 5,000 units of Heparin in 100 ml D5W.

First, decide how many ml's of fluid are needed to provide the ordered 5,000 units by setting up a proportion. If there are 5,000 units in 100 ml's of fluid how many ml's will be needed to administer 5,000 units.

Set up a proportion	5,000 units is to 100 ml's as 5,000 units is to x ml's
	↓
Multiply the two outer numbers	5,000 X x (outer) = 5,000x
Multiply the two inner numbers	100 X 5,000 (inner) = 500,000
	↓
State the ratio	5,000x = 500,000
	↓
Do the division	500,000 ÷ 5,000 = 100 ml
	↓

The amount of fluid needed to provide 5,000 units of Heparin is 100 ml.

You can now proceed to calculate the IV drip rate for 100 ml/hour based on the equipment to be used.

With a **60 drop micro drip set** - $\frac{100 \text{ ml}}{60 \text{ minutes}}$ X 60 gtts/ml = 100 gtts/minute

or

With a **15 drop set** - $\frac{100 \text{ ml}}{60 \text{ minutes}}$ X 15 gtts/ml = 25 gtts/minute

The order reads: Humulin R 2 units per hour. The IV solution contains 20 units Humulin R in 1,000 ml D½ NS.

20 units is to 1,000 ml's as 2 units is to x ml's

20 x X (outer) = 20x
↓
1,000 X 2 (inner) = 2,000
↓
20x = 2,000
↓
x = 100 ml's

Using a 60 drop/ml set the calculation that proceeds as before:

$$\frac{100 \text{ ml}}{60 \text{ minutes}} \times 60 \text{ gtts/ml} = 100 \text{ gtts/minute}$$

It is important to point out that there are times when the order or problem may appear complex, a closer examination will reveal that the amount is already stated.

For example:

The order reads 1 liter of D5W with Aminophylline 500 mgm at 140 ml/hour.

Note that in this example the amount of fluid to be infused is already given. There is no need to calculate how many mgm of Aminophylline is in a ml. Proceed to calculate the amount of solution to be given over the specified time using the drip factor of the equipment being used.

Using a 60 drop micro drip set:

$$\frac{140 \text{ ml}}{60 \text{ minutes}} \times 60 \text{ gtts/ml} = 140 \text{ gtts/minute}$$

Calculating Flow Rate for Infusion Pumps in ml/hour

In order to initiate, or check the flow rate for an infusion pump, you should use this formula:

$$\frac{\text{Amount of Solution (ml)}}{\text{Time (in hours)}} = \text{Flow Rate (ml/hour)}$$

For example:

The order states: Infuse 1 (one) liter of 0.9% Normal Saline in 8 hours.

First:

Convert liter to ml: x liters X 1,000 = # ml

$$\frac{1{,}000 \text{ ml}}{8 \text{ hours}} = \textbf{125 ml/hour}$$ (Flow rate that pump would be set at.)

Test Yourself

Try the following problems.

Write down your calculations so that you can figure out what you did right or wrong. After you have finished answering all the problems, go to the next page to view the correct answers.

1. Give 1 liter of NS IV in 5 hours. The IV set is a regular 15 drop set.

2. Give 1 unit (250 ml's) of packed red cells IV within 4 hours. The blood set delivers 10 gtts/ml.

3. Give 1,000 ml D5W to keep vein open over the next 24 hours. The set to be used delivers 60 drops/ml.

4. Give 150 ml of Normal Saline over 4 hours. The micro drip set delivers 60 gtts/ml.

5. Give 4,000 ml of D5W over 24 hours. The IV set package reads 20 gtts/ml.

6. Give 3,000 ml of D½ NS over 16 hours. The macro drip set delivers 15 gtts/ml.

7. Give 3,000 ml of D5W over 24 hours. The IV set delivers 15 gtts/ml.

8. Give 100 ml of Ringer's Lactate in 1 hour. The micro drip set delivers 60 gtts/ml.

9. Infuse Gentamicin 100 mg in 100 ml of 0.9% Normal Saline over 30 minutes.

Test Yourself Answers

Below are the answers to the problems on the previous page.

1. Give 1 unit (250 ml's) of packed red cells IV within 4 hours. The blood set delivers 10 gtts/ml.

   $\frac{250 \text{ ml}}{240 \text{ minutes}}$ X 10 gtts/ml = 10.41 gtts or **10 gtts/minute**
   (the fraction is not rounded up)

2. Give 1,000 ml D5W to keep vein open over the next 24 hours. The set to be used delivers 60 drops/ml.

   $\frac{1{,}000 \text{ ml}}{1{,}440 \text{ minutes}}$ X 60 gtts/ml = 41.66 gtts or **42 gtts/minute**
   (the fraction is rounded up)

3. Give 150 ml of Normal Saline over 4 hours. The micro drip set delivers 60 gtts/ml.

   $\frac{150 \text{ ml}}{240 \text{ minutes}}$ X 60 gtts/ml = **38 gtts/minute**
   (the fraction is rounded up)

4. Give 4,000 ml of D5W over 24 hours. The IV set package reads 20 gtts/ml.

   $\frac{4{,}000 \text{ ml}}{1{,}440 \text{ minutes}}$ X 20 gtts/ml = 55.55 gtts or **56 gtts/minute**
   (the fraction is rounded up)

5. Give 3,000 ml of D½ NS over 16 hours. The macro drip set delivers 15 gtts/ml.

   $\frac{3{,}000 \text{ ml}}{960 \text{ minutes}}$ X 15 gtts/ml = 46.87 gtts or **47 gtts/minute**
   (the fraction is rounded up)

6. Give 3,000 ml of D5W over 24 hours. The IV set delivers 15 gtts/ml.

   $\frac{3{,}000 \text{ ml}}{1{,}440 \text{ minutes}}$ X 15 gtts/ml = 31.24 gtts or **31 gtts/minute**
   (the fraction is not rounded up)

7. Give 100 ml of Ringer's Lactate in 1 hour. The micro drip set delivers 60gtts/ml.

   X 60 drops = $\frac{100 \text{ ml}}{60 \text{ minutes}}$ X 60 gtts/ml = **100 gtts/minute**

8. Infuse Gentamicin 100 mg in 100 ml of 0.9% Normal Saline over 30 minutes.

   (Be sure to convert minutes to hours.)

   Step 1: $\frac{30 \text{ min.}}{60}$ = 0.5 hr Step 2: $\frac{100 \text{ ml}}{0.5 \text{ hr}}$ = **200 ml/hour**

These examples are pretty simple to calculate, as easy as **A B C**.

A. As you see, the amount of fluid is always stated as the amount ordered. There is no need to calculate or change anything.

B. The time the solution is to run is calculated each time and the number of hours it is to run is multiplied by 60 (the number of minutes in one hour).

C. The number of drops per ml is stated in each problem in the type of IV set used – again, nothing to calculate or change.

Did you get the answers right? If not, go back and redo the problems. Compare your work the first time with the second time and with the explanations.

The most important thing however, is to learn a formula and ***always*** calculate the problem with the same steps. Learn the formula and plug in the facts as given in the medication order.

Advanced: Calculating IV Drip Medications

Common Conversions:
1 Liter = 1,000 Milliliters
1 Gram = 1,000 Milligrams
1 Milligram = 1,000 Micrograms
1 Kilogram = 2.2 pounds (lbs.)

There will be instances where you will receive orders written as: **mcg/kg/min.**

These orders incorporate your patient's weight (kg), and may require converting the fluid volume in order to accurately calculate the IV drip medication.

The formula to follow is:

$$\frac{\text{Dose of drug ordered (mcg) X pt's weight (kg) X 60 (minutes/hr)}}{\text{Drug Concentration (must match units in dose ordered)}} = \text{Flow Rate}$$

Example:

Your 143 lb. patient has dopamine ordered at 6 mcg/kg/min. The IV has 400 mg of dopamine in 250 ml IV bag. What is the correct IV pump rate?

A. First, determine the dose of medication per ml of IV fluid (Drug Concentration).

$$\frac{\text{400 mg dopamine}}{\text{250 ml IV fluid}} = \text{1.6 mg dopamine/ml IV fluid}$$

B. Then, convert your dose from mg to mcg (micrograms).

1.6 x 1,000 = 1,600 mcg/ml

C. Now you must attend to the patient's weight. Is it provided in lbs. or kg? The formula requires the patient's weight be entered as kg.

143 (lbs.) ÷ 2.2 = 65 kg

Now that you've converted the data into the necessary measurements, you can complete the formula.

$$\frac{\text{6 (rate) X 65 (pt. weight in kg) X 60 (minutes/hr)}}{\text{1,600 (mcg dopamine/ml)}} = \frac{\text{23,400}}{\text{1,600}} = \text{14.6 or } \mathbf{15\ ml/hr} \text{ (round up)}$$

More Complicated Problems

Try the following problems. They are a bit more complicated. For the first 3 questions you have to first calculate the amount of fluid needed to administer the correct dose of the medication. Question 4 requires you to first convert the patient's weight and drug dosage before calculating the flow rate. Check the answers and the math on the next page.

1. Give Heparin 500 units IV per hour. The IV solution contains 20,000 units per 1,000 ml D5W. A micro drip set is to be used (60 gtts/ml).

2. Give 1,000,000 units of Ampicillin IV in 2 hours. The drug comes from the pharmacy with 5,000,000 units in 1,000 ml D5W. A 15 drop IV set is to be used.

3. Give 40 mEq of potassium chloride IV over 8 hours. The solution available contains 80 mEq in 1,000 ml of D5W. The IV set delivers 10 gtts/ml.

4. The order is to run dopamine at 15 mcg/kg/min. The IV bag has 500 mg of dobutamine in 500 ml. The patient is 110 lbs. What rate will you set the IV pump at?

More Complicated Problems Answers

Below are the answers to the problems on the previous page.

1. Give Heparin 500 units IV per hour. The IV solution contains 20,000 units per 1,000 ml D5W. A micro drip set is to be used (60 gtts/ml).

   A. First, determine how much solution to give per hour by setting up a proportion

   $$\text{If } \frac{20{,}000 \text{ units}}{1{,}000 \text{ ml}} \quad \text{Then } \frac{500 \text{ units}}{x \text{ ml}}$$

   $$\downarrow$$

   $$20{,}000\,x = 500{,}000$$

   $$\downarrow$$

   $$500{,}000 \div 20{,}000 = 25 \text{ ml}$$

   B. Now, calculate the IV drip rate using the same formula as before. (Remember the IV set delivers 60 gtts/ml)

   $$\frac{25 \text{ ml}}{60 \text{ minutes}} \times 60 \text{ gtts/ml} = \textbf{25 gtts/minute}$$

2. Give 1,000,000 units of Ampicillin IV in 2 hours. The drug comes from the pharmacy with 5,000,000 units in 1,000 ml D5W. A 15 drop IV set is to be used.

   A. First, determine how much solution to give per hour by setting up a proportion.

   $$\text{If } \frac{5{,}000{,}000 \text{ units}}{1{,}000 \text{ ml}} \quad \text{Then } \frac{1{,}000{,}000 \text{ units}}{x \text{ ml}}$$

   $$\downarrow$$

   $$5{,}000{,}000\,x = 10{,}000{,}000{,}000$$

   $$\downarrow$$

   $$5{,}000{,}000 \div 10{,}000{,}000{,}000 = 200 \text{ ml}$$

   B. Now, calculate the IV drip rate using the same formula as before. (A 15 gtts/ml IV set is being used.)

   $$\frac{200 \text{ ml}}{120 \text{ minutes}} \times 15 \text{ gtts/ml}$$

   $$\downarrow$$

   $$3{,}000 \div 120 = \textbf{25 gtts/minute}$$

3. Give 40 mEq of potassium chloride IV over 8 hours. The solution available contains 80 mEq in 1,000 ml of D5W. The IV set delivers 10 gtts/ml.

A. First, determine how much solution to give per hour by setting up a proportion.

$$\text{If } \frac{80 \text{ mEq}}{1{,}000 \text{ ml}} \quad \text{Then} \quad \frac{40 \text{ mEq}}{x \text{ ml}}$$

$$\downarrow$$

$$80x = 40{,}000$$

$$\downarrow$$

$$40{,}000 \div 80 = 500 \text{ ml}$$

B. Now, calculate the IV drip rate using the same formula as before. (A 10 gtts/ml IV set is being used.)

$$\frac{500 \text{ ml}}{480 \text{ minutes}} \times 10 \text{ gtts/ml}$$

$$\downarrow$$

$$5{,}000 \div 480 = 10.41 \text{ or } \textbf{10 gtts/minute}$$

(the fraction is not rounded up)

4. The order is to run dopamine at 15 mcg/kg/min. The IV bag has 500 mg of dobutamine in 500 ml. The patient is 110 lbs. What rate will you set the IV pump at?

A. First, determine the dose of medication per ml of IV fluid (Drug Concentration).

$$\frac{500 \text{ mg dobutamine}}{500 \text{ ml IV fluid}} = 1 \text{ mg dobutamine/ml IV fluid}$$

B. Then, convert your dose from mg to mcg (micrograms).

$$1.0 \times 1{,}000 = 1{,}000 \text{ mcg/ml}$$

C. Remember, the formula requires the patient's weight be entered as kg.

$$110 \div 2.2 = 50 \text{ kg}$$

Now you can complete the formula.

$$\frac{15 \text{ (rate)} \times 50 \text{ (pt. weight in kg)} \times 60 \text{ (minutes/hr)}}{1{,}000 \text{ (mcg dobutamine/ml)}}$$

$$\downarrow$$

$$\frac{45{,}000}{1{,}000} = x \text{ ml/hr}$$

$$\downarrow$$

$$45{,}000 \div 1{,}000 = \textbf{45 ml/hr}$$

Conclusion

Because you can't always rely on electronic equipment or computers to be available and in working order, basic nursing competency must include the knowledge and ability to calculate IV drug doses and drip rates accurately. It can be helpful for the nurse administering intravenous solutions and medications to become familiar with one formula and use it for every drug dosage calculation problem. Because IV medications are immediately infused into the blood stream, systemic reactions can occur at once and can be very serious. Errors in mathematical computations can be life threatening and it may not be possible to "stop the medication."

Steps to eliminate the math errors include:

- ✓ Always using the same method to calculate IV drip rates and checking calculations at least twice.
- ✓ Don't eliminate any steps and don't do it "in your head" (Diehl, 2010).
- ✓ Any time the answer seems questionable or doesn't seem logical, ask another nurse to do the calculations and verify your results.
- ✓ It is important to know the usual doses so that unusual results can be questioned.

Lastly, it is important to remember that IV administration errors are medication errors that can subject a nurse to professional discipline, charges of malpractice, and legal actions.

Take time to read the order carefully, do the math and check your work. Verify that the answer is a logical dose or quantity. There is no room for careless errors.

Save your patient and your license!

Resources

Centers for Disease Control and Prevention (CDC)

1600 Clifton Rd.
Atlanta, GA 30333
Phone: 800-CDC-INFO (800-232-4636)
Web site: www.cdc.gov

For access to the complete *Guideline for Isolation Precautions: Preventing Transmission of Infectious Agents in Healthcare Settings* and bloodborne pathogen transmission related to needlestick injuries, please visit the CDCs Web site.

Infusion Nurses Society (INS)

315 Norwood Park South
Norwood, MA 02062
Phone: 781-440-9408
Web site: www.ins1.org

The Infusion Nurses Society (INS) is committed to bringing innovative new resources and opportunities to a wide range of healthcare professionals who are involved with the specialty practice of infusion therapy. In this new world of rapid technological advances and dramatic shifts in healthcare delivery, INS is setting the standard for dedicated clinicians who seek to provide excellent infusion care across all practice settings.

The Joint Commission

One Renaissance Blvd.
Oakbrook Terrace, IL 60181
Phone: 630-792-5800
Web site: www.jointcommission.org

Accreditation agency focused on patient safety and quality outcomes. Established National Patient Safety Goals to assist accredited organizations to address specific areas of concern in regards to patient safety.

National Council of State Boards of Nursing (NCSBN)

111 East Wacker Drive, Suite 2900
Chicago, IL 60601-4277
Phone: 312-525-3600
Web site: www.ncsbn.org

The National Council of State Boards of Nursing (NCSBN) is a not-for-profit organization whose purpose is to provide an organization through which boards of nursing act and counsel together on matters of common interest and concern affecting the public health, safety and welfare, including the development of licensing examinations in nursing.

Provides access for persons outside of New York State inquiring about their profession.

New York State Education Department (NYSED)
Office of Professions, Board of Nursing

89 Washington Ave
Albany, NY 12234-1000
Phone: 518-474-3817
Web site: www.op.nysed.gov/prof/nurse/

Provides answers to questions about the scope of practice, education, and updates required for licensure. Valuable information and telephone numbers can be found through this resource.

New York State Education Department (NYSED)
Office of Professions - Practice Alerts and Guidelines

Web site: http://www.op.nysed.gov/prof/nurse/nursepracticeissues.htm

Access to RN and LPN practice guidelines for IV therapy.

U.S. Department of Labor
Occupational Safety & Health Administration (OSHA)

200 Constitution Ave., NW
Washington, DC 20210
Phone: 800-321-OSHA (800-321-6742)
Web site: www.osha.gov

In 1970, Congress created the Occupational Safety and Health Administration (OSHA) to assure safe and healthful working conditions for working men and women by setting and enforcing standards and by providing training, outreach, education and assistance. State programs must meet or exceed federal OSHA standards for workplace safety and health.

Included are specific requirements for the prevention of needlestick injuries.

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Calculating IV Drips Accurately

Course Exam

After studying the downloaded course and completing the exam, you need to enter your exam answers ONLINE. Answers cannot be answered and graded on this downloadable version of the course. To enter your answers return to e-leaRN's Web site: **www.elearnonline.net** and click on the Login/My Account button. Next, login using your username and password. Follow the prompts to access the course material, and proceed to the course exam.

Note: Contact hours will be awarded for this online course until October 10**,** 2020**.**

1. It is not necessary to perform mathematical calculations when administering IV fluids if the pharmacy prepares and labels the solution.

    a. True
    b. False

2. All of the following must be labeled on a container of fluids for IV infusion **EXCEPT**:

    a. time the solution was started
    b. name of the physician who ordered the fluids
    c. identification data of nurse who started the solution
    d. name of any medications added to solution

3. Which of the following type pumps will require the nurse to calculate the number of drops to be delivered each minute?

    a. volumetric
    b. non volumetric

4. All of the following decimals are correctly stated **EXCEPT**:

    a. 67.4
    b. 67.0
    c. .67
    d. 06.74

5. When multiplying fractions the answer will always be a smaller fraction than either/any of the fractions in the problem.

    a. True
    b. False

6. The order reads "give 1,000 ml's of D5W in 8 hours. Use a 15 drop macrodrip set." The number of drops to be administered per minute is:

    a. 250 gtts
    b. 125 gtts
    c. 31 gtts
    d. 7 gtts

7. The order reads “give 200 ml’s of Ringer’s Lactate over 2 hours.” Using a 60 gtts microdrip set, how many drops will be administered per minute?

    a. 100 gtts
    b. 200 gtts
    c. 25 gtts
    d. 50 gtts

8. If the IV set delivers 10 drops per ml how many drops will it take to administer one unit of packed red cells (250 ml) in 1 hour?

    a. 4 gtts
    b. 42 gtts
    c. 15 gtts
    d. 150 gtts

9. The order reads “give 40 mEq Potassium Chloride IV in 12 hours.” The drug is available in 80 mEq /1,000 ml of D5W. The IV tubing set delivers 60 gtts/minute. How many drops per minute will you infuse?

    a. 42 gtts/minute
    b. 85 gtts/minute
    c. 125 gtts/minute
    d. 500 gtts/minute

10. If there is an adequate supply of pumps on a unit it will not be necessary for the nurse to have to calculate drip rates.

    a. True
    b. False