Setting up and priming an intravenous infusion


Summary
The setting up and priming of an intravenous infusion is a common nursing procedure. However, it is associated with certain complications, for example infection. This article describes a step-by-step guide to the equipment required, correct preparation of the patient and the procedure. It also provides readers with calculation of drip-rate formulae.

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SETTING UP and priming an intravenous (IV) infusion is a core clinical skill required in everyday nursing practice. It is estimated that approximately 80% of patients require some form of IV therapy (Finlay 2004). The most common reasons for an IV infusion include maintaining and restoring fluid and electrolyte balance, drug delivery, administration of blood and provision of nutrition (Jamieson et al 2007).

An infusion can be administered via the peripheral or central venous route. The route and device will depend on the condition of the patient and the type of therapy to be administered.

The IV infusion methods that require the setting up and priming of an administration set can be described as continuous or intermittent. The continuous method is used for either large or small fluid volumes infusing over a prolonged period, for example sodium chloride and heparin. The intermittent method is usually for smaller volumes that are repeated at regular intervals, for example antibiotics. In addition to these methods, bolus administration can be used for smaller, concentrated volumes of drugs and fluids, for example morphine and sodium chloride flushes (Tremayne and Parboteeah 2005).

Consideration must be given to the clinical skills and competency of the practitioner for both the administration and appropriate observation and management of the infusion in the designated environment (Royal College of Nursing (RCN) 2005, National Patient Safety Agency (NPSA) 2007, Nursing and Midwifery Council (NMC) 2008a).

This article focuses on the setting up and priming of a continuous or intermittent gravity IV infusion. The assumption is made that the vascular access device (VAD) has already been sited. A VAD is ‘inserted into either a vein or an artery, via the peripheral or central vessels, to provide for either diagnostic (blood sampling and central venous pressure reading) or therapeutic (administration of medications, fluids and/or blood products) purposes’ (Dougherty et al 2004).

Patient assessment
Before starting infusion preparation, the nurse must understand the clinical rationale for the intended infusion, the planned infusion time, projected length of treatment and the possible complications that may arise through administration of the infusion. The nurse should ascertain that the patient’s VAD is suitable for the intended therapy, is patent and free from signs of infection (RCN 2005).

Other factors to be assessed before the infusion begins include assessment of allergies and patient history, for example previous infusion experiences that have caused the patient distress, anxiety or difficulties with compliance. The nurse must also ascertain if the patient has other current infusions in progress and his or her compatibility with the proposed additional infusion. The patient may require additional flushes before, during and after treatment and
this could have implications for the patient’s overall fluid and electrolyte balance (RCN 2005, NPSA 2007, NMC 2008b).

Following patient assessment, it may be necessary to insert additional VADs or use other equipment, for example multi-lumen devices.

**Equipment preparation**

An accurate, legible and complete prescription instruction or valid patient group direction must be available to the nurse to administer the intended infusion therapy (NMC 2008b). A nurse must not administer any medication or fluid to a patient without a valid prescription instruction. Checks against the fluid type include verification that the fluids have been stored correctly, for example temperature and light-controlled environments. Further checks of both the fluids and administration equipment include expiry date and integrity of packaging for sterility and non-contamination (Box 1) (Lister and Sarpal 2004, Ingram and Lavery 2005).

**Administration sets**

Administration sets (Figure 1) are sterile-packed from manufacturers. The various components are discussed below.

A trocar is protected by a plastic sheath (protector). Depending on the manufacturer the drip chamber can be single or double, filtered or non-filtered. Administration sets for blood transfusions require a 170-200 micron filter (McClelland 2007). The purpose of this filter is to remove blood debris and/or clots (Macklin and Chernecky 2004). The tubing can differ in both diameter and material, for example light-barrier sets to protect light-sensitive infusions, polyvinyl chloride (PVC) sets for common fluid and blood infusions, and polyethylene-lined PVC sets for medication to allow flexibility and reduce the risk of permeation by chemicals within the infusion. Non-PVC sets are also available as PVC can interact with some medications, for example ciclosporin and nimodipine (British National Formulary 2008). It is important, therefore, to consider compatibility of the infusion set with the proposed therapy and to select the appropriate administration set accordingly.

An adjustable flow controller or roller clamp surrounds the tube. By moving the controller up or down, the flow is controlled. The narrower end of the flow controller device is usually the ‘off’ position. Manual flow rate controllers are less accurate than infusion pumps as the flow rate can vary significantly. If the patient position is changed or if the tubing becomes kinked or bent, the patient is at risk of potential fluid overload or reduced fluid volumes. Additionally, if the position of the roller clamp is not altered every six to eight hours, the flow rates can be affected by the indentation of the tubing (Macklin and Chernecky 2004).

Within the administration set there may be a Y-type injection port. Traditionally this was accessed by a needle and syringe or secondary administration set to deliver additional medication or infusions. However, as a result of the risks of needlestick injuries to healthcare workers, this Y-type injection port is increasingly being manufactured with a needle-free access device (Pratt et al 2007).

Administration sets may also be non-vented or vented. Non-vented administration sets are used with plastic bags. Vented administration sets are used if the infusion is in a glass bottle. Alternatively, an air-inlet needle can be used with a non-vented administration set when administering an infusion from a glass bottle (Lister and Sarpal 2004).

The Luer-Lok™ connector is at the end of the administration set and enables connection to the VAD. This connector is shielded by a plastic protector to maintain asepsis.

**BOX 1**

**Equipment for an intravenous infusion**

- Administration set.
- Air inlet (if required).
- Drip stand.
- Gloves.
- Infusion devices (if required).
- Infusion fluid or medication.
- Multi-lumen catheter (if required).
- Prescription.
- Sterile wipe.
Patient preparation

A clear explanation of the intended procedure should be given to the patient so that an informed decision can be made and informed consent for the procedure given. The patient must therefore be told the risks, benefits and alternatives of the intended infusion (Department of Health 2001). When appropriate nurses should discuss their contribution to the safe administration of the infusion, for example the actions they will take if they notice any changes in the flow rate and the patient’s condition, or if the infusion feels uncomfortable. They should also explain to the patient the importance of maintaining the height of the gravity infusion, how to mobilise safely while the infusion is running, and the potential dangers of tampering with the infusion system.

Infection risk

IV infusion administration carries an acknowledged risk of infection for the patient. Insertion of the VAD allows an entry portal to the patient’s bloodstream. Infection can result from harmful organisms entering the body via this route and multiplying (Finlay 2004).

Where IV infusion administration has been prescribed, the contaminant causes of infection associated with the therapy can be separated into two groups: extrinsic and intrinsic (Table 1). Infective harmful organisms can be introduced through intrinsic contamination of the required fluids, drugs or equipment. Extrinsic contamination can occur during the IV therapy administration process itself, when harmful organisms are introduced to the equipment and products being used. The skin surface of the patient and the healthcare worker carry organisms and these can be the cause of bacterial infection of the patient. Additionally, healthcare staff move frequently between patients, which increases the risk of cross-contamination. To minimise these risks it is essential that healthcare professionals undertake thorough and effective hand hygiene and check the integrity of all fluids, drugs and equipment before use (Nicol 1999, Finlay 2004).

Action and procedure

When handling the administration set and the insertion port of the intended fluid container, it is essential that the nurse does not touch or contaminate any of the sterile parts. Some administration sets allow the priming to be undertaken with the protective end cap remaining in place. If the administration set does not contain this feature, it is important not to touch the exposed Luer-Lok™ end and to cover it with a sterile cap once primed until it is ready to connect. The actions/procedures of setting up and priming an infusion system are detailed in Table 2, with the associated rationale.

Drip rate calculation

To establish the correct flow rate, it is essential that the nurse understands the calibration of the drip rate for the administration set being used. The calibration of an administration set can vary from between 10 and 20 drops/ml (the drip factor) and is written on the outside of the administration set packaging. Using the calculations shown in Figure 2, the practitioner is able to determine accurately the required drip rate. Once the desired drip rate has been calculated, the roller clamp should be adjusted and, using a watch, the drips for one minute counted. The practitioner should continue to do this until the required drip rate is established.

Monitoring

Once an infusion rate has been established, the nurse should observe and monitor the patient, flow rate and progress of the infusion at regular intervals. In addition, the nurse should monitor the VAD and site to ensure that the dressing is clean, dry and intact and that there are no signs of infection (RCN 2005). If accuracy of the infusion is an essential clinical requirement for the patient, consideration should be given to the use of an infusion pump. This will ensure accurate and timely delivery of the infusion (Medical Devices Agency 2003). Furthermore, problems in infusion flow can result with active
### Setting up and priming an intravenous infusion

<table>
<thead>
<tr>
<th>Action/procedure</th>
<th>Rationale</th>
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<tbody>
<tr>
<td>Check prescription validity</td>
<td>To reduce the potential for medication error</td>
</tr>
<tr>
<td>Check the patient’s biochemistry results, if indicated</td>
<td>To establish the reason for prescribed infusion and avoid inappropriate infusion</td>
</tr>
<tr>
<td>Select all required equipment, ensuring compatibility of products (Box 1)</td>
<td>To prepare for the intended procedure, To ensure safe delivery of infusion</td>
</tr>
<tr>
<td>Inspect all equipment and infusion fluid for integrity and expiry date</td>
<td>To reduce potential for intrinsic risk factors (Table 1)</td>
</tr>
<tr>
<td>Clean hands using effective hand hygiene technique</td>
<td>To reduce extrinsic infection risk</td>
</tr>
<tr>
<td>Apply gloves, in accordance with hospital policy</td>
<td>To reduce drug and bodily fluid exposure for healthcare worker</td>
</tr>
<tr>
<td>Clean infusion bag ports with an alcohol wipe and allow to dry (if manufacturing instructions indicate)</td>
<td>To reduce extrinsic infection risk</td>
</tr>
<tr>
<td>Open packaging of administration set and close roller clamp</td>
<td>To ensure effective priming of administration set and avoid spillage</td>
</tr>
<tr>
<td>Using non-touch technique remove protective trocar cover from administration set</td>
<td>To reduce extrinsic infection risk and handling of sharps</td>
</tr>
<tr>
<td>Rest bag of fluid on clean, flat surface and pierce access port of infusion fluid bag fully to hub of trocar</td>
<td>To reduce risk of piercing side of bag, ensure secure connection and avoid leakage (maintenance of closed system)</td>
</tr>
<tr>
<td>Fill drip chamber (two-thirds to one-half full) with infusion fluid by squeezing the chamber between thumb and forefinger or in accordance with the manufacturer’s instructions</td>
<td>To ensure safe and effective functioning of device, expulsion of air and aid fluid flow</td>
</tr>
<tr>
<td>Hang fluid container from drip stand, if not done already</td>
<td>To ensure gravity flow</td>
</tr>
<tr>
<td>Label administration set with details of commencement and set change date*</td>
<td>To minimise infection and infusion complications</td>
</tr>
<tr>
<td>Using roller clamp to control fluid flow, open sufficiently to allow slow and steady flow until end of administration set has been reached</td>
<td>To ensure complete filling of internal space of administration set and reduce opportunity for air bubbles and the risk of air embolus</td>
</tr>
<tr>
<td>Check full length of filled administration set to ensure no air bubbles are present. Expel any bubbles present according to local protocol</td>
<td>To reduce the potential of accidental introduction of air into the patient</td>
</tr>
<tr>
<td>When transporting infusion to patient, ensure sterility of administration set remains intact</td>
<td>To reduce extrinsic infection risk</td>
</tr>
<tr>
<td>Undertake positive patient identification before administration and reconfirm patient consent</td>
<td>To reduce medication error and ensure agreement from the patient</td>
</tr>
<tr>
<td>Clean port of vascular access device (VAD) with appropriate cleaning agent in accordance with local protocol</td>
<td>To reduce extrinsic infection risk</td>
</tr>
<tr>
<td>Check patency of VAD by flushing with a syringe of 0.9% sodium chloride 5-10ml</td>
<td>To ensure fluid prescription delivery</td>
</tr>
<tr>
<td>Remove administration set protection cap using non-touch technique and attach end of line to VAD securely†</td>
<td>To reduce extrinsic infection risk and avoid introduction of air embolus</td>
</tr>
<tr>
<td>Open roller clamp slowly and calculate drip rate (Figure 2)</td>
<td>To comply with prescribed fluid rate and prevent potential complications</td>
</tr>
<tr>
<td>Document administration accurately, legibly and completely in records: date, time, fluid type, rate, batch number, signature</td>
<td>To ensure patient record supports effective communication and accurate patient management</td>
</tr>
</tbody>
</table>

*Administration sets must be changed in accordance with manufacturers’ instructions, local guidance and medication/fluid properties. For example, standard administration sets are suitable for up to 72 hours, sets used for drugs, for example insulin, for up to 24 hours, and sets for blood transfusions are suitable for up to three units (12 hours in total) (McClelland 2007, Pratt et al 2007).†Needle-free connectors can be attached to the VAD or they can be integral to the administration set. Needle-free connectors reduce the use of sharps and are reported to reduce the risk of infection if used in accordance with manufacturing instructions. They also reduce the risk of air embolus to the patient as they maintain a closed system if the set becomes disconnected accidentally (Pratt et al 2007). (Harkreader and Hogan 2004, Potter and Perry 2006)
and mobile patients. In these cases infusion pumps may be appropriate. However, the use of an infusion device does not replace the need for regular nurse monitoring in accordance with local policy.

**Conclusion**

The setting up and priming of an IV infusion is primarily the responsibility of a registered nurse. Manufacturing developments and the purchase and supply of products within care settings can have a significant impact on the success and safety of the procedure.

Although this skill is frequently used in practice, nurses should not become complacent. It requires both theoretical and practical clinical knowledge that is current and up to date, as well as product and equipment recognition and understanding. Nurses must always seek clarity when unfamiliar with equipment. It is essential, therefore, that nurses recognise and understand the equipment available in their area of practice. Equally, healthcare organisations can standardise and limit product choice to reduce risk of error in the procedure (NPSA 2007).

Nurses should ensure that they have the knowledge, skills and competence to undertake the role requirements (NMC 2008a). NS

**References**


**FIGURE 2**

Drip rate calculations

**Calculation formula 1**

Volume to be infused (in ml) \times \frac{\text{Drip rate}}{60 \text{ minutes}} = \text{Drops per minute}

For example:

Volume to be infused = 1,000 ml

Time of infusion 2 hours

Drip rate = 20

\[
\frac{1000}{2} \times 20 = 167 \text{ drops per minute}
\]

(Lister and Sarpal 2004)

**Calculation formula 2**

Volume to be infused (in ml) \times \frac{\text{Drip factor (in drops/ml)}}{\text{Time of infusion (in minutes)}} = \text{Drops per minute}

For example:

Volume to be infused = 1,000 ml

Time of infusion 2 hours = 120 minutes (2 x 60)

Drip factor = 20

\[
\frac{1000}{120} \times 20 = 167 \text{ drops per minute}
\]

(Jamieson et al 2007)