NHS Fife

## Acute Services Division

# The Preparation and Administration of Medication by Infusion

# Training and Resource Pack

**NAME**……..

**WARD/DEPARTMENT**……..

**HOSPITAL/SITE**……

The following KSF dimensions C1 level 2, C3 level 2 and HWB7 level 2 will be met on completion of this programme

# Contents

# Introduction

## The Rationale for this Programme

As a registered practitioner you have a duty to provide a reliable and safe standard of care to patients in a competent, skilled manner (Finlay 2004). The administration of medication by infusion is a common form of treatment in health care impacting on daily practice for nurses, midwives and other healthcare professionals. This training and resource pack will assist your learning in all aspects of this programme.

Successful completion of this programme will ensure practitioners have the knowledge and skills to prepare and administer medication via the continuous, intermittent or bolus route safely and competently.

## Prior to undertaking the programme the following criteria must be met:

- All registered practitioners must be nominated by their senior charge nurse/ line manager prior to undertaking the programme.

- An assessor must be identified at the beginning of the programme. Practitioners who have completed this programme and competent in administering medication via an infusion can act as an assessor as agreed by their charge nurse/line manager.

- The practitioner must have an underpinning knowledge of the anatomy and physiology of the circulatory system.

## To complete this Programme Practitioners must:

- Complete the pre-course drug calculation workbook.
- Attend a theory / practice session.
- Attain 100% in drug calculation test paper.
- Undertake a period of supervised practice in the clinical area, using relevant assessment tools **within 3 months following attendance at a theory/practice session.**
- Be deemed competent to practice by an assessor.

## Competency

- As a registered practitioner you must be accountable and responsible for maintaining competency and updating your own practice as per your own Code of Conduct, e.g. Nursing and Midwifery Council.

- Your competency should be reviewed on at least an annual basis as part of your Personal Development Plan.

- Practitioners previously employed by other Healthcare establishments who have undergone IV/Infusion programmes must follow the Standard Operating Procedure for Transferability of Skills, or undertake the full programme if they are required to practice the skill in NHS Fife Acute Services Division.

**Recommended Reading:**

NURSING AND MIDWIFERY COUNCIL, 2008. The Code: Standards of conduct, performance and ethics for nurses and midwives. London: NMC.

NURSING AND MIDWIFERY COUNCIL, 2008. Standards for Medicines Management. London: NMC.

NHS FIFE, 2002. Code of Practice Medicine. Fife: NHS Fife.

**Further Reading:**

NHS FIFE, 2009. C2 - Obtaining Informed Consent . NHS Fife.

ROYAL COLLEGE OF NURSING, 2010. Standards for infusion therapy. RCN: London.

NHS SCOTLAND CLINICAL RESOURCE AND AUDIT GROUP, 2002. Good practice Statement for the Preparation of Injections in Near-Patient Areas. Scottish Executive: Edinburgh.

University College London Hospitals NHS, 2010. UCL Hospitals Injectable Medicines Administration Guide Pharmacy Department. 3rd ed. London: Wiley-Blackwell.

## Competency

**Following successful completion of the programme the table below describes the level of standards practitioners will achieve:**

| Competency Standards | Performance Indicators |
|---|---|
| **Discuss professional issues in relation to medication administration by infusion**. | • Understands the legal and ethical principles of this practice.<br>• Demonstrates the importance of decision making as part of the multidisciplinary team.<br>• Understands the importance of following the Incident Reporting procedure if an error/adverse event occurs. |
| **Performs accurate assessment of patients requiring medication by infusion.** | • Demonstrates knowledge and understanding of pharmacology in relation to medications to be infused.<br>• Identifies and analyses the appropriateness of the medication administration for individuals.<br>• Actively involves the patient in the decision making process respecting individual wishes and/or beliefs.<br>• Provides patient education regarding medication administration to aid decision-making.<br>• Recognises differences of paediatric medication administration for infusion and other specialist areas.<br>• Recognises when assistance is required from specialists<br>• Recognises the psychological impact medication administration may have for the patient. |
| **Demonstrates competence in the procedure of medication administration by infusion.** | • Obtains consent and prepares the patient for the procedure.<br>• Assembles and prepares equipment.<br>• Practices skill competently.<br>• Utilises and operates infusion devices competently and correctly.<br>• Communicates appropriately with multidisciplinary team by maintaining accurate records.<br>• Disposes of waste in accordance with NHS Fife Infection control policy (2012). |
| **Engages in evaluation and critical analysis post procedure.** | • Discuss clinical risks associated with medication administration by infusion to patient and practitioner and the appropriate action(s) to be taken to prevent and manage these risks.<br>• Have the knowledge to respond promptly and appropriately to unexpected changes in patients receiving medication by infusion, e.g. anaphylaxis.<br>• Reflects on attitude, behaviour and technique post procedure.<br>• Identifies areas for further learning.<br>• Draws on a range of resources for further learning/ reading. |

## Professional and Legal Aspects

Government initiatives such as Clinical Governance along with Professional Bodies require employing authorities to ensure employees have access to appropriate educational programmes.

As the role of the practitioner evolves, so too must the education and clinical support required to prepare practitioners with the knowledge, skills and competencies.

You as a registered practitioner must be fully aware of, and understand the professional parameters and legal responsibilities in relation to the role and duty of care owed to your patients. The following questions may help to clarify this:

- Will patient care be improved?
- Am I competent to do the task?
- If not, is education available?
- Do I have managerial support?

### Failure to Address These Questions May Jeopardise Patient Care and your Professional Standing

You are an accountable practitioner and must be able to explain and justify your actions and clinical decisions. In law there are four areas you may be called to account for your actions/decisions:

- Civil Law — the patient/relatives versus nurse/ doctor/ practitioner
- Criminal Law — when a breach of statute or common law occurs
- Professional — NMC/ Professional Codes of Conduct and frameworks
- Employer — contract of employment

There are two forms of liability of negligence:

**Negligence** can be established if and when:

- There was a breach in the duty of care provided.
- This breach has caused damage to the patient.
- The damage is recognised by a court of law.

**Direct Liability** is when the employer is directly at fault in a case of negligence, e.g. by not providing training when asking staff to undertake new skills.

**Vicarious liability** is when the hospital is legally responsible for the negligence of an employee.

However you will still be held personally liable for negligence, face disciplinary action from the employer and /or NMC/ Professional Body, or prosecuted for a criminal offence.

## Legislation Controlling the Supply, Storage and Administration of Medicines

As a practitioner you should be aware of the following:

- Medicines Act 1968
  This act classifies medicines into the following categories – Prescription –Only Medicines (POMs), Pharmacy-only Medicines and General sale list Medicines (GSLs)
- Misuse of Drugs Act 1971
  This legislation is concerned with the categorisation of controlled drugs.
- Unlicensed Medicines

### Unlicensed Medicines

Guidance from the NMC Standards for Medicines Management (2008) defines an unlicensed medicine as a medicine that has no marketing authorisation, granted by the Medicines Healthcare Products Regulatory Authority (MHRA) before it can be prescribed or sold. If an unlicensed medicine is administered to a patient, the manufacturer may not have liability for any harm that ensues. The person who prescribes and dispenses/supplies the medicine carries the liability which may have implications when obtaining informed consent.

The NMC Standards for Medicines Management (2008) Standard 22 states, “A registrant may administer an unlicensed medicinal product with the patient’s informed consent against a patient-specific direction but not against a patient group direction.

### Medicinal products used outside their licence

Medication which is licensed but used outside its licensed indications (commonly known as "off-label") may be administered under a patient group direction only where such use is exceptional, justified by best practice, and the status of the product is clearly described.

As a registrant, you should be satisfied that you have sufficient information to administer an unlicensed or ”off label” drug safely and, wherever possible, that there is acceptable published evidence for the use of that product for the intended indication. Liability for prescribing an off-label product sits with the prescriber and the dispenser/supplier.

The British National Formulary for children provides useful information for the administration of off-label medication for children. More information on unlicensed and off-label drugs can be found in the NMC publication Standards of Proficiency for Nurse Midwife Prescribers 2006, which can be viewed at:
http://www.nmc-uk.org/Educators/Standards-for-education/Standards-of-proficiency-for-nurse-and-midwife-prescribers/

### Knowledge a Practitioner Must Possess Before Administering Medications for Infusion

- The constituents of a valid prescription
- When the patient last received the medication for infusion
- Patient assessment necessary prior to administration e.g. checking B/P prior to administering hypotensive agent
- Therapeutic benefits to patients.
- Actions of drugs and possible side effects

- Patient allergies - Practitioners must ensure any allergies are documented in the notes, including the symptoms the allergy presents to reduce the risk of being prescribed medication which they are allergic to (DOH, 2004).
- Recommended dose range
- Aseptic Non Touch Technique for the preparation and administration of Medications for infusion
- Safe disposal of waste as per NHS Fife Infection Control Policy
- Special precautions during and after administration e.g. protection from light
- Appropriate diluent to use
- Method of administration e.g. intermittent infusion, Intravenous (IV) bolus, continuous subcutaneous infusion.
- Compatibility with other drug therapy and infusion.
- Patient monitoring required before, during or following medication administration.

**Every practitioner administering medications has a professional responsibility to ensure that he/she has sufficient knowledge of all aspects of therapy as medication errors are potentially more serious when using the IV route, especially bolus.** Good standards of nursing practice will ensure the risks involved are minimised.

## Types of Vascular Access

The IV route for the administration of medication and fluids is used to administer fluids, electrolytes, blood products, drugs and parenteral nutrition depending on the severity of illness and the nature and duration of treatment required.

### Peripheral Venous Access

Used in drug and/or fluid administration and blood transfusion, usually in the short-term. The veins most commonly used in the hand and arm are those on the dorsum of the hand, the cephalic and basilic veins of the forearm and the antecubital fossa.

The choice of cannula size is dependent on the patient's condition and treatment required e.g. fluid resuscitation requires a large cannula in a large vein, whilst a smaller cannula may be required to administer medication. The comfort of the patient should also be taken into account.

### Midline Venous Access

Midline catheters may be used when patients have poor peripheral venous access and require IV access for longer than 5 days.

The catheters are longer than peripheral cannula (about 20cm) and have a larger lumen. They do not extend past the patient's axilla and are inserted into the basilic or cephalic vein at the antecubital fossa.

### Central Venous Access

These are used in patients with poor peripheral venous access or those requiring long term therapy for chronic conditions.

The tip of a central venous access device lies in the superior vena cava or right atrium to allow monitoring of the heart and blood flow as well as the administration of large volumes of fluid, blood and vesicant (irritant) substances Finlay (2004). Access to these veins will be from the internal or external jugular, subclavian, femoral or peripheral veins.

## Administration of IV Medication

In hospital, medicines not given orally are usually given by the IV route rather than intramuscular or rectal routes:

- as the effect is quicker and more predictable
- the pain of multiple injections is avoided
- larger volumes can be given

### Continuous IV infusion

Is the addition of a drug to a large volume infusion bag (e.g. Sodium Chloride 0.9% 500mls), or a small volume in a syringe (e.g. dopamine, morphine, heparin) at a constant rate over a period of time.

Continuous infusions are indicated in the following:

- Constant therapeutic drug concentration is required.
- Drug has a rapid elimination rate.
- Very short half-life.
- When the patient requires large volumes of IV fluids.

### Intermittent IV infusion

Is the addition of a drug usually to a smaller volume infusion bag (e.g. Sodium Chloride 0.9% 100mls), administered over a set period of time, at a specified rate (e.g. antibiotics, ranitidine) at repeated intervals.

Intermittent infusions are indicated in the following:

- When a drug must be diluted in a volume of fluid larger than is practical for a bolus injection.
- When the plasma concentrations required are higher than those achievable by continuous infusion for therapeutic effect.
- When a faster response is required than that achieved by a continuous infusion.
- When the drug is unstable, or incompatible with fluids used for continuous infusion.

### IV Bolus

Is the introduction of a small volume of drug solution into a cannula, or the injection site of an administration set of a compatible continuous infusion (e.g. antibiotics, diuretics)

IV bolus is indicated in the following:

- To achieve immediate and high drug levels.
- Small volume of injection makes it ideal for fluid restricted patients on multiple therapies.
- Some drugs are metabolised too quickly.

**Advantages to Patients when Administering IV Medication**

- A means of rapid drug administration with immediate effect.
- Administer drugs that would otherwise damage surrounding tissues.
- A route for drugs that would be altered in, or could not be absorbed from the gut.
- A means of achieving constant plasma levels of a drug, avoiding the variables affecting uptake from the gut or tissues.
- A route for correcting fluid and electrolyte imbalances or administering IV nutrition when the gut is not functional.
- A painless way of administering drugs by injection.

**Disadvantages when Administering IV Medication**

- Once administered a drug cannot be retrieved and its effect may be experienced rapidly.
- 'Speed shock' can result when drugs are given too quickly - toxic levels in the plasma cause collapse and possible cardiac arrest.
- Drugs may react with other compounds in solution and precipitation of particles can occur, leading to embolism if infused.
- Venous access provides a direct route of entry into the body for micro-organisms, increasing the risk of infection.
- Cannulating a vein and administering substances into it is likely to cause irritation to the vein, risking phlebitis and thrombophlebitis.
- Administration may be time consuming.

(Finlay 2004)

## Administration of Continuous Subcutaneous Medication

Medicines may be injected into most body spaces therefore syringe drivers may also be used to deliver very slow flow rates of medication subcutaneously.

**Advantages to Patients when Administering Subcutaneous Medications**

- When the oral route of administration is not suitable or possible as the patient cannot swallow or absorb their medication.
- Giving analgesia this way avoids the problems associated with maintaining IV access.
- To control the symptoms of their disease/therapy.
- Two medicines may be prescribed for use in a single syringe driver. **However this must only be used under specialist advice** e.g. with a patient requiring palliative care, the Specialist Palliative Care Service must be involved in the decision and this must be clearly reflected in the patient's records.

**Disadvantages to Patients when Administering Subcutaneous Medications**

- Once administered a drug cannot be retrieved and its effect may be experienced rapidly.
- Not all medicines are suitable due to extremes of pH and the body's ability to absorb them.
- Infection at the infusion site.

## The Use of Infusion Devices

Infusion devices are used extensively throughout NHS Fife Acute Services Division. These devices administer prescribed medications and fluids through a designated subcutaneous or vascular access device at a set rate over a prescribed time period.

Types of devices used within the Acute Services Division include:

- **Gravity Controllers** – A clamping mechanism is used to regulate the flow of fluid under the force of gravity.
- **Volumetric Infusion Devices** – Employ pumping mechanisms which deliver fluids via a designated administration set accurately over a prescribed time period.
- **Syringe Drivers** – Work by pushing the plunger of the syringe forward at a pre determined rate. They are preferred when medications for infusion are prescribed at less than 5mls/hr.
- **Ambulatory Syringe Drivers –** These devices are sometimes known as miniature syringe drivers because they are light and portable. They are usually used when a small volume of fluid is delivered over a period of time such as a day.

Other devices available include:

- **Patient Controlled Analgesia (PCA) devices** – Allow the patient to have control of their analgesia within set parameters (training for these devices is delivered by the Pain Team)
- **Anaesthetic pumps** – These are syringe drivers and must only be used for the purpose of administering anaesthetic drugs.

Infusion devices have both advantages and disadvantages particularly as they have become more technical and complex to use**.**

**It is essential that all staff operating and monitoring patients receiving fluids/medication via these devices have competency based training for all infusion devices used within their clinical areas.**

This training will normally be delivered by designated trainers within each clinical area. For more specialised equipment training will be delivered by manufacturers designated trainers. If you have any problems accessing training please contact the Practice and Professional Development Unit.

## Monitoring Infusions

On commencement of an infusion the following information is recorded, on the NHS Fife Hourly IV Infusion Check Chart or specific charts e.g. the McKinley T34 Syringe Driver Subcutaneous Infusion check Chart:

- date and time infusion commenced
- expected completion time
- route
- serial number of device if used
- rate setting
- volume to be infused

- total volume infused
- volume of infusion remaining
- battery life, as appropriate
- checks on the infusion site
- any comments/reasons for any alterations
- the signature(s) of the practitioner(s) commencing the infusion and undertaking the hourly check.

## Risk Management of Medication for Infusion Administration

Medication for infused administration involves significant risk to the patient. The maintenance of safety throughout is dependent upon the knowledge and skills of the practitioner caring for the patient. It is vital that the practitioner can recognise potential and actual problems associated with this and initiate appropriate action effectively.

The following patient groups are particularly at risk of complications:

- paediatrics and neonates
- patients with compromised cardiovascular status
- patients with organ failure
- patients with major infection
- patients receiving multiple medication
- post-operative patients.

The risk usually occurs after the administration as a result of a rise in the systemic drug levels – the effects may be local or systemic.

| **Practitioner/Patient Risks Associated with Infusion Medication Administration** | | |
|---|---|---|
| **Risk** | **Cause** | **Preventative Action** |
| **To practitioner administering Infusion Medications** | • Sensitivity to the medication if in contact with skin<br>• Needlestick injury<br>• Blood contamination | Wear gloves and apron.<br><br>Follow medication administration procedures and infection control policies. Use sharp safe products when available. |
| **Patient receives the wrong medication** | • Medication name confusion<br>• Poorly written prescriptions<br>• Different medications with similar packaging<br>• Lack of second checks<br><br>• Inadequate checking of patients identity | Unambiguous prescribing; use of generic medication name.<br>Ensure illegible prescriptions are re-written.<br>Store similar packaged medications separately.<br>Medications to be administered by infusion must be checked by two registered practitioners one of whom must have successfully completed all aspects of this programme.<br>Once the infusion is prepared both practitioners must check the details on the patient's wristband with the prescription chart and verbally with the patient if possible, according to local policy. |

| Practitioner/Patient Risks Associated with Infusion Medication Administration | | |
|---|---|---|
| **Risk** | **Cause** | **Preventative Action** |
| **Patient receives the wrong dose** | • Incorrect calculation<br>• Incorrect dose on prescription<br>• Inaccurate monitoring of variable dose medication<br>• Same medication/dose administered twice<br>• Medication given out with prescribed time<br>• Incorrect use of infusion devices | Calculations should be carried out by two registered practitioners and agreement reached on the correct dose to be given.<br>All paediatric prescriptions should have intended dose written in mg/kg.<br>Where dose is weight specific, ensure weight in grams/kilograms is accurate.<br>Clear prescriptions; seek advice if unsure.<br>Ensure administered medications have been signed for.<br>Administer medication in accordance with local policy.<br>Staff must undergo competency based training before using infusion devices.<br>Whenever possible use medication that is in a ready to use form (C.R.A.G., 2002). |
| **The patient receives a medication via the wrong route** | • Prescription wrong<br>• Devices used inappropriately<br>• Patient lines not labeled<br>• Medications via various routes prepared at the same time and taken to patient together | Accurate prescribing, seeking assistance if unsure.<br>Correct use of infusion devices.<br>Clear labeling of patients invasive lines.<br>Confirm route during checking process.<br>Prepare medications to be administered for different routes at different times.<br>Never take medications for different routes to the patient at the same time. |
| **Patient given medication to which they have a pre-existing allergy** | • Allergy not communicated from patient to staff<br>• Failure to document known allergy<br>• Allergies not checked before prescribing or administration<br>• Inaccurate knowledge of medications administered | Ask patient/significant other of known allergies and document in records.<br>Share this information with the multi-disciplinary team and other hospital departments as necessary.<br>Ensure in-patients wear allergy bands.<br>Check allergies with patient and prescription chart prior to prescribing and administration.<br>Know the medications you are administering. |
| **Infection risk** | • Cross contamination between patients<br>• Poor aseptic technique when preparing medications for infusion | Good hand washing techniques and appropriate use of anti-bacterial hand gel.<br>Wear gloves and apron and use aseptic/non-touch technique during preparation and administration of medications for infusion. |

| | | |
|---|---|---|
| **Infection risk (continued)** | • Use of vascular access devices | Use aseptic, non-touch technique when inserting vascular access devices. Monitor the devices whilst in use using PVC and CVC bundles. Remove vascular access devices as soon as possible. |
| | • Inappropriate decontamination of infusion devices. | Ensuring appropriate decontamination carried out when using infusion devices (i.e. the 'hub must be scrubbed' in between use). |
| | • Inappropriate disposal of waste. | Dispose of all waste in appropriate receptacles as per Infection Control Policy. |

## Sources of Infection and Safety Compliance

Infusion therapy has many benefits for patient management and more than 60% of in-patients are likely to receive this form of treatment (Wilson 2001). With all invasive interventions there is still significant risk of infection which can be life threatening.

Infection can occur due to:

- **Intrinsic factors**: damaged packaging of equipment and/or faults in manufacturing. Check storage of products as per manufacturers' instructions and expiry dates.

- **Extrinsic factors**: are introduced during medication preparation and administration e.g failure to maintain a closed system, hub related contamination. (Dougherty and Lamb 2008).

The standard infection control principles that must be adhered to as per NHS Fife Infection Control Manual (2012):

- **Hand washing:** Hand washing is the single most important aspect of reducing infection and the hands of patients and practitioners are frequently identified as the main source of pathogens associated with IV fluids. Therefore infections can be reduced by good hand washing and aseptic techniques (Weinstein 2001).

- **Single use sterile equipment:** Inspect packaging to ensure it is intact and has not exceeded expiry date. Medication infusion administration lines must be also be changed as per policy.

- **Clean equipment:** e.g. infusion device or infusion stands.

- **The correct disposal of waste**: Safe disposal of clinical waste, sharps and management of spillages.

Most infections are preventable by adhering to the existing principles of best practice (RCN 2010).

## Considerations for Children and Young People

The risk of medication error in children is compounded by the need to carry out complex calculations to prepare correct doses (Department of Health (DOH), 2004). This increased risk has led to the practice of double checking all medications in Paediatrics. The risk of error can also be reduced by:

- Practitioners undergoing sufficient training in dose and infusion calculations.
- The use of standardised charts and aide memoirs.
- All doses on prescriptions must be written in mg/kg.

There are fundamental differences in prescribing and administering medications to children in comparison to adults. These differences include:

- The age, admission date and weight in kilograms will be entered for all children (patients of 12 years of age and under (DOH, 2004).
- Double signatures is recommended as good practice and required for administering medications to children and young adults (DOH, 2004)
- Medicine doses in paediatrics follow an mg/kg basis and this should be written for every drug on the prescription chart. It is essential that patients' weights are recorded and maintained.
- Parents or guardians must be involved in the decision-making process. (Huband & Mohammed 2006).
- Practitioners must explain the procedure to children using terminology appropriate for their development stage (McCall-Smith, 1992).
- Patient education almost always includes family members. (Huband & Mohammed 2006).
- Practitioners must be fully conversant with the paediatric anaphylaxis protocol. (Resuscitation Council, 2006).

## Recognition and Management Of Adverse Effects

Patients should be observed closely for the occurrence of adverse effects following infusion medication administration. Medical staff should be notified immediately of any cause for concern. The practitioner will contact medical staff in the event of:

- Allergic reactions and Anaphylaxis
- Respiratory depression (rate less than or equal to eight breaths per minute)
- Speed shock
- Infiltration
- Extravasation
- Phlebitis
- Thrombophlebitis
- Pain on IV Injection
- Rapid Administration
- Layering

## Allergic Reactions And Anaphylaxis

### Preventative Measures

- Gaining an accurate history of allergies and abnormal reactions is a vital part of any nursing assessment. It is essential that this information is fully documented.
- Health care professionals need to have a good understanding of anaphylaxis and the essential treatment.

### Anaphylaxis

Anaphylaxis is a severe, life-threatening, generalised or systemic hypersensitivity reaction. This is characterised by rapidly developing life-threatening airway and/or breathing and/or circulation problems usually associated with skin and mucosal changes, usually within minutes of exposure to the allergen, however symptoms may develop later over a number of hours. Causes include food, insect sting and **medications** of which muscle relaxants, antibiotics, NSAIDs and aspirin are the most common cause, although any class of drug can be implicated.

There are very limited data on trends in anaphylaxis internationally, but data indicate a dramatic increase in the rate of hospital admissions for anaphylaxis, this increasing from 0.5 to 3.6 admissions per 100,000 between 1990 and 2004: an increase of 700%

### Pathophysiological Responses in Anaphylaxis

Anaphylaxis happens usually when the body makes the wrong kinds of antibody, called **immunoglobulin E (**IgE) to protein in our food or medications. IgE sticks to the surface of mast cells and basophils. The cells are now sensitised.

On re-exposure the antigen seeks out the IgE and ultimately causes the mast cell or basophil to degranulate, resulting in the sudden release of chemical substances including histamine. However, it is important to note that, in many cases, no cause can be identified. A significant number of cases of anaphylaxis are idiopathic (non-IgE mediated).

Anaphylactic reactions can occur in anyone, but are more common in people with a history of allergy or previous reactions; there may also be a history of asthma. Agents which may cause an anaphylactic reaction include:

- Drugs, Blood and blood products, Colloidal IV infusions, Vaccines, Contrast Media.
- Insect stings, Venom.
- Certain foods e.g. eggs, peanuts, milk and chocolate.
- Latex products, Hair dye.
- Pollen, Animal Dander.

### Clinical Manifestations

When anaphylaxis is fatal, death usually occurs very soon after contact with the trigger. From a case-series, fatal food reactions cause respiratory arrest typically after 30–35 minutes; insect stings cause collapse from shock after 10–15 minutes; and deaths caused by IV medication occur most commonly within five minutes. Death has, so far, never occurred more than six hours after contact with the trigger. The clinical presentation can include some or all of the below symptoms:

- Anxiety and unease; these are often the first indication that an individual is developing an allergic reaction.
- **Airway** : Airway swelling e.g., throat & tongue, Hoarse voice, Stridor
- **Breathing** : Shortness of breath, Wheeze, Hypoxia, Cyanosis, Respiratory arrest
- **Circulation** : Hypotension, Tachycardia, Dizziness, ECG Changes & Cardiac arrest
- **Disability (Neuro)**: Loss or reduction in consciousness
- **Exposure – skin changes**: Erythema, patchy or generalised , Itchy urticarial weals, Swelling
- Gastrointestinal symptoms: including vomiting, abdominal pain and diarrhoea.

### Diagnosis

Diagnosis of anaphylaxis can be difficult due to the lack of any consistent clinical manifestations. A single set of criteria will not identify all anaphylactic reactions. There is a range of signs and symptoms, none of which are entirely specific for an anaphylactic reaction; however, certain combinations of signs make the diagnosis of an anaphylactic reaction more likely. See box below.

**Anaphylaxis is likely when all of the following 3 criteria are met:**

1. Sudden onset and rapid progression of symptoms
2. Life-threatening Airway and/or Breathing and/or Circulation problems
3. Skin and/or mucosal changes (flushing, urticaria, angioedema)

The following supports the diagnosis:

- Exposure to a known allergen for the patient

Remember:

- Skin or mucosal changes alone are not a sign of an anaphylactic reaction
- Skin and mucosal changes can be subtle or absent in up to 20% of reactions (some patients can have only a decrease in blood pressure, i.e., a Circulation problem)
- There can also be gastrointestinal symptoms (e.g. vomiting, abdominal pain, incontinence)

## Clinical Intervention

As the diagnosis of anaphylaxis is not always obvious, all those who treat anaphylaxis must have a systematic approach to the sick patient. In general, the clinical signs of critical illness are similar whatever the underlying process because they reflect failing respiratory, cardiovascular, and neurological systems, i.e., ABCDE problems. Use an ABCDE approach to recognise and treat an anaphylactic reaction. Treat life-threatening problems as you find them. The basic principles of treatment are the same for all age groups. The occurrence of anaphylaxis creates an emergency situation and prompt action is vital.

Patients having an anaphylactic reaction in any setting should expect the following as a minimum:

1. **Recognition that they are seriously unwell**
2. **An early call for help**
3. **Initial assessment and treatments based on an ABCDE approach.**
4. **Adrenaline therapy if indicated. (See treatment algorithm)**
5. **Investigation and follow-up by an allergy specialist**.

### Patient positioning.

Most patients with life threatening anaphylaxis should be laid flat if tolerated, however the following factors should be considered:

- Patients with Airway and Breathing problems may prefer to sit up as this will make breathing easier.
- Lying flat with or without leg elevation is helpful for patients with a low blood pressure (Circulation problem). **If the patient feels faint, do not sit or stand them up** - this can cause cardiac arrest.
- Patients who are breathing and unconscious should be placed on their side (recovery position).

### Remove the trigger if possible.

Removing the trigger for an anaphylactic reaction is not always possible.

- Stop any drug suspected of causing an anaphylactic reaction (e.g., stop IV infusion of a gelatin solution or antibiotic).
- Remove the stinger after a bee sting. Early removal is more important than the method of removal.
- After food-induced anaphylaxis, attempts to make the patient vomit are not recommended.
- Do not delay definitive treatment if removing the trigger is not feasible.

**Cardiorespiratory arrest** following an anaphylactic reaction.

Start cardiopulmonary resuscitation (CPR) immediately and follow current guidelines. Rescuers should ensure that help is on its way as early advanced life support (ALS) is essential. Use doses of adrenaline recommended in the ALS guidelines. The intramuscular route for adrenaline is not recommended after cardiac arrest has occurred.

### Anaphylaxis algorithm

The key steps for the treatment of an anaphylactic reaction are shown in the algorithm (Appendix 1 on page 47)

**Useful websites**
http://www.resus.org.uk/pages/reaction.htm
http://www.anaphylaxis.org.uk%3what.html
http://www.users.globalnet.co.uk/-aair/anaphlaxis.htm (Not available via NHS Fife Intranet)

## Respiratory Depression

When respiratory rate is ≤ 8 breaths per minute staff must alert medical staff. Therefore be extremely cautious when administering opiates to:

- Patients with respiratory disease
- Patients with liver failure
- Patients with renal failure

These factors may increase the risk of respiratory depression.

| Clinical Features | Intervention |
|---|---|
| • Low respiratory rate<br>• Cyanosis<br>• Lowered level of consciousness | • Stop infusion<br>• Notify medical staff<br>• Administer oxygen<br>• Prepare Naloxone |

The practitioner must have knowledge of the correct dose, effects and side effects of Naloxone (pure opioid antagonist, for the reversal of opioid induced respiratory depression, sedation and hypotension) and Adrenaline (a potent bronchodilator and vasoconstrictor capable of reversing the principal effect of histamine).

**Reversal of Opioid Action using Naloxone:**

Careful titration is necessary to reverse respiratory depression but maintain analgesia.
Adults: 100 – 200 micrograms IM or IV. Onset is within 2 minutes via the IV route. Duration of action 20 – 40 minutes, so observe patient for recurrence of problem as opioid action is longer than that of Naloxone.

**Naloxone should be prepared and incrementally titrated, according to medical instruction and patient response.**

## Speed Shock

This is a systemic reaction occurring when an IV bolus medication or an infusion containing a medication is administered too rapidly into the circulation (Dougherty and Lamb 2008). This rapid administration results in toxic concentrations of the medication entering the bloodstream, flooding the heart and brain which could cause anaphylactic type symptoms (Dougherty 2004).

**N.B.** There are some situations e.g. in the induction of an anaesthetic or cardiac arrest, where medication is given rapidly IV to have an effect.

**N.B.** This is not the same as circulatory overload as this relates to the volume of fluid administered.

When administering medication observe the patient for early signs of speed shock such as dizziness, facial flushing, headache medication-specific symptoms. This may lead very quickly to the patient experiencing tightness in the chest, tachycardia/ irregular pulse, hypotension and anaphylactic shock. (Dougherty and Lamb 2008)

**Prevention of 'Speed shock'** is dependant on the practitioner:

- Knowing the medication to be administered
- Adhering to the manufacturer's recommended rate of delivery
- Ensuring that the solution is flowing freely before adjusting the rate when using a gravity flow infusion.
- Using infusion devices appropriate to those patients at risk of developing complications, remembering to close clamps prior to removal of the administration set

Nursing interventions include discontinuing the infusion informing medical staff and maintaining IV device for emergency treatment as required Dougherty and Lamb (2008).

## Infiltration

This is a very common complication of IV therapy and is the unintentional infusion of a non-vesicant solution into the tissues surrounding a vein when the access device punctures the vein wall, or migrates out of the vein (Infusion Nurses Society 2006).

| Signs and Clinical Symptoms | Intervention |
|---|---|
| • Leakage of fluid from site<br>• Swelling at and above IV site<br>• Blanching or coolness of skin around IV site<br>• Slower flow rate<br>• Patient complains of discomfort, tightness around the site.<br>• Absent backflow of blood<br><br>**Note: Not all of these may be present** | • Immediately stop administration<br>• Remove cannula<br>• Assess range and motion and sensation of extremity<br>• Inform Medical Staff<br>• The area should be measured and the site monitored regularly.<br>• Restart infusion above infiltration site or in another limb.<br>• Document patient's condition and your actions in patient records. |

**Reducing the risk of infiltration:**

- Infiltration can be avoided by skilled cannulation, securing the device well and avoiding the cannulation of veins over joints whenever possible.

- Monitoring the insertion site hourly.

## Extravasation

Extravasation injury refers to tissue damage caused by the infiltration of vesicant or irritant solutions into the tissues surrounding the veins. A vesicant solution is one that causes the formation of blisters, with subsequent sloughing of tissues, usually within 1 - 4 weeks due to tissue necrosis (Dougherty and Lamb 2008). The extent of the damage depends on the type and amount of drug that infiltrates the tissues (Joanna Briggs 2009).

The potential for a delayed reaction should be remembered when the initial assessment of an extravasation site is made. With bolus, the whole dose may end up outside the blood vessel.

Once damage has occurred it may involve damage to nerves, tendons and joints. If treatment is delayed surgical debridement, skin grafting, or amputation may be an unfortunate consequence. Further information may be found by accessing the following website www.extravasation.org.uk

Solutions likely to cause an extravasation injury include:

- cytotoxic medications which are toxic to cells
- electrolytes
- fluids which are of different osmolarity or pH (sodium bicarbonate) from the tissues, and medications which have a vasoconstrictive action (dopamine).

**Drugs capable of causing severe tissue damage (non – cytotoxic):**

| | |
|---|---|
| Calcium chloride | Amphotericin |
| Calcium gluconate | Cefotaxime |
| Diazepam | Aciclovir |
| Phenytoin | Ganciclovir |
| Mannitol | |

Hypertonic solutions of Sodium Bicarbonate (greater than 5%)
Potassium Chloride (greater than 40mmol/L)

(Dougherty and Lamb 2008)

| Signs and Clinical Symptoms | Intervention |
|---|---|
| • Pain, burning/ stinging sensation at IV site.<br>• Swelling and irritation at site.<br>• Leakage at insertion site.<br>• Local blistering.<br>• Mottling or darkening of skin.<br>• White, cold skin with no capillary refill.<br>• Tissue damage is not usually evident. until 1 - 4 weeks after the injury.<br><br>**Note: Not all of these may be present** | • Immediately stop administration<br>• Inform medical staff.<br>• Elevate limb to promote venous drainage.<br>• Check/monitor circulatory function.<br>• Leave cannula in situ until advised to remove.<br>• Contact pharmacy for advice.<br>• Compresses (hot/cold), antidotes, steroid cream should only be administered as directed.<br>• Document patient's condition and actions taken inpatient records.<br>• Continue to monitor site for signs of damage, treat and document appropriately. |

(Adapted from Dougherty and Lamb 2008)

**Reducing the risk of extravasation:**

- Correct positioning of the cannula using the smallest gauge possible.
- Correct site placement, avoiding sites near joints.
- Consider a central venous catheter for slow infusions of high-risk drugs.
- Prior to giving an IV medication it is essential to flush the cannula to ensure patency.
- Administer drug by slow IV push into side-arm port of a fast running I.V. infusion of compatible solution.
- Administer vesicant drugs first.
- Avoid administering vesicant drugs at night.
- Observe the site continuously as per hospital policy– do not bandage limb.
- If in doubt, stop and resite cannula.
- Ask the patient to report any sensation of pain, burning or stinging.
- Ensure all trace of the drug is flushed into the circulatory system.

If a vein is punctured repeatedly before a successful device is secured, or a cannula is sited below a previous venepuncture site, drugs are more likely to leak into surrounding tissues.

Areas which infuse irritant fluids on a regular basis often have prepared kits for dealing with extravasation and a specific policy relating to this.

**An incident form must be completed if an extravasation occurs.**

## Phlebitis

Infusion phlebitis is the acute inflammation of the tunica intima of the vein (Dougherty and Lamb 2008). There are 3 types of phlebitis:

- Mechanical trauma may result form the cannula rubbing against the lumen of the vein. Poor vein/cannula ratio (i.e. cannula too big or long for vein), poor cannula placement (e.g. over joint), increased dwelling time, or securing of cannula are contributory factors.
- Infusions of vesicant medications or hyperosmolar solutions such as Dextrose 50%, some antibiotics and potassium chloride may initiate an inflammatory response causing a chemical reaction. This can create a rough cell wall where platelets will readily adhere to.
- Bacterial infection of the tunica intima, which is less common, may cause the patient to develop septicaemia.

| Signs and Clinical symptoms | Intervention |
|---|---|
| • Tenderness, pain at tip of device and/or above.<br>• Fluid leaking from the insertion site.<br>• Erythema at tip and/or along vein.<br>• Blisters.<br>• Oedema, swelling, puffy area over vein<br>• Increased warmth.<br>• Palpable venous cord.<br>• Purulent discharge. | • Discontinue infusion.<br>• Assess phlebitis using Maddox scale Cannula should be removed carefully (1+ on Maddox scale) to prevent further damage to vein.<br>• Apply pressure for at least one minute and elevate arm.<br>• Covered site with a sterile dressing.<br>• Seek medical advice if Maddox score 3+ or more.<br>• Document patient's condition and your actions in patient records. |

**The Maddox Scale: Criteria for Judging Phlebitis**:

| Grade | Description |
|---|---|
| 0 | No pain at site, no erythema, no indurations, no palpable venous cord |
| 1+ | Painful IV site, no erythema, no indurations, no palpable venous cord |
| 2+ | Painful IV site with erythema or some degree of swelling or both, no indurations, no palpable venous cord |
| 3+ | Painful IV site with erythema, swelling, indurations and palpable venous cord |
| 4+ | Painful IV site with erythema, swelling, indurations and palpable venous cord greater than 3 inches (7.5 cm) above IV site |
| 5+ | Frank vein thrombosis along with all signs of 4+ - IV may have stopped running due to thrombosis |

For further information please refer to the Nursing and Midwifery Cannula Care Guideline (CCG1)

**Reducing the risk of Phlebitis**:

- Good standard infection control precautions when preparing and inserting the cannula.
- Correct cannula placement, using smallest gauge cannula to deliver therapy in the appropriate vein, avoiding joints.
- Secure the cannula once in situ ensuring secondary taping of infusion line to prevent traction trauma.
- Monitor the site, inspecting hourly when checking IV fluids, document on infusion check chart and carry out the cannula care bundle.
- Review rationale for cannula regularly to reduce cannula dwell time. Remove and review cannula every 72 hours, or as patients' needs dictate and rotate sites
- Use recommended diluents or solutions, dilute known irritant medications as much as possible, administer medication/solutions at recommended rate.

**Thrombophlebitis**

This may follow on from phlebitis and is inflammation of the vein with formation of a blood clot on the vein wall. It is caused by damage to the vessel walls, altered blood flow around the infusion device and changes in blood chemistry as in dehydration or sepsis. Platelets adhere to the inflamed vessel, trapping blood cells forming a plug or thrombus. The danger is that the thrombus will break up and emboli will be carried to the respiratory circulation or the brain.

In addition if there is infection at the cannula insertion site septicaemia or bacterial endocarditis may develop (Finlay 2004).

| Signs and Clinical Symptoms | Intervention |
|---|---|
| • Infiltration or sluggish IV flow.<br>• Swelling, local oedema.<br>• Painful, reddened area.<br>• Palpable thrombosis of vein. | • Stop administration.<br>• Remove cannula.<br>• Inform medical staff.<br>• Support affected limb and apply cold compress and then warm compresses.<br>• Observe for signs of fever and take blood sample for full blood count to check level of white blood cells.<br><br>If infection suspected:<br>• If purulent discharge present take specimen for culture prior to cleaning the skin.<br>• Clean the skin with alcohol and allow to air dry before the cannula is removed for culture.<br><br>Document patient's condition and your interventions in patient records. |

(Dougherty and Lamb 2008)

Any reaction to IV therapy or medication administration must be reported to the medical staff and appropriate manager. A critical incident form must be completed.

**Reducing the risk of Thrombophlebitis:**

Similar methods should be taken as with phlebitis plus:

- Cannulation should be undertaken by a skilled practitioner
- Avoid repeated attempts to cannulate
- Avoid the use of medications with a high pH whenever possible

## Pain on Infusion

The common factors contributing to pain when infusing medications include:

- Not following the manufacturers recommended administration advice.
- Hypertonic drugs.
- The pH, tonicity and chemical irritancy of drugs.
- IV site problems.

The most common examples of medications that cause pain are:

- Erythromycin
- Potassium infusions
- Glucose solutions > 10%
- Tetracycline
- Sodium Bicarbonate 8.4%
- Phenytoin
- Vancomycin

## Rapid Administration

Some medications require rapid administration to be effective, therefore manufacturer's administration advice must be followed. If advice is not followed then a wide variety of problems could develop e.g. speed shock, fluid overload and excessive pharmacological action i.e.

- Furosemide – increased risk of ototoxicity (deafness) at > 4mg/minute.
- Vancomycin – increased risk of Red Man Syndrome (flushing (macular rash), fever, rigors) especially if given over less than 1 hour.
- Potassium Chloride - >20mmol/hour arrythmias, cardiac arrest
- Lignocaine – arrythmias, cardiac arrest

## Layering

This can occur if there is insufficient mixing of medications with different densities, e.g. Potassium Chloride is denser than Glucose 5%. There is a risk of Potassium Chloride lying at the bottom of an infusion bag if the products are not mixed properly. If this is given to a patient it can result in a cardiac arrest as a high concentration of Potassium is given to a patient over a relatively short period of time.

## Inflammation at Needle Insertion Site with Subcutaneous Infusion

To reduce the risk of complications when administering medications via the subcutaneous infusion route the drug dose, volume, concentration, rate, availability of sites and anticipated length of therapy should be taken into consideration. This is to maintain the integrity and condition of the patient's subcutaneous tissue. (RCN 2010)

| Signs and Clinical Symptoms | Intervention |
|---|---|
| • Irritation due to concentration or combination of drugs.<br>• Infection.<br>• Allergy to nickel in a winged infusion set. | • Stop infusion.<br>• Consider a larger volume of diluent if appropriate and seek advice from pharmacy if unsure.<br>• If infection suspected change syringe and administration set and resite in appropriate area.<br>• If nickel allergy suspected change the administration set to a Sof-Set, or seek advice from palliative care team. |

# Compatibility and Stability

Over recent years there have been many developments in the area of infusion therapy. There have been several new, often very potent, drugs some of which can only be given IV. There has also been an improvement in administration sets and devices so that patients who might not previously have been treated now may have extremely complex infusion medication regimes. The increased complexity means that the potential for problems of compatibility and stability is also increased.

Drugs, the solutions used to dissolve them (e.g. glucose 5%) and water are all chemicals, capable of causing reactions that can change another of the chemicals present, so affecting the drug's effect on the patient. The more chemicals that are mixed together the more chance there is of some reaction happening.

Medications can be given subcutaneously, by bolus injection, intermittent or continuous infusion. The volume can range from less than 1ml to more than 3 litres, and the time of administration from a few seconds to more than 24 hours. Various pumps and controlling devices are used, all made of various materials. These should all be considered when thinking about compatibly and it is essential to be familiar with all medications and equipment before starting (e.g. Nimodipine requires a polyethylene infusion set).

## Potential Problems

- Medication / medication interactions - Physical / Chemical
- Medication / container interactions
- Choice of appropriate diluent
- Choice of appropriate volume
- Flushing of Cannula

## Medication / Medication Interactions:

### Physical Changes

In this case the drug molecule is unchanged, but its physical characteristics are changed (e.g. the drug comes out of solution to form a solid precipitate). This may cause the drug to be less effective if it cannot get to the active site, or even dangerous. There are three main areas of concern regarding physical effects.

- Precipitation
- Fat emulsion
- Blood products

### Precipitates

Precipitates are generally inactive as drugs but can still be hazardous. Not all precipitates form immediately and it may be several hours before one is seen. A precipitate can block catheters or cannulae, damage capillaries and veins and in extreme cases cause an embolism. If a blockage is attributed to a thrombosis rather than a precipitate, the wrong treatment may be given with potentially damaging results. The situation must be evaluated.

## Causes of Precipitation

### pH Changes

Some drugs are only soluble at a certain pH. If the pH of the solution is altered then the drug may come out of solution.

### Exceeding Maximal Solubility

A given volume of solvent can only dissolve a certain amount of drug. Some drugs are presented as solutions close to their maximal solubility and are therefore vulnerable to changes. This is most often associated with the addition of a new drug or a change in temperature.

### Dilution

Some drugs are poorly soluble in water and require special formulation techniques. If the solution is then added to a mini bag, some of the effects of the special formulation may be lost so that the drug comes out of solution.

A further point to note is that some special formulations can have an effect on the droplet size, so if the infusion rate is being controlled by drip rate alone an over or under dose may occur e.g. Amiodarone

### Insoluble Ion Pairs

Some drugs exist in solution as large ionised molecules. If two such molecules (with opposite charges) come together they will associate to form an even larger combination which may not be soluble.

### Insoluble Salts

Drugs are generally formulated with the least reactive ion that allows successful formulation. If a more reactive ion is added to a drug solution, a reaction may take place which will cause the formation of the salt of the drug with the more reactive ion. This new salt may not be soluble.

### Fat Emulsions

In terms of drug delivery, a fat emulsion consists of tiny droplets of oil stabilized within an aqueous vehicle. These systems are inherently unstable and can be easily destabilized by inappropriate mixing. Destabilization causes the droplets to coalesce, forming large globules of oil that can cause an embolism.

### Blood Products

Blood is **the** most complex mixture given to any patient. Its administration is also a comparatively risky procedure so that any act which might increase the risk should be avoided. It is impossible to predict what effect a drug will have on each of the blood components and vice versa, so drugs should **never** be mixed with blood products.

## Chemical Changes

In this case the active drug molecule is changed into a new chemical molecule. This molecule may be more active, equally active, less active, inactive or even toxic. There are four main scenarios:

- Hydrolysis (breakdown by water)
- Oxidation (alteration by oxygen)
- Light induced
- Temperature (has some effect on all chemical reactions)

## Hydrolysis

Those drugs which are presented as a powder requiring reconstitution are generally susceptible to degradation by hydrolysis (e.g. antibiotics). This might be accelerated by inappropriate pH, temperature or the presence of another drug. In practice few drugs pose problems at ward level over the time-scale of a single bolus or infusion, providing the mixture is prepared correctly.

## Oxidation

A few drugs are susceptible to degradation in the presence of oxygen. Again this can be accelerated by inappropriate pH or temperature. Adrenaline and Dopamine are both susceptible to oxidation which results in a change of colour.

## Light Induced Degradation

This usually occurs as a result of exposure to Ultra Violet light. Since this is blocked by windows it is not usually a problem in practice (except in Special Care Baby Unit's where UV incubators are in use). There are a few exceptions which must be protected from light at all times (e.g. Nitroprusside, Amphotericin, vitamins A and K) but this information will be on the label.

## Temperature

Some drugs are susceptible to high temperatures and should be 'stored in the fridge' (2-8°C) or 'stored in a cool place' (<25°C). Drugs that have been diluted with infusion fluids should be used immediately. However if they are to be stored for a short period they are usually kept in the fridge. Although some drugs (e.g. Acyclovir) should be stored at room temperature to avoid precipitation. Therefore always read the package label/insert before storage.

## Drug / Container Interactions:

## Adsorption

Small protein molecules (e.g. insulin, interferon) can bind irreversibly to the internal surfaces of glass or plastic containers. This bound drug can be a significant proportion of the amount intended to be given to the patient.

## Absorption

This is a reversible process where the drug molecules move into the plastic structure of containers. A proportion of the drug is not available to the patient. PVC (Viaflex) is worse for this than polyethylene (Polyfusor) and polyolefin (Viaflo). Absorption is more common than adsorption, it is a slower process and eventually equilibrium occurs. The drugs most affected are diazepam and chlorpromazine.

## Permeation

This process is similar to absorption, except that some of the molecules which migrate into the plastic will continue and pass out of the other side and are lost to the atmosphere. This can be a problem with PVC containers. The drugs most affected are nitrates - GTN and chlormethiazole.

## Choice of Appropriate Diluent:

There will be specific instructions from manufacturers regarding the correct diluent for each medicine therefore it is necessary check product information.

## Choice of Appropriate Volume:

Consider:

- stability of medicine in solution
- patient's fluid requirements
- effect of drug concentration on patient
- cost effective use of all materials

## Flushing of Cannula:

Peripheral IV cannulae should be flushed to maintain patency and to prevent the mixing of incompatible medication and/or solutions. Extensive research has been conducted to determine the efficiency of normal saline and heparinised saline flushes. Current best practice is to use normal saline (0.9% Sodium Chloride) to flush peripheral cannulae and to use heparinised solutions only when specifically indicated.

## Clinical Pharmacokinetics of Medications

This is the movement of drugs within the body, and this can be subdivided into:

- Absorption
- Distribution
- Metabolism
- Excretion

### Absorption

- Process by which the drug is taken into the body and is dependant on both the patient and route of administration.
- Bioavailability refers to the proportion of the original amount given which is available in the circulation.
- The Bioavailability of an IV drug is assumed to be 100% as its injected directly into the circulation.

### Distribution

This is the movement of absorbed drug within the body; it begins with the circulatory system, blood carrying the drug to its target site. This process is influenced by the size of the patient and the characteristics of the drug molecules.

Some drugs can be highly bound to the blood plasma and therefore require to be administered in higher doses so sufficient active molecules reach their target. More lipid soluble drugs reach their targets more easily as they are able to penetrate tissues more effectively.

### Metabolism

Elimination from the body may occur by:

- Metabolism
- Excretion
- Or both

Drugs given orally are usually absorbed in the small intestine and enter the portal route to the liver where they are metabolised.

For some drugs metabolism in the liver occurs to such a great extent that little drug reaches the target organ - this is called the First Pass Effect or First Pass Metabolism.

### Excretion

The kidneys are the major route of excretion for drugs, but some drugs may undergo metabolism by the liver or plasma enzymes also.

The drug's half-life describes the time taken for a drug to lose half its strength.

## Sources of Information

It is essential to have proven information regarding the stability of drug mixtures before administering an injection, as the person administering the injection/infusion is responsible for it being appropriate.

Sources available to nursing staff:

- BNF
- BNF for Children
- WeBNF
- eMC  Trust or Data Sheet Compendium
- I.V. Drug Monograph Folders
- Medicines for Children
- Manufacturer's Information Sheet / Package Insert
- UCL Hospitals Injectable Drug Administration Guide
- Pharmacy
- Clinical Pharmacist

## Preparation Area

A designated preparation area must be identified in each clinical area where all infusions are prepared. This area should be easy to clean, have good lighting and away from any distractions such as telephones.

### Equipment required for Infusion Medication Administration

- IV infusion stand – star based
- Infusion device as appropriate
- Patients prescription chart
- Container of appropriate infusion fluid if required
- Drug(s) to be administered
- Clinically clean receiver or tray
- Monitoring charts
- Apron
- Non sterile Gloves
- 70% Alcohol swabs
- Drug additive labels
- Sharps container
- Sterile needles
- Filter needles
- Sterile luer-lock syringes
- Compatible flush solution
- Sterile injection cap
- Administration set
- Hypoallergenic tape/sterile clear occlusive dressing (e.g. Tegaderm) as required
- Clinical waste bag (orange) for soiled disposables

## General Procedures For The Preparation Of Infusion Medication In Near - Patient Areas

Where possible, 'ready to use' products should be used. If a suitable formulation is not commercially available then it may be possible to obtain the drug aseptically prepared from the Pharmacy Department. If the drug is not suitable for this, or if the pharmacy is closed, then the dose should be prepared on the ward according to the guidelines below and the manufacturers' information.

**Each dose should be freshly prepared as follows:**

(1). Check patient's drug record of administration and Infusion chart for drug dosage, appropriate diluent, appropriate volume and incompatibilities with other medications.

(2). Clean surface preparation area with neutral liquid detergent and warm (hand hot) water before and after use. (NHS Fife Infection Control Manual 2012).

(3). Decontaminate hands; gather equipment and drugs required for the procedure.

(4). Calculate the volume of drug to add/draw up.

(5). Prepare appropriate label (as page 34).

(6). Decontaminate hands again and put on apron and non sterile gloves.

(7). Follow method of preparation as directed within the procedures for IV Drug Preparation tools A – J which can be accessed in the IV Drug monograph folder held in your clinical area as appropriate :

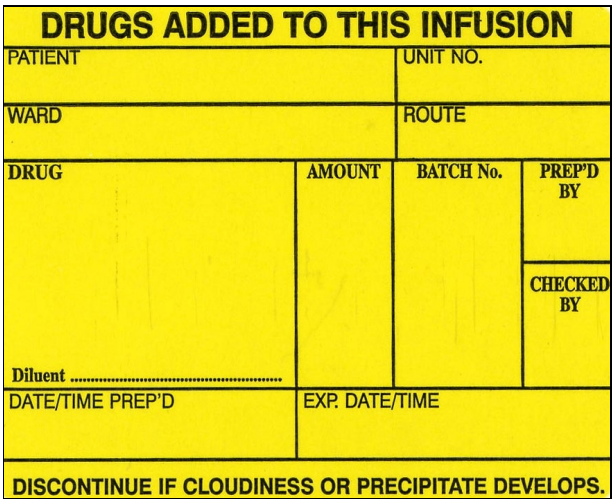
A. Withdrawing liquid from a glass ampoule and adding to an IV infusion fluid using a needle and syringe.
B. Withdrawing liquid from a plastic ampoule and adding to an IV infusion fluid using a needle and syringe.
C. Withdrawing liquid from a glass vial and adding to an IV infusion fluid using a needle and syringe.
D. Reconstitution of drug in powder form and withdrawing from vial/amp and adding to an IV infusion fluid using a needle and syringe.
E. For the addition of a powdered vial to an IV Infusion Fluid using a reconstitution device.
F. For the reconstitution of a mini-bag plus.
G. Withdrawing liquid from a glass ampoule into a syringe.
H. Withdrawing liquid from a plastic ampoule into a syringe.
I. Withdrawing liquid from a glass vial into a syringe
J. The reconstitution of drug in powder form with appropriate diluent and withdraw the solution into a syringe.

(8). Draw up medication into the syringe, add to infusion bag, attach administration set, or remove needle and add syringe cap for bolus administration and sign and apply label as directed.

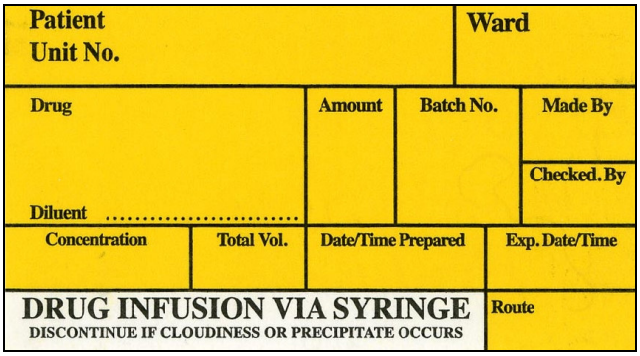
## Labeling Requirements for Infusion Medication Preparation in Near - Patient Areas

The label should be written immediately prior to preparation of the infusion/ IV bolus and all details entered on the label before the procedure is carried out. The label should be positioned as follows:

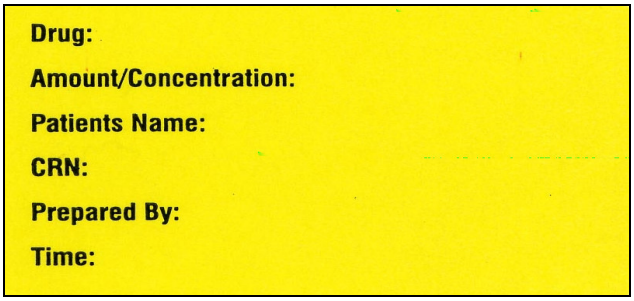
**Infusion Bag**: Attach the label on the back of the infusion bag so that there is no mistaking a drug has been added.




**Syringe for Infusion:** Graduations should not be covered to allow monitoring of the volume of the infusion delivery.

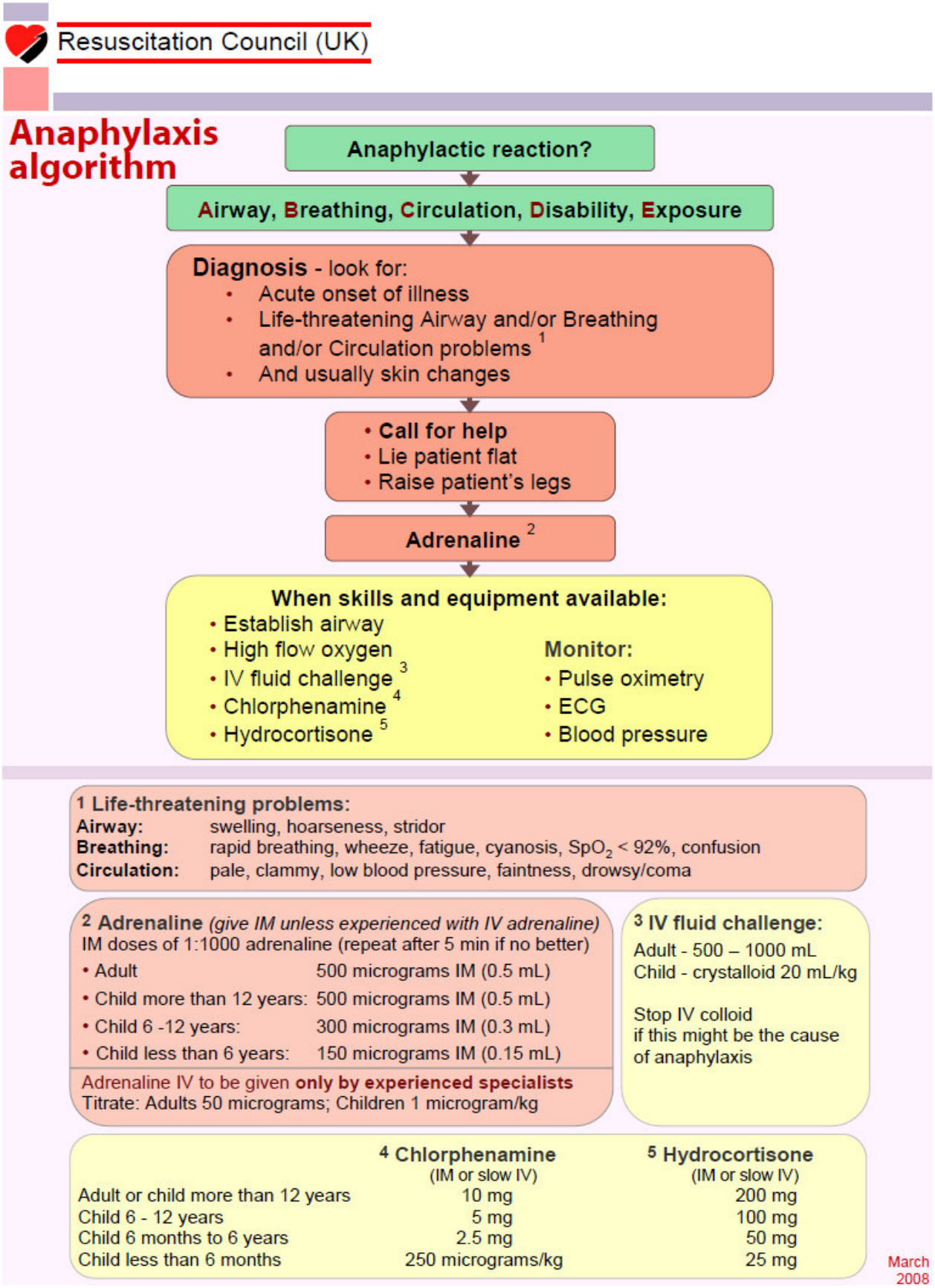



**Bolus syringe:** Do not cover graduations as this will make administration of the drug more difficult.




The expiry time should be within 30 minutes of the estimated finishing time for that infusion, or no more than 24 hours after preparation time.

All labels are available from Pharmacy.


Resuscitation Council (UK)
Anaphylaxis algorithm
Anaphylactic reaction?
Airway, Breathing, Circulation, Disability, Exposure
Diagnosis - look for:
• Acute onset of illness
• Life-threatening Airway and/or Breathing and/or Circulation problems 1
• And usually skin changes
• Call for help
• Lie patient flat
• Raise patient's legs
Adrenaline 2
When skills and equipment available:
• Establish airway
• High flow oxygen
• IV fluid challenge 3
• Chlorphenamine 4
• Hydrocortisone 5
Monitor:
• Pulse oximetry
• ECG
• Blood pressure
1 Life-threatening problems:
Airway: swelling, hoarseness, stridor
Breathing: rapid breathing, wheeze, fatigue, cyanosis, SpO2 < 92%, confusion
Circulation: pale, clammy, low blood pressure, faintness, drowsy/coma
2 Adrenaline (give IM unless experienced with IV adrenaline)
IM doses of 1:1000 adrenaline (repeat after 5 min if no better)
• Adult 500 micrograms IM (0.5 mL)
• Child more than 12 years: 500 micrograms IM (0.5 mL)
• Child 6 -12 years: 300 micrograms IM (0.3 mL)
• Child less than 6 years: 150 micrograms IM (0.15 mL)
Adrenaline IV to be given only by experienced specialists
Titrate: Adults 50 micrograms; Children 1 microgram/kg
3 IV fluid challenge:
Adult - 500 – 1000 mL
Child - crystalloid 20 mL/kg
Stop IV colloid if this might be the cause of anaphylaxis
4 Chlorphenamine (IM or slow IV)
5 Hydrocortisone (IM or slow IV)
Adult or child more than 12 years 10 mg 200 mg
Child 6 - 12 years 5 mg 100 mg
Child 6 months to 6 years 2.5 mg 50 mg
Child less than 6 months 250 micrograms/kg 25 mg
March 2008

# Administration Procedure for Infusion Medication Appendix 2

**1. Assess patient's need for medication via Infusion route.**

- Clarify appropriate treatment, correct drug(s) by the correct route
- The drug(s) are prescribed correctly

↓

**2. Assess access device appropriate for medication.**

- Check site of cannula and size appropriate for administration of medication

↓

**3. Preparation of prescribed Infusion medication.**

- Two Registered nurses, one Infusion trained will check compatibility of medication and prepare the drug(s) (or two registered nurses if controlled drugs required) for administration (drug calculations must be performed separately and then compared)

↓

**4. Check patient name and date of birth verbally (if appropriate) with name band and prescription.**

↓

**5. Check allergy Status.**

↓

**6. Administration of Infusion medication.**

- Explain reason and procedure to the patient and obtain consent
- If there is an infusion in progress check for compatibility of drug(s) to be given.
- Inspect access site by checking for Inflammation/Pain/Swelling.
- If medication to be given IV check venous patency of cannula by administering flush
- Continue to observe for resistance and/or any local/systemic reaction when administering the drug.
- Flush cannula after IV administration of drug
- Re-establish infusion if appropriate.
- Complete appropriate documentation

↓

**7. Discard remaining drug.**

- Discard any remaining drug and sharps in the appropriate waste disposal containers as per policies.

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**8. Monitoring**

- Assess patient for any adverse reaction(s)
- Monitor infusion hourly or more frequently if deemed clinically necessary on appropriate charts.
- Continue to monitor and assess patient for desired therapeutic effect and document in records.

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