Infusion Rates and Drip Rates

LEARNING OBJECTIVES
After completing this chapter, the student will be able to:

1. Calculate the rate of infusion if the volume of infusion and the time of the infusion are known.
2. Calculate the rate of flow for an IV in drops/min if the calibration of the IV set is known along with the volume of the infusion and the time of the infusion.
3. Calculate the rate of flow for an IV in ml/hour if the volume of the infusion and the time of the infusion is known.

Physicians write orders for the rate at which an IV is infused into a patient. Infusion rates can be expressed as number of milliliters per minute, milliliters per hour, amount of drug per hour, and often as the length of time for a volume to be infused. For example:

- Infuse at 125 ml/hr
- Infuse 1,000 ml over 8 hours
- Infuse 10 mg per minute

If the volume of the infusion and the time of the infusion are known, then the rate of infusion can be calculated from the following formula:

\[
\frac{\text{Volume}}{\text{Time}} = \text{Rate}
\]

EXAMPLE
Infuse 1,000 ml over 8 hours. What is the rate of infusion in ml/hr?

\[
\frac{1,000 \text{ ml}}{8 \text{ hr}} = \text{Rate} \rightarrow 125 \text{ ml/hr}
\]

The time of an infusion can be calculated using the same formula. For example, if the rate of infusion is 100 ml/hr and the volume of the infusion is 1,000 ml, how long will this bag last?

\[
\frac{1,000 \text{ ml}}{\text{Time}} = 100 \text{ ml/hr} \rightarrow \text{Time} = \frac{1,000 \text{ ml}}{100 \text{ ml/hr}} \rightarrow 10 \text{ hours}
\]

Similarly, the volume of an infusion can be calculated using the same formula.

Infusions that are administered to a patient by gravity flow are infused through IV sets that are calibrated in drops per milliliter. The rate of infusion is expressed as drops per minute.

KEY TERMS
Calibrated: the number of drops per ml for a given IV set
drops/min: drops of IV solution administered per minute
Infusion rate: the volume of solution or drug to be administered in a set amount of time for an intravenous preparation
IV set: tubing and equipment for delivering IVs
mg/min: milligrams of drug administered per minute
ml/hr: milliliters of IV solution administered per hour
ml/min: milliliters of IV solution administered per minute
Conversions are made to a flow rate of drops per minute from the infusion rate ordered by physicians.

To convert a flow rate in ml/hr to drops/min, two steps are involved.

- To convert a flow rate in ml/hr to drops/per min two conversion factors are needed. The first conversion factor is 60 min/hr and the second conversion factor is to determine drops/ml. The number of drops/ml is determined by the size of the tubing and the nature of the administration set.

Miscalculating the drip rate and accidentally administering the incorrect dose of a medication may have lethal consequences.

- Drop (drip) factor refers to the size of the IV tubing and is stated on the IV administration package.

Common drop factors:
- 10 drops/ml (gtt/ml) macro
- 15 drops/ml (gtt/ml)
- 60 drops/ml (gtt/ml) micro

**EXAMPLE**
The flow rate of an IV infusion ordered by a physician is 125 ml/hr. The IV set to be used for the infusion is calibrated at 15 drops/ml. Calculate the rate of flow in drops/min.

Convert the flow rate from ml/hr to ml/min. 1 hour = 60 minutes

Set up a ratio and proportion.

\[
\frac{125 \text{ ml}}{60 \text{ mins}} = \frac{X}{1 \text{ min}} \Rightarrow \frac{X \times 60 \text{ min}}{60 \text{ min}} = \frac{125 \text{ ml} \times 1 \text{ min}}{60 \text{ min}}
\]

\[X = 2.08 \Rightarrow 2.1 \text{ ml/min} \]

Calculate the drops for 2.1 ml/min using the calibration of the IV set \( \rightarrow 15 \) drops/ml.

Set up a ratio and proportion.

\[
\frac{15 \text{ drops}}{1 \text{ ml}} = \frac{X}{2.1 \text{ ml}} \Rightarrow \frac{X \times 2.1 \text{ ml}}{2.1 \text{ ml}} = \frac{15 \text{ drops} \times 2.1 \text{ ml}}{1 \text{ ml}}
\]

\[X = 31.5 \Rightarrow 32 \text{ drops/min answer} \]

All conversions from ml/hr to drops/min can be calculated using this two-step method.

**EXAMPLE**
A physician orders 12,500 units of heparin in a 1,000 ml bag of 5% dextrose injection for a patient. The rate of infusion is 500 units over one hour. What will be the rate of infusion in ml/hour?

Calculate the volume, in milliliters, that will contain 500 units.

Set up a ratio and proportion problem.

\[
\frac{12,500 \text{ units}}{1,000 \text{ ml}} = \frac{500 \text{ units}}{X}
\]
Cross multiply and divide both sides by 12,500 units.

\[
\begin{align*}
& \quad X \times 42,500 \text{ units} = 1,000 \text{ ml} \times 500 \text{ units} \\
& \quad 42,500 \text{ units} \\
& \quad X = 40 \text{ ml/hr} \quad \text{answer}
\end{align*}
\]

**EXAMPLE**

A 1 liter bag of D5W is to be run at 100 ml/hr. The bag is started at 8:00 a.m. What time will the bag finish?

1 liter = 1,000 ml

1,000 ml at 100 ml/hr

Set up a ratio and proportion to calculate how long the bag will take to finish.

\[
\begin{align*}
\frac{100 \, \text{ml}}{1 \, \text{hr}} &= \frac{1,000 \, \text{ml}}{X} \quad \Rightarrow \quad X = \frac{1,000 \, \text{ml} \times 1 \, \text{hr}}{100 \, \text{ml}} \\
& \quad = 10 \, \text{hr}
\end{align*}
\]

The bag is started at 8:00 am and will finish 10 hours later.

\[
\Rightarrow 6:00 \, \text{pm} \quad \text{answer}
\]

**EXAMPLE**

A 1 liter bag containing 300 mEq sodium chloride is running at 25 ml/hr. How many mEq of NaCl is the patient receiving per hour?

Set up a ratio and proportion to find mEq in 25 ml.

\[
\begin{align*}
\frac{300 \, \text{mEq}}{1,000 \, \text{ml}} &= \frac{X}{25 \, \text{ml}} \quad \Rightarrow \quad X = \frac{300 \, \text{mEq} \times 25 \, \text{ml}}{1,000 \, \text{ml}} \\
& \quad = 7.5 \, \text{mEq per hour} \quad \text{answer}
\end{align*}
\]

**EXAMPLE**

A patient is to receive an IV of 1 liter of Lactated Ringer’s over 8 hours. The IV set to be used is calibrated at 10 drops per ml. What is the flow rate in drops/min?

Convert the flow rate to ml/hr.

Set up a ratio and proportion.

\[
\begin{align*}
\frac{1,000 \, \text{ml}}{8 \, \text{hours}} &= \frac{X}{1 \, \text{hr}} \quad \Rightarrow \quad X = \frac{1,000 \, \text{ml} \times 1 \, \text{hr}}{8 \, \text{hours}} \quad \Rightarrow \quad 125 \, \text{ml/hr}
\end{align*}
\]

Convert the flow rate to ml/min. 1 hour = 60 mins

Set up a ratio and proportion.

\[
\begin{align*}
\frac{125 \, \text{ml}}{60 \, \text{mins}} &= \frac{X}{1 \, \text{min}} \quad \Rightarrow \quad X = \frac{125 \, \text{ml} \times 1 \, \text{min}}{60 \, \text{min}} \quad \Rightarrow \quad 2.08 \, \text{ml/min} \quad \Rightarrow \quad 2.1 \, \text{ml/min}
\end{align*}
\]

The IV set is calibrated at 10 drops/ml.

Set up a ratio and proportion to find drops per minute.

\[
\begin{align*}
\frac{10 \, \text{drops}}{1 \, \text{ml}} &= \frac{X}{2.1 \, \text{ml}} \quad \Rightarrow \quad X = \frac{10 \, \text{drops} \times 2.1 \, \text{ml}}{1 \, \text{ml}} \quad \Rightarrow \quad 21 \, \text{drops/min}
\end{align*}
\]

\[
\Rightarrow 21 \, \text{drops/min} \quad \text{answer}
\]
1. If a 1 liter bag of D5W is run through an IV into a patient's arm over eight hours, what is the rate of infusion in ml/hr?

2. If a 500 ml bag of 0.9% sodium chloride injection is run over eight hours, what is the rate of infusion?

3. If a 1,000 ml bag of normal saline is run at 100 ml/hr, how long will the bag last?

4. A sterile solution request form is received for a large volume parenteral. The infusion rate is 125 ml/hr. The nurse requests enough 1 liter bags for the next 24 hours. How many bags do you make?

5. If the infusion rate for an IV is 80 ml/hr and it is run for four and a half hours, how many ml has the patient received?

6. If 1 liter of D5W is started on a patient at 1400 hours on Tuesday, at what time and day will the next liter be required if the rate is:
   a. 125 ml/hr next bag needed at ________________ on __________ day
   b. 80 ml/hr next bag needed at ________________ on __________ day
   c. 200 ml/hr next bag needed at ________________ on __________ day
   d. 50 cc/hr next bag needed at ________________ on __________ day
7. Potassium chloride 30 mEq is to be given in 1 liter of IV fluid. The infusion rate is 125 ml/hr. How many mEq/hr are being infused?

8. A 50 ml IVPB bag of ampicillin 500 mg in normal saline is to be run in over 20 minutes. What is the infusion rate in ml/hr?

9. An order is for heparin IV to infuse at 1,000 units per hour. What will be the flow rate in ml/hr for a 500 ml bag of D5W with 25,000 units of heparin?

10. A patient is on a heparin drip, 12,500 units in 250 ml of 0.45% sodium chloride injection. He is to receive 1,500 units per hour. At what rate (ml/hr) should the drug be infused?

11. How many drops per minute will a patient receive if an IV of 1,000 ml of 5% dextrose injection is run in over eight hours? The drip factor is 15 drops/ml.
12. One hundred micrograms of a drug, dissolved in 240 ml of solution, is to be infused at a rate of 75 mcg/hr. If 1 ml = 15 drops, what should the rate of administration be in drops/min?

13. Calculate the infusion rate in ml/hr for a drip, concentration 5 g/500 ml. The rate is 25 mcg/kg/min. The patient weighs 112 kg.

14. What is the flow rate, in drops/min, for a TPN compounded with 500 ml of D_{10}W and 500 ml 7% Trivasol run in over 24 hours? The IV administration set is calibrated to deliver 10 drops/ml.

15. The physician orders 3,000 ml of D5W IV over a 24-hour period. If the IV set is calibrated to deliver 15 drops per ml, how many drops must be administered per minute?

16. How long will it take to complete an IV infusion of 1.5 L of 0.9% sodium chloride injection being administered at 45 drops/minute? The IV set is calibrated to deliver 15 drops per ml.
17. Ampicillin 500 mg in 50 ml IVPB is to be administered over a period of 15 minutes. The drop factor for the IV administration set is 10 drops/ml. Calculate the rate of flow in drops per minute.

18. The drop factor for an IV line is set at 30 drops/min. Calculate the rate of infusion in ml/hr. The drop factor is 15 drops/ml.

19. You have a 500 ml bottle of an 8% drug. The rate of infusion is 5 g/hr. What is the rate of infusion in ml/hr and how long will the bottle last?

20. What volume of fluid will a patient receive if a large volume parenteral bag is running at 50 ml/hr and is begun at 0800 and discontinued at 1400?

21. A physician orders an IV to be infused at 30 mg/minute for 24 hours. What is the total gram dose for this patient?
22. A patient is to receive 2 g of an antibiotic in 250 ml of D5W/NS over 1 hour. The rate of infusion is 30 mg/minute. How long will it take for the patient to receive the infusion?

23. The rate of infusion of a drug is 45 ml/hr as ordered by the physician. A bag of 1,000 ml of D5W is hung on day 1 at 0400 hours. What time will the next 1,000 ml bag be needed?

24. A 50 ml IVPB bag contains 500,000 units of penicillin G. The rate of infusion ordered by the physician is 120 ml/hr. How long will the IVPB take to infuse?

25. An IV is running at 50 ml/hr. The 500 ml bag contains 180 mEq of potassium chloride. How many mEq of potassium chloride is the patient receiving per hour?

26. A physician orders a drug to be infused at 10 mcg/kg/min. The patient weighs 70 kg. The total dose the patient is to receive is 21 mg. How long must the IV continue for the patient to receive this dose?
27. A patient order is for 1,000 ml to be infused over 75 minutes. What is the rate of infusion in ml/hr?

28. The infusion rate for 50 ml of D5W containing 3.5 g of an antibiotic is 200 ml/hr. What is the infusion rate in drops/min if the IV set is calibrated at 10 drops/ml?

29. A 500 ml IV bag of Lactated Ringer's is to be infused at 100 ml/hr. How many 500 ml bags will be needed for 24 hours?

30. A 250 ml bag of D5W is to be infused at 40 drops/min. The IV set drop factor is 60 drops/ml. The IV is started at 6:00 a.m. When will the next bag be needed?

31. The physician orders a 500 mg loading dose of a drug to be administered over 20 minutes by IV infusion. A 50 ml IVPB containing the 500 mg is supplied. At what rate in ml/hr should the IVPB be infused?

32. An order is received to infuse 750 ml of IV fluid every 6 hours. At what rate should the IV pump be set for (in ml/hr)?
33. A patient is receiving 250 ml of D5W infusing at 33 gtt/min. The IV tubing is calibrated for 10 gtt/ml. What is the infusion time for the bag?

34. An MD orders a continuous infusion at a rate of 3 ml/min. The 1,000 ml IV bag contains a 2 g dose of the medication ordered. How many mg of the drug will the patient receive in 20 minutes?

35. 37 units of regular insulin is to be administered over 1 hour as a continuous infusion. The insulin is added to a 250 ml bag of 0.9% sodium chloride solution. What infusion rate (gtt/min) should be used if the IV set is calibrated for 10 drops/ml?

36. A medication is ordered by the physician 2 g in 250 ml NS to be administered by continuous IV around the clock for 24 hours. The rate of infusion is 100 ml/hr. If the first bag is started at 0800, how many bags in total will be needed?

37. With reference to question 36, give the times (in military time) that each bag will be started.

38. A continuous infusion is to be administered at a rate of 2 mg/min. 200 mg of the drug is added to 250 ml of Ringer's solution. What is the rate of infusion in ml/hr?
39. A drug is to be administered at 40 mcg in 25 minutes. The patient is receiving 0.12 mg in 1,000 ml of D5W. What is the rate of infusion in ml/hr?

40. A drug is to be administered at 200 ml/hr. The IV set being used is calibrated at 8 drops/ml. What is the drip rate in gtt/min?

41. A physician reduces an IV flow rate to 30 ml/hr. There are 270 ml remaining of the 1,000 ml IV bag. The time is 10:30 a.m. At what time will the infusion be completed?

42. A patient is receiving 1,000 ml of NS at 40 ml/hr. The IV set is calibrated at 60 gtt/ml. What is the flow rate in drops/min?

43. A patient is receiving an IV 1,000 cc per 8 hr. When 600 ml have been run in from the 1 L bag, the physician ordered the remainder to be infused over the next 6 hours. The IV set is calibrated at 10 gtt/ml. What is the new flow rate?

44. A patient is to receive 40 mg of medication in 100 ml of D5W over 60 min. The IV set is calibrated at 15 drops/ml. What is the flow rate in

   a. ml/hr?

   b. gtt/min?