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of Nursing

# **Standards for infusion therapy**

November 2005





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# Standards for infusion therapy

**RCN IV Therapy Forum**

**November 2005**

## RCN IV Therapy Forum

July 2003

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## Disclaimer

In this text it has not been possible to avoid individual names of products or manufacturers because of their common usage. In none of these instances should the appearance of such a name be taken as a recommendation. In most cases, alternative products or manufacturers will have to be considered.

The risks associated with IV therapy are complex and each situation must be judged on its own merits and it is unreasonable for readers simply to follow instructions in the standard without proper assessment of individual circumstances.

Neither the authors nor the publishers can accept responsibility for any consequences that may result from decisions made upon the basis of the advice given herein.

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## From the authors

Welcome to the second edition of the standards for infusion therapy. In this edition we have concentrated on updating any key sections and references and have made corrections. We have also added some of the frequently asked questions and clinical issues raised by the RCN IV Forum membership following the publication of the last edition of the Standards for Infusion Therapy. We hope that this will add clarity to some of the standards and that it will prove to be more a more useful document.

# Acknowledgements

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# Foreword

Infusion therapy continues to be associated with a relatively high risk of complications. To decrease this risk it is essential not only to develop standards but also to have practical guidance in implementing them. This first edition of the Standards for Infusion Therapy developed by the RCN and other multi-professional organisations provides both these requirements with clearly defined standards supported by practical guidance. The standards are provided as statements, which can be readily incorporated into local Infusion-related Policies and Procedures, Performance Improvement Programmes, Performance Evaluations and Educational approaches. The practice criteria should also assist the healthcare professional in the development of infusion policies and procedures as well as presenting useful guidance on many supplementary areas. Each of the standard statements and practice criteria have been extensively peer reviewed with supportive literature where available, which acts as an additional resource for health professionals. The supportive literature is also graded to facilitate this process.

The standards deal with all aspects of infusion therapy ranging from products and documentation, infusion equipment, site selection and care, prosthetic devices to infusion therapies and related complications. The format of the text is well designed and allows ready access to various aspects of infusion therapy. In particular, unlike many guidelines it also provides clear practical answers to many of the questions which healthcare workers raise when faced with a list of standards to apply. Without doubt this book should become a standard in itself and be of value to all healthcare workers involved in infusion therapy.

**Professor T S J Elliott**, BM, BS, BmedSci, PhD, D.Sc, FRCPath



# How to use this document

Each topic covered in this document includes the standard itself and a set of practice criteria:

- The **standard** provides criteria for nursing accountability. Statements set out under the standard are to be incorporated into infusion-related policies and procedures, quality assurance and performance improvement programmes, nursing performance evaluations and orientation and educational programmes.
- The **practice criteria** provide specifications for direct implementation of the standard, as well as criteria for evaluating levels of compliance. The practice criteria will help healthcare professionals to develop and implement individual care plans, and provide information for use in the development of infusion policies and procedures.
- Both **standards** and **practice criteria** include references to relevant supporting literature and further reading. The reference list will help nurses enhance their knowledge and understanding of a particular infusion practice. In order that the reader may evaluate the strength of the research base, each reference has been graded as follows:
  - I. Randomised controlled trials, including meta-analysis.
  - II. Non-randomised controlled trials and retrospective studies.
  - III. Clinical experience and anecdote.<sup>1</sup>

<sup>1</sup> Evans D T (2000) "Homophobia in evidence based practice" Nurse Researcher 8 (1) 47-53

- Organisational policies and procedures should be developed and implemented based on the **standards** and the **practice criteria**.

The document also includes a number of appendices, with diagrams, an index and a glossary.

## Definitions

Throughout, the term 'healthcare professional' is used to cover nurses and radiographers. Doctors and radiologists are referred to as medical staff or clinicians.

## Abbreviations

The following organisations are referred to by abbreviations throughout this document:

|             |   |
|-------------|---|
| <b>DH</b>   | Department of Health                                |
| <b>HSE</b>  | Health and Safety Executive                         |
| <b>ICNA</b> | Infection Control Nurses Association                |
| <b>INS</b>  | Intravenous Nurses Society                          |
| <b>MDA</b>  | Medical Device Agency                               |
| <b>MHRA</b> | Medicines and Healthcare Products Regulatory Agency |
| <b>NICE</b> | National Institute for Clinical Excellence          |
| <b>NPSA</b> | National Patient Safety Agency                      |
| <b>RCN</b>  | Royal College of Nursing                            |

# Introduction

The majority of patients admitted to hospital at the beginning of the 21<sup>st</sup> century will become a recipient of a vascular access device at some stage (Petersen 2002). However, infusion therapy is not confined solely to inpatient settings. Demands for acute hospital beds, changes in treatment regimens, changes in government policy and greater patient participation in treatment decisions are challenging traditional ideas that infusion therapy is confined to the hospital environment (Kayley 1999; DH 2000; Kayley 2003). Advances in technology are leading to the emergence of a range of vascular access devices that can meet the clinical requirements of individual patients at the same time as suiting their lifestyles, making community-based infusion therapy an increasingly viable option (Kayley 1999; Gabriel 2000; Gabriel et al 2005). However, the increasing number of vascular access devices does have implications for practice. How do we ensure that each patient receives the most appropriate infusion therapy?

## Scope of practice

Infusion therapy is now an integral part of the majority of nurses' professional practice. It can range from caring for an individual with a peripheral cannula in situ, to nursing a patient requiring multiple parenteral drugs/infusions in the critical care environment. Whatever the route, peripheral or central, infusion therapy is not without risk (Scales 1999; Gabriel et al 2005).

In 1992 the then regulatory body for nurses in the UK, the UK Central Council for Nursing, Midwifery and Health Visiting (UKCC), published *'The Scope of Professional Practice'* (UKCC 1992). This document has been instrumental in helping nurses to develop their individual practice for the benefit of patients, the proviso being that the nurse is knowledgeable and skilled for the role he/she is undertaking. In 2002, the Nursing and Midwifery Council (NMC) replaced the UKCC. Their first professional document was *'The Code of Professional Conduct'* (NMC 2004) which not only encouraged nurses to expand their practice, provided they had the necessary knowledge and skills and accepted responsibility for their actions, but also recognised the importance of involving patients/clients in decisions affecting their care. The updated 2004 version of the code of conduct includes standards for conduct, performance and ethics.

## Involving patients/clients

The priorities for a patient requiring infusion therapy in the emergency/acute care setting will be largely dependent upon their clinical needs. Generally, these patients will be recipients of a vascular access device for a comparatively short period of time. When the intravenous administration of drugs/fluids is

considered for the longer term, the majority of patients will be well enough to participate in the decision as to which device is selected and what is the most comfortable insertion site for them. Yet despite the move towards involving patients in decisions relating to their care, there is little published evidence to support the concept of user involvement in relation to the selection of vascular access devices. Especially given that patients may be expected to 'live' with their vascular access device and infusion device in the home care setting (Kayley 1999; DH 2000; Gabriel 2000; Nugent et al 2002; NPSA 2003).

Younger patients will have differing clinical and lifestyle considerations to older people. Some individuals will have access to supportive carers, while others will be socially isolated. Infusion therapy may just be one part of a patient's healthcare needs. All these factors need to be taken into consideration when assessing each patient for infusion therapy.

## Patient assessment

Patient assessment is not just about identifying the most suitable vein to site an IV cannula. It should start by identifying what medications the patient will require for their clinical needs and by what route(s) they can be administered. If the intravenous route is required, account should be taken of how long the treatment is intended to last, whether the drugs/infusates are vesicant, how frequently and what volumes are to be infused, and whether the treatment will be administered in hospital or at home. This should then be matched against the various vascular access devices – peripheral cannulae, midline catheters, central venous access devices – to decide which is the most suitable for the individual patient. Where possible, and certainly for a prolonged course of treatment, the patient should be consulted about the choice of vascular access device and where it is sited. This consultation should include all the relevant information in order for the patient to reach an informed decision (Gabriel et al 2005).

## Evidence-based care

The NMC's *Code of Professional Conduct (2004)* clearly states that individual nurses have a responsibility to deliver evidence-based care. Patients have the right to receive a uniformly high standard of care, regardless of who they are and where they are treated (DH 2000). The production, implementation, auditing and regular updating of clinical standards to reflect the latest research findings will ensure that all patients can benefit from safe and appropriate care.

## Research

Advances in clinical care depend on research and dissemination of its findings. When a new therapy, method of

delivery or indeed a new piece of equipment require clinical evaluation, the views of patients should be sought. Clinical governance arrangements for research require all such studies to be reconciled with the welfare of the research subjects in the light of the broader ethical implications (The Royal College of Physicians 1996; HSC 2001; North and Mid Hants LREC 2002). Essentially, this means that no patient should be disadvantaged by receiving a treatment known to be inferior to answer medical curiosity. Where there is no intended clinical benefit for the individual participating in the study, this information should be clearly communicated to them. It is then up to the patient whether they wish to participate or not. If they decline, their current and future care should not be adversely affected by such a decision.

Research should be employed to expand the evidence base of nursing knowledge in infusion therapy, to validate and improve practice, to advance professional accountability, and to enhance decision-making (INS 2000). Where appropriate nurses should actively participate in infusion therapy research activities that are relevant to their job responsibilities, education, experience and practice setting (INS 2000).

## Consent

'It is a general legal and ethical principle that valid consent must be obtained before starting treatment or physical investigation or providing personal care' (DH 2001). All patients have a right to receive accurate information about their condition and intended treatment. It is the responsibility of the individual practitioner proposing to carry out the treatment to ensure that the patient understands what is proposed (NMC 2004). Consent can be given orally, in writing or by co-operation (NMC 2004). Children under the age of 16 can give consent providing that they are legally competent. However, it is considered good practice to involve the individual with parental responsibility in all discussions where consent to treatment is required for a child (DH 2001). Parents can consent to treatment on behalf of children under 16 (DH 2002).

Infusion therapy has become more complex in recent years. These guidelines are intended to help individual practitioners ensure that their patients receive the most appropriate care for their individual circumstances.

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## 1

# Education and training

## 1.1 Staff education

### Standard

The nurse inserting devices and/or providing infusion therapy should be competent in all clinical aspects of infusion therapy and have validated competency in clinical judgment and practice, and practice in accordance with the NMC's *Code of Professional Conduct*: that is, they will maintain their knowledge and skills (Scales 1996; Hyde 2002; NMC 2004).

### Practice criteria

Registered nurses undertaking the insertion of vascular access devices will have undergone theoretical and practical training in the following:

- Anatomy and physiology of normal arm (and where appropriate central vessels) including veins, arteries and nerves, the feel and appearance of healthy veins including the presence of valves and junctions.
- Assessment of patient vascular access, therapy and quality of life needs.
- Improving venous access, for example the use of tourniquets.
- Selection of veins and problems associated with venous access due to thrombosed, inflamed or fragile veins, the effects of aging on veins, disease process, previous treatment, lymphoedema or presence of infection.
- Selection of device and other equipment.
- Infection control issues (hand-washing, skin preparation).
- Pharmacological issues (use of local anaesthetics, management of anxious patients, management of haematoma, phlebitis, etc.).
- Patient's perspective on living with a vascular access device
- Risk management in order to reduce the risk of blood spills and needlestick injury.
- Professional and legal aspects (consent, professional guidance, knowledge and skill maintenance and documentation).
- Performing the procedure.
- Prevention and management of complications during insertion (nerve injury, haematoma, etc.).
- Monitoring and care of the site (flushing, dressing removal, etc.).
- Product evaluation.
- Patient information and education.
- Documentation.
- Specific training for insertion of vascular access devices

in certain groups, for example neonates, children and oncology patients.

Nurses undertaking the administration of infusion therapy and care and management of vascular access devices will have undergone theoretical and practical training in the following aspects (BCSH 1999; RCN 1999; Cole 1999; Lonsway 2001; Hyde 2002; NPSA 2003; MDA 2003; NICE 2003; DH 2004; RCN 2005):

- Legal, professional and ethical issues.
- Anatomy and physiology.
- Fluid balance and blood administration.
- Mathematical calculations related to medications.
- Pharmacology and pharmaceuticals related to reconstitution and administration.
- Local and systemic complications.
- Infection control issues (see the DH Infection Control Controls Assurance Standard 2003).
- Use of equipment, including infusion equipment.
- Drug administration.
- Risk management/health and safety.
- Care and management of vascular access devices.
- Infusion therapy in specialist areas covered separately (paediatrics, oncology, parenteral nutrition, transfusion therapy) (Delisio 2001).

All staff have a professional obligation to maintain their knowledge and skills (NMC 2004). It is also the responsibility of the organisation to support and provide staff with training and education.

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## 1.2 Patient and caregiver education

### Standard

The patient, caregiver or legal guardian must receive instruction and education related to the vascular access device; prescribed infusion therapy; infection control and plan of care (Redman 1997; NICE 2003).

The patient, caregiver, or legally authorised representative must be informed of potential complications associated with treatment or therapy (Dougherty et al 2004).

The nurse shall document the information given and the patient's, caregiver's, or legally authorised representative's response in the patient's medical and nursing notes (Redman 1997).

Education and training of patients or caregivers should be in accordance with the *Code of Professional Conduct (NMC 2004)* and *Guidelines for the Administration of Medicines (NMC 2002)*.

The practitioner responsible for educating and training patients and caregivers to administer intravenous therapy should ensure that reasonable foreseeable harm does not befall a person as a consequence of his/her instructions and delegation (of care) (Dimond 1990).

### Practice criteria

- The patient/caregiver should be assessed for ability and willingness to undertake administration of intravenous therapy (Birmingham 1997; Chrystal 1997; Cole 1999; Hammond 1998; Kayley 1999; Stover 2000; RCN 2001).
- The patient, caregiver or legal guardian should be informed in clear and appropriate terminology about all aspects of the therapy, including the physical and psychological effects, side-effects, risks and benefits (Kayley 1999; INS 2000; NICE 2003).
- The patient, caregiver or legal guardian should be given a demonstration and a set of verbal and written instructions that are tailored to his or her cognitive, psychomotor, and behavioural abilities (Hamilton and Fermo 1998; INS 2000; RCN 2001;).
- The patient, caregiver or legal guardian should demonstrate understanding and the ability to perform procedures and care (Redman 1997; RCN 2001; NICE 2003).
- The intravenous therapy to be administered by the patient/caregiver should be assessed as appropriate for administration in the home environment (Chrystal 1997; Cole 1999; Kayley 1999).
- An assessment as to the appropriateness of the home setting for the preparation, administration and storage of intravenous therapy and equipment should be undertaken (Birmingham 1997; Hammond 1998;

Kayley 1999).

- Education, training and written information should be provided that includes the storage of the drug and equipment, aseptic technique and hand-washing, preparation and administration of the drug and infusion delivery equipment, care and maintenance of the vascular access device, side-effects of therapy, spillage precautions, and management and recognition of allergic/anaphylactic reactions (Birmingham 1997; Chrystal 1997; Cole 1999; Hammond 1998; Kayley 1999; RCN 2001; Stover 2000; NICE 2003).

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## 2

# Infection control and safety compliance

## 2.1 Infection control

### Standard

Use of aseptic technique, observation of universal precautions, and product sterility are required in infusion procedures.

Gloves should be used and consideration must be given to maximal sterile barrier precautions when performing infusion procedures such as insertion of central venous access devices (ICNA 2003).

Thorough hand-washing techniques must be employed before and after clinical procedures.

All disposable blood-contaminated and/or sharp items – including, but not limited to, needles or stylets and surgical blades – must be disposed of in non-permeable, puncture-resistant, tamper-proof container which complies with UN 3921 and BS7320 standards and should be located at a suitable and safe level in places which are not accessible to the public (HSE 2002; ICNA 2003).

Non-disposable equipment such as surgical instruments requiring resterilisation should be handled according to manufacturer's guidelines for sterilisation of items posing a hazard. However, disposable equipment should be used wherever possible.

Morbidity and mortality rates associated with catheter-related infections should be reviewed, evaluated and reported on a regular basis.

A quality assurance and performance improvement programme incorporating infection control practices should be implemented to minimise potential for development of nosocomial infection and to provide corrective action, when necessary.

### Practice criteria

- The elements of, and protocol for, aseptic technique should be established in organisational policies and procedures (NICE 2003; Hart 2004 RCN 2005).

- Protocol for ascertaining product integrity and sterility should be established in organisational policies and procedures.
- Practitioners performing procedures which result in the generation of droplets or splashing of blood and/or body fluids should employ appropriate personal protective equipment including well fitting gloves, mask, gown, protective eyewear and drapes (ICNA 2003; RCN 2005).
- Regulation sharps containers should be placed at multiple convenient and safe locations, should be easily accessible and, when filled to the fill line, should be sealed shut and labeled with the patient's name/ward/clinic and dates. They should then be disposed of by designated personnel (Hanrahan and Reutter 1997; Health Service Advisory Committee 1999; DH 2001).
- Ideally, all needles should have a safety device, with engineered sharps injury protection, to minimise the potentially serious consequences of exposure to bloodborne pathogens and the potential for permanent and disabling injury (INS 1996; UK Health Departments 1998). Risk assessments should be undertaken, and the use of these devices considered in line with local policies.
- Performance improvement measures, including site rotation and administration set changes, should be implemented in accordance with the standards incorporated in this document.
- Infection statistics should be documented and retained by each organisation (RCN 2002; DH Infection Control Controls Assurance Standard).
- The Centre for Disease Control and Prevention (CDC 2002) standard for infection rate calculation is:

$$\frac{\text{Number of IV device related infections}}{\text{Total number of catheter days}} \times 1,000 =$$

Number of IV device-related infections per 1,000 catheter days.

### References

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2. DH, 2001. 'Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters'. In *Journal of hospital infection* 47 (supplement), S47–S67. (III)
3. DH, 2003. *Infection Control Controls Assurance Standards*. (III)
4. Gabriel J, Bravery K, Dougherty L, Kayley J, Malster M, Scales K; Vascular access: indications and implications for patient care. *Nursing Standard* 19(26): 45-54. March 2005 (III)
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6. Hart, S, 2004. 'Aseptic technique'. In Dougherty, L & Lister S. *The Royal Marsden Hospital Manual of clinical nursing procedures*. 6th ed. Oxford: Blackwell Publishing (III)
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12. NICE, 2003. Infection control: prevention of healthcare-associated infection in primary and community care (clinical guidelines 2). London: NICE. (I)
13. RCN, 2005. Good practice in infection control. London: RCN. (III)
14. UK Health Departments, 1998. Guidance for clinical healthcare workers: protection against infection with blood-borne viruses. London: HMSO (III)

## 2.2 Hand-washing

### Standard

Hand-washing should be performed both before and immediately after clinical procedures, and before putting on and after removing gloves.

### Practice criteria

- Hand-washing should be a routine practice established in organisational policies and procedures (Hart 1999; RCN 2000; RCN 2005).
- Bar soap should not be used, as it is a potential source of bacteria. However, hands that are visibly soiled or potentially grossly contaminated with dirt or organic material should be washed with liquid soap and water (DH 2001; NICE 2003; RCN 2005).
- Care should be taken to prevent contamination of liquid soap or antiseptic dispensers. These containers should be discarded and replaced according to organisational policies and procedures (RCN 2005).
- Paper hand towels should be used to dry the hands because hot air dryers are not recommended in clinical settings (ICNA 1997).
- Alcohol handrub should be used when hands are clean or when running water is compromised or unavailable. The alcoholic handrub should be rubbed over all areas of the hands and wrists vigorously until the solution has evaporated and the hands are dry (DH 2001; NICE 2003).
- All wrist and hand jewellery should be removed at the beginning of each clinical shift and cuts and abrasions covered with a waterproof dressing. The fingernails should be kept short and clean; the wearing of nail varnish, false nails and nail art are inappropriate as they are a potential reservoir for micro-organisms (Hedderwick et al. 2000; DH 2001; Jeanes and Green 2001; RCN 2005).

### References

1. DH, 2001. 'Standard principles for preventing hospital-acquired infections'. In *Journal of hospital infection* 74 (supplement), S21–S37. (III)
2. Hart, S, 1999. 'Infection control in intravenous therapy'. In Dougherty,

- L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, Chapter 4, 85–116. (III)
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4. ICNA, 1997. *Guidelines for hand hygiene*. Edinburgh: ICNA. (III)
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6. Jeanes, A and Green, J, 2001. 'Nail art: a review of the current infection control issues'. In *Journal of hospital infection*, 49, 139–142. (III)
7. NICE, 2003. Infection control: prevention of healthcare-associated infection in primary and community care (clinical guidelines 2). London: NICE. (I)
8. RCN, 2000. *Methicillin resistant staphylococcus aureus (MRSA): guidance for nurses*. London: RCN. (III)
9. RCN, 2005. *Good practice in infection control*. London: RCN. (III)

## 2.3 Personal protective equipment (PPE)

### 2.3.1 Gloves

#### Standard

Gloves should be used when performing infusion procedures.

#### Practice criteria

- The use of gloves is not a substitute for hand-washing. Hand-washing should be performed before and immediately after procedures and before putting on and after removing gloves (DH 2001a; Pellowe et al 2004; RCN 2005).
- Gloves do not provide protection against needle stick injury, but they should be worn to protect hands from contamination from organic matter, micro-organisms and toxic substances, and to reduce the risk of cross-contamination to both patient and staff (Hart 1999; ICNA 2003; DH 2001b).
- Gloves must conform to European Community standards (CE) and must be of a suitable quality (DH 2001b).
- Gloves must be available in all clinical areas (DH 2001b).
- Powdered and polythene gloves should not be used for infusion procedures (DH 2001a).
- Gloves should be well fitting; gloves which are too small may be punctured by the wearer's fingernails, while gloves which are too large may impede manual dexterity (Jeanes and Green 2001; RCN 2005).
- Following removal, gloves must be discarded in an appropriate clinical waste bag (DH 2001b).
- For practitioners and patients who are sensitive to natural rubber latex, alternative gloves must be made available and their use should be supported in the local policies and procedures (MDA 1996; ICNA 1999; DH 2001b).

## References

1. DH, 2001a. 'Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters'. In *Journal of hospital infection*, 47 (supplement), S47– S67. (III)
2. DH, 2001b. 'Standard principles for preventing hospital-acquired infections'. In *Journal of hospital infection*, 74 (supplement), S21– S37. (III)
3. Hart, S, 1999. 'Infection control in intravenous therapy'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone. (III)
4. ICNA, 1999. *Glove usage guidelines*. Edinburgh: ICNA. (III)
5. ICNA 2003 *Reducing sharps injury – prevention and risk management*, Infection Control Nurses Association, February. (III)
6. Jeanes, A and Green, J, 2001. 'Nail art: a review of the current infection control issues'. In *Journal of hospital infection*, 49, 139– 142. (III)
7. MDA, 1996. *Latex sensitisation in the healthcare setting*. MDA. (III)
8. Pellowe CM et al 2004 *The epic project. Updating the evidence base for national evidence –based guidelines for preventing healthcare-associated infections in NHS hospitals in England: a report with recommendations*; *British Journal of Infection Control*, 5 (6), 10 – 16; (I)
9. RCN, 2005. *Good practice in infection control*. London: RCN. (III)

## 2.3.2 Plastic aprons

### Standard

Disposable plastic aprons should be worn during the performance of infusion procedures.

### Practice criteria

- Where there is a risk of contamination by blood and bodily fluids a disposable plastic apron should be worn to prevent contamination of clothing (DH 2001; RCN 2005).
- The apron should be worn for a single procedure and then discarded and disposed of as clinical waste (DH 2001; RCN 2005).

### References

1. DH, 2001. 'Standard principles for preventing hospital-acquired infections'. In *Journal of hospital infection*, 74 (supplement), S21– S37. (III)
2. RCN, 2005. *Good practice in infection control*. London: RCN. (III)

## 2.3.3 Face masks, caps and eye protection

### Standard

The wearing of a face mask and cap is not essential during the performance of infusion procedures per se.

Protective clothing should be worn when the practitioner is at risk from splashes of substances or body fluids.

### Practice criteria

- There is no evidence to suggest that wearing a face mask and cap during central venous catheter insertion reduces

the incidence of infection to the patient (DH 2001a & b).

- To prevent possible infection of staff, face masks, caps and eye protection should be worn when there is a risk that the procedure could cause hazardous substances or body fluids to splash into the face, eyes or mouth (Romney 2001; COSHH 2002; Pellowe et al 2004; RCN 2005).

## References

1. COSHH, 2002. *Control of substances hazardous to health*. London: Stationery Office. (III)
2. DH, 2001a. 'Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters'. In *Journal of hospital infection*, 47 (supplement), S47– S67. (II)
3. DH, 2001b. 'Standard principles for preventing hospital-acquired infections'. In *Journal of hospital infection*, 74 (supplement), S21– S37. (III)
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5. RCN, 2005. *Good practice in infection control*. London: RCN. (III)
6. Romney, MG, 2001. 'Surgical face masks in the operating theatre: re-examining the evidence'. In *Journal of hospital infection*, 47, 251– 256. (III)

## 2.3.4 Gowns

### Standard

The wearing of a sterile gown should be part of the optimal aseptic technique during central venous access device insertion.

### Practice criteria

- The risk of infection during insertion of central vascular access devices is significantly higher than for short peripheral cannulae and wearing a sterile gown will reduce this risk (Elliott 1994; DH 2001; Wilson 2001).

### References

1. DH, 2001. 'Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters'. In *Journal of hospital infection*, 47 (supplement), S47– S67. (I)
2. Elliott, TSJ, Faroqui, MH, Armstrong, RF and Hanson, GC, 1994. 'Guidelines for good practice in central venous catheterisation'. In *Journal of hospital infection*, 28, 163– 176. (III)
3. Wilson, J, 2001. 'Preventing infection associated with intravenous therapy'. In *Infection control in clinical practice*. 2nd edition, London: Bailliere Tindall (III)

## 2.4 Reconstitution

### Standard

Chemical, physical, and therapeutic properties and compatibilities must be ascertained prior to reconstituting medications using aseptic technique.

A laminar flow hood or isolator must be used for reconstitution



of medicines which are hazardous to health, for example cytotoxic drugs, in accordance with national guidance (RCN 1998; COSHH 2002). Ideally, all drugs should be available in a ready-to-use form that is either pre-prepared by pharmacy or purchased pre-prepared from a pharmaceutical company (Taxis and Barber 2003).

### Practice criteria

- Protocol for reconstitution should be established by and conducted under the direction of the pharmacy.
- The list of medications that the nurse may not reconstitute should be set out in an organisational policy.
- Where possible injections/infusions that are in a ready-to-use form should be used (NPSA 2003; Taxis and Barber 2003). If this is not available a risk assessment should be completed to determine the most appropriate location for preparation and any action required to minimise the hazards (NPSA 2003).
- The nurse should have a thorough knowledge of the principles of reconstituting, including, but not limited to, aseptic technique, compatibility (physical, chemical and therapeutic), stability, storage, labelling, interactions, dosage and calculations (see Appendix 4) and appropriate equipment (NMC 2002; Taxis and Barber 2003; Lister 2004).
- Reconstituting procedures and safeguards should be congruent with standards set by the COSHH (2002) and the NMC (2002).
- Prepared medicines should not be stored even for a short period without being labelled and labels should include the name of the medicine, its strength, route, diluent and final volume, the patient's name, the expiry date and the name of practitioner preparing the medicine (NPSA 2003; Cousins et al 2005).
- Aseptic technique should be used throughout reconstitution. This includes adequate cleaning of additive ports of infusion bags and the tops of medicine vials and ampoules.
- Where used, the nurse should be trained and know the general operating procedures for the use of a laminar flow hood/isolator (DH 1995; Weinstein 2001).
- Maintenance, quality assurance and performance improvement measures should be implemented based on appropriate national regulations, manufacturer's guidelines, and recommendations (Weinstein 2001).

### References

1. COSHH, 2002. Control of substances hazardous to health. London: Stationery Office. (III)
2. Cousins, D et al (2005) Medication errors in intravenous drug preparation and administration : a multicentre audit in the UK, German and France, *Qual Saf Health Care*, 14; 190 - 195
3. DH, 1995. The Farwell report – standards for aseptic dispensing for NHS patients. London: DH. (III)
4. Lister, S 2004. 'Drug administration general principles'. In Dougherty, L & Lister S, *The Royal Marsden Hospital Manual of clinical nursing procedures*. 6th ed. Oxford: Blackwell Publishing. (III)
5. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
6. NMC, 2002. Guidelines for administration of medicines. London. (III)
7. NPSA, 2003. Risk analysis of infusion devices. London. (III)
8. RCN, 1998. 'The administration of cytotoxic chemotherapy – clinical practice guidelines – recommendations'. London: RCN. (III)
9. Taxis, K and Barber, N, 2003. 'Ethnographic study incidence and severity of intravenous drug errors'. In *British medical journal*, 326, 684–7. (II)
10. Weinstein, SM, 2001. *Plumer's principles and practice of infusion therapy*. 7th ed. Philadelphia: Lippincott Williams and Wilkins, Chapter 18. (III)

## 2.5 Compatibility

### Standard

Chemical, physical, and therapeutic compatibilities must be ascertained prior to the reconstitution and administration of prescribed infusion medications. Compatibility between medications and delivery systems must be ascertained prior to the administration of prescribed infusion medications

### Practice criteria

- Manufacturer's guidelines should be followed for reconstituting and administration of a specific medication (Weinstein 2001).
- A registered pharmacist should be consulted on issues of compatibility (Trissel 1998; Shulman et al 1998).
- Adequate flushing should be performed between each drug to prevent incompatibilities from occurring (Nicol 1999; Lister 2004).
- Use of multi lumen catheters can help to reduce the risk of drug incompatibilities.

### References

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2. Nicol, M, 1999. 'Safe administration and management of peripheral intravenous therapy'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, 141
3. Sani, M, 1999. 'Pharmacological aspects of intravenous therapy'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone. (III)
4. Shulman, R et al, 1998. 'Management of extravasation of IV drugs'. In *UCL injectable drug administration*. Oxford: Blackwell Science. (III)
5. Trissel, LA, 1998. 'Drug stability and compatibility issues in drug delivery'. In *Handbook on injectable drugs*. 10th ed. Bethesda, MD: American Society of Health-System Pharmacists. (III)
6. Weinstein, SM, 2001. *Plumer's principles and practice of infusion therapy*. 7th ed. Philadelphia: Lippincott Williams and Wilkins, Chapter 18. (III)

## 2.6 Expiry dates

### Standard

Medications must not be administered and products and equipment must not be used beyond their expiry dates.

### Practice criteria

- Manufacturer's guidelines for proper storage of medication should be followed to ensure the validity of the expiry date.
- Expiry dates should be verified prior to initiation or administration of therapy.
- Expiry dates should be verified by the healthcare professional by checking supplementary information received from the manufacturer, or by checking labels attached to the medication, product or equipment.
- The maximum expiry date for any injection/infusion prepared in a clinical area is 24 hours or less in accordance with the manufacturer's specification of product characteristics (NPSA 2003).

### References

1. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
2. NPSA, 2003. Risk analysis of infusion devices. London. (III)
3. NMC, 2002. Guidelines for administration of medicines. London. (III)

## 2.7 Disposal of sharps, hazardous material and hazardous waste

### Standard

All used disposable sharp items – including, but not limited to, needles or stylets and surgical blades – should be disposed of in a non-permeable, puncture-resistant, tamper-proof container complying with UN 3921 and BS7320 standards.

Sharps must not be resheathed, broken or bent (ICNA 2003; NICE 2003; NHS Employees 2005; RCN 2005).

Needles and syringes must not be taken apart by hand prior to disposal.

All hazardous materials (for example cytotoxic drugs) and wastes should be discarded in the appropriate containers according to national guidelines and institutional policies and procedures (DH 2001; COSHH 2002).

### Practice criteria

- Protocols for safe handling of hazardous materials and hazardous waste should be set out in organisational

policies and procedures. (ICNA 2003).

- The manufacturer's guidelines, standards of practice and national regulations should be adhered to when developing organisational policies and procedures pertaining to the safe handling of hazardous materials, hazardous and paper waste (DH 2001).
- Because of the potentially serious consequences of exposure to bloodborne pathogens and the potential for permanent and disabling injury, ideally all needles should have a safety device with engineered sharps injury protection. (ICNA 2003; NHS employers 2005).
- Exposure to potentially infectious materials or injury from sharps should be identified, reported, tracked, and analysed for trends. Corrective action should be taken. (ICNA 2003; NHS Employees 2005).
- All sharps must be accounted for before, during, and immediately upon completion of a procedure. (ICNA 2003)

### References

1. COSHH, 2002. Control of substances hazardous to health. London: Stationery Office. (III)
2. DH, 2001. 'Standard principles for preventing hospital-acquired infections'. In *Journal of hospital infection*, 74 (supplement), S21–S37. (I)
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4. ICNA 2003 Reducing sharps injury – prevention and risk management, Infection Control Nurses Association, February. (III)
5. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
6. Jagger, J, 1996. 'Reducing occupational exposure to bloodborne pathogens'. In *Infect. Control Hosp. Epidemiol.*, 17, 573– 5. (III)
7. NHS Employers 2005 The Management of health, safety and welfare issues for NHS staff, London, chapter 19 (III)

## 2.8 Cleaning and sterilising reusable equipment

### Standard

All medical equipment, dressings and solutions used during invasive procedures must be sterile.

All medical equipment, for example drip stands, etc., must be cleaned both routinely and following patient use.

Sterilisation and disinfection solutions must be in accordance with manufacturer's guidelines.

Disinfection solutions must be bacteriocidal, virucidal, fungicidal, sporicidal and tuberculocidal.

### Practice criteria

- Protocols for disinfection of medical equipment should

- be set out in organisational policies and procedures.
- To prevent cross-infection, cleaning of medical equipment should be performed prior to patient use and at established intervals during long-term single-patient use (MDA 2000).
- Cleaning of medical equipment should include: drip stands, electronic infusion devices, splints and other non-disposable infusion-related equipment used in providing patient care (MDA 1996).
- The disinfection solution should not cause damage that could alter the integrity or performance of the equipment.
- Single use devices are meant for single use only (MDA 2000).

## References

1. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
2. MDA, 2000. 'Single use medical devices: implications and consequences of reuse'. In Device bulletin 2000, (04). London: DH. (III)
3. MDA, 1996. Sterilisation, disinfection and cleaning of medical equipment: guidance on decontamination from the Medical Advisory Committee to the DOH. (III)
4. National Audit Office, 2000. The management and control of hospital-acquired infection in acute NHS trusts in England. London: HMSO. (III)

labelled yellow plastic clinical waste bag.

- Disposable tourniquets should be used with infectious patients.

## References

1. COSHH, 2002. Control of substances hazardous to health. London: Stationery Office. (III)
2. DH, 2001. 'Standard principles for preventing hospital-acquired infections'. In Journal of hospital infection, 74 (supplement), S21-S37. (I)
3. Health and Safety at Work Regulations 1992. London: Stationery Office. (III)
4. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)

## 2.9 Isolation procedures

### Standard

Patient isolation should be required for selective transmissible diseases, specific immunosuppressed conditions, and surgical/medical interventions that compromise graft-host acceptance.

Proper handling and disposal of body fluids, supplies, equipment, and other materials should be in accordance with COSHH (2002) and the Health and Safety at Work Regulations (1992).

### Practice criteria

- Protocols for isolation precautions, including airborne droplet or contact precautions, should be set out in organisational policies and procedures.
- Hands should be promptly and thoroughly washed before and after each patient contact and after contact with blood, body fluids, secretions, excretions and contaminated equipment.
- Protective contact barriers used in isolation should include gown, gloves, mask, cap, and protective eyewear.
- All used sharps should be placed in an appropriately labelled, non-permeable, puncture-resistant, tamper-proof container located in the patient's room or home.
- All clinical waste should be placed in an appropriately

## 3

## Products and documentation

### 3.1 Product requirements

#### Standard

All medical devices must have CE marking.

#### Practice criteria

- Any product not meeting the requirements should be withdrawn from use, retained for examination and reported to the Medicines and Healthcare Products Regulatory Agency (MDA/2005/01).

#### References

1. BS EN ISO 10555-5, 1997. BS EN ISO 10555-1 and BS EN 10555-3 1997. British Standards Institute (III)
2. Dimond, B, 2002. 'Medical devices regulations and the Medical Devices Agency'. In *British journal of nursing*, 11, (15), 1007-1009. (III)
3. EU Directive 93/42/EEC. (III)
4. Medicines and Healthcare products Regulatory Agency Device Alert MDA 2005/01 and Device Bulletin DB 2005(01) reporting Adverse Incidents and Disseminating Medical Device Alerts. MHRA London. (III)
5. Medicines and Healthcare products Regulatory Agency Device Bulletin 2003(05) management of Medical devices prior to repair, service or investigation. MHRA London.

### 3.2 Product defect reporting

#### Standard

All product defects must be reported in writing to the appropriate department within the organisation, national regulatory agencies such as the MHRA or the NPSA, and the manufacturer.

#### Practice criteria

- All institutions should have a policy for reporting product complaints.
- Product complaints should include any suspected damage, incorrect labelling, packaging damage or tampering
- Any contaminated product must be dealt with according to the institution's policy and should be decontaminated.
- Product reports should include details of the complaint, the effect of the defect on the procedure, if any, and the lot number of the product
- Product complaints should be reported to the Medicines and Healthcare Products Regulatory Agency (MHRA),

the manufacturer and the appropriate department within the institution (MDA 2005/01).

- All adverse incidents must be reported as soon as possible to the MHRA via the most appropriate method and should contain as much relevant detail as available.

#### References

1. Medicines and Healthcare products Regulatory Agency Medical Device Alert MDA 2005/01 and device Bulletin DB 2005/01: *Reporting Adverse Incidents and Disseminating Medical Device Alerts* MHRA London. (III)

### 3.3 Labelling

#### Standard

Colour labels/packaging/products should not be relied upon for product or drug identification.

Clear, accurate labelling should be used for product and drug identification.

#### Practice criteria

- Labelling for drugs should include: the brand name and the generic name with prominence given to the generic name. Other information that should be included when labelling medicines includes the name of the drug, its strength (amount per unit volume) and total amount in volume, route of administration, dosage and warnings (Committee on Safety of Medicines 2001; MCA 2003; DH 2004a). Recommended International Non-Proprietary Names (rINNs) should be used in the packaging and labelling of medicinal substances (DH, 2004b, MHRA, 2005).
- Labelling for catheter products should include: size, gauge, length and material (INS 2000).

#### References

1. Committee on Safety of Medicines, 2001. Report to the Committee on Safety of Medicines from the working group on labelling and packaging of medicines. London. (III)
2. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
3. MCA, 2003. Good practice on the labelling and packaging of medicines. (III)
4. Department of Health, 2004a. Building a safer NHS for patients. Improving medication safety, London DH. (III)
5. Department of Health. 2004b. Change in names of certain medicinal substances. London DH (PL/CMO/2004/1, PL/CNO/2004/1, PL/CPHO/2004/2). (III)
6. Medicines and Healthcare Products Regulatory Agency (2005) Product information: changing substance names from BANs to rINNs, London: MHRA. Available from: <http://www.medicines.mhra.gov.uk/inforesources/productinfo/banrinn.htm> (Accessed 25 May 2005) (Internet) (III).

## 3.4 Patient safety incidents

### Standard

A patient safety incident report should be used to document incidents that could have or did lead to harm for one or more persons receiving NHS-funded healthcare (NPSA, 2004).

Healthcare providers must have in place a holistic and integrated system covering management, reporting, analysis and learning from all patient safety incidents involving patients, staff and others and other types of incidents not directly involving people (DH 2001, NPSA, 2004).

### Practice criteria

- The patient safety incident report must be managed and reported to a designated person or persons in accordance with local and national organisational policies and procedures
- Patient safety incidents should be reported locally using a centralised risk management system and nationally via the National Reporting and Learning System (NPSA, 2004).
- All reported incidents must be graded, investigated and analysed in accordance with local and national organisational policies and procedures.
- Serious untoward incidents should be reported to the appropriate Strategic Health Authority and Department of Health (NPSA, 2004).
- Any adverse incident involving a medical device must be reported to MHRA using the adverse incident reporting system (MHRA, 2005)
- Improvement strategies that aim to reduce risk to future patients should be implemented and monitored by the health care provider (DH 2001).
- Adverse drug reactions and defects with medicine products should be reported directly to the MHRA (NPSA, 2004).

### References

1. DH, 2001. Doing less harm. London: DH. (III)
2. DH, 2004. Seven steps to patient safety. London: DH. (III).
3. Hyde, L, 2002. Legal and professional aspects of intravenous therapy. In *Nursing Standard*, 16, (26), 39–42. (III)
4. MHRA, 2005. Medical Device Alert. MHRA MDA/2005/001. London. (III)
5. NPSA, 2003. Risk analysis of infusion devices. London. (III)
6. NPSA, 2004. Seven steps to patient safety. London: NPSA (III)

## 3.5 Audit and benchmarking

### Standard

A quality assurance and performance improvement strategy should be established within an organisation.

The strategy should specify performance objectives, identify processes whereby these objectives should be achieved, monitor progress and evaluate their outcome.

### Practice criteria

- The audit and benchmarking programme should be in line with national, professional standards of practice (DH 1998; Stark et al 2002).
- The audit and performance improvement strategy should provide accountability criteria and expected treatment outcomes (Ellis 2000).
- Audit should be an ongoing process in order to monitor, maintain and improve clinical practice in infusion therapy. Identified deficiencies should be documented and evaluated, and form the basis of an action plan for performance improvement (Lamb 1999).

### References

1. DH, 1998. A first class service: quality in the new NHS. London: HMSO. (III)
2. Lamb, J, 1999. 'Legal and professional aspects in intravenous therapy'. In Dougherty, L and Lamb, J (eds) *Nursing practice*. Edinburgh: Churchill Livingstone. (III)
3. Ellis, J, 2000. 'Sharing the evidence: clinical practice benchmarking to improve continuously the quality of care'. In *Journal of advanced nursing*, 32, (1), 215–225. (III)
4. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
5. Stark, S, MacHale, A, Lennon, E and Shaw, L, 2002. 'Benchmarking: implementing the process in practice'. In *Nursing Standard*, 16, (35) 39–42. (III)

## 3.6 Documentation

### Standard

Documentation in the patient's nursing and/or medical record must contain complete information regarding infusion therapy and vascular access (INS 2000; ICNA 2000).

Documentation must comply with the guidelines for records and record-keeping (NMC 2005).

### Practice criteria

Protocol for documentation should be set out in organisational policies and procedures.

All aspects of intravenous therapy should be documented according to local policy and procedures (Nicol, 1999).

Documentation should include:

- Evidence of consent.
- Type, length, and gauge of vascular access device, date and time of insertion (DOH 2003), number and location of attempts, identification of the site, type of dressing, patient's tolerance of the insertion, and the name of the person placing the device.
- For midline and peripherally inserted central catheters: external catheter length, midarm circumference, effective

length of catheter inserted and radiographic confirmation of the location of catheter tip if required.

- Site care and condition/appearance using standardised assessment scales for phlebitis and/or infiltration/extravasation (Dougherty 1999; INS 2000).
- Specific safety or infection control precautions taken.
- Patient or caregiver participation in and understanding of therapy and procedures.
- Communication among healthcare professionals responsible for patient care and monitoring.
- Type of therapy: drug, dose, rate, time and method of administration.
- Patient's tolerance of therapy.
- Pertinent diagnosis, assessment and monitoring of vital signs.
- Patient's response to therapy, symptoms, and/or appropriate laboratory tests taken and results documented.
- Complications and side-effects of infusion therapy.
- Discontinuation of therapy (DOH 2003), including catheter length and integrity, site appearance, dressing applied and patient tolerance (INS 2000).

## References

1. DH, 2003. Winning ways. Working together to reduce healthcare associated infection in England. London: DH
2. Dougherty, L, 1999. 'Obtaining peripheral vascular access'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone. (III)
3. ICNA, 2000. Guidelines for preventing intravascular catheter-related infections. Fitwise Publication. (III)
4. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
5. NMC, 2005. Guidelines for records and record-keeping. London: NMC. (III)
6. Nicol, M, 1999. 'Safe administration and management of peripheral intravenous therapy'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, 141–162. (III)

## 4

# Infusion equipment

## 4.1 Add-on devices

### Standard

Add-on devices include: stopcocks, ramping systems, extension sets, blind hub caps, injectable caps ports, needleless systems and filters. All add-on devices should be of Luer-Lok design.

Catheters should be stabilised in a manner that does not interfere with assessment and monitoring of the infusion site or impede delivery of the prescribed therapy.

### Practice criteria

- Protocols for the use of add-on devices should be established in organisational policies and procedures.
- Protocols for use and frequency of change of add-on devices and junction securement devices should be in accordance with manufacturer's guidelines (MHRA 2005).
- When add-on devices are used, they should be changed with each cannula or administration set replacement, or whenever the integrity of either product is compromised and according to manufacturer recommendations (Nicol 1999).

### References

1. INS, 2000. *Standards for infusion therapy*. Cambridge, MA: INS and Becton Dickinson. (III)
2. Medicines and Healthcare products Regulatory Agency Medical Device Alert MDA 2005/01 and device Bulletin DB 2005/01: Reporting Adverse Incidents and Disseminating Medical Device Alerts MHRA London. (III)
3. Nicol, M, 1999. 'Safe administration and management of peripheral intravenous therapy'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone. (III)

## 4.2 Splints

### Standard

Indication for the use of a splint should be documented in the patient's medical and nursing notes.

### Practice criteria

- A device designed for splinting should be used to facilitate infusion delivery only when the device is placed in or around an area of flexion or it is at risk of dislodgement, for example when it is being used on a child (Bravery

1999; Perucca 2001).

- Protocol for the use of splints should be set out in organisational policies and procedures.
- The splint should be removed and the circulatory status of the patients extremity should be assessed at established intervals (Nicol 1999; Weinstein 2001).
- Reusable splints and immobilisation devices should be cleaned and disinfected between episodes of patient use (Nicol 1999).
- The correct type of splint should be used depending on the site of flexion, for example the elbow or wrist, to ensure the extremity remains in a functional position (Weinstein 2001).

### References

1. Bravery, K, 1999. 'Paediatric intravenous therapy in practice'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, Chapter 15, 401–446. (III)
2. INS, 2000. *Standards for infusion therapy*. Cambridge, MA: INS and Becton Dickinson. (III)
3. Nicol, M, 1999. 'Safe administration and management of peripheral intravenous therapy'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, Chapter 6, 141–162. (III)
4. Perucca, R, 2001. 'Obtaining vascular access'. In *Infusion therapy in clinical practice*. (2<sup>nd</sup> ed.). Pennsylvania: WB Saunders, Chapter 20, 338–397. (III)
5. Weinstein, S, 2001. *Plumer's principles and practices of intravenous therapy*. Philadelphia: Lippincott Williams and Wilkins. (III)

## 4.3 Filters

### Standard

For non-lipid-containing solutions that require filtration, an additional 0.2 micron filter containing a membrane that is both bacteria/particulate-retentive and air-eliminating should be used (INS 2000; Nicol 1999). All infusion sets should contain in-line filtration appropriate to the solution being administered. Clear fluids require 15micron filtration (or less) which is usually provided by a standard clear fluid set. (INS 2000; Nicol 1999).

For lipid infusions or total nutrient preparations that require filtration, a 1.2 micron filter containing a membrane that is both bacteria/particulate-retentive and air-eliminating should be used (INS 2000).

In-line blood component filters (integral mesh filter 170-200µm pore size), appropriate to the therapy, should be used to reduce particulate matter and microaggregates in infusions of blood components (INS 2000; RCN 2005).

### Practice criteria

- Indications and protocol for the use of bacteria/particulate-retentive, air-eliminating, and blood and blood component filters should be set out in organisational policies and procedures (Trautman et al

- 1997).
- Use of filters should adhere to the manufacturer's guidelines and the filtration requirements of the therapy.
- Bacteria/particulate-retentive and air-eliminating membrane filter changes should coincide with administration set changes.
- Blood and blood component filters should be changed every four hours and/or coincide with blood administration set changes (that is, they should be changed after every second unit for example) (McClelland 2001; Perucca 2001; RCN 2005).
- In-line bacteria/particulate-retentive, air-eliminating membrane filters should be located as close to the catheter insertion site as possible (Perucca 2001).

## References

1. INS, 2000. *Standards for infusion therapy*. Cambridge, MA: INS and Becton Dickinson. (III)
2. McClelland, DBL, 2001. *Handbook of transfusion medicine* (3rd ed.). London: Stationery Office. (III)
3. Nicol, M, 1999. 'Safe administration and management of peripheral intravenous therapy'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, 141–162. (III)
4. Perucca, R, 2001. 'Obtaining vascular access'. In *Infusion therapy in clinical practice*. 2nd ed. Pennsylvania: WB Saunders, Chapter 20, 338–397. (III)
5. RCN, 2004. *Right blood, right patient, right time*. London: RCN (III)
6. Trautman, M, Zauser, B, Wiedeck, H, Buttenschon, K and Marre, R, 1997. 'Bacterial colonisation and endotoxin contamination of intravenous infusion fluids'. In *J. Hospital Infect.*, 37, 225–36. (III)

## 4.4. Flow control devices

### 4.4.1 Manual flow control devices

#### Standard

The rate of infusions can be routinely regulated by manual flow control devices to ensure accurate delivery of the prescribed therapy.

The healthcare professional responsible for monitoring the patient should be accountable for the use of manual flow control infusion devices.

#### Practice criteria

- Protocols for the use of manual flow control devices should be set out in organisational policies and procedures.
- Use of manual flow control devices should adhere to manufacturer's guidelines; these devices include, but are not limited to, slide and roller clamps.
- Manual flow control devices should be suitable for the regulation of most infusions. To ensure patient safety consideration should be given to the patient's age and condition, prescribed therapy, and the care setting in

- which the therapy is delivered (Dolan1999; Sarpal 2004).
- A manual flow control device should achieve accurate delivery of the prescribed therapy with minimal deviation from manufacture's guidelines.
- The nurse should demonstrate knowledge and competency related to manual flow control devices, including indications for use and ability to calculate flow rates.
- Manual flow control devices should be considered as an adjunct to nursing care and are not intended to alleviate the nurse's responsibility for regularly monitoring and documenting the infusion rate of the prescribed therapy.
- Frequency of flow rate monitoring should be performed depending on the patients' clinical requirements (Quinn 2000).

## References

1. Dolan, M, 1999. 'Intravenous flow control and infusion devices'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone. (III)
2. INS, 2000. *Standards for infusion therapy*. Cambridge, MA: INS and Becton Dickinson. (III)
3. Quinn, C, 2000. 'Infusion devices: risks, functions and management'. In *Nursing Standard*, 14, (26), 35–41. (III)
4. Sarpal, N 2004. 'Drug administration - Infusion devices'. In Dougherty, L & Lister S *The Royal Marsden Hospital Manual of clinical nursing procedures*. 6th ed. Oxford: Blackwell Publishing. (III)

### 4.4.2 Electronic flow control devices

#### Standard

Electronic infusion devices should be used in a way that suits the circumstances, that is neonatal/paediatric use, patient condition, care setting and prescribed therapy should all be taken into account.

The healthcare professional responsible for monitoring the patient should be accountable for the use of electronic flow control infusion devices.

Electronic flow control infusion devices should be standardised throughout the organisation (NPSA 2003; MDA 2003).

#### Practice criteria

- Protocols for the use of electronic infusion devices should be set out in organisational policies and procedures.
- Manufacturer's guidelines should be adhered to in the use of electronic infusion devices; and consideration should be given to electrical safety in the use of these devices.
- The safety features of the equipment should be of prime consideration in the selection of electronic infusion



devices. Safety features include, but are not limited to, audible alarms, battery life and operation indicators, anti-free-flow protection, adjustable occlusion pressure levels, accuracy of delivery indicator, drug dosage calculation, in-line pressure monitoring and anti-tampering mechanisms (MDA 1995, 1997, 2003; Pickstone 2000).

- Electronic infusion devices should generate flow under positive pressure. These devices include, but are not limited to, peristaltic, syringe, and pulsatile pumps (Quinn 2000).
- The frequency of preventive maintenance of electronic infusion devices should be established in organisational policies and procedures, and should adhere to the manufacturer's guidelines and those established by the MHRA. The establishment of an equipment library is also recommended (MDA 2003; NPSA 2003).
- It is recommended that the following information is recorded: date and time that the infusion started, expected completion time, route, device serial number, rate setting, volume to be infused, total volume infused, volume remaining, checks of infusion site and indication of reason for any alterations (MDA 2003).
- The nurse should demonstrate knowledge and competency which has been assessed relative to electronic infusion devices, including indications for use, programming the device to deliver the prescribed therapy, mechanical operation, the use of lock-out safety devices, troubleshooting, pounds per square inch (PSI) rating, the recommended height of the device, monitoring and safe use (Quinn 2000; Pickstone 2000; Murray and Glenister 2001; MDA 2003; DH 2004).
- When an electronic infusion device is indicated to administer a vesicant medication, a low-pressure device should be the instrument of choice.
- When an electronic infusion device is indicated for the arterial access device, a high-pressure device should be the instrument of choice.
- When an electronic infusion device is used to administer high-risk drugs, a device with anti-free-flow protection should be in the instrument of choice.
- Electronic infusion devices should be used for central venous access device infusions wherever possible.
- Electronic infusion devices should always be used where infusions are to be administered in paediatric patients due to the need for pressure monitoring and rapid occlusion alarms (Bravery 1999).
- Electronic infusion devices should be considered an adjunct to nursing care and are not intended to alleviate the nurse's responsibility for regularly monitoring and documenting the infusion rate of the prescribed therapy.

## References

1. Bravery, K, 1999. 'Paediatric intravenous therapy in practice'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, Chapter 15, 401–446. (III)
2. DH 2004 Building a safer NHS for patients – improving medication safety, Department of Health, London (III)
3. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
4. MDA, 1995. Infusion systems device bulletin. MDA Device Bulletin 9503. London: MDA. (III)
5. MDA, 1997. Selection and use of infusion devices for ambulatory applications. MDA Device Bulletin 9703. London: MDA. (III)
6. MDA, 2003. Infusion system device bulletin. MDA Device Bulletin 2003, (02). London. (III)
7. Murray, W and Glenister, H, 2000. 'How to use medical devices safely'. In *Nursing Times*, 97, (43), 36–38. (III)
8. NPSA, 2003. Risk analysis of infusion devices. London. (III)
9. Pickstone, M, 2000. 'Using the technology triangle to assess the safety of technology-controlled clinical procedures in critical care'. In *International journal of intensive care*, Summer, 90–96. (III)
10. Quinn, C, 2000. 'Infusion devices: risks, functions and management'. In *Nursing Standard*, 14, (26), 35–41. (III)

## 4.5 Blood/fluid warmers

### Standard

Devices used for blood/fluid warming must be specifically designed for that purpose and must be validated before use.

When blood is warmed, care should be taken to prevent haemolysis by using a blood warmer (Porter 1999).

### Practice criteria

- Protocols for the use of blood/fluid warmers must be set out in organisational policies and procedures and in accordance with the standards for administration of blood.
- Blood/fluid warmers must be used when warranted by patient history and/or prescribed therapy (Porter 1999; McClelland 2001 ; Weir 2001).
- Blood warmers should be used in the following situations: adults receiving infusion of blood at rates > 50 ml/kg/hour; children at rates > 15 ml/kg/hour; exchange transfusion of infants; and transfusing a patient who has clinically significant cold agglutinins (British Committee for Standards in Haematology, 1999; McClelland, 2001). Recipients with cold agglutinins disease have auto-cold antibody, which results in lysis of their own or donor cells. The administration of cold blood in these patients may result in a severe haemolytic reaction (Cook 1997 a&b).
- Blood warmers must be correctly maintained and used according to the manufacturer's instructions (McClelland 2001 ; Weir 2001).
- Blood must not be warmed by any other method for example a microwave oven (British Committee for Standards in Haematology, 1999; McClelland, 2001, RCN, 2005).
- The nurse should demonstrate knowledge of appropriate

- use and operation of blood/fluid warmers.
- Manufacturer's guidelines must be adhered to when using blood/fluid warmers (McClelland 2001 ; Weir 2001).
- Blood/fluid warmers should undergo routine quality control inspections and be equipped with warning systems including an audible alarm and visual temperature gauges (McClelland 2001; Ryan 2004; RCN 2005).

## References

1. British Committee for Standards in Haematology Blood Transfusion Task Force, 1999. Guidelines for the administration of blood and blood components and the management of transfused patients. London: BCSH. (III)
2. Cook, LS, 1997a. Blood transfusion reactions involving an immune response. In *Journal of intravenous nursing*, 20, (1), 5-14. (III)
3. Cook, LS, 1997b. Non-immune transfusion reactions: when type-and-cross match aren't enough. In *Journal of intravenous nursing*, 20, (1), 15-22. (III)
4. INS, 2000. *Standards for infusion therapy*. Cambridge, MA: INS and Becton Dickinson. (III)
5. McClelland, DBL, 2001. *Handbook of transfusion medicine*. 3<sup>rd</sup> ed. London: Stationery Office. (III)
6. Porter, H, 1999. 'Blood transfusion therapy'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, Chapter 13, 359-376. (III)
7. RCN, 2004. Right blood, right patient, right time. London: RCN (III)
8. Ryan, P 2004. 'Transfusion of blood and blood products'. In Dougherty, L & Lister S. *The Royal Marsden Hospital Manual of clinical nursing procedures*. 6th ed. Oxford: Blackwell Publishing. (III)
9. Weir, JA, 2001. 'Blood component therapy'. In Hankins, J, Lonsway, RA, Hedrick, C and Perdue, MB (eds). *Infusion therapy in clinical practice* (2<sup>nd</sup> ed.). Pennsylvania: WB Saunders, Chapter 10, 156-175. (III)

## 4.6 Injection access site

### Standard

Injection access sites such as injection caps should be aseptically cleansed prior to access (Maki and Mermel 1998; NICE 2003; MHRA 2005).

A safety device system, for example a needle-free system, is the preferred method of accessing an injection access site.

Accessing the injection access site must be accomplished by the smallest gauge, shortest needle that will accommodate the prescribed therapy (Nicol 1999).

Injection access sites that are not integral to the device should be changed at established intervals according to manufacturer's instructions, or immediately if the integrity of the access site is compromised or if residual blood remains within the access site (Perucca 2001; MHRA 2005).

Injection access sites that are not integral to the device should be of Luer-Lok design.

### Practice criteria

- Protocols for disinfection, accessing and changing of injection access sites should be set out in organisational policies and procedures and should be in accordance with the manufacturer's guidelines (NICE 2003; MHRA 2005).
- To prevent the entry of micro-organisms into the vascular system, the injection access site should be aseptically cleansed with an approved antimicrobial solution, such as chlorhexidine in alcohol, immediately prior to use (NICE 2003; MHRA 2005).
- If a needle must be used, it should be between 25 and 21 gauge and not exceed one inch (2.5cm) in length. A needle smaller than 25 gauge should not be used (Nicol 1999; Lister 2004).
- The integrity of the injection access site should be confirmed before and immediately after each use; if the integrity of the injection access site is compromised, it should be replaced immediately, and consideration should be given to changing the device and/or administration set (Nicol 1999; Perucca 2001; MHRA 2005).
- The optimal interval for changing injection access sites on central, peripherally inserted central and midline catheters is unknown; therefore it is recommended that they be changed in accordance with manufacturers recommendations (MHRA 2005).
- Any time an injection access site is removed from a vascular access device, it should be discarded and a new sterile injection access site should be attached.

### References

1. Lister, S, 2004. 'Drug administration- general principles'. In Dougherty, L, & Lister, S, *The Royal Marsden Hospital Manual of clinical nursing procedures*. 6th ed. Oxford: Blackwell Publishing. (III)
2. Maki, DG and Mermel, LA, 1998. 'Infections due to infusion therapy'. In Bennett, JV and Brachman, PS (eds). *Hospital infections*. 4th ed. Philadelphia: Lippincott-Raven. (III)
3. MHRA 2005 Medical Device Alert on all brands of needle free intravascular connectors, MDA/2005/030, issued 17 May 2005, London (III)
4. NICE, 2003. Infection control: prevention for healthcare-associated infection in primary and community care (clinical guidelines 2). London: NICE. (I)
5. Nicol, M, 1999. 'Safe administration and management of peripheral intravenous therapy'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, 141-162. (III)
6. Perucca, R, 2001. 'Obtaining vascular access'. In *Infusion therapy in clinical practice*. 2nd ed. Pennsylvania: WB Saunders, Chapter 20, 338-397. (III)

## 4.7 Tourniquet

### Standard

A tourniquet should be properly applied to promote venous distention and to impede venous but not arterial blood flow (Weinstein 2001; Perucca 2001).

### Practice criteria

- The tourniquet should be applied at an appropriate location proximal to the selected insertion site (Weinstein 2001; Witt 2004).
- A pulse should be easily palpable distal to the tourniquet location (Weinstein 2001).
- The tourniquet should not be applied for an extended period of time in order to prevent circulatory impairment (Ernst and Ernst 2001; Perucca 2001).
- The tourniquet material should be considered with regard to potential latex allergy.
- The tourniquet should be single-patient-use where there is the potential for microbial cross-contamination between patients (Golder et al 2000).
- The tourniquet should be a quick release model which allows one-handed use.

### References

1. Ernst, D and Ernst, C, 2001. *Phlebotomy for nurses and nursing personnel*. Indiana: Health Star Press. (III)
2. Golder, M, Chan, CL, O'Shea, S, Corbett, K, Chrystie, IL and French, G, 2000. 'Potential risk of cross-infection during peripheral-venous access by contamination of tourniquets'. In *The Lancet*, 355, (9197), 44. (III)
3. INS, 2000. *Standards for infusion therapy*. Cambridge, MA: INS and Becton Dickinson. (III)
4. Perucca, R, 2001. 'Obtaining vascular access'. In *Infusion therapy in clinical practice*. 2nd ed. Pennsylvania: WB Saunders, Chapter 20, 338–397. (III)
5. Weinstein, S, 2001. *Plumer's principles and practices of intravenous therapy*. Philadelphia: Lippincott Williams and Wilkins. (III)
6. Witt, B 2004. 'Venepuncture'. In Dougherty, L. & Lister S *The Royal Marsden Hospital Manual of clinical nursing procedures*. 6th ed. Oxford. Blackwell Publishing (III)

## 4.8 Administration sets

### 4.8.1 Primary and secondary continuous sets

#### Standard

Primary and secondary continuous administration sets must be changed every 72 hours and immediately upon suspected contamination or when the integrity of the product or system has been compromised (Elliott and Tebbs 1998; INS 2000; DH 2001; Wilson 2001; CDC 2002; NICE 2003).

Primary and secondary administration sets must be changed using aseptic technique, observing universal precautions and following manufacturer's recommendations.

Only recommended or designated administration sets should be used in electronic infusion devices (MDA 2003).

#### Practice criteria

- Protocols for primary and secondary continuous

administration set changes must be set out in organisational policies and procedures.

- Product integrity must be ascertained prior to use of the administration set.
- The primary administration set change should coincide with peripheral catheter change and/or initiation of a new container of solution; the secondary administration set change should coincide with change of the primary administration set and/or initiation of a new container of solution.
- An organisation that exhibits an increased rate of catheter-related bloodstream infection when carrying out 72-hour administration set changes should return to a 48-hour administration set change interval.
- Changing of add-on devices such as, but not limited to, extension sets, filters, stopcocks, and needleless devices should coincide with the changing of the administration set.
- The type of solution administered via primary or secondary continuous administration set, for example parenteral nutrition, lipids, blood and blood components, should dictate whether the administration set is changed more frequently.
- Use a sterile blood administration set with a screen filter (blood giving set). It must be changed at least 12 hourly during red cell infusion. A new giving set should be used if another fluid is to be infused following the blood components (McClelland 2001, RCN 2005).
- Once a secondary administration set is detached from the primary administration set, the secondary set should be discarded.

### References

1. CDC, 2002. 'Guidelines for the prevention of intravascular catheter-related infections'. In *Morbidity and mortality weekly report*, 51 (RR-10), S35–S63. CDC. (I)
2. DH, 2001. 'Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters'. In *Journal of hospital infection*, 47 (supplement), S47–S67. (I)
3. Elliott, TSJ and Tebbs, SE, 1998. 'Prevention of central venous catheter-related infection'. In *Journal of hospital infection*, 40, 193–201. (III)
4. INS, 2000. *Standards for infusion therapy*. Cambridge, MA: INS and Becton Dickinson. (III)
5. MDA, 2003. *Infusion system device bulletin*. MDA Device Bulletin 2003, (02). London. (III)
6. NICE, 2003. *Infection control prevention of healthcare-associated infection in primary and community care (clinical guidelines 2)*. London: NICE. (I)
7. Wilson, J, 2001. 'Preventing infection associated with intravenous therapy'. In *Infection control in clinical practice*. 2<sup>nd</sup> edition, London Bailliere Tindall (III)

### 4.8.2 Primary intermittent sets

#### Standard

Primary intermittent administration sets should be changed every 24 hours if remaining connected to the device or

discarded after each use if disconnected. The set should be disconnected immediately upon suspected contamination and discarded when the integrity of the product or system has been compromised, in line with manufacturer's instructions (INS 2000; Lister 2004).

Primary intermittent administration sets must be changed using aseptic technique and observing standard precautions (Wilson 2001).

### Practice criteria

- Protocols for primary intermittent administration set changes should be set out in organisational policies and procedures.
- Product integrity should be ascertained prior to use of the administration set.
- Administration sets and needles or needleless devices should be aseptically maintained between medication doses.
- Change or add-on devices such as, but not limited to, extension sets, filters, stopcocks, and needleless devices should coincide with the changing of the administration set.

### References

1. INS, 2000. *Standards for infusion therapy*. Cambridge, MA: INS and Becton Dickinson. (III)
2. Lister, S 2004 Drug administration – general principles In Dougherty, L. & Lister S The Royal Marsden Hospital Manual of clinical nursing procedures. 6th ed. Oxford: Blackwell Publishing. (III)
3. Wilson, J, 2001. 'Preventing infection associated with intravenous therapy'. In *Infection control in clinical practice*. 2<sup>nd</sup> edition, London: Bailliere Tindall (III)

## 4.8.3 Parenteral nutrition

### Standard

Administration sets used for parenteral nutrition (PN) should be changed every 24 hours or immediately upon suspicion of contamination or when the integrity of the product or system has been compromised (Elliott and Tebbs 1998; INS 2000; DH 2001; NICE 2003).

PN administration sets should be changed using aseptic technique and observing universal precautions.

### Practice criteria

- Protocols for PN administration set changes should be set out in organisational policies and procedures.
- Product integrity should be ascertained prior to use of the administration set.
- Changing of add-on devices such as, but not limited to, extension sets, filters, stopcocks, and needleless devices should coincide with the changing of the administration set.

### References

1. DH, 2001. 'Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters'. In *Journal of hospital infection*, 47 (supplement), S47–S67. (I)
2. Elliott, TSJ and Tebbs, SE, 1998. 'Prevention of central venous catheter-related infection'. In *Journal of hospital infection*, 40, 193–201. (III)
3. INS, 2000. *Standards for infusion therapy*. Cambridge, MA: INS and Becton Dickinson. (III)
4. NICE, 2003. *Infection control prevention of healthcare-associated infection in primary and community care (clinical guidelines 2)*. London: NICE. (I)

## 4.8.4 Blood and blood components

### Standard

Use a sterile blood administration set with a screen filter (blood administration set). It must be changed every 12 hours during red cell infusion. A new administration set should be used if another fluid is to be infused following the blood components (McClelland 2001, RCN 2005).

Administration sets used for blood components must be changed immediately upon suspected contamination or when the integrity of the product or system has been compromised.

Administration sets used for blood components must be changed using aseptic technique and observing universal precautions, in line with manufacturer's instructions.

### Practice criteria

- Protocols for blood and blood component administration set changes should be set out in organisational policies and procedures.
- Product integrity should be ascertained prior to use of the administration set.
- In-line blood and blood component filters appropriate to the therapy should be used.

### References

1. McClelland, DBL, 2001. *Handbook of transfusion medicine*. 3rd ed. London: Stationery Office. (III)
2. RCN, 2005. *Right blood, right patient, right time*. London: RCN. (III)

## 4.8.5 Haemodynamic and arterial pressure monitoring

### Standard

The disposable or reusable transducer and/or dome and other components of the system, including the administration set, continuous flush device and the flush solution used for invasive haemodynamic pressure monitoring, are considered a closed system and must be changed every 96 hours or sooner if contamination is suspected or when the integrity of

the product or system has been compromised (Lai 1998; Ciano 2001; CDC 2002).

The equipment should be changed using aseptic technique and observing universal precautions.

### Practice criteria

- Protocols for haemodynamic and arterial pressure monitoring set changes should be set out in organisational policies and procedures.
- Product integrity should be ascertained prior to use of the haemodynamic monitoring system.
- Filters should be used as appropriate to the therapy.
- Haemodynamic monitoring set changes should coincide with the initiation of a new container of solution.
- Changing of add-on devices such as, but not limited to, extension sets, filters, stopcocks, and needleless devices should coincide with the changing of the haemodynamic monitoring set.

### References

1. Ciano, BA, 2001. 'Haemodynamic monitoring'. In Hankins, J, Lonsway, RA, Hedrick, C and Perdue, MB (eds). In *Infusion therapy in clinical practice*. 2<sup>nd</sup> ed. Pennsylvania: WB Saunders, Chapter 23, 404–417. (III)
2. CDC, 2002. 'Guidelines for the prevention of intravascular catheter-related infections'. In *Morbidity and mortality weekly report*, 51 (RR-10), S35– S63. CDC. (I)
3. Lai, KK, 1998. 'Safety of prolonging peripheral cannula and IV tubing use from 72 hours to 96 hours'. In *American journal of infection control*, 26, 66–70. (II)

## 5

## Site selection and placement

### 5.1 Site selection

#### Standard

Site selection for vascular access should include: assessment of the patient's condition, age and diagnosis; vascular condition; infusion device history; and the type and duration of the therapy as well as the potential complications associated with vascular access devices (Hamilton and Fermo 1998; Sansivero 1998; Gabriel 1999; Wise et al 2001).

The vasculature should accommodate the gauge and length of the device required by the prescribed therapy (Dougherty et al 2004)

Prior to peripherally inserted central catheter (PICC) insertion, anatomical measurements should be taken to determine the length of the catheter required to ensure full advancement of the catheter with catheter tip placement in the superior vena cava/right atrium (Wise et al 2001).

Placement of central vascular access catheters other than PICCs is thought of as a medical procedure in many hospitals but is a developing area within current nursing practice (Hamilton et al 1995; Benton and Marsden 2002; Boland et al 2003).

Placement of any vascular access device, particularly central vascular access devices, is an aseptic procedure which should only be undertaken by staff who have had appropriate training.

#### General practice criteria

- Criteria for site selection should be set out in organisation policies and procedures.
- Site selection should be determined in line with the manufacturer's guidelines for insertion (Hamilton 2000).
- Site selection for central vascular access catheters, other than PICCs, is usually thought of as a medical procedure (Dougherty et al 2004).

#### Peripheral devices: cannulas and midline catheters

- Veins that should be considered for peripheral cannulation are those found on the dorsal and ventral surfaces of the upper extremities including the metacarpal, cephalic and basilic (Dougherty 1999;

- Hadaway 2001; CDC 2002; Dougherty et al 2004).
- Veins in the lower extremities should not be used routinely in adults due to the risk of embolism and thrombophlebitis (Dougherty et al 2004; Hadaway 2001).
- Site selection should involve assessment for previous venepuncture and subsequent damage to the vein.
- Site selection should be routinely initiated in the distal areas of the upper extremities; subsequent cannulation should be made proximal to the previously cannulated site (Weinstein 2001).
- Choice of an alternative site due to infiltration/extravasation of solutions into the extremity should require assessment of the type of solution, its pH, osmolarity, the estimated volume of the infusate and the condition of the vein.
- Site selection should avoid areas of flexion (Dougherty et al 2004) although this may not always be possible in an emergency situation such as during resuscitation when the antecubital fossa is recommended (*European resuscitation guidelines for adult advanced life support* 2003).
- Arterial flow should not be compromised when pressure is applied to produce venous distension (Dougherty 1999; Perucca 2001).
- Blood pressure cuffs and tourniquets should not be used on an extremity where a peripheral device has been placed.
- Cannulation of fistulae and grafts for infusion therapy requires the approval of a doctor. Alternatively, organisational policies and procedures must be followed.
- Peripheral devices should not be routinely used for blood sampling but blood can be taken immediately following insertion.
- A clinician should be consulted and the decision documented prior to cannulation of the arm of a patient who has undergone mastectomy and/or axillary node dissection/radiotherapy or who may have existing fistulated access or other contra- indications: for example, they require future fistula formation
- Therapies not appropriate for certain peripheral devices include continuous vesicant chemotherapy, parenteral nutrition exceeding 10 per cent dextrose and /or 5 per cent protein, solutions and/or medications with pH less than five or greater than nine and solutions and/or medications with osmolarity greater than 500mOsm/l (INS 2000).
- The cephalic, basilic or median cubital veins of the patient's arm can be used for the insertion of a midline catheter in adults (Gabriel 1999; Dougherty et al 2004).
- Placement of the midline should be just above or below the fold of the antecubital area so as to aid patient comfort when flexing their arm. This will also minimise the potential for catheter kinking.
- As the tip of the midline catheter does not extend beyond the axillary vein, X-ray confirmation of tip placement is not required prior to use.

## Central venous access devices

- The cephalic, basilic or median cubital veins of the adults patient's arm can be used for the insertion of a PICC (Gabriel 1999; Weinstein 2001; Perucca 2001; CDC 2002 Dougherty et al 2004).
- In neonates and children, the external jugular, axillary, long and short saphenous, temporal and posterior auricular veins can be used for PICC insertion (Bravery 1999).
- Placement of the PICC should be just above or below the fold of the antecubital area so as to aid patient comfort when flexing their arm. This will also minimise the potential for catheter kinking.
- The most appropriate veins for non-tunnelled, tunnelled or implantable device cannulation include the internal jugular and subclavian (Hamilton 2000; Weinstein 2001; Dougherty et al 2004).
- Central catheters should have the distal tip dwelling in the lower third of the superior vena cava or right atrium (Nightingale et al 1997; Gabriel 1999; Wise et al 2001).
- The femoral vein should be used with caution for catheterisation. However, if used, the tip should dwell in the inferior vena cava (Hamilton and Fermo 1998; Gabriel 1999).

## Arterial catheters

- Criteria for site selection should include the presence of a pulse and assessment of the distal circulation.
- The most appropriate arteries for percutaneous cannulation are those which have a collateral circulation to preserve blood flow to the distal limb, this includes the radial artery (collateral flow from the ulnar artery) and the dorsalis pedis (collateral flow from the posterior tibial artery). The brachial and femoral arteries are used in practice but as neither has collateral flow, assessment of limb perfusion is essential.
- When the radial artery has been selected for cannulation, an Allen's test should be performed to assess the circulation. Failure of the Allen's test preclude cannulation (Dougherty et al 2004).

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## 5.2 Device selection

### Standard

The device selected should be the smallest gauge and shortest length that will be accommodated by the vein for the prescribed therapy (Sansivero 1998).

The length of the central vascular access catheters will be selected in order to ensure that the distal tip of the catheter lies in the lower third of the superior vena cava or right atrium (Nightingale et al 1997; Gabriel 1999; Wise et al 2001; Dougherty et al 2004).

Femorally placed central vascular access catheters should have the distal tip dwelling in the inferior vena cava (INS 2000). Midline catheters should have the distal tip dwelling in or at the junction of the axillary vein (INS 2000).

The device should be selected according to the type of technique used to introduce midline and PICCs into one of the antecubital fossa veins, for example 'over the needle', 'through the needle' or 'Seldinger' techniques (Sansivero 2000).

All catheters must be radiopaque (Gabriel 1999; Keradag &

Gorgulu 2000).

### General practice criteria

- The insertion of any vascular access device should require demonstrable knowledge of the product in regard to technique, potential complications, appropriateness to prescribed therapy, manufacturer's guidelines and requirements of the NMC (Hamilton 2000).
- The nurse should be educated and competent, according to organisational policies and procedures to care for, maintain and/or insert vascular access devices (INS 2000).
- The type of device inserted should be dependent on the length of therapy, the type of medication, the patient's condition and preference (Hamilton and Fermo 1998; Dolan and Dougherty 2000; Hamilton 2000; ICNA 2000).
- Consideration should be given to site placement in relation to dwell times and development of potential complications (Sansivero 1998; Hamilton 2000).
- Central catheters should be of single-lumen configuration unless additional therapies are required (INS 2000; DH 2001).

### Peripheral devices

- Ideally peripheral devices should be equipped with a safety device with engineered sharps injury protection. Risk assessments should be undertaken concerning the use of these devices and their use considered in line with local policies.
- The use of stainless steel needles should be limited to bolus injections of non-vesicant drug administration (CDC 2002).
- A peripheral cannula is defined as one that is less than or equal to three inches (3.5cm) in length (INS 2000; Dougherty et al 2004).
- A midline catheter for adults should be defined as one that is between three and eight inches (7.5cm–20cm) in length (INS 2000; Dougherty et al 2004).

### Central venous access devices

- The use of ultrasound is recommended to locate and assist in central venous access device insertion (NICE 2002).
- Non-tunneled CVCs should ideally, particularly in high risk situations, be coated with antibactericidals/antimicrobials (Elliott 1999; Veenestra et al 1999; Mermel 2000; CDC 2002; Bassatti et al 2001; DH 2001; Sampath et al 2001; Pellowe et al 2004).
- The port or reservoir of an implanted venous access device should produce minimal computed tomography (CT) or magnetic resonance (MR) artifacts. Consideration should therefore be given to the placement of plastic ports (Camp Sorrell 1990; Mauro 1998).
- The implanted venous access device port or reservoir

should be of an appropriate size and type for the patient's needs.

### Arterial access devices

- Consideration should be given to the use of a designated arterial access device wherever possible.

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## 5.3 Hair removal

### Standard

Hair removal around the insertion site should be accomplished using scissors or clippers (Hart 1999; Dougherty et al 2004).

### Practice criteria

- Shaving with a razor should not be performed because of the potential for causing microabrasions, which increase the risk of infection (INS 2000; Weinstein 2001; Perucca 2001; Carlson et al 2001).
- Depilatories should not be used because of the potential for allergic reaction or irritation (Perucca 2001).
- Electric clippers should have disposable heads for single-patient use (INS 2000; Carlson et al 2001).

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## 5.4 Local anaesthesia

### Standard

An injectable or topical local anaesthetic drug should be used only upon the written order of a doctor or under a patient group direction (RCN 2001; Waters 2001).

When local anaesthesia is ordered or required, the agent that is the least invasive and/or carries least the risk for allergic reaction should be considered first (Carrie et al 1996; Wildsmith 1996; Moureau and Zonderman 2000).

### Practice criteria

- Protocol for the use of local anaesthesia should be

established in organisational policies and procedures.

- The nurse administering the local anaesthesia should have demonstrated competency and knowledge of the drug and method of administration used (Hood 1996; Fry and Anholt 2001).
- Use of injectable anaesthetic should be monitored because of the potential for allergic reaction, tissue damage and inadvertent injection of the drug into the vascular system (Wildsmith 1996).
- Other types of local anaesthesia, such as iontophoresis or topical transdermal agents, should be considered and used according to organisational policies and procedures and manufacturer's guidelines (Brown et al 1999; Kim et al 1999; Fetzer 2002; Galinkin et al 2002; Moureau and Zonderman 2002).
- The nurse should be able to implement emergency interventions in the event of an adverse reaction to the anaesthetic agent (Hood 1996).

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## 5.5 Insertion site preparation

### Standard

Prior to peripheral, midline, arterial, central and peripherally inserted central catheter placement insertion, the intended site should be cleansed with antimicrobial solution(s) using aseptic technique for between 30 seconds (peripheral) and two minutes (central). The recommended solution is chlorhexidine gluconate (Elliott et al 1994; ICNA 2000; DH 2001; CDC 2002; Pellowe et al 2004).

### Practice criteria

- Protocols for site preparation should be set out in organisational policies and procedures.
- Maximum barrier precautions including sterile gown, gloves, mask, protective eyewear, surgical scrub, and large sterile drapes and towels should be used for arterial, central and peripherally inserted central catheter insertions in order to minimise the risk of infection to the patient (Elliott et al 1994; Hart 1999; DH 2001).
- After initial site preparation, unless sponge holding forceps (or similar) have been used sterile gloves should be changed prior to midline, arterial, central, and peripherally inserted central catheter placement (Elliott 1994; INS 2000).
- Powder-free gloves should be used (sterile powder-free when inserting midline or any central vascular access device) (Dougherty et al 2004).
- Clipping should be performed to remove excess hair at intended vascular access site when necessary (Wilson 2001; Dougherty et al 2004).
- Antimicrobial solutions that should be used include chlorhexidine as single agents or in combination (Maki et al 1991; Carlson et al 2001; DH 2001; LSC 2002; CDC 2002).
- Antimicrobial solutions in a single-unit-use configuration should be used wherever possible (Mermel 2000; INS 2001).
- The antimicrobial preparation solution(s) should be allowed to air-dry completely before proceeding with the vascular access device insertion procedure (Dougherty et al 2004; DH 2001).

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## 5.6 Device placement

### Standard

All vascular access device placement should be for definitive therapeutic and/or diagnostic purposes (Hamilton 2000).

The vascular access device selected should be the smallest gauge that will accommodate the prescribed therapy (Sansivero 1998).

Aseptic technique must be used and universal precautions should be observed during vascular access device placement (INS 2000; DH 2001; Wilson 2001; CDC 2002).

Only one vascular access device should be used for each cannulation attempt (INS 2000; MDA 2000).

The distal tip of a central venous access device should dwell in the lower third of the superior vena cava or right atrium; and catheter tip location should be determined radiographically and documented in the patient's medical record prior to initiation of the prescribed therapy (Gabriel 1999; Wise et al 2000).

The placement of peripheral cannulae, midline and PICCs is usually thought of as a nursing procedure in most hospitals.

The placement of tunnelled catheters and implantable port is usually thought of as a medical procedure in most hospitals but is a developing area of nursing practice (Hamilton et al

1995; Benton and Marsden 2002). However the placement of non tunnelled central catheters is increasingly becoming a nursing procedure.

### Practice criteria

- Protocols for the placement of vascular access devices should be set out in organisational policies and procedures.
- The nurse placing any vascular access device should have a comprehensive understanding of anatomy and physiology, vascular assessment techniques, and insertion techniques appropriate to the specific device (Sansivero 1998; Hamilton 2000).
- The nurse should inspect the vascular access device for product integrity prior to insertion (Dougherty 1999).
- Caution should be employed when stylets, needles, and/or wires are used to facilitate vascular access device placement (Hart 1999).
- Stylets that are part of the catheter product should never be reinserted due to the risk of severing and/or puncturing the catheter (INS 2000; Perdue 2001).
- The nurse's role in assisting the clinician or healthcare professional with central vascular access device placement should be set out in organisational policies and procedures.
- The manufacturer's guidelines for product use should be followed in the preparation and placement of vascular access devices, including modifications made to the catheter tip (Hamilton 2000).
- Peripheral and central vascular access device placement, including gauge and length, product name, batch and lot number, number of attempts, anatomical location, and patient's response to the placement, should be documented in the patient's nursing and medical notes (INS 2000).
- Radiological confirmation of the tip location should be obtained in the following clinical situations: prior to use of the central vascular access device; difficulty with catheter advancement; pain or discomfort after catheter advancement; inability to obtain positive aspiration of blood; inability to flush the catheter easily; difficulty in removing guidewire or guidewire bent on removal (INS 2000; Wise et al 2001).

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## 5.7 Device stabilisation

### Standard

Catheters should be stabilised in a manner that does not interfere with assessment and monitoring of the access site or impede delivery of the prescribed therapy.

Catheter stabilisation should be performed using aseptic technique (DH 2001; Maki 2002).

Site protection material should allow visual inspection of the site, and should be placed so as not to impede circulation or impede infusion through the access device (Dougherty 1999; DH 2001).

Removal of site protection material should be done at established intervals to allow visual inspection of the access site and monitoring of skin integrity and minimise the potential for infection (Dougherty et al 2004).

### Practice criteria

- Protocols for stabilisation of the catheter should be set out in organisational policies and procedures.
- When a catheter securement device is used for stabilisation, placement should be in accordance with manufacturer's guidelines.
- Products employed to stabilise the catheter include sterile

tapes, transparent semipermeable membrane (TSM) dressing, sutures, manufactured catheter securement devices, and sterile surgical strips (Hanchett 1999; Sheppard et al 1999; INS 2000; Gabriel 2001).

- When sterile tape is used, it should be applied only to the catheter adapter and should not be applied directly to the catheter-skin junction site (INS 2000).
- When using a TSM dressing for stabilisation, the manufacturer's guidelines for use should be followed and only sterile tapes should be used beneath the dressing, if required (INS 2000).
- Sutures should not be routinely used for stabilisation of midlines, PICCs or non-tunnelled central vascular access devices due to their potential for contributing to the risk of infection (CDC 2002; Maki 2002).
- A catheter that has migrated externally should not be readvanced prior to restabilisation.
- Sutures used for tunnelled central catheter stabilisation may need to be replaced if they become loose or are no longer intact before the dacron cuff in the subcutaneous tunnel has fibrosed with surrounding tissue, which takes approximately 21 days (INS 2000; Dougherty et al 2004).

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## 5.8 Dressings

### Standard

A sterile dressing must be applied and maintained on vascular and non-vascular access devices for example subcutaneous

infusions.

All dressings must be changed at established intervals and immediately if the integrity of the dressing is compromised (DH 2001; CDC 2002).

The insertion site must be assessed at the minimum, on a daily basis at least for the potential development of infusion-related complications (Hart 1999).

### Practice criteria

- Protocols for the use of gauze and/or transparent semi-permeable membrane (TSM) dressings should be set out in organisational policies and procedures (Lau 1996).
- The integrity of gauze dressing edges should be maintained with an occlusive material (Gabriel 1999; INS 2000).
- All central vascular access device dressings should be changed between 24 and 48 hours after insertion or if their integrity is compromised and then thereafter as below (Ryder 2001; LSC 2002).
- Gauze dressings should be changed routinely every 24–48 hours on peripheral and central catheter sites and immediately if the integrity of the dressing is compromised (DH 2001; NICE 2003).
- Gauze used in conjunction with a TSM dressing should be treated as a gauze dressing and changed every 48 hours (INS 2000).
- A TSM dressing on the peripheral vascular access device should be changed at the time of catheter site rotation and immediately if the integrity of the dressing is compromised (DH 2001; CDC 2002).
- If a non-coring needle is to be left in an implanted port, a stable TSM dressing should be used to cover the port site (INS 2000).
- For central venous access devices, the optimal time interval for changing TSM dressings will depend on the dressing material, age and condition of the patient, infection rate reported by the organisation, environmental conditions and manufacturer's guidelines, but they should not remain in place longer than seven days and should be changed if the integrity of the dressing is compromised (Elliott and Tebbs 1998; Todd 1998; Gabriel 1999; Hart 1999; Carlson et al 2001; Wilson 2001; CDC 2002; NICE 2003).
- The insertion site should be visually inspected and palpated for tenderness daily through the intact dressing (Hart 1999).
- In the event of tenderness at the site, fever without obvious source, symptoms of local or systemic infection, or the presence of exudate, the dressing should be removed and the site inspected directly (DH 2001).
- Documentation in the patient's nursing notes should reflect routine assessment and describe the condition of the insertion site.

- Patient education regarding dressing care and maintenance should be documented in the patient's nursing notes.

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## 6

## Site care and maintenance

### 6.1 Site care

#### Standard

Vascular access device site care must be performed using aseptic technique and observing universal precautions and should coincide with dressing changes (Elliott and Tebbs 1998; Wilson 2001; CDC 2002; NICE 2003; Dougherty et al 2004).

Vascular access device site care should allow for the observation and evaluation of the catheter-skin junction and surrounding tissue.

#### Practice criteria

- Protocols for vascular access device site care should be set out in organisational policies and procedures.
- Vascular access device site care should consist of aseptic cleansing of the catheter-skin junction with an appropriate anti-microbial solution and application of a sterile dressing (Wilson 2001).
- Anti-microbial solutions should be used in accordance with manufacturer's guidelines.
- Anti-microbial solutions that should be used for site care are chlorhexidine, as a single agent or in combination with alcohol or aqueous solution (Pellowe et al 2004). Where alcohol is used, check manufacturer's recommendations for any potential damage to catheter material.
- The use of sterile gloves should be employed with all insertion site care for central venous access devices (Maki et al 1991; DH 2001; CDC 2002).
- Documentation of catheter site care should reflect the condition of the catheter site; specific nursing actions should be taken to resolve or prevent adverse reactions and interventions should be documented in the patient's medical record.
- When ports are accessed the non-coring needle should be changed every seven days (INS 2000; Goodman 2000).

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### 6.2 Maintaining patency

#### a) Standard

The patency of the catheter will be checked prior to administration of medications and/or solutions. However, there is no requirement to routinely withdraw blood and discard it prior to flushing (except prior to blood sampling although the first sample can be used for blood cultures).

#### Practice criteria

#### Checking for blood return

- The nurse should aspirate the catheter and check blood return to confirm patency prior to administration of medications and/or solutions (INS 2000).
- If resistance is met and absence of blood return is noted, the nurse should take further steps to assess patency of the catheter prior to administration of medications and/or solutions (INS 2000).
- Follow the relevant algorithm for checking blood return from a central venous access device (see Appendix 5).

#### Withdrawal prior to flushing

- There is an increased risk of infection and occlusion when withdrawing blood via a central venous catheter (Gabriel et al 2005).
- If blood is withdrawn prior to flushing, then the same procedure should be carried out for both inpatients and outpatients. This could cause anxiety in patients at home if they were unable to withdraw blood.
- It has been shown that small clots may be present in the lumens of open-ended tunnelled catheters. However, the consequences of flushing these clots into the circulatory system are unknown (Anderson Johnston et al 1987).
- There is no other scientific evidence to support

withdrawal in adults.

- Risk-benefit analysis suggests more disadvantages than advantages.
- Expert opinion supports this standard (See appendix 9.1).

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## b) Standard Flushing solutions and frequency

The catheter will be flushed at established intervals to promote and maintain patency and to prevent the mixing of incompatible medications and/or solutions.

### Practice criteria

- A meta-analysis of randomised controlled trials focused on central venous catheters concluded that heparin significantly reduced bacterial colonisation and showed a strong but non-significant trend towards reduction of catheter-related bacteraemia (DH 2001; Pellowe et al 2004).
- A nurse should routinely flush indwelling peripheral with sodium chloride 0.9% and central venous catheters with an anticoagulant when the device is not in regular use, unless advised otherwise by the manufacturer (DH 2001).
- It is usually recommended that pressure-activated valved catheters and some positive pressure flush devices are flushed with 0.9 per cent sodium chloride (Dawn Camp 1998; INS 2000).
- The volume of the flush solution should be equal to at least twice the volume of the catheter and add-on devices – usually 5–10 ml.
- The concentration of heparin should be the lowest possible that will maintain patency – usually 10iu Heparin in 1 ml 0.9% sodium chloride
- Frequency of flushing should be daily for peripheral devices, 8 hourly for short term central venous catheters and weekly for long term central venous access devices unless occlusive problems indicate otherwise (Kelly et al 1992; Dougherty 2004).
- Flushing with 0.9 per cent sodium chloride solution to ensure and maintain patency should be performed before, between and after the administration of incompatible medications and/or solutions (INS 2000; NICE 2003).

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## c) Standard Flushing techniques

The patency of the catheter will be maintained using the correct techniques.

### Practice criteria

- The nurse will flush using a pulsated push-pause and positive pressure method.
- The pulsated flush creates turbulence within the catheter lumen, removing debris from the internal catheter wall (Goodwin and Carlson 1993; Todd 1998; Gabriel et al 2005).
- Positive pressure with the lumen of the catheter should be maintained to prevent reflux of blood (INS 2000) using the correct technique or specially designed injection sites 'positive pressure or positive displacement caps' (Berger 2000; Lenhart 2000; Mayo 2001; Rummel et al 2001; Gabriel et al 2005).

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## 6.3 Catheter clearance

### Standard

The nurse should ascertain the cause of the occlusion – either thrombotic or non- thrombotic (Dougherty et al 2004).

The nurse should understand the predisposing factors and preventative strategies (Kryzdwa 1999).

#### 6.3.1 Thrombotic occlusions

Thrombolytic agents specifically indicated for dissolving clots should be administered and must be prescribed or administered under patient group direction.

The instilled volume of thrombolytic agents should not exceed the volume capacity of the catheter.

#### 6.3.2 Non-thrombotic occlusions

Agents specifically indicated for dissolving medication and/or solution precipitate should be administered and must be prescribed or administered under patient group direction.

The instilled volume of precipitate clearance agents should not exceed the volume capacity of the catheter.

### Practice criteria

- Protocols for the use and contraindications of thrombolytic agents and precipitate clearance agents to restore catheter patency should be set out in organisational policies and procedures.
- Thrombolytic agents specifically indicated for catheter clearance should be administered (Haire 2000; Ponec et al 2001; Deitcher et al 2002; Timoney et al 2002).
- Only precipitate clearance agents specifically indicated for catheter clearance should be administered (Kupensky 1995).
- Use of these agents should adhere to manufacturer's guidelines.
- The healthcare professional using a thrombolytic agent or precipitate clearance agents should have knowledge of dosage, contraindications, side-effects and mechanism of instillation (Bagnell Reeb 1998; NMC 2002).
- The nurse's responsibilities should include assessment for appropriateness of use, documentation of outcome, and continued surveillance of the patient (Lenhart 2000).
- Instillation, aspiration, and flushing of vascular access devices should be performed using a method that is within the catheter manufacturer's maximum pressure limits in pounds per square inch (PSI).
- The syringe size used for this procedure should be in accordance with the catheter manufacturer's guidelines, as excessive pressure may cause complications such as catheter separation and/or rupture, resulting in loss of

catheter integrity. It is recommended that a syringe smaller than 10 ml is not used (Conn 1993).

- Should the procedure using these thrombolytic agents or precipitate clearance agents not restore catheter patency, the doctor should be notified.
- Other methods such as endoluminal brushes could be considered (Archis 2000).
- The procedure should be documented in the patient's medical and nursing notes.

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## 6.4 Catheter removal

### Standard

The removal of cannulas, midline catheters, PICCs, or non-tunnelled CVCs must only be undertaken by an appropriately trained practitioner.

The removal of tunnelled catheters or implantable ports is



usually performed by a doctor but may be undertaken by authorised and appropriately trained nursing staff (Drewett 2000b; Dougherty et al 2004).

### General practice criteria

- A vascular access device may be removed by the nurse in accordance with established organisational policies and procedures, provided that they have the appropriate experience, knowledge and skills (Dougherty et al 2004).
- If a catheter-related complication is suspected, the catheter should be considered for removal immediately (Drewett 2000a).
- If a catheter-related infection is suspected, consideration should be given to culturing the catheter by sending the tip for culture and antimicrobial sensitivity.
- If a vesicant medication has extravasated, treatment should be determined prior to device removal.
- A catheter should never be readvanced following completion of initial placement.
- The nurse should be responsible for care and monitoring of the site, implementing interventions as necessary and documenting observations and actions in the patient's nursing and medical notes.
- The integrity of the catheter should be ascertained upon removal, nursing interventions should be implemented as necessary, and observations and actions should be documented in the patient's medical and nursing notes (INS 2000; Drewett 2000a).
- A catheter defect should be reported to the organisation's risk management department, the manufacturer, and the MHRA and NPSA.

### Peripheral devices

- A peripheral cannula should be removed every 72–96 hours, depending on cannula type and type of therapy, or sooner, if complications are suspected (Bregenzer 1998; Holmer and Holmes 1998; Carlson 2001; Catney et al 2001; Frey 2001; CDC 2002).
- A peripheral cannula inserted in an emergency situation where aseptic technique has been compromised should be replaced within 24 hours.
- The optimal dwell time for removal of midline catheters is unknown; ongoing and frequent monitoring of the access site should be performed (CDC 2002).
- A midline catheter should be removed if the tip location is no longer appropriate for the prescribed therapy.
- After midline catheter removal, the dressing should be changed and where possible the access site assessed every 24 hours until the site has healed.

### Central vascular access devices

- The optimal dwell time for removal of peripherally inserted central catheters, tunnelled catheters or implanted ports is unknown; ongoing and frequent

monitoring of the access site should be performed (Drewett 2000a; INS 2000).

- After central vascular access device removal, the dressing should be changed and where possible the access site assessed every 24 hours until the site has epithelised (Weinstein 2001).
- Radiographic confirmation should be obtained prior to initiation of therapy and intermittently to confirm catheter tip location in the superior vena cava or right atrium. If the catheter is located outside the superior vena cava, the catheter is no longer considered a central catheter and should be removed, as the tip location may no longer be appropriate for the prescribed therapy (Wise et al 2001).
- Caution should be used in the removal of central venous catheters, including precautions to prevent air embolism. Digital pressure should be applied until haemostasis is achieved, then a sterile occlusive dressing should be applied to the access site upon catheter removal and should remain in situ for 72 hours. Air embolism has been shown to occur up to 72 hours after catheter removal (Gabriel 1999; Scales 1999; Drewett 2000a; Drewett 2000b; Dougherty et al 2004).
- If resistance is encountered when the catheter is being removed, the catheter should not be removed and the doctor be notified immediately and/or local policies followed (Marx 1995).
- Protocols for post-removal site assessment should be set out in organisational policies and procedures.
- After implanted venous access device removal, the wound should be kept dry for five to seven days and the wound monitored until healed (Perrucca 2001).

### Arterial catheters

- An arterial catheter inserted in an emergency situation where aseptic technique has been compromised should be replaced within 24 hours wherever possible (CDC 2002).
- When a peripheral arterial catheter is removed, digital pressure should be applied until haemostasis is achieved (5 to 15 minutes), then a dry, sterile, pressure dressing should be applied to the access site (Ciano 2001).
- After the removal of the arterial catheter the peripheral circulatory status distal to the access site should be assessed and documented in the patient's records (Ciano 2001).

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## 6.5 Catheter dislodgment

### Standard

External catheters should be secured appropriately to prevent catheter dislodgment.

If catheter dislodgment is suspected the catheter should not be used for the administration of medication, solutions or chemotherapy until the catheter tip position has been confirmed.

### Practice criteria

- Protocols for securing external catheters should be set out in organisational policies and procedures.
- When a catheter securement device is used for stabilisation, placement should be in accordance with manufacturer's guidelines.
- Products employed to stabilise the catheter should include: sterile tapes, transparent semi-permeable membrane dressings, sutures, manufactured catheter securement devices and sterile surgical strips.
- When sterile tape is used, it should be applied only to the catheter adapter and should not be applied to the catheter-skin junction site.

- When using a transparent semi-permeable membrane dressing for stabilisation, the manufacturer's guidelines for use should be followed; only sterile tapes should be used beneath the dressing if required.
- If sutures are used for catheter stabilisation, placement of sutures should be set out in organisational policies and procedures and carried out in accordance with the manufacturer's guidelines and the NMC's *Code of professional conduct* (NMC 2004).
- If sutures become loose or are no longer intact, other measures should be implemented to prevent catheter migration or dislodgment.
- A catheter that has migrated externally should not be readvanced prior to reestablishment.
- External catheters should be secured with tape, sutures and an intact dressing (Hadaway, 1998).
- Use of tape and or transparent dressing, plastic shields or adhesive anchors (for example Statlock) will reduce the risk of catheter dislodgment (Hanchett, 1999).
- The patient and/or caregiver should be instructed in ways of avoiding catheter dislodgment (Hadaway, 1998).
- The practitioner caring for the patient with a central venous access device should be knowledgeable about the complications of catheter dislodgment. These include: occlusion, thrombosis, fibrin sheath, extravasation and vessel perforation if catheter tip is outside the superior vena cava (SVC) (Wise et al 2001).
- If the catheter tip is outside of the SVC the catheter should be repositioned, replaced or removed (Wise et al 2001).

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## 6.6 Catheter exchange

### Standard

Exchange should only be performed if there is no evidence of infection at catheter site or proven bloodstream infection (DH 2001; CDC 2002). Gloves should be changed after removing the old catheter and before touching the new catheter (CDC 2002).

Midline catheters, PICCs and non-tunnelled central catheters can be exchanged over a guidewire or through a peel-away sheath introducer.

Aseptic technique must be used and universal precautions should be observed during the exchange of the catheter following manufacturer's instructions.

Only one catheter should be used for each exchange attempt (MDA 2000).

### Practice criteria

- Protocols for exchanging midlines, PICCs and non-tunnelled central vascular access devices should be set out in organisational policies and procedures.
- The nurse undertaking the exchange of a catheter should have a comprehensive understanding of the technique involved for the particular device (INS 2000).
- The nurse should inspect the catheter for product integrity prior to placement.
- The manufacturer's guidelines for product use should be considered in the preparation and placement of the device.
- The integrity of the catheter should be ascertained immediately following retrieval. Nursing interventions should be implemented as necessary and observations and actions documented in the patient's notes.
- Any defect in the retrieved catheter should be reported to the organisation's risk management department and the manufacturer as well as the MHRA and NPSA (MDA 2005/01).
- A record of the procedure should be recorded in the patient's medical and nursing notes.

### References

1. CDC 2002 'Guidelines for the prevention of intravascular catheter related infections', Morbidity and Mortality weekly report, 51 (RR-10), S35 – S63 (I)
2. DH, 2001. 'Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters'. In *Journal of hospital infection*, 47 (supplement), S47–S67. (II)
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5. MDA 2000 Single use medical devices: Implications and consequences of reuse DB 2000 (04) (III)
6. Timsit, JE, 2000. Scheduled replacement of central venous catheters is not necessary. In *Infection control and hospital epidemiology*, 21, (6), 371–374. (III)

## 6.7 Catheter repair

### Standard

When the external portion of a vascular access device is damaged, the device must be repaired according to the manufacturer's guidelines, using aseptic technique and observing universal precautions (Reed and Philips 1996; Gabriel 1999).

### Practice criteria

- Vascular access devices that can be repaired include midline catheters, PICCs and tunnelled central catheters (Reed and Philips 1996; Gabriel 1999).
- All catheter repairs must be performed by a registered nurse or practitioner who is educated and competent to perform the procedure (Reed and Philips 1996; INS 2000).
- Assessment of the patient's risk/benefit ratio should be performed before repairing the device (Reed and Philips 1996; INS 2000).
- Access device repair should be documented in the patient's medical and nursing notes (Reed and Philips 1996; INS 2000).
- An incident form should be completed and any defective devices should be reported to risk management, the manufacturer and the MDA.

### References

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2. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
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## 7

## Specific devices

### 7.1 Intrapleural catheters

#### Standard

The insertion of an intrapleural catheter is a medical procedure.

Administration of medicines through an intrapleural catheter will be in accordance with a valid prescription and following local training to include recognition of side effects that could occur if the catheter migrates from the pleural space.

Removal of an intrapleural catheter will be performed in agreement with the doctor managing the patient's care and is usually a nursing procedure.

#### Practice criteria

- The optimal dwell time for an intrapleural catheter is unknown; ongoing and frequent monitoring of the access site should be performed.
- An intrapleural catheter may be removed by a nurse in accordance with established organisational policies and procedures.
- Caution should be used in the removal of an intrapleural catheter to prevent pneumothorax, digital pressure should be applied until haemostasis is achieved and a sterile occlusive dressing should be applied to the access site upon catheter removal.
- If resistance is encountered when the catheter is being removed, the catheter should not be removed and the doctor responsible for the patient's care should be notified.

#### References

1. Clarke, K, 1999. 'Effective pain relief with intrapleural analgesia'. In *Nursing Times*, 95, (12), 49–50. (III)
2. Hyde, L, 2004. 'Cytotoxic drugs: handling and administration'. In Dougherty, L & Lister S (eds). *The Royal Marsden Hospital Manual of clinical nursing procedures*. 6th ed. Oxford: Blackwell Publishing, Chapter 44. (III)
3. Miniero, E, Sacco, R, Grande, L, D'Angelo, P, Cavallini, G and Mucilli F, 1998. 'Control of post-operative pain with intrapleural analgesia' [Italian]. In *(Minerva) Chirurgica*, 53, (7–8), 631–4. (I)
4. Mehta, Y, Swaminathan, M, Mishra, Y and Trehan, N, 1998. 'A comparative evaluation of intrapleural and thoracic epidural analgesia for post-operative pain relief after minimally invasive direct coronary artery bypass surgery' [Comment]. In *Journal of cardiothoracic and vascular anaesthesia*, 12, (2), 162–5. (I)

### 7.2 Arteriovenous fistulae, shunts and haemodialysis catheters

#### Standard

The construction or removal of an arteriovenous (AV) fistula or shunt is considered to be medical procedure.

The insertion of a haemodialysis catheter is usually a medical procedure in most hospitals but is a developing area of nursing practice.

Administration of medicines and/or solutions through an AV fistula, shunt or haemodialysis catheter will be in accordance with a valid prescription or patient group direction.

Removal of a haemodialysis catheter will be performed in agreement with the doctor managing the patient's care and is a nursing procedure.

#### Practice criteria

- The nurse should be educated and competent, according to organisational policies and procedures, to care for and maintain an AV fistula, shunt or haemodialysis catheter.
- AV fistulae, shunts and haemodialysis catheters should not be used for routine administration of parenteral medication and/or solutions (INS 2000).
- Aseptic technique should be used for all procedures relating to haemodialysis access devices.
- To minimise the potential for catheter-related complications, consideration should be given to the gauge and length of the haemodialysis catheter.
- When removing the guidewire from the catheter, or removing the needle from the fistula, techniques should be employed to reduce the potential for bleeding and to promote haemostasis.
- Haemodynamic monitoring and venepuncture should not be performed on the extremity containing an AV fistula except in an emergency and where there is no alternative.
- Protocols for the removal of haemodialysis catheters should be set out in organisational policies and procedures and should be in accordance with manufacturer's guidelines.
- The optimal dwell time for the removal of a non tunnelled haemodialysis catheter is unknown; ongoing and frequent monitoring of the access site should be performed. Depending on the type of catheter, and the clinical risk factors it will usually be removed at seven days. If it is not, it should be assessed every 24 hours thereafter until it is removed.
- The haemodialysis catheter will be removed immediately

when contamination or complication is suspected or when therapy is discontinued.

- Radiographic confirmation should be obtained prior to the initiation of therapy.
- Caution should be used in the removal of a haemodialysis catheter, including precautions to prevent air embolism; digital pressure should be applied until haemostasis is achieved; then a dry, sterile, occlusive dressing should be applied to the access site.
- The occlusive dressing should remain in situ for 72 hours to prevent delayed air embolism. The dressing should be assessed regularly during this time to ensure that it remains intact and effective.

## References

1. Bonomo, RA et al, 1997. 'Risk factors associated with permanent access site infection in chronic hemodialysis patients'. In *Infect. Control Hosp. Epidemiol.*, 18, 757–61. (III)
2. Garofalo, RS et al, 1999. 'Exchange of poorly functioning tunneled permanent haemodialysis catheters'. In *Am J Roentgenol*, 173, 155–8. (III)
3. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
4. Kalman, PG et al, 1999. 'A practical approach to vascular access in haemodialysis: aged vs adult patients'. In *Journal of vascular surgery*, 30, 727–33. (III)
5. Sands, J and Miranda, CL, 1997. 'Increasing numbers of AV fistulas for haemodialysis access'. In *Clin. Nephrol.*, 48, (2), 114–7. (III)

## 7.3 Cutdown surgical site

### Standard

Insertion of a vascular catheter via a cutdown surgical site should be performed by a clinician or healthcare professional with the appropriate skills and should not be used routinely (CDC 2002).

### Practice criteria

- Protocols regarding cutdown surgical sites, including catheter removal, should be set out in organisational policies and procedures.
- Aseptic technique should be used and universal precautions should be observed when caring for a patient with a cutdown surgical site.
- Consideration should be given to the establishment of alternative vascular access prior to the removal of a cutdown access device.

## References

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2. Drewett, SR, 2000a. 'Complications of central venous catheters: nursing care'. In *British journal of nursing*, 9, (8), 466–478. (III)
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and Dougherty, L (eds). *Manual of clinical nursing procedures*. 5th ed. Oxford: Blackwell Science, Chapter 44. (III)

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7. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
8. Kim, DK, Gottesman, MH and Forero, A, 1998. 'The CVC removal distress syndrome: an unappreciated complication of central venous catheter removal'. In *Am. Surg.*, 64, 344–347. (III)

## 7.4 Intraosseous access

### Standard

Intraosseous access should be obtained for emergency or short-term treatment when access by the vascular route cannot be achieved and the patient's condition is considered life threatening (infants and children) (American Heart Association 2000; INS 2000).

Intraosseous access should be initiated upon the order of a trained practitioner with the experience, knowledge and skills to undertake this procedure in accordance with profession specific regulations.

Aseptic technique should be used and universal precautions should be observed for intraosseous access (INS 2000).

### Practice criteria

- Indications and protocols for use of intraosseous access should be set out in organisational policies and procedures (INS 2000).
- The nurse caring for a patient with an intraosseous access device should have knowledge of the principles involved in paediatric fluid resuscitation; anatomy and physiology of the intraosseous route; potential complications; and patient/family education; the nurse should be educated and competent in intraosseous access (INS 2000).
- The nurse's responsibilities should include site assessment, care, and maintenance; discontinuation of access; and documentation (INS 2000).
- Intraosseous access device placement is a temporary, emergency procedure, and the device should be removed within 24 hours (West 1998; INS 2000).
- Intraosseous ports (implanted intraosseous port that is, Osteoport, a 1 inch titanium or stainless steel needle with a self-sealing cap that can be implanted in a large bone of the hip or leg) should be removed within 30 days of insertion or immediately if complications develop (Weinstein, 2001).
- Conventional vascular access should be established as soon as the patient's condition has stabilised (Smith

- 1998).
- Intraosseous access should not be attempted on sites where intraosseous access has been previously attempted, on a fractured or traumatised leg, on areas of infected burns or cellulitis, or on patients with osteoporosis, osteopetrosis or osteogenesis imperfecta (Manley 1989).
  - Intraosseous access is recommended for the administration of medications in children with no acceptable vascular access *in situ* before arrest. The use of the intraosseous route extends to children of all ages (European Resuscitation Council 2000).
  - The preferred site for paediatric intraosseous access should be the anterior tibial bone marrow. Alternative sites include the distal femur, medial malleolus, or anterior superior iliac spine (American Heart Association and International Liaison Committee on Resuscitation 2000).
  - The growth plate in children's bones should be avoided (Manley 1989).
  - If the intraosseous access method is indicated in adults, the preferred sites should be the iliac crest or sternum (INS 2000). Use of the sternum may be associated with complications and may be impractical for patients receiving cardiopulmonary resuscitation or with significant chest trauma (Lavis 1999).
  - Access devices used to obtain 24-hour intraosseous access should include a rigid needle specifically designed for intraosseous access, a Jamshidi-type bone marrow needle or a butterfly needle (American Heart Association and International Liaison Committee on Resuscitation 2000).
  - Consideration should be given to the use of an access device with a short shaft to avoid accidental dislodgment (INS 2000).
  - Consideration should be given to the use of commercially prepared, disposable access equipment specifically designed for intraosseous infusions (INS 2000).
  - Prior to infusion, access device placement should be confirmed by aspiration of bone marrow followed immediately by a flush of preservative-free 0.9% sodium chloride solution (injectable) using a separate syringe (Smith 1998; INS 2000).
  - The intraosseous access device should be secured to prevent migration and extravasation into the subcutaneous tissues (Smith 1998; West 1998).
  - Fluid administered for rapid volume resuscitation may require the use of an infusion pump or forceful manual pressure (American Heart Association and International Liaison Committee on Resuscitation 2000).

## References

1. American Heart Association and International Liaison Committee on Resuscitation, 2000. 'Paediatric advanced life support'. In *Resuscitation*, 46, 343–399. (III)
2. European Resuscitation Council (ERC), 2000. 'European Resuscitation Council guidelines 2000 for advanced paediatric life support'. In *Resuscitation*, 48, 231–324. (III)
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9. West, AL, 1998. 'Alternate routes of administration'. In *Journal of intravenous nursing*, 21, (4), 221–231. (III)

## 7.5 Subcutaneous injection/infusion

### Standard

The nurse must assess the patient for appropriateness and duration of the prescribed therapy (Hypodermoclysis Working Group 1998).

Drug dose, volume, concentration, and rate should be appropriate with regard to the integrity and condition of the patient's subcutaneous tissue (Hypodermoclysis Working Group 1998).

### Practice criteria

- Specific criteria should be set out in organisational policies and procedures for access site management, prescribed medication, rate of administration, availability of sites, required therapy, diagnosis, anticipated length of therapy and maintenance of the integrity of the subcutaneous tissue (Hypodermoclysis Working Group 1998).
- Specific indications, appropriateness, and assessment criteria for subcutaneous infusion by hypodermoclysis should be defined by organisational policies and procedures (Hypodermoclysis Working Group 1998).
- The nurse should be educated and competent in the use of medications, solutions and subcutaneous administration procedures (Hypodermoclysis Working Group 1998).
- Consideration should be given to the use of an electronic device, for example, a syringe drive, when administering medications via the subcutaneous infusion route (Lister 2000).
- A standard administration set (20 drops per ml) should be used for the administration of fluids and solutions

(hypodermoclysis) which should be gravity fed, not pumped (Hypodermoclysis Working Group 1998).

- The selected access site should have intact skin and be located away from bony prominences, areas of infection, the patient's waistline, previously irradiated skin, sites near a joint and lymphoedematous limbs (Hypodermoclysis Working Group 1998; Lister 2004).
- The access site should be prepared using aseptic technique and observing universal precautions (Lister 2004).
- A sterile transparent occlusive dressing should be used to cover the administration site (Hypodermoclysis Working Group 1998).
- To reduce the risk of complications, the subcutaneous access site should be observed regularly, rotated a minimum of every three days or if the patient complains of pain at the administration site, the skin is red and/or inflamed, the skin is white and/or hard, or blood is present in the administration set, plastic cannula or winged infusion device (Hypodermoclysis Working Group 1998; INS 2000; Lister 2004).
- The device selected should be of the smallest gauge and shortest length necessary to establish subcutaneous access (Hypodermoclysis Working Group 1998).
- Consideration should be given to the use of additives that enhance absorption and diffusion of the medication or solution (Hypodermoclysis Working Group 1998).
- The medication or solution should be as near to isotonic as possible (Hypodermoclysis Working Group 1998).
- Documentation in the patient's medical and nursing notes should include evaluation of the need for subcutaneous infusion, patient response to therapy, and the established intervals of monitoring the infusion site (Hypodermoclysis Working Group 1998).

## References

1. Hypodermoclysis Working Group, 1998. Hypodermoclysis: guidelines on the Technique. Wrexham: CP Pharmaceuticals. (III)
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## 7.6 Intraventricular access device: the Ommaya reservoir

### Standard

Drugs for administration via an intraventricular access device (an Ommaya reservoir) should be prepared and administered using aseptic technique and universal precautions. Protective clothing should be used when preparing intraventricular

chemotherapy.

The practitioner administering intraventricular therapy should be knowledgeable about the indications for intraventricular therapy, the side-effects of drugs administered via this route, and the complications of use of an intraventricular access device.

Measures should be taken to minimise the risk of complications of use of an intraventricular access device.

Chemotherapy administered using an Ommaya reservoir must be administered in accordance with the updated *National guidance on the safe administration of intrathecal chemotherapy* as this includes drugs delivered by lumbar puncture and other routes, for example Ommaya reservoirs (DH, 2003).

Aseptic technique and universal precautions should be used when accessing an intraventricular access device.

### Practice criteria

- All NHS trusts where chemotherapy is administered via an Ommaya reservoir must ensure full implementation of and adherence to the updated *National guidance on the safe administration of intrathecal chemotherapy* (DH 2003).
- Protocols for the administration of drugs via an intraventricular access device should be established in organisational policies and procedures (INS 2000).
- Aseptic technique should be used when administering drugs via an intraventricular access device.
- Drugs to be administered via an intraventricular access device must be prepared using aseptic technique and be free of preservatives (INS 2000).
- Alcohol should not be used for site preparation as it is neurotoxic (West 1998; INS 2000).
- Correct placement of the intraventricular access device should be confirmed prior to use. Consider the use of a postoperative Computerised tomography (CT) scan before the administration of intraventricular chemotherapy (Sandberg et al 2000).
- Confirm placement of the reservoir by slightly depressing the dome several times. There should be free flow of Cerebral spinal fluid (CSF) from the ventricle into the dome. If the patient exhibits abnormal neurologic signs the reservoir should not be used (West 1998).
- A small non-coring needle or 25-gauge scalp vein needle should be used to access the reservoir (West 1998).
- A small amount of CSF equal to the amount of drug/solution to be instilled should be removed prior to the administration of the drug/solution via the intraventricular access device. The drug/solution should be administered slowly. No resistance should be felt during the administration. To facilitate dispersal of the

drug/solution within the CSF the dome should be compressed and released. Do not flush or heparinise the intraventricular access device. This is not required as CSF flows freely through the device (West 1998).

- Complications of use of an intraventricular access device such as infection, intraventricular catheter malposition, leukoencephalopathy, malfunction, intracerebral haematoma, leakage and skin erosion should be documented and reported to the doctor (Karavelis et al 1996; Chamberlain et al 1998; Sandberg et al 2000).
- The nurse caring for the patient should monitor the patient for side-effects of the drugs.
- The patient or caregiver should be taught how to access and maintain the device if appropriate (West 1998; Kosier and Minkler 1999).

## References

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2. Department of Health, 2003. Updated National guidance on the safe administration of intrathecal chemotherapy. HSC 2003/010. London: DH. (III)
3. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
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## 8

# Infusion therapies

## 8.1 Medication and solution administration

### Standard

The administration of medications and solutions should be initiated upon the order of a doctor or an authorised nurse prescriber or as part of a patient group direction (depending on medication or solution) (NMC 2002).

Aseptic technique must be used and universal precautions must be observed in the administration of medications and solutions.

### Practice criteria

- A list of approved medications and solutions for each type of administration (continuous, intermittent or bolus) should be set out in organisational policies and procedures.
- The nurse should review the prescription for appropriateness for the patient's age and condition, access device, dose, route of administration and rate of administration, particularly related to the speed of the bolus injection (Taxis and Barber 2003; DH 2004).
- The nurse administering medications and solutions should have knowledge of indications for therapy, side-effects and potential adverse reaction, and appropriate interventions (Nicol 1999), particularly related to the management of anaphylaxis (DH 2004).
- Prior to administration of medications and solutions, the nurse should appropriately label all containers, vials and syringes; identify the patient; and verify contents, dose, rate, route, expiration date, and integrity of the solution (Schulman et al 1998; Nicol 1999; NMC 2002; Lister 2004).
- The nurse is accountable for evaluating and monitoring the effectiveness of prescribed therapy; documenting patient response, adverse events, and interventions; and achieving effective delivery of the prescribed therapy (NMC 2004).
- The nurse should report any adverse events to the MCA via yellow card system and as per organisational policies and procedures.
- After being added to an infusion bag, a medication or solution should be infused or discarded within 24 hours (BMA and RPS 2005).

### References

1. BMA and RPS 2005 British National Formulary. London
2. DH 2004 Building a safer NHS for patients – improving medication

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5. NMC, 2002. Guidelines for the administration of medicines. London. (III)
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8. Taxis, K and Barber, N, 2003. 'Ethnographic study incidence and severity of intravenous drug errors'. In British medical journal, 326, 684–7. (II)

## 8.2 Intrathecal chemotherapy administration

### Standard

Intrathecal chemotherapy must be administered in accordance with the updated *National guidance on the safe administration of intrathecal chemotherapy* (DH 2003).

Aseptic technique, universal precautions and protective clothing shall be used when preparing and administering intrathecal chemotherapy.

### Practice criteria

- All NHS Trusts where intrathecal chemotherapy is administered must ensure full implementation of and adherence to the updated *National guidance on the safe administration of intrathecal chemotherapy* (DH 2003).
- Protocols for the administration of intrathecal chemotherapy should be established in organisational policies and procedures.
- Aseptic technique should be used when administering intrathecal chemotherapy.
- Drugs to be administered intrathecally must be prepared using aseptic technique and be free of preservatives (Hyde 2004).
- Alcohol should not be used for site preparation, as it is neurotoxic (West 1998; INS 2000).
- The patient should be assessed for response to therapy at regular intervals, and findings should be documented in the patient record.
- Complications such as infection, haemorrhage, localised bruising, headache, backache, leakage from the site and arachnoiditis should be documented and reported to the doctor (Hyde 2004).
- The nurse caring for the patient should monitor the

patient for side-effects of the drugs such as headache, nausea and vomiting, drowsiness, fever, stiff neck and meningitis, although this is rare (Hyde 2004).

## References

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2. Hyde LS 2004. 'Drug administration – cytotoxic drugs'. In The Royal Marsden Hospital manual of clinical nursing procedures. Edited Dougherty, L & Lister S 6th ed. Oxford: Blackwell publishing. (III)
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## 8.3 Oncology and chemotherapy

### Standard

Administration of cytotoxic agents should be initiated upon the prescription of an appropriately qualified clinician (DH 2000; DH 2004a & b).

The patient's informed consent should be obtained prior to the administration of these agents and should be documented in the patient's medical record.

The nurse managing cytotoxic agents should be required to have knowledge of and technical expertise in both administration and specific interventions associated with cytotoxic agents and have received education and training (RCN 1998; DH 2000; NHSE 2001; DH 2004b).

### Practice criteria

- Protocols for the administration of cytotoxic agents should be set out in organisational policies and procedures.
- The patient and/or caregiver should be informed of all aspects of chemotherapy including the physical and psychological effects, side-effects, risks, and benefits.
- Prior to administration of chemotherapeutic agents, laboratory data should be reviewed and the patient assessed for appropriateness of the prescribed therapy.
- The nurse administering chemotherapeutic agents should have knowledge of disease processes, drug classifications, pharmacological indications, actions, side-effects, adverse reactions, method of administration (that is, intravenous bolus or continuous infusion), rate of delivery, treatment goal (that is, palliative or curative), drug properties (that is, vesicant, non-vesicant or irritant), and specific drug calculations of dose and volume relative to age, height and weight, or body surface area (Perdue 2001).
- Vascular access device types should be selected based on

the prescribed therapy and patient condition.

- Electronic infusion devices should be considered for specific types of chemotherapeutic administration and for all continuous administrations.
- When administering a vesicant medication, where possible a new access site should be initiated prior to any peripheral vesicant administration (Weinstein 2001).
- Access device patency should be verified prior to the administration of each chemotherapeutic agent by aspirating the device for confirmation of positive blood return (LSC 2002).
- Extravasation protocols should be set out in organisational policies and procedures and implemented when a vesicant extravasates.
- When extravasation of a vesicant agent occurs, the extremity should not be used for subsequent vascular access device placement, and alternative interventions should be explored such as discontinuation of therapy, use of the other arm, or use of a central vascular access device.
- Organisational policies and procedures for the protection of personnel and the patient should be in accordance with the Control of Substances hazardous to Health (COSHH) guidelines.
- All chemotherapy should preferably be prepared in a pharmacy setting (COSHH 2002).
- The nurse handling and mixing chemotherapeutic agents should strictly adhere to protective protocols, such as mixing under vertical laminar flow hoods or biological safety cabinets and wearing protective clothing.
- Pregnant women or women planning a pregnancy should be advised of the potential risks associated with handling chemotherapeutic agents and given the opportunity to refrain from preparing or administering these agents.
- Handling of spilled products and equipment used for chemotherapeutic agents should be in keeping with the guidelines for hazardous waste materials (COSHH 2002).

### References

1. COSHH, 2002. Control of substances hazardous to health. London: Stationery Office. (III)
2. Hyde, L, 2004. Drug administration Cytotoxic drugs. The Royal Marsden Hospital manual of clinical nursing procedures. 6th ed. Oxford: Blackwell Publishing. (III)
3. DH 2000. Manual of cancer standards. (III)
4. DH 2004a Manual of Cancer Measures (III)
5. DH 2004b Building a safer NHS for patients – improving medication safety, Department of Health, London (III)
6. INS, 2000. Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson. (III)
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12. Weinstein, S, 2001. Plumer's principles and practices of intravenous therapy. Philadelphia: Lippincott Williams and Wilkins. (III)

## 8.4 Patient-controlled analgesia

### Standard

Patient controlled analgesia (PCA) should usually be initiated upon the order of a clinician.

The patient and/or caregiver should be educated in the use of PCA therapy and the patient's and/or caregiver's ability to comply with procedures should be evaluated prior to, and at regular intervals during, therapy.

Medications should be obtained, administered, discarded and documented in accordance with legal requirement for controlled substances.

### Practice criteria

- A protocol for the use of PCA should be established in organisational policies and procedures (Audit Commission 1997, INS 2000), together with a protocol for 'step-down' analgesia (NHS QIS 2004).
- The measurement of pain management outcomes should be defined in the organisational performance improvement programme (Audit Commission 1997).
- The patient should be involved in the decision-making process (NHS QIS 2004).
- Patient and/or caregiver information should be clear and understandable, and appropriate to the duration of therapy (short or long-term) and care setting (NHS QIS 2004). This information should include the purpose of the PCA therapy, operating instructions for the device, expected outcomes, precautions and potential side effects (NHS QIS 2004, Morton 1998, RCOA 2003), Stannard & Booth 1998).
- The appropriateness of therapy and patient's comprehension of the intended therapy should be assessed prior to initiation of therapy; whenever possible, patients should be offered the opportunity to self-manage pain by using PCA (Morton 1998, Smeltzer & Bare 2000, Wilkie et al 1995).
- Baseline data should be obtained prior to initiation of therapy and should include patient health status and pain history (Hawthorn & Redmond 1998, Stannard & Booth 1998).
- The practitioner must have knowledge of analgesic pharmacokinetics and equianalgesic dosing, contraindications, side effects, appropriate administration modalities and anticipated outcome, and should document this information in the patient's record (McQuay 1999, McQuay & Moore 1998, Portenoy & Lesage 1999, Taverner 2003).
- The practitioner should maintain continued surveillance of the patient and should document assessment and monitoring in the patient's record (Hawthorn & Redmond 1998).
- Nursing interventions should include evaluating the efficacy of therapy, assessing the need for changing treatment methods, monitoring for potential or actual side-effects and ongoing assessment of patient self-report of pain using a consistent pain scale (Hawthorn & Redmond 1998, JCAHO 2001, Schofield 1995, Stannard & Booth 1998, Turk & Okifuji 1999).
- A standard drug solution should be administered via a designated single device in order to reduce the risk of user error (NHS QIS 2004).
- In order to minimise the risk of adverse outcomes, validation by a second competent practitioner should be employed prior to administration of PCA and when the syringe, solution container, or rate is changed, - with special attention paid to the concentration of medication and rate of infusion (Brown et al 1997).
- An anti-siphon valve or anti-reflux valve should be used on all extension sets to reduce the risk of the drug solution siphoning into the patient (NHS QIS 2004).
- The use of PCA infusion devices should adhere to manufacturer's guidelines (Stannard & Booth 1998).
- The practitioner should be educated and competent in the preparation and use of the electronic infusion device (EID), including programming the device to deliver the prescribed therapy, administration and maintenance procedures, and the use of lock-out safety devices (Stannard & Booth 1998). All device users should have mandatory device training on a regular basis (NHS QIS 2004).
- PCA therapy and its outcomes should be documented in the patient's medical and nursing notes (NHS QIS 2004).

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## 8.5 Parenteral nutrition

### Standard

Parenteral nutrition should be administered according to the order of the clinician.

Informed consent by the patient or legal guardian should be obtained prior to commencing the administration of parenteral nutrition and should be documented in the patient's medical record.

Infusion specific filtration and an electronic infusion device (EID) must be used during the administration of this therapy.

Administration sets used for parenteral nutrition (PN) must be changed every 24 hours and immediately upon suspected contamination or when the integrity of the product or system has been compromised.

PN administration sets must be changed using aseptic technique and observing universal precautions.

### Practice criteria

- The nurse shall communicate with the clinician, pharmacist and dietician on the development and implementation of a nutrition care plan (Colagiovanni 1997; King's Fund 1992).
- Nutritional solutions containing final concentrations exceeding 10 per cent dextrose and/or 5 per cent protein (nitrogen) should be administered via a central venous catheter with tip placement in the superior vena cava (BMA & RPS 2003).
- PN solutions in final concentrations of 10 per cent dextrose or lower and/or 5 per cent protein (nitrogen) or

lower should not be administered peripherally for longer than 7 to 10 days unless concurrent supplementation with oral or enteral feeding is provided to ensure adequate nutrition (BMA & RPS 2003).

- Parenteral nutrition solutions should be infused or discarded within 24 hours, once the administration set is attached (Burnham 1999).
- A protocol for changing PN administration sets should be established in organisation policies and procedures (King's Fund 1992).
- Product integrity should be established before using the administration set.
- The changing of add-on devices such as, but not limited to, extension sets, filters, stopcocks, and needleless devices should coincide with the changing of the administration set.
- Parenteral nutrition solutions should be removed from refrigeration one hour prior to infusion in order to reach approximate room temperature.
- Parenteral nutrition solutions not containing lipids should be filtered with a 0.2 micron filter during administration (Weinstein 2001), or as specified in the product information (BMA & RPS 2003).
- Parenteral nutrition solutions containing lipid emulsion should be filtered using a 1.2 micron filter during administration, or as specified in the product information (BMA & RPS 2003).
- Solutions should be prepared in the pharmacy using aseptic technique under a horizontal laminar flow hood (Hart 1999).
- Medications added to parenteral nutrition prior to administration of the solution should be assessed for compatibility (BMA & RPS 2003).
- Medications added to parenteral nutrition should be documented on the label that is affixed to the infusate container (Harkreader 2000).
- Medications should not be added to the parenteral nutrition solution once it is actively infusing (Weinstein 2001).
- Parenteral nutrition administration systems, whether central or peripheral, should be dedicated to those solutions (Burnham 1999).
- Parenteral nutrition should be administered via a lumen kept exclusively for this purpose (DH 2001).
- Push or piggy-back medications should not be added to these infusion systems, with the exception of lipid emulsions with verified compatibility (BMA & RPS 2003).
- The nurse should monitor the patient for signs and symptoms of metabolic-related complications and electrolyte imbalances (Henry 1997; Burnham 1999).
- The nurse should monitor the patient for signs and symptoms of catheter-related complications (Henry 1997).
- The nurse should assess, monitor and document the

patient's response to therapy in their medical record (Burnham 1999).

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## 8.6 Transfusion therapy

### Standard

Organisational policies and procedures regarding all aspects of transfusion therapy should be established in accordance with Health Services Circular 2002/009 Better Blood Transfusion - Appropriate Use of Blood (DH 2002) and national guidelines and websites for the safe, effective and appropriate use of blood (which are indicated in the reference list with a \*).

Informed consent of the patient or a responsible person legally authorised to act on the patient's behalf must be obtained before administering any transfusion therapy (British Committee for Standards in Haematology 1999; Porter 1999; NMC 2004; DH 2002; RCN 2005; Ryan 2004). A record should be made in the patient's medical notes that the reason for the proposed transfusion has been explained to the patient (or to the responsible person) (McClelland 2001).

Positive patient identification, appropriateness of therapy and administration setting and blood and/or blood component compatibility must be verified before administering blood and/or blood components (RCN 2005). Blood components should only be prescribed by a doctor (British Committee for Standards in Haematology 1999; McClelland 2001). Blood components are considered as medicines for administration purposes and should only be administered by a doctor, or a nurse holding current registration with the NMC (British Committee for Standards in Haematology 1999).

### Practice criteria

- The nurse administering blood or blood components should have an in-depth knowledge and understanding of all aspects of transfusion therapy to ensure safe and effective delivery of care (Porter 1999; INS 2000). This includes immunohaematology, blood and its components, blood grouping, administration equipment and techniques appropriate for each component, transfusion reactions, and the risks to the patient and nurse (INS 2000).
- All health care practitioners' involved in the transfusion process should receive appropriate education (RCN, 2005).
- Blood components must be transfused through a blood administration set with an integral mesh filter (170–200 micron pore size) (RCN, 2005). Standard blood administration sets contain in-line filters that will remove particles of 170–200 microns and above (British Committee for Standards in Haematology 1999; McClelland 2001). The use of additional inline blood filters is not indicated for the majority of transfusions. For infants and small children a standard giving set with a screen filter (170–200 microns) or an alternative system incorporating the same filtration must be used. Where small volumes are drawn into a syringe an appropriate filter must be used (British Committee for Standards in Haematology, 2004). All blood components are leucocyte-depleted within 48 hours of collection in the UK to minimise the theoretical risk of transmission of new variant Creutzfeldt-Jakob disease. Leucocyte depletion filters are no longer used and may be detrimental (McClelland 2001; Ryan 2004).
- For information on the use of blood warmers see Standard 4.5 page 20
- Temperature, pulse and blood pressure should be measured and recorded before the start of each unit of blood/blood component, and when the transfusion is completed. Temperature and pulse should be measured 15 minutes after the start of each unit of blood/blood component. The patient should be observed throughout the transfusion. Further observations need only be taken if the patient becomes unwell or shows signs of a transfusion reaction (conscious patient). If the patient is unconscious, their pulse and temperature should be checked at intervals during the transfusion. Transfusions should only be administered in clinical areas where patients can be readily observed by clinical staff (British Committee for Standards in Haematology 1999; McClelland 2001 RCN, 2005).
- Document the start and finish times of each unit of blood. Record the volume of blood transfused on the patients fluid balance chart or 24 hour chart (RCN, 2004).
- There is no minimum or maximum size of cannula for administration of blood/blood components. The cannula size used should depend on the size of the vein and the speed at which the transfusion is to be infused (British

- Committee for Standards in Haematology 1999; McClelland 2001).
- All blood components should be transfused within four hours of removal from the blood fridge or hospital transfusion laboratory (RCN, 2005).
  - For the administration of transfusion therapy outside a hospital setting the Haematology guidelines for out-of-hospital blood transfusion should be followed (British Committee for Standards in Haematology 1999; [www.transfusionguidelines.org.uk/toolkit](http://www.transfusionguidelines.org.uk/toolkit)).
  - Conventional guidance is that drugs should not be added to any blood component pack. Dextrose solution (5%) can cause haemolysis and must not be mixed with blood components. Calcium solutions may cause a clotting of citrated blood. Desferrioxamine may be administered via a Y connection with blood (RCN 2005; [http://www.cbbsweb.org/enf/desferal\\_simultx.html](http://www.cbbsweb.org/enf/desferal_simultx.html)).
  - Transfusion reactions require immediate nursing and/or medical intervention. If a transfusion reaction is suspected stop the transfusion and immediately inform a doctor. If the reaction appears life-threatening, call the resuscitation team. Record the adverse event in the patient record. Report the adverse event in accordance with local hospital policy and national reporting procedures (RCN, 2005; UK Blood Safety & Quality Regulations 2005). The blood and the administration set should be retained for analysis by the blood transfusion laboratory.
  - Hospitals should have a policy for the management and reporting of adverse events (including 'near misses') following transfusion of blood components. All adverse events related to transfusion reactions should be reported to the hospital transfusion department. In addition, all transfusion reactions should be reviewed by the Hospital Transfusion Committee. Serious non-infectious adverse events and near miss events should be reported to the Serious Hazards of Transfusion (SHOT 2004) reporting scheme and the NPSA. Adverse events associated with licensed plasma derivatives or blood products should be reported to the UK MCA (British Committee for Standards in Haematology 1999; McClelland 2001).
  - External compression devices should be equipped with a pressure gauge and must exert uniform pressure against all parts of the blood container (INS 2000).
  - Electronic infusion pumps may be used for blood components providing they have been verified as safe to use for this purpose according to the manufacturer's instructions (British Committee for Standards in Haematology 1999; McClelland 2001; RCN 2005).
  - Blood and blood products should be transfused using a sterile administration set designed for this procedure. For platelet concentrates a standard blood or platelet administration set should be used. Platelets must not be transfused through giving sets that have been used for blood. Special paediatric giving sets should be used for transfusion to an infant, or a screen filter used if the transfusion is to be administered via syringe (British Committee for Standards in Haematology 1999; McClelland 2001). Change the administration set at least every 12 hours for a continuing transfusion and on completion of the transfusion (RCN, 2005).
  - All trusts involved in blood transfusion are required to ensure that Better Blood Transfusion is an integral part of NHS care, to make blood transfusion safer as part of clinical governance responsibilities, avoid unnecessary use of blood and provide better information to patients and the public about blood transfusion (DH 2002).
  - Patient information is essential to ensure informed consent (Porter 1999). Information sheets that outline the risks and benefits of blood transfusion can be helpful to patients. The NHS leaflet 'Receiving a blood transfusion' (available from hospital blood banks and The National Blood Service Hospitals and Science Website [www.blood.co.uk/hospitals/library/pi/](http://www.blood.co.uk/hospitals/library/pi/)), or locally produced information can be used (McClelland 2001). Examples of patient information leaflets will in the future, be available from the Better Blood Transfusion website.

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14. UK Blood safety and Quality Regulations (2005) Statutory Instrument 2005/50 and Statutory Instrument 2005/1098

## Websites

- \* Guidelines for the Blood Transfusion Services in the United Kingdom (<http://www.transfusionguidelines.org.uk/>).
- \* British Blood Transfusion Society ([www.bbts.org.uk](http://www.bbts.org.uk)).
- \* British Committee for Standards in Haematology guidelines  
<http://www.bcshguidelines.com>  
Better Blood Continuing Education Programme, E-learning website <http://learnbloodtransfusion.org.uk/>

## 8.7 Intravenous conscious sedation

### Standard

Intravenous conscious sedation (IVCS) should be initiated upon the order of a clinician or in accordance with individual organizations policies and procedures for example Patient Group Directions) and should be provided in a controlled setting, with appropriate monitoring and resuscitation equipment available.

Informed consent of the patient, or a representative legally authorised to act on the patient's behalf, including the risks of IVCS, should be obtained prior to the procedure and documented in the patient's medical and nursing notes.

### Practice criteria

- A clinician should select and order the medications for conscious sedation (Smeltzer and Bare 2000) unless the medication is administered under a patient group direction).
- Guidelines for drug administration, patient monitoring and responses to complications and emergencies should be available and established in accordance with evidence-based practice (Berlin 2001).
- The practitioner should demonstrate knowledge of the risks of airway obstruction, its management and the identification of 'at risk' patients (Benumof 2001; Miller et al 1997).
- The practitioner managing the patient receiving IVCS should be educated and competent in the principles of IVCS and the administration of the therapy. The organisation providing the service should have an education and competency verification system in place (Greenfield et al 1997; Sury et al 1999; Laurence 2000; Smeltzer and Bare 2000).
- IVCS should be performed in a controlled setting, which includes a clinician, available written protocol and appropriate equipment for administering the therapy, monitoring the patient and for resuscitation (British Society of Gastroenterology 1991; Laurence 2000).
- The patient receiving IVCS should be continuously monitored and vascular access should be maintained throughout the procedure (Booth 1996; Smeltzer and Bare 2000); the practitioner should have knowledge of the sedation rating scales which can be used to assess the patient (Whitwam 1994; Miller 1997).
- The practitioner managing the patient receiving IVCS should not leave the patient unattended or compromise continuous monitoring by participating in other duties (Smeltzer and Bare 2000).

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## 8.8 Epidural analgesia infusion

### Standard

The epidural analgesia infusion should be initiated upon the order of a clinician.

The patient and/or caregiver should be educated in the use of epidural infusion and the patient's and/or caregiver's ability to comply with procedures should be evaluated prior to, and at regular intervals during, therapy.

Medications should be obtained, administered, discarded and documented in accordance with legal requirement for controlled substances.

### Practice criteria

- A protocol for the use of epidural analgesia should be established in organisational policies and procedures (Audit Commission 1997, INS 2000, Morton 1998), together with a protocol for 'step-down' analgesia (NHS QIS 2004). Guidelines on the management of potential problems and adverse outcomes should also be available (NHS QIS2004).
- Continuous epidural analgesia should only be used in environments where this method of analgesia is frequently employed, in order to optimise expertise and safety (RCA 2004). There must be 24-hour access to advice from an anaesthetist (RCA 2004).
- The measurement of pain management outcomes should be defined in the organisational performance improvement programme (Audit Commission 1997 Morton 1998).
- The patient should be involved in the decision-making process (NHS QIS 2004).
- Patient and/or caregiver information should be appropriate to the duration of therapy (short or long-term) and care setting. This information should include the purpose of the therapy, operating instructions for the device, expected outcomes, precautions and potential side effects (Morton 1998, RCA 2004, Stannard & Booth 1998).
- The appropriateness of epidural analgesia, the environment and patient's comprehension of the intended therapy should be assessed prior to initiation of therapy; whenever possible, patients should be offered the opportunity to self-manage pain by using patient-controlled epidural analgesia (PCEA) (Morton 1998, Smeltzer & Bare 2000, Wilkie 1995).
- Baseline data should be obtained prior to initiation of therapy and should include patient health status and pain history (Hawthorn & Redmond 1998, Stannard & Booth 1998, Wigfull & Welchew 2001).
- The patient must have a patent venous access device in situ during epidural analgesia (NHS QIS 2004)
- The practitioner must have knowledge of analgesic pharmacokinetics and equianalgesic dosing, contraindications, side effects, appropriate administration modalities and anticipated outcome, and should document this information in the patient's medical and nursing notes (McQuay 1999, McQuay & Moore 1998, Stannard & Booth 1998, Taverner 2003, Wigfull & Welchew 1999 & 2001).
- The practitioner should maintain continued surveillance of the patient and should document assessment and monitoring in the patient's record (Hawthorn & Redmond 1998, Morton 1998, Stannard & Booth 1998).
- Nursing interventions should include evaluating the efficacy of therapy, assessing the need for changing treatment methods, monitoring for potential or actual side-effects and ongoing assessment of patient self-report of pain using a consistent pain scale (Hawthorn & Redmond 1998, Schofield 1995, Stannard & Booth 1998, Turk & Okifuji 1999, Wigfull & Welchew 2001).
- Strict asepsis should be observed during the insertion of the epidural catheter (RCA 2004).
- Epidural analgesia catheters should be colour-coded and should not include injection ports (NHS QIS 2004); an antibacterial filter should always be used (RCA 2004).
- The catheter should be secured so that movement of the catheter in and out of the epidural space is minimized and the dressing should facilitate inspection of the insertion site (RCA 2004).
- There should be protocols or guidelines which identify a restricted list of drugs and their concentrations, which can be used for epidural infusion (RCA 2004). Clear labels should permit the practitioner to distinguish easily epidural infusions from other infusions (RCA 2004). Specific storage for epidural solutions should be provided to separate them from other infusions (RCA 2004).
- A standard preservative free drug solution should be administered via a designated single device in order to reduce the risk of user error (NHS QIS 2004)
- In order to minimise the risk of adverse outcomes, a thorough checking procedure should be employed prior to administration of analgesia and when the syringe, solution container, or rate is changed. Special attention must be paid to the concentration of medication and rate of infusion as per organisational policy (Brown et al 1997).
- The use of epidural infusion devices should adhere to manufacturer's guidelines (Stannard & Booth 1998).
- Pumps should be specifically set up for continuous epidural infusion with pre-set limits for maximum infusion rate and bolus size (RCA 2004). The practitioner should be educated and competent in the preparation



and use of the electronic infusion device including programming the device to deliver the prescribed therapy, administration and maintenance procedures, and the use of lock-out safety devices (Stannard & Booth 1998, Wigfull & Welchew 1999 & 2001). All device users should have mandatory device training on a regular basis (NHS QIS 2004).

- Patients having epidural analgesia should have deep vein thrombosis (DVT) prophylaxis adjusted, as appropriate, to minimize the risk of epidural haematoma (NHS QIS 2004, SIGN 2002).
- Patients who have had orthopaedic or vascular surgery should be observed in order to detect the development of compartment syndromes (RCA 2004).
- Epidural analgesia therapy, together with any complications should be documented in the patient's record (Cooper 1996, Hutton & Christie 2001, Malak et al 2001, Stannard & Booth 1998) together with observations of the patency of the VAD and integrity of pressure areas.

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## 8.9 Intravenous immunoglobulin therapy

### Standard

Intravenous immunoglobulin (IVIG) should be prepared and administered using aseptic technique and universal precautions.

The nurse administering intravenous immunoglobulin should be knowledgeable about the indications for IVIG therapy, side-effects, potential adverse reactions and the appropriate interventions.

Measures should be taken to minimise the risk of allergic/anaphylactic reactions during the administration of IVIG.

IVIG should be administered in a safe, appropriate environment.

### Practice criteria

- Protocols for the administration of IVIG should be set out in organisational policies and procedures.
- If IVIG is administered in the home setting by a community nurse, patient, parent or caregiver, the person administering the IVIG should be able to recognise the side-effects and signs of an allergic/anaphylactic reaction and take the appropriate action(s). A pre-filled syringe containing adrenaline (for example Epi-pen) should be readily available for use and the caregiver taught to seek medical help/call an ambulance should an allergic/anaphylactic reaction occur (Royal College of Pathologists 1995; Kayley 1999; Nolet 2000; RCN 2001).
- If IVIG is to be administered in the home setting the caregiver/patient/parent should be educated in the preparation and administration of IVIG, use of any delivery system, venepuncture, correct infusion rates, disposal of used equipment, immediate and long-term side-effects, potential adverse reactions, and instructed in the use of pre-filled adrenaline syringes (Nolet 2000; RCN 2001).
- Patients and carers trained to administer IVIG in the

home should be formally trained by a specialist immunology nurse in one of the designated home therapy centres in the UK (RCN 2001).

- The use of permanent venous access devices should be avoided where possible as the patient has an increased susceptibility to infection (RCN 2001). The patient receiving long-term IVIG therapy should be considered for placement of an appropriate venous access device (Bravery 1999; Kayley 1999; Nolet 2000; Schleis 2000).
- IVIG should be prepared, stored, and administered according to the manufacturer's guidelines. Once the IVIG has been reconstituted it should be administered within a short period (usually several hours – check manufacturer's instructions) (RCN 1999; Nolet 2000; Schleis 2000).
- The IVIG infusion should be started slowly and the rate increased in incremental steps until the patient's maximum infusion rate is reached. Once tolerance has been established, the infusion can be administered more rapidly. This procedure should be followed each time the brand of IVIG is changed (RCN 1999; Schleis 2000). Side-effects and adverse reactions are reduced by avoidance of rapid infusion rates (RCN 1999; Cornelius 2000; Swenson 2000).
- Infusion rates are calculated at ml/kg/minute. It is important that an accurate weight is used to calculate the infusion rate (Nolet 2000).
- The administration set used to administer IVIG should have a 15-micron filter to prevent infusion of undissolved immunoglobulin or other foreign material into the patient (RCN 1999).
- The patient should be observed during infusion of IVIG for signs of an adverse reaction. Recording of vital signs is not normally required (RCN 1999).
- Common side-effects such as headache and slight hypotension may be alleviated by slowing the infusion rate (Schleis 2000).
- Flu-like symptoms can be treated with the administration of either paracetamol or ibuprofen pre- and post-infusion (Schleis 2000; Swenson 2000).
- Post-infusion headaches accompanied by nausea and vomiting (aseptic meningitis) can occur from 12 hours to several days after the IVIG. This may be treated by administration of antihistamines, corticosteroids and hydration before the infusion and analgesia post-infusion as necessary. These symptoms may be relieved by administering IVIG as a 24-hour infusion (Schleis 2000; Swenson 2000).
- Anaphylaxis/allergic reactions are rare and are associated with the first infusion of IVIG or when products are changed. If a reaction occurs antihistamines, corticosteroids and adrenaline may be required. An emergency trolley and oxygen should be readily available during first infusion or brand change of IVIG. This type

of reaction diminishes with subsequent infusions. Pre-medication with antihistamine and corticosteroid lessens the risk of a reaction (RCN 1999; Nolet 2000; Schleis 2000).

- First and second doses of IVIG should be administered in a hospital setting (Cornelius 2000).
- If a patient has an active infection present the IVIG should be delayed for 24 hours until the infection has been treated with antibiotics. An adverse reaction is more likely to occur if an infection is present (RCN 1999).
- Methods should be employed to minimise the risk of pathogen transmission via IVIG (Lee et al 2000; Swenson 2000).
- If the patient is deficient in immunoglobulin A (IgA) and has high titre anti-IgA antibodies the patient should receive IgA-depleted immunoglobulin (RCN 1999).
- The batch number, timing, product name and procedure should be recorded in the patient's notes (RCN 1999).

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## 8.10 Apheresis procedures (donor/therapeutic)

### Standard

Apheresis procedures should be undertaken by a trained practitioner with the experience, knowledge and skills to perform this procedure.

Aseptic technique and universal precautions should be observed during apheresis procedures.

Apheresis procedures should be performed in accordance with the NMC's *Code of Professional Conduct* (NMC 2004) or other profession-specific regulations.

### Practice criteria

- Protocols for apheresis procedures should be set out in organisational policies and procedures.
- The venous access device used for apheresis procedures must be able to withstand the high flow rates necessary for apheresis (Haire and Sniecinski 1994; Secola 1997).
- Peripheral or central venous access may be used (BCSH 1998).
- Clinical decisions regarding the use of blood cell separators are the responsibility of a medical consultant (or equivalent) (BCSH 1998).
- Informed consent for apheresis procedures should be obtained from the patient (or their relative or guardian) and the donor (BCSH 1998; UKBTS 2002).
- The selection of patients and donors and their pre-donation medical and laboratory assessment is the responsibility of a medical officer who is familiar with the use of cell separators. Volunteer donors, related and unrelated, must fulfill the appropriate UK guidelines for selection of donors. Donors should not be subjected to undue pressure to donate (BCSH 1998; UKBTS 2002).
- Paediatric patients require special care and should only be selected and managed by staff trained in the clinical assessment and management of children (BCSH 1998; Bravery and Wright 1998).
- Practitioners responsible for donor/patient care during apheresis should have knowledge of the potential complications of apheresis and the management of these complications (BCSH 1998).
- Blood cell separators should be used, serviced and operated in accordance with the manufacturer's instructions (BCSH 1998).
- Staff proficiency in the operation of cell separators must be maintained by regular use of the equipment (BCSH 1998).
- Practitioners undertaking apheresis procedures should

be trained in cardiopulmonary resuscitation (BCSH 1998; UKBTS 2002).

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## 8.11 Blood sampling via direct venepuncture and venous access devices

### Standard

Blood sampling should be performed upon the order of a clinician and/or healthcare professional according to established protocols, using aseptic technique and observing universal precautions.

Blood sampling protocol should be established in accordance with the NMC's *Code of Professional Conduct* (NMC 2004) and other profession-specific regulations.

All hazardous materials and waste must be discarded in the appropriate containers and disposed of safely according to statutory requirements.

### General practice criteria

- The patient should be positively identified before obtaining a blood sample (RCN 2005)
- Pre labelling of the sampling tube should not occur (BCSH 1999).
- Blood collection tubes should be checked for expiry date.
- The vacuumed tube or syringe method should be used (Dougherty 1999; Witt 2004).
- The amount of blood obtained for discard should be sufficient to avoid laboratory error without compromising the patient.
- For the paediatric patient, the amount of blood obtained for laboratory assay should be documented in the patient's nursing notes.
- Collection tubes should be clearly labelled with patient

identifiers.

- Blood samples should be transported in an accepted biohazard container.
- Policies and procedures for safe handling and disposal of sharps should observe COSHH 2002 regulations. Any policy should form part of the written health and safety policy as required under the Management of Health and Safety at Work Regulations and the Health and Safety at Work Act 1974 (MDA 2001).
- All sharps should be disposed of safely after use in accordance with current guidance (BMA 1990; HSE 1999; DOH 2001; MDA 2001; NHS Employees 2005).
- Sharps containers should comply with BS 7320 1990, Specification for sharps containers (MDA 2001).
- Safety devices that reduce the risk of accidental needlestick injury should be used where possible (DH 1998; Dougherty 1999; DH 2001; Witt 2004; NHS Employees 2005).

### Blood sampling via direct venepuncture

- The venepuncture site should be prepared according to organisational policies and procedures.
- Patient education, assessment and monitoring should be ongoing during the phlebotomy procedure.
- Blood samples should be obtained from the non-cannulated extremity; when this is not possible, the peripheral infusion should be stopped and flushed to prevent device occlusion and the venepuncture made distal to the catheter location.
- Proper haemostasis should be maintained at the venepuncture after removal of the phlebotomy device, and instructions should be given to the patient concerning weight-bearing exercises involving the phlebotomised extremity.
- The practitioner performing venepuncture should minimise discomfort to the patient and utilise measures to reduce the fear, pain and anxiety associated with venepuncture (Dougherty 1999).
- The practitioner performing venepuncture should be knowledgeable about the relevant anatomy and physiology, skin preparation and asepsis, measures to improve venous access, and be aware of the contraindications of venepuncture sites (Dougherty 1999; Witt 2004).
- The smallest possible gauge needle should be used (Black and Hughes 1997; Perucca 2001, Weinstein 2001; Ernst and Ernst 2001).
- Gloves should be available to all practitioners and worn during the venepuncture procedure (ICNA 2003). Inexperienced venepuncturists should become accustomed to wearing gloves at the beginning of their training, and should not take blood from patients infected with blood-borne viruses unless trained and competent. Gloves should also be worn if there are cuts or

abrasions on the hands (which should be covered with a waterproof dressing) (DH 1998).

### Blood sampling via access devices

- Peripheral catheters should not be used for routine blood sampling. However if necessary then using a large syringe (larger than 10 ml) or a vacuum system to obtain blood samples from a cannula may increase haemolysis of the sample. Consideration should be given to the use of a smaller syringe to obtain samples.
- Blood should not be drawn through an infusion administration set.
- If the patient has an infusion in progress in the vein selected, the infusion should be stopped and the device flushed off prior to blood sampling.
- Venous access devices should be flushed with a sufficient volume of 0.9 % sodium chloride solution (injectable) to clear the catheter of all residual blood after blood sampling.
- When taking blood samples from venous access devices, consideration should be given to the type of sample to be obtained, the effect of the catheter size/materials, and pressure on the ability to obtain blood samples (Frey 2001)
- The most appropriate method for obtaining blood samples from venous access devices has not yet established by research (Keller 1994). Three methods are reported in the literature: the push-pull or mixing method, the discard method and the reinfusion method (Hinds et al 1991; Holmes 1998; Cosca et al 1998; Frey 2001).
- Blood samples, for example coagulation tests and drug levels, obtained from access devices may be inaccurate (Pinto 1994; Mayo et al 1996).
- Methods of blood sampling utilising reinfusion of discard may introduce clots into the system (Cosca et al 1998).
- Gloves should be used for procedures that have been assessed as carrying a risk of exposure to blood, body fluids, secretions and excretions, and when handling sharp or contaminated instruments (DH 2001).

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## 9

# Infusion-related complications

## 9.1 Phlebitis

### Standard

Phlebitis is the inflammation of the intima of the vein (Perdue 2001) and there are three main types of phlebitis: mechanical, chemical and infective (Lamb 1999; Lister 2004).

Statistics on incidence, degree, cause and corrective action taken for phlebitis should be maintained and readily retrievable.

The nurse must be competent to assess the access site and determine the need for treatment and/or intervention in the event of phlebitis.

Phlebitis must be documented using a uniform standard scale for measuring degrees or severity of phlebitis (Jackson 1998).

### Practice criteria

- The phlebitis scale should be standardised and used in documenting phlebitis; phlebitis should be graded according to the most severe presenting indicator (Jackson 1998) (see Appendix 2).
- The organisation should have guidelines regarding prevention of phlebitis. These should include appropriate device and vein selection, dilution of drugs and pharmacological methods, for example Glycerol trinitrate (GTN) patches (Hecker 1988; Campbell 1998 a&b; Jackson 1998; Keradag & Gorgulu 2000).
- All vascular access sites should be routinely assessed for signs and symptoms of phlebitis.
- The nurse should have knowledge of the management of phlebitis (Campbell 1998 a&b).
- Any incident of phlebitis rating Grade 1 or higher should be investigated by the appropriate healthcare professional to identify cause and possible steps for future prevention.
- Any incident of phlebitis, along with intervention, treatment, and corrective action, should be documented in the patient's nursing notes.
- The acceptable phlebitis rate should be 5 per cent or less in any given patient population.
- Organisational policies and procedures should require calculation of phlebitis rates as a means of outcome assessment and performance improvement.
- The peripheral phlebitis incidence rate should be calculated according to a standard formula:

$$\frac{\text{Number of phlebitis incidents}}{\text{Total number of IV peripheral devices}} \times 100 = \text{\% peripheral phlebitis}$$

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## 9.2 Infiltration

### Standard

Infiltration is defined as the inadvertent administration of non-vesicant medication or solution into the surrounding tissue instead of into the intended vascular pathway (ONS 1999; INS 2000; Perdue 2001).

An infiltration should be identified and assessed by the nurse, and appropriate nursing intervention should be implemented to minimise the effects of the infiltration (INS 2000).

All information related to the event, including photographic records, where appropriate, should be reported and documented in the patient's medical and nursing notes.

### Practice criteria

- The infiltration scale should be standardised and used in documenting the infiltration; infiltration should be graded according to the most severe presenting indicator (see Appendix 2).
- Observation of an infiltration occurrence should prompt

- immediate discontinuation of the infusion (Lamb 1999).
- Treatment should be dependent upon the severity of the infiltration.
- Ongoing observation and assessment of the infiltrated site should be performed and documented.
- The presence and severity of the infiltration should be documented in the patient's medical and nursing notes
- Infiltration statistics should be maintained and should include frequency, severity and type of infusate.
- The infiltration rate should be calculated according to a standard formula:

$$\frac{\text{Number of infiltration incidents}}{\text{Total number of IV peripheral devices}} \times 100 = \frac{\%}{\text{peripheral infiltrations}}$$

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## 9.3 Extravasation

### Standard

Extravasation is defined as the inadvertent administration of vesicant medication or solution into the surrounding tissue instead of into the intended vascular pathway (RCN 1998; ONS 1999; INS 2000; Perdue 2001; Stanley 2002).

All organisations must have a policy relating to the recognition, prevention, management and reporting of extravasation (Camp Sorrell 1998; Hyde 2004).

An extravasation should be identified and assessed by the nurse, and appropriate nursing interventions should be implemented to minimise the effects of the extravasation (Hyde 2004).

Extravasation should prompt immediate discontinuation of the infusion and should require immediate intervention (Goodman 2000; Weinstein 2001; Stanley 2002; Hyde 2004). All information related to the event should be documented in

the patient's medical and nursing notes and on a clinical incident form (INS 2000).

### Practice criteria

- Treatment should be dependent on the pharmaceutical manufacturer's guidelines, the properties of the extravasated agent and the severity of the extravasation (CP Pharmaceuticals 1999; Stanley 2002).
- If a vesicant medication has extravasated, treatment should be determined prior to catheter removal (Stanley 2002).
- Ongoing observation and assessment of the extravasated site should be performed and documented in the patient's medical record.
- An extremity should not be used for subsequent vascular access device placement when extravasation of a vesicant agent has occurred (INS 2000).
- The doctor should be notified when an extravasation occurs.
- A critical incident form as well as specific extravasation documentation should be completed.
- Extravasation statistics (to include frequency, severity, and type of infusate) should be maintained within the Trust and nationally both by using the green card reporting system (Stanley 2002; www.extravasation.org.uk).

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## 9.4 Haematoma

### Standard

Haematoma will be defined as uncontrolled bleeding at a venepuncture site, usually creating a hard painful swelling filled with infiltrated blood (Perdue 2001).

Statistics on incidence, degree, cause and corrective action taken for haematoma should be maintained and readily retrievable.

The practitioner should be competent to assess the access site and determine the need for treatment and/or intervention in the event of haematoma.

### Practice criteria

- The organisation should have guidelines regarding the prevention of haematoma.
- The practitioner should perform a risk assessment in order to identify individuals who may be particularly susceptible to haematoma formation, including older people, those having anticoagulation therapy and children (Lamb, 1999).
- Strategies to minimise the risk of haematoma should be employed. These should include the use of optimal pressure to the venepuncture/cannulation site following a failed procedure or removal of a vascular access device, and the practitioner should have the appropriate level of expertise for insertion of the device (Lamb 1999, RCN 1999; Perdue 2001).
- The nurse should have knowledge of the management of a haematoma including the use of pharmacological methods such as Hirudoid cream (BMA & RPS 2005).
- Incidence of haematoma, together with cause and its treatment, should be recorded in the patient's notes, so that possible steps for future prevention can be identified (Perdue 2001).

### References

1. BMA and RPS, 2005. British national formulary. BNF (III)
2. Lamb, J, 1999. 'Local and systemic complications of intravenous therapy'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, Chapter 7, 163–194. (III)
3. Perdue, MB, 2001. 'Intravenous complications'. In *Infusion therapy in clinical practice*. 2nd ed. Pennsylvania: WB Saunders, Chapter 24, 418–445. (III)
4. RCN, 1999. *Guidance for nurses giving intravenous therapy*. London: RCN. (III)

## 9.5 Haemorrhage

### Standard

An incidence of haemorrhage should be reported as an

adverse patient outcome.

The practitioner must be competent to identify haemorrhage and employ appropriate strategies to minimise blood loss/arrest bleeding (Scales 1999).

Statistics on incidence, degree, cause and corrective action taken for haemorrhage should be maintained and readily retrievable.

All information relating to the event should be documented in the patient's nursing and medical notes.

### Practice criteria

- Assessment of the risk of haemorrhage should be made. These risk factors include, but are not limited to, the patient's health status, anticoagulant therapy and the chosen access site (Scales 1999).
- Observation of haemorrhage occurrence should prompt immediate treatment to arrest bleeding/minimise blood loss whilst adhering to universal precautions.
- Treatment should be dependent on the cause/site of the bleeding.
- Ongoing observation and assessment of the haemorrhage site should be performed and documented.
- Details of the cause and action taken should be documented in the patient's record.

### References

1. Scales, K, 1999. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, Chapter 7, 163–194. (III)

## 9.6 Pneumothorax and haemothorax

### Standard

Statistics on incidence, degree, cause and corrective action taken for pneumothorax/haemothorax should be maintained and readily retrievable.

The practitioner should be competent to identify pneumothorax/haemothorax and determine the need for treatment and/or intervention.

All information relating to the event should be documented in the patient's nursing and medical notes.

### Practice criteria

- The practitioner should demonstrate knowledge of the relevant anatomy for the insertion of central venous catheters (Scales 1999).
- Strategies to minimise the risk of pneumothorax/



haemothorax should be employed including, but not limited to, choice of venous access site, optimal patient positioning and respiratory pause and use of ultrasound imaging (NICE 2002).

- Radiological determination of the catheter placement, following insertion, should be made (Wise et al 2001).
- Treatment should be dependent on the needs of the individual patient.
- Information relating to the cause, action taken and outcome of the event should be documented in the patient's record.

### References

1. NICE, 2002. Ultrasound imaging for central venous catheter placement. London: DOH. (I)
2. Scales, K, 1999. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, Chapter 7, 163–194. (III)
3. Wise, M, Richardson, D and Lum, P, 2001. 'Catheter tip position: a sign of things to come'. In *Journal of vascular access devices*, 6, (2), 18–27. (III)

## 9.7 Cardiac tamponade

### Standard

Statistics on incidence, degree, cause and corrective action taken for tamponade should be maintained and readily retrievable.

The practitioner should be competent to identify tamponade and take appropriate action.

All information relating to the event should be documented in the patient's nursing and medical notes.

### Practice criteria

- Assessment of the risk of tamponade should be carried out by a skilled professional. These risk factors include, but are not limited to, the patient's health status, anticoagulant therapy, and the procedure being performed. Tamponade is associated with central venous catheters and can occur on insertion or subsequently, particularly if the catheter is placed in the heart chambers (RCN 1999; Scales 1999; Perdue 2001).
- The practitioner should demonstrate knowledge of the signs and symptoms of tamponade (Smeltzer and Bare 2000).
- Observation of the signs and symptoms of tamponade occurrence should prompt immediate treatment to relieve cardiac compression (Smeltzer and Bare 2000).
- Ongoing observation and assessment of the patient should be performed and documented.
- Information relating to the cause, action taken and outcome of the event should be documented in the patient's record.

- Incidence of tamponade, together with the cause, should be recorded so that possible steps for future prevention can be identified.

### References

1. Perdue, MB, 2001. 'Intravenous complications'. In *Infusion therapy in clinical practice*. 2nd ed. Pennsylvania: WB Saunders, Chapter 24, 418–445. (III)
2. RCN, 1999. *Guidance for nurses giving intravenous therapy*. London: Johnson and Johnson. (III)
3. Scales, K, 1999. 'Vascular access in the acute care setting'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, 261–299. (III)
4. Smeltzer, SC and Bare, BG (eds), 2000. *Brunner and Suddarth's textbook of medical-surgical nursing*. 9th ed. Philadelphia: Lippincott Williams and Wilkins. (III)

## 9.8 Air embolus

### Standard

Measures must be employed to avoid air embolus when inserting, removing, and accessing vascular access devices.

The insertion and removal of vascular access devices must be performed upon the order of a trained health care professional with the experience, knowledge and skills to perform this procedure.

Removal and insertion of vascular access devices should be performed in accordance with the NMC's *Code of Professional Conduct* or other profession-specific regulations (NMC 2004).

### Practice criteria

- Protocol for the insertion, removal and use/access of vascular access devices should be established in organisational policies and procedures.
- A healthcare professional with the appropriate training, experience, knowledge and skills should be responsible for the insertion and removal of venous access devices.
- Practitioners caring for patients with vascular access devices should be aware of the potentially lethal complications of air embolus associated with the use of central venous catheters (Heckmann et al, 2000). Practitioners should know how to recognise an air embolism and the action to be taken to manage air embolism (Scales, 1999).
- The patient should be placed in the Trendelenburg position during insertion of central venous access devices in the large veins in the upper part of the body (Scales 1999).
- During the insertion procedure the end of the catheter should be occluded when guidewires or syringes are removed or disconnected (Scales 1999).
- Ideally the patient undergoing elective insertion of a central venous access device insertion should not be

- hypovolaemic (Scales 1999).
- To avoid air embolism during PICC insertion the patient's arm should be kept below the level of the heart (Richardson and Brusio 1993).
- Central venous access devices placed in the large veins in the upper part of the body should be removed with the patient supine or in the Trendelenburg position. The catheter should be removed while the patient performs the Valsalva manoeuvre (forced expiration with the mouth closed) or during expiration if the patient is unable to perform this technique (Scales 1999; Drewett 2000; Weinstein 2001; Lister 2004).
- Caution should be used in the removal of vascular access devices, including precautions to prevent air embolism; gentle digital pressure should be applied to the exit site and vein entry site until haemostasis is achieved; and a sterile occlusive, air tight (air impermeable) dressing should be applied to the access site immediately on catheter removal. The dressing should remain in situ for 72 hours (Scales 1999; Drewett 2000; INS 2000; Lister 2004).
- It is recommended that the patient should lie flat for 30 minutes after catheter removal (Drewett 2000) although there is no scientific evidence for this.
- Air-in-line detectors should be used to monitor for the air bubbles in administration sets when delivered via an electronic infusion device (Lamb 1999; MDA 2003).
- Air should be 'purged' from administration sets and extension tubing prior to attachment to a vascular access device (Lamb 1999; Weinstein 2001; Lister 2004).
- All equipment used with vascular access devices should be Luer-Lok to minimise the risk of disconnection (Lamb 1999; Weinstein 2001; Lister 2004).
- The in-line clamp or an external clamp should be used to close the catheter when changing equipment, for example end caps and administration sets (Lister 2004).
- Infusion bags and containers should not be allowed to run dry/empty during an infusion (Weinstein 2001).

## References

- Drewett, SR, 2000. 'Central venous catheter removal'. In *British journal of nursing*, 9, (22), 2304–6, 2308, 2310. (III)
- Heckmann, JG, Lang, CJG, Kindler, K, Huk, W, Erbguth, FJ and Neundorfer, B, 2000. 'Neurologic manifestations of cerebral air embolism as a complication of central venous catheterisation'. In *Critical care medicine* 28, (5), 1621–1625. (III)
- INS, 2000. *Standards for infusion therapy*. Cambridge, MA: INS and Becton Dickinson. (III)
- Lamb, J, 1999. 'Local and systemic complications of intravenous therapy'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, 163–193. (III)
- Lister S 2004. 'Drug administration – general principles'. In *The Royal Marsden Hospital manual of clinical nursing procedures*. Edited Dougherty, L & Lister S 6th ed. Oxford: Blackwell publishing. (III)
- MDA, 2003 Device bulletin. *Infusion systems*. MDA DB2003 (02).
- NMC, 2004. *The NMC Code of Professional Conduct: standards for conduct, performance and ethics*. London: NMC (III)
- Richardson, D and Brusio, R, 1993. 'Vascular access devices – management of common complications'. In *Journal of intravenous nursing*, 16, (1), 44–49. (III)
- Scales, K, 1999. 'Vascular access in the acute care setting'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, 261–299. (III)
- Weinstein, SM, 2001. *Plumer's principles and practice of infusion therapy*. 7th ed. Philadelphia: Lippincott Williams and Wilkins. (III)

## 9.9 Speedshock/fluid overload

### Standard

The administration of medication and/or infusion should be performed over the specified time in order to prevent the development of speedshock and fluid overload (Lister 2004).

### Practice criteria

- The nurse administering the medication and/or infusion should have the knowledge of the speed or rate over which to perform administration (Lamb 1999).
- S/he must be able to prevent the occurrence and recognise the signs and symptoms of speedshock and overloading (Lamb 1999).
- Should either occur, the nurse must be able to act accordingly and the doctor should be notified.

### References

- Lamb, J, 1999. 'Local and systemic complications of intravenous therapy'. In Dougherty, L and Lamb, J (eds). *Intravenous therapy in nursing practice*. Edinburgh: Churchill Livingstone, Chapter 7, 163–194. (III)
- Lister S 2004. 'Drug administration – general principles'. In *The Royal Marsden Hospital manual of clinical nursing procedures*. Edited Dougherty, L & Lister S 6th ed. Oxford: Blackwell publishing. (III)
- Perdue, MB, 2001. 'Intravenous complications'. In *Infusion therapy in clinical practice*. 2nd ed. Pennsylvania: WB Saunders, Chapter 24, 418–445. (III)
- Weinstein, SM, 2001. *Plumer's principles and practices of intravenous therapy*. Philadelphia: Lippincott Williams and Wilkins. (III)

## 9.10 Septicaemia

### Standard

The nurse should be able to recognise and act upon the signs and symptoms of septicaemia.

When an infusion-related infection is suspected, the catheter tip, the access site and the infusate, if it is suspected as a source of sepsis, should be cultured using aseptic technique and observing universal precautions (INS 2000).

### Practice criteria

- Protocols for the management of septicaemia should be set out in organisational policies and procedures.
- When intrinsic contamination is suspected, the

pharmacy, the manufacturer and the MCA should be notified.

- Consideration should be given to obtaining blood cultures through the suspected device as well as via peripheral venepuncture in order to identify and compare the proliferation of infusion-related infection (INS 2000).

## References

1. Carlson, K, Perdue, MB and Hankins, J, 2001. 'Infection control in infusion therapy'. In *Infusion therapy in clinical practice*. 2nd ed. Pennsylvania: WB Saunders, Chapter 8, 126–140. (III)
2. CDC, 2002. 'Guidelines for the prevention of intravascular catheter-related infections'. In *Morbidity and mortality weekly report*, 51 (RR-10), S35–S63. (I)
3. DH, 2001. 'Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters'. In *Journal of hospital infection*, 47 (supplement), S47–S67. (I)
4. Elliott, TSJ and Tebbs, SE, 1998. 'Prevention of central venous catheter-related infection'. In *Journal of hospital infection*, 40, 193–201. (III)
5. INS, 2000. *Standards for infusion therapy*. Cambridge, MA: INS and Becton Dickinson. (III)
6. Weinstein, SM, 2001. *Plumer's principles and practices of intravenous therapy*. Philadelphia: Lippincott Williams and Wilkins. (III)
7. Wilson, J, 2001. 'Preventing infection associated with intravenous therapy'. In *Infection control in clinical practice*. 2nd edition, London Bailliere Tindall (III)

## 9.11 Thrombosis

### Standard

Thrombosis is the formation of a blood clot within a blood vessel (Weinstein 2001).

Statistics on incidence, degree, cause and corrective action taken for thrombosis should be maintained and readily retrievable.

The nurse must be competent to identify peripheral venous thrombosis secondary to peripheral cannulation or drug administration.

The nurse must be competent to identify central venous thrombosis secondary to central venous catheter insertion or treatments related to the access device.

All information relating to the event should be documented in the patients nursing and medical notes.

### Practice criteria

- Protocols for the management of thrombosis should be set out in organisational policies and procedures.
- The nurse should demonstrate knowledge of the anatomy associated with peripheral and central venous access devices.
- The nurse should demonstrate knowledge of the causative factors related to the development of a thrombosis such as underlying disease, material, tip location, treatment and

previous history (Moureau et al 1999; Vesely 2003).

- The nurse should be aware of the strategies to minimise the risk of peripheral and central venous thrombosis e.g. use of warfarin (Mayo 2000; Bern et al 1990; Young et al 2005; Couban et al 2005).
- The nurse should demonstrate knowledge of the anatomy associated with peripheral and central venous access devices.
- The nurse should observe for secondary effects e.g. pulmonary embolism, limb perfusion.

## References

1. Bern, M. M., Lokich, J. J., Wallach, S. R., & Bothe, A. e. a. 1990, "Very low doses of warfarin can prevent thrombosis in central venous catheters: a randomized prospective trial", *Annals of Internal Medicine*, 112, (6) 423-428 (I)
2. Couban S, Goodyear M, Burnell M, Dolan S, Wasi P, Barnes D, Macleod D, Burton E, Andreou P, Anderson DR. 2005 Randomized placebo-controlled study of low-dose warfarin for the prevention of central venous catheter-associated thrombosis in patients with cancer *J Clin Oncol*. Jun 20;23(18):4063-9. (I)
3. Mayo, D. J. 2000, "Catheter-related thrombosis", *Journal of Vascular Access Devices*, . 5 (2) 10-20 (III).
4. Moureau, N et al 1999 Multidisciplinary management of thrombotic catheter occlusions in vascular access devices, *Journal of Vascular Access Devices*, 4 (2), 22-29 (III)
5. Vesely, T. M. 2003, "Central venous catheter tip position: A continuing controversy", *Journal of Cardiovascular & Interventional radiology*, 14 (5) 527-534 (III).
6. Weinstein, SM, 2001. *Plumer's principles and practices of intravenous therapy*. Philadelphia: Lippincott Williams and Wilkins. (III)
7. Young, A. M. Begum, G. Billingham, L. J. et al WARP Collaborative Group, UK, 2005, WARP - A multicentre prospective randomised controlled trial (RCT) of thrombosis prophylaxis with warfarin in cancer patients with central venous catheters (CVCs), *ASCO Meeting Abstracts* June, 23 (16S): LBA8004 (I)

# Appendix 1 Phlebitis scale

(Jackson 1998)

## Policy Statement

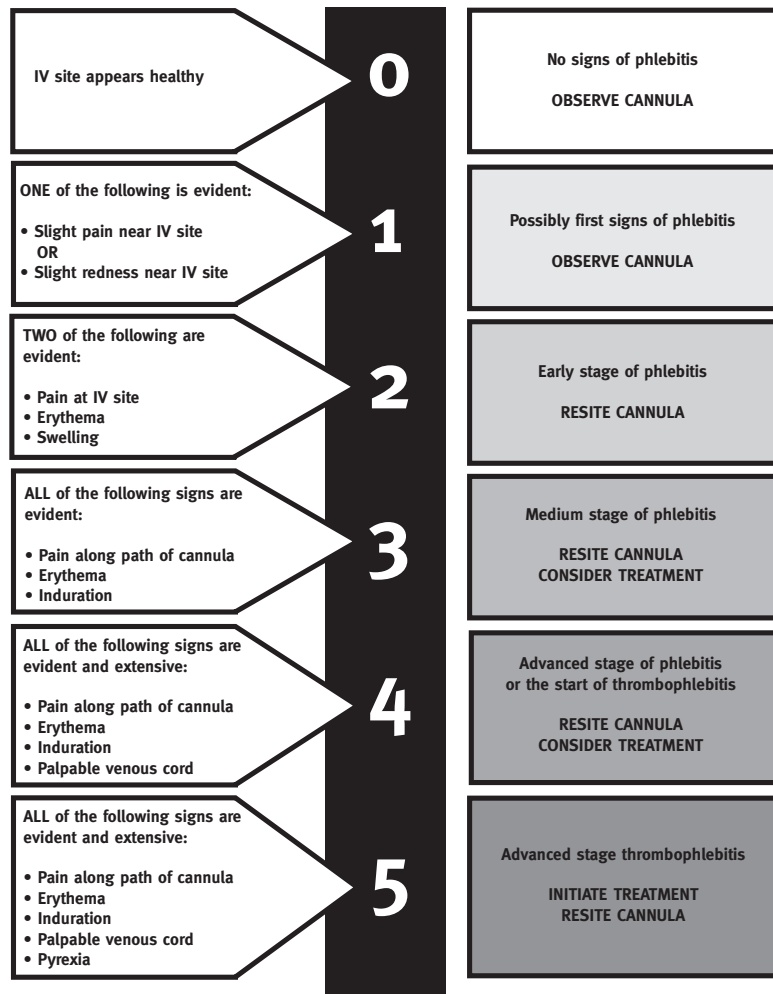
All patients with an intravenous access device in place must have the IV site checked at least daily for signs of infusion phlebitis. The subsequent score and action(s) taken (if any) must be documented.

The cannula site must also be observed:

- When bolus injections are administered
- IV flow rates are checked or altered
- When solution containers are changed

The incidence of infusion phlebitis varies but the following good practice points may assist in reducing the incidence of infusion phlebitis:

- Observe cannula site at least daily
- Secure cannula with a proven intravenous dressing
- Replace loose and contaminated dressings
- Cannula must be inserted away from joints whenever possible
- Aseptic technique must be followed
- Consider re-siting the cannula every 48 - 72 hours
- Plan and document continuing care
- Use the smallest gauge cannula most suitable for the patients need
- Replace the cannula at the first indication of infusion phlebitis (stage 2 on the VIP Score)



## Appendix 2

### Infiltration scale (INS 2000)

| Grade | Clinical criteria  |
|-------|--|
| 0     | <ul style="list-style-type: none"> <li>• No symptoms</li> </ul>  |
| 1     | <ul style="list-style-type: none"> <li>• Skin blanched</li> <li>• Oedema &lt;1 inch (2.5cm) in any direction</li> <li>• Cool to touch</li> <li>• With or without pain</li> </ul>   |
| 2     | <ul style="list-style-type: none"> <li>• Skin blanched</li> <li>• Oedema 1–6 inches (2.5cm–15cm) in any direction</li> <li>• Cool to touch</li> <li>• With or without pain</li> </ul>  |
| 3     | <ul style="list-style-type: none"> <li>• Skin blanched, translucent</li> <li>• Gross oedema &gt;6 inches (15cm) in any direction</li> <li>• Cool to touch</li> <li>• Mild to moderate pain</li> <li>• Possible numbness</li> </ul>   |
| 4     | <ul style="list-style-type: none"> <li>• Skin blanched, translucent</li> <li>• Skin tight, leaking</li> <li>• Skin discolored, bruised, swollen</li> <li>• Gross oedema &gt;6 inches (15cm) in any direction</li> <li>• Deep pitting tissue oedema</li> <li>• Circulatory impairment</li> <li>• Moderate to severe pain</li> <li>• Infiltration of any amount of blood product, irritant, or vesicant</li> </ul> |

## Appendix 3

# Calculation formulae

### Drug calculation

$$\frac{\text{What you WANT}}{\text{What you've GOT}} \times \text{Stock}$$

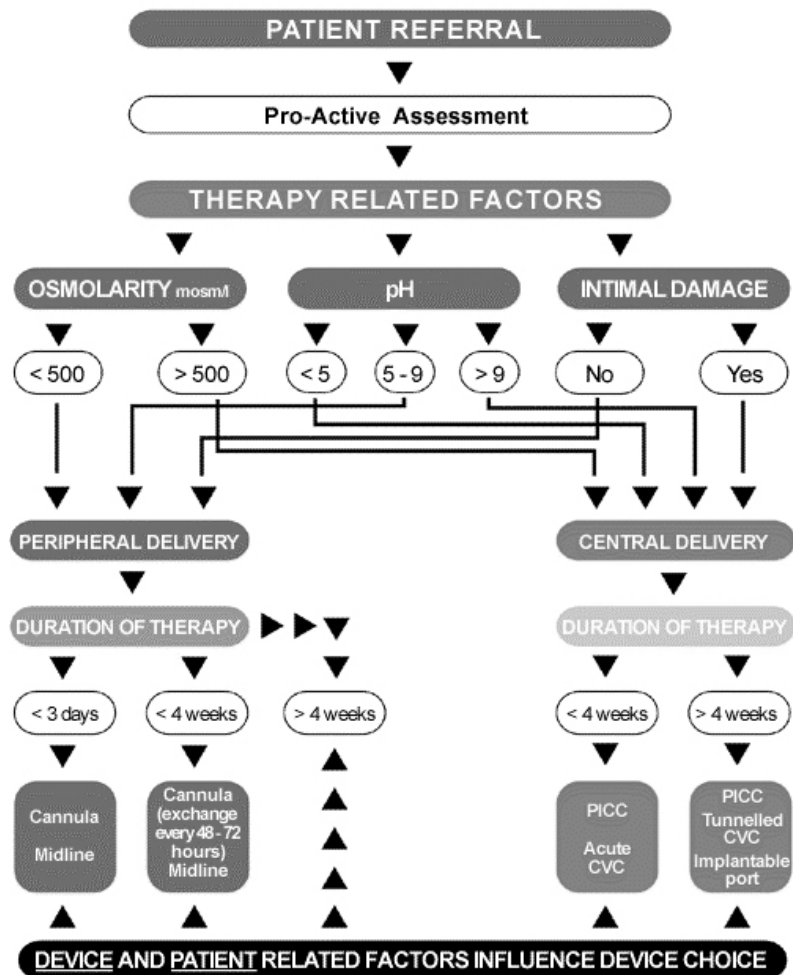
### Gravity flow

$$\frac{\text{VOLUME in ml}}{\text{HOURS of infusion}} \times \frac{\text{Drops per ml}}{60}$$

## Appendix 4

# AccessAbility algorithm

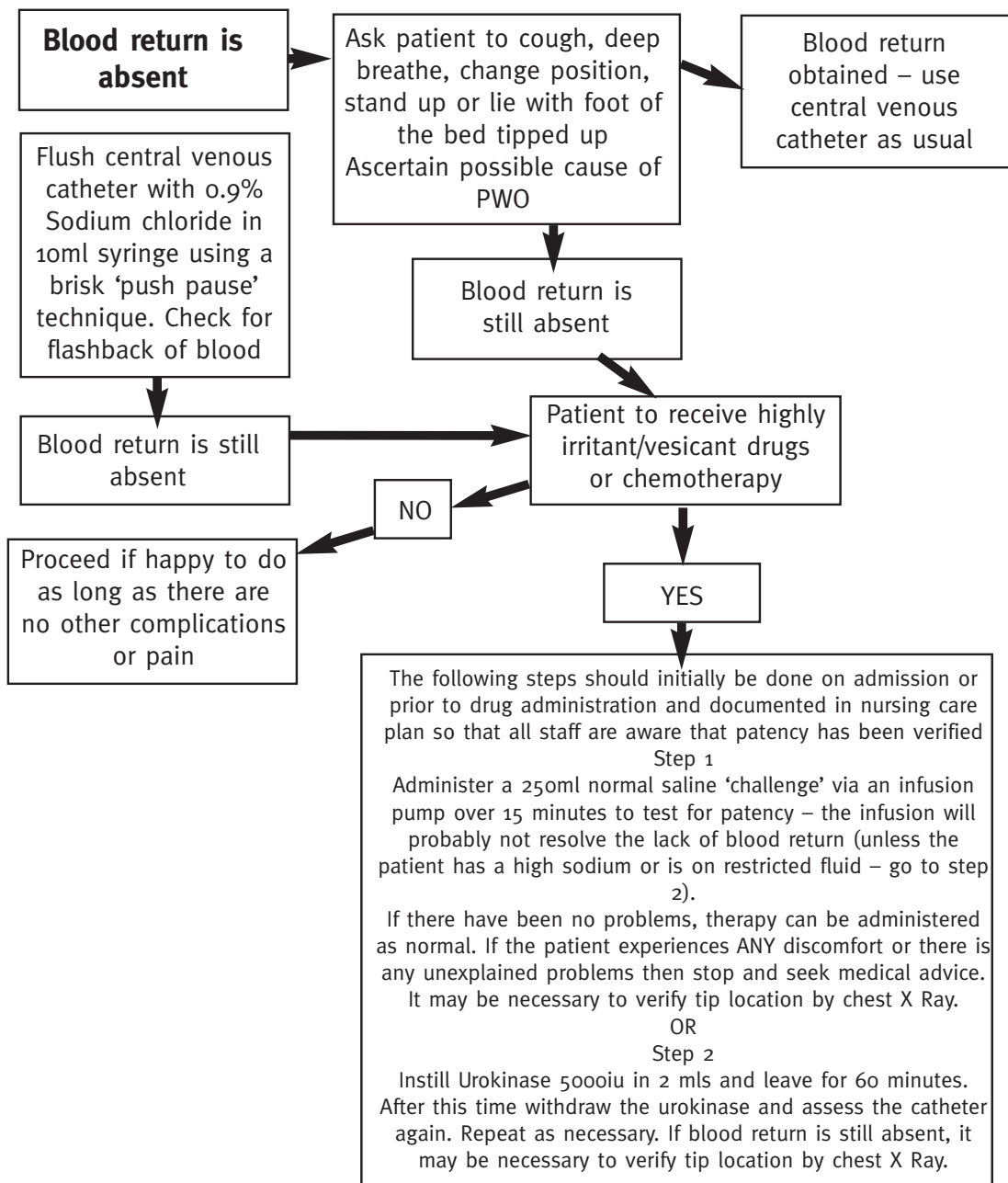
The AccessAbility™ is an Internet-based decision-making model designed to help healthcare professionals select the most appropriate venous access device.



AccessAbility™ is a registered trademark of C.R. Bard, Inc. For more information see [www.accessabilitybybard.co.uk](http://www.accessabilitybybard.co.uk)

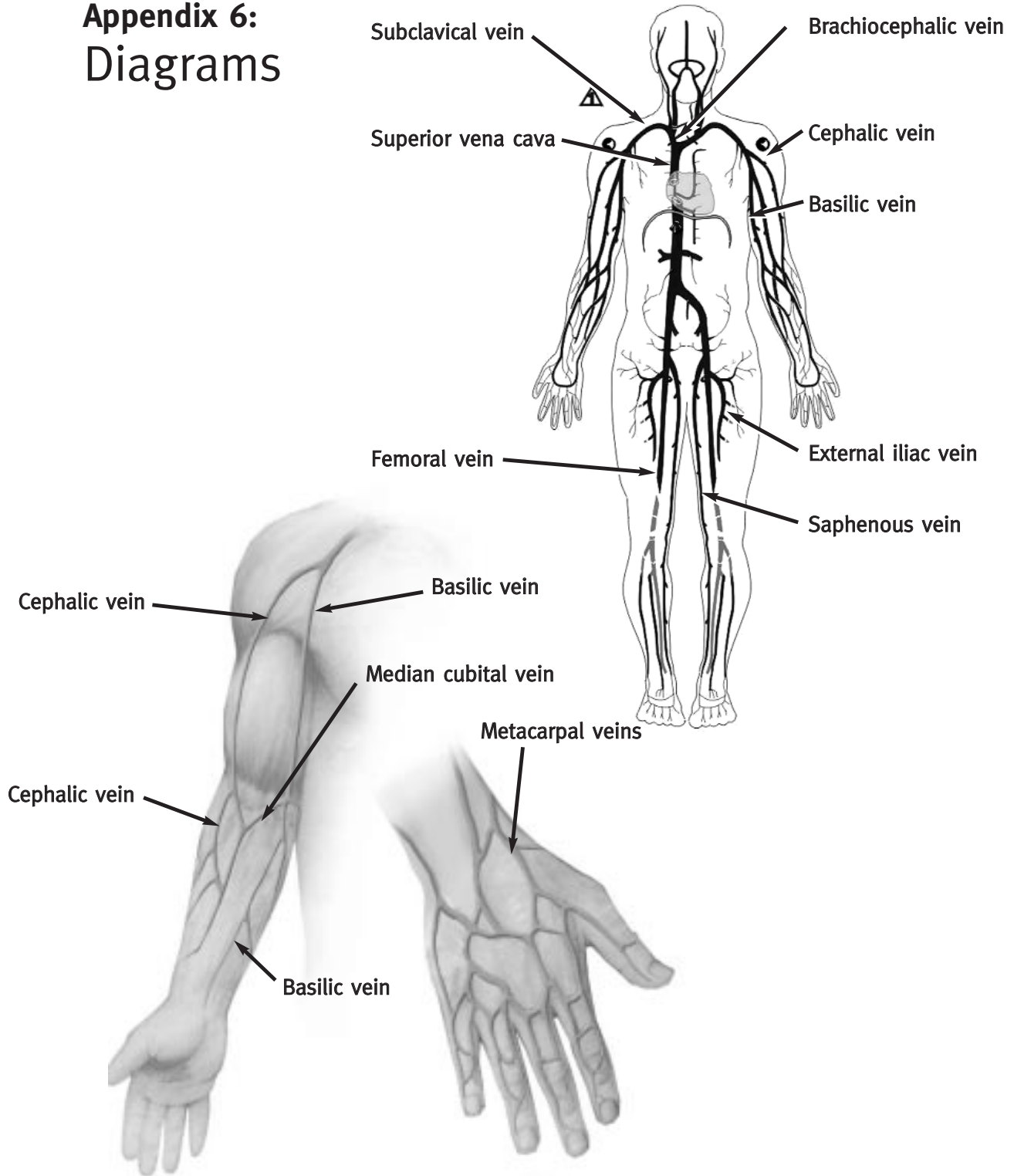
## Appendix 5: Algorithm persistent withdrawal occlusion

i.e. fluids can be infused freely by gravity but blood cannot be withdrawn from the catheter (London Standing Committee 2000)





## Appendix 6: Diagrams



## Appendix 7: Useful organisations

### The National Patient Safety Agency

The National Patient Safety Agency (NPSA) is a special health authority created to co-ordinate nationwide efforts to report and, more importantly, to learn from, adverse events and near misses occurring in the NHS. The NPSA will play a key role in raising standards of patient care and making them consistent across the country by implementing a national reporting system encouraging staff, patients and carers to report mistakes. This information will enable the NPSA to initiate preventative measures so that the whole country can learn from each case, and improve patient safety throughout the NHS. As well as making sure events are reported in the first instance, the NPSA will promote a more open and fair culture in the health service, encouraging NHS staff to report incidents without fear of personal reprimand.

The NPSA will promote patient safety by:

- establishing and managing a national reporting and learning system for adverse events and near misses;
- assimilating safety-related information from other organisations;
- designing solutions that prevent harm;
- setting targets and monitoring progress;
- promoting research;
- advising ministers and others on patient safety issues;
- promoting an open and fair culture in the NHS;
- developing memoranda of understanding with other key healthcare organisations that have an interest or involvement in patient safety

#### Contact details

National Patient Safety Agency  
4–8 Maple Street  
London W1T 5HD  
Tel: +44 20 7927 9500  
Fax: +44 20 7927 9501  
Email: [enquiries@npsa.nhs.uk](mailto:enquiries@npsa.nhs.uk)  
Web: [www.npsa.nhs.uk](http://www.npsa.nhs.uk)

#### MHRA

The Medicines and Healthcare products Regulatory Agency is an executive agency of the Department of Health. MHRA (Devices)'s primary purpose is to "take all reasonable steps to protect the public health and safeguard the interest of patients and users by ensuring that medical devices and equipment meet appropriate standards of safety, quality and

performance and that they comply with the relevant directives of the European Union". This is fulfilled in three ways:

- negotiating, introducing and enforcing controls as set out in the European Medical Device Directives,
- evaluating medical devices and publishing the findings,
- investigating adverse incidents associated with medical devices.

The MHRA (Devices) is responsible for ensuring the safety and quality of all medical devices used in the UK. It relies on nurse, doctors and all other healthcare workers, within hospitals and the community, to make reports of adverse event to the MHRA's Adverse Incidents Centre. An adverse incident is an event which can produce, or has potential to produce, unwanted effects involving the safety of patients, users or others. These may arise from shortcomings in the device, its operating instructions, user practices, servicing and maintenance, or conditions or use. All incidents are investigated and, depending on the outcome, may result in the issuing of advice to the Health Service through Medical Device Alerts or, in some instances recall of the device.

The MHRA also produces a number of publications to guide the procurement and safe use of medical devices. The majority of these are available via our website: [www.mhra.gov.uk](http://www.mhra.gov.uk).

#### Contact Details

If you have an adverse incident to report, please contact:  
MHRA Adverse  
Incident Centre  
Hannibal House  
Elephant and Castle  
London SE1 6TQ,  
Telephone number 020 7972 8080.  
Incidents can also be reported on line via the website.  
For nursing enquiries related to devices,  
please telephone 020 7972 8128  
and ask for Jonathan Plumb, Nursing Adviser.  
For medical enquiries, please contact  
020 7972 8123 for Dr Susanne Ludgate  
or 020 7972 8126 for Dr Jon Hopper.

## Appendix 8: Frequently Asked Questions (FAQs)

### 1. Can a unit of blood be administered, once it has been out of the fridge for 30 minutes?

This relates to the interpretation of Standard 8.6. There remains confusion about whether a unit of red cells can be used, after it has been out of the fridge for more than 30 minutes. The Handbook of Transfusion Medicine, 3rd edition (McClelland, 2001) had the following statement: 'If the infusion is not started within 30 minutes, the pack must be returned to the blood bank and must be labelled to show 'out of fridge more than 30 minutes'.

Whereas the British Committee for Standards in Haematology (1999) guidelines state:

'If a unit of blood has been out of the refrigerator for more than 30 minutes and there is no prospect of its imminent transfusion, the hospital blood bank should be informed that it has been unrefrigerated for more than 30 minutes, and the blood returned to the hospital blood bank for disposal'.

In the 4th edition of the Handbook of Transfusion Medicine which is due to be published in the next 3 months, the statement has been rewritten to prevent it being ambiguous and being interpreted in several different ways. As yet, the wording has not been finalised, but the emphasis is likely to be on the maximum duration of the transfusion of a unit of blood, once it has been removed from the fridge.

The RCN guidance for improving transfusion practice is also to be published in the next few months. This document states that all blood components should be transfused within 4 hours of spiking the pack and within 4 hours of removal from blood fridge.

#### References and Further Reading

1. Bell et al (2002) Out-of-the-fridge temperature changes in red cell units Transfusion Medicine (12) Supplement 1 p6
2. British Committee for Standards in Haematology Blood Transfusion Task Force, 1999. Guidelines for the administration of blood and blood components and the management of transfused patients. London: BCSH. (III)
3. McClelland, DBL, 2001. Handbook of transfusion medicine. 3rd ed. London: Stationery Office. (III)

### 2. Which size needle is recommended for drawing-up medications for IM and IV use? How practical is it to use a 23G needle to draw-up viscous medications?

We would advocate the use of 'filter needles' for drawing up from glass ampoules, whenever possible, to minimise the risk of injecting glass particles into patients. However, if a filter needle cannot be obtained, a 23G needle should be used, unless the solution is oily or viscous, in which case a larger gauge needle should be used, as appropriate.

The risk of aspirating glass particles, associated with drawing-up medications from glass ampoules, is highlighted by Lye & Hwang (2003) and Meister (1998). They also identify the subsequent health risks to patients, from these glass particles and recommend the use of filter needles.

There is evidence to suggest that a small gauge needle will reduce the risk of aspirating glass particles, but this should be combined with avoiding aspiration from the dependent part of the ampoule, where glass particles numbers will be greater (Lye & Hwang 2003).

#### References

1. ASHP Guidelines on quality assurance for pharmacy prepared sterile products American Society for Health System Pharmacists at <http://www.ashp.org/bestpractices/guidelines> accessed 9.1.04
2. Lye ST & Hwang NC (2003) Glass particle contamination: is it here to stay? Anaesthesia (58) 1 93-94
3. Meister FL (1998) Filter needles and glass ampules AACCN (18) 4 at <https://www.aacn.org/aacn/practice.nsf/0/69d2c30ba9fa866c88256754006d7cde?OpenDocument> (accessed 14.4.04)

### 3. Standard 8.5 recommends that add-on devices such as, needleless systems should be changed at the same time as the administration set. However, we've recently introduced a new needleless system for TPN use, and the manufacturer recommends that the device should be changed every 7 days or after 100 actuations (which ever comes first). If we were to change the needleless device every 24 hours, it may defeat the purpose of using it. What do you suggest?

We would view the injection cap as part of the catheter, and not giving set. After all, it is better to maintain a closed system to reduce risk of infection with TPN, so it could be left on for 7 days.

### 4. I note that you advocate a small micron filter for TPN. We currently use larger filters as our pharmacist feels that small filters would 'clog up' with lipids. Do you have any suggestions?

Standard 8.5 states:

Parenteral nutrition solutions not containing lipids should be filtered with a 0.2 micron filter during administration. (Weinstein 2000), or as specified in the product information (BMA & RPS 2003).

Parenteral nutrition solutions not containing lipids should be filtered with a 0.2 micron filter during administration.

(Weinstein 2001), or as specified in the product information (BMA & RPS 2003).

This guidance is in line with the Infusion Nurses Society Guidelines (INS 2000) and the British Pharmaceutical Nutrition Group also concurs on the size of filters to be used (Bethune et al 2001). Whilst acknowledging that filters may become clogged, these statements are further supported by the American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.) in its Practice Guidelines for 'Safe Practices for Parenteral Nutrition Formulations' (p 87). Further details of the limitations of filters, their type, selection and size are identified in this publication and would be a useful resource for discussions with colleagues.

However, Smeltzer & Bare (2000 p850) suggest that: 'Amino acid-dextrose formulas should be infused using a 1.2 micron filter'. 'Fat emulsions (Intralipid) which are infused simultaneously through a Y-connector close to the infusion site, should not be filtered'. There are strict criteria which apply before commencing this administration. They also state that 'Total Parenteral Admixture refers to amino acid-dextrose-lipid (3 in 1 formulation) and should be administered using a special 1.5 micron filter'.

#### References

1. ASPEN (1998) Practice Guidelines for Safe practices for Parenteral Nutrition Formulations
2. Bethune et al (2001) Use of filters during the preparation and administration of parenteral nutrition: Position paper and guidelines prepared by a British Pharmaceutical Nutrition Group working party Nutrition (17) 5 403-408
3. BMA and RPS (2003) British National Formulary
4. Infusion Nurses Society (2000) Standards for Infusion Therapy Cambridge MA: INS ad Becton Dickinson
5. Smeltzer CSA & Bare BG (Editors) (2000) Brunner & Suddarth's Medical/Surgical Nursing Philadelphia: Lippincott 9th edition Unit 7
6. Weinstein SM (Ed) (2001) Plumer's principles and practice of intravenous therapy 7th ed Philadelphia: Lippincott Williams & Wilkins

#### 5. Can a nurse administer sodium chloride 0.9% flush without a prescription?

The flushing of VADs a very common practice and one which gives rise to many queries. The need for a prescription for the flush solution is a common concern. Sometimes, 'flushing' is included as part of an agreed protocol or procedure. However, the use of a Patient Group Direction (PGD) may be more appropriate. PGDs first came into use in 2000 and, according the National Prescribing Centre (2004), 'constitute a legal framework which allows certain health care professionals to supply and administer medicines to groups of patients that fit the criteria laid out in the PGD'.

There are a few websites which offer practical help with the development of PGDs, some of which contain examples which individual Trusts have volunteered to publish. Useful addresses include:  
www.mhra.gov.uk

www.druginfozone.org  
www.nurse-prescriber.co.uk

There is also a very useful document on PGDs from the National Prescribing Centre, which includes a helpful flowchart to assist practitioners in deciding whether or not a PGD is appropriate, which is available from:  
www.groupprotocols.org.uk

Further information about this clinical issue will soon be available on the IV Therapy Forum website, together with examples of specific PGDs related to flushing VADs and the use of local anaesthetic agent prior to cannulation.

#### Reference

NPC (2004) Patient Group Directions: A practical guide and framework of competencies for all professionals using patient group directions March

#### 6. Which Vascular Access Device (VAD) is most suitable for use in the community:

Peripheral cannula  
Midline catheter  
Peripherally Inserted Central Catheter (PICC)  
Tunnelled catheter  
Implanted port?

The choice of VAD is dependent on a number of different factors:

The patient's lifestyle and choice.

A detailed patient assessment is essential prior to any decision as to the choice of VAD to ensure that it is appropriate and manageable for the IV therapy, meets the patient's clinical needs and is acceptable to them.

The type of IV therapy or drug that is being administered. Consider the PH and osmolarity of the drug and are they compatible with the VAD?

Duration of therapy.

If this is more than a few days then should a midline or PICC be considered rather than a peripheral cannula?

Who is administering the IV therapy?

Is the VAD and its position (for example - left or right arm for midlines or PICCs) appropriate for the person who is administering the IV therapy?

If a peripheral cannula is used then who will resite this if needed? Will the patient have to travel back to hospital each time the cannula requires resiting? Consider the potential complications related to the VAD. Do they outweigh its benefits for use in the community?

#### Rurther Reading

Kayley J, Finlay T (2003) Vascular access devices for patients in the community. Community Practitioner 76(6) 228-231.

## Appendix 9: Issues in Clinical Practice

### 1. Syringe size – does it matter?

Appropriate syringe size is a widely debated topic. It is recommended that instillation, aspiration and flushing of vascular access devices should be performed using a method that is within the catheter manufacturer's maximum pressure limits in pounds per square inch (PSI). The syringe size used for unblocking vascular access devices (VADs) should be in accordance with the catheter manufacturer's guidelines, as excessive pressure may cause complications such as catheter separation and/or rupture, resulting in loss of catheter integrity (Conn, 1993; INS, 2000; RCN, 2003).

Macklin (1999) explains pressure as it relates to flushing of VADs. The safest way to use syringes with any vascular access device is to know how the syringe size impacts PSI. When flushing a VAD your thumb applies the force to the plunger of the syringe. When a force is applied to the plunger of a small syringe, a higher PSI will be generated than when the same force is applied to a larger syringe

A force of 3.5 PSI is required to move a syringe plunger on a small pre filled syringe. Thus when 3.5 PSI is applied to a 3ml syringe a little over 29 PSI is generated compared with a pressure of approximately 11 PSI if the same force is applied to the plunger of a 10 ml syringe (see table 1).

Table 1.

Pressures generated using varying forces against the plungers of 3 ml, 10 ml and 20 ml syringes

| Force applied to plunger (PSI) | Pressures generated by syringes |                   |                  |
|--------------------------------|---------------------------------|-------------------|------------------|
|                                | 3 ml                            | 10 ml             | 20 ml            |
| 1.0                            | 9.8 PSI/490mmHg                 | 3.1 PSI/155 mmHg  | 1.4 PSI/70 mmHg  |
| 3.0                            | 28.5 PSI/1425 mmHg              | 10.2 PSI/510 mmHg | 6.4 PSI/270 mmHg |
| 5.0                            | 48.5 PSI/2425 mmHg              | 18.3 PSI/915 mmHg | 9.7 PSI/485 mmHg |

1 PSI = 50 mmHg

Table 2.

The forces needed to withdraw liquid from a tube without creating a vacuum

| Syringe size | Force required |
|--------------|----------------|
| 1 ml         | 0.4 PSI        |
| 3 ml         | 1.3 PSI        |
| 5 ml         | 2.5 PSI        |
| 10 ml        | 3.75 PSI       |

PICCs have varying PSI limits but veins and cannulae have very different elastic capacities. The vein and the PICC must stretch to their limit before the pressure will rise. However once the PSI limit is passed rupture of the vein wall or catheter tubing is inevitable. It is the presence of an occlusion that allows pressure to build within a catheter. A partial occlusion such as a venous spasm or muscle contraction over the catheter track may occur at any time. Flushing before using a small syringe does not protect you from a random partial occlusion. If increased force is used when an occlusion is present catheter rupture can occur even with a 10 ml syringe (Macklin, 1999).

Use of small syringes is often raised as being problematic in paediatric IV therapy. Sometimes very small amounts of drugs are given necessitating the use of a syringe smaller than 10 ml to ensure accuracy of dose. With care, and, only if absolutely necessary, a small syringe may be used after catheter patency has been established. However it may be safer practice to transfer small volume medications to larger syringes for administration purposes. Conversely, the opposite applies when withdrawing blood from venous access device. When a smaller syringe is used in this instance, less force is applied to withdraw fluid from a catheter and so prevents a vacuum from being formed in the syringe barrel (see table 2). So if you can't withdraw from a catheter try a 5 ml syringe or smaller (Macklin, 1999).

### References

1. Conn C., (1993) The importance of syringe size when using implanted vascular access devices. *Journal of Vascular Access Networks* 3(1) p11-18
2. Macklin D., (1999) *Journal of Vascular Access Devices* 4(2) p7-11
3. Intravenous Nurses Society (2000) *Infusion nursing standards of practice*. INS:Cambridge, USA
4. Royal College of Nursing Intravenous Therapy Forum (2003) Standard 6.2 Maintaining patency

## 2. Blood withdrawal prior to flushing and drug administration

The patency of any vascular access device (VAD) should be established prior to administration of medicines and/or solutions (INS 2000; Maki 2002). McCloskey (2002) defined occlusion as:

- complete occlusion – inability to withdraw and infuse fluids.
- partial occlusion – difficulty in withdrawing.
- withdrawal occlusion – inability to withdraw blood, but the device retains its capacity to infuse fluids easily.

Any type of occlusion is an indication that something untoward is occurring with/in the patient's vascular access device (VAD). Complete occlusion can be a result of a blood clot or drug precipitation within the VAD itself or a fibrin sheath completely enveloping the device. Partial occlusion can be a consequence of a small blood clot within the lumen of the VAD, an external obstruction overlying the VAD for example, a tight anchoring device, or a thrombosis. A withdrawal occlusion can result from the formation of a fibrin tail or a malpositioned tip in a central vascular access device (CVAD) (McCloskey 2002; Roth 2003; Masoorli 2003).

To minimise the risk of extravasation injury to a patient, an adequate blood return should be obtained prior to administration of a medicine or infusion. If problems are encountered in freely withdrawing blood from the device, especially if a vesicant is going to be administered through a CVAD, the location of the catheter tip should be confirmed prior to use. On no account should a vesicant drug or vesicant infusion be administered through a CVAD where difficulty is experienced in withdrawing blood (Masoorli 2003).

As well as confirming the patency of the CVAD, obtaining an adequate blood return signifies that the catheter tip is positioned within a large blood vessel (Masoorli 2003). However, obtaining only a 'flash' of blood or 'pink-tinged sodium chloride' is not an indication that the catheter is functioning properly within the vein (Masoorli 2003). Determining that the catheter tip is positioned within a large blood vessel and that the CVAD is functioning properly will minimise the risk of extravasation injury to the patient (Masoorli 2003). Therefore checking for blood return is essential if vesicant drugs are to be administered (Masoorli 2003).

When it comes to withdrawing blood prior to 'routine' flushing of a VAD to maintain patency, many of us have received conflicting advice. In 2002, Maki presented a paper at the annual conference of National Association of Vascular

Access Networks (NAVAN) in San Diego, which highlighted the risks of infection associated with manipulation of VADs, especially the injection hubs. Contamination of injection hubs was first identified by Linares et al (1985) as the commonest cause of catheter-related septicaemia. Based on further research into this, Maki (2002) suggests that it is unnecessary to aspirate blood from a CVAD prior to routine flushing, as this is more likely to contribute to the risk of infection than decrease it.

The incidence of catheter-related infections can be greatly reduced by:

- ensuring a strict aseptic technique when undertaking the flushing of a CVAD
- minimising the manipulations to the catheter hub
- using needlefree systems
- ensuring the device is securely anchored to the patient's skin
- using an appropriate dressing.

## References

1. Infusion Nurses Society (INS) 2000 'Infusion Nursing Standards of Practice' in *Journal of Intravenous Nursing* 23 (6S), supplement.
2. McCloskey D. 2002. Reflux in Venous Access Devices – A Manageable Problem. Oral presentation NAVAN Conference San Diego, Ca
3. Maki D. G. 2002 The Promise of Novel Technology for Prevention of Intravascular Device-related Bloodstream Infection. Oral presentation NAVAN Conference San Diego, CA
4. Masoorli S. 2003 Extravasation Injuries associated with the use of central venous access devices. *Journal of Vascular Access Devices*. 21-23 Spring
5. Roth D. 2003 Extravasation injuries of peripheral veins: a basis for litigation? *Journal of Vascular Access Devices*. 13-19 Spring
6. Linares J, Sitges-Serra A, Garau J 1985 Pathogenesis of catheter sepsis: a prospective study with quantitative and semi-quantitative cultures of catheter hub and segments. *Journal of Clinical Microbiology* 21(3): 357-360

## 3. Checking for blood return to confirm patency prior to the administration of medications and/or solutions.

Standards 6.2 & 8.3 This issue has been the subject of much discussion and debate both before and since the publication of the RCN Standards for Infusion Therapy (RCN 2003). The Standards state that 'the nurse should aspirate the catheter and check for blood return to confirm patency prior to the administration of medications and/or solution' (INS 2000). There is a very useful algorithm (Appendix 5, page 65) to follow, if blood cannot be withdrawn from the catheter but fluids can be infused freely by gravity (London Standing Conference 2002).

This issue is particularly challenging for nurses working in the community as they do not have medical and nursing colleagues readily available to ask for advice if they are unable to get a blood return. Therefore whilst checking for blood return prior to the administration of medication

and/or infusions is best practice generally, and essential if vesicant drugs are to be administered there are also a number of other equally important issues that should be taken into account:

1. Information provided about the VAD
  - the exact position of the catheter tip should be known and documented.
  - whether the hospital have ever been able to get a blood return from the catheter.
  - information about the VAD including possible complications and the signs and symptoms of these (Kayley & Finley 2003).
  
2. A thorough patient assessment should be carried out, each time, a nurse visits to administer any IV medication and/or infusion. This should include:
  - asking the patient if s/he has any pain, discomfort, swelling in the area of the VAD or if s/he is experiencing any new/different symptoms.
  - asking the patient if s/he have pulled or caught the catheter.
  - measuring the length of the external portion of the catheter at each visit to ensure it remains the same, and documenting the length.
  - checking the exit site and surrounding area to ensure there is no visible swelling, exudate, redness or signs of infection (Kayley & Finley 2003).
  
3. Knowing about the medication/infusion that is to be administered:
  - is the drug a vesicant or hyperosmolar solution?
  - what is the pH and osmolarity of the drug?
  - how should it be given that is via a centrally placed catheter? (Kayley & Finley 2003).

It is important that all the relevant information and each patient assessment are clearly documented even if nothing abnormal is detected. If the community nurse is concerned about any aspect of the assessment then advice should be sought from the referring hospital unit or community IV specialist nurse (if appropriate). If a routine flush to maintain patency of the VAD is being carried out then there is no requirement to routinely withdraw blood and discard it prior to flushing (except prior to blood sampling, but not blood cultures) (RCN 2003).

## References

1. INS (2000) Standards for infusion therapy. Cambridge, MA: INS and Becton Dickinson.
2. Kayley J, & Finlay T (2003) Vascular access devices used for patients in the community. *Community Practitioner* 76(6): 228-231.
3. LSC (2002) Standards of care for external central venous catheters in adults. London, Standing Conference.
4. RCN (2003) Standards for infusion therapy. London, RCN and Becton Dickinson

## Appendix 10: Glossary

**Air embolism.** Presence of air in the vascular system. Venous air embolism may occur during insertion, use or maintenance of a central venous catheter and after catheter disconnection and removal. Symptoms of air embolism include: shortness of breath, altered consciousness, visual disturbance, hemiparesis, chest pain, and a low cardiac output state.

**Ambulatory infusion device.** Electronic infusion device specifically designed to be worn on the body to promote patient mobility and independence.

**Amino acids.** Organic components of protein.

**Ampoule.** Hermetically sealed glass medication container which must be broken at the neck to access the medication.

**Anastomosis.** Surgical formation of a passage between two normally distant structures, for example two blood vessels.

**Anti-free-flow administration set.** An administration set that stops when removed from the infusion device, yet allows gravity flow when the user manipulates the regulatory mechanism.

**Antimicrobial.** Preventing or destroying the growth and development of micro-organisms.

**Apheresis.** Apheresis involves the separation and subsequent collection of one or more blood components. Apheresis procedures include platelet depletion, therapeutic plasma exchange, red cell exchange, rapid red cell transfusion, white blood cell (mononuclear cell or polymorphonuclear cell) procedures and peripheral blood stem cell procedures.

**Arterial pressure monitoring.** Monitoring of arterial pressure through an in-dwelling arterial catheter connected to an electronic monitor.

**Arteriovenous (AV) fistula.** Surgical structure created between an artery and a vein, usually made of synthetic material.

**Aseptic technique.** Mechanisms employed to reduce potential contamination.

**Bacteria.** Micro-organisms that may be non-pathogenic (normal flora) or pathogenic (disease-causing).

**Bolus.** Concentrated medication and/or solution given rapidly over a short period of time.

**Body surface area.** Surface area of the body expressed in square meters. Used in calculating paediatric dosage, managing burn patients and determining radiation and chemotherapy dosage.

**Cannula.** Hollow tube made of silastic, rubber, plastic or metal, used for accessing the body.

**Cardiac tamponade.** The effusion of blood, air or pus into the pericardial sac, causing compression of the heart.

**Catheter.** Tube for injecting or evacuating fluids.

**Catheter dislodgement.** Movement of the catheter into and out of the insertion site. Causes of catheter dislodgment

include inappropriate securement of the catheter, and motion of the extremity, neck or shoulder. Catheter dislodgment may cause occlusion of the catheter and lead to a change in the catheter tip location. Signs and symptoms of catheter dislodgment include changes in the external length of the catheter, clinical signs of local catheter infection, and inability to flush or infuse via the catheter

**Central venous catheter.** Catheter inserted into a centrally located vein with the tip residing in the vena cava; permits intermittent or continuous infusion and/or access into the venous system.

**Chemical incompatibility.** Change in the molecular structure or pharmacological properties of a substance that may or may not be visually observed.

**Closed system.** Administration system with no mechanism for external entry after initial set-up and assembly.

**Colour coding.** System developed by manufacturers that identifies products and medications by the use of a colour system. Colour code systems are not standardised. Each manufacturer uses different colour code systems.

**Compatibility.** Capability to be mixed and administered without undergoing undesirable chemical and/or physical changes or loss of therapeutic action.

**Conscious sedation.** Minimally depressed level of consciousness in which the patient retains the ability to maintain a patent airway independently and continuously and to respond appropriately to physical stimulation and verbal commands. The drugs, doses and techniques used are not intended to produce loss of consciousness.

**Contamination.** Introduction or transference of pathogens or infectious material from one source to another.

**Criteria.** Relevant, measurable indicators.

**Critical or adverse incident.** an event or omission arising during clinical care and causing physical or psychological injury to a patient.

**Cross-contamination.** Movement of pathogens from one source to another.

**Curative.** Having healing or remedial properties.

**Cutdown.** Surgical procedure for locating a vein or artery.

**Delivery system.** Product that allows for the administration of medication. The system can be integral or can have component parts and includes all products used in the administration, from the solution container to the catheter.

**Disinfectant.** Agent that eliminates all micro-organisms except spores.

**Distal.** Farthest from the center or midline of the body or trunk, or farthest from the point of attachment; the opposite of proximal.

**Distention.** An increase in size because of pressure from within; stretching or inflation.

**Document.** Written or printed record containing original, official or legal information.

**Documentation.** Record in written or printed form, containing original, official, or legal information.



**Dome.** Plastic component used in haemodynamic monitoring.

**Electronic infusion device (EID).** Electronic instrument, either a pump (that is, positive pressure) or controller (that is, gravity-fed), used to regulate the flow rate of the prescribed therapy; often referred to as an electronic flow-control device.

**Embolus.** Mass of undissolved matter present in blood or lymphatic vessel. Emboli may be solid, liquid or gaseous.

**Epidemiology.** Study of the distribution and determinants of health-related states and events in populations; defines and explains the relationship between host, agent, and environment.

**Epidural space.** Space superior to the dura mater of the brain and the spinal cord and inferior to the ligamentum flavum.

**Epithelialised.** Grown over with epithelial cells; said of a wound or catheter site.

**Erythema.** Redness of skin along vein track that results from vascular irritation or capillary congestion in response to irritation; may be a precursor to phlebitis.

**Extravasation.** Inadvertent infiltration of vesicant solution or medication into surrounding tissue; rated by a standard scale.

**Extrinsic contamination.** Contamination that occurs after the manufacturing process of a product.

**Fat emulsion (lipid emulsion).** Combination of liquid, lipid and an emulsifying system suitable for intravenous use.

**Filter.** Special porous device used to prevent the passage of air or other undesired substances; product design determines size of substances retained.

**Fluid overload.** A fluid and electrolyte imbalance caused by the volume of fluid infusion into a patient.

**Free flow.** Non-regulated, inadvertent administration of fluid.

**Grade.** Degree of standing or value.

**Haemodynamic pressure monitoring.** General term for determining the functional status of the cardiovascular system as it responds to acute stress such as myocardial infarction and cardiogenic or septic shock. A pulmonary artery catheter is used to directly measure intracardiac pressure changes, cardiac output, blood pressure and heart rate.

**Haemolysis.** Destruction of the membrane of the red blood cells resulting in the liberation of haemoglobin, which diffuses into the surrounding fluid.

**Haemostasis.** Arrest of bleeding or of circulation.

**Haemothorax.** The presence of blood in the pleural space.

**Hypertonic.** Solution of higher osmotic concentration than that of a reference solution or of an isonic solution; having a concentration greater than the normal tonicity of plasma.

**Hypodermoclysis.** Injection of fluids into the subcutaneous tissues to supply the body with liquids quickly.

**Hypotonic.** Solution of lower osmotic concentration than that of a reference solution or of an isotonic solution; having a concentration less than the normal tonicity of plasma.

**Immunocompromised.** Having an immune system with reduced capability to react to pathogens or tissue damage.

**Implanted port.** A catheter surgically placed into a vessel or body cavity and attached to a reservoir located under the skin.

**Implanted pump.** A catheter surgically placed into a vessel or

body cavity and attached to a reservoir located under the skin that contains a pumping mechanism for continuous medication administration.

**Immunoglobulin therapy.** Intravenous immunoglobulin (IVIG) has been used in the treatment of primary and secondary antibody deficiencies for more than 20 years. IVIG has also been used to treat a variety of autoimmune or allergic diseases. IVIG is produced from human blood plasma pooled from many individual donations. Both the plasma donor and the donation are screened for clinically significant viruses. During production of IVIG, steps are taken to inactivate or remove any infectious agents. The mechanism of IVIG action is unknown. IVIG is usually administered on a monthly basis but can be given every two to three weeks.

**Incompatible.** Incapable of being mixed or used simultaneously without undergoing chemical or physical changes or producing undesirable effects.

**Infection.** Presence and growth of a pathogenic micro-organism.

**Infiltration.** Inadvertent administration of a non-vesicant solution or medication into surrounding tissue; rated by a standard scale.

**Infusate.** Parenteral solution administered into the vascular or non-vascular systems; infusion.

**Injection access site.** Resealable cap or other configuration designed to accommodate needles or needleless devices for administration of solutions into the vascular system.

**Intact system.** A closed infusion system.

**Intermittent intravenous therapy.** Intravenous therapy administered at prescribed intervals with periods of infusion cessation.

**Intraosseous.** Within the bone substance. The intraosseous route is an alternative for intravenous access in the critically ill or injured patient. This route is used for emergency drug administration, fluid resuscitation and access to the vascular system in situations where conventional routes cannot be utilised or would cause delays in treatment. The intraosseous access needle consists of a needle and stylet such as a standard bone marrow needle. The intraosseous access needle is advanced through the skin to the bony cortex where the needle is further advanced into the marrow cavity. The stylet is then removed prior to use. Any drug administered intravenously can be given via the intraosseous route.

**Intrathecal.** Within the spinal canal.

**Intrathecal chemotherapy.** The administration of cytotoxic drugs into the central nervous system via the cerebrospinal fluid by means of a lumbar puncture. Used in the treatment of leukaemia and lymphoma. Only thiopeta, cytarabine, methotrexate, hydrocortisone and interferon may be administered by this route.

**Intraventricular access device.** The Ommaya reservoir is an implanted ventricular access device that enables the delivery of drugs directly into the central nervous system. The Ommaya reservoir consists of a mushroom-shaped, self-sealing silicone port that is placed subcutaneously

underneath a scalp flap, usually in the frontal region. A ventricular catheter is attached to the reservoir and inserted into the lateral ventricle to provide access to the cerebrospinal fluid (CSF).

**Intrinsic contamination.** Contamination that occurs during the manufacturing process of a product.

**Investigational drug.** Drug undergoing investigation for a specific use via a clinical trial to determine its safety and effectiveness in humans.

**Irritant.** Agent capable of producing discomfort or pain at the venepuncture site or along the internal lumen of the vein.

**Isolation.** Separation of potentially infectious individuals for the period of communicability to prevent or limit direct or indirect transmission of the infectious agent.

**Isotonic.** Having the same osmotic concentration as the solution with which it is compared (that is, plasma).

**Laminar flow hood.** Contained work station with filtered air flow; assists in preventing bacterial contamination and collection of hazardous chemical fumes in the work area.

**Lipid emulsion.** See **Fat emulsion**.

**Lumen.** Interior space of a tubular structure, such as a blood vessel or catheter.

**Lymphoedema.** Swelling caused by obstruction of the lymphatic vessel(s).

**Manual flow-control device.** Manually operated device to control the flow rate of the infusion.

**Maximal barrier protection.** Equipment and clothing used to avoid exposure to pathogens, including mask, gown, protection eyewear, cap, sterile gloves, sterile drapes and towels.

**Medical act.** Procedure performed by a licensed physician.

**Microabrasion.** Superficial break in skin integrity that may predispose the patient to infection.

**Microaggregate.** Microscopic collection of particles such as platelets, leukocytes and fibrin that occurs in stored blood.

**Microaggregate blood filter.** Filter that removes microaggregates and reduces the occurrence of non-haemolytic febrile reactions.

**Micron ( $\mu$ ).** Unit of length equal to one-millionth of a meter, or one-thousandth of a millimeter.

**Micro-organism.** Minute living body not perceptible to the naked eye.

**Midline catheter.** A midline catheter is a device that is inserted via the antecubital veins and advanced into the veins of the upper arm but not extending past the axilla (usually about 20cm in length).

**Milliosmoles (mOsm).** One-thousandth of an osmole; osmotic pressure equal to one-thousandth of the molecular weight of a substance divided by the number of ions that the substance forms in a litre of solution.

**Morbidity rate.** Number of infected individuals or cases of disease in relation to a specific population.

**Mortality rate.** Death rate; ratio of number of deaths in a population to number of individuals in that population.

**Multiple-dose vial.** Medication bottle that is hermetically

sealed with a rubber stopper and is designed to be used more than once.

**Needleless system.** Substitute for a needle or a sharp access catheter, available in various designs, for example blunt, recessed and valve.

**Needlestick injury.** Needlestick injuries are wounds caused by needles that accidentally puncture the skin. Needlestick injuries are a hazard for people who work with needles and other sharps equipment. These injuries can occur at any time when people use, handle or dispose of needles. When not disposed of properly, needles can become concealed in linen or waste and injure other workers who encounter them unexpectedly. Needlestick injuries transmit infectious diseases, especially blood-borne viruses

**Nonpermeable.** Able to maintain integrity.

**Non-vesicant.** Intravenous medication that generally does not cause tissue damage or sloughing if injected outside a vein.

**Ocluded.** Blocked because of precipitation of infusate, clot formation or anatomic compression.

**Osmolality.** Characteristic of a solution determined by the ionic concentration of the dissolved substances per unit of solvent; measured in milliosmoles per kilogram.

**Osmolarity.** Number of osmotically active particles in a solution.

**Outcome.** Interpretation of documented results.

**Palliative.** Relieving or alleviating without curing.

**Palpable cord.** Vein that is rigid and hard to the touch.

**Palpation.** Examination by application of the hands or fingers to the external surface of the body in order to detect evidence of disease or abnormalities in the various organs.

**Parenteral.** Administered by any route other than the alimentary canal, for example by the intravenous, subcutaneous, intramuscular or mucosal routes.

**Parenteral nutrition.** Intravenous provision of total nutritional needs for a patient who is unable to take appropriate amounts of food enterally; typical components include carbohydrates, proteins and/or fats, as well as additives such as electrolytes, vitamins and trace elements.

**Particulate matter.** Matter relating to or composed of fine particles.

**Pathogen.** Micro-organism or substance capable of producing disease.

**PH.** Degree of acidity or alkalinity of a substance.

**Pharmacology.** Concerns the actions of medicines in the body.

**Pharmaceutics.** Concerns the formulation, manufacture/preparation, stability and packaging of medicines.

**Phlebitis.** Inflammation of a vein; may be accompanied by pain, erythema, oedema, streak formation and/or palpable cord; rated by a standard scale.

**Phlebotomy.** Withdrawal of blood from a vein.

**Physical incompatibility.** Undesirable change that is visually observed within a solution.

**Peripherally inserted central catheter (PICC).** Soft, flexible, central venous catheter inserted into an extremity and advanced until the tip is positioned in the lower third of the superior vena cava.

**Pneumothorax.** The presence of air between the pleura.

**Policy.** Written statement describing a course of action; intended to guide decision-making.

**Positive pressure.** Constant, even force within a catheter lumen that prevents reflux of blood; achieved by clamping while injecting or by withdrawing the needle from the catheter while injecting.

**Post-infusion phlebitis.** Inflammation of the vein occurring after the infusion has been terminated and the catheter removed, usually identified within 48 hours after removal.

**Pounds per square inch (PSI).** Measurement of pressure. One PSI equals 50 mm Hg or 68 cm H<sub>2</sub>O.

**Preservative-free** . Containing no added substance capable of inhibiting bacterial contamination.

**Procedure.** Written statement of steps required to complete an action.

**Process.** Actual performance and observation of performance based on compliance with policies, procedures, and professional standards.

**Product integrity.** Condition of an intact, uncompromised product suitable for intended use.

**Proximal.** Closest to the centre or midline of the body or trunk, or nearer to the point of attachment; the opposite of distal.

**Psychomotor.** Characterising behaviours that place primary emphasis on the various degrees of physical skills and dexterity as they relate to the thought process.

**Purulent.** Containing or producing pus.

**Push.** Manual administration of medication under pressure.

**Quality assurance/performance improvement.** An ongoing, systematic process for monitoring, evaluating and problem solving.

**Radiopaque.** Impenetrable to X-rays or other forms of radiation; detectable by radiographic examination.

**Risk management.** Process that centres on identification, analysis, treatment and evaluation of real and potential hazards.

**Safety device system.** Engineered physical attribute of a device that effectively reduces the risk of bloodborne pathogen exposure.

**Scale.** Tool to measure gradations.

**Sclerosis.** Thickening and hardening of the layers in the wall of the vessel.

**Semiquantitative culture technique.** Laboratory protocol for isolating and identifying micro-organisms.

**Sepsis.** Presence of infectious micro-organisms or their toxins in the bloodstream.

**Sharps.** Objects in the healthcare setting that can be reasonably anticipated to penetrate the skin and to result in an exposure incident, including but not limited to needle devices,

scalpels, lancets, broken glass or broken capillary tubes.

**Single-use vial.** Medication bottle that is hermetically sealed with a rubber stopper and is intended for one-time use.

**Site protection material.** Material used to protect an infusion catheter insertion site.

**Skin tunnelled catheter.** Vascular access device whose proximal end is tunnelled subcutaneously from the insertion site and brought out through the skin at an exit site.

**Speedshock.** The rapid uncontrolled administration of a drug, where symptoms occur as a result of speed with which medication is administered rather than the volume of drug/fluid. This can therefore occur even with small volumes.

**Standard.** Authoritative statement enunciated and promulgated by the profession by which the quality of practice, service or education can be judged.

**Statistics.** Systematic collection, organisation, analysis and interpretation of numerical data.

**Sterile.** Free from living organisms.

**Structure.** Elements on which a programme is based, including resources such as federal and state laws, professional standards, position descriptions, patient rights, policies and procedures, documentation, quality controls and corrective action programmes.

**Stylet.** Rigid metal object within a catheter designed to facilitate insertion.

**Surfactant.** Surface-active agent that lowers the surface tension of fluid.

**Surveillance.** Active, systematic, ongoing observation of the occurrence and distribution of disease within a population and the events or conditions that alter the risk of such occurrence.

**Tamper-proof.** Unable to be altered.

**Thrombolytic agent.** Pharmacological agent capable of dissolving blood clots.

**Thrombophlebitis.** Inflammation of the vein in conjunction with formation of a blood clot (thrombus).

**Thrombosis.** Formation, development or existence of a blood clot within the vascular system.

**Transfusion therapy.** A transfusion consists of the administration of whole blood or any of its components to correct or treat a clinical abnormality

**Transducer.** Device that converts one form of energy to another.

**Transparent semipermeable membrane (TSM).** Sterile, air-permeable dressing that allows visual inspection of the skin surface beneath it; water-resistant.

**Universal precautions.** Guidelines designed to protect workers with occupational exposure to bloodborne pathogens.

**Vesicant.** Agent capable of causing injury when it escapes from the intended vascular pathway into surrounding tissue.

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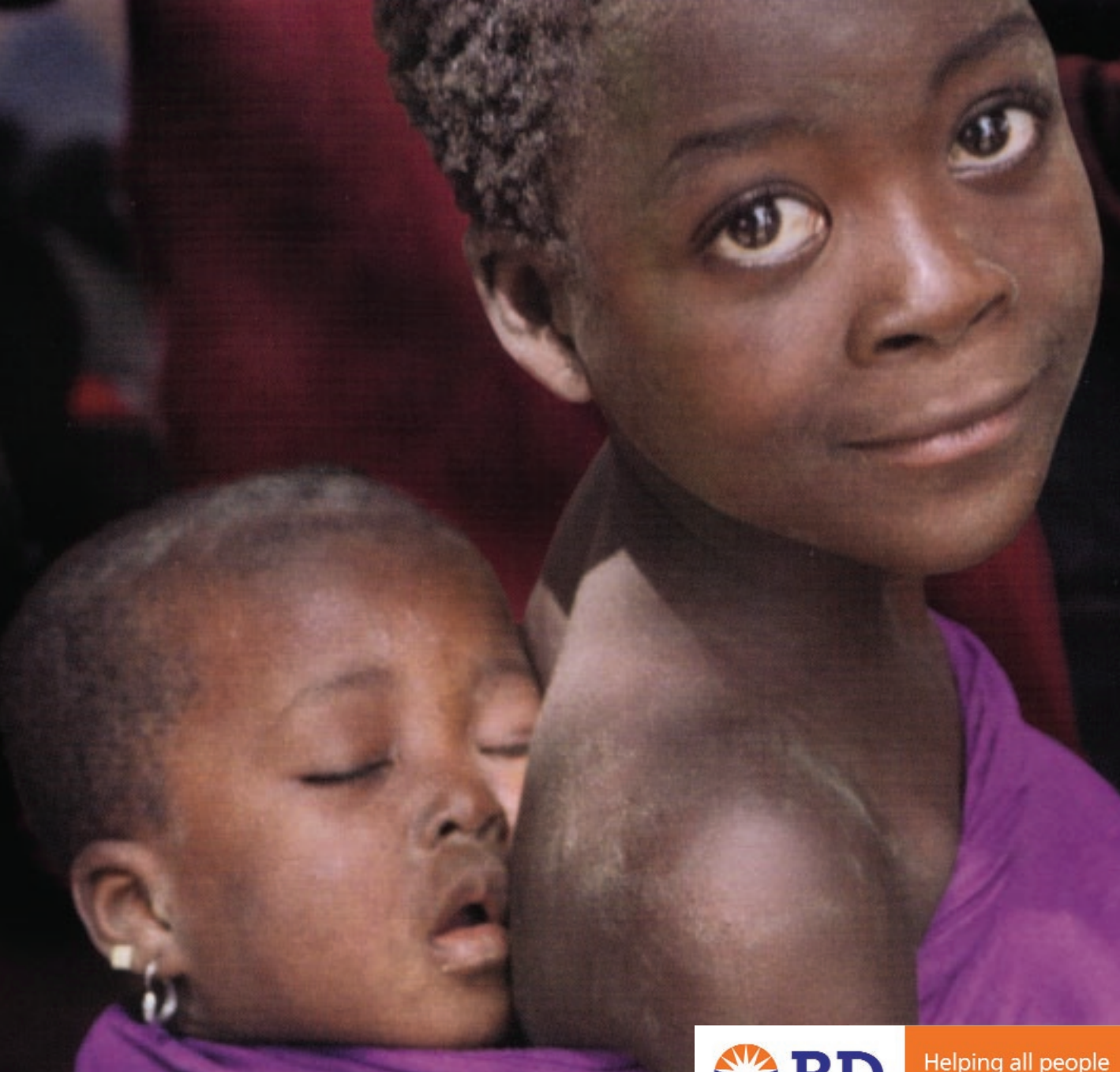
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