Infusion Pumps

By David Scott

1. Simplest form- IV bag gravity fed into patient.

The IV bag is at a height higher than the patient. IV Fluid is gravity fed to patient. A roller clamp controls the flow. Drops are manually counted. The IV tubing will have markings on it indicating mL/Drop. Timing how fast the drops fall through the tube drip chamber a rate can be set. The greater the bag height, the higher the flow rate. Each foot in height produces about 25 mmHg of pressure.

This method is used in Emergency Rooms and by paramedics in ambulances. Athletic trainers also use it.

2. 2nd version- Infusion controller. AKA drop counter

The IV bag is higher than the patient in this set up also. It works very similar to #1. This version will count the drops and time the rate. The controller has to know drops per minute desired. The user can then calculate mL/Drop X drops per minute and get an infusion rate. It usually has a clamp at the top of the pump that will pinch off or restrict the flow for the desired rate. The infusion controller is not used as readily in modern times. The infusion pump has replaced it.

3. 3rd version- Infusion pump.

The infusion pump is the most sophisticated of all of these pumps. It also has the IV bag higher than the pump and patient. The infusion pump can control a rate/hr, rate/bodyweight and rate over a time period. It also can be programmed with the IV bag volume.

Patient Dangers when using an infusion pump

1. Air embolism
2. Free uncontrolled flow to the patient
3. Occlusion to the patient
4. Over/under infusion
5. IV bag running out of fluid
6. Vein closing when infusion is complete

Addressing the dangers to patients

1. IV pumps have an air in line sensor. This is typically a photo detector or an ultrasonic sensor.
2. JCAHO requires all hospitals to have a free flow guard on their IV pumps. The free flow is normally controlled by an anti-free flow infusion set. This usually involves some kind of anti-siphon device.
3. All infusion pumps have a patient occlusion alarm. This alarm is usually some kind of stall sensor on the IV pump stepper motor or a pressure transducer in the line.

4. A microprocessor controlled stepper motor controls under/over infusion. This stepper motor sometimes has other sensors associated with it like: direction circuitry. Optical flags to double check the rate by telling speed of motor. Every manufacturer has a little different way of addressing this. Some have a flow error alarm.
5. The IV bag volume is programmed into most modern infusion pumps. The pump will alarm when the bag is near empty to alert patient care staff to change the bag.
6. All IV pumps have a KVO function. This stands for Keep Vein Open. This happens when the time or volume to be infused is met. This keeps the infusion needle from clogging. KVO infusion rate is always lower than the set infusion rate.

Infusion Pumps infuse by: peristaltic action or by some kind of cassette pumping mechanism built into the IV set.

Peristaltic action is like a continuous rippling wavelike motion. It is also sometimes called peristaltic finger action. This is a linear action. Peristaltic can also be a rotary action. The Baxter Colleague pumps use linear peristaltic type of pumping action. Rotary peristaltic action is used on feeding pumps and PCA pumps (Patient Controlled Analgesic, AKA "pain pumps")

Cassette type has some kind of plunger built in the tubing set. The stepper motor drivers the plunger up and down. The cassette also has a valve in it. This valve is timed to open when the plunger is pumping and close when it is not. This valve is sometimes used as a free-flow mechanism also. The Ivion Kids pumps used this type of pumping mechanism. Some PCA pumps used this method also.

Many modern infusion pumps have drug libraries in them. One of the newer features on modern infusion pumps is a drug calculator. This enables the pump to limit the amount of a drug per body weight that can be programmed into the pump. This reduces any math errors that may happen.

<u>All Infusion Pumps Have These Features in Common</u>

1. Control panel
2. Air in line detector- optical or ultrasonic circuitry
3. Pumping mechanism- linear or rotary peristaltic or cassette type.
4. Line or cassette in place
5. Downstream (patient) occlusion detector- stall detector or pressure detector
6. Speaker for alarms
7. Battery charger and power
8. Motor speed controller- many times it is a microprocessor

SOME Infusion Pumps Have These Features in Common

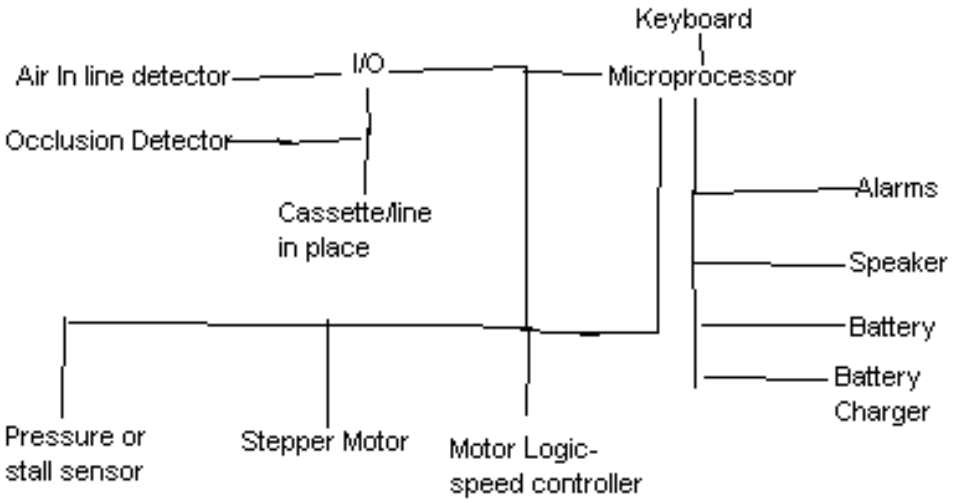
1. Upstream (bag) occlusion- stall or pressure detector
2. Drug library
3. Multiple programs for different types of users.
4. Drug dose limiting
5. Remote programmability (now or very new future)
6. Network Connectivity (now or very near future)
7. Bar code reader

IV Pump Testing

When testing an infusion pump all the sensors should be tested. The rate should be tested and any other special features the pump has.

To calculate rate use this formula: rate/60. This gives mL per minute. Then you can calculate how many minutes it would take to get to a desired volume. If you have a 20 mL burette that you are filling lets calculate a rate and time to fill the 20 mL burette. Rate per minute = 240/60= 4. The pump will infuse 4 mL per minute. Then use this formula: desired volume/ rate per minute. 20 cc/4 mL per minute = 5 minutes. So it would take 5 minutes to fill the 20 mL burette. A stopwatch should be used to observe time elapsed.

Further testing should refer to the manufacturer service manual or the Procedure # on the PM sheet.



Infusion Pump Diagram