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## *Nursing Best Practice Guideline* *Shaping the future of Nursing*

# *Care and Maintenance to Reduce Vascular Access Complications*



**RNAO**

Registered Nurses' Association of Ontario  
L'Association des infirmières et infirmiers  
autorisés de l'Ontario

NURSING BEST PRACTICE GUIDELINES PROGRAM



## *Greetings from Doris Grinspun*

### *Executive Director*

### *Registered Nurses' Association of Ontario*

It is with great excitement that the Registered Nurses' Association of Ontario (RNAO) disseminates this nursing best practice guideline to you. Evidence-based practice supports the excellence in service that nurses are committed to deliver in our day-to-day practice.

We offer our endless thanks to the many institutions and individuals that are making RNAO's vision for Nursing Best Practice Guidelines (NBPGs) a reality. The Government of Ontario recognized RNAO's ability to lead this program and is providing multi-year funding. Tazim Virani – NBPG program director – with her fearless determination and skills, is moving the program forward faster and stronger than ever imagined. The nursing community, with its commitment and passion for excellence in nursing care, is providing the knowledge and countless hours essential to the creation and evaluation of each guideline. Employers have responded enthusiastically to the request for proposals (RFP), and are opening their organizations to pilot test the NBPGs.

Now comes the true test in this phenomenal journey: Will nurses utilize the guidelines in their day-to-day practice?

Successful uptake of these NBPGs requires a concerted effort of four groups: nurses themselves, other healthcare colleagues, nurse educators in academic and practice settings, and employers. After lodging these guidelines into their minds and hearts, knowledgeable and skillful nurses and nursing students need healthy and supportive work environments to help bring these guidelines to life.

We ask that you share this NBPG, and others, with members of the interdisciplinary team. There is much to learn from one another. Together, we can ensure that Ontarians receive the best possible care every time they come in contact with us. Let's make them the real winners of this important effort!

RNAO will continue to work hard at developing and evaluating future guidelines. We wish you the best for a successful implementation!

Doris Grinspun, RN, MSN, PhD (cand), OOnt



Executive Director

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## How to Use this Document

**This nursing best practice guideline** is a comprehensive document providing resources necessary for the support of evidence-based nursing practice. The document needs to be reviewed and applied, based on the specific needs of the organization or practice setting/environment, as well as the needs and wishes of the client. Guidelines should not be applied in a “cookbook” fashion but used as a tool to assist in decision making for individualized client care, as well as ensuring that appropriate structures and supports are in place to provide the best possible care.

Nurses, other healthcare professionals and administrators who are leading and facilitating practice changes will find this document valuable for the development of policies, procedures, protocols, educational programs, assessments and documentation tools. It is recommended that the nursing best practice guidelines be used as a resource tool. Nurses providing direct client care will benefit from reviewing the recommendations, the evidence in support of the recommendations and the process that was used to develop the guidelines. However, it is highly recommended that practice settings/environments adapt these guidelines in formats that would be user-friendly for daily use. This guideline has some suggested formats for such local adaptation and tailoring.

Organizations wishing to use the guideline may decide to do so in a number of ways:

- Assess current nursing and healthcare practices using the recommendations in the guideline.
- Identify recommendations that will address identified needs or gaps in services.
- Systematically develop a plan to implement the recommendations using associated tools and resources.

RNAO is interested in hearing how you have implemented this guideline. Please contact us to share your story. Implementation resources will be made available through the RNAO website to assist individuals and organizations to implement best practice guidelines.



## *Care and Maintenance to Reduce Vascular Access Complications*

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Declarations of interest and confidentiality were made by all members of the guideline development panel. Further details are available from the Registered Nurses’ Association of Ontario.

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## *Care and Maintenance to Reduce Vascular Access Complications*

### **Disclaimer**

These best practice guidelines are related only to nursing practice and not intended to take into account fiscal efficiencies. These guidelines are not binding for nurses and their use should be flexible to accommodate client/family wishes and local circumstances. They neither constitute a liability or discharge from liability. While every effort has been made to ensure the accuracy of the contents at the time of publication, neither the authors nor the Registered Nurses' Association of Ontario (RNAO) give any guarantee as to the accuracy of the information contained in them nor accept any liability, with respect to loss, damage, injury or expense arising from any such errors or omission in the contents of this work. Any reference throughout the document to specific pharmaceutical products as examples does not imply endorsement of any of these products.

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## Summary of Recommendations

RECOMMENDATION		*LEVEL OF EVIDENCE
<b>Practice Recommendations</b>		
Site Selection: Peripheral	1.0 Nurses will select a peripheral insertion site appropriate for the required therapy and with the least risk of complication.	IV
Site and Catheter Care Safety/Infection Prevention Control	2.0 Nurses will prevent the spread of infection by following routine practices and using additional precautions.	IV
Skin Antisepsis	3.0 Nurses will consider the following factors when performing catheter site care using aseptic technique: ■ Catheter material (composition); ■ Antiseptic solution; and ■ Client's tolerance (skin integrity, allergies, pain, sensitivity and skin reaction)	IV
		IV
Tip Placement	4.0 Nurses will not use the central venous access device (CVAD) until tip placement has been confirmed.	
Dressings	5.0 Nurses will consider the following factors when selecting and changing VAD dressings: ■ Type of dressing; ■ Frequency of dressing changes; and ■ Client's choice, tolerance and lifestyle.	IV
Securement	6.0 Nurses must stabilize the VAD in order to: ■ Promote assessment and monitoring of the vascular access site; ■ Facilitate delivery of prescribed therapy; and ■ Prevent dislodgement, migration, or catheter damage.	III
Patency/Flushing/ Locking	7.0 Nurses will maintain catheter patency using flushing and locking techniques.	IV
	8.0 Nurses will know what client factors, device characteristics and infusate factors can contribute to catheter occlusion in order to ensure catheter patency for the duration of the therapy.	IV
Occlusion	9.0 Nurses will assess and evaluate vascular access devices for occlusion in order to facilitate treatment and improve client outcomes.	IV
Blood Withdrawal	10.0 Nurses will minimize accessing the central venous access device (CVAD) in order to reduce the risk of infection and nosocomial blood loss.	IV
Add-Ons	11.0 Nurses will change all add-on devices a minimum of every 72 hours	IV
Documentation	12.0 Nurses will document the condition of vascular access devices including: ■ The insertion process; ■ Site assessment; and ■ Functionality.	III
Client Education	13.0 Nurses will help clients to attain the highest level of independence through client education.	IV

\* Please refer to page 12 for *Interpretation of Evidence*.

## Summary of Recommendations

RECOMMENDATION		*LEVEL OF EVIDENCE
<b>Education Recommendations</b>		
	<p><b>14.0</b> The principles and practice of infusion therapy should be included in the basic education curriculum, be available as continuing education, be provided in orientation to new employees and be made available through continuing professional development opportunities.</p> <p><b>15.0</b> Schools of Nursing will include RNAO best practice guidelines <i>Assessment and Device Selection for Vascular Access</i> and <i>Care and Maintenance to Reduce Vascular Access Complications</i> as reference material for core curricula.</p>	<p>IV</p> <p>IV</p>
<b>Organization &amp; Policy Recommendations</b>		
	<p><b>16.0</b> Health care organizations will have policies that address components of vascular access therapy in order to ensure positive client outcomes.</p> <p><b>17.0</b> Health care organizations, in collaboration with their infection control teams, will monitor complications of infusion therapy and use data to employ risk reduction strategies.</p> <p><b>18.0</b> Health care organizations will implement the use of safety engineered devices and equipment to reduce the nurse's risk of sharps injuries that can lead to blood borne diseases. The organization's risk management program will monitor assessment of these practices and incidents.</p> <p><b>19.0</b> Health care organizations have access to infusion therapy nursing expertise to support optimal vascular access outcomes.</p> <p><b>20.0</b> Nursing best practice guidelines can be successfully implemented only where there are adequate planning, resources, organizational and administrative support, as well as appropriate facilitation. Organizations may wish to develop a plan for implementation that includes:</p> <ul style="list-style-type: none"> <li>■ An assessment of organizational readiness and barriers to education.</li> <li>■ Involvement of all members (whether in a direct or indirect supportive function) who will contribute to the implementation process.</li> <li>■ Dedication of a qualified individual to provide the support needed for the education and implementation process.</li> <li>■ Ongoing opportunities for discussion and education to reinforce the importance of best practices.</li> <li>■ Opportunities for reflection on personal and organizational experience in implementing guidelines.</li> </ul> <p>In this regard, RNAO (through a panel of nurses, researchers and administrators) has developed the <i>Toolkit: Implementation of Clinical Practice Guidelines</i> based on available evidence, theoretical perspectives and consensus. The Toolkit is recommended for guiding the implementation of the RNAO guideline <i>Care and Maintenance to Reduce Vascular Access Complications</i>.</p>	<p>IV</p> <p>IV</p> <p>III</p> <p>III</p> <p>IV</p>

## *Interpretation of Evidence*

### Levels of Evidence

- Ia Evidence obtained from meta-analysis or systematic review of randomized controlled trials.
- Ib Evidence obtained from at least one randomized controlled trial.
- IIa Evidence obtained from at least one well-designed controlled study without randomization.
- IIb Evidence obtained from at least one other type of well-designed quasi-experimental study without randomization.
- III Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies.
- IV Evidence obtained from expert committee reports or opinions and/or clinical experiences of respected authorities.



## Responsibility for Development

The Registered Nurses' Association of Ontario (RNAO), with funding from the Government of Ontario, has embarked on a multi-year project of nursing best practice guideline development, pilot implementation, evaluation and dissemination. In this sixth cycle of the project program, one of the areas of emphasis is on vascular access care and management to reduce complications for the client. This guideline was developed by a panel of nurses convened by the RNAO, conducting its work independent of any bias or influence from the Ontario Government of Ontario.

## Purpose & Scope

**Best practice guidelines (BPG)** are systematically developed statements to assist practitioners' and clients' decisions about appropriate health care (Field & Lohr, 1990). This best practice guideline focuses on assisting all nurses in diverse practice settings, both institutional and community, who provide care to clients requiring vascular access. This guideline incorporates best practices related to the care and maintenance of vascular access devices applicable to all adult clients requiring this kind of care. It should be noted that the main focus of this guideline is the care and maintenance of central venous access devices (CVAD); however, where care and maintenance strategies can be used for both CVAD and peripheral venous access devices (PVAD), this has been articulated in the specific recommendations. This guideline does not include recommendations related to the care of clients requiring infusion therapy through the following devices: arterial lines, hemodialysis catheters, pulmonary artery lines, pheresis lines, epidural catheters, pressure monitoring devices, umbilical vein, femoral catheters, and/or intraosseous lines. Nurses working with other types of vascular access devices will require further practice direction from guidelines in their unique area of practice.

As part of the health care team, nurses caring for clients with indwelling vascular access devices have an important role in providing safe infusion therapy. This guideline focuses its recommendations on: *Practice Recommendations* that assist the nurse to provide appropriate care for the client, including site selection, site care, and catheter care; *Education Recommendations* for supporting the knowledge, skills, and judgment required for nurses; and *Organization and Policy Recommendations* addressing the importance of a supportive practice environment as an enabling factor for providing high quality nursing care, which includes ongoing evaluation of guideline implementation.

The purpose of this guideline is to provide evidence-based support for nurses related to the care and maintenance of vascular access devices, client education and safety. Specific clinical questions to be addressed include:

- How can the risk of complications be minimized through appropriate care and maintenance of vascular access devices?
- What strategies should be used for client and staff education to address the care and maintenance of vascular access devices?

It is acknowledged that the individual competencies of nurses varies between nurses and across categories of nursing professionals (RPNs and RNs) and are based on knowledge, skills, attitudes, critical analysis and

## *Care and Maintenance to Reduce Vascular Access Complications*

decision making which are enhanced over time by experience and education. It is expected that individual nurses will perform only those aspects of care and maintenance for vascular access devices for which they have received appropriate education and have experience. It is expected that nurses will seek appropriate consultation in instances where the client's care needs surpass the nurse's ability to act independently. It is acknowledged that effective healthcare depends on a coordinated health care team approach incorporating ongoing communication between health professionals and clients, ever mindful of the personal choices and unique needs of each individual client.

## *Development Process*

**In June of 2004**, a panel of nurses with expertise in vascular access from institutional, community, educational and industry settings (including vendor companies) was convened under the auspices of the RNAO. At the outset, the panel established the scope of the guideline through a process of discussion and consensus. It was decided to focus on the care and maintenance of vascular access in order to reduce complications for the client.

A set of nine published guidelines related to vascular access care and maintenance were identified through a structured search, the details of which are described in *Appendix A*. These guidelines were reviewed according to a set of screening criteria, established through panel consensus, which resulted in the elimination of two guidelines. The screening criteria used were:

- Guideline was in English;
- Guideline was dated no earlier than 2000;
- Guideline was strictly about the topic area;
- Guideline was evidence-based; and
- Guideline was available and accessible for retrieval.

Seven guidelines were critically appraised with the intent of identifying existing guidelines that were current, developed with rigour, evidenced-based and which addressed the scope identified by the panel for this best practice guideline. A quality appraisal was conducted on these seven clinical practice guidelines using the *Appraisal of Guidelines for Research and Evaluation (AGREE) Instrument* (AGREE Collaboration, 2001). This process yielded a decision to work primarily with five existing guidelines including:

1. Centers for Disease Control and Prevention (CDC) (2002). Guidelines for the prevention of intravascular catheter-related infections. *Morbidity and Mortality Weekly Report (MMWR)* 51 (No. RR-10), 1-29.
- 2a. Department of Health (DH) (2001a). Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters: Introduction. *Journal of Hospital Infection* 47, S13-S19.
- 2b. Department of Health (DH) (2001b). Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters. *Journal of Hospital Infection* 47, S47-S67.
- 3a. Evidence-Based Practice in Infection Control (EPIC) (2001a). *The EPIC project: Developing national evidence-based guidelines for preventing hospital-acquired infections. National evidence-based guidelines for preventing hospital-acquired infections associated with the use of central venous catheters. Technical report part A.* Available: <http://www.epic.tvu.ac.uk/epicphase/epic1.html>
- 3b. Evidence-Based Practice in Infection Control (EPIC) (2001b). *The EPIC project: Developing national evidence-based guidelines for preventing hospital-acquired infections. National evidence-based guidelines for preventing hospital-acquired infections associated with the use of central venous catheters. Technical report part B.* Available: <http://www.epic.tvu.ac.uk/epicphase/epic1.html>
4. Intravenous Nurses Society (INS) (2000). Infusion nursing: Standards of practice. *Journal of Intravenous Nursing*, 23, S1-S88.
5. Royal College of Nursing (RCN) (2003). *Standards for infusion therapy*. London: Author.

The panel members divided into subgroups to undergo specific activities using the short-listed guidelines, other literature and additional resources for the purpose of drafting recommendations. This process yielded a draft set of recommendations. The panel members as a whole reviewed the recommendations, discussed gaps, available evidence and came to consensus on a draft guideline.

This draft was submitted to a set of external stakeholders for review and feedback. An acknowledgement of these reviewers is provided at the front of this document. Stakeholders represented various health care disciplines, clients and families, as well as professional associations. External stakeholders were provided with specific questions for comment, as well as the opportunity to give overall feedback and general impressions. The results were compiled and reviewed by the development panel. Discussion and consensus resulted in revisions to the draft document prior to publication.

## Definition of Terms

For terms not included here, please refer to *Appendix B: Glossary of Clinical Terms*.

**Clinical Practice Guidelines or Best Practice Guidelines:** Systematically developed statements to assist practitioner and client decisions about appropriate health care for specific clinical (practice) circumstances (Field & Lohr, 1990).

**Consensus:** A process for making decisions, not a scientific method for creating new knowledge. At its best, consensus development merely makes the best use of available information, be that scientific data or the collective wisdom of the participants (Black et al., 1999).

**Education Recommendations:** Statements of educational requirements and educational approaches/strategies for the introduction, implementation and sustainability of the best practice guideline.

**Infusion Therapy:** The parenteral administration of fluids, medications, nutritional support, and transfusion of blood and blood products, delivered through a vascular access device (VAD) inserted into a peripheral or central vein.

**Organization & Policy Recommendations:** Statements of conditions required for a practice setting that enable the successful implementation of the best practice guideline. The conditions for success are largely the responsibility of the organization, although they may have implications for policy at a broader government or societal level.

**Practice Recommendations:** Statements of best practice directed at the practice of healthcare professionals that are ideally evidence-based.

**Vascular Access Devices:** Catheters placed directly into the venous system for infusion therapy and/or phlebotomy purposes.

## *Background Context*

**Vascular Access Devices (VADs)** are a common and important part of clinical practice for the administration of parenteral fluids, nutrients, medications and blood products. In addition, VADs provide a route to monitor the hemodynamic status of a client. Over the last two decades vascular access device (VAD) technology has advanced and new treatment regimens have emerged. These changes bring with them the desire to support best practice to provide more effective vascular access care. The desired clinical goal is positive client outcomes as evidenced by completion of therapy, absence of complications and client satisfaction with care delivery.

Nurses practicing vascular access care require the knowledge, skill, and judgment to manage VADs. The clinical focus is on the prevention of complications; however if complications develop, nurses must recognize, report, and intervene appropriately for positive client outcomes.

Nurses with additional education and clinical expertise in infusion therapy serve as clinical champions and advocates. This specialized role, in concert with supportive organizational structures and processes, leads to improved overall infusion practice and client outcomes (Centers for Disease Control and Prevention (CDC), 2002; Farr, 1996; Fridkin et al., 1996; Intravenous Nurses Society (INS), 2000; Miller et al., 1996). As an integral part of the multidisciplinary team, these nurses create a link between all aspects of care and bridge the gap between hospital and community.

Healthcare organizations are challenged by nursing shortages. In particular the role of the infusion nurse specialists in Ontario has been reduced due to downsizing and constrained resources. Clients are more acutely ill, and have more complex care needs than ever before. Therefore, a nursing assessment of risk factors, device selection, and catheter maintenance to minimize complications is a critical factor to client recovery and survival (Mezey & Schoder, 2003). These skills are required by all nurses in order to ensure the best possible client outcomes, recognizing limited resources.



## Care and Maintenance to Reduce Vascular Access Complications

### Critical Thinking

In nursing, critical thinking is crucial to the potential impact on client outcomes and is often viewed as reasonable, purposeful or goal-directed. Critical thinking, although dependent on clinical reasoning that is creative and intuitive, is contextual and changes depending on circumstances. Critical thinking is defined as the “intellectually disciplined process of actively and skillfully conceptualizing, applying, synthesizing, or evaluating information” (Zunkel, et al., 2004, p. 162).

Scheffer and Rubenfeld (2000) recently reported the results of an attempt to define the concept of critical thinking in nursing. Fifty-five nursing experts from nine countries participated in the investigation. This panel of experts identified the characteristics and skills essential for critical thinking in nursing. Although complete consensus was not achieved, 45 of the 51 participating experts agreed on the following definition of critical thinking: “Critical thinking in nursing is an essential component of professional accountability and quality nursing care.... Critical thinkers in nursing practice the cognitive skills of analyzing, applying standards, discriminating, information seeking, logical reasoning, predicting and transforming knowledge” (Scheffer & Rubenfeld, 2000, p. 357).

It is important for nurses to apply critical thinking skills when performing comprehensive assessments related to appropriate device selection. These would include but are not limited to prescribed therapy, support system/resources, client preference, language/cultural barriers, lifestyle and occupation, and other variables as outlined in the *Assessment and Device Selection for Vascular Access* nursing best practice guideline (RNAO, 2004). These same assessment criteria are also essential when providing care and maintenance of vascular access devices.

To decrease the risk of complications associated with the use of vascular access devices, it is essential not only to develop guidelines but to have a process for the implementation of the guidelines. While the content of this guideline provides practical direction to practitioners, the need to apply critical thinking skills in problem solving and decision making is recognized as key to the successful implementation of this guideline into direct practice.



## *Practice Recommendations*

**This best practice guideline is developed** on the foundation provided by the following standards of practice of the College of Nurses of Ontario (CNO):

*Practice guideline: Consent* (CNO, 2004a), which provides an overview of the major features of the legislation, pertinent definitions and the steps nurses need to take to obtain consent. It does not address consent under the Mental Health Act.

*Practice guideline: Culturally sensitive care* (CNO, 2004b), which guides nurses in problem solving for commonly encountered culturally sensitive situations.

*Practice guideline: Disagreeing with the multidisciplinary plan of care: Fact sheet* (CNO, 2004c), which was developed to provide direction to nurses when they disagree with other care providers regarding the plan of care or when they believe the client has not been given informed consent to the plan. It provides the nurse with a tool for advocacy.

*Practice guideline: Guide to decide* (CNO, 2004d), which was designed to assist nurses to understand their accountability in performing procedures and provides a framework for decision making.

*Practice guideline: Medical directives – Revised 2000* (CNO, 2004e), which may be implemented for a number of clients when specific conditions are met, and when specific circumstances exist.

*Practice standard: Confidentiality and privacy – personal health information* (CNO, 2004f), which provides an overview of current Ontario legislation, and clarifies nursing standards for confidentiality and of privacy health information.

*Practice standard: Documentation* (CNO, 2004g), which outlines nurses' professional accountability in record keeping, and the expectations for documentation for all nurses in direct practice.

*Practice standard: Ethics* (CNO, 2004h), which describes the ethical values that are most important to the nursing profession in Ontario.

*Practice standard: Infection prevention and control* (CNO, 2004i), which describes a nurse's role in infection prevention and control, recognizing that some client care situations may require consultation with an Infection Control Practitioner.

*Practice standard: Medication* (CNO, 2004j) which provides standards for nurses to administer medications safely and effectively in all practice settings.

## Care and Maintenance to Reduce Vascular Access Complications

*Practice standard: Professional standards – Revised 2002* (CNO, 2004k) which outlines professional expectations for all Ontario nurses in the areas of service to the public, knowledge, application of knowledge, ethics, continued competence and accountability/responsibility.

*Practice standard: Therapeutic nurse-client relationship* (CNO, 2004l), which provides direction, regarding establishing therapeutic nurse-client relationships.

In addition to the College of Nurses of Ontario documents identified above, it is expected that nurses will have knowledge of workplace policies and procedures that support infusion therapy and management within their organization. The nurse should also consider current legislation in the province or country in which they practice.

### Site Selection: Peripheral

#### Recommendation 1.0

Nurses will select a peripheral insertion site appropriate for the required therapy and with the least risk of complication.

*Level IV*

### Discussion of Evidence

When selecting a site for a peripheral venous access device (PVAD) insertion, the nurse should:

- Avoid areas of flexion (INS, 2000);
- Avoid the inner aspect of the wrist in order to decrease the risk of damage to the radial, ulnar, and/or median nerves which are located within a five centimetre (cm) radius of the inner aspect of the wrist (Masoorli, 1998; Thrush, 1995);
- Avoid the routine use of the veins of the lower extremities due to the increased risk of embolism, thrombophlebitis of and infection (CDC, 2002; INS, 2000; Tagalakakis, 2002);
- Choose the smallest gauge catheter to accommodate the prescribed therapy (INS, 2000);
- Choose a vein with a diameter and blood flow rate for adequate hemodilution of prescribed therapy. For example: a one time dose of dilantin which has a pH of 12, should be infused using a 22 gauge PVAD into a vein with a high blood flow rate for greatest hemodilution. Venous blood flow rates to be considered are as follows:
  - Dorsal arch for metacarpal veins (hand veins) diameter varies, with flow rate 10ml/min;
  - Cephalic vein: 6mm diameter with flow rate 40ml/min at the level of the antecubital fossa and above; and
  - Basilic vein: 8mm diameter with flow rate of 95ml/min at the level of the antecubital fossa and above. See *Appendix C: Vein Anatomy & Blood Flow Rates*, for a visual depiction of site location.
- Avoid the the antecubital fossa and metacarpal veins if a vesicant has to be peripherally delivered due to the difficulty in detecting infiltration at these sites of flexion (Oncology Nursing Society (ONS), 2004).
- Assess the type of solution, pH, osmolarity, estimated volume of the infusate and vein condition prior to selecting an alternative site due to infiltration/extravasation (INS, 2000).

For CVAD site selection, refer to RNAO (2004) best practice guideline: *Assessment and Device Selection for Vascular Access*.

**Alert:** Clients receiving vascular access therapy longer than six days should be assessed for intermediate to long-term dwelling devices. Refer to the RNAO (2004) best practice guideline *Assessment and Device Selection for Vascular Access*.

## Site & Catheter Care

### Safety/Infection Prevention and Control

#### Recommendation 2.0

Nurses will prevent the spread of infection by following routine practices and using additional precautions.

Level IV

#### Discussion of Evidence:

In Ontario, nurses are expected to follow infection control standards of practice as outlined by the College of Nurses of Ontario (CNO, 2004) and by Health Canada (Public Health Agency of Canada (PHAC), 1998, 1999, 2003). Infection prevention and control is based on two levels of precautions:

- Routine practices; and
- Additional precautions.

Routine practices, prevention strategies ***used with all clients at all times***, are based on the assumption that all blood and certain body fluids have the potential to harbour infectious organisms (e.g., bacteria, virus or fungus). Routine practices reduce the risk of exposure to:

- Blood, including blood products, and materials soiled with blood;
- All body fluids (secretions and excretions) except sweat, regardless of whether they contain blood (e.g., urine, feces, semen, vaginal and respiratory secretions, cerebral spinal fluid);
- Non-intact skin, weeping or draining lesions or wounds; and
- Mucous membranes: eyes, nose, mouth, rectum or vagina (PHAC, 1999).

Routine practices include:

- Hand hygiene;
- Assessment of client risk factors;
- Screening;
- Hazard or risk reduction; and
- Application of personal protective equipment (PPE).

#### Hand Hygiene

Hand hygiene reduces the transmission of infection (e.g., micro-organism) by the hands and includes cleaning hands with soap and water or with alcohol-based hand cleansers before and after, and as required during all client care.

Hand hygiene also includes maintaining hand health, avoiding nail polish, artificial nails or jewellery and keeping nails trimmed and clean. The fingernail area has been associated with a major portion of hand flora as it can harbour micro-organisms (CDC, 2002; Health Canada, 2003).

**Alert:** Hand hygiene is the single most important infection prevention and control practice.

## Care and Maintenance to Reduce Vascular Access Complications

### Assessment of Client Risk Factors

Other routine practices include screening and assessment of client risk factors in order to reduce hazards associated with infectious diseases. It is beyond the scope of this guideline to present a comprehensive, inclusive discussion on infection control practices, nor replace governmental recommendations around the use of protective equipment. Rather this guideline aims to alert the nurse to the importance of following these practices.

Assessing client risk factors helps the nurse to determine the level of protection required by the client. Factors to consider include:

- Immunosuppression;
- Coagulopathies;
- Signs and symptoms of infection;
- History of exposure to infectious disease; and
- Client response during site assessment.

### Screening

In addition to **assessing** clients for potential infection, the nurse should also **screen** families and visitors for illness in order to protect the client from potential risk. Client screening for infectious diseases is ongoing and encompasses client feedback (e.g., verbalized concerns regarding discomfort from IV site, chills, etc.) (CNO, 2004; Ministry of Health and Long-Term Care (MOHLTC), 2002).

### Hazard or Risk Reduction

Risk reduction or hazard control strategies begin with an analysis by the nurse in order to make an informed decision as to what strategies to employ to protect both the client and the staff. Risk reduction strategies begin at the source (e.g., having the client who is coughing wear a mask during CVAD care); and can include procedural changes to the care performed by the nurse to reduce the risk (e.g., using safety engineered devices, proper disposal of infectious waste) (CNO, 2004i; PHAC, 2002). Nurses can further reduce risk of hazard to themselves with the use of personal protective equipment (PPE).

### Personal Protective Equipment (PPE)

Application of personal protective equipment (PPE) is used to reduce or control any of the risks identified as a result of the screening and risk assessment. PPE includes, but is not limited to: gloves; eye protection; gowns; and masks. PPE is applied before direct contact with the client and prior to starting a procedure. For example, the nurse applies gloves before removing a soiled dressing from the exit site of the CVAD (PHAC, 1999). Nurses should refer to Ministry of Health directives and organizational policies and procedures for direction regarding to the use of PPE.

**Alert:** Reusable medical equipment will be cleaned, disinfected or sterilized between client use in adherence to national and provincial regulations and requirements (e.g., Health Canada or Provincial Ministries of Health). Any single use item (e.g., tourniquets, vacutainers) will remain with the client (PHAC, 1998).

## Skin Antisepsis

### Recommendation 3.0

Nurses will consider the following factors when performing catheter site care using aseptic technique:

- Catheter material (composition);
- Antiseptic solution; and
- Client tolerance (skin integrity, allergies, pain, sensitivity and skin reaction).

*Level IV*

## Discussion of Evidence

Skin cleansing and antisepsis of the insertion site is considered one of the most important measures for preventing infections associated with vascular access devices (Evidence-Based Practice in Infection Control (EPIC), 2001a, 2001b; LeBlanc & Cobbett, 2000; Pearson, 1996a, 1996b). Skin must be **clean**; that is, free of soil, dust, and organic material prior to applying the antiseptic (CDC, 2002; Health Canada, 2003). Organisms responsible for catheter-related infections originate mainly from the client's own skin flora (Crow, 1996; Jackson, 2001; RCN, 2003) or from the hands of the health care professional inserting or handling the device (Hadaway, 2003b; Jackson, 2001). These organisms can be introduced along with the catheter or can gain access while the catheter is in place. Catheter movement in or out of the insertion site (known as "pistoning") can also allow for skin organisms to migrate into the tract and potentially cause infections (Hadaway, 2003b).

### Catheter Material (composition)

Nurses must be knowledgeable about the type of device (central or peripheral) in order to make appropriate care decisions around the skin antiseptic to be used during catheter care. Nurses will disinfect **clean** skin with an appropriate antiseptic before catheter insertion and with each dressing change. The antiseptic solution must be compatible with the catheter material (Hadaway, 2003a). Acetone products should be avoided as they may cause irritation and affect the integrity of the catheter (O'Grady, et al., 2002; Pearson, 1996a, 1996b) and alcohol-based solutions are not recommended for certain devices. Therefore, the nurse must be aware of the health setting's procedures around specific devices in order to protect the client from harm.

### Antiseptic Solution

Studies have shown that 2% chlorhexidine gluconate solution significantly lowers catheter-related bloodstream infection rates when compared with 10% povidone-iodine and 70% isopropyl alcohol (LeBlanc & Cobbett, 2000; Maki, Ringer & Alvarado, 1991; Mimos, et al., 1996; Rosenthal, 2003; Zitella, 2004). Chlorhexidine gluconate offers a broad spectrum of antimicrobial activity and long-term microbacteriocidal action after application (Hadaway, 2003a). Antiseptics should remain on the insertion site and be allowed to air dry before catheter insertion and/or dressing change. *Table 1* describes the required drying time needed for particular solutions in order to prevent skin breakdown as a result of chemical reaction between the solution and the dressing.

Table 1: Drying Times

Solution	Required drying time
Chlorhexidine gluconate 2% with alcohol	■ 30 seconds (Hadaway, 2003b).
Chlorhexidine gluconate without alcohol	■ 2 minutes (Panel consensus, 2005).
Povidone-iodine	■ 2 minutes (Hadaway, 2002).
70% isopropyl alcohol	■ Dries quickly, kills bacteria only when first applied. No lasting bactericidal effect; can excessively dry the skin (Hadaway, 2002; Sansivero, 1998).

### Client Tolerance

Client tolerance and preference may influence the use of antiseptic solutions. Where alternative antiseptic solutions are not indicated in a procedure, the nurse should consult the appropriate health care practitioner to determine the best solution for the client.

### Tip Placement

#### Recommendation 4.0

Nurses will not use the central venous access device (CVAD) until tip placement has been confirmed.

*Level IV*

### Discussion of Evidence

Correct tip position of a CVAD is essential for both preventing complications and for delivering the prescribed therapy. Verifying tip position is essential for positive client outcomes. Three complications caused ***directly*** by incorrect tip position include:

- Central venous perforation;
- Thrombosis; and
- CVAD dysfunction.

Following insertion, the exact anatomical position of the CVAD must be determined radiographically and documented prior to the initiation of any therapy through the device. Professional and regulatory organizations recommend optimal tip position for all CVAD to be the distal Superior Vena Cava (SVC) and/or the caval/atrial junction (Department of Health (DH), 2001b; INS, 2000; ONS, 2004; Ruesch, 2002; Vesely, 2003). Clients whose CVAD tip rests within the middle to upper SVC, in the brachiocephalics or in the periphery are at higher risk for catheter-related thrombosis (Bona, 2003; Dierks & Whitman, 1995; INS, 2000; Ruesch, 2002; Vesely, 2003; Wise, Richardson & hum, 2001). While there may be clinical situations where alternate tip position may enhance client outcomes, nurses must be aware of the tip position of all CVAD in order to monitor the patient for potential complications and CVAD functionality (Kowalski, Kaufman, Rivitz & Waltman, 1997; Vesely, 2003).

Although the tip position is identified immediately post insertion, it is critical to understand that there are significant changes in the position of a catheter tip when the client changes position. On average, all peripherally inserted central catheters (PICCs) will move at least two centimetres (cm) caudal (away from the head) with arm movement. Catheters inserted via the subclavian or jugular veins will move on average two to three cm cephalad (toward the head). A catheter, whose initial post insertion x-ray shows the tip to be in the distal SVC, may in fact have a final tip position (once the patient sits up) in the high SVC. This position could lead to an increased risk of complications as outlined above.

Although there is discussion that tip position should be “routinely” checked, an optimal time frame has not been identified. At a minimum, the tip position should be checked radiographically if the CVAD functionality changes and/or signs and symptoms of complications are observed (INS, 2000; ONS, 2004). Nurses need to seek expert advice and advocate on the client’s behalf for other appropriate tests in order to troubleshoot CVAD functionality. Some of these procedures include:

- X-ray to verify tip position;
- Dye study as indicated;
- Ultrasound and/or Doppler ultrasound; and
- Fluoroscopy.

*Appendix D* contains a visual representation of the correct tip position of a tunneled CVAD.

## Dressings

### Recommendation 5.0

Nurses will consider the following factors when selecting and changing VAD dressings.

- Type of dressing;
- Frequency of dressing changes; and
- Client choice, tolerance and lifestyle.

*Level IV*

## Discussion of Evidence

### Type

The type of dressing used on the VAD has been recognized as one of the variables which affect complication rates associated with these devices (Larwood, 2000). In addition, dressings offer securement of the VAD. Most studies support and recommend the use of dressings (Larwood, 2000); however, the type of dressing remains controversial (CDC, 2002). Dressings may be sterile transparent semi-permeable membrane (TSM), colloid or sterile gauze (Hadaway, 2003). Sterile gauze dressings are more appropriate than transparent dressings when insertion sites are bleeding, oozing or if the client is diaphoretic (CDC, 2002; Hadaway, 2003b; Rosenthal, 2003).

## Care and Maintenance to Reduce Vascular Access Complications

### Frequency of Dressing Change

Factors pertaining to recommended dressing changes include moisture vapour permeability and the type of product used (dry sterile gauze versus transparent dressing). Dressing changes using aseptic technique should be completed every 48 hours for gauze and every seven days for TSM dressings or sooner if contaminated, non-adherent, damp, loose, or visibly soiled (CDC, 2002; Hadaway, 2003b; O'Grady et al., 2002; Pearson, 1996a, 1996b; Rosenthal, 2003; Ross & Orr, 1997). For accessed implanted VAD, the non-coring needle is replaced every five to seven days, in concert with the dressing change (INS, 2000; Karamanoglu et al., 2003). Sterile gauze under a transparent dressing is considered a gauze dressing and should be changed at a minimum of every 48 hours (Jackson, 2001; INS, 2000; Rosenthal, 2003). For newly inserted CVAD, dressings should be changed 24 hours post insertion (Cook, 1999).

### Client Tolerance

The type of dressing may be a matter of client preference (CDC, 2002; Gillies et al., 2003). A meta-analysis comparing the risk for catheter-related blood stream infections (CRBSIs) for groups using transparent dressings versus groups using gauze dressing was reviewed by the Centers for Disease Control and Prevention (CDC, 2002). The risk for CRBSIs did not differ between the groups and thus the choice of dressing was a matter of preference (CDC, 2002).

**Alert:** The use of sterile versus non-sterile clean gloves during dressing changes remains an unresolved issue (CDC, 2002; Pearson, 1996a, 1996b). Therefore, either type can be used when performing catheter site care (O'Grady et al., 2002).

### Practice Considerations

- Antimicrobial ointments ***should not*** be applied to insertion sites as they promote fungal infections and antimicrobial resistance (CDC, 2002; EPIC, 2001; Hadaway, 2003a; Larwood, 2000; O'Grady et al., 2002).
- Transparent dressings, should be placed on the skin (avoid stretching) and smoothed from the center out to the edge and molded around the catheter. The edges of the transparent dressing should not be sealed with tape (Jackson, 2001).
- Transparent dressings require less frequent changes than standard gauze and tape and are reported to save nursing time (CDC, 2002). A reduction in unscheduled restarts as well as an increase in dwell time were noted when transparent dressings were used. A trend towards lower frequencies of phlebitis and infiltration was reported in clients with transparent dressings (Tripepi-Bova et al., 1997).
- Tunneled vascular access devices that are well healed may not require a dressing (CDC, 2002; O'Grady et al., 2003). Implanted vascular access devices, which are healed and ***not accessed***, do not require a dressing. If the device is accessed, a sterile transparent semi-permeable dressing should be applied (INS, 2000).

## Securement

### Recommendation 5.0

Nurses must stabilize the VAD in order to:

- Promote assessment and monitoring of the vascular access site;
- Facilitate delivery of prescribed therapy; and
- Prevent dislodgement, migration, and/or catheter damage.

*Level III*

## Discussion of Evidence

In addition to securement using dressings, the following adjuncts can be used to further secure the VAD:

- Tape and/or sterile surgical strips;
- Sutures;
- Securement devices; and
- Stabilization dressings: specially designed securement and dressing products.

### Tape

Without obscuring the insertion site, the catheter hub can be secured with tape or sterile surgical strips as long as the tape is not applied directly to the catheter-skin junction site (INS, 2000). Other products may be appropriate for clients whose skin integrity may predispose the use of tape as a means of securement. Similar to choosing an appropriate antiseptic solution the nurse should also consider the client's tolerance for various types of tape, providing one which minimizes client discomfort.

**Alert:** Do not use pins of any kind to secure a device as this can damage the device and subsequently interfere with therapeutic outcomes for the client.

### Sutures

Sutures may be used to secure the hub of the catheter to the client's skin. However, in the event that sutures become loose or are no longer intact, the nurse should notify the physician and use sterile surgical tape or a securement device as a temporary measure to prevent dislodgement (INS, 2000).

Both taping and suturing can allow micro-movement of the catheter that can result in complications including but not limited to: phlebitis; infiltration; extravasation; dislodgement; disconnection; and infection. Additionally, suturing the catheter increases the risk of needle stick injuries to the health care provider. The Occupational Safety and Health Administration (Occupational Health and Safety and Health Administration (OSHA), 2001), recommends using engineering controls as one option to secure medical catheters. Engineering controls are designed to reduce the potential for needle sticks by eliminating the need to suture medical catheters.

### Securement Devices

There are a number of commercially available securement devices that can be used for central and peripheral devices. These devices are designed to reduce complications associated with suturing including needle stick injuries and client infection. A study by Crinch and Maki (2002) compared a sutureless securement device with sutures for the securement of PICCs. In this study ( $p \leq 0.01$ ), catheter-related blood stream infections were significantly lower in the group of clients that received the sutureless securement device.

## Care and Maintenance to Reduce Vascular Access Complications

A prospective, controlled study by Sheppard et al. (1999) determined that the peripheral vascular access dwell time associated with a securement device resulted in significantly longer average dwell times and significantly fewer local complications. The securement device also reduced clinical time in managing vascular access. McMahon (2002) found that securement devices used with PICCs reduced catheter migration and thus reduced the rate of catheter repair and exchange.

**Alert:** Securement devices must be changed at least every seven days (CDC, 2002).

Transparent dressings also assist in the securement of the device, allow for continuous visual inspection of the catheter and permit the client to bathe and shower without saturating the dressing. The frequency of peripheral vascular access catheter dislodgement by the client was significantly less with a transparent dressing (EPIC, 2001; Larwood, 2000; Pearson, 1996a, 1996b).

### Practice Considerations

Tubing can be looped to relieve tension and is secured with **tape** independent of catheter tape, thus preventing dislodgement of the catheter by an accidental pull on the tubing (Weinstein, 2001).

### Patency/Flushing/Locking

#### Recommendation 7.0

Nurses will maintain catheter patency using flushing and locking techniques.

Level IV

### Discussion of Evidence

Maintaining catheter patency is an important measure for all types of VADs. Regardless of the frequency, type or volume, the majority of literature on maintaining patency recommends the use of correct **flushing and locking** techniques (RCN, 2003). **Flushing** prevents the mixing of incompatible medications or solutions and/or cleans the catheter lumen of blood or fibrin buildup. **Locking** prevents blood from backing up into the catheter lumen when the device is not in use (ONS, 2004).

### Flushing

#### *Turbulent Flush Technique*

Although the issue of turbulent flush technique is addressed in the literature, there are no randomized controlled trials (RCT) to support this technique. Despite the lack of RCT, the panel recommends the turbulent flush technique as the best practice at this time to help prevent VAD occlusion.

All VADs (peripheral and central) should be flushed using turbulent flush technique to prevent the mixing of incompatible medications or solutions and to reduce complications such as fibrin buildup or accumulation of medication precipitate inside the catheter lumen. While flushing is meant to prevent fibrin buildup, it is important to recognize that all VADs will accumulate fibrin coating to some extent (ONS, 2004).

In order to perform a flush with **turbulence**, the nurse should use a push-pause (stop-start) method. This allows the solution to “scrub or clean” the inside of the device wall to promote removal of blood/fibrin and to help prevent buildup of medication precipitate on the internal lumen of the device. (Dougherty, 1997; RCN, 2003).

**Alert:** Excessive flushing pressure can cause clots to be dislodged, catheter separation and/or catheter rupture. In order to reduce the potential of excessive pressure, it is generally recommended that a 10 mL (or larger) syringe be used for flushing (RCN 2003). Larger syringes create **less pressure when flushing and more pressure when withdrawing or aspirating**. Smaller syringes on the other hand produce **more pressure when flushing and less pressure when withdrawing**.

When using the turbulent flush technique, it is important to assess device function as high pressures could be generated in devices that have occlusion complications (e.g., fibrin buildup) or are constricted in any way (e.g., kinked or clamped). *Appendix F* contains information for assessment of blood withdrawal and management of withdrawal occlusion.

## Locking

### *Positive pressure locking technique*

Positive pressure locking techniques maintain positive pressure inside the lumen in order to prevent blood reflux from the vein into the lumen of the VAD, thus preventing fibrin buildup, clots and thrombotic device occlusions (INS, 2000; RCN, 2003). Nurses must know how to achieve positive pressure locking with the VAD and infusion equipment they are using. Hadaway (2001) reports that positive pressure locking techniques are rarely employed consistently and correctly, leading to a slowly building thrombus in the device lumen. When using open ended VADs without systems to achieve fluid displacement (see the discussion that follows on valve technology), the correct technique involves maintaining positive pressure on the syringe plunger while closing the clamp and before removing the syringe from the cap of the device (INS, 2000; Macklin, 1997).

### *Valve technology – Positive pressure caps*

Devices with positive fluid displacement reduce or eliminate the variable of inconsistent flushing technique. Several positive pressure cap products consistently achieve positive fluid displacement and positive end-pressure. Positive pressure caps work by redirecting a small amount of fluid into the internal catheter tip when the tubing or syringe is disconnected from the device hub. This prevents blood reflux into the lumen. Catheters using positive pressure valves should not be clamped until after disconnection of the flush syringe. Early studies are reporting a decrease in catheter occlusion with use of this type of valve (INS 2000; RCN, 2003).

### *Valve technology – Vascular access devices*

A closed or open-ended valved CVAD is designed to resist blood reflux into the catheter lumen from the vein. The closed-ended valved CVAD (e.g., Groshong® – see *Appendix E*) has an internal three way valve at the tip of the catheter. Alternately, the open-ended valved CVAD (e.g., Pressure Activated Safety Valve (PASV®)) has an open ended tip, and a pressure valve in the hub of the catheter. When the syringe is disconnected the valve for both of these technologies is in a neutral position preventing flow in either direction. The nurse needs to maintain positive pressure on the syringe plunger when disconnecting the syringe from the cap or hub. Positive pressure caps can also be used with valved catheters (INS, 2000; ONS, 2004, RCN, 2003).

## Care and Maintenance to Reduce Vascular Access Complications

### *The Four Elements of Flushing and Locking*

Flushing and locking interventions involve four elements that need to be described in **client specific orders** and/or in established **medical directives**. It is important that flushing/locking interventions are based on standards of practice, evidence-based practice guidelines and current research (EPIC, 2001b; INS, 2000; RCN 2003). These four elements include:

- Type of solution;
- Concentration of solution;
- Volume of solution; and
- Frequency of administration.

#### 1. Type of solution

**Flushing:** The nurse should choose normal saline or other compatible solutions to flush the VAD in order to prevent incompatibilities between two infusates.

**Locking:** Locking solutions used with positive pressure technique maintain catheter patency by preventing blood reflux and by reducing the risk of blood clotting in the device lumen when blood reflux occurs. Locking solutions include:

- Normal saline; and
- Heparin.

#### *Positive Pressure Saline Locking*

There is a significant amount of literature which supports **normal saline locking** to maintain patency of CVADs when using **valved CVADs** (e.g. PASV® or Groshong®) and/or when using **positive pressure caps** (EPIC, 2001b; INS, 2000; RCN 2003).

#### *Positive Pressure Heparin Locking*

When **open-ended devices** are used **without positive pressure technology** (i.e., positive pressure caps), blood can reflux into the device lumen. To reduce the incidence of the refluxed blood clotting heparin can be used to lock the device. Concentrations of heparin reported for use in CVADs range from 10-1000 IU/mL of which the most commonly reported heparin concentration is 100 IU/mL.

A meta-analysis of randomized controlled trials focusing on CVADs (CDC, 2002) concluded that heparin significantly reduced bacterial colonization and showed a strong but non-significant trend towards reductions of catheter-related bacteremia. Because thrombi and fibrin deposits on catheters might serve as a nidus for microbial colonization of intravascular catheters the use of anticoagulants might have a role to play in the prevention of catheter related blood stream infections (CRBSI) (CDC, 2002). Despite this benefit, heparin should be used with caution because it poses the risk of serious complications even in small doses. Heparin has been associated with iatrogenic hemorrhage (a life-threatening reaction to heparin), heparin induced thrombocytopenia (HIT), drug interactions and inaccurate blood results (Dougherty, 1997; EPIC 2001b; Hadaway, 2001). Therefore, it should be used only when necessary in order to reduce heparin-related complications.

## Critical Thinking

**Remember to heparinize the device not the client.** Some clients that require a significant volume or concentration of Heparin locking solutions may experience complications. Consider withdrawal of the heparin lock prior to flushing to reduce the amount of heparin a client receives. While this is practiced in some settings, there is no scientific evidence to support this recommendation. The panel offers this as an option that could be considered based on the risks and benefits for some clients at high risk of device occlusion.

### 2. Concentration of Solution

The concentration of the flushing or locking solution relates to the use of heparin. The heparin used should be the **lowest therapeutic concentration** (e.g., 10 IU/mL) and have the **smallest volume** that will maintain patency relative to the internal volume of the device (DH, 2001b; INS, 2000; RCN, 2003).

### 3. Volume of Solution

**Flushing:** Nurses will use sufficient volumes of flush solutions to clean the internal lumen of the device (3-5 mL for PVAD and 10-20 mL for CVAD). The volume after blood withdrawal and medication administration should be at least 20 mL for all VADs. Macklin (1997) concludes that problems may occur with too little flush solution but not with too much.

**Locking:** The volume should be at least twice the volume capacity of the catheter lumen (usually between 3-10 mL for all devices (Macklin, 1997)) plus the priming volume of all add-on devices of the infusion system (e.g., extension tubing) (INS, 2000).

### 4. Frequency of Administration

Generally, flushing shall be performed:

- After blood sampling;
- When converting from continuous to intermittent therapies;
- Before and after medication administration;
- Before and after administration of blood components;
- Before and after intermittent therapy; and
- For maintenance of a dormant device (INS, 2000; RCN, 2003).

Frequency of device use often determines the frequency of flushing and locking. Devices used intermittently are flushed before administration and are flushed and locked at a minimum after every infusion or medication administration. The schedule of catheter flushes varies among practice settings and among indwelling devices (Ray, 1999). Despite this, VADs should be flushed and locked at established intervals to maintain patency and to prevent occlusion.

*Table 2* summarizes the recommended flushing and locking interventions related to VAD tip position and technology.

## Care and Maintenance to Reduce Vascular Access Complications

Table 2: Flushing & Locking Interventions

Device	Flush Solution, Concentration & Frequency	Locking Solution, Concentration & Frequency
Peripheral VADs	<ul style="list-style-type: none"> <li>Routinely <b>flush</b> intermittent devices with 3-5 mL of 0.9% sodium chloride solution or compatible solution with each use</li> <li><b>Flush</b> every 12 hours if frequency of use is &gt;12 hours.</li> </ul>	<ul style="list-style-type: none"> <li>Routinely <b>lock</b> peripheral devices using the last 1-2 mL of normal saline flush solution</li> <li><b>Lock</b> the device using at least twice the volume capacity of the catheter plus the priming volume of add-on devices. (e.g., extension tubing – commonly from 3-10 mL)</li> </ul>
Midline (a peripheral device with the tip below the level of the axilla)	<ul style="list-style-type: none"> <li>Routinely <b>flush</b> midlines with 5-10 mL of 0.9% sodium chloride solutions.</li> <li>Routinely <b>flush</b> midlines weekly when dormant</li> </ul>	<ul style="list-style-type: none"> <li>Routinely <b>lock</b> midlines using the last 1-2 mL of normal saline flush solution</li> <li><b>Lock</b> midlines using at least twice the internal volume of the catheter plus priming volume of add-on devices</li> </ul>
Valved CVADs (PASV®, Groshong®)	<ul style="list-style-type: none"> <li>Routinely <b>flush</b> valved or closed-ended CVADs with 10-20mL of normal saline.</li> <li><b>Flush</b> devices used intermittently with each use</li> <li><b>Flush</b> dormant devices at the same schedule as locking according to the manufacturer unless occlusive problems indicate otherwise</li> </ul>	<ul style="list-style-type: none"> <li>Routinely <b>lock</b> valved CVADs with the normal saline flush solution maintaining positive pressure on the syringe plunger when disconnecting the syringe.</li> <li><b>Routinely lock</b> dormant CVADs or lumens every seven days or according to the manufacturer unless occlusive problems indicate otherwise</li> <li><b>Lock</b> the device using at least twice the volume capacity of the catheter plus the priming volume of add-on devices</li> <li>Adhere to the manufacturer's recommendations for <b>locking</b> solutions</li> </ul>
Open-ended non-valved CVADs	<ul style="list-style-type: none"> <li>Routinely <b>flush</b> open ended CVADs with 10-20mL normal saline or compatible solutions</li> <li><b>Flush</b> dormant open ended CVADs weekly with normal saline</li> </ul>	<ul style="list-style-type: none"> <li>Routinely <b>lock</b> open ended CVADs once weekly with heparin when not in use (e.g., dormant CVADs or used intermittently)</li> <li><b>Lock</b> dormant (not in use) CVADs or lumens using 3 to 5ml of 10-100 units/mL heparin unless occlusive problems indicate otherwise</li> <li><b>Lock</b> using at least twice the volume of the catheter lumen volume plus the priming volume of add-on devices</li> </ul>
CVADs utilizing positive pressure flush caps	<ul style="list-style-type: none"> <li><b>Flush</b> CVADs with normal saline when using a positive pressure cap</li> </ul>	<ul style="list-style-type: none"> <li><b>Lock</b> CVADs with normal saline when using positive pressure flush caps</li> </ul>
Ports – Implanted VAD (IVAD)	<ul style="list-style-type: none"> <li>Routinely <b>flush</b> IVADs when dormant or when used intermittently with normal saline</li> </ul>	<ul style="list-style-type: none"> <li><b>Lock</b> the IVAD using at least twice the volume capacity of the device plus the priming volume of add-on devices</li> <li>Frequently reported <b>heparin lock</b> volumes for IVADs are between 5mL to 10mL</li> <li><b>Lock</b> closed ended IVADs with normal saline</li> <li>Follow the manufacturer's recommendation for <b>locking</b> solutions</li> </ul>

(DH, 2001b; Hadaway, 2001; INS, 2000; Krzywda, 1998; ONS, 2004; RCN, 2003; Wade & Bush, 1998)

## Recommendation 8.0

Nurses will know what client factors, device characteristics and infusate factors can contribute to catheter occlusion in order to ensure catheter patency for the duration of the therapy. *Level IV*

### Discussion of Evidence:

Nurses need to be knowledgeable about client and device factors that increase the risk of VAD occlusion. Ongoing assessment and evaluation of contributing factors and advocacy with the multidisciplinary health care team will lead to appropriate treatment and improved client outcomes.

#### Client Factors

Several client factors can play a role in contributing to increased risk of thrombosis and subsequent device occlusion. The nurse should assess clients for the following factors:

- Disease processes and/or medications that may alter circulation and/or coagulation status;
- History of clots such as Deep Vein Thrombosis (DVT) and pulmonary embolus;
- Prior history of device occlusion(s);
- Client adherence to catheter care protocols; and
- Changes in intrathoracic pressure caused by persistent coughing, retching or vomiting, excessive crying, heavy lifting and vigorous exercise that can cause blood reflux into the CVAD (Haire & Herbst, 2000).

#### Device Factors (catheter characteristics)

In order to reduce the risk of occlusion and maintain catheter patency, the nurse, in concert with the health care team should:

- Choose the appropriate device for the therapy considering the size of device (smaller lumens have increased chance of intra-luminal clots and less chance of extra-luminal clots whereas large lumen devices have less chance of intra-luminal clots and greater chance of extra-luminal clots)
- Choose valve technologies that are designed to minimize blood reflux and reduce the occurrence of occlusion (e.g., Groshong®, PASV®, and positive pressure caps);
- Minimize blood sampling through CVADs due to the increased risk of fibrin deposits and thrombus device occlusions (Gorski & Czaplewski, 2004; Haire & Herbst, 2000; Krzywda 1998);
- Monitor clients regularly for altered tip position of CVADs. Tip position outside the superior vena cava increases the risk of vein thrombosis and subsequent device blockage; and
- Be knowledgeable of incompatibilities between infusates in order to choose locking and flushing techniques that will prevent/reduce occlusions.

#### Infusate Factors

Certain intravenous solutions can also cause thrombus formation and device occlusion. These include:

- Irritants whose pH lies outside the normal range (7.35 – 7.45 pH). The greater the deviation from normal pH, the more irritating the infusate and the more risk of luminal thrombosis;
- Vesicants with pH less than 5 and greater than 9, and/or osmolarity greater than 500 Osmol/L increase the risk of luminal thrombosis and subsequent device blockage; and
- Medications that have the potential to precipitate and cause occlusion. The nurse should flush the VAD with sufficient amounts of normal saline following administration prior to locking, administering another medication or resuming infusion in order to clear the lumen of any residual buildup.

### Occlusion

#### Recommendation 9.0

**Nurses will assess and evaluate vascular access devices for occlusion in order to facilitate treatment and improve client outcomes.**

*Level IV*

### Discussion of Evidence

Catheter occlusion is a common complication of CVADs with 60% of occlusions caused by thrombosis (Haire & Herbst, 2000). Occlusions are identified by the inability to infuse solutions or withdraw blood. “Nurses should aspirate the catheter to confirm patency prior to [the] administration of medications and/or solutions. If resistance is met or no evidence 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, p. 56). Attempts to force a flush into a catheter that presents resistance especially with the inability to withdraw blood may potentially pose a risk to the client (Cook, 1999). Restoring catheter patency is often an urgent matter because loss of patency means loss of venous access in many patients.

Loss of patency occurs for many reasons and may include kinking or malposition, fibrin sheath buildup, lipid deposition, device rupture or breakage and drug precipitates. The most common reasons for occlusion are fibrin sheaths or clots.

“Determining the most probable cause of a catheter occlusion requires first assessing whether the problem is mechanical, non-thrombotic, or thrombotic. The initial check of the catheter should include the assessment for mechanical obstruction within the tubing, pumps, catheter, clamps, catheter insertion site or sutures. Assessment must also include identification of the last medication infusion and the type of flush. A sluggish flow or inability to infuse fluids or withdraw blood is the first indication of an occlusion. The entire infusion plan should be assessed to determine whether drugs and fluids are being given appropriately and that the device is being maintained correctly” (Haire & Herbst, 2000, p. 35).

Treatment of an occluded catheter is dependent upon the cause of the occlusion. Time is a factor in the success of catheter clearance. The longer the catheter remains occluded the lower the success rate of clearance. Protocols for the use and contraindications of thrombolytic/precipitate clearance agents to restore catheter clearance patency should be established in organizational policies and procedures and are supported by manufacturer’s guidelines (INS, 2000).

Methods to clear non-thrombotic precipitate occlusions are:

- 70% ethanol and sodium hydroxide (0.1N) for lipid occlusions:
- 0.1N hydrochloric acid (HCl) for medication precipitates with low pH; and
- 1.0 mEq/mL sodium bicarbonate for high pH precipitates.

Methods to clear a thrombotic occlusion include using a thrombolytic agent early to reduce the incidence of complete occlusion, saving time and money. Early identification and treatment of problematic catheters with thrombolytics can reduce the incidence of catheter occlusion and subsequent thrombosis (ONS, 2004).

The use of an algorithm for identification and management of thrombotic catheter occlusions may lead to improved patient outcomes and resource utilization (Barton et al., 1998). *Appendix F: Catheter Patency* contains a trouble shooting algorithm and describes further actions for managing occlusions.

## Blood Withdrawal

### Recommendation 10.0

Nurses will minimize accessing the central venous access device (CVAD) in order to reduce the risk of infection and nosocomial blood loss.

Level IV

## Discussion of Evidence

Where frequent blood sampling from a client is needed and using the CVAD for blood sampling is indicated, it is important to minimize the number of entries into the central venous system in order to prevent complications.

Nosocomial blood loss (blood loss occurring as a result of blood testing or treatment) is a potential risk for clients whose CVADs are used frequently for blood sampling. Obtaining blood samples from a CVAD is a potential source of infection to the patient (CDC, 2002). Minimal entries into the CVAD should be part of the assessment and plan of care for the patient and should be scheduled to conserve blood and to minimize manipulation of the hub/device. Aseptic technique is used for all entries into the CVAD (CDC, 2002).

Methods described in the literature for obtaining blood samples from CVADs include:

- Re-infusion (Cosca et al, 1998; Hinds 1991);
- Push-pull (Holmes, 1998); and
- Discard (Frey, 2003).

See *Appendix G* for a description of these methods.

Consensus on a preferred single method for blood sampling through a CVAD has not been reached due to the potential complications that can occur with any of these techniques. The re-infusion method may introduce blood clots back into the client's venous system (Cosca et al., 1998) while frequent blood sampling using the discard method can cause a significant loss of blood over time resulting in negative outcomes (e.g., anemia). To reduce the total amount of blood loss, nurses can incorporate blood conservation strategies including:

- Peripheral sampling whenever possible and/or when the clinical situation does not preclude the use of peripheral sampling; and
- Flushing prior to withdrawing;

The amounts of discard recorded in the literature varies; however, the discard amount should be sufficient to yield a non-contaminated sample. Weinstein (2001) recommends three to six millilitres (mL) discard and McCall, et al. (2003) states two times the internal volume for coagulation tests. The INS (2002) describes the amount of discard as "appropriate".

The literature does not identify specific volumes that a CVAD should be flushed with post blood withdrawal. The Royal College of Nursing *Standards of Infusion Therapy* (2003) describes the amount of flush as the "amount needed to clear the catheter of all residual blood" (p. 33). There are no standard amounts supported by the literature. In actual practice flushing volumes may vary from five to 30 mL, and nurses need to be aware of protocols in their particular practice settings.

## Add-Ons

### Recommendation 11.0

Nurses will change all add-on devices at a minimum of every 72 hours.

Level IV

## Discussion of Evidence

The intravenous (IV) system includes:

- Parenteral fluids;
- Administration sets;
- Add-ons; and
- In the case of PVAD, the peripheral short catheter.

When vascular access add-on devices are used, they are changed at least as frequently as with each catheter or administration set replacement, or whenever the integrity of either product is compromised. The system should be assessed prior to medication administration, ensuring all components are intact. The integrity of the injection/access ports should be confirmed before and immediately after each use and if compromised, be replaced immediately (INS, 2000; RCN 2003).

## Administration Sets

The administration set starts at the spike and terminates at the hub with a Luer-Lok™ connection to the vascular device. All primary and secondary continuous IV administration sets should be replaced at a minimum every 72 hours or changed immediately if contamination is suspected or the integrity of the system has been compromised (CDC, 2002; DH, 2001b; INS, 2000). Further, the IV administration set should be replaced whenever the vascular access device is re-sited (DH, 2001b). The type of solution administered can dictate the frequency of administration set changes (CDC, 2002; INS, 2000; RCN, 2003). Intermittent administration sets should be changed every 24 hours or immediately upon suspected contamination or when the integrity of the product or system has been compromised (Dougherty, 1997; INS, 2000; RCN, 2003). Exceptions to the 72 hour rule include lipids, blood and blood products. *Table 3* gives change times for each of these.

Table 3: Change Times According to Solution Type

Solution Type	Set Change Frequency
Parenteral Nutrition (Amino Acids)	q 72 hours or when integrity compromised
Lipids, Parenteral Nutrition Solutions containing Lipids	q 24 hours or when integrity compromised
Whole blood & components (platelets, red blood cell concentrate, plasma, cryoprecipitate)	4 hours or 2 units or immediately upon suspected contamination
Fractionated products( IvIG, Clotting factors, Albumin)	Upon completion of infusion

(Canadian Standards Association, 2004; CDC, 2002; DH, 2001b; EPIC, 2001b; RCN, 2003)

Prior to changing any add-on component and before accessing the system, the nurse must disinfect external surfaces of the catheter hub and connection ports with an appropriate solution (*Recommendation 3.0*) to prevent the migration of microorganisms (DH, 2001b). Tape should not be used as a method of junction securement (INS, 2000; RCN, 2003) because it can cause the migration of micro-organisms.

### Electronic Infusion Devices

While not a true add-on device, the electronic infusion device, an adjunct for the administration of prescribed infusates is not intended to alleviate the nurse's responsibility for monitoring the prescribed rate of infusion. The device should have anti-free flow protection and have a lock-out feature to prevent tampering. The nurse will have working knowledge of the devices, including how to operate and troubleshoot alerts and alarms of the infusion pump. Organizational policies should outline criteria for pump use, and should include routine preventive maintenance programs which adhere to manufacturer guidelines (INS, 2000; RCN, 2003).

### Peripheral Short Catheters Site Rotation

Despite the focus on CVAD in this guideline, complications related to peripheral IV sites require consideration. In order to prevent complications associated with prolonged dwell time much of the literature supports removing and rotating peripheral IV sites at least every 72 hours or immediately if contamination is suspected (CINA, 1999; CDC, 2002; INS, 2000; RCN, 2003). In fact, studies of short peripheral catheters indicate that the incidence of thrombophlebitis and bacterial colonization of catheters increases when they are left in place greater than 72 hours (CDC, 2002). While some settings may advocate changing sites every 96 hours, there are insufficient RCT available to support this claim. As a result, the development panel recommends 72 hour site rotation as best practice at this time.

## Documentation

### Recommendation 12.0

Nurses will document the condition of the vascular access device including:

- The insertion process;
- Site assessment; and
- Functionality.

*Level III*

## Discussion of Evidence

Documentation in the client's health record is an integral part of safe and effective nursing practice (CNO, 2004g). Clear, comprehensive and accurate documentation is a record of the judgment and critical thinking used in professional practice and provides an account of nursing's unique contribution to health care (CNO, 2004g, 2004k).

For the purposes of this guideline, the documentation will include recording in the client's health record all information reflective of the equipment and supplies being used. Initial VAD insertion documentation should include, but not be limited to, the following:

- Insertion;
- Site assessment; and
- Functionality.

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### Insertion documentation includes:

- The insertion date and time;
- The name of the anatomic location (peripheral or central) to describe the insertion site. Do not identify a device by vein used (e.g., subclavian line);
- The type of VAD, catheter gauge and length. Use trade names (e.g., Hickman, Angiocath, Insyte) as appropriate to identify the actual catheter *in situ*. Do not interchange trade names to describe devices. If the trade name is not known, use the generic terms such as peripheral vascular access device (PVAD); implanted vascular access device (IVAD) or implanted port;
- The number of attempts required to insert VAD and type(s) of VADs used in each attempt; and
- The client's response using his/her own words. Do not use descriptive statements (e.g. patient tolerated procedure well) (Masoorli, 2002).

### Site assessment documentation includes:

- The assessment of the VAD site. Avoid using the statement “dry and intact” as this is unacceptable and lacks sufficient meaning; and
- Any complication observed. In the event of no complications document “no complications noted” (Masoorli, 2002).

### Functionality documentation includes:

- The function of the VAD including presence of blood return, amount of blood draw and infusion solution; and
- The IV solution and/or medications or flushing solution used (Masoorli, 2002).

Table 4 contains a sample of documentation and Appendix H includes a sample documentation tool.

Table 4: Sample Documentation

Sample Documentation of PICC Line Insertion*	Sample Documentation for PVAD insertion*
<p><b>25/01/05 1000 hours</b> Double lumen, 5Fr., 53cm PICC inserted via basilic vein in the right forearm, on first attempt. External length 2cm. Client stated he was comfortable during the procedure. PICC line capped pending X-ray confirmation of tip position. A. Nurse, RN</p> <p><b>25/01/05 1115 hours</b> X – ray for confirmation of tip position post PICC insertion completed. Verbal order taken from Dr. Ross: “Catheter tip in lower third of SVC. May start IV therapy”. A. Nurse, RN</p> <p><b>25/01/05 1125 hours</b> IV Infusion ringers lactate at 100cc/hr started via infusion pump #12. PICC line patent and infusing at prescribed rate. No complications noted. A. Nurse, RN</p>	<p><b>01/02/05 1800 hours</b> #22, 1 inch, PVAD inserted on first attempt into left cephalic vein in the left forearm. Insertion site dressed with a transparent dressing. D5W infusion started at 50mL/hr by gravity. Client stated no significant discomfort during and after PVAD insertion. Client states “that did not hurt much”. A. Nurse, RN.</p> <p><b>01/02/05 2110 hours</b> Client receiving IV therapy via peripheral VAD, left cephalic vein in the left forearm. D5W infusing at 50ml/hr by gravity. No complications noted from insertion site. Client states that he has no pain at this time. A. Nurse, RN</p>

\*Documentation of dressings is not included in this table due to the variety of available products and the differences in practice setting policies and procedures.

## Client Education

### Recommendation 13.0

**Nurses will help clients to attain the highest level of independence through client education.**

*Level IV*

### Discussion of Evidence

While the foundation of client education is communication between the nurse and the client/caregiver, in the absence of providing culturally sensitive care, optimal patient outcomes cannot be achieved (CNO, 2004b). The care provider's ability to communicate effectively with clients and caregivers can also affect health outcomes (Schillinger, et al., 2004; Wilson, 2003). The importance of communicating effectively is evident when faced with these facts:

- According to Statistics Canada (1996) almost 1/2 of Canadian adults and 80% of seniors have limited literacy skills. Low literacy occurs in all demographic groups of the population.
- Low literacy skills and poor health are clearly related (Wilson, 2003).
- Health literacy has been defined as one's ability to access, understand and use health information. People with limited literacy skills have low health literacy (Wilson, 2003).
- Poor literacy may be a marker for other communication problems, beyond reading. People with low health literacy may have difficulty speaking with health care providers and understanding what their health care providers tell them (Roter, Stashefsky-Margalit & Rudd, 2001).

To enable clients to become as independent as possible, nurses need to not only communicate effectively but they also need to apply the principles of adult learning within their practice. Freda (2004) has adapted the foundation of adult learning principles by Malcolm Knowles, for care providers who teach clients and caregivers. Adult learning principles are as follows (Freda, 2004):

- Adults learn best when they perceive a need to learn;
- Adults learn best using active participation;
- Adults require opportunities to practice new skills;
- Adults need the behaviour reinforced;
- Teaching of adults should progress from the known to the unknown;
- Teaching of adults should progress from simpler concepts to more complex topics; and
- Immediate feedback and correction of misconceptions increases learning.

To foster independence in a client with a vascular access device, nurses can frame questions around the general goals of client education to determine what the client is ready to learn.

The general goals of client education include:

1. To make informed decisions;
2. To develop basic survival self-care skills;
3. To recognize problems and know what to do in response; and
4. To get questions answered and find resources for answers.

## Care and Maintenance to Reduce Vascular Access Complications

Strategies to help the nurse engage in effective client education include:

- Being aware that clients may have low or limited literacy skills. This affects how well they can understand verbal and written communication;
- Speaking and writing clearly, using familiar words without jargon, using simple definitions of medical terms that the client needs to understand, and using examples that relate to the client's experiences;
- Repeating key messages several times, and using different ways to present the information (e.g., talking, looking at pictures, watching a video, using models, or using the computer);
- Interacting with printed information to reinforce what is being taught including writing the client's name on the material, underlining or highlighting important information or the answers to the client's questions; and sending printed information home with the client;
- Including a family member or support person (with the client's permission) when teaching;
- Assessing the client's recall and comprehension at the end of the encounter by asking the client to restate the main concepts and what he or she will do;
- Developing client "plain language" education materials that are specific to the client's needs. Nurses can consult with other members of the health care team to contribute to and/or review the material. Clients and families can also evaluate the material to make sure it meets their needs. The following appendices contain resources for developing patient education materials:
  - *Appendix I: Developing Patient Teaching Materials*
  - *Appendix J: Planning Guide for Educational Materials*
  - *Appendix K: Patient Education Materials – Example*
- Providing a contact number in the event the client or caregiver has further questions; and
- Documenting what you taught, what materials you gave, and the client's response.

## Education Recommendations

### Recommendation 14.0

The principles and practice of infusion therapy should be included in the basic education curriculum, be available as continuing education, be provided in orientation to new employees and be made available through continuing professional development opportunities. *Level IV*

### Discussion of Evidence

Nurses are responsible for ensuring that they have the requisite knowledge, skill and judgment necessary to provide safe and effective care and maintenance of VADs (CNO, 2004k).

Nurses have a professional responsibility to participate in continuing education to sustain and advance nursing practice. Active participation in infusion-related continuing education programs is essential to ensure current knowledge of infusion care and improved client outcome through collaboration and sharing of current information. Organizations should provide and facilitate opportunities for nurses to continually expand their knowledge and skills in this clinical area (INS, 2000).

The Food and Drug Administration noted in a study conducted in the United States over a two year period, that 55% of vascular access device infections were related to healthcare professionals not having sufficient education and training in this area (Food and Drug Administration (FDA), 1994).

The Centers for Disease Control and Prevention (CDC, 2002) highlighted the need for well-organized didactic and interactive education programs for health care providers who insert and maintain catheters to prevent intravascular catheter infections. Other training recommendations include education regarding the indications for intravascular catheter use, proper procedures for the insertion and maintenance of devices, evaluation using performance indicators and appropriate infection control measures to prevent intravascular catheter infections.

Nursing knowledge and expertise relative to care and maintenance of VADs spans the continuum from generalist nurse to specialist infusion nurse practicing in an expanded role (INS, 2000). The Canadian Intravenous Nurses Association (CINA, 1999) and the Intravenous Nurses Society (INS, 2000) support a curriculum for VAD education that addresses both theoretical knowledge and clinical application. Ryder (1993) reflected not only on the need to master a skill but in addition the requirement to practice in such a manner that skill, knowledge, competency and accountability are demonstrated. Recommended content areas for formalized instruction programs to address theories and principles of infusion therapy include (but are not limited to) (CINA, 1999; Dugger, 1997; INS, 2002):

- Principles and practices of vascular access planning, including client assessment and device selection;
- Anatomy and physiology;
- Technology and clinical application (e.g., devices, delivery systems);
- Fluid and electrolyte balance;
- Pharmacology;
- Infection control;
- Recognition of specialty populations (e.g., pediatrics, hematology, geriatrics, oncology);
- Transfusion therapy;
- Parenteral nutrition;
- Approaches to prevent, detect and minimize complications;
- Communication and advocacy; and
- Quality Assurance/Performance Improvement

*Appendix L* contains a list of educational resources designed to support nursing professional development.

### Recommendation 15.0

Schools of Nursing will include the RNAO best practice guidelines *Assessment and Device Selection for Vascular Access* and *Care and Maintenance to Reduce Vascular Access Complications* as reference material for core curricula.

*Level IV*

### Discussion of evidence

There is significant support in the literature acknowledging the need for the implementation of more infusion therapy content, both didactic and practical application, in nursing school curricula (Verweyst Kaufman, 1992). Faculty in baccalaureate programs must adjust their curricula to meet the needs of students entering health care settings where rapid changes mean increased responsibility for the performance of all basic vascular access procedures (Barry Frame & Chrystal, 1999). Some of the expectations of staff nurses' performance include assessment and device selection, care and maintenance of VADs, PVAD insertion, transfusion of blood/blood components, and the collection of blood specimens.

The recommendations contained in the RNAO best practice guidelines related to vascular access can be used to guide curriculum development in order to meet student needs and to facilitate knowledge transfer of evidence-based practice.

## Organization & Policy Recommendations

### Recommendation 16.0

Health care organizations will have policies that address components of vascular access therapy in order to ensure positive client outcomes.

*Level IV*

### Discussion of Evidence

Policies and procedures are the fundamental basis for clinical applications of infusion therapies and serve as a guide to provide the clinician with information necessary to provide quality care (INS, 2002). Mismanaged treatment related to vascular access can lead to increased morbidity, disability, and increased length of stay. Policies and procedures that address mismanagement serve to benefit the organization in several ways. In a quasi-experimental study, Barton, Danek, Johns & Coons (1998) (as cited in McConnell, Nelson & Virani, 2004) studied the impact of nursing assessment at the onset of infusion therapy and found improved client outcomes, fewer delays in therapy related to loss of the VAD, fewer device complications, shorter length of stay (LOS) and decreased costs. Policies describe the course and purpose of the action(s) to be taken. Procedures detail the particular steps to be undertaken with expected outcome(s) with additional steps to be taken if adverse events occur. Both should be developed with the input of the multidisciplinary team in order to ensure client safety and positive client outcomes.

### **Recommendation 17.0**

**Health care organizations, in collaboration with their infection control teams, will monitor complications of infusion therapy and use data to employ risk reduction strategies.** *Level IV*

#### **Discussion of Evidence**

Individual organizations need to base their decisions on how to apply infection prevention and control principles not only on published data but also on their own infection surveillance statistics. Those with relatively high infection rates should implement conservative practices until acceptable rates are achieved. Sound epidemiologic judgment based on accurate data is required to plan risk reduction interventions which are most likely to have an impact on a given infection problem (PHAC, 1998).

### **Recommendation 18.0**

**Health care organizations will implement the use of safety engineered devices and equipment to reduce the nurse's risk of sharps injuries that can lead to blood borne diseases. The organization's risk management program will monitor assessment of these practices and incidents.** *Level III*

#### **Discussion of Evidence**

Nurses exposed to sharps are at an increased risk of needle stick injuries. This type of injury can lead to serious or fatal blood borne diseases such as Hepatitis B, Hepatitis C, and Human Immunodeficiency Virus (HIV). Safety engineered devices decrease injuries by 62-88% (National Institute for Occupational Safety & Health (NIOSH), 1999).

An environmental scan of the Ontario health regulations found no actual legislation to enforce such implementation (Ministry of Ontario, Occupational Health and Safety Act, Regulation 67/93); however, workplace safety legislation directs provincial intervention by the Ministry of Labour to audit employers for both implementation of risk management programs and health care setting policies and procedures designed to increase staff and client safety (CDC, 2002; NIOSH, 1999).

### **Recommendation 19.0**

**Health care organizations have access to infusion therapy nursing expertise to support optimal vascular access outcomes.** *Level III*

#### **Discussion of Evidence**

Excellence in practice, ongoing education and research can best be attained when infusion therapy nursing experts supported by their health care organizations, work to improve vascular access outcomes for their clients.

Staff nurses are expected to perform all basic vascular access procedures and acquire an expanded set of skills in vascular access maintenance (Barry Frame & Chrystal, 1999). In addition, ongoing changes and new technology designed to improve vascular access outcomes continue to challenge the staff nurse to remain current in practice. Infusion nurse specialists provide relevant and timely nursing education reflecting evidence-based best practice, improve overall infusion practice by sharing their knowledge and expertise, as well as by participating in the implementation of risk management strategies to monitor practice.

## Recommendation 20.0

Nursing best practice guidelines can be successfully implemented only where there are adequate planning, resources, organizational and administrative support, as well as appropriate facilitation. Organizations may wish to develop a plan for implementation that includes:

- An assessment of organizational readiness and barriers to education.
- Involvement of all members (whether in a direct or indirect supportive function) who will contribute to the implementation process.
- Dedication of a qualified individual to provide the support needed for the education and implementation process.
- Ongoing opportunities for discussion and education to reinforce the importance of best practices.
- Opportunities for reflection on personal and organizational experience in implementing guidelines.

In this regard, RNAO (through a panel of nurses, researchers and administrators) has developed the *Toolkit: Implementation of Clinical Practice Guidelines* based on available evidence, theoretical perspectives and consensus. The *Toolkit* is recommended for guiding the implementation of the RNAO guideline *Care and Maintenance to Reduce Vascular Access Complications*. Level IV

## Discussion of Evidence

Graham et al. (2002) indicate that in order for guidelines to be implemented successfully, a critical step must be the formal adoption of the guidelines by the organization. One way this can be accomplished is by incorporating recommendations into policy and procedures with respect to care and maintenance of vascular access devices. This key step helps to provide direction regarding the expectation of the organization and facilitates integration of the guideline into such systems as the quality management process.

New initiatives such as the implementation of best practice guidelines require strong leadership from nurses who are able to transform the evidence-based recommendations into useful tools that will assist in directing practice. It is suggested that the RNAO *Toolkit* (2002) be considered to assist organizations to develop the leadership required for successful implementation. Refer to *Appendix M* for a description of the RNAO *Toolkit: Implementation of Clinical Practice Guidelines*.



## *Research Gaps & Future Implications*

There is limited Canadian clinical research in terms of randomized controlled trials and/or cohort studies to support current practices regarding vascular access care and maintenance. Information is not consolidated in one area or guideline and the development panel were challenged in gathering current relevant information for the development of this guideline.

The development panel, in reviewing the evidence, has identified several gaps in the research literature related to VAD care and maintenance. In considering these gaps, the following research priorities were identified that would benefit client outcomes:

### **Interventions**

- Effectiveness of various cleansing solutions for reducing VAD complications.
  - Which solutions are most effective for which VAD?
  - Which solutions are most effective for clients with factors that predispose them to VAD complications?
- Effectiveness of various types of dressings on reducing VAD complications.
- Effectiveness of various securement methods for preventing VAD migration.
- Effectiveness of scheduled thrombolysis treatments to reduce CVAD thrombolytic occlusions in clients with hypercoagulation.
- Effectiveness of various flushing techniques and solutions and their impact on VAD complications.
- Effectiveness of heparin versus 0.9% normal saline for locking.
- Effectiveness of changing IV administration sets every 96 hours versus every 72 hours.

### **Education**

- Effectiveness of targeted client education on reducing VAD complications.
- Effectiveness of various nursing education techniques in academic and clinical settings to foster critical thinking around care and maintenance of vascular access devices.
- Effectiveness of increasing nursing knowledge of patient types and disease process on improving client outcomes.

### **Monitoring/Evaluation**

Development and validation testing of audit and surveillance tools for complications of VAD.

### **Advocacy**

Development of Ontario legislation mandating the use of safety engineered devices.

## Evaluation/Monitoring of Guideline

**Organizations implementing the recommendations** in this nursing best practice guideline are recommended to consider how the implementation and its impact will be monitored and evaluated. The following table, based on a framework outlined in the RNAO *Toolkit: Implementation of Clinical Practice Guidelines* (2002), illustrates some indicators for monitoring and evaluation:

	Structure	Process	Outcome
<b>Objectives</b>	To evaluate the supports available in the organization that allow for nurses to care for and maintain vascular access devices.	To evaluate the changes in practice that lead towards improved care and maintenance practices.	To evaluate the impact of implementation of the recommendations.
<b>Organization/ Unit</b>	<p>Review of best practice guideline recommendations by organizational committee(s) responsible for policies or procedures that relate to the recommendations in this guideline.</p> <p>Availability of, and access to, infusion therapy specialists.</p> <p>Structures to facilitate continuity of care between provider organizations.</p> <p>Structures to support nurses to attend educational sessions related to VAD care and maintenance.</p> <p>Opportunities for nurses to participate in committee meetings related to VAD care and maintenance.</p>	<p>Monitoring of common complications such as:</p> <ul style="list-style-type: none"> <li>■ Phlebitis rate;</li> <li>■ Line occlusion;</li> <li>■ Infection; and</li> <li>■ Number of failed attempts.</li> </ul> <p>Number of admissions to emergency department for complications/restarts.</p> <p>Availability of structured vascular access assessment tools/algorithms.</p>	<p>Existence of policies related to VAD Care and Maintenance that include VAD complications.</p> <p>Existence of policies that address safety and reduce the risk of injury.</p> <p>Appropriate VAD care and maintenance that include prevention of VAD complications.</p> <p>Decrease in readmission rates related to central vascular access device complications.</p> <p>Increased data collection.</p> <p>Existence of supports and resources.</p> <p>Access to infusion therapy specialist at each facility.</p>

	Structure	Process	Outcome
Nurse/ Provider	<p>Availability of educational opportunities re: VAD Care and Maintenance practices within the organization.</p> <p>Number of nurses attending educational sessions re: VAD Care and Maintenance.</p>	<p>Evidence of documentation in client record consistent with guideline recommendations regarding:</p> <ul style="list-style-type: none"> <li>■ Assessment;</li> <li>■ Care Plan;</li> <li>■ Client Education; and</li> <li>■ Interventions to reduce complications.</li> </ul> <p>Documentation of complications such as:</p> <ul style="list-style-type: none"> <li>■ Phlebitis;</li> <li>■ Infiltration;</li> <li>■ Occlusion;</li> <li>■ Infection; and</li> <li>■ Number of failed attempts.</li> </ul> <p>Nurses using critical thinking skills or process.</p>	<p>Number of nurses who are credentialed in IV therapy (CINA, INS).</p> <p>Nurse satisfaction with vascular access outcomes.</p> <p>Nurse satisfaction with confidence in preventing, identifying and managing VAD complications.</p> <p>Number of nurses participating in learning activities.</p> <p>Number of chart audits showing documentation of care and maintenance of vascular access devices.</p> <p>Number of nurses able to problem solve using case studies.</p>
Client		<p>Evidence of client/family involvement in decision-making related to VAD Care and Maintenance.</p> <p>Evidence that client/family education included:</p> <ul style="list-style-type: none"> <li>■ Implications for care and maintenance;</li> <li>■ Complications; and</li> <li>■ Resources for follow-up.</li> </ul>	<p>Documented client complication rates.</p> <p>Client satisfaction related to:</p> <ul style="list-style-type: none"> <li>■ Number of attempts for access;</li> <li>■ Pain experienced during procedure;</li> <li>■ Number of complaints related to IV therapy; and</li> <li>■ Lifestyle.</li> </ul> <p>Percentage of clients who completed therapy successfully.</p>
Financial Costs	<p>Provision of adequate financial and human resources for guideline implementation.</p>	<p>Costs related to VAD care and maintenance.</p>	

## *Implementation Strategies*

**The Registered Nurses' Association of Ontario**, and the guideline development panel has compiled a list of implementation strategies to assist healthcare organizations or healthcare disciplines that are interested in implementing this guideline. A summary of these strategies follows:

- Have a dedicated person such as an advanced practice nurse or a clinical resource nurse who will provide support, clinical expertise and leadership. The individual should also have good interpersonal, facilitation and project management skills.
- Establish a steering committee comprised of key stakeholders and members committed to leading the initiative. Keep a work plan to track activities, responsibilities and timelines.
- Provide educational sessions and ongoing support for implementation. The education sessions may consist of presentations, facilitator's guide, handouts and case studies. Binders, posters and pocket cards may be used as ongoing reminders of the training. Plan education sessions that are interactive, include problem solving, address issues of immediate concern and offer opportunities to practice new skills (Davies & Edwards, 2004).
- Provide organizational support such as having the structures in place to facilitate the implementation. For example, hiring replacement staff so participants will not be distracted by concerns about work and having an organizational philosophy that reflects the value of best practices through policies and procedures. Develop new assessment and documentation tools (Davies & Edwards, 2004).
- Identify and support designated champions on each unit to promote and support implementation. Celebrate milestones and achievements, acknowledging work well done (Davies & Edwards, 2004).
- Organizations implementing this guideline should look at a range of self-learning, group learning, mentorship and reinforcement strategies that will over time, build the knowledge and confidence of nurses in implementing this guideline.
- Beyond skilled nurses, the infrastructure required to implement this guideline includes access to specialized equipment and treatment materials. Orientation of the staff to the use of specific products must be provided and regular refresher training planned.

- Teamwork, collaborative assessment and treatment planning with the client and family and through interdisciplinary work are beneficial in implementing guidelines successfully.
- RNAO's Advanced/Clinical Practice Fellowships (ACPF) Project is another way that registered nurses' in Ontario may apply for a fellowship and have an opportunity to work with a mentor who has expertise in vascular access management. With the ACPF, the nurse fellow will have the opportunity to hone their skills in this topic area.
- Identify, develop and support Best Practice Champions and include people who have expertise in the topic area, facilitation skills and knowledge of adult education principles in order to support, develop, mentor, and train other nurses within organizations to ensure knowledge transfer.

In addition to the tips mentioned above, the RNAO has developed resources that are available on the website. A *Toolkit* for implementing guidelines can be helpful if used appropriately. A brief description of this *Toolkit* can be found in *Appendix M*.

A complete version of the document is available at: <http://www.rnao.org/bestpractices>.



## *Process for Update/Review of Guideline*

**The Registered Nurses' Association of Ontario** proposes to update the best practice guidelines as follows:

- 1 Each nursing best practice guideline will be reviewed by a team of specialists (Review Team) in the topic area every three years following the last set of revisions.
- 2 During the three-year period between development and revision, RNAO Nursing Best Practice Guidelines program staff will regularly monitor for relevant literature in the field.
- 3 Based on the results of the monitor, program staff will recommend an earlier revision period. Appropriate consultation with a team of members comprising original panel members and other specialists in the field will help inform the decision to review and revise the Guideline earlier than the three-year milestone.
- 4 Three months prior to the three year review milestone, the program staff will commence the planning of the review process by:
  - a Inviting specialists in the field to participate in the Review Team. The Review Team will be comprised of members from the original panel as well as other recommended specialists.
  - b Compiling feedback received, questions encountered during the dissemination phase as well as other comments and experiences of implementation sites.
  - c Compiling new clinical practice guidelines in the field, systematic reviews, meta-analysis papers, technical reviews and randomized controlled trial research and other relevant literature.
  - d Developing detailed work plan with target dates and deliverables.

The revised Guideline will undergo dissemination based on established structures and processes.

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## ***Appendix A: Search Strategy for Existing Evidence***

### **STEP 1 – Database Search**

A database search for existing infusion therapy guidelines was conducted by a university health sciences library. After the scope of the guideline was established, a search of the MEDLINE, Embase and CINAHL databases for guidelines and articles published from January 1996 to November 2004 was conducted using the following search terms: “catheterization, peripheral/ or catheterization, peripheral central venous”, “central venous catheters/or peripherally inserted central catheters”, “nursing role”, “nursing care”, “vascular access devices/or catheters”, “vascular/or vascular access devices”, “implantable”, “catheter-related complications”, “equipment contamination”, “equipment safety” “catheter care, vascular”, “catheter occlusion”, “catheter-related infections”, “nursing assessment”, “practice guideline(s)”, “clinical practice guideline(s)”, “standards”, “consensus statement(s)”, “consensus”, “evidence based guidelines” and “best practice guidelines”. This search generated numerous abstracts which were then reviewed by a masters prepared Research Assistant assigned to the project for the purposes of selecting articles based on inclusion criteria that related to the clinical questions. The Research Assistant conducted a quality appraisal of the selected articles and summarized the studies according to the following:

- Study type;
- Sample (number of subjects/characteristics);
- Intervention used in the study;
- Measures used in the study;
- Findings; and
- Limitations.

This summary was distributed to the panel.

### **STEP 2 – Structured Web Site Search**

One individual searched an established list of 53 web sites for content related to the topic area. This list of sites, reviewed and updated in July 2003, was compiled based on existing knowledge of evidence-based practice websites, known guideline developers and recommendations from the literature. Presence or absence of guidelines was noted for each site searched as well as date searched. The websites at times did not house a guideline but directed to another web site or source for guideline retrieval. Guidelines were either downloaded if full versions were available or were ordered by phone/email.

- Agency for Healthcare Research and Quality: <http://www.ahrpr.gov>
- Alberta Heritage Foundation for Medical Research – Health Technology Assessment: <http://www.ahfmr.ab.ca/hta>
- Alberta Medical Association – Clinical Practice Guidelines: <http://www.albertadoctors.org/>
- American College of Chest Physicians: <http://www.chestnet.org/guidelines>
- American Medical Association: <http://www.ama-assn.org>
- Association of Women’s Health, Obstetric and Neonatal Nursing: <http://www.awhonn.org>
- British Columbia Council on Clinical Practice Guidelines: <http://www.hlth.gov.bc.ca/msp/protoguides/index.html>
- BC Office of Health Technology Assessment: <http://www.chspr.ubc.ca>
- Canadian Centre for Health Evidence: <http://www.cche.net/che/home.asp>
- Canadian Coordinating Office for Health Technology Assessment: <http://www.ccohta.ca>

- Canadian Institute for Health Information: [http://secure.cihi.ca/cihiweb/home\\_e.html](http://secure.cihi.ca/cihiweb/home_e.html)
- Centers for Disease Control and Prevention: <http://www.cdc.gov>
- Centre for Evidence-Based Mental Health: <http://cebmh.com>
- Centre for Evidence-Based Pharmacotherapy: <http://www.aston.ac.uk/lhs/teaching/pharmacy/cebp>
- CMA Infobase: Clinical Practice Guidelines: <http://mdm.ca/cpgsnew/cpgs/index.asp>
- CREST: <http://www.crestni.org.uk>
- Cochrane Database of Systematic Reviews: <http://www3.interscience.wiley.com/cgi-bin/mrw/home/106568753/HOME>
- Core Library for Evidence-based Practice: <http://www.shef.ac.uk/scharr/ir/core.html>
- Database of Abstracts of Reviews of Effectiveness (DARE): <http://www.york.ac.uk/inst/crd/darehp.htm>
- Evidence-based On-Call: <http://www.eboncall.org>
- Guideline Advisory Council: <http://gacguidelines.ca>
- Guideline International Network: <http://www.g-i-n.net>
- Institute of Child Health: <http://www.ich.ucl.ac.uk/ich>
- Institute for Clinical Systems Improvement: <http://www.icsi.org/index.asp>
- Joanna Briggs Institute: <http://www.joannabriggs.edu.au/about/home.php>
- Medic8.com: <http://www.medic8.com/ClinicalGuidelines.htm>
- Medscape Women's Health: <http://www.medscape.com/womenshealthhome>
- Monash University Centre for Clinical Effectiveness: <http://www.med.monash.edu.au/healthservices/cce/evidence>
- National Guideline Clearinghouse: <http://www.guidelines.gov>
- National Institute for Clinical Excellence: <http://www.nice.org.uk>
- National Library of Medicine Health Services/Technology Assessment:  
<http://hstat.nlm.nih.gov/hq/Hquest/screen/HquestHome/s/64139>
- Netting the Evidence: A SchARR [School of Health & Related Research, University of Sheffield, UK]  
Introduction to Evidence Based Practice on the Internet <http://www.shef.ac.uk/scharr/ir/netting>
- New Zealand Guidelines Group: <http://www.nzgg.org.nz>
- NLM Health Services/Technology Assessment: <http://hstat.nlm.nih.gov/hq/Hquest/screen/Contents/s/43466>
- NHS R & D Health Technology Assessment Programme: <http://www.hta.nhsweb.nhs.uk/htapubs.htm>
- Nursing & Midwifery Practice Development Unit: <http://www.nmpdu.org>
- Oregon State Board of Nursing: <http://www.oregon.gov/OSBN>
- Periodic Task Force on Preventive Health Care: <http://www.ctfphe.org>
- PEDro: The Physiotherapy Evidence Database: <http://www.pedro.fhs.usyd.edu.au/index.html>
- Queen's University at Kingston: <http://post.queensu.ca/~bhc/gim/cpgs.html>
- Royal College of General Practitioners: <http://www.rcgp.org.uk>
- Royal College of Nursing: <http://www.rcn.org.uk/index.php>
- Royal College of Physicians: <http://www.rcplondon.ac.uk>
- Sarah Cole Hirsh Institute: <http://fpb.cwru.edu/HirshInstitute>
- Scottish Intercollegiate Guidelines Network: <http://www.sign.ac.uk>
- Society of Obstetricians and Gynecologists of Canada Clinical Practice Guidelines:  
[http://www.sogc.medical.org/sogcnet/index\\_e.shtml](http://www.sogc.medical.org/sogcnet/index_e.shtml)
- The Canadian Cochrane Network and Centre: <http://cochrane.mcmaster.ca>
- The Qualitative Report: <http://www.nova.edu/ssss/QR>
- Trent Research Information Access Gateway: <http://www.shef.ac.uk/scharr/triage/TRIAGEindex.htm>
- TRIP Database: <http://www.tripdatabase.com>
- University of California, San Francisco: <http://medicine.ucsf.edu/resources/guidelines/index.html>

### STEP 3 – Search Engine Web Search

A website search for existing guidelines was conducted via the search engine “Google”, using the search terms identified above. One individual conducted this search, noting the search term results, the websites reviewed, date and a summary of the findings. The search results were further critiqued by a second individual who identified guidelines and literature not previously retrieved.

### STEP 4 – Hand Search/Panel Contributions

Additionally, panel members were already in possession of a few of the identified guidelines. In some instances, a guideline was identified by panel members and not found through the previous search strategies. These were guidelines that were developed by local groups or specific professional associations.

### STEP 5 – Core Screening Criteria

This above search method revealed nine guidelines, several systematic reviews and numerous articles related to care and maintenance of vascular access devices.

The final step in determining whether the clinical practice guideline would be critically appraised was to have two individuals screen the guidelines based on the following criteria. These criteria were determined by panel consensus:

- Guideline was in English;
- Guideline was dated no earlier than 2000;
- Guideline was strictly about the topic area;
- Guideline was evidence based, and
- Guideline was available and accessible for retrieval.

## RESULTS OF THE SEARCH STRATEGY

The results of the search strategy and the decision to critically appraise identified guidelines are itemized below. Nine guidelines met the screening criteria and were critically appraised using the *Appraisal of Guidelines for Research and Evaluation (AGREE) Instrument* (AGREE Collaboration, 2001).

## PRACTICE GUIDELINES RETRIEVED AND CRITICALLY APPRAISED

- Centers for Disease Control and Prevention. (2002). Guidelines for the prevention of intravascular catheter-related infections. *Morbidity and Mortality Weekly Report (MMWR)*, 51 (No. RR-10), 1-29
- Department of Health. (2001a). Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters: Introduction. *Journal of Hospital Infection*, 47, S13-S19
- Department of Health. (2001b). Guidelines for preventing infections associated with the insertion and maintenance of central venous catheters. *Journal of Hospital Infection*, 47, S47-S67
- Evidence Based Practice in Infection Control. (2001a). The EPIC project: Developing national evidence-based guidelines for preventing hospital-acquired infections. National evidence-based guidelines for preventing hospital-acquired infections associated with the use of central venous catheters. Technical report part A. Available: <http://www.epic.tvu.ca.uk/epicphase/epic1.html>
- Evidence Based Practice in Infection Control. (2001a). The EPIC project: Developing national evidence-based guidelines for preventing hospital-acquired infections. National evidence-based guidelines for preventing hospital-acquired infections associated with the use of central venous catheters. Technical report part B. Available: <http://www.epic.tvu.ca.uk/epicphase/epic1.html>
- Intravenous Nurses Society (2000). Infusion nursing: Standards of practice. *Journal of Intravenous Nursing*, 23, S1-S88
- Oncology Nursing Society. (2001). *Chemotherapy and biotherapy guidelines and recommendations for practice*. Pittsburgh: Author.
- Oncology Nursing Society. (2004). *Access device guidelines: Recommendations for nursing practice and education*. Pittsburgh: Author.
- Royal College of Nursing. (2003). *Standards for infusion therapy*. London: Author.

## ***Appendix B: Glossary of Clinical Terms***

**Additional Precautions:** Extra precautions in addition to routine practices that are based on the way organisms are transmitted. These modes include:

- Contact;
- Droplet; and
- Airborne transmission.

**Add-ons:** These are devices that include stopcocks, extension sets, manifold sets, extension loops, solid cannula caps, injection/access ports, needles or needleless systems and filters.

**Antiseptic:** A substance that destroys or stops the growth of micro-organisms on living tissue (i.e., skin) (CNO, 2004).

**Caps:**

- Provide access to the vascular system for the purpose of medication administration, and/ or connectivity of administration sets;
- May be used to cap unused lumen, or as a part of a saline lock; and
- May be of needle free or needle access design.  
(CDC, 2002; INS, 2000; RCN, 2003).

**Catheter dislodgement:** Movement of the catheter into and out of the insertion site. Causes of catheter dislodgement include inappropriate securement of the catheter, and motion of the extremity, neck or shoulder. Catheter dislodgement may cause occlusion of the catheter and lead to a change in the catheter tip location. Signs and symptoms of catheter dislodgement include changes in the external length of the catheter, clinical signs of local catheter infection and inability to flush or infuse via the catheter (RCN, 2003).

**Caudal:** Toward the tail or end of the body, away from the head (Mosby, 1990).

**Cephalad:** Toward the head (Mosby, 1990).

**Chemical incompatibility:** Change in the molecular structure or pharmacological properties of a substance that may or may not be visually observed (RCN, 2003).

**Compatibility:** Capability to be mixed and administered without undergoing undesirable chemical and/or physical changes or loss of therapeutic action (RCN, 2003).

**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 (RCN, 2003).

**Extension Sets:**

- Are customized IV tubing which adds length to the administration set, or alternatively may be capped and added to PVAD to create a saline lock;
- May be added to CVAD for line maintenance/access; and
- Are considered part of the device if added under sterile conditions at time of CVAD insertion.

**Extravasation:** Inadvertent infiltration of vesicant solution of medication into surrounding tissue; rated by a standard scale (RCN, 2003).

**Hypertonic:** Solution of higher osmotic concentration than that of a reference solution or of an isotonic solution; having a concentration greater than the normal tonicity of plasma (RCN, 2003).

**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 (RCN, 2003).

**Implanted Vascular Access Device or Implanted Port:** A catheter surgically placed into a vessel or body cavity and attached to a reservoir located under the skin (RCN, 2003).

**Incompatible:** Incapable of being mixed or used simultaneously without undergoing chemical or physical changes or producing undesirable effects (RCN, 2003).

**Infiltration:** Inadvertent administration of a non-vesicant solution or medication into surrounding tissue; rated by a standard scale (RCN, 2003).

**Irritant:** Agent capable of producing discomfort or pain at the venipuncture site or along the internal lumen of the vein (RCN, 2003).

**Isotonic:** Having the same osmotic concentration as the solution with which it is compared (i.e., plasma) (RCN, 2003).

**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 (RCN, 2003).

**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 (RCN, 2003).

**Occluded:** Blocked because of precipitation of infusate, clot formation or anatomic compression (RCN, 2003).

**Osmolality:** Characteristic of a solution determined by the ionic concentration of the dissolved substances per unit of solvent; measured in milliosmoles per kilogram (RCN, 2003).

**Osmolarity:** Number of osmotically active particles in a solution (RCN, 2003).

## *Care and Maintenance to Reduce Vascular Access Complications*

**pH:** Degree of acidity or alkalinity of a substance (RCN, 2003).

**Phlebitis:** Inflammation of a vein; may be accompanied by pain, erythema, edema, streak formation and/or palpable cord; rated by a standard scale (RCN, 2003).

**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 (RCN, 2003).

**Personal protective equipment (PPE):** Specialized clothing or equipment worn by an employee for protection against an infectious hazard (e.g., gloves, masks, protective eyewear, gowns). General work clothes (e.g., uniforms, pants, shirts or blouses) not intended to function as protection against a hazard and are not considered to be personal protective equipment (CNO, 2004).

**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.

**Proximal:** Closest to the centre of midline of the body or trunk, or nearer to the point of attachment; the opposite of distal (RCN, 2003).

**PSI:** Pounds per square inch; a measurement of pressure; 1 PSI = 50 mm/Hg (Weinstein, 2001).

**Routine Practices:** Chosen by Health Canada to emphasize that it is the level of care that should be provided for all clients at all times. It incorporates previous precautions against blood borne pathogens (Universal Precautions) but with the addition of body fluid precautions. The focus is on prevention.

**Safety device system/Safety engineered device:** Engineered physical attribute of a device that effectively reduces the risk of blood borne pathogen exposure (RCN, 2003).

**Standard Precautions:** Is the term used by the U.S. Centers for Disease Control and Prevention and is used for what in Canada is known as Routine Practices. The two don't differ in principle, however; "Standard Precautions" were written for Acute Care Settings and may not be appropriate for community care practice settings.

**Tunneled catheter:** Vascular access device whose proximal end is tunneled subcutaneously from the insertion site and brought out through the skin at an exit site (see *Appendix D*) (INS, 2000).

**Thrombolytic agent:** Pharmacological agent capable of dissolving blood clots (RCN, 2003).

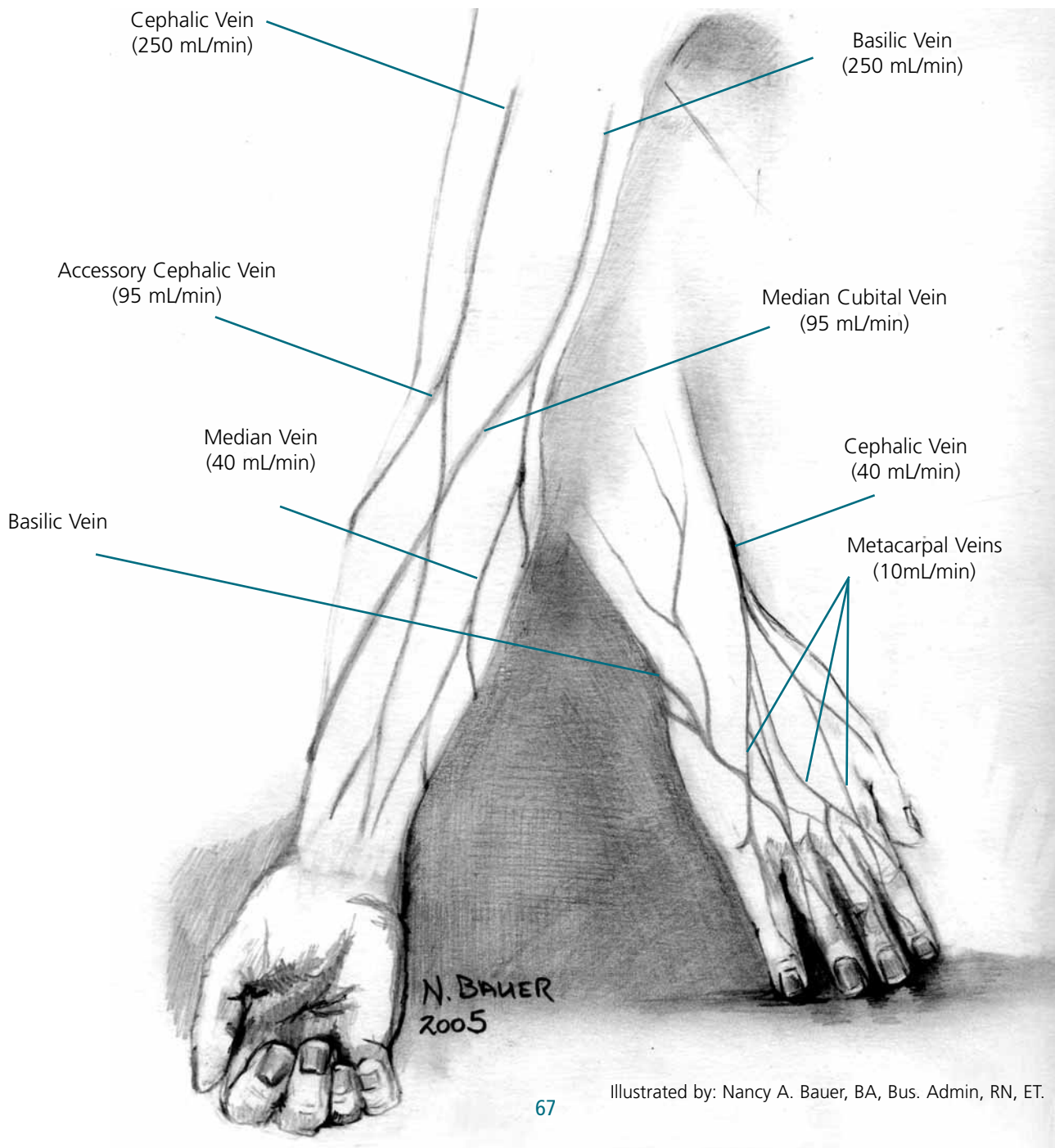
**Vesicant:** Agent capable of causing injury when it escapes from the intended vascular pathway into surrounding tissue (RCN, 2003).

**Universal Precaution:** An outdated term used for precautions against blood borne pathogens. Refer to Routine Practices.

## Appendix C: Vein Anatomy & Blood Flow Rates for Peripheral Site Selection

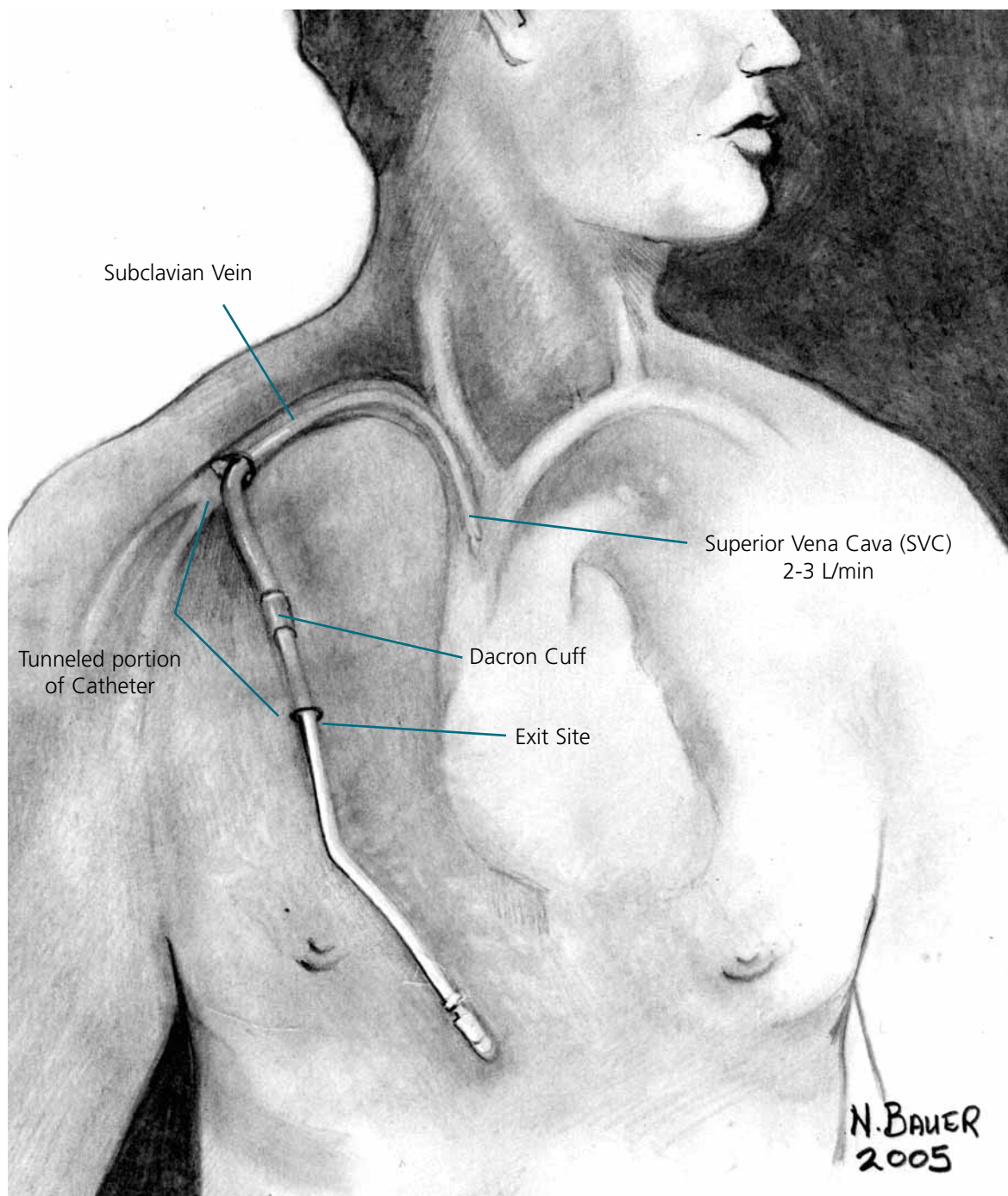
Venous blood flow rates nurses will consider when selecting a peripheral site include:

- Dorsal arch (metacarpal veins) diameter varies, with flow rate 10mL/minute
- Flow rate in upper arm, just below the axilla, is approximately 250 mL/minute
- Flow rate in hand and lower forearm ranges from 10-95 mL/minute



Illustrated by: Nancy A. Bauer, BA, Bus. Admin, RN, ET.

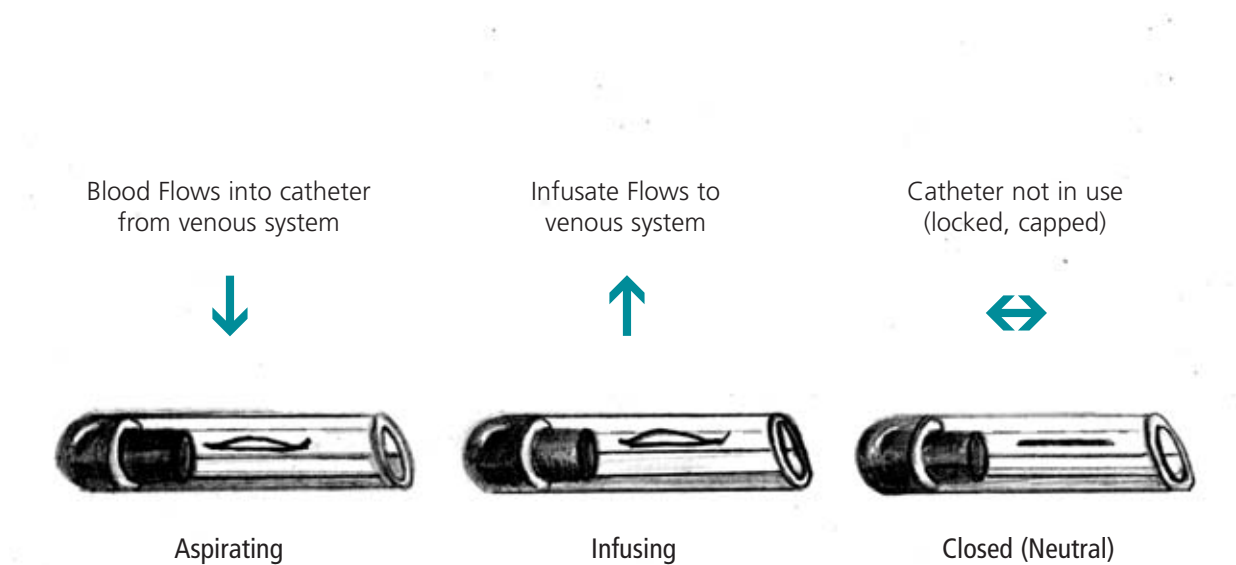
## ***Appendix D: Tip Placement for Tunneled Catheter***



Illustrated by: Nancy A. Bauer, BA, Bus. Admin, RN, ET.

## ***Appendix E: Groshong® Valve Function***

The Groshong® catheter has a rounded, closed catheter tip that incorporates a three-way valve. This pressure sensitive valve remains closed during normal vena cava pressure. Applying negative pressure (aspirating) allows the valve to open inward and infusing fluids creates positive pressure into the catheter and forces the valve to open outward.



Illustrated by: Nancy A. Bauer, BA, Bus. Admin, RN, ET.

## Appendix F: Catheter Patency

To check patency the nurse should aspirate the CVAD and check for the presence of blood return without resistance.

If resistance is met or there is absence of blood return, the nurse will take further actions to assess the device and take or seek appropriate intervention(s) to restore patency before administration of medications or solutions. These actions include:

- Ruling out the presence of mechanical obstruction or problems (e.g., closed clamps, kinks, device damage);
- Attempting to flush the device – if resistance is met, no attempt should be made to continue flushing and/or using additional pressure as a thrombus may be dislodged, causing a pulmonary embolism (Haire & Herbst, 2000; INS, 2000; RCN, 2003);
- Flushing the device (if no resistance is noted) with normal saline in a 10 mL syringe using the turbulent flush technique;
- Checking for blood return again – a smaller barrel syringe exerts less negative pressure when withdrawing blood and may result in more success. If blood withdrawal is not obtained, do not infuse medications or solutions through the device; and
- Documenting the assessment and actions taken in the client's chart to provide continuity of care. When documenting blood return, indicate “no complications noted” or specify the complication (e.g., no blood return obtained; or blood return obtained with resistance). Thrombus formation may be present as a fibrin sleeve outside the device or as a partial or complete obstruction of the internal lumen of the device progressing to central venous obstruction (RCN, 2003).

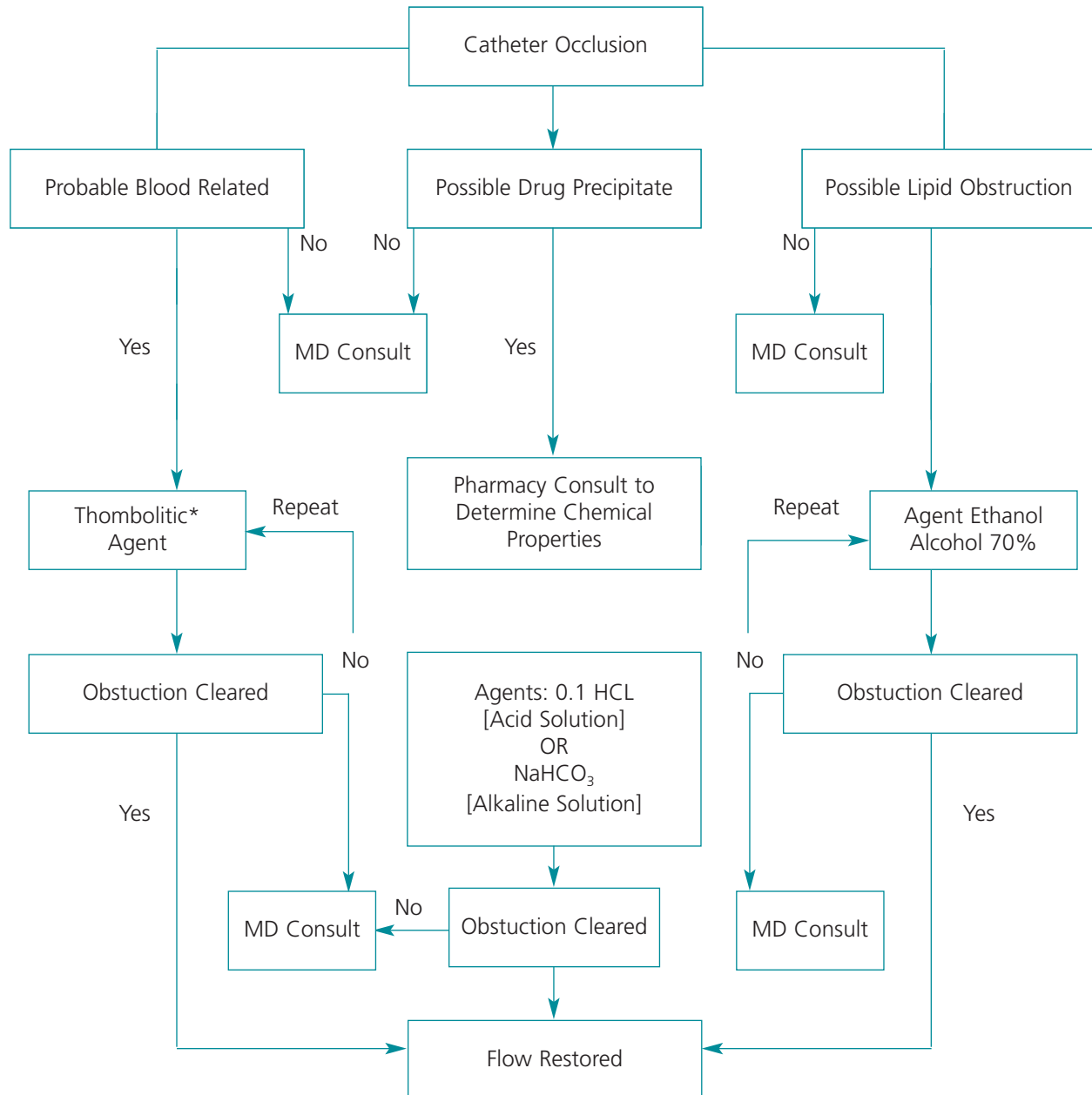
### Managing withdrawal occlusions

Withdrawal occlusions are defined as the ability to flush a CVAD and infuse fluids and medications but an inability to withdraw blood. If a withdrawal occlusion persists, it is expected that the individual nurse will perform only those aspects of the assessment and resolution of the withdrawal occlusion for which they have experience. It is expected that nurses seek appropriate consultation in instances where the client's care needs surpass their ability to act independently. Nurses are expected to report the withdrawal occlusion to physician, advocate for appropriate medical interventions to determine the cause of the occlusion and for resolution of the occlusion before using the device for medication or fluid administration. Solutions such as irritants, vesicants with a pH less than 5.0 or greater than 9.0 or osmolarity greater than 500 should not be administered through a device where blood return is not obtained because if the device is malpositioned it can result in complications (e.g., infiltration and extravasation).

### Critical Thinking

In some situations (e.g., palliation, access is severely limited, unblocking interventions limited or client choice), it may be necessary to analyze the risk and benefits of using a device with a withdrawal occlusion. Involvement of the other members of the health care team as well as the client in the decision is important to ensure appropriate decision-making. The client/caregivers should be assisted to make an informed consent by understanding the risk and benefits of receiving their specific infusion through a device with a withdrawal occlusion. Solutions that are non-irritating, non-vesicant and with a pH greater than 5.0 and less than 9.0, and osmolality <500, will generally result in less severe complications if infiltration occurs. Ensure safety measures are in place to reduce the risk (e.g., careful assessment for complications during the infusion).

## Algorithm for troubleshooting catheter occlusion



Source: Hamilton Health Sciences Centre IV Team (2002). *Algorithm for troubleshooting catheter occlusion*. (Unpublished document). Hamilton: Author. Adapted with permission.

**\*Alert:** Nurses require a medical directive or direct client order prior to instilling thrombolytic agents, 0.1 HCL[Acid Solution], NaHCO<sub>3</sub> [Alkaline solution] or Ethanol Alcohol 70%. Consult with MD.

## Appendix G: Blood Withdrawal from Central Venous Access Devices

### Blood Withdrawal

Method of Blood Withdrawal	Description	Potential Complication
<b>Discard</b> <ul style="list-style-type: none"><li>■ Removes potential contaminate from the catheter (CVAD)</li></ul>	<ul style="list-style-type: none"><li>■ Remove a specific amount of blood from catheter (CVAD) via syringe or vacutainer</li><li>■ Use a “new” syringe or vacutainer for the blood sample</li><li>■ Flush CVAD with 0.9% saline</li></ul>	<ul style="list-style-type: none"><li>■ Potential nosocomical blood loss</li><li>■ Potential to confuse a discard syringe with blood sample syringe</li></ul>
<b>Push – Pull</b> <ul style="list-style-type: none"><li>■ Requires mixing the blood back and forth in a syringe several times to eliminate contaminates from the catheter (CVAD)</li></ul>	<ul style="list-style-type: none"><li>■ Using a 10 ml syringe, flush catheter (CVAD) with 5 ml 0.9% saline</li><li>■ Without removing syringe, 6 ml of blood is aspirated, then pushed back into catheter (CVAD)</li><li>■ Repeat this process x3</li><li>■ Remove the empty syringe and attach new syringe/vacutainer to obtain blood sample</li><li>■ Flush CVAD with 0.9% saline</li></ul>	<ul style="list-style-type: none"><li>■ May be difficult to obtain enough blood for 3 – 4 push-pull sequences</li><li>■ Risk of haemolysis with the agitation of blood</li></ul>
<b>Re-infusion</b> <ul style="list-style-type: none"><li>■ Involves returning the discard specimen after obtaining blood samples</li></ul>	<ul style="list-style-type: none"><li>■ Aspirate 6 ml of blood into a syringe and cap with a sterile cap</li><li>■ Obtain blood specimen(s) via a syringe or vacutainer</li><li>■ Re-infuse the discard from the 1st syringe.</li></ul>	<ul style="list-style-type: none"><li>■ Potential to re-infuse clot(s)</li><li>■ Potential to re-infuse contaminated discard</li><li>■ Potential for error including the possibility of confusing the discard syringe with the blood sample</li></ul>

(Cosca et al., 1998; Holmes, 1998)

## Blood Withdrawal – Additional Considerations

<b>Lumen</b>	<ul style="list-style-type: none"> <li>■ Use the largest Lumen for blood draws</li> <li>■ Dedicate a lumen for blood draws when CVAD has multiple lumens</li> <li>■ Generally not recommended to use heparinized catheter (CVAD) for coagulation studies</li> <li>■ Use of lumens for drug levels if the drug was infused via that lumen: <ul style="list-style-type: none"> <li>● Does not support the use of silastic catheters for sampling drug levels if the drug is given through the same catheter</li> <li>● Aminoglycoside drug levels should be obtained by standard venicollection (in leukemia patients with indwelling right atrial catheters)</li> <li>● If venipuncture is contraindicated or difficult to perform, the drug level should be obtained from the catheter only after flushing</li> <li>● One method describes to infuse a solution a minimum of 30 min after the dose and then obtain peak levels by standard procedure</li> <li>● Another method is to administer a 10 mL IV push flush with 0.9% NaCl through the catheter, which would ensure delivery of the full dose of the aminoglycoside to the patient and then obtain the peak level by standard procedures</li> <li>● Regardless of methods, one should view all drug levels obtained from these catheters with skepticism since the system has several possible sources for contamination</li> </ul> </li> </ul>
<b>Amount of Discard</b>	<ul style="list-style-type: none"> <li>■ Appropriate amount to ensure accuracy of lab results</li> <li>■ Discard 3-6 mL</li> <li>■ Consider dead space volume of CVAD <ul style="list-style-type: none"> <li>● 2x dead space volume – non coagulation tests</li> <li>● 6x dead space volume – non coagulation tests</li> </ul> </li> </ul>
<b>Equipment</b>	<ul style="list-style-type: none"> <li>■ Use the vacutainer or syringe or a combination of both to obtain blood samples</li> <li>■ Use safety engineered devices whenever possible (e.g., transfer devices) to reduce the potential for negative outcomes (e.g., needle stick injury)</li> <li>■ Smaller syringes exert less negative pressure when withdrawing blood samples from catheters (CVAD)</li> </ul>

(Frey, 2003; INS, 2000; McCall et al., 2003; ONS, 2004)



## Appendix H: Data Collection Tool for Central Venous Access Devices

Patient Information: Add relevant information for your Practice Setting

Diagnosis: \_\_\_\_\_

Factors predisposing patient to complications:

- |  |  |   |                                       |
|--|--|---|---------------------------------------|
| <input type="checkbox"/> Immune suppressed | <input type="checkbox"/> Diabetes      | <input type="checkbox"/> Obesity          | <input type="checkbox"/> Coagulopathy |
| <input type="checkbox"/> CVA               | <input type="checkbox"/> Bony Trauma   | <input type="checkbox"/> Thoracic Surgery | <input type="checkbox"/> Malnourished |
| <input type="checkbox"/> Breast CA         | <input type="checkbox"/> Previous CVAD | <input type="checkbox"/> Other: _____     |                                       |
| <input type="checkbox"/> Comments: _____   |  |   |                                       |

Insertion Date: \_\_\_\_\_

Inserted by: \_\_\_\_\_

Vein Selected: ☐ Right ☐ Left ☐ Basilic ☐ Cephalic ☐ Median Cubital  
☐ Brachial ☐ Subclavian ☐ Internal Jugular ☐ Femoral

Catheter Brand: \_\_\_\_\_ Lot #: \_\_\_\_\_ Lumens: ☐ Single ☐ Dual

☐ Triple ☐ Quadruple

Gauge: \_\_\_\_\_ # of Attempts: \_\_\_\_\_ Insertion Length: \_\_\_\_\_ (if appropriate)

External Length: \_\_\_\_\_ (if appropriate)

Anatomic Tip Location: \_\_\_\_\_

### Bloodwork & Flushing:

Use for Bloodwork: ☐ Yes ☐ No

Flush: Solution: \_\_\_\_\_ Dose: \_\_\_\_\_ Frequency: \_\_\_\_\_

Dressing: ☐ Transparent

☐ Gauze ☐ None

Securement Device:

☐ Suture

☐ Adhesive Strip Closure (Steristrips™)

☐ Stat Lock™

☐ Other

Add-Ons: (Needleless Adapter, Extension Set, etc.)

☐ Yes

☐ No

Type: \_\_\_\_\_

Catheter Removal:

Date: \_\_\_\_\_ Removed by: \_\_\_\_\_

Dwell time: \_\_\_\_\_

Reason for Removal:

☐ Therapy completed

☐ Occluded

☐ Infection

☐ Thrombus

☐ Catheter damage

☐ Phlebitis

☐ Other \_\_\_\_\_

Discharge Planning: \_\_\_\_\_

Patient Education Information Provided: \_\_\_\_\_

Comments: \_\_\_\_\_

### Post Insertion Complications

☐ **Early stage mechanical phlebitis:**

Intervention: \_\_\_\_\_

☐ **Phlebitis:**

- 0 pain at site, no erythema, swelling, induration or palpable venous cord at or around the site
- +1 pain at site, no erythema, swelling, induration or palpable venous cord
- +2 some erythema or swelling or both at site, no induration or palpable venous cord
- +3 erythema and swelling at site, palpable venous cord < 7.5 cm. above site
- +4 erythema and swelling at site, induration and palpable venous cord > 7.5 cm. above site

Intervention: \_\_\_\_\_

☐ **Occlusion:**

Unblocking procedure performed:

Occlusion resolved

☐ **Thrombotic**

☐ **Precipitate**

☐ Yes ☐ No

☐ Yes ☐ No

☐ **Lipids**

# of times \_\_\_\_\_

☐ **Infection:**

☐ Insertion site (drainage, erythema, tender) \_\_\_\_\_

☐ Catheter sepsis (positive blood culture, positive catheter tip culture, same organism, may be febrile) \_\_\_\_\_

☐ Catheter sepsis suspected (no positive blood culture, fever resolves after removal) \_\_\_\_\_

☐ Infection resolved \_\_\_\_\_

☐ **Thrombus** (validated radiographically)

Location: \_\_\_\_\_

☐ **Embolus**

Type:

☐ Air

☐ Catheter

☐ Thrombus

☐ **Catheter Damage:** (describe) \_\_\_\_\_

Successful repair: (date) \_\_\_\_\_

☐ **Pain:** (describe) \_\_\_\_\_

☐ **Leaking at Insertion Site:** \_\_\_\_\_

☐ **Other:** \_\_\_\_\_

### Comments:

\_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

Source: Hamilton Health Sciences Centre IV Team (2002). *Data collection tool for central venous access devices*. (Unpublished document). Hamilton: Author. Reprinted with permission.

## Appendix I: Developing Patient Teaching Materials

### The process of developing patient education materials

1. Starting the process: establishing a planning group  
↓
2. Assess available patient education materials  
↓
3. Identify your purpose and the patient population  
↓
4. Decide on the content  
↓
5. Write the first draft in plain language  
↓
6. Apply a clear design  
↓
7. Get feedback from the clinical team  
↓
8. Get feedback from patients and families  
↓
9. Get approval from the clinical team  
↓
10. Produce the material  
↓
11. Distribute and use the material  
↓
12. Evaluate the effectiveness of the material

Source: Wizowski, L., Harper, T., & Hutchings T. (2002) *Writing health information for patients and families*. Hamilton, ON: Hamilton Health Sciences. Reprinted with permission.

## Appendix J: Planning guide for Educational Materials

Purpose	<p>What knowledge or attitudes are you trying to enhance?</p> <p>What specific behaviour(s) are you trying to change?</p> <p>What “message” do you wish to convey?</p> <p>How will this material be different from existing materials?</p> <p>How will this material help/benefit your practice/program?</p> <p>How will this material be helpful to the learner?</p>
Target audience	<p>Who is the target audience? Students, patients, staff?</p> <p>What are the characteristics of the target audience?</p> <p>What is their previous experience?</p> <p>What do they already know?</p> <p>What motivates the audience?</p> <p>What are their interests and habits related to the topic?</p> <p>Are members of the target audience available to evaluate materials?</p>
Content	<p>Has a literature search been completed?</p> <p>Have you identified and assessed existing materials?</p> <p>Has the target audience validated the learning need, content and format?</p> <p>Have content experts validated the accuracy and relevance of the content?</p> <p>Does the content support the hospital's mission, vision and values?</p>
Theory	<p>What theoretical framework guides the knowledge, value or behaviour change?</p> <p>Is this framework appropriate and relevant to the learner?</p>
Format	<p>How will this material be used by the learner?</p> <p>Is the material easy to access and use?</p> <p>How will this material be displayed and distributed?</p> <p>Does the format support learning (self-directed, group)?</p> <p>Is the material user-friendly?</p> <p>If computer-based, is it compatible with existing systems?</p> <p>If printed, do table of contents, index and bibliography contribute to ease of use?</p>
Budget	<p>What source(s) of funding will be used to acquire or develop this material?</p> <p>What quantity is needed?</p> <p>Can production costs be estimated from printing specifications? (# of pages, paper size, paper weight, artwork, binding, # of copies)</p>
Validity	<p>Is the material up-to-date?</p> <p>Does it replace existing material?</p> <p>Does it add additional information?</p> <p>Are the producer, editor and author reputable?</p>

Source: Wizowski, L., Harper, T., & Hutchings T. (2002) *Writing health information for patients and families*. Hamilton, ON: Hamilton Health Sciences. Reprinted with permission

## Appendix K: Patient Education Material – Example

Name: \_\_\_\_\_

Learning about...

### Going home with your PICC

Information about your PICC for your community nurse:

Your PICC was put in by \_\_\_\_\_ on \_\_\_\_\_  
doctor or nurse date

At:

McMaster University Medical Centre

☐

Other

☐ Hamilton General Hospital

\_\_\_\_\_

☐ Henderson General Hospital

\_\_\_\_\_

☐ St. Joseph's Healthcare

\_\_\_\_\_

If you have problems with you PICC, call

\_\_\_\_\_

Brand name of PICC

\_\_\_\_\_

Size or gauge of the PICC

\_\_\_\_\_

☐ Valved ☐ Non-valved ☐ Single Lumen ☐ Double Lumen

Distal tip location:

☐ SVC

☐ Right Atrium Junction

☐ Right Atrium

Trimmed:

☐ Yes

☐ No

Length of internal catheter \_\_\_\_\_ cm

Length of external catheter \_\_\_\_\_ cm

Comments: \_\_\_\_\_

The above information was completed by \_\_\_\_\_

Nurse

On \_\_\_\_\_ Date \_\_\_\_\_

unit or ward

You are going home with a PICC. PICC stands for Peripherally Inserted Central Catheter. The catheter is a long thin tube and may stay in your arm for several weeks or months. Your PICC may be used to give you fluids, medications, nutrition, blood products and/or to take blood samples for testing.

Your PICC will need routine care, such as dressing changes and flushing. Your community nurse will discuss this with you.

## When you first get your PICC

When you first get home, it is normal for the area around your PICC to be sore. This can last a few days. It may bleed or ooze a little. When the community nurse comes to your home, he or she will change the dressing and check the area around your PICC. Please let the nurse know your concerns. Your nurse's first visit is about 12 to 24 hours after you get home.

### Warm compress

On the arm where the PICC is, place a warm and moist compress. A compress can be a folded washcloth, small towel or a warm pack. Wet the washcloth, ring out the excess water, wrap in plastic and then place over the PICC. Do this when you get home and for the next 3 days. Do this 4 times a day for 10 minutes.

### Before your nurse visits

Try not to move the area too much as you do your normal activities. Move your arm as you feel comfortable. You can shower or bathe, but keep the area dry. Wrapping the PICC in plastic wrap is a way to keep it dry. Your PICC should always be covered with a dressing. This helps to keep it free of germs.

### When you have a PICC do not:

- Lift heavy objects (such as a 10 pound sack of potatoes) with the PICC arm
- Use scissors near the PICC
- Swim with the PICC
- Play contact sports
- Shovel or garden with the PICC arm

Problem	What to do
■ The dressing is soaked with blood	<ul style="list-style-type: none"> <li>■ Do not remove the dressing. Apply pressure with another dressing or clean cloth</li> <li>■ Call the community Nurse</li> <li>■ If you bleed a lot or the bleeding does not stop – go to Emergency</li> </ul>
■ The dressing is soaked with clear fluid	<ul style="list-style-type: none"> <li>■ Cover with a clean dressing or cloth</li> <li>■ Call the community nurse</li> </ul>
■ The area around your PICC gets more puffy and swollen	<ul style="list-style-type: none"> <li>■ Call the community nurse</li> </ul>
■ The PICC breaks or falls out	<ul style="list-style-type: none"> <li>■ Cover with a clean dressing or cloth</li> <li>■ Call the community nurse</li> </ul>
■ Irregular or strange heart beat	<ul style="list-style-type: none"> <li>■ Call the community nurse or go to Emergency</li> </ul>
■ If you have trouble breathing	<ul style="list-style-type: none"> <li>■ Call 911 or go to Emergency</li> </ul>

## Care and Maintenance to Reduce Vascular Access Complications

### Supplies

Before leaving the hospital you may be given a few supplies. More supplies will be sent to your home in a big box. In the box there may be a bag with medications. Check the label on the bag to see if the medications need to go into the fridge. There are supplies in the box for dressings, medications and taking care of the PICC. When you are ready, your nurse will help you learn about these.

Keep your supply box in a clean dry safe place and away from children or pets.

Your supplies are provided by the CCAC. Talk with your nurse about making sure that you have the right supplies. If you run out of supplies – call your community nurse.

You will need to have these other supplies:

- Liquid soap in a pump, or bottle of waterless soap
- Paper towels
- Garbage bag
- Clean towel

### Living with your PICC

Your PICC should always be covered. Do not have your blood pressure taken, blood work taken or IV's started with the PICC arm. When you return to your normal routine such as household chores, cooking, work or sexual activity, you can use your arm as you feel comfortable. Do not overuse your arm with the PICC. (Please review the section on the bottom of page 79.)

Your PICC needs special care to keep it clean and working well. This care may be done by you, a family member, a friend or a nurse. Your nurse will help you learn about the care of your PICC.

### When you have a PICC, it is a good idea to:

- Have your emergency telephone numbers close by
- Have your community nurse telephone number close by
- Keep a list of your questions, problems, notes in a book or diary
- Keep a calendar for clinic appointments and follow-up appointments with your community nurse

### Setting up your home

You will need a work area or space to lay out the supplies. When choosing the best place to do your PICC care, keep these things in mind:

- Good lighting
- A room that is easy to keep clean and free of dust
- A comfortable spot in the room to sit or lie down
- A safe area away from children and pets
- A place free of drafts away from open windows, heating ducts and fans

### When your community nurse comes or when you do your PICC care:

- Set aside 20 to 45 minutes
- Limit distractions: such as not answering your phone
- Try to do it the same time each day: tell your friends and family this time so they do not bother you
- Clean your work area before and after the PICC care

## *Appendix L: Education Resources*

The following is a list of resources the development panel thought to be useful for education purposes. It should not be considered a complete or comprehensive list.

### Websites

Canadian Institute for Health Information (CIHI)  
[www.cihi.ca](http://www.cihi.ca)

Institute for Safe Medication Practices (ISMP)  
[www.ismp.org](http://www.ismp.org)

Public Health Agency of Canada (PHAC)  
[www.phac-aspc.gc.ca](http://www.phac-aspc.gc.ca)

Registered Nurses' Association of Ontario. (2004.) *Assessment and Device Selection for Vascular Access*. Toronto: Author.  
Available: [http://www.rnao.org/bestpractices/completed\\_guidelines/BPG\\_Guide\\_C4\\_iv\\_therap.asp](http://www.rnao.org/bestpractices/completed_guidelines/BPG_Guide_C4_iv_therap.asp)

The National Institute for Occupational Safety and Health (NIOSH)  
[www.cdc.gov/niosh/homepage.html](http://www.cdc.gov/niosh/homepage.html)

Professional Practice Network of Ontario (PPNO)  
[www.ppno.ca](http://www.ppno.ca)

### Other resources

Registered Nurses' Association of Ontario. (2004). *User Guide: Implementation of the Home Health Care Orientation Program for Nurses*. Toronto: Author. Available: [www.rnao.org](http://www.rnao.org)

Registered Nurses' Association of Ontario. (2004). *Preceptorship Resource Kit*. Toronto: Author.  
Available: [www.rnao.org](http://www.rnao.org)

## Appendix M: Description of the Toolkit

### Toolkit: Implementing Clinical Practice Guidelines

**Best practice guidelines** can only be successfully implemented if there are: adequate planning, resources, organizational and administrative support as well as appropriate facilitation. RNAO, through a panel of nurses, researchers and administrators, has developed the *Toolkit: Implementation of Clinical Practice Guidelines* based on available evidence, theoretical perspectives and consensus. The *Toolkit* is recommended for guiding the implementation of any clinical practice guideline in a healthcare organization.

The *Toolkit* provides step-by-step directions to individuals and groups involved in planning, coordinating, and facilitating the guideline implementation. Specifically, the *Toolkit* addresses the following key steps in implementing a guideline:

1. Identifying a well-developed, evidence-based clinical practice guideline
2. Identification, assessment and engagement of stakeholders
3. Assessment of environmental readiness for guideline implementation
4. Identifying and planning evidence-based implementation strategies
5. Planning and implementing evaluation
6. Identifying and securing required resources for implementation

Implementing guidelines in practice that result in successful practice changes and positive clinical impact is a complex undertaking. The *Toolkit* is one key resource for managing this process.

The *Toolkit* is available through the Registered Nurses' Association of Ontario. The document is available in a bound format for a nominal fee, and is also available free of charge from the RNAO website. For more information, an order form or to download the *Toolkit*, please visit the RNAO website at [www.rnao.org/bestpractices](http://www.rnao.org/bestpractices).

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## Review 2008

### Nursing Best Practice Guideline

Shaping the future of Nursing



### Care and Maintenance to Reduce Vascular Access Complications

Guideline supplement

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#### Supplement Integration Review Process

This supplement to the nursing best practice guideline *Care and Maintenance to Reduce Vascular Access Complications* is the result of a scheduled review of the guideline. As part of its commitment to ensure consistency with the best available evidence, the Registered Nurses' Association of Ontario (RNAO) has established a monitoring and review process, which involves a full review of each guideline every 3 years.

As part of the health care team, nurses caring for clients with indwelling vascular access devices have an important and continued role in providing safe infusion therapy, across the continuum of care. Therefore, they have an important role in helping clients understand and reduce their risk for complications. Importantly, though the main focus of this guideline review remains the care and maintenance of central venous access devices (CVAD), some recommendations apply to both CVAD and peripheral venous access devices (PVAD) as per the original guideline. Please note that to ensure consistency with the scope of the original guideline, this review has not addressed recommendations related to the care of clients requiring infusion therapy through the following devices: arterial lines, hemodialysis catheters, pulmonary artery lines, pheresis lines, epidural catheters, pressure monitoring devices, umbilical vein, femoral catheters, and/or intraosseous lines. Nurses working with these devices will require further practice direction from guidelines in their areas of practice.

A panel of specialists was assembled for this review, comprised of members from the original development panels of the *Assessment and Device Selection for Vascular Access* and *Care and Maintenance to Reduce Vascular Access Complications* guidelines, as well as other recommended individuals with particular expertise in this practice area. A structured evidence review based on the scope of the original guideline was conducted to capture the relevant literature. Initial findings regarding the impact of the current evidence base on the original guideline were summarized for the review panel. The review panel members were given a mandate to review the original guideline in light of the new evidence, specifically to ensure the validity, appropriateness and safety of the guideline recommendations as published in 2005. In December 2007, the panel met to achieve consensus on the impact of this new evidence on the existing recommendations.



## Review of Existing Guidelines

One individual searched an established list of websites for published guidelines and other relevant content. This list was compiled based on existing knowledge of evidence-based practice websites and recommendations from the literature. Six international guidelines on infusion therapy were critically appraised using the *Appraisal of Guidelines for Research and Evaluation Instrument* (AGREE, 2001). From this appraisal, two guidelines were identified to inform the review process and were circulated to all panel members:

Central Venous Access Device Guideline Panel. (2006). Managing central venous access devices in cancer patients: A clinical practice guideline. Toronto (ON): Cancer Care Ontario (CCO).

Infusion Nurses Society (INS). (2006). Infusion Nursing Standards of Practice. *Journal of Infusion Nursing*, 29(15), S1-S92.

## Literature Review

Concurrent with the review of existing guidelines, a search for recent literature relevant to the scope of the guideline was conducted with guidance from the Review Chair. The search of electronic databases, including CINAHL, Medline and EMBASE, was conducted by a health sciences librarian. Articles identified and recommended by panel members were also considered. A Master's prepared nurse completed the inclusion/exclusion review, quality appraisal and data extraction of the retrieved studies, and the summary of the literature findings. The comprehensive data tables and reference lists were provided to all panel members.

A summary of the evidence review is provided in the flow chart below.

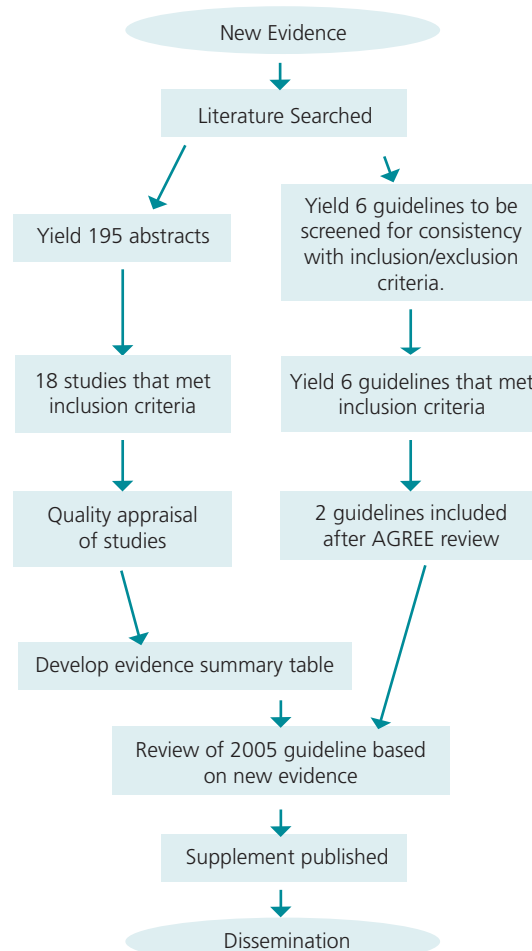
## Panel Review

After a review of the current evidence, no substantive changes were made to the recommendations; however, several inaccuracies were noted in the original publication, and will be addressed in this review document. Additional resources have also been identified and are listed below as **Appendix A**.

## Review Findings

A review of the most recent research studies and relevant guidelines published since the development of the original guideline does not support substantive changes to the recommendations. However, the panel has identified several research gaps in the available evidence, which will be outlined below.

Review Process Flow Chart



Original recommendations identified by the panel for update	Review Findings 2008
<p><b>3.0</b> Nurses will consider the following factors when performing catheter site care using aseptic technique:</p> <ul style="list-style-type: none"> <li>• Catheter material (composition);</li> <li>• Antiseptic solution; and</li> <li>• Client's tolerance (skin integrity, allergies, pain, sensitivity and skin reaction)</li> </ul> <p>(Level IV)</p>	<p>Although the evidence supports the original recommendation, the panel would like to include an alert:</p> <p>Aseptic technique must include choice of solution, use of friction, and adequate contact time in order to be considered an effective use of technique. Please consult your institutional policy <b>or</b> infection control policies for more details.</p> <p>The panel also recognizes there has been discussion around circular vs. east-west application techniques; although evidence does not exist at present to support a recommendation for one technique over the other, this topic will be noted for future cycles of guideline review.</p>
<p><b>4.0</b> Nurses will not use the central venous access device (CVAD) until tip placement has been confirmed.</p> <p>(Level IV)</p>	<p>Although the evidence supports the original recommendation, the panel would like to include an alert:</p> <p>Anatomical tip location must be documented by a radiologist/attending physician following insertion, and this documentation must be accessible to all the client's health care providers throughout the continuum of care.</p> <p>Please note: the original discussion of the evidence referred to an illustration (Appendix D of the original guideline) which is inaccurate; please refer to <b>Appendix B</b> below for a revised visual representation of correct tip placement.</p>
<p><b>7.0</b> Nurses will maintain catheter patency using flushing and locking techniques.</p> <p>(Level IV)</p>	<p>The panel has identified some inaccuracies in Table 2 (p. 32) of the original guideline. These have been updated below; please refer to <b>Appendix C</b>.</p>
<p><b>11.0</b> Nurses will change all add-on devices at a minimum of every 72 hours.</p> <p>(Level IV)</p>	<p>The current review of the evidence has resulted in the recognition of a research gap around the rates of catheter-related bloodstream infections and phlebitis related to increasing the time interval for replacement of add-on devices. As sufficient evidence does not exist at present to change the original recommendation, this topic will be noted for future cycles of guideline review.</p>
<p><b>19.0</b> Health care organizations have access to infusion therapy nursing expertise to support optimal vascular access outcomes.</p> <p>(Level III)</p>	<p>Although the evidence supports the original recommendation, the panel would like to emphasize the importance of health care organizations having access to credentialed infusion therapy nurses to support optimal vascular access outcomes. Please refer to the corresponding recommendation and discussion in the RNAO best practice guideline <i>Assessment and Device Selection for Vascular Access</i> (Recommendation 6).</p>

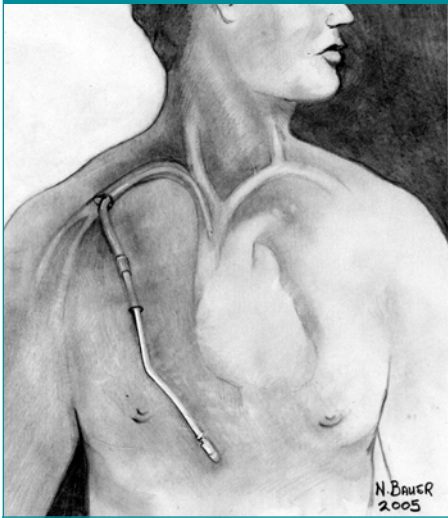
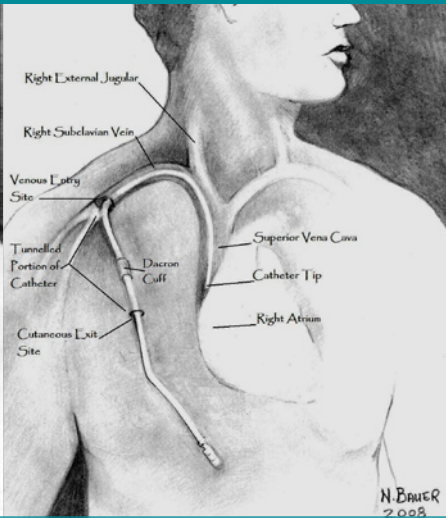
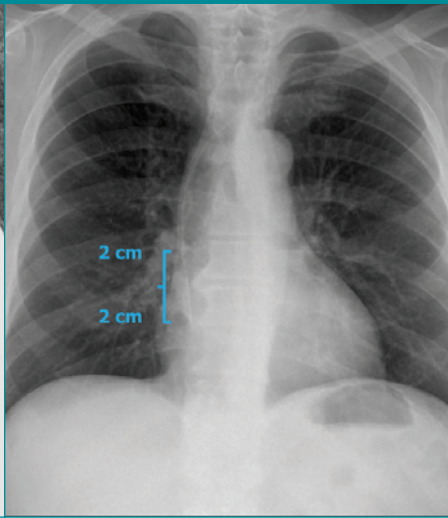


## Appendices

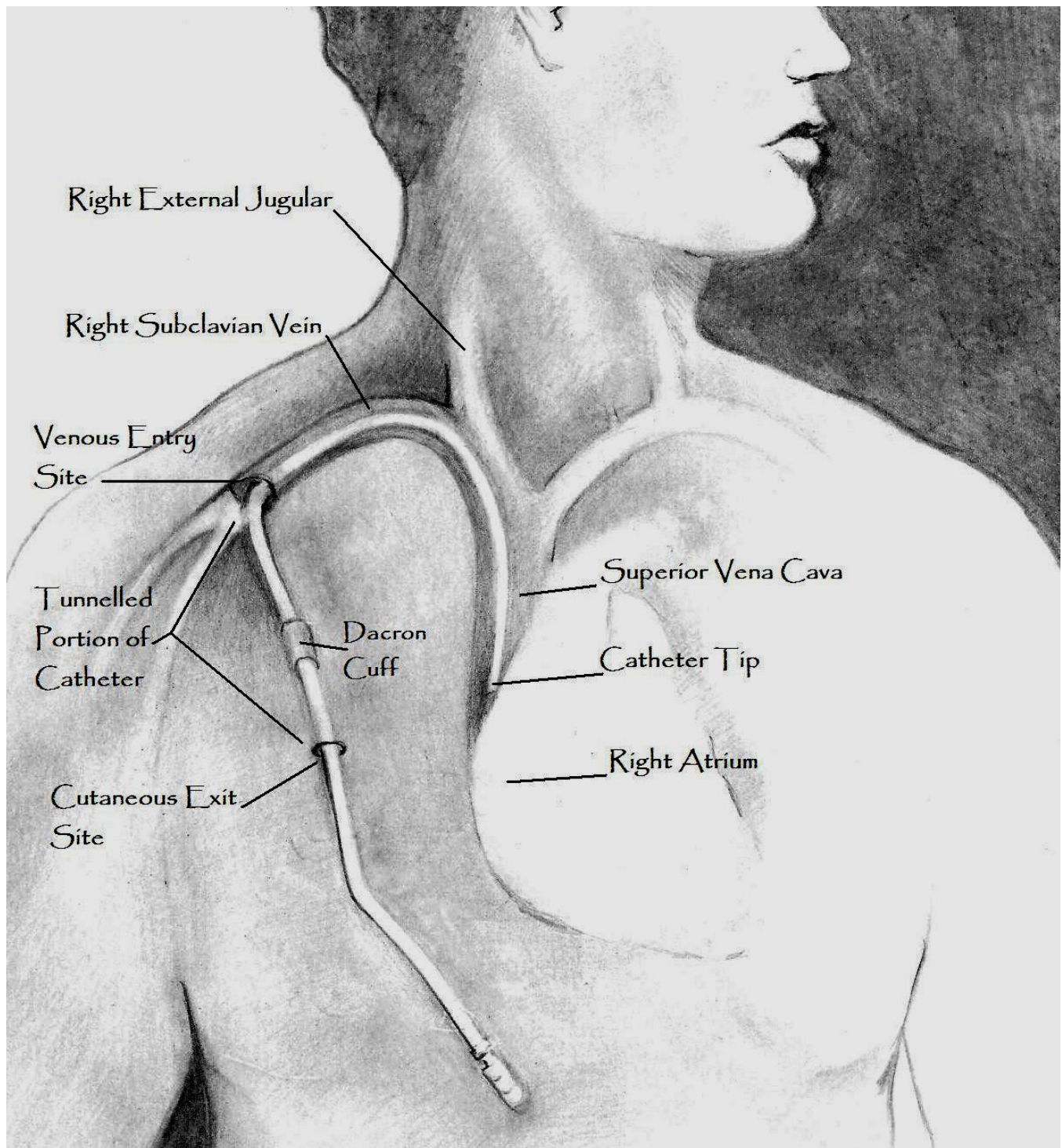
### Appendix A: Additional Resources

Registered Nurses' Association of Ontario (RNAO)	Vascular Access self-directed e-learning modules: Caring for Your Patients Receiving Intravenous Therapy <a href="http://www.RNAO.org/intravenous/">www.RNAO.org/intravenous/</a>  Health Education Fact Sheet – You and Your IV
Canadian Vascular Access Association (CVAA)	<a href="http://www.cvaa.info/">http://www.cvaa.info/</a>
Government of Ontario	Legislation 474/07 of the Occupational Health and Safety Act – Needle Safety <a href="http://www.e-laws.gov.on.ca">www.e-laws.gov.on.ca</a>
Infection Control Today	<a href="http://www.infectioncontrolday.com">www.infectioncontrolday.com</a>
Institute for Safe Medication Practices Canada	<a href="http://www.ismp-canada.org">www.ismp-canada.org</a>
Ontario Ministry of Health and Long-Term Care	<a href="http://www.health.gov.on.ca">www.health.gov.on.ca</a>
Safer Healthcare Now	<a href="http://www.saferhealthcarenow.ca">www.saferhealthcarenow.ca</a>

### Appendix B: CVAD Tip Placement

INCORRECT PLACEMENT (from original guideline; tip too high)	CORRECT PLACEMENT *(see larger scale image on page 5)	CORRECT PLACEMENT (X-RAY)
		
Illustrated by: Nancy A. Bauer, BA, Bus. Admin, RN, ET (2005)	Illustrated by: Nancy A. Bauer, BA, Bus. Admin, RN, ET (2008)	Used with permission. Bard Canada (2007). CVAD tip position. Mississauga, Ontario: Bard Canada.

## Correct Placement



## Appendix C: Flushing and Locking Interventions

Organizations may choose to modify Appendix C based on current clinical practice, device technology, and/or patient assessment.

Ensure that the catheter lumen is flushed using Sodium Chloride 0.9% prior to locking the lumen.

VASCULAR ACCESS DEVICE	FLUSHING SOLUTION	LOCK SOLUTION	FREQUENCY
Peripheral Short-Catheter	Flush and lock with 3 mL 0.9% sodium chloride		After each access or daily if not in use
Peripheral Midline-Catheter ( <b>non-valved</b> )	5 – 10 mL 0.9% sodium chloride	Heparin (commonly used concentrations are 10 or 100 units/mL)	After each access or weekly if not in use
Peripheral Midline-Catheter ( <b>valved technology</b> )	Flush and lock with 10 – 20 mL 0.9% sodium chloride		After each access or weekly if not in use
Central Vascular Access Device (CVAD), <b>non-valved</b> (e.g. Percutaneous, Tunneled, PICC)	10 – 20 mL 0.9% sodium chloride	Heparin (commonly used concentrations are 10 or 100 units/mL)	After each access or weekly if not in use
CVAD with <b>valved technology</b> (e.g., Groshong®, PASV®)	Flush and lock with 10 – 20 mL 0.9% sodium chloride		After each access or weekly if not in use
Implanted Vascular Access Devices (IVAD), <b>non-valved</b>	10 – 20 mL 0.9% sodium chloride	Heparin (commonly used concentrations are 10 or 100 units/mL)	After each access or every four weeks if not in use
IVAD with <b>valved technology</b> (e.g. Groshong®, PASV®)	10 – 20 mL 0.9% sodium chloride	As per manufacturers' recommendations	As per manufacturers' recommendations

Note: Heparin is absolutely contraindicated in patients with Heparin-induced Thrombocytopenia (HIT), consult with physician re: alternative measures. For more details about flushing and locking solutions, please refer to the manufacturer's recommendations.



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# *Nursing Best Practice Guideline*

## *Care and Maintenance to Reduce Vascular Access Complications*



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Registered Nurses' Association of Ontario  
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